

## RESEARCH ARTICLE OPEN ACCESS

# From Stakeholder Pressure to Strategic Advantage: A Framework of Achieving Environment Sustainability Through Pathway of Carbon Neutrality

Sanjeev Yadav<sup>1</sup> | Ashutosh Samadhiya<sup>2</sup>  | Anil Kumar<sup>3,4</sup>  | Sunil Luthra<sup>5</sup>  | Krishan Kumar Pandey<sup>1</sup>

<sup>1</sup>Office of Doctoral Studies, O. P. Jindal Global University, Sonapat, Haryana, India | <sup>2</sup>School of Business Administration, American University of Sharjah, Sharjah, UAE | <sup>3</sup>Guildhall School of Business and Law, London Metropolitan University, London, UK | <sup>4</sup>Jaipuria Institute of Management, Indore, Madhya Pradesh, India | <sup>5</sup>All India Council for Technical Education (AICTE), Delhi, India

**Correspondence:** Anil Kumar ([a.kumar@londonmet.ac.uk](mailto:a.kumar@londonmet.ac.uk))

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## ABSTRACT

Businesses are increasingly striving to reduce their carbon footprint, with carbon offsetting emerging as a viable pathway towards achieving carbon neutrality. Such efforts signify a demonstrated commitment to fostering environmental sustainability and contributing to a more sustainable future. Many countries have pledged to become carbon neutral in order to prevent climate change, but very little is understood about the micro-level influences. Nevertheless, a critical question remains: To what extent can carbon neutrality be achieved without the active involvement of stakeholders? Current scholarly literature offers limited discussion on this issue, indicating a gap that warrants further exploration. Therefore, the study aims to investigate the key influence of stakeholders on businesses tending to achieve carbon neutrality via the use of green innovative practices in their pursuit of environmental sustainability. The semistructured interviews were conducted with the manufacturing industries' experts. Rigorously, a qualitative analysis was employed, and the five major drivers were identified based on 11 subthemes for carbon neutrality and green innovation, that is, 'customer enforcement,' 'sustainable business value,' 'potential benefits,' 'environmental legitimacy' and 'competitive pressure.' Customers and competitors were the most influential external stakeholders. Shareholders and top management with intrinsic environmental values, being internal stakeholders, played pivotal roles in a proactive move to carbon neutrality and green innovation when there was limited regulatory pressure. The finding shows that the potential benefits of transitioning to carbon neutrality not only minimize waste and pollution but also lead to financial gains and a better image if implemented effectively, and the early movers/investors also believe in the long-term economic benefits. Based on the research findings, a proposition-based support framework was proposed by stakeholder and institutional theory to guide firms' managers in transitioning towards carbon neutrality goals or climate neutrality policies aligned with Sustainable Development Goal 13 (SDG 13).

## 1 | Introduction

Carbon neutrality (CarNeu) is the balancing of the amount of greenhouse gases (GHGs) that a company or individual releases into the atmosphere by removing an equal amount from the atmosphere (Zhang et al. 2023). The reasoning behind CarNeu is

that the only way to reduce global warming and climate change is to reduce the emissions of GHGs. Thus, to be carbon neutral, it is necessary to reduce emissions, transition to low-carbon technologies and/or purchase carbon credits or use carbon sinks to compensate for additional emissions (Ghosh et al. 2020). Thus, the need to reverse Earth's climate change effects is dire in the

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fight against global warming and climate change; becoming carbon neutral is a critical objective for organizations, governments and individuals worldwide (Zhang et al. 2022). Organizations can do their part in combating GHG emissions and other causes that contribute to climate change, which would create a more sustainable planet (Cheng et al. 2025).

Business firms play a critical role in the urgent global decarbonization effort (de Sousa Jabbour et al. 2019; Wang et al. 2025). Several ecological debates, notably the Conference of Parties 28 (COP28) in Dubai, as well as the rising relevance of the UN Sustainable Development Goals (SDG 13), have emphasized the notion that environmentally friendly measures have progressed from 'nice to accomplish' to 'must-do' actions (Ramanathan et al. 2025). Stakeholders' impact on important climate change initiatives was clearly obvious at the environmental policy deliberations at COP28 in Dubai. Recent research has indicated that stakeholder pressures have a major effect on the implementation of green initiatives by enterprises or supply chains when evaluated through the perspective of stakeholder theory (Ramanathan et al. 2025). GSCM techniques may combat the growing concern of environmental degradation by ensuring adherence and increasing the sustainable capability of the complete SC. In order to achieve zero carbon emissions by 2060 and the United Nations Sustainable Development Goals (SDG 13) by 2030, nations like China are embracing GSCM policies (Rashid et al. 2025). In a related vein, all stakeholders, including consumers, suppliers and competitors, are under pressure from nonprofit organizations (NGOs) to implement GSCM. Environmental regulations and public interest are additional factors that motivate companies to adopt green practices (Khan and Qianli 2017). Therefore, commitment to CarNeu goals provides organizations with accountability and legitimacy in a sustainable business environment that is based on relations with people and the environment (Zhang et al. 2022). Consequently, most leading global organizations have begun planning for CarNeu in their operation and value chains. Only four United Nations Framework Convention on Climate Change (UNFCCC) member states and 26 Forbes 500 corporations have a net zero objective at the Paris Conference of the Parties (COP). By mid-2023, 149 nations had net zero objectives, representing 92% of global GDP (Green et al. 2025).

On the other hand, organizations that attempted to cut their GHG emissions discovered that their operational emissions were less than half of their supply chain contribution (Plambeck 2012). Supply chain emissions exceed operational emissions by a factor of 5.5, meaning that organizations must adopt a supply chain approach if they are to achieve their CarNeu ambitions (CDP 2019). Some low-carbon SC practices include reducing the carbon footprint of purchases made by the organization (Gong et al. 2018). Organizations can use packing with environmentally friendly packaging material to reduce waste, reorganize their logistics to reduce carbon emissions from transportation (Cadez et al. 2019; Dhanda et al. 2022) and select suppliers with low carbon emissions as well as adopt a circular economy with the use of a waste reduction system to reuse and recycle (Shaharudin et al. 2019).

According to the 450 scenarios of the International Energy Agency, green solutions, likewise green technology innovation, could help achieve over 60% of the carbon reduction goals (Rani

et al. 2025). Depending on whether they work together, green innovation (GI) can be divided into two categories. Firstly, cooperation, rather than independence, could accelerate the progress of GI and facilitate the technology to be shared, which can help develop green technologies (Van Beers et al. 2008). Additionally, as each R&D partner has its own advantages, the cooperation can increase the amount and quality of GI (Jiang et al. 2019). Enterprise green technology innovation refers to the process of applying GI ideas to make new products and processes that are better for the environment and designed to be sold as green products or services (Aboelmaged and Hashem 2019; Li, Zhao, et al. 2019; Ma et al. 2019). There are two types of green technology innovation: green process innovation and green product innovation (Huang and Li 2017; Xie et al. 2019). Green process innovation is mainly used by firms to protect the environment in their production processes (Tang et al. 2018; Xie et al. 2019). Moreover, green product innovation is the highest form of green technology innovation because it can stop pollution at the source (Tang et al. 2018; Wang et al. 2019).

A limited number of studies have looked at the relationship between GI and carbon emissions. Specifically, their analyses of the carbon reduction benefits of GI (Zhang et al. 2017; Xu et al. 2021), different impacts of GI and the linking of innovation and environmental compliance to reduce CO<sub>2</sub> emissions (Wang and Wei 2020). GI can help cut carbon pollution because protecting the environment is an externality. Several ways to cut carbon pollution are highlighted below. GI can cut carbon pollution right away when used, for example, carbon capture and storage technology in a coal plant (Xu et al. 2021). A green advance in clean energy technology can be so good that most people prefer it to that from nonrenewable sources (Van der Ploeg and Withagen 2012). GI makes the production process better, as it may have better production technology (Xu et al. 2021), may introduce cleaner technology, may increase the use of cleaner production (Wang et al. 2012), may increase energy efficiency (Wang et al. 2021) and may increase resource use and recycling (WIPO 2022). However, how does GI cut or increase carbon pollution? Very few studies have examined how GI affects carbon pollution. To sum up, the people outside the company, like government agencies, customers and communities at large, pressure each other through external forces, like stakeholders' pressures (Xie et al. 2024). For example, external forces like these may force companies to find greener ways of doing things, like engaging in joint GI and developing environment-friendly goals (Graham 2020). However, external pressures do not work in isolation because internal factors play a substantial role (Alt et al. 2015; Dhanda et al. 2022). For instance, internal factors show what the people in the organization think, believe and feel about the environment. These will impact how environmental problems rank and how they are solved (Han et al. 2019). Hence, understanding GI and CarNeu requires researchers to put an external and internal factor and see how it works over time (Zhao et al. 2023; Xu et al. 2025). Stakeholder pressures are an area that needs more research. Most studies have shown that external factors like government rules on how a company should reduce its emissions (Berrone et al. 2013; Chen and Liu 2018). Other external groups, like customers and competitors, have also not been studied so much. If these are left out of the study, it is possible that the effects these groups have on low carbon practices will be left out of the study. For example, people have a choice

over which company to choose; people choose environmentally friendly companies (Horbach et al. 2012; Zhang et al. 2025) and companies that are competitors do so.

