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Multinational and large national corporations and climate adaptation - Are we asking the right questions? A review of current knowledge and a new research perspective

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Abstract

Adapting to climate change requires the engagement of all actors in society. Until recently, the predominant research focus has been on governments, communities and the third sector as key actors in the adaptation process. Yet, there is a growing emphasis internationally on understanding the role of and the need to engage businesses in adaptation given their potential to finance projects, develop technologies and innovative solutions, and enhance the scale and cost-effectiveness of certain adaptation measures. Large national and multinational corporations are among the key

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3 actors in this respect. Already, many of these corporations are purportedly taking steps to adapt
4 their operations to climate change. Some stated reasons for their engagement include minimising
5 potential impacts on value chains, improving resource efficiency, enhancing production of
6 sustainable raw materials, and supporting customers', suppliers' and communities' climate change
7 adaptation efforts. However, there is a paucity of work analysing adaptation actions by these
8 corporations, their motivations and contribution to broader adaptation and climate resilient
9 development efforts, as well as possible instances of maladaptation. We apply a three-tier
10 framework on drivers, responses and outcomes to examine the state of knowledge according to
11 recent literature on private sector and corporate adaptation to climate change. Our review
12 highlights that the literature on the impact and outcomes of corporate adaptation actions is sparse
13 and we consider the implications for future research. Our analysis concludes with a reflection on the
14 relevance of corporate-led adaptation – for the companies themselves, policy-makers at all scales, as
15 well as society at large.
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22 Introduction

23 Climate change is expected to lead to major impacts on human and natural systems and increase
24 risks for individuals, businesses, infrastructure, assets and economies¹. No single intervention will
25 deliver adaptation to climate change, as efforts cutting across various sectors and timescales will be
26 required. Adding to this complexity is the uncertainty and long-term timescales of climate change
27 impacts, which go beyond normal investment decision cycles in the private sector and policy
28 planning cycles of governments².
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31 The magnitude of the climate challenge has led to a growing recognition at international and
32 national levels of the need to engage the private sector³⁻⁹. Given the scale of investment required to
33 address both climate change mitigation and adaptation and the limited public resources available
34 the private sector is seen as a key player for the transition to low carbon and climate resilient
35 development. Yet, the main focus in the academic and policy literature so far has been on the role of
36 the private sector in mitigating climate change, while the role and impact of the private sector in
37 delivering adaptation remains poorly understood. In addition, in practice the private sector has been
38 until recently more engaged in mitigation activities than in adaptation^{10, 11}.
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42 The central role of the private sector in relation to mitigation has been emphasised from early on in
43 international climate debates. Based on the polluter pays principle governments designed policies
44 aimed at limiting emissions of greenhouse gases (GHGs) from the emitters and incentivised cleaner
45 low carbon technologies. According to a recent study, over 75 per cent of global GHG emissions are
46 covered by economy-wide emission reduction targets covering 45 countries (including the EU as a
47 block)¹². The critical drivers for corporate strategies on climate change mitigation have been the
48 direct and anticipated regulatory pressure and the related pressure from the shareholders. The
49 private sector has reacted to these pressures to play a key role in mitigation and reduce their GHG
50 emissions by investing in and developing renewable energy and energy efficient technologies.
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54 By contrast, adaptation came to the fore in international climate policy much later than mitigation. It
55 did not feature prominently in the Kyoto Protocol and only became a significant part of the UNFCCC
56 negotiation processes when it was formally recognised as the second pillar in the Bali Action Plan in
57 2007, a decade later than mitigation. To date, the main responsibility for adaptation lies with the
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3 governments and the largest share of finance is expected to come from the public sector. However,
4 this adaptation landscape is changing with the United Nations (UN) calling for the private sector to
5 play a key role in shaping and furthering the global climate change adaptation and sustainable
6 development agendas. The private sector is seen as being able to contribute significant levels of
7 financing, develop and implement new technologies and innovative solutions, and enhance the
8 scale, efficiency and cost-effectiveness of certain adaptation measures, in particular within the
9 context of public-private initiatives^{5,7,9,13}. New policies at national and international levels are being
10 developed to promote and facilitate private sector engagement in adaptation. For example, some of
11 the major climate finance mechanisms, including the Climate Investment Fund's Pilot Programme for
12 Climate Resilience (PPCR) private sector competitive set-aside and the Private Sector Facility being
13 developed by the Green Climate Fund, are financing programmes and projects that promote private
14 sector engagement in adaptation¹⁴. In addition, there is growing evidence of private sector action on
15 adaptation, as revealed by initiatives, such as the UNFCCC's Private Sector Initiative and the UN's
16 Caring for Climate Initiative.

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21 As the participation of the private sector in adaptation becomes increasingly important a key
22 question from a policy perspective is how it can be facilitated [incentivised] in a way that helps
23 improve overall society-wide climate resilience. Equally relevant is recognising how private sector
24 action can potentially increase risks and lead to maladaptation, i.e. actions that lead to inadvertent
25 increases in vulnerability to climate change impacts¹⁵, in order to prevent this outcome. Yet, it is
26 important to recognise that the private sector is very diverse. It encompasses all entities not owned
27 or controlled by the public sector, incorporated under law and geared to making profits¹⁶. Private
28 corporations differ in size, and in the location and economic sector they operate in. Some are single
29 businesses operating locally while others, known as Multinational Corporations (MNCs) have a
30 parent company that controls assets and equity capital of subsidiaries, associate enterprises or
31 branches operating across various countries¹⁷. Thus, not all corporations will have the same ability
32 and capacity to take into consideration the impacts of climate change and engage in and deliver
33 adaptation to climate change for their operations or the communities in which they operate.

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38 This study focuses specifically on large corporations, and in particular those operating in multiple
39 countries so-called multinational corporations (MNCs), as their characteristics make them potential
40 key actors for climate change adaptation. These large corporations tend to have high levels of
41 technical, financial and human resources and the potential for significant impact on national
42 economies, businesses and populations. MNCs represent a special case, as having operations and
43 value chains across the world gives them the ability to operate and move resources across countries
44 and sectors and serve as suppliers of some of the credit required to fuel innovation, economic
45 growth and climate resilient development worldwide¹⁸. Their geographical reach also means that the
46 way they respond and adapt to climate change will impact local economies, businesses and
47 populations across the world, including poor communities in developing countries who are
48 especially vulnerable to the impacts of climate change¹⁹. Adaptation measures implemented by large
49 corporations, including MNCs, have the potential to not only improve the company's climate
50 resilience but to also make the local workforce, businesses and communities better adapted to
51 climate change. Conversely, actions by these corporations also have the potential to increase the
52 vulnerability of local actors and communities. With their financial, technical and human resources
53 large corporations are also seen as having the ability to supply the resources and/or know-how
54 needed for adaptation^{7,13,20-26}. Large corporations have considerable potential for innovation which
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3 may provide them with the ability to take advantage of new market opportunities that may arise
4 from climate change by being able to respond to demand for new climate-resilient goods and
5 services and also re-design current products to be better adapted to a changing climate. MNCs in
6 particular are prominent actors in international climate policy debates and have the potential to
7 take on the role of 'trend-setters' among the private sector through their participation in
8 international climate initiatives such as Caring for Climate and by being examples of 'first adapters'
9 or 'early movers' and transferring this expertise within their value chains. In addition, MNCs are
10 likely to be significantly impacted by climate change as they experience a high level of exposure in
11 part from their role in coordinating close to 80 per cent of global trade²⁷ through their global value
12 chains.
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16 The objective of this paper is to contribute to the academic and policy debates by assessing the
17 existing state of knowledge and the key gaps on actions, motivations and consequences of
18 adaptation to climate change by large corporations and in particular MNCs. Applying a three-tier
19 framework on drivers, responses and outcomes we examine the state of knowledge in the recent
20 literature on private sector and MNC adaptation to climate change. Further, on the basis of our
21 review we provide a critical conceptual narrative for the assessment of outcomes of adaptation by
22 large corporations, which is largely absent from the burgeoning literature.
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25 Our paper is directly responding to the needs of the current adaptation policy discourse: Whether at
26 city level, in the context of national adaptation plans or within the UN's global adaptation
27 framework – all those efforts require a better understanding of how to enhance the private sector's
28 role in delivering adaptation. In this context we particularly focus on the following questions that are
29 highly relevant for today's adaptation discourse: Are large corporations, and in particular MNCs,
30 responding to calls for action? If so, what motivates them to do so? And what are the consequences
31 of their actions?
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35 **DEFINING CORPORATE ADAPTATION TO CLIMATE CHANGE**

