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OVERVIEW

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Corporations and climate change: An overview

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Abstract

Corporations are primary emitters of greenhouse gases yet are also portrayed as key agents in responding to climate change. This overview article explains corporate responses to the climate crisis at three levels of analysis: (i) *political* (shaping the climate debate and influencing climate policy); (ii) *organizational* (enacting strategies and practices to address climate change); and (iii) *individual* (managers and employees caring about and acting on climate change in their personal and professional lives). Our synthesis of the burgeoning literature on corporations and climate change in the fields of management and organization studies, human geography, and political economy highlights *how* and *why* particular corporate responses have been enacted, encompassing managerial as well as more critical and radical understandings of business activities.

This article is categorized under:

Climate, History, Society, Culture > Disciplinary Perspectives
Climate Economics > Economics and Climate Change
The Carbon Economy and Climate Mitigation > Decarbonizing Energy and/or Reducing Demand
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KEYWORDS

"green" business, climate change, corporate environmentalism, corporate political activity, corporations

1 | INTRODUCTION

Over the last two decades, corporations have become increasingly central actors in political debates over climate change. Many of the world's largest corporations have committed to future "net-zero" emissions targets guided by the United Nations (UN) Sustainable Development Goals (SDGs; Heras-Saizarbitoria et al., 2022). At UN climate change conferences, corporations actively lobby and negotiate with government and nongovernment entities over commitments to carbon emissions reductions and fossil fuel use (Banerjee, 2012; Pulver, 2005). Indeed, prominent business leaders have become vocal advocates for specific strategies and technologies to "solve" the problem of climate change

(e.g., Gates, 2021; Polman & Winston, 2021), arguing that business-led technological innovation, rather than carbon regulation, is the best response to a worsening climate crisis.

Yet, corporations and state-owned enterprises have driven escalating greenhouse gas emissions (Heede, 2014). Fossil fuel companies in particular bear significant responsibility for the current climate crisis (Frumhoff et al., 2015). Despite warnings that extracting more fossil fuels will prevent the achievement of net-zero emissions by 2050 (IEA, 2021), major industry players continue to expand their operations in the pursuit of greater profitability and the incentive of government subsidies (Skovgaard & van Asselt, 2019). Understanding the current climate crisis and the dominant discourse on appropriate responses thus requires considering the role of corporations.

In this overview article, we review the literature on corporations and climate change at three levels of analysis. At the *political* level, corporations and industry associations play a central role in shaping climate policy responses (Downie, 2017; Dunlap & McCright, 2011; Levy & Egan, 2003). This political activity extends to the lobbying and support of political parties and the battle for public opinion through corporate investment in public relations, advertising, and marketing (Aronczyk & Espinoza, 2021; Supran & Oreskes, 2021). At the *organizational* level, corporations enact strategies and practices to respond to the regulatory, reputational, market, and physical risks of climate change. Businesses have increasingly implemented "eco-efficiency" initiatives, technological innovations, "green" products and services, and climate adaptation programs (Dauvergne & Lister, 2013; Wright & Nyberg, 2017). At the *individual* level, senior managers and employees can express concern about climate change and may promote climate action in their personal and professional lives in an effort to challenge business-as-usual assumptions (Rickards et al., 2014; Wright et al., 2012). In reviewing corporate climate action at these three levels, we identify how businesses have responded to the growing public concern over climate change by rejecting the need for carbon regulation and presenting themselves as the actors best placed to provide "solutions" within the existing business model of profit maximization and growth.

2 | CORPORATE RESPONSES TO CLIMATE CHANGE: POLITICAL LEVEL

While the science of the "greenhouse effect" dates back nearly two centuries (Edwards, 2011; Weart, 2011), political knowledge of the threat of human-induced climate disruption was evident by the 1960s (Howe, 2014), and major oil companies like Exxon and Total were aware of their products' climate impacts by the 1970s (Bonneuil et al., 2021; Supran & Oreskes, 2017). Nevertheless, corporations were slow to awaken to climate change, largely ignoring the issue until the late 1980s, when the UN established the Intergovernmental Panel on Climate Change (IPCC) and international negotiations to limit global warming began (Gupta, 2010). An early concern for many corporations, particularly in high-emitting sectors such as fossil fuels, energy, and manufacturing, was the "regulatory risk" of politically acknowledging climate change and the potential for legislation aimed at reducing greenhouse gas emissions (Hoffman, 2005). In response, corporations engaged in a range of political activities to push back against such regulatory intervention.

2.1 | Fossil fuels forever?

The fossil fuel sector, which drove the extraordinary expansion of global economic development over the last 200 years, has been at the forefront of the politics of climate change (Wright & Nyberg, 2021). ExxonMobil, Saudi Aramco, Gazprom, Sinopec, British Petroleum (BP), Shell, and Chevron are amongst the world's largest and most profitable companies and have largely defined the global market economy, in what some have termed a "petro-market civilization" (DiMuzio, 2012).