To measure the impact of stakeholder expectations on CarNeu targets, the combined impact of stakeholder expectations must be measured over the long run. Additionally, there is little research available on the impact of stakeholder demand, environmental ethics and environmental consciousness on CarNeu (Zhang et al. 2022). Although there have been individual studies on each of these, not many studies explain the relationship between the three terms and how this affects low-carbon activity (Jakhar 2017). A broad and in-depth review of the literature reveals that there is a wealth of information on emission reduction, but limited empirical research into GI and CarNeu remains, as they are new concepts. The reason for selecting a qualitative research design is that it is suitable for investigating new topics and developing research phenomena. In this study, we have an investigative goal: case study approach. Because our research has descriptive and explanatory goals, a case study is an appropriate way to do research (Yin 2013).

Additionally, the data evaluation and coding procedure were facilitated using qualitative software (NVivo). According to Hilal and Alabri (2013), NVivo simplified the entire coding procedure and minimized the complexity and challenge of the data analysis phase. Additionally, NVivo enabled each researcher to independently code documents, which they could subsequently merge into a single document for code comparison when the analysis was completed (Butt 2021). Based on the above research and previously reviewed studies in Table 1, the following research questions have been proposed for guiding future researchers:

**RQ1.** How would the various stakeholders' pressures lead firms' transition towards green innovation and low carbon SC practices (CarNeu goals)?

**RQ2.** How would the green innovation driven by stakeholders' pressures further facilitate the low carbon SC practices (CarNeu goals)?

The current study uses empirical information from several case studies of various locations and economic situations to address the aforementioned research questions. Using a unified conceptual lens that integrates institutional and stakeholder theories, we evaluate 10 case organizations that are the initial adopters of the innovative approaches towards environmentally friendly SC activities. In-depth within-case and cross-case analyses are part of our matrix coding queries, which aim to comprehend the factors that influence carbon centrality commitment within the supply chain management of various firms. In order to formulate open-ended questions, the current study used semistructured interviews that were driven by institutional and stakeholder theory. Following that, aggregated trends are reached using the quantitative tool NVivo based on open-ended questions posed to respondents from case firms.

In three ways, our research adds to the body of literature. First, we contribute to the expanding body of research on how businesses are adapting to the changing climate. Second, we expand

the study examining the connection among stakeholder demands and environmental behaviours by demonstrating the varied internal and external stakeholder influences on the particular type of decarbonization approach that enterprises utilize. Third, we provide perspectives on how to encourage adherence to CarNeu objectives in a multitier supply chain by expanding the literature on the relationship between stakeholder demands and GI, which eventually drives low carbon SC procedures or climate policies that affect climate actions (SDG 13).

## 1.1 | Research Motivation and Scope Towards Achieving CarNeu Goals

According to recent reviews by de Sousa Jabbour et al. (2019) and Ramanathan et al. (2025), much research has been conducted on environmentally friendly manufacturing and processing. However, studies into the emerging idea of zero emissions remain in their early stages. The limited study on carbon offsets takes a macro-level approach, debating and extending global, local and national projects while focusing on political and technological factors (Zhang et al. 2023). Furthermore, while some academics have investigated what motivates organizations to implement proactively environmental policies, there is limited academic research examining what motivates an organization's dedication to zero emissions or environmentally friendly practices (Mehmood et al. 2024; Cheng et al. 2025). Although the impact of stakeholders' pressure, especially from customers and regulatory bodies, has been adequately researched, the notion of stakeholder scrutiny or strict regulations, emphasized by institutional theory, which is an even more sophisticated indication of the stakeholders' continuous surveillance and participation, has received less scrutiny (Cao et al. 2023). Stakeholder engagement is important in organizational managerial decisions because it influences how organizations distribute assets, prioritize operations and match their objectives with net-zero environmentally friendly procedures (Zhao et al. 2023; Block et al. 2024).

This study contributes significantly to current literature in four domains. Initially, this study provides a deeper comprehension of how stakeholder promotes environmental or net zero initiatives. This study extends towards demonstrating an immediate link between stakeholder demand and environmentally responsible strategies by including innovative green practices (product and process) as an intermediate element. Thus, understanding the importance of product and process innovation, as well as embracing and carrying out green innovative strategies, in enhancing the welfare of the environment. Furthermore, this study introduces a contextual element to institutional theory by focusing on government initiatives that involve coercive constraints, normative demands from consumers' and other stakeholders' financial goals, and competition-associated mimetic influences. As a consequence, the research provides a better insight into how institutional aspects or regulations respond to stakeholder expectations for attaining sustainable SC procedures and net-zero targets aligned with SDG 13. SDG 13, which focuses on climate actions, is a key objective in worldwide initiatives to combat climate disruption. To achieve this aim, integrated actions at the local, national and international levels must be reinforced by powerful regulations, enough financing and legal arrangements.

**TABLE 1** | Previous research on stakeholder pressure, green innovation and carbon neutrality goals.

Study	Methodology adopted	Industry type	Carbon neutrality		Findings
			Green innovation	goals or low carbon practices	
Weng et al. (2015)	Empirical survey	Taiwanese service and manufacturing companies			There were substantial and beneficial impacts on GI methods from employee behaviour, government regulation and competitive pressure. Furthermore, only in the connection between green product innovation techniques and employee conduct did innovation orientation serve as a moderator.
Das and Jharkharia (2019)	Content analysis by systematic literature review	Not applicable	✓		Though it is still in its early stages, research on low carbon SCM is on the rise. By factoring in concerns about emissions, the entire supply chain has been rethought, including tasks like supplier selection, inventory planning, network design and logistical considerations.
Shaharudin et al. (2019)	Review of the literature and social network analysis	Not applicable			Six main domains of low carbon SC practices are 'sustainability, climate change, green supply chain management, supply chain management, innovation, sustainable development and environmental management.'
Mao et al. (2017)	Survey-based empirical analysis	High-performance manufacturing project			The results demonstrate that integrating low-carbon practices inside benefits a company's environmental performance but hurts its bottom line. Financial and environmental outcomes are both enhanced by external low carbon integration.
Das and Jharkharia (2019)	Fuzzy Delphi method, interpretive structural modelling	Pakistani manufacturing industry			In Pakistan's manufacturing industry, 'cost reduction' and 'government support' rank highest among the factors driving GI adoption, while 'green image' ranks lowest.
Yuan and Cao (2022)	Linear regression	Manufacturing companies in China			The findings revealed that CSR practices greatly boost green product and green process innovation. Green dynamic capability greatly boosts green product and process innovation. Green dynamic capabilities serve as a bridge between CSR and GI.

(Continues)

**TABLE 1** | (Continued)

Study	Methodology adopted	Industry type	Carbon neutrality		Findings
			Green innovation	goals or low carbon practices	
Al-Swidi et al. (2023)	Hierarchical regression analysis	Manufacturing firms in Yemen		Stakeholders' pressure	Green innovation (GI) is favourably correlated with green manufacturing practices (GMP), which in turn are positively correlated with green entrepreneurial orientation (GEO), according to the empirical results. Furthermore, GMP acts as a go-between for GEO and GI.
Jayaraman et al. (2023)	Quantitative survey approach	Malaysian manufacturers			Organizational sustainability performance is heavily influenced by stakeholders both inside and outside the company, including customers, government regulations, suppliers and employees. This is particularly true when it comes to GI efforts.
Jum'a et al. (2024)	Survey-based empirical analysis	Manufacturing companies in Jordan			The study findings revealed that GSCM and total quality management (TQM) have a hugely beneficial effect on environmental sustainability. When compared to GSCM, TQM had a greater effect on environmental sustainability. To add insult to injury, the moderating effect of EMP was not even mentioned.
Zhao et al. (2023)	Regression analysis	Cities in China.			Collaborative GI is superior to standalone GI when it comes to reducing carbon emissions. When it comes to carbon reduction, R&D partners benefit more from companies' collaborative GI than from research organizations.
Barbosa and Cansino (2024)	Partial least squares structural equation modelling	Agri-food companies			Customer and regulatory demands mediate the beneficial association between environmental collaboration and all five aspects of environmental performance, including energy efficiency, water footprint management, greenhouse gas emission control and overall performance.

(Continues)

TABLE 1 | (Continued)

Study	Methodology adopted	Industry type	Carbon neutrality			Findings
			Green innovation	Carbon goals or low carbon practices	Stakeholders' pressure	
Sun et al. (2025)	Partial least squares structural equation modelling	Manufacturing and mining firms				The research demonstrated that stakeholder and government regulation has a considerable and positive effect on sustainable processes, whereas public demand has a negligible beneficial consequence. Customer pressures have a little negative impact on green initiatives. This research revealed that green innovation significantly affects the relationship between stakeholder influence and environmentally friendly strategies.
Garg et al. (2025)	AMOS (covariance)-based structural equation modelling	Manufacturing firms				Results show that stakeholder influence and circular economy adoption are positively correlated, leading to supply chain consequences that are carbon neutral. The findings indicate that net-zero regulations influence the association between stakeholders and the circular economy, with innovative skills contributing as a partial mediation.
Shahzad et al. (2026)	Partial least squares structural equation modelling	Manufacturing firms				The results show how Industry 4.0 capabilities and green supply chain integrations may stimulate green innovation for sustainable goods and processes, and they offer specific instances of how these technologies might be used in a sustainable circular economy.
Present research	Qualitative analysis	Manufacturing and services firms				'Customer enforcement' (coercive pressures), 'sustainable business value,' 'potential benefits,' 'environmental legitimacy,' 'competitive pressures' and 'mimetic pressure' are the five main drivers for GIs and CarNeu that emerge from the 11 subthemes.