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37 Adaptation to climate change is defined in the 5th Assessment Report by the Intergovernmental
38 Panel on Climate Change (IPCC) as "the process of adjustment to actual or expected climate and its
39 effects"²⁸. A key challenge for any study on adaptation and corporations is terminology:
40 corporations use a wide range of terms when describing their responses to climate risks: resilience,
41 business continuity, enterprise risk management, or flood risk management, to name a few. Looking
42 for 'adaptation' may not necessarily reveal any of those actions. As mentioned by Agrawala et al¹⁰
43 many actions undertaken by corporations to improve their resilience or manage environmental or
44 climate risks may be part of their standard risk management processes and will not be explicitly
45 labelled as adaptation.
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49 The need for clarity on the definition of adaptation for large corporations is important as the
50 distinctions between adaptation and mitigation are not always clear in this context¹³. Indeed, while
51 corporations seem to have a clear understanding of mitigation, they seem less clear about the
52 meaning of adaptation, and in particular sometimes confuse adapting to GHG emissions mitigation
53 policy and adapting to future climate impacts²⁹. For example, a 2009 survey by Natural Resources
54 Canada found that of the 40% of businesses claiming to be taking adaptation measures 73% of them
55 were in fact describing mitigation actions (e.g. such as measures to respond to the existing or
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3 anticipated regulation to reduce emissions) and only 18% described adaptation actions, while the
4 synergies between both sets of actions were largely overlooked²⁹.
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6 From a corporate perspective, mitigating climate change involves changes in operational practices
7 and in corporate governance, which result in the development of a set of measures that aim to
8 reduce the company's GHG emissions or to lower its carbon footprint through investment in carbon
9 sequestration or the purchase of carbon credits³⁰. Measures to reduce emissions can vary from low
10 commitment ones, such as carbon inventories and disclosure, to high commitment ones, such as
11 corporate carbon targets and green technology investments³⁰. Measures that will need to be taken
12 by corporations to adapt to climate change are quite different. Examples of such adaptation
13 measures and activities include installing flood protection devices in factories, selecting suppliers
14 according to their resilience credentials, developing back-up systems to deal with disruptions of
15 water or electricity supply, gathering information about future risks and vulnerabilities and
16 incorporating this into internal plans, as well as (co-) investing in infrastructure aimed to protect
17 assets and processes.
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22 Understanding the meaning and implications of climate change adaptation for corporations is not as
23 straight forward as for mitigation. In particular, it is important to consider whether and in what way
24 adaptation to climate change means anything new or different for them. Anticipating and
25 responding to risks is considered business-as-usual for many corporations, alongside their efforts to
26 respond to other external changes and stressors, such as industry structures and institutional
27 conditions, suggesting that corporate adaptation is part of corporate risk management. For example,
28 Berkhout et al³¹ and Weinhofer and Busch³² see adaptation as involving the generic risk
29 management stages of identifying, assessing and responding to the risks. In fact, many corporations
30 appear to include climate change risks in existing risk management or business continuity plans and
31 processes. A 2012 CDP study of the UK FTSE 100 companies found that only 10% of those surveyed
32 have a specific climate change risk management process, whereas 88% have integrated risk
33 management into their multi-disciplinary company-wide risk management processes³³. This trend
34 does not appear to be UK specific as Crawford and Seidel's study of the S&P Global 100 companies
35 found that a majority of companies reported including changes in extreme weather risks due to
36 climate change into existing business continuity plans and processes³⁴.
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41 Yet, adaptation to climate change may represent an additional challenge for corporations beyond
42 adapting to economic, policy or legislative changes, as it involves adapting to complex, non-linear
43 and potentially irreversible environmental changes with uncertain impacts³⁵⁻³⁷. Traditional risk
44 management approaches can be applied to the impacts and changes that can be anticipated and
45 quantified but new approaches may be needed to deal with the discontinuous change that climate
46 change represents^{36,38}. Climate change can also be seen as a 'risk multiplier' and corporations have
47 yet to understand its full meaning and impact on all aspects of their business and in particular their
48 supply chains³⁹. Climate change may also make current management practices progressively
49 ineffective⁴⁰. To date little research on sustainability management has looked at how to create
50 innovative, robust and resilient organisations³⁶.
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55 For the purpose of this study we adopt the above IPCC definition and consider 'adaptation by
56 corporations as the process of adjustment by companies to actual or expected climate and its effects
57 through changes in business strategies, operations, practices and/or investment decisions'.
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AN ANALYTICAL FRAMEWORK FOR TAKING STOCK OF THE STATE OF KNOWLEDGE

In this paper we set out to review and analyse the state of knowledge on corporate adaptation to climate change to better understand the motivations, adaptation actions and their potential contribution to broader adaptation and climate resilient development efforts, with particular focus on MNCs. To achieve this aim, we apply a three-tier framework on drivers, responses and outcomes of corporate adaptation actions. While this is a simple framework, it has important implications for theory and practice.

From a theoretical perspective, this framework allows us to undertake a thorough review of three critical elements of corporate adaptation—namely drivers, responses and outcomes; reveal key gaps in the literature; and identify critical areas for future academic research. It enables us to identify questions that remain unanswered and outline suggested ways forward to address the main gaps. Our examination of these core areas of inquiry provides a foundation for the subsequent development of conceptual framings and approaches addressing, for example, welfare implications of private sector adaptation, the nature of effective partnerships, the spatial dimensions of adaptation actions as well as potential spill-overs of adaptation measures across locations (also in terms of maladaptation).

From a practice perspective, this framework allows us to shed light on how policy makers can develop and support favourable conditions for corporate adaptation; the entry points to engage with businesses on climate change adaptation. Results presented in the framework also provide an indication of corporate progress in developing and implementing adaptation actions and where some key gaps are, and highlights some implications that these actions may have on the vulnerability or conversely resilience of communities, regions and countries in which they operate. As each dimension is understood and clarified it becomes increasingly useful for the relevant actors in each domain, in particular for policymakers who are interested in promoting corporate-led adaptation as a supplement to broader societal adaptation.

A few important points regarding the application of our analytical framework to the literature need to be mentioned. First, assessing corporate climate change adaptation actions is complicated by several factors. For instance, as highlighted above, companies may not classify their actions as adaptation per se, and may use other terms, such as resilience or risk management. In light of this lack of conceptual clarity we have opted to be inclusive in reviewing a broad array of papers with a different understanding of adaptation and in considering relevant evidence on responses to the effects of climate change even if not explicitly labelled as adaptation. Our approach responds to the cross-disciplinary treatment required to understand actions by corporations in response to climate change and its impacts.