Aware of the threat that government action on climate change posed for their business model, US fossil fuel companies quickly coordinated corporate political activity to limit and/or delay carbon regulation. Responding to intensifying political attention and the establishment of the IPCC in the late 1980s, major US corporations from the fossil fuel, energy, and manufacturing sectors formed the Global Climate Coalition (GCC) to thwart proposals to regulate carbon emissions (Levy & Egan, 1998). Invoking Gramsci's (1971) theorization of hegemony, Levy and Egan (2003) argued that this corporate response involved the establishment of a "historic bloc" which reinforced perceptions of inevitable fossil fuel expansion, irrespective of the implications of climate science.

A diverse range of institutions contributed to this politically organized "climate-change denial machine" (Dunlap & McCright, 2011, p. 147), including major fossil fuel corporations, industry groups, conservative industry-funded

foundations and think tanks, and so-called "astroturfing" organizations. Following the tobacco industry's example, the US fossil fuel sector also launched public relations and advertising campaigns to shift public sentiment by promoting doubts about peer-reviewed science (Oreskes & Conway, 2010). Fossil fuel companies also played a key role in swaying conservative politicians against carbon regulation by seeding "uncertainty" and "doubt" about climate science, highlighting the economic costs of cutting emissions, and promoting the views of climate "skeptics" in government representations, media, and publications (Oreskes & Conway, 2010). Their interactions with conservative politicians and right-wing media created an echo chamber of denial (Brulle, 2014; Dunlap & McCright, 2011). This coordinated corporate opposition to emissions reductions undermined the US government's attempts to respond to climate change throughout the 1990s and as the US rejected demands for global controls, so international climate negotiations also faltered (Brulle, 2021; McCright & Dunlap, 2003).

Nor was this a uniquely American trend as other countries highly dependent on fossil energy extraction and export followed a similar path. For instance in Australia, a country highly reliant on coal and gas exports, multinational mining companies and industry associations aligned with conservative political parties and media outlets to defeat proposals for carbon pricing and renewable energy development, leading to the fall of governments and political leaders (Crowley, 2017; Wright et al., 2022). In Canada, energy companies promoted exploitation of the Alberta tar sands using the term "ethical oil" and framing Canada as a morally worthy context for fossil fuel extraction, a position endorsed by provincial and federal governments (Kuteleva & Leifso, 2020).

Thus, a key political response by corporations to the initial threat of carbon regulation was to establish a coalition of political actors to maintain the hegemony of fossil energy in the face of calls for decarbonization—what some have termed a "fossil fuels forever" imaginary (Levy & Spicer, 2013).

2.2 | Corporate acknowledgment of climate change

However, while the initial organized political denial of climate change proved highly effective during the 1990s and 2000s, growing social and political attention to the issue forced variations in the public stance of different corporations. In contrast to the US corporate setting, the corporate denial of climate change was far from uniform around the world. For instance, in the early 2000s, European oil majors Royal Dutch Shell and BP publicly acknowledged the importance of climate change and highlighted their investments in renewable energy, carbon capture and storage (CCS), and energy efficiency (Boon, 2019; Kolk & Levy, 2001; Levy & Egan, 2003). A prominent example was BP's 2000 rebranding as "bp – beyond petroleum", in which then-CEO John Browne, sought to reinvent the company as an environmentally aware energy business. This followed the company's (and later Shell's) public departure from the GCC (Beder, 2002; Pulver, 2007). While some viewed this as a fundamental corporate reorientation towards climate change, others highlighted BP and Shell's greater exposure to European regulation and mounting public concerns in Europe over the issue (Kolk & Levy, 2001; Levy & Kolk, 2002).

Another sector that was also more progressive in acknowledging the threat of climate change was finance and insurance where a number of corporations began to advocate for carbon pricing and carbon markets from the mid-2000s (Hawker, 2007; Wright & Nyberg, 2017). For instance, major global reinsurance companies such as Munich Re and Swiss Re became strong advocates for emissions mitigation and more proactive government policies on climate change based on their modeling of increasingly extreme weather events (Thistlethwaite & Wood, 2018). High-profile government inquiries into the economics of climate change in the UK and Australia also drove increasing corporate attention to the issue by emphasizing the need to incorporate carbon pollution into the economic system (Garnaut, 2008; Stern, 2007).

While important in highlighting variations of corporate response, these examples of corporate engagement with climate change were exceptions, with even the apparently more progressive European oil majors reverting to a "business as usual" approach during the 2010s, disbanding their renewable energy divisions and expanding oil exploration and production. Allegations of "greenwashing" intensified in 2010 when BP's Deepwater Horizon oil rig exploded in the Gulf of Mexico, killing 11 employees and causing one of the largest known oil spills in history (Hoffman & Jennings, 2011). Thus while some corporations could adopt a more progressive stance on climate change, these businesses often found it difficult to maintain this position as leaderships changed and critics emphasized the need to maintain a focus on the maximization of shareholder value rather than "green" causes (Siegel, 2009; Wright & Nyberg, 2017).