## 2 | Literature Review

The literature review consists of theories underpinning the open codes of the case respondents and previous research on the nexus between organization stakeholders, GI and CarNeu practices, as shown in Table 1.

### 2.1 | Stakeholder and Institutional Theories

Prominent theoretical foundations for understanding the adoption of environmentally friendly practices are the stakeholder theory and the institutional theory (Tsinopoulos et al. 2018).

These two theories are related, given that according to Zhang et al. (2023) and Tsinopoulos et al. (2018), the institutional theory suggests that social pressure, industry standards and the ambition to acquire organizational credibility are the primary drivers behind the acceptance of specific firm actions (such as GI and low carbon SC practices). Nonetheless, it is important to note that numerous stakeholder communities within that particular business are the source of this social power and organizational legitimacy (Block et al. 2024). This suggests that companies functioning in today's business settings are inextricably linked to society and their stakeholders; as a result, stakeholders largely pressure them to embrace specific strategies that have a significant impact on the nature of their resources (Baah et al. 2021). According to Zhang et al. (2023), stakeholder endorsement—which denotes obtaining assistance, commitment, confidence and fulfilment from stakeholders—can be used to justify this legitimacy. As a result, ethical and social assets are further explored, demonstrating the relationship between institutional theory and stakeholder theory (Baah et al. 2021). Thus, in order to investigate the relationship between different SC stakeholders, GI and low carbon SC practices, the current study combined the two theories.

The institutional theory posits that under social influence and industry-related standards and regulatory requirements considerable research shows that businesses might adopt various practices, while, on the other hand, the notion of organizational legitimacy is associated with stakeholder variety, including multiple groups (Deephouse 2017; Tsinopoulos et al. 2018). Stakeholder theory explains the reciprocal relations between a business and a variety of stakeholders and argues that businesses might achieve economic success if they consider the interests of the stakeholders involved (Donaldson and Preston 1995). Freeman (1984) understands a stakeholder as any social group or individual with an interest in, or that has an impact on, the business. Primary stakeholders involve the 'organizations, employees, customers/consumers, suppliers, competitors, government, communities, activist organizations and trade unions' (Donaldson and Preston 1995; Jawahar and McLaughlin 2001). Furthermore, the stakeholder theory is involved in many of the environmental and sustainability-related works and is recognized as making business move out of a requirement ornament to enhance carbon transparency, which leads to more impactful carbon abatement projects (Ching and Gerab 2017; Miles 2019). In addition, Pålsson and Kovács (2014) argue that stakeholder pressures result in the markets, creating expectations for minimal emissions reductions in freight transport across industries

and countries. Moreover, Cadez et al. (2019) argue that the pressure of stakeholders impacts the owners of the GHG-intensive enterprises to reduce the emissions piling, resulting in their entire GHG-related performance. Dhanda et al. (2022) state that companies' carbon abatement mechanisms are used to respond to diverse stakeholder pressures driven by climate change risks and wield the power to command financial support. Stakeholders' persons that affect business operations and their needs and pressure influence the decisions made by a business (Vilchez et al. 2017; Fu et al. 2019).

Based on their relationship with stakeholders and society, businesses have perspectives on their responsibilities to society, including environmental protection (Maak and Pless 2009). Deephouse (2017) argues that the principles of organizational legitimacy and institutional isomorphism can offer insights into the concept of institutional theory. While organizational legitimacy describes a firm's action as proper and desirable, institutional isomorphism points to whether enterprises in the industry treat their operations through similar processes and practices. Tsinopoulos et al. (2018) define institutional theory as one that focuses on how organizations follow industry-established norms. This statement aligns with Deephouse (2017) assertion that the implementation of environmentally friendly activities improves an organization's legitimacy. The endorsement of the stakeholders also plays a critical role because it indicates that they also conform to the changes (Andoh-Baidoo et al. 2024). For example, if the organization fails to adopt green energy, it may disapprove of the green energy idea, thus capturing other market players in a perspective that will reduce a firm's legitimacy (Yuan and Cao 2022).

Institutional theory also explains the corporate social responsibility (CSR) and GI concept in a theoretical framework (Tariq et al. 2017; Tarraço et al. 2023). Institutional theory is employed to suggest that the corporate social objective is not a profit maximization but the fruits from the other goals of managers and that corporate activities are constrained and otherwise affected by externally imposed pressures for legitimacy (Yuan and Cao 2022). However, to gain the trust of an external institution, a business must implement GI (Chang 2011). Notably, numerous studies used institutional theory to rationalize that various forces exerted by the institutions induce companies to implement corporate greening (Clemens and Douglas 2006; Huang and Chen 2022). Institutional theory also emphasizes that if an organization faces pressures from externals, the company needs to respond effectively to nullify the jeopardy and threats (Bag et al. 2021). There are three types of drivers in institutional theory that make such pressure: 'coercive, normative and mimetic' (DiMaggio and Powell 1983). Two more drivers emerged based on integrated stakeholders and institutional theories, likewise, stakeholders' sustainable business value and potential benefits as discussed further.

Coercive isomorphism highlights the pressure that firms encounter from regulatory agencies and government organizations to follow sustainability growth laws and policies. These constraints, which include emissions guidelines, disposal rules and renewable energy obligations, may result in taxes, sanctions and legal consequences (Alessa et al. 2024). As a result, company managers comply and participate in more sustainable

activities to prevent sanctions and protect their organization's reputation and competitiveness in the marketplace, thereby improving their ultimate environmental footprint (Sun et al. 2025). Mimetic isomorphism occurs when organizations adopt the tactics and procedures of successful competitors or top competitors (Zhang et al. 2023). Under the field of environmentally ethical business, organizations may notice that stakeholders, such as investors and customers, have a positive impression of competitors who use environmentally conscious procedures (Bello-Pintado et al. 2023). As a result, organizations may use these methods to increase their reputation, position and competitiveness in the business world. Mimetic constraints can have an impact on the sector-wide execution of environmentally friendly measures, as firms attempt to duplicate the latest environmentally friendly procedures and standards (Zhang et al. 2020; Sun et al. 2025).

As an illustration of normative isomorphism, the pressure from third-party stakeholders (such as end users and other competitors) that seek to develop organizational behaviours influenced by widespread ethics, typically from customers or suppliers who prefer adhering to societal and ecological norms—businesses worldwide are turning to the Global Reporting Initiatives (GRI) guidelines for providing information concerning the environment and society (Zhang et al. 2023; Block et al. 2024). Skilled organizations often provide additional guidelines and rules to encourage sustainable growth in the manufacturing industry (Block et al. 2024). According to these recommendations, organizations can obligate or motivate individuals to adopt green, environmentally friendly procedures (Garg et al. 2025). Institutional impact from competing industrial guidelines and standards may have an impact on enterprises' adoption of GI practices (Wiredu et al. 2023). 'Sustainable business advantages gained by internal stakeholder' appeared as the fourth driver of GI and sustainable practices. Establishing strong relationships with all stakeholders should be a top priority for company managers, according to stakeholder theory (Garg et al. 2025). Therefore, in order to preserve positive relationships with stakeholders, executives of businesses must develop and implement environmentally friendly processes and goods that have a lower adverse influence on the climate to comply with stakeholders' sustainability objectives (Sun et al. 2025). Thus, in order to satisfy stakeholder demands and support sustainable development objectives, leaders of businesses today acknowledge and incorporate sustainable efforts into their operations (Block et al. 2024).

Lastly, specific risk attributes and possible economic advantages to internal stakeholders are identified as additional elements or obstacles in the scenario of GI and other net-zero sustainable practices because of the difficulties of switching from conventional to green or sustainable procedures, as well as fluctuations in public perception (Zhang et al. 2023). Internal stakeholders typically emphasize the short-term effects of the expenditures and have significant monetary concerns in the business (Sun et al. 2025). The corporation frequently considers the monetary risks and possible delays in revenues connected with GI (Cheng et al. 2025). Due to the substantial stakeholders' dedication to safeguarding their monetary assets, this shift may cause corporations to make careful decisions, prioritizing their economic security over significant investment in GI and other environmentally friendly procedures (Garg et al. 2025). This is also consistent with stakeholder theory, which holds that businesses are

accountable to all stakeholders, in addition to their shareholders (Alessa et al. 2024). This means that as businesses work towards their corporate goal of maximizing profits, their business plan must take these objectives into account.

Based on the preceding discussion, the current study combined stakeholder and institutional theory, because stakeholder theory emphasizes regulating the interactions and requirements of multiple stakeholders, encompassing both main and secondary groups, to accomplish organizational goals (Block et al. 2024). While institutional theory provides a larger view, it emphasizes the underlying effect of institutionalized social networks on corporate action, which includes regulatory systems and societal norms (Garg et al. 2025). It claims that organizations must adjust to formal as well as informal institutional influences to acquire legitimacy, which includes firms' acceptability by important stakeholders, and to function efficiently in the local environment (Zhang et al. 2023; Sun et al. 2025). Thus, institutional theory encouraged the organization leadership to embrace sustainable manufacturing procedures that have a lower environmental impact and conform with stakeholders' requirements in order to preserve good relationships with both primary and secondary stakeholders (Block et al. 2024; Ramanathan et al. 2025).

### 3 | Research Methodology

To gather primary data, researchers used a semistructured interview format, which allows for both guided and unguided discussion (Eisenhardt 1989). You can find the interview questions in Appendix A. After a thorough brainstorming meeting among the authors, the interview questions were developed. We wrote down each question that originally struck our thoughts. We started eliminating questions and topics that were not relevant when we got a final list of questions. Additionally, we looked through academic literature to determine what types of questions other researchers could have asked in relevant research (Zhang et al. 2023).