A second related point is the use of the term 'private sector' which is often applied interchangeably and unevenly across academic and policy literature often with little clarification whether referring to MNCs or other types of corporations. Our review suggests large corporations, and in particular MNCs, have received more attention than small and medium sized businesses but findings are far from representative of the population of MNCs that in 2009 amounted to 82,000, with approximately 810,000 foreign affiliates worldwide⁴¹.

Our review of corporate adaptation to climate change was based on two main sources: i) relevant peer-reviewed academic papers through searches in Web of Science and Google Scholar; and ii) relevant grey literature, as this literature reflects some of the latest thinking in the field⁴². The search for academic papers had two main purposes, which were to firstly identify specific case studies or sector studies of adaptation by the private sector, and in particular MNCs, and secondly to review the more theoretical literature on private sector and organisation-centred adaptation to climate change. For the academic papers we did extensive searches using the terms CLIMAT and ADAPT as well as CLIMAT and RESILIENCE, EVALUAT and ADAPT, OUTCOME and ADAPT, EFFECTIVENESS and ADAPT with a variety of terms to denote the private sector, including: PRIVATE SECTOR, BUSINESS, ORGANISATION, CORPORATION, FIRM. This search highlighted that the literature on corporate adaptation is still emerging and contains mainly a small number of sectoral case studies, in particular focusing on the construction, energy, food/beverage, insurance, winter tourism, and water sectors^{32, 42-48} as well as a few overview⁴⁹ and theoretical papers on business and organisational adaptation^{21, 35, 50}. Given the nascent nature of this literature our review is also underpinned by selected readings from other bodies of related literature including business management and organisational studies, risk management, corporate social responsibility and multi-sectoral partnerships. The search of the grey literature enabled us to access reports from international organisations, non-governmental organisations, consultancies and business organisations, many of which focused on analysing large surveys, such as the Carbon Disclosure Project and the 2010 Caring for Climate survey of 72 corporate signatories to the UN Global Compact and the UN Environment Programme Caring for Climate initiative^{5, 29, 33, 51-54}. This literature therefore provided additional critical material on adaptation by large corporations, and in particular MNCs. Finally, we also conducted an assessment of survey data underpinning the majority of quantitative studies of business adaptation (see Box 1). This assessment informed our analytical framework and identification of gaps in adaptation research on large corporations and MNCs.

Box 1. CORPORATE ADAPTATION AND THE INVESTOR CARBON DISCLOSURE PROJECT

Given a paucity of systematic data as input to our analytical framework we undertook a quantitative review of responses to the Investor CDP survey by a subset of companies in the 2012 Global FT 500 list who voluntarily answered the questionnaires at two points in time: 2009 and 2010. Our final sample consisted of a total of 386 corporations. Our examination did not review open-ended questions.

We found the source an imperfect input for our three-part framework; not unexpected, since CDP investor's questionnaires were not designed with adaptation analysis in mind. Only in 2009 did it include a limited number of adaptation questions. We found sample size to limit representativeness and statistical accuracy; changes to survey questionnaires to limit tracking changes over time (see also Berry⁵⁵ and Wellstead⁵⁶); and the voluntary nature of the survey to introduce sample selection bias⁵⁷⁻⁵⁹. At a more basic level it remains unclear to what extent responses conflate adaptation with risk management, resilience, etc. Limited instrument validity and reliability suggest adaptation research reliant on CDP data to be at best exploratory. In-depth interviews can help to validate conclusions (see for example Agrawala et al¹⁰).

The growing role of corporations for overall adaptive capacity raises the desirability of a data collection effort specifically designed to monitor private sector adaptation. This would go beyond UNFCCC's Adaptation Private Sector Initiative (PSI) designed to assist developing countries to improve their understanding of climate change impacts and their vulnerability, and respond accordingly.

DRIVERS OF CORPORATE ADAPTATION TO CLIMATE CHANGE

Understanding what might drive and motivate the private sector and in particular large domestic and multinational corporations to adapt to climate change is critical as it can enable policy makers to provide and support favourable conditions for, as well as remove barriers to corporate adaptation and can provide entry points for non-profit organisations, international organisations and governments to engage with businesses on climate change adaptation^{29, 45}. While corporate action on mitigation is driven predominantly by regulatory and shareholder pressure, our review of the literature finds that private sector adaptation action appears to be motivated by a wider range of drivers external and internal to a business^{8, 10, 13, 21, 29, 31-34, 42-45, 48, 52-54, 60-63}. These drivers are discussed below, although we recognise that this internal/external division is slightly artificial, as the internal capabilities and processes of businesses are influenced by markets and shaped by and fitted to their external social and institutional environment^{21, 50}.

Internal drivers

Internal factors and capabilities within a company can influence its decision to adapt to climate change^{21, 43, 50, 60}. Climate change will have a variety of impacts on large corporations and MNCs, including disrupting their logistical and manufacturing operations, reducing their production capacity, increasing the cost of materials and infrastructure maintenance, increasing insurance prices and disrupting their supply chains^{10, 34, 53}. To maintain their current operations and competitive advantage, self-interest would therefore seem to be a powerful driver for corporations to adopt adaptation measures that seek to reduce costs, minimise disruption to their production and services, increase their profitability and improve their ability to do business. Yet, to date only a minority of corporations appear to have developed adaptation measures to reduce the impacts of climate change or take advantage of new opportunities¹⁰. In fact, Linnenluecke et al⁵⁰ suggest that key decision makers such as executives, managers and change agents at lower levels of a company have a key role to play in influencing a company's pro-environmental behaviour. Based on findings from the Caring for Climate survey UN Global Compact et al⁵ highlight the need for internal champions to identify and communicate climate risks and opportunities and support adaptation decision-making. However, very little research has been undertaken to investigate how decision makers within companies are responding to climate change and the role they have in influencing company-level action⁵⁰. In their paper focusing on private sector responses to climate change, Pulver and Benney³⁰ suggest that organisational characteristics influence how companies experience, interpret and respond to climate risks. They state that foreign ownership, firm size, export orientation, financial performance all correlate with environmental performance and are likely organisational predictors of corporate engagement on climate change. Although they focus on

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3 mitigation aspects, these factors may be relevant in influencing a company's actions on adaptation
4 to climate change.
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8 **External Drivers**