2.3 | Corporate engagement with climate policy

Over the last decade, as the urgency of the climate crisis has increased and social movements for climate action have grown (Fisher & Nasrin, 2021), the corporate discourse on climate change has also needed to adapt. For instance, after 195 nations signed the 2015 Paris Climate Accord (Morgan & Northrop, 2017), limiting future greenhouse gas emissions to "net-zero" became politically salient. Adopting the language of nation-states, corporate media announcements increasingly emphasized "net-zero by 2050" and "science-based targets" (Hale et al., 2022; Walenta, 2020).

Once again, oil major BP was an early mover, announcing in 2020 that it would become a net-zero carbon emitter by 2050. Shell and Total followed suit, and even ExxonMobil and Chevron adopted future targets (Li et al., 2022). Similarly, tech giants such as Microsoft, Apple, Facebook, Amazon, and Google committed to using renewable energy and performing carbon audits across their supply chains. Amazon, for instance, promotes itself as the world's largest corporate purchaser of renewable energy, with over 500 solar and wind plants worldwide (West, 2023). This shift in discourse has become pervasive, and politically emphasizes the benefits of business self-regulation and market-based approaches (e.g., carbon pricing, emissions trading) as the favored policy path, while relegating governments and international bodies to providing legal and administrative structures for new markets (Böhm et al., 2012; Wright & Nyberg, 2015).

For the fossil fuel sector, the shift towards a "net-zero" emissions future poses significant challenges. Moving the global economy from its reliance upon fossil energy to a radically decarbonized and increasingly renewable energy near-future requires the wholesale reinvention of not only fossil energy extraction and use, but also downstream industries such as petrochemicals, manufacturing, and transport. Responding to these growing social and political pressures, oil, and gas companies have stressed their future role in a decarbonized economy through their strategic capabilities in extraction, processing, and distribution which could be applied to the development of new industries such as offshore wind, hydrogen production and carbon capture and storage (CCS) (Hunt et al., 2022; IEA, 2020). European oil companies such as Total, BP, Eni, Equinor, and Repsol have also emphasized their investments in renewable and alternative technology pathways, stressing their future role as potentially broad-based "energy" companies. For instance, Total has steadily increased its investment in renewable energy businesses since 2016 with an ambition to reach 35 gigawatts (GW) of renewable capacity by 2025 and 100 GW by 2030 and 400 GW by 2050 (equivalent to 50% of its total energy production; TotalEnergies, 2024). BP intends to develop a renewable energy capacity of 20 GW by 2025 and 50 GW by 2030 (Larson, 2021).

However, as critics have noted, this shift to "net zero" involves many heroic assumptions (Nyberg et al., 2023; Shue, 2023). Carbon neutrality is assigned to the future with vague definitions of emissions reductions. Moreover, "net-zero" pledges often rely on shifting to "transition fuels" of dubious merit (e.g., methane, "blue" and "gray" hydrogen) and the development of CCS technologies which are not yet practical at scale (Boon, 2019). Additionally, most corporate commitments to "net-zero" emissions rely heavily on "carbon offsets" which enable corporations to maintain or even increase their own carbon emissions by investing in unregulated and supposedly carbon negative activities (e.g., reforestation; Anderson, 2012; Trouwloon et al., 2023). Furthermore, there is no guarantee that emissions reduction pledges will be fulfilled in the long term (Li et al., 2022). Indeed, the recent rebound in the value of fossil fuel stocks as a result of the wars in Ukraine and Gaza have led oil companies to reassess their earlier emissions reduction commitments (Yoda, 2023).

Critical studies of recent proposals by major corporations in the fossil fuel and petrochemical sectors for a "net-zero" future argue that many of these claims are more about responding to reputational risk and reframing growing social critique while maintaining political legitimacy (Megura & Gunderson, 2022; Tilsted et al., 2022). The shift away from an explicit denial of climate change toward a discourse of future emissions reduction based upon corporate innovation allows for continued growth and expansion while skirting difficult questions of dramatic and urgent decarbonization. Here, critics argue that corporations present a public face of climate concern and pledge future action, yet fossil fuel extraction and use continue to grow.

3 | CORPORATE RESPONSES TO CLIMATE CHANGE: ORGANIZATIONAL LEVEL

While conventional economic thinking viewed environmental regulation as impeding business competitiveness (Friedman, 1970), alternative perspectives began to gain traction during the 1990s and 2000s. For example, the discourse of "corporate environmentalism" (Jermier et al., 2006) argued that innovative capacity and profit motives could

make companies ideally suited to solving environmental problems (Hart, 1995; Porter & van der Linde, 1995). Aligned to related discourses such as "corporate social responsibility" (CSR), "social purpose" and "shared value" (Bakan, 2020; Porter & Kramer, 2011), corporate environmentalism promoted a "win–win" vision of increasing profitability by improving environmental performance, or "doing well by doing good" (Falck & Heblich, 2007), communicating a seductive message that companies could develop effective climate change responses without costly and unpopular carbon taxes and regulation. As Harvard strategy "guru" Michael Porter proclaimed: "While many companies may still think of global warming as a corporate social responsibility issue, business leaders need to approach it in the same hardheaded manner as any other strategic threat or opportunity" (Porter & Reinhardt, 2007, p. 24). Indeed, by 2019, climate change was identified as the most likely and impactful economic challenge facing businesses (World Economic Forum, 2019).