We use an inductive method for developing theory that combines induction (extrapolating results from novel details and fresh observations in the evidence) and deductive methods (establishing an arrangement by the perspective of stakeholder and institutional theories) (Dubois and Gadde 2002; Kovács and Spens 2005). When choosing case companies, we used a purposive sample strategy (Yin 2013). Organizations must have fulfilled their promises and implemented efforts to achieve zero emissions at the supply chain levels to participate in our study and also represent a variety of socioeconomic origins and industrial domains. We proceeded by conducting an online inquiry for companies that are dedicated to zero carbon emissions. We then engaged their top management, who had extensive knowledge of SCM and environmentally friendly endeavours, to confirm data quality. We kept trying to enlist case companies as long as we reached conceptual saturation, which occurred after the ninth and tenth cases, as their replies offered no additional details. The details of the interviewed case firms, interviewers and data sources are given in Table 2. Each of the interviewees has extensive expertise in CarNeu initiatives, sustainable practices and GI. Our method of triangulating interview primary data with secondary sources is based on Tracy (2010).

TABLE 2 | Profile of case companies, interviewees and data sources.

<b>Firms (cases)</b>	<b>Industry sector and business activities</b>	<b>No. of employees</b>	<b>No. of interviews</b>	<b>Interviewee designation (years of experiences)</b>
Case A	'Food and beverages (franchisee manufacturer of a multinational brand)'	50–100	1	General manager of supply chain and operations (10)
Case B	'Textile (manufacture and export textile and garments)'	700–1000	1	Manager project and compliance (10)
Case C	'Electronic manufacturing (The company is a global one-stop provider of electronic manufacturing services.)'	500–700	2	Director of projects and sustainability (10), R&D department head (10)
Case D	'Electrical industries (It provide tailored solutions for the entire product life cycle [from concept to after-sales support] of electrical components.)'	500–700	1	Director of projects and sustainability (10)
Case E	'Beverage machine manufacturing (The company is leader in making highly automated beverage machine in-house for consumer and professional buyers.)'	1000–1500	2	R&D department head (5), sales and marketing manager (8)
Case F	'Nanoparticle manufacturing and integration (Their technology helps companies develop faster by generating nanoparticles on-site and integrating them directly into the final product.)'	More than 1500	1	R&D department head (8)
Case G	'Packaging (manufacture and sales to domestic and overseas markets)'	700–1000	3	General manager supply chain and operations (6), sales and marketing manager (5), director of projects and sustainability (10)
Case H	'Textile (manufacture textile and garments and sales to domestic and overseas markets)'	More than 1500	2	Director of Projects and sustainability (10), manager project and compliance (5)
Case I	'Logistics and transport (international logistics, courier and package delivery)'	50–100	1	Freight Manager (10)
Case J	'Automobile (The company can assist with research and development or perhaps take on the role of the R&D and production departments of automobile parts.)'	700–1000	1	R&D department head (15)

In the present study, the so-called Gioia technique (Gioia et al. 2013) was followed: It consists of three stages, that is, gathering the raw materials, developing broader words and finally applying a theoretical notion, as followed by Abiodun et al. (2023) also shown in Figure 1. The first stage is open coding as a first-order notion (Strauss and Corbin 1998), which involves extracting ideas that uphold study respondents' initial thoughts (Gioia et al. 2013). Open coding approaches are consistent with the grounded theory approach (Strauss and Corbin 1998). The analyst draws theory from evidence instead of enforcing pre-existing theory on it, so advancing the basic goal of introspective psychology. The first stage creates an enormous number of notions, which pass into the second stage, the second-order evaluation stage. In this stage, the researchers emerged second-order categories based on the logical relationships between first-order categories. This is accomplished by integrating the researchers' theoretical viewpoints into first-order ideas (Shkedi 2004), considering the setting in which the notions were addressed. The third step of evaluation is another iterative cycle around the second-order ideas, at this point using an appropriate theoretical lens to find aggregate attributes, which establish a logical framework for the concern research objectives (Abiodun et al. 2023). The aggregate dimensions were derived in an 'abductive' fashion from the second-order themes during the third stage of analysis (Gioia et al. 2013; Sundgren 2022). Finally, as stated by Nurhayati et al. (2023), a matrix coding query was subsequently run to identify which themes were present in each case firm. Four criteria for determining the quality of research were identification, including credibility, transferability (generalizability), dependability and conformability (freedom from biases) (Lincoln and Guba 1985).

In order to make sure that the results align with the context under investigation, the triangulation of data sources, such as secondary data and interview transcripts, ensured credibility. We gathered participants based on various tasks (e.g., operations managers, sales managers, R&D managers, etc.) and selected a diverse group of participants with relevant expertise in respective domains to preserve transferability (Butt 2022). In order to determine if the findings are transferable to other contexts and/or sectors, respondents were questioned from a variety of industries, including electronics, electrical, services, food and automobile. In the end, by calculating the intercoder reliability, trustworthiness among the participants in the coding procedure, and conformability was achieved by guaranteeing coding consistency. NVivo allowed the assessment of intercoder reliability. If any disparities appeared throughout the open coding procedure, researchers examined the individual parts to identify the source of the deviations. In addition, to ensure intercoder consistency while open coding, every researcher preserved extensive memo records (Butt 2022).

#### 4 | Discussion of Results

The results consist of matrix coding query for co-occurrence between various subthemes (Table A1, Figures A2–A6, online supplementary) and co-occurrence between case firms and subthemes (Table A2 and Figure A1). Furthermore, various first order, second order and aggregated themes have been illustrated in Figure A7. In both tables, percentage represents the level of overlapping among various themes or between case firms and subthemes. Discussion consists of four sections. The first section

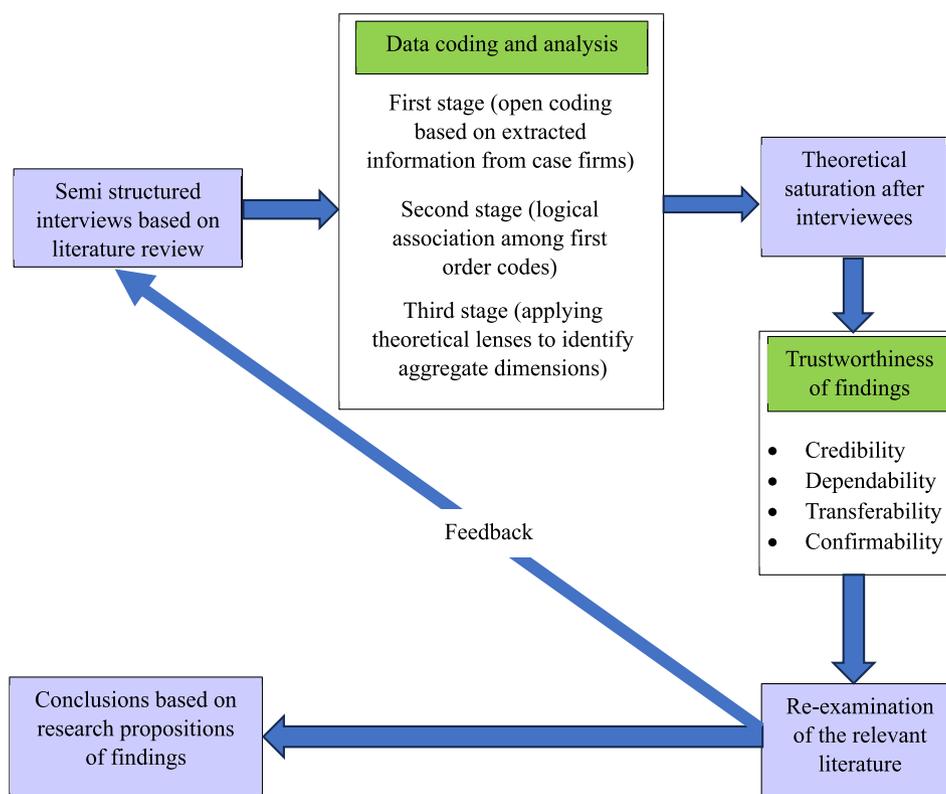


FIGURE 1 | Research methodology process.

explains the findings of co-occurrence between various stakeholders and GI, the second section explains the findings of co-occurrence between various stakeholders and CarNeu, and the third section explains the findings of co-occurrence between various GI and CarNeu via low carbon supply chain practices. Based on the themes analysis, seven propositions have been formulated as shown in Figure 2. Finally, the fourth section illustrated managerial and practical implications of the present research.