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10 Many corporations are already experiencing direct and indirect climatic impacts and anticipate that
11 these will increase in the future^{10, 51-53, 60, 64}. These climatic impacts have been identified as one of the
12 key drivers for private sector adaptation to climate change, as corporations start to internalise and
13 consider these risks in their investment decisions. Several studies note the importance of previous
14 experience of extreme weather events or of gradual or average changes in climate (e.g. increase in
15 average temperature) as key drivers for action^{10, 29, 32, 34, 48, 53, 60}. The experience of extreme weather
16 events as a driver for adaptation is particularly relevant for MNCs which have subsidiaries in multiple
17 locations, as they are more directly exposed to different types of extreme weather events and more
18 likely to have experienced such an event than a company based in only one location. Other studies
19 suggest that simply awareness of possible climate change impacts can drive corporate adaptation
20 and lead to anticipatory adaptation responses^{37, 43, 45, 46, 65}. Yet in their analysis of the 2009 CDP data
21 Agrawala et al¹⁰ found that although private sector awareness of climate risks was increasing, only a
22 minority of corporations who responded to the survey had conducted risk assessments and fewer
23 still had evaluated adaptation options, which suggests that awareness of climate risks alone will not
24 be sufficient to drive large-scale adaptation action in the private sector.
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30 Regulatory and legal drivers also play a critical role in stimulating private sector engagement by
31 encouraging or requiring adaptation action by corporations. For example, studies of water supply
32 companies in England and Wales have found that the regulatory environment played a critical role in
33 encouraging adaptation action, as these companies are required to incorporate climate change in
34 the water supply assumptions they use in their 25-year plans^{42, 46}. In addition, financial disclosure
35 rules can require companies to disclose the physical risks from climate change when these risks
36 impact a company's financial situation. Such disclosure rules or guidelines are in place for companies
37 listed on exchanges in the US, Australia, Denmark, South Africa, Sweden and the UK³⁴. Governments
38 also have a key role to play in encouraging corporate adaptation by providing credible, readily
39 accessible scientific information, models and tools, co-financing research and development of new
40 products and services, and forming public-private partnerships^{10, 13, 34}. For example, the Spanish
41 government is supporting the development of new technologies to improve water resource
42 management through CETaqua, a public-private partnership between the government, a university
43 and the water company Agbar¹³. In addition, guidelines and toolkits developed by national
44 governments and international agencies which advise companies on ways to make their operations
45 and projects more resilient to climate change can drive greater adaptation by the private sector (see
46 for example, the European Commission Guidelines for Project Managers on making vulnerable
47 investments climate resilient⁶⁶).
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53 Reputational, corporate citizenship and stakeholder/investor pressures represent additional stimuli
54 for private sector adaptation, as they may enhance the rationale to act. Companies can face
55 increasing pressures from stakeholders, including insurers, banks, investors, regulators, civil society
56 organisations, governments and customers, to address climate risks^{6, 8, 29, 34, 61}. The Global Framework
57 for Climate Risk Disclosure released in 2006 is a guidance from institutional investors to companies
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3 reporting on climate change and calls for them to report on the material and physical impacts that
4 climate change may have on their business and operations as well as on the actions they can take to
5 adapt to these impacts and the costs of such actions³⁴. Industry and professional associations can
6 also play leading roles in driving climate change adaptation, as they are recognised as the standard
7 setter and authority within their industries/professions and develop guidelines, codes and toolkits to
8 set the criteria for best practice on key issues, including climate change adaptation. For example, the
9 Chartered Institution of Building Services Engineers (CIBSE), the International Council on Mining and
10 Metals (ICMM), the World Association for Waterborne Transport Infrastructure (PIANC) and the
11 global oil and gas industry association for environmental and social issues (IPIECA) have all been
12 active on climate change mitigation and adaptation and engage at national and international levels
13 of policy making and debate on these issues.
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18 Market drivers also play a role, as corporations seek to respond to changing demand, develop new
19 products and services, access new markets and seize new business opportunities from climate
20 change^{10, 44, 52, 53, 62, 63}. Several sectors have recognised that adaptation represents new business
21 opportunities, including the agricultural, consulting, water and insurance sectors. For example, in
22 the insurance sector several of the leading global insurers and reinsurers consider adaptation as part
23 of their quest for new growth markets. In addition, the UN Global Compact & UNEP¹³ report
24 revealed that companies see a robust business case for strategic engagement on adaptation as they
25 recognise the connections between their ability to operate and thrive and the well-being of the
26 groups that make up their value chain, including suppliers, employees, customers and the people
27 living in the areas in which they operate. However, it is worth noting that this report profiled
28 companies who are part of the UN Caring for Climate Initiative and are thus most likely to be on the
29 forefront of adaptation action.
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34 As we have noted, the global presence of MNC operations and the overall economic importance of
35 large corporations more broadly make them prime candidates to advance adaptation. Yet it may
36 also conspire to delay or even prevent corporate engagement. At the core of this predicament is the
37 quality of formal and informal institutions in the locations in which they operate, generating
38 additional costs to companies and information asymmetries. Thus policies and incentive structures
39 that distort price signals may not only constrain productive investment but also investment in
40 adaptation or ensue in maladaptation^{67, 68}. Poor business environments and uncertain regulatory and
41 legal frameworks may constrain the ability of corporations to adapt to climate change impacts and
42 take advantage of new opportunities^{10, 68-72}.
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46 Uncertainties regarding the extent, timing and location of future climate impacts also make it
47 difficult for corporations to develop appropriate adaptation responses, in particular in anticipation
48 of those impacts^{34, 53}. In addition, the long-term nature of climate risks requires a long-term planning
49 approach which contrasts with the short-term business planning and investment horizons of many
50 companies^{10, 34, 53}. In some cases a disparity exists between these planning horizons and the likely
51 returns on adaptation investments. These short-term investment horizons of businesses can impact
52 their willingness to invest in longer-term adaptation measures and develop product and services to
53 reduce climate impacts⁶⁸. A further significant consideration is that maladaptation can occur well
54 beyond a project life cycle. Corporations are thus faced with a further critical challenge of ensuring
55 that assessments of maladaptation account for the discounted value of the impacts of a climate
56 measure both for the present and future⁷³.
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3 In addition, there are many company-specific factors that can constitute a barrier to private sector
4 adaptation more broadly. In particular, the lack of appropriate information and knowledge,
5 insufficient resources, low levels of awareness of risks and in particular indirect risks (e.g. value chain
6 risks) and inadequate expertise within a company will constrain their capacity and ability to invest in
7 adaptation action^{10, 34, 53}. While large corporations may generally be considered to have sufficient
8 financial resources to adapt to climate change, a survey of 16 companies – the majority of which are
9 MNCs – undertaken by Agrawala et al¹⁰ found that the high costs of adaptation measures was a key
10 reason why the companies did not implement those measures. In fact, the companies that did
11 implement adaptation actions were those that had been publicly subsidised or were able to pass on
12 their costs to consumers. Companies without climate change leaders or champions may also lack the
13 desire to engage in adaptation, particularly amongst their key senior decision makers⁵³. Finally,
14 investing in measures to build resilience and adapt to climate change competes with other business
15 objectives and resources, which may be more immediate and provide quicker returns³⁴. Companies
16 may face trade-offs between focusing on short-term growth and actions to reduce climate risk⁷⁰.
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23 **CORPORATE ADAPTATION RESPONSES**

24 **Categorising adaptation responses**

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27 Building on the above discussion on drivers for corporate adaptation, this section considers some of
28 the various ways in which corporate adaptation responses can be described/summarised. A number
29 of typologies and categories of adaptive responses have been proposed in the diverse literature
30 examining adaptation processes^{74, 75}. These typologies, in our view, can be grouped into two broad
31 types. The first group encompasses the typologies that classify responses based on the motivation
32 and the level of initiative taken by companies in relation to adaptation. This typology includes
33 categorisations such as proactive versus reactive; ‘wait-and-see’ versus ‘active’; ‘cautious planner’ to
34 ‘explorer’; and no/low regret options approaches. Another group of typologies includes those that
35 classify responses based on the type of action undertaken, for example whether it involves
36 investment into fixed assets (hard vs. soft adaptation).
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40 Given their diversity, large corporations experience different combinations of climate risks, some of
41 which are internal, while some emerge across value chains and others relate to external risks such as
42 shareholder expectations and regulatory markets²⁹. This in turn results in diverse combinations of
43 responses that cut across the different typologies discussed below.
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48 **Responses by company’s motivation and level of initiative**

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50 A common distinction is between anticipatory/proactive and reactive adaptation⁷⁶. Reactive
51 adaptations are implemented in response to a climate hazard or extreme event such as flooding that
52 necessitates an urgent response. Proactive adaptation is undertaken in anticipation of the future
53 climate impacts and is becoming increasingly urgent for corporations to reduce or avoid adverse
54 climate impacts and to seize beneficial opportunities⁷⁷. There are some examples of pioneering
55 proactive MNC responses such as IBM’s development of a software system to collect and analyse
56 weather, rainfall and water-level data to support local government and emergency decision making
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3 on flood threats and evacuation plans⁷⁸. However, as explained in the previous section proactive
4 corporate stances have been hampered by perceived uncertainty about the magnitude and timing of
5 impacts, as well as a lack of policy and regulatory incentives²⁹. Indeed, several studies focusing on
6 CDP data have found that reactive approaches continue to dominate and are often perceived by
7 corporations as sufficient^{10, 34, 79}.