3.1 | Climate risk and corporate response

Climate change became salient to profits and shareholder value as awareness grew about the regulatory market, and reputational and physical threats that climate change posed to corporate competitiveness (Lash & Wellington, 2007). As we have noted above, the salience of these risks varied across industries, with carbon-intensive sectors such as resources, energy, and manufacturing most exposed to regulatory and reputational pressures. However, business focus on climate change was also driven by growing financial pressures from investors and regulators. For instance, in 2015, in a widely publicized speech delivered at the headquarters of insurance giant Lloyd's of London, Mark Carney, the then Governor of the Bank of England (Carney, 2015), cited extreme weather events and the prospect of stranded carbon assets as evidence of the threat climate change could pose to the insurance industry. Following this, the G20 Financial Stability Board published recommendations for the disclosure of climate risk in corporate financial reporting (TFCD, 2017). Major institutional investors such as BlackRock, HSBC, and the Norwegian Sovereign Wealth Fund then announced plans to reduce their exposure to fossil fuel stocks and instead focus on "green" investment opportunities (Holter & Sleire, 2019). Indeed, the International Energy Agency (IEA), a long-time advocate of fossil energy, in 2021 called for the cessation of all new fossil fuel projects and an accelerated phase-out of unabated coal and oil power plants to achieve a net-zero carbon economy by 2050 (IEA, 2021).

Indicative of the growing but varied corporate focus on climate change, a survey of 7000 companies by the nonprofit Carbon Disclosure Project (2020) revealed the range of climate concerns facing different businesses and industries, such as water scarcity threatening Coca-Cola's production, increased flooding leading to mortgage loan defaults for Bank of America, and severe weather impacting mining productivity for BHP Billiton. However, companies also anticipated various opportunities in a climate-changed world. For example, CSL and Merck & Co expected accelerated spread of disease to drive demand for pharmaceuticals and biotech products, Downer EDI foresaw extreme weather expanding disaster recovery operations, and Home Depot anticipated increased demand for air conditioners and ceiling fans.

Many corporations have begun to identify threats and opportunities associated with climate change (see also Backman et al., 2017). As corporate environmentalism spread, companies presented themselves as role models and promoted voluntary initiatives, innovations, and new technologies to address climate disruption (Wright & Nyberg, 2015, 2017; Table 1).

One key avenue of corporate attention in responding to the climate challenge was improved eco-efficiency as a means of not only reducing a corporation's carbon footprint but also improving productivity and profitability (Dauvergne & Lister, 2013; Esty & Winston, 2006). Activities included auditing direct and indirect carbon emissions, reducing energy usage, shifting to renewable energy sources, cutting waste, changing car fleets to hybrid and electric vehicles, and optimizing logistics (Birnik, 2013). The eco-efficiency trend was popularized through high-profile examples, such as Walmart's commitment to 100% renewable energy use and rigorous analysis of GHG emissions across the entire supply chain (Humes, 2011), and General Electric's "Ecomagination" initiative with aggressive targets to reduce energy intensity and water consumption and double R&D for "green products" while growing corporate revenue (Chesbrough, 2012). Indeed, eco-efficiency became a common trend across the corporate landscape, as companies as diverse as News Corporation, Apple, Amazon, McDonalds, Google, and FedEx found new ways to slash operating costs and generate profit (Nyberg et al., 2023).

Eco-efficiency programs also sought to harness employee enthusiasm for environmental issues through programs focused on emissions and waste reduction, "green teams" and competitions for climate champions (Renwick

TABLE 1 Examples of corporate climate initiatives.