#### 4.1 | Stakeholders Pressures and GI

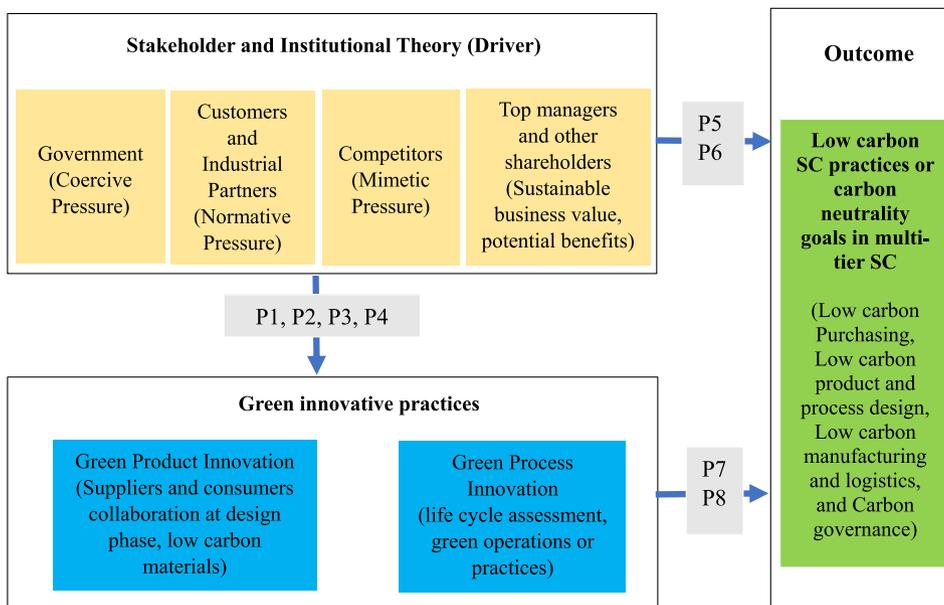
To answer the first research question, the results show that green product innovation is most influenced by coercive pressure from external stakeholders (62.96%), followed by normative pressure from external stakeholders (54.43%) and mimetic pressure from external stakeholders (28.51%), while considering external stakeholders. In addition, green product innovation is most influenced by potential benefits realized by internal stakeholders (63.17%), followed by sustainable business value realized by internal stakeholders (62%), while considering internal stakeholders. Furthermore, green process innovation is most influenced by mimetic pressure (71.49%), followed by normative pressure (45.77%) and coercive pressure (37.04%) while considering external stakeholders. In addition, green process innovation is most influenced by sustainable business value (38%), followed by potential benefits (36.83%), while considering internal stakeholders (see Tables A1–A2, online supplementary file). The above results may be validated based on the discussions below and the firms' case respondents' quotations.

Customers exert normative pressure on enterprises in terms of environmental matters by assessing them on their environmental performance. According to Peng and Wei (2015), customers have a higher effect on GI than suppliers. First, He et al. (2019) suggest that aware buyers would be interested in products that

do not harm the ecosystem. Enterprises may satisfy customer demand for environmentally benign goods by developing GI, getting environmental qualification accreditation and permit and generating low-pollution and energy products (Cheng and Shiu 2012). Additionally, according to Pujari (2006), firms can also draw on client feedback and information regarding GI. Second, Kim (2013) and Garg et al. (2025) say that in order to fulfil customer demand, enterprises would bring green technology to the market. This reduces the root cause of GI market difficulty. The interviewee from Case B shared:

Customers may consider whether the activities and production of the company are harmful to workers or the community and whether it produces goods that are harmful.

Most businesses use eco-friendly strategies because businesses work in environments plagued by stringent environmental policies (Schmitz et al. 2019; Tetteh et al. 2025). Sun et al. (2019) state that investigating environmental pollution and penalizing environmental defaulters has a bearing on an enterprise's environmental governance. Sun et al. (2019) argue that many developing countries, including China, place a high value on the protection of their natural bodies. Companies are required to comply with environmental standards set by the government recently. Ford et al. (2014) exemplify how companies are forced to advance green technologies as long as they follow the environmental protection protocol. Such rules and policy-based requirements can be developed by the government regarding industry specifications, market access and so on to force companies to participate in environmentally sustainable activities (Li, Wang, et al. 2019). The government may possibly pass an act raising the cost of any breach in their policies, whether due to environmental gaffe or similar (Xie et al. 2024). The government may well offer the incentive option to companies, giving those companies that choose to develop sustainably the ability to 'evade



**FIGURE 2** | Conceptual model based on proposed propositions for achieving carbon neutrality goals via stakeholders' pressures and green innovation.

fines' (Zhang et al. 2011; Block et al. 2024). Consequently, by accepting to introduction guidelines over the GI commitment, companies can now evade the most pressing issue of cost and risk concerning the corporate GI process (Cao and Chen 2019). The interviewee from Case D shared:

On environmental policy and institution level, strong environmental policies could contribute to holistic green innovation, which consists of pollution charge, environmental tax, government's subsidy, green credit policy and emissions trading.

The possible benefits of government-regulated incentive schemes, which encourage eco-innovation and emissions reductions, are more likely to be recognized by executives with a higher level of ecological awareness (Yin et al. 2019). In addition, they may offer ambidextrous learning to aid businesses in making superior decisions about how their resources and staff are allocated, which can boost the effectiveness of eco-innovations. This 'win-win' conduct is further supported by employees with a considerable environmentally friendly frame and attitudes who are more prone to spotting the possible advantages of eco-innovation (Huang et al. 2020). Today, this is also due to the existing legal restrictions, the dynamics of the market and how profits are distributed to shareholders. It is easier to perceive the benefits and opportunities for businesses once they grow more environmentally friendly (Sun et al. 2025). The reasons are that executives who took responsibility for environmentally friendly behavioural conduct, rather than source the customer-driven interest in eco-innovation and supplier motivation to offer eco-products as an opportunity to access green knowledge from internal and external bodies to produce and acquire a competitive edge (Yuan and Cao 2022). Innovation incitement and other fresh innovation policies, for instance, monetary grants to those who genuinely implement innovation, likewise impact them. Additionally, the likelihood of increased ecological concern by executives to result in the ascent from seemingly modest innovators to innovators with a lead boosts the efficiency of resource development and human resources, finally cultivating eco-innovation (Sun et al. 2025). Finally, eco-innovation appears to be more frequent among business leaders who have a solid environmental sense of duty and forceful environmental ambitions (Chang 2011). The interviewee from Case H shared:

At an organizational level, stakeholders' pressure on executives results in a set of conditioning factors that have a direct impact on green innovation. These factors include an organization's capacity, demand, size, certified environmental management systems, and governance systems, social accumulation, and knowledge.

It is further believed that employees who are willing to make environmental sacrifices are more willing to contribute to environmental solutions and become acquainted with new technologies (Davis et al. 2009). For example, as Daily and Huang (2001) argue, environmentally minded employees also search for ways to maximize the environmental facilities available. Jayaraman

et al. (2023) argue that employees of an organization's policies could help the operation achieve its environmental objectives. Employees are usually thought to be the first people to engage in environmental matters.

Additionally, the aforementioned results are consistent with Shashi et al. (2019), who found that adopting green practices had a substantial impact on economic and environmental outcomes, particularly when it involved product creation and innovations. According to Baah et al. (2020), organizational stakeholder demands are essential to a company's existence; hence, most businesses make every effort to comply with them. This statement supports González-Benito and González-Benito's (2006) claim that organizational stakeholders have a significant impact on the implementation of progressive environmental policies because of their impact. Additionally, the results are corroborated by Tsinopoulos et al. (2018) and Cheng et al. (2025), who predicted that green innovative methods use a significant amount of assets and, when executed correctly by internal stakeholders, will help businesses achieve their goals over the long run.

Similarly, Garg et al. (2025) revealed that stakeholder pressure enhances the organization's environmental performance, with ethical innovation functioning as a partial intermediate. This research's findings, which show the diverse impact of such variables on green product innovative practices, corroborate the argument of stakeholder theory, which states that varied stakeholder demands may greatly affect organizations' GI actions. Furthermore, Baah et al.'s (2021) analysis found that organizational and statutory demands from stakeholders have a substantial influence on the deployment of environmentally friendly manufacturing approaches. Societal pressure refers to the standards and impact that a local community imposes on businesses as well as other agencies. Organizations endeavour to retain a strong brand and social acceptance in their communities as they comply with cultural standards, population needs for environmental procedures, which may promote GI (Adomako and Tran 2022). In addition, findings also coherent with the interviewee from Case F shared:

Employees' dedication driven by top managers' pressures enhances green resource sharing, green knowledge transfer, green knowledge learning and exchange through the cooperation network with external partners, which have the most crucial effects on green innovation.

Buyers of our organizations have become more environmentally conscious as well as environmentally conscious, looking for services and goods that align with their values, including those that prioritize ecological responsibility and conservation of resources. As a result, there is a raised emphasis on businesses to embed GI into their products/services to comply with public expectations and stay competitive in the marketplace.

Finally, as highlighted by Cheng et al. (2025), owing to the economic emphasis placed by key stakeholders within an

organization, businesses may deliberately restrict GI, because these stakeholders frequently prioritize immediate monetary benefits. To address this, businesses can increase their attempts to communicate the highlights of the long-lasting advantages of sustainable growth. In addition, findings also coherent with the interviewee from Case E shared:

Adjusting performance evaluation systems in our firm to include metrics related to GI could also motivate primary stakeholders to support these initiatives.

Involving secondary stakeholders can leverage their enthusiasm and creative insights to foster innovative green projects.

Based on the above discussion, the following propositions are proposed as given below:

**P1.** *Coercive pressure from government regulation and normative pressures from consumers/communities' social expectations would influence green product innovation, which ultimately leads to green innovation.*

**P2.** *Coercive pressure from government regulation and normative pressures from consumers/communities' social expectations would influence green process innovation, which ultimately leads to green innovation.*

**P3.** *Executives' pressures at organizational level to follow competitive industries as memetic pressure towards environmental practices would influence green product/process innovation, which ultimately leads to green innovation.*

**P4.** *Executives' pressures to achieve firms' benefits would influence (positively or negatively) employee commitment towards environmental practices, which would influence green product/process innovation or green innovation.*

## 4.2 | Stakeholders Pressures and CarNeu Goals (Low Carbon SC Practices)

To answer the second research question, the findings show that coercive pressure by external stakeholders will influence most carbon governance (31.36%) to achieve CarNeu followed by low carbon product and process design (30.83%) (see Table A1, online supplementary file). Similarly, other results show the impact of normative, memetic pressures, potential benefits and sustainable business values on low carbon SC practices to achieve CarNeu goals. The above results may be validated based on the discussions below and the firms' case respondents' quotations (see Table A1–A2, online supplementary file).