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10 Drawing on CDP data, several authors^{34, 79, 80} have developed detailed analyses of how MNCs in
11 particular are addressing climate change risks. Based on their investigation of CDP data from 136
12 Global S&P 500 companies Kolk and Pinkse⁷⁹ propose a useful typology (ranging from 'cautious
13 planner' to 'explorer' corporations) for categorising corporations according to their emergent
14 climate change response strategy. While these authors focus mostly on mitigation examples, we find
15 this characterisation of responses also useful for adaptation. They found that the majority (67%) of
16 corporations fall in the narrow range of 'cautious' (little to no specific climate measures in place) to
17 'emergent' planners (early stages of considering a more comprehensive and concrete climate
18 strategy). Only 5% of corporations were classified under their definitive cluster: 'horizontal
19 explorers' (exploring and entering new markets and opportunities, sometimes through
20 partnerships). Our review of the literature broadly affirms this trend for adaptation with the most
21 common corporate adaptation responses falling under cautious or emergent planner categories,
22 often with a strong internal focus.
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27 Some typologies of adaptation responses further refer to 'no-regret' or 'low regret' measures¹⁰,
28 with the two terms sometimes being used interchangeably (e.g. Dilling et al⁸¹), to describe
29 adaptation measures that are beneficial today regardless of future climate impacts. While the 'no
30 regrets' rhetoric is commonly used it can be argued that there are very limited empirical examples of
31 entirely no-regret opportunities in adaptation, with cost-benefit equations being difficult to
32 determine and "no/low regrets does not necessarily mean low cost or no opportunity costs"⁸¹.
33 Dilling et al⁸¹ also caution that the term 'no regrets' implies simplified solutions rather than
34 recognising the multifaceted dynamics of vulnerability and the need for flexible and iterative
35 approaches to adaptation. We prefer the use of the term 'low regret' and, while recognising that
36 there are multiple slightly different definitions, define such measures as those that "reduce
37 vulnerability under the present climate regime, whilst being socially acceptable, technically and
38 economically feasible given the prevailing regulatory environment"⁸². Therefore, 'low regret'
39 adaptation activities characteristically address current climate variability concerns and are co-
40 beneficial to existing operations, while also supporting resilience to climate variability and risks⁸¹.
41 For example, implementing measures to improve water efficiency and development and
42 enforcement of building codes are classified as low regrets in IPCC AR5 WGII^{81, 83}.
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48 Some companies are yet to implement specific adaptation measures. This 'no adaptation' response
49 can be attributed to multiple factors, which are often company specific. For example, given the
50 incremental and long-term nature of some adaptation measures combined with economic
51 pressures, some company executives may defer adaptive action and others may opt not to pursue
52 any immediate adaptation if vulnerability assessments reveal no significant climate risks to the
53 business^{10, 29, 84}. No adaptation can also be a result of inter alia regulatory, financial, political, as well
54 as informational and knowledge barriers to adaptation faced by corporations⁸⁵. Significantly, Jones
55 et al⁷³ argue that 'deliberate non-action' that contributes to increased climate risks and adverse
56 outcomes for individuals and communities should be considered maladaptation.
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Responses by type of measure undertaken

Some scholars propose dividing adaptation responses into soft or 'hard' adaptation measures¹⁰ based on the type of measure being undertaken. Soft adaptation measures usually entail adapting existing procedures and operations to be more flexible or resilient to climate change without investment into machinery, engineering facilities or any other hardware or fixed assets.

Concrete examples of 'soft' response to climate change identified in the literature include climate change sensitivity analyses, changes in operational practices; activities in political arenas; changes in corporate governance; public awareness campaigns; capacity building; working with existing suppliers to ensure minimisation of climate impacts; inter-firm co-operation; and initiating partnerships or collaborations for supporting adaptation^{10, 30, 34, 48, 50, 60, 63, 84, 86, 87}.

Often going through some 'soft' responses that are part of overall decision-making is a prerequisite for a company to move to a more active stance (e.g. from emergent planner to explorer) or to move towards hard adaptation measures. Some of the most commonly reported methods used by large corporations to manage climate change risks include using conventional business continuity or emergency preparedness plans, conducting a specific environmental vulnerability assessment and transferring risk through insurance policies^{34, 43, 65}. As an example, IPIECA's⁸⁷ and Gasbarro's⁶⁵ assessments of the oil and gas sector suggests that climate risk management is key to decision making frameworks in these industries with several corporations undertaking the aforementioned risk management methods, although most did not specifically mention adaptation. While many companies use existing risk management frameworks in their approach to climate change adaptation these may be inadequate to deal with climate risks in the future or if linked with broader management objectives may become progressively ineffective for delivering expected results^{34, 36, 40}.

'Hard' adaptation actions typically have a specific adaptation purpose and entail actions such as adjusting infrastructure and technology, often requiring significant investments⁸⁸. The implementation of hard adaptation measures commonly relates to industry sectors, such as mining, that are reliant on long-term fixed assets^{39, 63}.

While more difficult to cost than hard structural measures, some authors^{88, 89} suggest that because soft adaptation measures can be easier to reverse they may be viewed as more suitable for some companies in dealing with uncertain climate and policy contexts. Agrawala et al¹⁰ identify 'low/no regret' and soft adaptation as the most common response amongst private sector companies in their study. Rather than being mutually exclusive, the different types of adaptation measures can be implemented simultaneously by large corporations.

A number of corporate adaptation measures are undertaken as collaborative ventures between business and public or third sector actors⁸⁴. For example, some MNCs in the insurance industry have explored the issue of climate change by collaborating with scientists, publicly engaging in policy debates, and also assessing the climate impacts on and opportunities for their own products⁹⁰. They do this on their own or through sectoral initiatives, such as ClimateWise and UNEPFI's Insurance Working Group, as well as industry organisations such as the Chartered Insurance Institute, the Geneva Association and national trade bodies. Large corporations and MNCs in particular are

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3 increasingly acting through partnerships with governments, local communities, non-governmental
4 organisations and other companies as part of their adaptation responses^{10, 13, 20, 29, 91, 92}. For example,
5 the R4 Rural Resilience initiative is a public-private partnership with Oxfam, WFP and Swiss Re aimed
6 at enabling poor farmers and other food insecure households to manage weather and climate
7 vulnerability through a comprehensive and affordable risk management and resilience building
8 program⁹³. MNCs such as SABMiller and Nestlé have adopted a strong partnership ethos to support
9 improved resource management decisions and facilitate local knowledge sharing in the communities
10 in which they operate⁹⁴. Public-private collaboration on resilience building and adapting to climate
11 change are often most effective when linked objectives exist within a sector but opportunities to
12 scale-up such co-operative arrangements have been inadequately exploited to date⁸⁰.
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18 **OUTCOMES OF CORPORATE ADAPTATION**