Company	Description
Asahi (Japan)	A major global beverage manufacturer, the company aims to achieve zero CO_2 emissions across Scope 1, 2, and 3 by 2050, and to reduce CO_2 emissions by 70% in Scope 1 and 2 and by 30% in Scope 3 by 2030. Direct emissions reductions have come from procuring electricity from renewable sources in its European and Oceania plants. In Japan, almost all plants (29 out of 33) have purchased electricity from renewable sources.
Gazprom (Russia)	The world's third-largest emitter of industrial GHG emissions, Gazprom adopted an Environmental Policy in 1995 and Comprehensive Environmental Program in 2011. Through improved eco-efficiency, the company claims to have reduced operational GHG emissions by 14% in the last 2 years and saved over 3 billion tons of fugitive methane. It aims to reduce gross pollutant emissions and contaminated effluents in surface-water and has introduced an ISO 14001-compliant environmental management system.
Google (US)	Google claims to have been carbon neutral since 2007 and aims to be carbon-free by 2030, matching its energy use with 100% renewable energy. Key initiatives include developing "carbon-free" energy and storage facilities; procuring carbon offsets for historical emissions; issuing sustainability bonds valued at $5.75 billion to encourage green energy; sponsoring a €10 million challenge to fund climate innovation; investing in carbon capture and reafforestation.
HSBC (UK)	Europe's second largest fossil fuel financier, HSBC released its 2020 climate plan with the goal of becoming the leading bank supporting the transition to net zero. Its goals include using the Paris Agreement Capital Transition Assessment (PACTA) tool to achieve net zero emissions in direct operations and supply chain by 2030; help develop a functioning global carbon offset market; and provide financial support (estimated between $750 billion and $1 trillion over the next 10 years) to support heavy-emitting companies to progressively decarbonize.
Ikea (Netherlands)	Ikea aims to be "climate positive" by reducing carbon emissions across its value chain, halving GHG emissions by 2030 and becoming "net-zero" by 2050. Specific strategies include improving eco-efficiency and seeking 100 per cent renewable energy in its operations; sourcing cotton, timber and other products from sustainably certified suppliers; and increasing the recycled content in products.
L'Oreal (France)	A major cosmetics manufacturer which in 2015 was one of the first companies to join the Science Based Targets initiative. By 2021, the company had reduced CO_2 emissions from all its plants and distribution centers by 87% compared with 2005 without relying on carbon offsets. The company claims to also focus on waste management, plastic pollution, and biodiversity loss.
Toyota (Japan)	One of the world's largest auto companies, Toyota states that it supports the Paris Agreement and is committed to action in line with its requirements. This includes the goal of carbon neutrality for all global plants by 2035; expansion of investment and production of electric vehicle models including global sales of 3.5 million battery electric vehicles by 2030; and accelerated development of hydrogen and biofuel technologies.
Walmart (US)	The world's largest retailer, Walmart has committed to science-based targets for emissions reduction, including achieving zero emissions across global operations by 2040 and engaging suppliers to reduce supply chain emissions by 1 billion metric tons by 2030. The company aims to power up to 50% of its operations with renewable energy by 2025 rising to 100% by 2035.

Source: Derived from Carbon Disclosure Project (2022) and corporate websites.

et al., 2013; Wright & Nyberg, 2012). These strategies aligned with a clear "business case" for reducing costs and improving efficiency, transforming environmental concerns into business opportunities (Dauvergne & Lister, 2013).

Corporations also sought to push back against reputational risks by promoting their voluntary reporting of corporate environmental performance (e.g., Carbon Disclosure Project, Global Reporting Initiative, Dow Jones Sustainability Index; Bebbington et al., 2008; Knox-Hayes & Levy, 2011). For instance, the development of environmental, social, and governance (ESG) reporting across the corporate landscape has reinforced the message of corporate concern for environmental issues like climate change and has sought to counter arguments that mandatory reporting and state-enforced regulation are necessary (although regulation of emissions reporting is being adopted in different regional contexts). This new environmental reporting culture also created demand for a multi-billion-dollar market for sustainability advisory services which global management consulting firms have quickly embraced (Mazzucato & Collington, 2023).

This shift towards corporate environmentalism and business "sustainability" has become a pervasive feature of the global business landscape, promoting the idea that climate change is being addressed through voluntary corporate action. However, as critics noted, by improving efficiency and reducing costs, these corporate climate responses also encouraged greater consumption, ultimately contributing to increased overall emissions, resource use, and environmental damage (Hickel & Kallis, 2019; Owen, 2011). Moreover, research suggests real limits to the capacity to maintain

corporate greening initiatives over time. For instance, one study found that despite initial strong commitments to a range of climate initiatives, even the most progressive green companies often abandon their climate programs over time due to stakeholder criticism, leadership changes, and weak financial performance (Wright & Nyberg, 2017). It thus appears that without strong regulatory pressure, corporate environmentalism often falls prey to the more dominant logics of short-term profitability and shareholder value.

3.2 | Climate opportunity and green consumption

Beyond promoting greater eco-efficiency and environmental reporting, the other side of the "greening" of corporations has focused on product and market development opportunities. Early examples included GE's "Ecomagination" program which promoted the company's investment in "green" products including wind turbines and more fuel-efficient jet engines, as well as public innovation contests for climate-friendly technologies (Chesbrough, 2012). Car manufacturers like Toyota developed hybrid vehicles (such as the hugely popular Prius model, launched in 1997), which appealed to consumers concerned about both the environment and rising fuel costs (Nonaka & Peltokorpi, 2006). Likewise, "carbon-neutral" and climate-friendly products from beer to bread appeared on supermarket shelves, appealing to environmentally focused consumers (Dangelico & Vocalelli, 2017). Advertisements for "green" products also regularly incorporate representations of the environment to placate consumers' climate concerns (Garland et al., 2013). For example, Nissan's (2010) award-winning commercial for its Leaf electric vehicle featured a polar bear embracing a car owner in gratitude for his environmentally conscious purchase, with the tagline, "Innovation for the planet. Innovation for all". Corporations also partnered with environmental organizations and sponsored conservation initiatives (Dauvergne & Lebaron, 2014).