Coercive pressure has been implemented by external stakeholders, imposing rising legal requirements and governance on businesses to comply with the legal requirements and norms in the environmental sector (Roxas and Coetzer 2012; Tetteh et al. 2025). Thus, both coercive pressures do occur when a regulating agency or a big client coerces a business to enforce

greenwashing or SDG 13, which calls for swift action to mitigate climate change and its effects (Berrone et al. 2013; Garg et al. 2025; Ullah et al. 2025). Additionally, coercive pressure occurs when customers force producers to implement carbon-reducing efforts (Lewandowski 2017). In addressing climate change, increasing regulatory pressure has compelled firms to minimize emissions. Dhanda et al. (2022) argue that forced pressure is generally more efficient than institutional pressure in the implementation of mitigation techniques to cut carbon. Compared with the diverse array of stakeholders, normative pressure could result in more immediate concerns for businesses to become interested in considering meaningful carbon reduction rather than carbon awareness (Sprengel and Busch 2011; Zhang et al. 2023). A company's brand could be tainted if it does not take action on customer feedback or opposes public-sector union demands for higher green privileges (Roxas and Coetzer 2012). However, the level of effect of normative pressure is generally less than that of coercion (Dhanda et al. 2022). However, as businesses transition to CarNeu, they may seek to manage public opinion through a strategy plan that includes a comprehensive approach to CarNeu. The interviewees from different cases are shared as follows:

*Case A. I can think of an analogy that works: If you were ISO accredited, you would be able to qualify for a customer who asked about it a few years ago. Everyone else was asked to leave if they were not invited. In terms of controlling emissions, that's roughly the direction things are heading. Accordingly, I believe that client compliance is the primary factor.*

*Case I. Indirectly contributing to the decrease in GHG emissions, the respondent pointed out, the government audit and study of production energy usage also played a role.*

*Case D. The respondent observed that in the past, when supply chain partners or NGOs were forced to provide CO<sub>2</sub> accounting data and information, it raised their level of awareness and tacit understanding about the importance of reducing emissions.*

*Case J. Organizations are compelled by coercive pressure to devise solutions for incorporating emission-related concerns into purchase decisions. Carbon reduction goals and strategies, support from upper management, measuring and assessing carbon footprints and risks, developing and training suppliers to reduce emissions and transferring technology to reduce emissions are all parts of this process.*

*Case I. Issues pertaining to product stewardship that are imposed on the managers of these enterprises by normative pressure are: reduction of harmful compounds, increased use of reusable and recyclable materials and improved product design all contribute to a lessening of environmental impact.*

*Case H. In India, the Environmental Protection Agency (EPA) is in charge of regulating activities and legislation that benefit the environment. They do not have any carbon emission-related regulations, but they are working on a number of programmes to reduce pollution. For example, the government is promoting electric automobiles to reduce pollution. These benefits are mostly for export enterprises, and the government is charging them less tax as well.*

*Case G. Normative pressure forces the firms' managers to consider competitive issues related to process stewardship, which are the reduction of the environmental impact in production and distribution; the use of cleaner technology for energy savings; and end-of-life management processes.*

One of the examples includes a company facing a concern that its tardy reaction will allow competitors to capture new markets and business prospects in the case of CarNeu (Zhao et al. 2023). In addition, if more of one's peers embrace CarNeu, a company is worried that it will be forced to join in such a cause due to uncertainty regarding which growing sustainability approaches will take hold. Another example is when a supplier expects that its consumers will be able to easily compare its emissions performance to that of its competitors, potentially exposing the firm to competition (Koh et al. 2023). In view of the transition to CarNeu of the industry, a supply firm expects to be compelled to participate in CarNeu activities to continue operating (Koh et al. 2023). Interviewees from a variety of cases expressed similar sentiments, suggesting that the market of various industries would make it hard for them to stay in operation if they did not adhere to ecologically sound management as well as client demand (Zhang et al. 2022). Top management has also found that organization-wide sustainable business value is a significant motivator to achieve (Burke et al. 2021). Top management must also play a role in the implementation of long-term business value and successfully make it come true. They are accountable for linking many plans and projects to sustainability to limit pollution, save on natural resources and cut emissions. Third is their responsibility for making this long-term business value happen.

According to Block et al. (2024), companies that respond to statutory stakeholder demands receive a substantial degree of stakeholders' engagement and business credibility as they are seen as legitimate and functioning within established industry standards. According to Zhang et al. (2023), meeting these stakeholder constraints also results in improved relationships with regulatory agencies and other community-representing stakeholders, which raises monetary and sustainability improvements. By using raw materials more efficiently, reducing waste, using less energy and cutting down or eliminating unnecessary manufacturing operations, a shift to low carbon SC practices also lowers the price of manufacturing (Baah et al. 2021). These practices guarantee low levels of pollution by lowering GHG emissions, which also lowers the expenses related to environmental pollution. These initiatives to lessen adverse environmental effects have an enormous impact on a company's financial, sustainable business values and potential benefits (Zhang et al. 2023). In addition, Tetteh et al. (2025) suggested and showed that SC stakeholders' demands influence the association between green logistics procedures (GLP) and zero emissions targets (ZETs). This reveals how business organizations perceive influence from the SC to assist the effects of GLP on ZET. The results suggest that organizations not only use GL for environmental objectives but also in response to environmental issues posed by supply SCs' stakeholders. Rashid et al. (2025) conducted an empirical investigation of the influence of pressure from institutions on productivity in manufacturing. The analysis emphasizes the relevance of policies, government participation and global commitments in driving SCs' stakeholder

collaboration to enhance environmental sustainability and achieve zero emission targets. Government intervention, competitive demand and treaties all play important roles in encouraging ecologically friendly packaging, cleaner manufacturing, sustainable design and stakeholder collaboration to reduce emissions threats (Cheng et al. 2025). The research also emphasizes the importance of mimetic motivations in promoting collaboration in green production. Manufacturers should work with stakeholders to increase revenue, establish brands and improve their commitment to sustainability (Sun et al. 2025).

The example of Case A shows how their top management commitment becomes the principal explanation for the change to CarNeu. The board of directors urged employees to pursue CarNeu. Similarly, the interviewees from Case G and Case J shared:

That's no longer an option, not do environmentally good things—that's no longer an option. Our CEO is committed. It is something we must do; otherwise, we do not exist. Despite the fact that customer-driven forces also contributed to the rapid movement towards carbon neutrality, the company's vision of meeting environmental challenges strengthened its carbon neutrality from the outside ....

*A company manager can also compel its suppliers to develop an environmental certification offering, such as ISO 14001.*

In today's world, firms must demonstrate their 'legitimacy' to the stakeholders and the rest of society by adhering to business and social standards (Zhang et al. 2022; Koh et al. 2023). The sample firms' certifications and accreditations on carbon cutting, for example, ISO 14001, were pursued because of their quest for environmental legitimacy. The firms sought to prove that they were environmentally sustainable by earning social credits and working towards carbon-neutral status.

Case B and Case H respondents stated:

*Case B respondent suggested that our customer base sees it as very important for us. The customers who invest in my company need me to be able to show our carbon neutrality.*

*Case H respondent suggested that our shareholders pressure us to develop long-term contracts with nongovernmental organizations and environmental stakeholders for the effective reduction of GHG.*

As stated in the institutional theory, firms are worried when they cannot offer their customers what their competitors can if a competitive disadvantage is overcome simply. An apparent approach is to follow the track adopted by the competitors (Zhao et al. 2023; Sun et al. 2025). According to this proposition of the institutional theory, the sample firms' CarNeu commitment is noticeable. There are four case companies, A, B, E and G, which took competitive pressure as the main driver. For example, when asked if the main competitors had a benefit due to the commitment to CarNeu, an interviewee in Case G responded as follows:

Indeed, the company has had advantages in terms of expanding its market presence, as evidenced by its commitment to achieving carbon neutrality by 2030. For example, the company has witnessed favourable outcomes in terms of attracting a larger market share.