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20 Evaluation of adaptation to climate change by the private sector in general and by large corporations
21 and MNCs specifically has not received much attention in business and management academic
22 literature^{95, 96}. One of the challenges for the evaluation of outcomes of adaptation actions by large
23 corporations is the lack of incentives for companies to share information about their climate risk
24 exposure and actions to address it, since it can be sensitive for their competitiveness¹⁰. While there
25 are a range of case studies and illustrative examples, no comprehensive measure exists to calculate
26 the impact of adaptation activities. Measuring and tracking climate resilience is inherently difficult,
27 not just in the context of the private sector^{42, 70}. In addition to long time frames and uncertainties,
28 Bours et al⁹⁷ highlight the difficulty of measuring non-events; that is, in assessing the effectiveness of
29 an adaptation programme for example in typhoon-prone areas in the absence of a typhoon.
30 Furthermore the interplay of different actions and the difficulty in defining baseline conditions
31 without the interventions make attribution of impact to a particular adaptation response a
32 challenging task⁹⁷. For example, reduced damages from flooding could be due to changes in planning
33 control or construction of new flood defences or an artefact of natural variability in the flood
34 regime⁴². There are also the challenges of differences between private and societal effects, with a
35 potential of private actions leading to maladaptation as discussed below.
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43 **Defining the outcomes of adaptation**

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45 The analysis of the outcomes of particular decisions and actions requires clarity on objectives.
46 However, the varied definitions of adaptation in the literature and lack of consensus on what
47 constitutes a successful adaptation measure present particular challenges.
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50 If adaptation is seen as a decision process, then the evaluation of outcome is concerned with
51 availability of tools and capacity to inform decisions. If adaptation is understood as a result, e.g.
52 improved resilience, reduction of impacts and exposure to them, then the evaluation of outcome
53 focuses on the long term effectiveness of the decisions. However such evaluation may be
54 complicated due to uncertainty of how adaptation will work under changing climatic conditions;
55 differences between short-term and long-term impacts of an adaptation action; unintended spill-
56 over effects onto other actors; dependence of adaptation on the actions by others and uncertainty
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3 about the future⁹⁸.

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5 Further distinction can be made between the outcomes of adaptation that are internal to a
6 corporation and external ones. Internal outcomes relate to the impact of adaptation responses
7 evaluated against the corporation's performance and the resilience and adaptive capacity of the
8 company and its supply chains. It could also include evaluation of business opportunities realized in
9 relation to adaptation. External outcomes refer to the impact of adaptation responses by the
10 corporations on wider society, including on adaptation responses, adaptive capacity, resilience and
11 overall development of communities and the local and national economy. This would also include
12 potential maladaptation. Given the importance of large corporations to local economies, particularly
13 in developing countries⁹⁹⁻¹⁰¹, this aspect of corporate adaptation becomes of great interest to policy
14 makers.
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20 **Internal outcomes**

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22 As noted, climate change adaptations can be similar to and entangled with other strategic choices
23 that corporations face to adapt to external pressures and therefore may occur as part of standard
24 risk management or planning processes^{10, 102}. Management and organisational theory literature
25 suggests that organisational adaptation can involve enhancing organisational performance through
26 direct adaptation to existing (or expected) contingencies; and/or enhancing adaptive capacity^{102, 103}.

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28 A framework for the evaluation of internal outcomes of corporate climate change adaptation
29 therefore could include a set of quantitative and qualitative assessment tools or indicators linked to
30 both aspects - the corporations' performance and to its ability to adapt and respond to changing
31 external conditions.
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35 Indicators of performance could include losses avoided, reduced insurance costs, change of
36 exposure due to changed production location, and ability to maintain business continuity in the face
37 of climate change impacts. Several studies provide examples of companies reporting performance,
38 business continuity and ability to meet obligations towards customers among the principal
39 objectives and outcomes of their adaptation responses^{13, 34, 46, 48}. For example, all water supply
40 companies in England and Wales surveyed by Arnell and Delaney⁴⁶ stated that their aim in adapting
41 to climate change was to continue to provide current standards of service, and to enhance these
42 standards where necessary. Haigh and Griffiths⁴⁸ report similar trends for the energy sector, where
43 companies are for example implementing measures to ensure that supply reliability can be
44 maintained through hotter summers.
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48 Evaluation of the ability to adapt could include the capability to make changes to avoid risks arising
49 from climate change; the capacity to recover from losses from climate impacts; and the capability to
50 pursue opportunities arising from adaptation¹⁰². The Economics of Climate Resilience study applied
51 this approach to the UK and evaluated adaptive capacity across sectors, although they did not look
52 into the adaptive capacity of individual companies¹⁰⁴.
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55 Some companies will have a mixture of objectives for their adaptation responses targeting both their
56 performance and their ability to adapt. For example, the health multinational corporation Merck has
57 developed a global water strategy and global water policy throughout its supply chain to respond to
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3 possible changes in water supplies. The company has also implemented business continuity planning
4 to respond to interruptions of supply or production due to exceptional weather events¹⁰⁵.

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6 While the above has provided some examples of indicators or measures of success of adaptation
7 responses, these by no means provide a comprehensive picture of a corporation's resilience or
8 adaptive capacity. Much depends on location, type of business activity, and company size⁷⁰. There is
9 a clear need for further analysis in this area.
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11 12 13 14 **External outcomes**

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16 Adaptation responses by large corporations and MNCs in particular also have impacts on the
17 communities, regions and countries in which they operate. External outcomes of corporate
18 adaptation need to be analysed in the context of their influence on building resilience and reducing
19 vulnerability of communities that they affect. It should be noted that such impacts could be positive,
20 as well as negative, making the relationship between corporate adaptation actions and societal
21 outcomes often more complex than for mitigation.
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24 Since large corporations have a sizeable share in local economies directly and through their supply
25 chains, particularly in developing countries, they are likely to have a significant impact on overall
26 resilience and adaptive capacity of societies. No studies directly exploring external outcomes of
27 adaptation by large corporations or MNCs have been identified in the review. Some examples
28 however were reported through individual case studies. For example, the 2012 UN Global Compact
29 and UNEP¹³ report provides examples of external outcomes of adaptation responses by ten case
30 study companies from the Caring for Climate and CEO Water Mandate initiative. These corporations
31 reported external outcomes in terms of benefits for the wider communities alongside the internal
32 outcomes of their adaptation responses. For example, Coca-Cola is applying a methodology to
33 calculate and quantify the benefits of its community water partnerships. Its water stewardship
34 efforts in India have enabled the company to achieve full balance between the groundwater used in
35 beverage production and the amount of water the company is replenishing to communities. This
36 programme delivers both internal and external outcomes.
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41 Finally, external outcomes of corporate adaptation should be evaluated in terms of potential mal-
42 adaptation. For example, while a shift towards more industrialised forms of building houses provides
43 better control from climatic conditions during construction, prefabrication could also introduce new
44 vulnerabilities. A higher degree of standardization in the building industry would also reduce the
45 ability to respond to regionally diverse climatic conditions and may increase vulnerability to long-
46 term rises in temperature⁴³. Similarly, MNC efforts to reduce exposure to climate risks through
47 changing location or supply base, can have concomitant adverse impacts on communities dependent
48 on supply chain linkages for jobs or on land for food production⁷⁸. Evaluation of such negative
49 outcomes may fall outside of the consideration by MNCs due to being outside of the objectives of
50 their adaptation responses.
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54 While corporations generally recognise that their internal adaptation efforts may have limited value
55 if the surrounding communities and infrastructure are not resilient to future climate impacts^{87, 106},
56 the concept of resilience of societies is not universally defined and many different vulnerability
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3 indicators and assessments exist¹⁰⁷⁻¹¹⁰. Most approaches to evaluation of adaptation focus on either
4 adaptation costs or vulnerability and risk management¹⁰⁹. Furthermore, in the absence of some form
5 of regulation, companies are likely to be driven by their own risk-reward consideration in making
6 adaptation decisions.
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9 This is therefore a critical area for policy makers to pay attention to in order to encourage that
10 adaptation by large corporations contributes in a positive way to overall resilience of the
11 communities. Demonstrating to corporate actors and policy makers how maladaptation can
12 manifest in practice is critical, especially since this 'negative' aspect highlights the multi-dimensional
13 and multi-scalar implications of corporate adaptation for wider societal resilience^{73, 78}.
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16 17 **REFLECTIONS ON THE CURRENT UNDERSTANDING OF CORPORATE CLIMATE ADAPTATION**