However, the corporate promotion of green products and services were also open to critique as forms of "greenwashing" (Santos et al., 2023). Indeed, against the backdrop of a worsening climate crisis, the UN Secretary General, António Guterres recently advocated for a worldwide ban on fossil fuel advertising (Milman, 2024). Thus, corporate responses to the reputational risks of climate change have generated further reputational—and potentially, regulatory—risks.

Against this, however, there are signs that the growing political commitment to future net-zero goals since 2020 is leading to disruptive industry trends in which new technologies and corporate players are emerging. For instance, the rapidly declining cost curve of renewable energy sources such as solar and wind, along with technological innovations in battery storage, have dramatically exceeded market forecasts and made traditional energy options such as coal-fired power far less price competitive (Jacobson, 2020; Luderer et al., 2022). This has resulted in a steady decline in demand for thermal coal in different markets with governments in countries such as Germany and South Korea reducing their reliance on coal-fired electricity in favor of wind and solar investment (BP, 2020). By the beginning of 2024, renewable energy made up 43% of the world's installed energy capacity, with China contributing nearly 40% of the global renewable energy make-up (IRENA, 2024). Indeed, recent estimates suggest China's top solar companies (Tongwei, GCL, Xinte, and Longi), benefiting from significant government incentives, now rival the world's oil majors in terms of their actual energy contribution in raw exajoules (Fickling, 2024).

The dramatic uptake of electric vehicles (EVs) worldwide is also forcing a reinvention of the global automotive industry as established companies such as Toyota, GM, Ford, and Volkswagen respond to new entrants such as Tesla, BYD, Polestar, and other new EV manufacturers (Anderson et al., 2022). Many European countries have already announced the phase-out of internal combustion engine vehicles within the next decade and in 2023, EV sales grew to 14 million (nearly one in five cars sold) with the most rapid growth occurring in China, Europe, and the US (IEA, 2024). The rapid growth of EVs not only suggests dramatic rationalization of the auto industry, but also the global oil industry given 60% of the oil and gas market is transport related (Hunt et al., 2022). As noted earlier, here there is significant potential for the emergence of a "green hydrogen" economy based on cheap renewable energy to unlock a potential zero-carbon fuel stock with significant implications for industries such as steel production (Venkataraman et al., 2022).

Global energy and production markets are thus undergoing significant change driven by the movement toward renewable energy and decarbonization. This poses significant risks and opportunities for the corporations in these markets. However, while the world's energy demands continue to increase, it remains unclear whether the growth of renewable energy will limit global carbon emissions. Despite rapid growth, renewable energy additions are falling short of the UN-agreed target of 11TW by 2030 to achieve the World Energy Transitions Outlook 1.5°C Scenario

(IRENA, 2024). Moreover, fossil fuel use continues, with the world still deriving 82% of its energy needs from coal, oil, and gas, while renewables' share of total primary energy consumption has grown to 15% (Energy Institute, 2024).

3.3 | Corporate adaptation to physical climate risk

Corporations also are becoming increasingly aware of the physical risk climate change poses to their operations and supply chains. In 2004, 25% of 250 large multinational corporations had climate policies focused on the potential impacts of weather-related catastrophes (Kolk & Pinkse, 2004). This emphasis on physical climate risk is particularly evident in industries such as forestry, fishing, agriculture, mining, electricity production, manufacturing, and transport, which are particularly vulnerable to intensifying natural disasters. These uncertainties extend across supply chains and have significant financial implications (PREP, 2012).

For some corporations, managing physical risks involves studying shifting weather patterns to identify the nature and extent of future threats. For instance, insurance companies have fostered closer relations with climate scientists and invested in internal capabilities to cope with extreme events and long-term weather patterns (Hawker, 2007; Thistlethwaite & Wood, 2018). Others have engaged in scenario-based planning to identify and reduce weather-related operational vulnerabilities. For example, electricity producers have introduced a range of "climate-related operational flexibility" measures (Busch, 2011), and mining companies have retrofitted infrastructure to handle greater storm intensity and increased flooding (Odell et al., 2018). Global food manufacturers have incorporated more sophisticated models of future water supply and crop yields into production facility location decisions, collaborated with farmers to implement more efficient irrigation methods, and invested in genetic engineering for drought-resistant crops (Smit & Skinner, 2002).

Corporate adaptation to physical climate risk has been likened to the cycle of growth, contraction, decline, and reorganization observed in disrupted natural ecosystems (Clément & Rivera, 2017; Linnenluecke & Griffiths, 2010). Companies typically react to climate shocks by attempting to preserve existing business models before implementing more transformative changes (e.g., relocating facilities, diversifying operations, switching to entirely different business activities) as climate impacts worsen (Linnenluecke et al., 2011). Examples include winemakers relocating to cooler areas (Ollat et al., 2016), and ski resorts becoming multi-seasonal tourist destinations (Rivera & Clement, 2019). Although such approaches assume a relatively unproblematic process of identifying and responding to the effects of climate change, climate adaptation has not been a strategic priority for many firms. Research has highlighted senior managers' lack of awareness of potential vulnerabilities, as they typically adjust operational activities only after weather-related disruptions catch them by surprise (Haigh & Griffiths, 2012; Pinkse & Gasbarro, 2019).