Even though it is not the most common motivating factor, for the majority of cases, companies to reach the CarNeu is 'the pursuit of long-term economic gains.' The sales and marketing manager from Case E and Case F gave an unambiguous answer to the question of why his company is committed to reaching the CarNeu as:

*Case E respondent suggested that ROI (return on investments) would since our clients are not very focused on this carbon-neutral thing at all.*

Based on the above discussion, the following propositions are proposed:

**P5.** *Pressure from the government policies such as coercive pressures, normative pressures from the customers' economic expectations and competition related mimetic pressure from the competitors would influence low carbon SC practices (carbon neutrality goals).*

**P6.** *Top managers' pressures for sustainable business values and other shareholders (investors) pressures for long-term economic merit would influence the low carbon SC practices (carbon neutrality goals).*

### 4.3 | Green Innovation and CarNeu (Low Carbon SC Practices)

To answer the third research question, the findings show that green product innovation influences most carbon governance (34.82%) most followed by low carbon product and process design (28.99%). In addition, green process will influence most low carbon product and process design (33.05%), followed by low carbon manufacturing and logistics (28.99%) (see Table A1–A2, online supplementary file). The above results may be validated based on the discussions below and the firms' case respondents' quotations. Findings are aligned with Rehman et al. (2021) and Awan et al. (2025), which suggest businesses that indulge in green process and product innovation are capable of hypothetically changing the manner in which they run their current operations, as well as creating entirely new goods and services that are much less harmful to the environment. It is applicable to state that businesses can innovatively affect the environment via GIs in technology (Wang et al. 2020; Mehmood et al. 2024). On one hand, it lessens production's environmental legitimacy investment and is linked to better long-term pollution management, conservation of nature and restoration (Yuan and Cao 2022; Singh 2025). From this context, various studies (Albort-Morant et al. 2016; Mehmood et al. 2024) support that GI refers to the creation of new products and services that are less harmful to the environment. Other examples of GI are the use

of green raw materials, principles or ecological product design material, and energy saving, material utilization reduction, emission reduction of pollutants, and water, electricity and other raw materials consumption. For example, green product innovation entails changing product design for less defilement with production material or the utilization of nontoxic or biodegradable substances (Lin et al. 2013). Some of the green process innovation examples supported by Xie et al. (2019) and Yuan and Cao (2022) include water utilization reduction, efficiency improvement of resources and energy, shift from use of fossils to bioenergy, as well as waste gas and water emission reduction. GI is also one of the fundamental means to effectively and efficiently enhance the EINS condition, and it is likewise a crucially successful strategy altogether environmental regulatory pressure (Zhao et al. 2023). Eco-design and logistics management seem to be extremely reliant on green purchasing (Krause et al. 2009; Zhu et al. 2012). Mitra and Datta (2014) also prove that there was a strong collaboration with suppliers as a communication booster for greener product design and logistics. Based on our research outcomes, GI was positively and significantly linked with low carbon product and process design creation, and this result falls in line with the findings of Das and Jharkharia (2019). The findings mentioned are also consistent with Huang and Huang (2024), who emphasized that GI embraces green product innovations, green process innovations and eco-friendly approaches targeted at reducing environmental impact and promoting organizational sustainable development.

The latter found that a high level of manufacturing ability promotes eco-friendly production methods. Product stewardship, cleaner technology and life cycle assessment (LCA) need suppliers' collaboration, technological improvement and tacit knowledge. Similarly, Das and Jharkharia (2019) suggested that product stewardship for emission reduction during the lifecycle of a product lowers emissions and capital spending of companies from the natural resources-based view (NRBV). Product stewardship, which once had the aim of minimizing emissions during a product's lifecycle and the corporation's competing use of end-of-pipe-control, such as recycling and process difference, is also part of its pollution avoidance and product stewardship plan (Mao et al. 2017; Cheng et al. 2025). Therefore, product stewardship and pollution avoidance comprised low carbon process and product design (Shaharudin et al. 2019). Finally, the previous literature stressed that GI contributes significantly to the sustainability of the environment by reducing releases of GHGs, preserving renewable resources and encouraging environmentally responsible behaviours in all domains (Cheng et al. 2025). Furthermore, GI enables the development and deployment of environmentally beneficial products/processes across sectors, hence increasing total ecological impact (Sun et al. 2025). The above findings are also aligned with the following case respondents' suggestions:

*Case A. LCSC aims to decrease carbon emissions and keep control over the whole supply chain, from sourcing materials to designing and manufacturing products to distributing and handling logistics. With the right carbon emission management in place, every step of the supply chain that produces carbon emissions may be reduced.*

Case D. Companies can currently mitigate carbon emissions during supplier procurement by acquiring low-carbon materials and commodities and services, low-carbon energy and/or renewable energy alternatives and low-carbon energy and materials.

Case G. The procurement of low carbon energy, low carbon materials and low carbon commodities or services by businesses enables them to initiate the process of product design and development.

Case I. In order to cut down on carbon emissions throughout the design phase, our companies work together to include consumers and suppliers in the process.

Case C. Firm can substitute the traditional materials with renewable and recycled materials while using low carbon material reduce carbon emissions.

Case G: Life cycle assessment used by our firms help us discover new insights into materials and product life.

Case J. Manufacturing the product once the design phase is completed is one of the highest carbon emission stages. Firms can reduce carbon emissions at this stage by using low carbon energy, such as renewable energy and training their employees on its uses.

Case H. We are making investments in low-carbon technologies and machinery, using low-carbon materials, life cycle evaluation and funding for carbon emissions reductions and energy conservation and hardness project.

Case G. Businesses can switch to less environmentally harmful packaging. The cost of carbon emissions and the amount of damage inflicted shall be minimized.

Case C. GI is present in LCSC characteristics such as, but not limited to, the monitoring of carbon emissions at the company level, energy consumption and subsequent emissions, carbon-intensive materials, direct carbon emissions, production methods and operations.

Case E. GI is environmental reputation, overall performance, pollution and waste reduction, compliance with general environmental regulations and other comprehensive attributes.

Case F. Manufacturing companies can reduce their carbon footprint, boost stakeholder happiness, increase product quality, cut expenses and concentrate on sustainability initiatives.

Case I. Green process innovation permits management to buy low-carbon technology that optimizes both efficiency and transportation.

Case D. GI is used to generate plans for society to ensure the future populace lives in a natural point with plenty of natural materials to sustain a free, safe and wealthy life.

Based on the above discussion following propositions are formulated as given below:**P7.** Green product innovation (suppliers and consumers collaboration at design phase, low carbon

materials) leads to carbon neutrality goals by effectively driving low carbon purchasing, low carbon process and product design, low carbon manufacturing and logistics and carbon governance.

**P8.** Green process innovation (e.g., life cycle assessment, green operations or practices) leads to carbon neutrality goals by effectively driving low carbon purchasing, low carbon process and product design, low carbon manufacturing and logistics and carbon governance.

#### 4.4 | Practical and Managerial Implications

We also hope that our work contributes to the economy expanding, the environment becoming cleaner and the country being better off. Specifically, this research is anticipated to contribute to the current body of literature by enlightening the issue of the importance of GI in manufacturing industries to the manufacturers and policymakers. The intricacy of handling multiple influences from various actors that impact manufacturing industries' plants' sustainability initiatives is highlighted by study outcomes that indicate practitioners are influenced by pressures from both internal (the workers and executives) and external (consumers, the governing body) stakeholders. Thus, the results demonstrate the significance of leadership's dedication to environmental responsibility in an organization's capacity to effectively embrace eco-friendly practices (Reliance Industries Limited 2024).

In addition, research findings emphasize the value of instructing and training staff to build sustainability competencies that increase their initiative in adopting and putting low carbon SC practices into practice (European Commission 2024). External influences from the government and consumers should also be considered because they significantly influence industrial facilities to act responsibly. Regarding the environmental strategy of multinational corporations, which is typically established at the corporate level for the entire organization, current research gives local leadership a bit of flexibility so they can react suitably to the demands of the most critical stakeholders in their particular scenarios.

While undertaking this investigation, managers will acquire a better understanding of stakeholder activities and roles in GI. Professionals within the manufacturing field will learn more about the advantages of GI offered by the research. This is because the scenario of green product innovation and process innovation is vivid, requiring subsidiaries to respond in multiple ways to numerous aspects (European Commission 2024). Businesses should also have the capability to respond to order-takers by developing and selling products that cause less harm to the environment. Businesses should take this into account and wait to become ISO-certified to attract customers. Because staff members are consumers as well, managers can benefit from this by motivating them to support GI and encourage others to do it as well. Managers must build a connection with suppliers so that they may provide resources that are critical to a company's green strategies. Managers will be able to understand how emissions are distributed across the SC by making SCs more transparent through the current study. Managers need to obtain a

comprehensive image of the emissions, and CarNeu is a feasible general goal. They must conduct the necessary checks with their internal strategy, and then they may act in the SC. The current research can help enterprises understand the significance of SC's transparency to take through all SC steps and report well on the emissions.

According to the results of the current study, governments may assist manufacturing SMEs in adopting green operational approaches by establishing regulations and providing financial support for sustainable investments and technology. Policies like this will encourage cleaner manufacturing methods, particularly in the areas of product development, packaging, recycling and innovation in terms of commodities and resources. Furthermore, following stakeholder demands and using green manufacturing procedures support a balance between the environment and thriving communities, which are marked by hygienic workplaces, safer consumption goods, high stakeholder fulfilment and improved business success.

As an example, the 12th plan of Malaysia aims to boost the nation's gross domestic product and pass the high-income threshold through the implementation of GI, which is appropriate to this plan. Likewise, the goal is to drive labour productivity by consistently migrating from labour-intensive to knowledge- and innovation-intensive economic activity, which will create employment opportunities for 2030 with the addition of green creative goods and processes. All economic sectors would likely have robust growth in manufacturing industries by employing GI up to CarNeu. Because most stakeholders are unfamiliar with GI and CarNeu, the outcomes of this research may be beneficial to policymakers in low-potential countries as well. Harmonizing the demands of internal and external stakeholders is required to achieve double effects on CarNeu through GI. On the one hand, the government must tighten up rules to pressure corporations to use GI and CarNeu; on the other hand, customers have an important role to play in purchasing green-friendly goods. Firms should have a greater opportunity to boost their need in the local green market as a result of this.