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19 The analytical framework applied in this paper has allowed us to systematically and critically
20 investigate current knowledge on corporate adaptation along three dimensions: what triggers and
21 stimulates adaptation action ('drivers'), what type of action is taken ('response'), and what are the
22 implications of these actions ('outcome'). Figure 1 advances our three-tiered framework to include
23 additional components and feedback loops that characterise climate change adaptation by large
24 corporations and MNCs in particular and emphasises the broader societal context that has a
25 constraining or facilitative effect on such adaptations. Feedback loops in particular deserve
26 attention as additional entry points to advance corporate and overall societal adaptation.
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30 <Insert Figure 1 here>
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33 34 **A critical reflection on the knowledge gaps**

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36 While many corporations are aware of climate change impacts only a minority have actually started
37 to develop and implement targeted adaptation measures^{10, 52, 111}. Sectoral differences, variations in
38 organisation structure, corporate culture and the regulatory environments make comparisons
39 between corporations difficult. Furthermore, in the case of MNCs the global scale of operations
40 makes local adaptation efforts at a subsidiary level hard to detect. Some reported activities may be
41 part of a group strategy, while others occur only in a local context, not reflected within the overall
42 company reporting. Our assessment and review has shown that the existing literature offers only
43 limited insights specifically on MNC climate adaptation, with gaps remaining in our knowledge about
44 drivers, responses and most significantly in relation to the evaluation of outcomes of corporate
45 adaptation actions. Yet, filling these gaps, in our view, is critical for advancing the theory and applied
46 work around the implications of climate change impacts for large national and multinational
47 corporations, and their role in broader societal adaptation. In this context we propose that some of
48 these critical gaps are considered by academics and practitioners as priority areas for the future
49 research agenda.
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54 The first area for additional research concerns furthering understanding of what drives and what
55 constrains large corporations to adapt to climate change^{37, 50}. Indeed, a systematic assessment of the
56 relative importance of the different drivers, in particular internal ones, in inducing action is missing.
57 In addition, although many of the examples provided in the literature focus on MNCs, there is rarely
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3 an attempt to unpick what is meant by the term private sector and distinguish between large
4 national and multinational corporations and small and medium enterprises. Yet in particular the
5 global nature of MNCs and their cross-country operations means that these corporations face
6 multiple and often conflicting pressures from the institutional and regulatory environments of their
7 home country, the host countries and the global industry. The barriers to and drivers for adaptation
8 by the headquarter company and by the subsidiaries will likely be quite different, as they will be
9 subject to different legal and regulatory environments, social and cultural values and norms, as well
10 as stakeholder and customer pressures¹¹². A better understanding of these by sector, geography and
11 type of MNC and private sector in general would allow the identification of policy entry points for
12 stimulating their engagement in adaptation.
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16 Additionally, further systematic primary research on adaptation by large corporations that would
17 consider the differences and ambiguities in understanding and terminology around adaptation and
18 address some of the discrepancies discussed below is required. Our review suggests that large
19 corporations are still predominantly at early stages in adaptation responses, often making slight
20 adjustments to existing practices without full consideration of climate change risks. While business
21 attention to the climate change challenge has grown in recent years, few corporations appear to be
22 adopting clear and structured response strategies to incorporating adaptation into regular business
23 activities and operations and attempting to elicit conclusive adaptation response trends among
24 specific sectors is a complex task²⁹. In this context, additional analysis is needed on the potential
25 exposure of current assets under control mainly by MNCs and other large corporations due to
26 climate change impacts, as well as comprehensive research on the potential implications of climate
27 change impacts for future business models and strategies.
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32 Our review has also identified a significant research gap in the analysis of outcomes of adaptation in
33 relation to the private sector and to large domestic and multinational corporations in particular. The
34 literature offers very little about the impact of the implementation of adaptation actions both for
35 corporations and for communities, or about the conditions for the intended outcomes of adaptation
36 to be achieved. There is thus a need for further studies on the performance outcomes of adaption
37 measures and evaluating the conditions under which such measures have intended consequences.
38 This has also been identified by corporations as a need for further investigation: through the
39 ClimateWise insurance industry initiative several insurers have agreed to focus more on the
40 outcome and impact of their climate activities¹¹³. With climate change still being relatively new on
41 companies' radars it may take some time for specific empirical evidence to be generated at scale.
42 Similarly, we have not identified any systematic research focusing specifically on the outcomes of
43 corporate adaptation and their interplay with policy environment. There is a clear need for further
44 analytical and empirical research in this area. Accordingly we suggest that a systematic approach to
45 the measurement of internal and external outcomes would firstly need clarity on the criteria of what
46 consists 'successful adaptation'; and secondly, an understanding of the link between actions that
47 build corporate adaptive capacity and actual implementation. The former would link to internal
48 process-related results; the latter would start with an assessment of the redesign or development of
49 new practices and products.
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55 For assessing the performance of a project where implementation involves interacting with
56 communities corporate adaptation can potentially contribute to broader societal adaptation in two
57 main ways: through a more resilient workforce, or in the form of new products and services to assist
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3 the vulnerable. Such outcomes would benefit communities and broader societal resilience and are
4 also in the self-interest of corporations. The current discussions on non-financial reporting for
5 corporations provide a promising avenue for integration of performance evaluation of corporate
6 adaptation. Some of the proposed frameworks, such as, for example, the Integrated Reporting
7 Framework¹¹⁴, envision companies providing comprehensive reports to providers of financial capital
8 on how they create value for themselves and for others over time. The former allows for accounting
9 for internal outcomes of adaptation, while the latter provides scope for taking into account societal
10 impacts of adaptation.
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14 Further to the above gaps in knowledge about drivers, responses and evaluation of corporate
15 adaptation, we have identified several additional key policy relevant limitations and gaps on
16 corporate adaptation to climate change, which require further research. These relate to
17 terminological confusion, concern about maladaptation and multi-sectoral partnerships.
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20 Adaptation is a relatively new concept for large national and multinational corporations, and terms
21 such as 'resilience', 'risk management' and 'supply chain management' are frequently used instead
22 to describe relevant actions. This makes it difficult to ascertain whether actions can be considered
23 as fundamental shifts towards explicit climate change adaptation or are extensions of existing risk
24 management or Corporate Social Responsibility (CSR) strategies. It is also difficult to understand
25 whether actions described by corporations relate to short-term resilience or long-term adaptation.
26 Further challenges relate to assigning specific adaptation outcomes to actions and the lack of
27 systematic analysis and recording of such responses in the literature. Relatedly, a key question that
28 remains is whether emerging strategies and projects on climate change are truly forms of adaptation
29 or simply examples of business as usual or 'green washing'. There is great need to undertake further
30 work on clarifying the terminology, in particular bridging the concepts used in environmental policy
31 and business and management literatures, as well as to extend the analysis to include a more
32 representative sample of the population of large corporations beyond the more vocal companies.
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37 Historically, large corporations, and in particular MNCs, have often played the role of 'problem-
38 solving units' under power sharing arrangements between them and governments, international
39 organisations, citizen groups or non-governmental organisations^{115, 116}. Collaborative arrangements
40 between public, private and third sector actors for tackling complex environmental and socio-
41 economic problems are not new, but have proliferated in recent decades. Public-private
42 partnerships (PPPs) or multi-sectoral, multi-stakeholder partnerships are receiving increasing
43 attention as key instruments for tackling climate change concerns as they harness the strengths of
44 private, public and non-profit partners¹¹⁷⁻¹¹⁹. Partnerships have the potential to enable corporations
45 to develop more robust adaptation strategies by using the specific knowledge of governments and
46 communities on local exposures, vulnerabilities and capacities; build adaptive capacities of the
47 communities they work in or next to; and ensure that their adaptation activities do not make these
48 communities more vulnerable to climate change¹⁰⁶. Yet, public-private or multi-sectoral partnerships
49 are not a panacea and have been subject to long standing critique in sustainability and other
50 literature^{120, 121}. In particular, differing goals such as private sector profit motives versus not for
51 profit organisation goals or inequitable risk transfers can lead to complications. In this context
52 further research is needed to analyse the extent to which various forms of adaptation partnerships
53 between large corporations, governments, NGOs and academia influence the capacity to adapt and
54 implementation of adaptation actions both for the corporations and the communities.
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3 A further major area for future analysis is a critical assessment of the risk of maladaptation by large
4 national and multinational corporations. Considering the growing demand for private sector
5 engagement in adaptation, particularly within developing countries^{22, 24, 26, 106}, it is important to
6 understand if and how actions by these corporations can benefit or hinder societal adaptation,
7 growth and development efforts, particularly in developing countries⁷³. This is a central policy
8 question to enable governments to amplify synergies between corporate-led and government-led
9 adaptation efforts, also in the countries where MNCs operate, and to minimize potential adverse
10 impacts.