Thus, despite numerous examples of corporate climate vulnerability, climate adaptation tends to be centered on a firm's immediate operational orbit (Table 2). Research suggests that responses typically focus on the short-term, with relatively little input from external stakeholders (Andersson & Keskitalo, 2018; Averchenkova et al., 2016). Moreover, an emphasis on business "resilience" tends to ignore the scale of commitments required. Much like the denial and delay characterizing corporate responses to emissions mitigation, corporations have generally made minor changes to business operations, often assuming that current practices can continue, irrespective of external climatic shifts.

4 | CORPORATE RESPONSES TO CLIMATE CHANGE: INDIVIDUAL LEVEL

Finally, it is worth considering how managers' and employees' individual perspectives on climate change have also affected corporate practices. While early research on corporate greening revealed significant managerial resistance and ambivalence to pro-environmental initiatives (Fineman, 1997), as public awareness of climate change has increased, managers and employees have begun to voice their concerns about a worsening climate crisis and sought to develop pro-environmental activities within their organizations as part of a broader search for meaning and fulfillment at work (Hoffman, 2010).

4.1 | Corporate executives and climate engagement

Many of the corporations which have adopted a progressive stance on climate change have been led by executives who have expressed strong concerns about the issue. In companies such as BP, GE, Patagonia, and many others, "green"

TABLE 2 Examples of corporate climate adaptation.

Company (industry)	Headquarters	Example
Allianz (insurance)	Germany	"We are using special modeling techniques for natural catastrophes which combine portfolio data (geographic location, characteristics of insured objects and their values) with simulated natural disaster scenarios to estimate the magnitude and frequency of potential losses... The results provide the basis for group-wide risk-monitoring, risk limits, and subsequent business decisions."
BHP (resources)	Australia/UK	"An example is provided by our Petroleum business, which has specifically designed severe weather mitigation systems for Floating Production and Storage Offtake vessels (FPSOs). Although the FPSOs are connected to subsea oil and gas infrastructure, they have the capability to disconnect from this infrastructure and can sail away from impending cyclonic or extreme weather events."
Maersk (freight transport)	Denmark	"To understand and plan for protecting business value from the risks caused by the physical impacts of climate change, we conducted a hot-spot analysis in 2018, estimating the effect of five climate hazards on ports, other fixed assets, and strategic commodities within a 2020–2040 timeframe. The five hazards are heat stress, floods, cyclones, water stress, and sea-level rise."
Nestlé (food)	Switzerland	"Farmer Connect is our sourcing program for working directly with farmers to identify local farming issues... Through Farmer Connect we identify and prioritize issues through a materiality assessment. This helps to define and articulate long-term sustainability goals and outcomes; measure ongoing progress towards short- and medium-term milestones; question any assumptions we have made in defining our goals; and identify and mitigate physical and reputational risks."
Tesco (grocery retail)	UK	"Growing public concern for the environment is expected to drive a shift in demand from animal-based to plant-based proteins. Research conducted in 2020 found that 70% of Tesco customers are actively trying to reduce their intake of meat, while 80% want supermarkets to do more to help, including offering healthier and more sustainable options. We are adapting our product portfolio accordingly."

Source: Derived from Carbon Disclosure Project (2020) and corporate websites.

CEOs have made public pronouncements on climate change, joining growing ranks of celebrities from popular culture, the arts, and politics who advocate for climate action (Bakan, 2020; Boykoff & Goodman, 2009; Nisbet, 2014).

Often these concerns have been framed around their personal values, beliefs, and experiences. For example, in 2007, American venture capitalist John Doerr stunned a Silicon Valley audience during a TED talk in which he made a tearful and anguished appeal for greater climate action, stressing the need for corporate leadership if his children and humanity were to have a future (Wright & Nyberg, 2012). Other corporate CEOs, such as Paul Polman (Unilever) and Jochen Zeitz (Puma) related their awakening to climate change to personal epiphanies and moments of revelation about the huge impact and urgency of climate disruption (Confino, 2012). In Polman's case, this led to not only the reinvention of Unilever's corporate strategy around sustainability but also his role as a public champion for climate action promoting the idea of decoupling business growth from environmental impact (Polman & Winston, 2021). Other former CEOs like Richard Branson (Virgin) have formed non-profit groups such as the B-Team, which engages with prominent climate spokespeople to advocate on climate issues.

While this personal engagement by senior business executives has served to reshape individual corporate strategies, maintaining such initiatives once executives retire or leave their organizations is difficult. Moreover, many of these more progressive climate perspectives view environmental well-being as best served through continued business profitability and growth. Indeed, some of the strongest individual actions have been provided by former and retired business executives less constrained by the demands of shareholder value maximization, who in their post-corporate lives have adopted positions of climate activism and protest (Sanderson, 2016).