Organizations that are participating in the fight against climate change should aggressively consider like-minded partners to help GI solutions, particularly R&D units, whether in universities or organizations. Managers must persuade R&D partners to engage in GI to accomplish this goal. Present research emphasizes that stakeholders, funds and GI are conducive to carbon reduction. Therefore, managerial policies related to attracting stakeholders and government financial support for GI will make great contributions to CarNeu and impact wider climate integration in urban policymaking (SDG 13).

## 5 | Conclusions

The climate crisis has been recognized as so severe and pressing that the United Nations has deemed CarNeu by 2050 to be the world's biggest priority. A lack of investigation has been undertaken on the topic of how individual firms and the corresponding supply chains are preparing to achieve this goal, despite the growing number of country commitments in this

area. In this context, the article examines existing approaches used by firms and the supply chain industry to achieve CarNeu. Drawing on the open quotes of the respondents from the case industries, the current results found that the 11 subthemes extracted frequently co-occur. The study aims to provide a means of investigating, systematically, the impact of various institutional forces on GI and CarNeu, as well as the role of stakeholders; the current study provides an integrated theoretical lens that brings together stakeholder theory and institutional theory. Additional research in this area is required because the challenges posed by climate change require countries, businesses and people worldwide to take collective action. This type of coordinated initiative is critical for achieving SDG 13, and the present research acts as a foundation for future global treaties to improve the successful implementation of environmental policies on a global scale.

Second, the findings indicate that CarNeu and GI's primary drivers were mimetic pressures from competitors, followed by normative pressures for environmental legitimacy, and coercive pressures from customers. Thus, our analysis underlines that the commitment to CarNeu is predicated largely on the sustainable business value of shareholders and senior management. They believe that in the long run, it would be beneficial for the economy if it reaches CarNeu. For one enterprise to employ eco-friendly products and processes, it is expected to have a 'flow-on effect' on the whole supply chain. This study explores the elements that lead to CarNeu and the way they affect companies and multitier supply chains. In order to methodically investigate the influence of stakeholders and the effects of various institutional constraints, it used an integrative theoretical lens that combines the theories of stakeholders and institutions. The present study goes beyond a single theoretical viewpoint and offers an extensive conceptual system to develop novel perspectives into how organizations manage and encourage environmentally friendly innovations with different sustainable processes in the presence of numerous external influences and contextual variables. It does this by examining how stakeholder awareness triggered by institutional requirements collectively shapes GIs and other environmentally friendly procedures. More research on this subject is necessary because reducing the risks posed by climate change requires cooperation from governments, businesses and communities.

This research has a few shortcomings, regardless of its novel findings. With 15 respondents from diverse types of businesses and real-world involvement with climate neutrality endeavours, the sample we used was a bit small. Because the objective of CarNeu is still in its early stages, it was difficult to find individuals who were sufficiently familiar with the concept. Future research may enlist additional respondents from different nations and a wider spectrum of sectors.

Therefore, it is relevant to expand the current framework to other GI and CarNeu-related fields, such as the construction and tourism industry, to ensure that the findings are valid in other areas. Later research might be able to include numerous company types and a larger number of countries. Additionally, the research explores how customer, regulatory, stakeholder and societal factors drive environmentally friendly initiatives like carbon-neutral SC and GIs. However, the impact of

**TABLE 3** | Potential research questions for future research exploration towards carbon neutrality goals.

Present research questions	Unexplored themes	Future research questions
<i>RQ1: How would the various stakeholders' pressures lead firm's transition towards green innovation and low carbon SC practices (CarNeu goals)?</i>	Impact of internal stakeholders' pressure on cooperative green innovation	<ul style="list-style-type: none"> <li>• How can top managers' practices help improve employees' organizational identity and encourage employees to implement pro-environmental behaviours?</li> <li>• How will top managers develop a green organizational culture or climate that positively influences employees' adoption of green innovative behaviour?</li> <li>• What should external resources be available for organizations under investigation because they can implement both green product and process innovation to diminish the negative impact of the items produced and the production and damage to the environment?</li> </ul>
	Impact of external stakeholders' pressure on cooperative green innovation	<ul style="list-style-type: none"> <li>• In terms of product and corporate operations, how might customer demand lead companies to innovate with green products and processes?</li> <li>• How would businesses become part of the stakeholder interaction network in order to facilitate and acquire the resources for green innovation?</li> <li>• How may governments rate companies based on environmental impact? For instance, would they set environmental standards, or would they require the application of green technology in order to reduce adverse effects, perhaps?</li> <li>• What could suppliers do if they wanted the client organizations to buy an environmental innovation that they developed or if they needed to make their environmentally friendly innovation compatible with current adoption?</li> <li>• How might a government implement pollution standards or trade programmes in order to make high-scoring industries cleaner and favour SDG 13 through incorporation of climate actions?</li> </ul>
	Impact of internal stakeholders' pressure on carbon neutrality goals	<ul style="list-style-type: none"> <li>• What factors influenced the firm's dedication to carbon neutrality policies or SDG 13, if anything, shareholders and senior management's confidence in the profitability of carbon neutrality projects?</li> <li>• How did family business owners who had strong environmental values but were incentivized by potential rewards, become carbon neutral?</li> </ul>
	Impact of external stakeholders' pressure on carbon neutrality goals	<ul style="list-style-type: none"> <li>• How do carbon neutral aspirations, promoted by conscientious consumers, become carbon neutral as a result of external pressure from some B2B customers?</li> <li>• What legislation will the government formulate to ensure that businesses reveal their environmental, social and governance nature and emissions to their supply chain and consumers, as an initiative of leading to carbon neutrality?</li> <li>• Why do people believe that a company with not even one local client should have pledged to be carbon neutral?</li> <li>• What are the legislative pressures concerning the attitudes of shareholders and senior management of a company with zero local clients ready to adopt behaviours to environmental sustainability?</li> </ul>

(Continues)

TABLE 3 | (Continued)

Present research questions	Unexplored themes	Future research questions
<i>RQ2: How would the green innovation driven by stakeholders' pressures further facilitate the low carbon SC practices (CarNeu goals)?</i>	Direct impact of green innovation on carbon neutrality	<ul style="list-style-type: none"> <li>• What are the implications of businesses interacting to innovate in a sustainable way, thus raising the extent of their innovation and facilitating more effective carbon reduction?</li> <li>• How can an organization's carbon neutrality aspirations affect its green technology innovation and organizational environmental management agenda?</li> <li>• How can executives, with a higher level of environmental consciousness, understand government-regulated incentive programmes, which promote eco-innovation and decrease emissions, and what benefits might such incentive programmes provide?</li> <li>• To what extent would green innovation lead to the reduced micro-level investment in the production's environmental legitimacy?</li> <li>• How does green innovation contribute to the endowment, replenishment and long classical progress of natural resources for preserving the ecosystems' and the pollution control's ecological service value?</li> <li>• What are the best ways to reduce gas emissions through product design and by generally considering the life cycle assessment (LCA)?</li> </ul>
	In-direct impact of green innovation on carbon neutrality	<ul style="list-style-type: none"> <li>• How would green innovation affect and reduce miniature carbon SC practices by cutting down on trash consumption and the use of noxious materials at production and throughout logistics?</li> <li>• How would brighter procurement, production and distribution innovations affect and lead to better environmental performance?</li> <li>• How can suppliers adopt an environmental management system that is largely impacted by green innovation, which helps design products that are kind to the environment by cutting materials and energy endowment and consumption across the supply chain, improving manufacturing processes to reduce water use and emitting processes and emissions caused by various distribution activities?</li> <li>• How might cleaner technology as an environmental innovation and generally being environmentally proactive lead to the improvement of environmental performance by significantly cutting water and energy use and waste emissions?</li> </ul>

various suppliers, employees, labour associations and other stakeholders needs to be taken into account in future studies. Understanding the complicated dynamics of stakeholder engagement and its effects on GI and other initiatives related to sustainability will be significantly simpler with this comprehensive perspective. This will result in more efficient ways to promote environmental practices. Additionally, there are no control parameters in the research, which might lead to biases because of omitted characteristics. Stakeholder engagement may be influenced by certain elements, and as the current study has shown, different sustainability approaches might

conflict with one another. To guarantee more trustworthy findings, future research should incorporate appropriate control variables. Future researchers may also focus their later research on the identified critical drivers. 'Level of "customer enforcement," a major driver for each enterprise to innovate green, and CarNeu is a function.' It is also necessary to include quantitative research in later research for the requirements of the model construction and the wider degree of adoption of the relationship between stakeholders, GI and CarNeu to be validated. Based on this research, limitations and future directions are shown in Table 3.

## Author Contributions

All authors contributed significantly to the work.

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### Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Figure A1:** Co-occurrence (word coded) between firms' cases and various subthemes. **Figure A2:** Co-occurrence (word coded) between external stakeholders' pressure and green innovation. **Figure A3:** Co-occurrence (word coded) between external stakeholders' pressure and low carbon SC practices towards carbon neutrality. **Figure A4:** Co-occurrence (word coded) between

internal stakeholders' pressure and green innovation. **Figure A5:** Co-occurrence (word coded) between internal stakeholders' pressure and low carbon SC practices towards carbon neutrality. **Figure A6:** Co-occurrence (word coded) between green innovation and low carbon SC practices towards carbon neutrality. **Table A1:** Matrix coding query results between various subthemes. **Table A2:** Matrix coding query results between firms' cases and various subthemes. **Figure A7:** First/second-order codes and aggregated themes for stakeholders, green innovation and carbon neutrality goals/low carbon SC practices.