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14 Finally, private sector adaptation remains a nascent area of investigation and would greatly benefit
15 from further interdisciplinary research and integration of the lessons learnt. For example, applying
16 insights from risk management and organisational change literature to climate change-related
17 stimuli, as well as building upon the more extensive literature on CSR would help generate relevant
18 knowledge on corporate adaptation. These fields have to date remained largely disconnected and
19 produced very little interdisciplinary discussion^{50, 122}.

20 21 22 23 24 **Conclusion**

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27 Growing interest among policy makers to ‘engage with the private sector’ and MNCs in particular
28 has brought the expectation that MNCs and their domestic counterparts will play a key role in
29 driving adaptation. The very extensive and diverse body of work reviewed here notwithstanding,
30 additional research is still required to understand more fully the relative importance of different
31 drivers of corporate adaptation and their barriers, the extent that adaptation responses embody
32 climate change risk substantially, and the impacts or outcomes of adaptation measures for societal
33 and organisational resilience. Key limitations are in part due to lack of conceptual clarity about
34 adaptation and of benchmark objectives and evaluative criteria. Our review summarises insights
35 from the recent literature into how researchers and adaptation experts have approached corporate
36 adaptation, as well as how companies themselves have presented their activities. However, we
37 notice that while providing useful pointers, this often does not provide the answers to key questions
38 that decision makers’ may have. More investigative and analytical work is required, reaching across
39 disciplines and enhancing our knowledge base with the aim of offering some clear guidance to
40 governments and businesses alike. Thus as we reviewed the state of knowledge on corporate
41 adaptation with particular attention to MNCs and identified actionable research gaps we have also
42 suggested key areas for future analysis and highlighted entry points for policymakers and other
43 actors.

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49 Based on our analysis, we suggest moreover that a future research agenda, in particular, would
50 benefit from a comprehensive evaluation of outcomes of adaptation responses by large
51 corporations to a set of objectives, from reducing vulnerability of the corporation itself, of its supply
52 chain and of the community where it operates; building adaptive capacity of the corporation, its
53 supply chain and of the community where it operates; to transferring as well as adopting
54 technologies and acting on opportunities related to adaptation. An adaptation-focused systematic
55 data collection effort to monitor corporate and more broadly private sector adaptation could
56 support such efforts. Determining synergies with national adaptation policies and an appropriate
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3 mix of public policy and market responses requires better understanding of internal and external
4 drivers and their barriers, responses of corporate adaptation and their outcomes. In other words,
5 what is needed is better clarity on the broader context and a consideration of 'what we need to
6 know about corporate adaptation and why'. Determining this clearly depends on the state of current
7 knowledge relative to the problems that need addressing: for a business it may be a question of
8 better understanding the actions by competitors or assessing climate resilience of suppliers. For
9 governments, the focus may be on how much action can be expected privately, what policies are
10 required to support and/or incentivise adaptation action, or how to avoid maladaptation. The
11 articulation of an appropriate mix of public policy and market responses depends on a better
12 understanding of the current level of corporate adaptation. In this paper we have laid the
13 foundation for such inquiry.
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35 Related Articles

37 DOI	38 Article title
39 10.1002/wcc.68	39 Panacea or paradox?: cross-sector partnerships, climate change, and development.
40 10.1002/wcc.154	40 Adaptation to climate change by organizations
41 10.1002/wcc.214	41 Firm and industry adaptation to climate change: a review of climate adaptation 42 studies in the business and management field

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Figure 1. Large national and Multinational Corporation Adaptation Framework: Drivers, Responses and Outcomes.

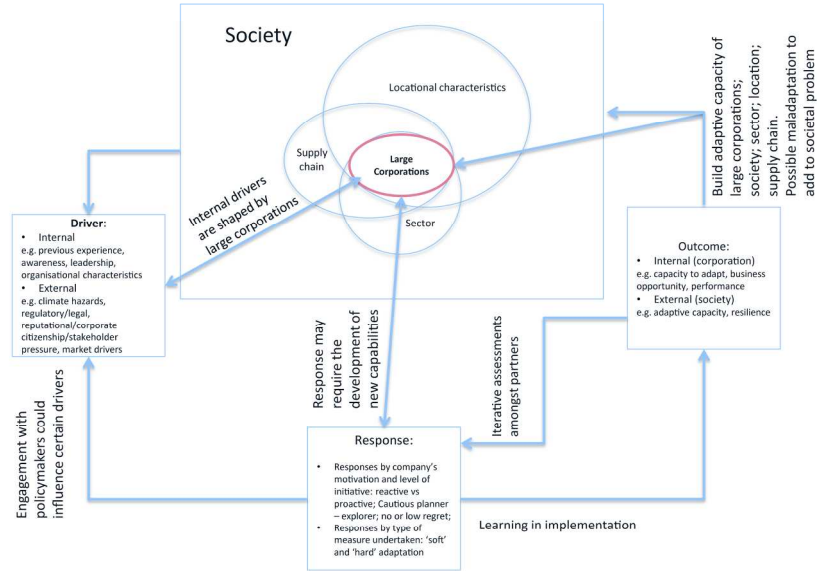


Figure 1. Large national and Multinational Corporation Adaptation Framework: Drivers, Responses and Outcomes.
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