4.2 | Sustainability professionals as "green change agents"

Beyond examples of executive promotion of climate initiatives, the growth of corporate environmentalism has also led to the emergence of a new cadre of sustainability managers and consultants charged with promoting environmental issues within their companies, reporting on sustainability initiatives, leading green culture change programs, and

seeking to shift their organizations towards more sustainable activities. (Tams & Marshall, 2011; Wright et al., 2012). As specialists engaged with these issues, these individuals also need to negotiate conflicts between the sustainability discourse and the dominant corporate objective of shareholder value and economic growth (Carollo & Guerci, 2017). Indeed, sustainability work in corporations is constrained by requirements for a clear profit-oriented "business case" as well as executive-level support (King & Pucker, 2021).

Research into sustainability professionals' work suggests they experience significant resistance and push-back in promoting a pro-environmental agenda (Rickards et al., 2014; Wright & Nyberg, 2017). This requires skillful management of their public identities and emotional work, framing sustainability agendas in ways that appeal to different organizational audiences, "issue-selling", and building allies and networks within the organizational arena (Andersson & Bateman, 2000; Wright et al., 2012). Thus, while sustainability professionals can act as "green change agents" promoting climate initiatives such as emissions reductions, they face the dilemma of working within broader corporate constraints while at the same time often being held to account by their own employees and external critics.

4.3 | Internal critique and protest

Finally, it is worth noting that there have been recent examples of employees more generally challenging their companies over their environmental and climate impacts and demanding greater action. For instance, despite tech giant Amazon's claims as a leader in the use of renewable energy, thousands of its employees have staged walk-outs and protests over several years focused on the company's soaring carbon emissions and collaboration with fossil fuel corporations (Weise, 2019).

Employee protests over climate inaction have also been evident at the most elite ends of the labor market. In 2021 in the lead-up to the annual UN climate talks in Glasgow, 1000 employees from the elite management consultancy McKinsey & Co. signed an open letter expressing outrage at the firm's continued work with fossil fuel majors such as BP, ExxonMobil, Gazprom, and Saudi Aramco. They observed that the "climate crisis is the defining issue of our generation" and urged McKinsey to publicly disclose the aggregate amount of carbon pollution produced by its clients. While the consultancy's partners responded by claiming that their work was helping the planet transition to a net-zero future, its staff pointed out that much of the consultancy's work focused on improving the efficiency of fossil fuel extraction and enhancing corporate profitability. In the words of one departing employee: "Having looked at the actual hours billed to the world's largest polluters, it is very hard to argue today that McKinsey is the 'greatest private-sector catalyst for decarbonization' ... It may well be the exact opposite" (Forsythe & Bogdanich, 2021). Thus, beyond external critique from environmentalists, social movements and the media, as studies of corporate climate responses have demonstrated (Wright & Nyberg, 2017), employee critique from within corporations can also serve as a check upon overly optimistic "green" pledges and "greenwashing".

5 | CONCLUSION

While much attention in the public debate over climate change focuses on nation states, governments, and international negotiations, often missing from this analysis is the critical role that corporations and businesses play in both contributing and responding to worsening climate disruption. As we have outlined, corporate responses to climate change have intensified in response to growing political and social concerns over a worsening climate crisis. Carbon-intensive groups such as the US fossil fuel industry initially pursued a defensive political strategy aimed at seeding doubt about climate science. This proved to be highly effective, as climate change became weaponized as a partisan political issue across Western nations. Nevertheless, some businesses responded to climate change by adopting the discourse of corporate environmentalism and promoting "green" practices. Climate change was perceived as a threat to corporate operations and reputations while offering opportunities to develop new markets, products, and services. The implementation of climate-related strategies and practices within many industries and businesses also enabled new managerial occupations to emerge. For instance, corporate sustainability managers and consultants have become key actors in the implementation of climate-related business practices, many of whom seek to balance their professional and personal identities as "green change-agents".

We live in a global "corporate society" (Bakan, 2020; Barley, 2007) in which large multinational companies not only drive the continued expansion of economic activity and consumption underpinning the climate crisis, but also shape

how humanity will respond to associated environmental costs. Recognizing this broader context of the climate crisis requires acknowledging how corporations both contribute to the climate crisis, while also promoting themselves as humanity's saviors. This dual role of corporations highlights the need for a conceptual understanding of the political economy of climate change (Paterson, 2021; Sovacool & Linnér, 2016), and how corporations maintain their position of authority despite growing social and political critique. Given the outsized influence, corporations now have on political, economic, and social life, understanding how and why humanity has failed to respond to the worsening climate crisis requires better accounting for the role of corporations at the political, organizational, and individual levels of action.

AUTHOR CONTRIBUTIONS

Christopher Wright: Conceptualization (lead); formal analysis (lead); methodology (lead); project administration (lead); writing – original draft (lead). **Daniel Nyberg:** Conceptualization (supporting); formal analysis (supporting); writing – original draft (supporting).

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