Processes of elite power and low-carbon pathways: experimentation, financialisation, and dispossession

Article (Accepted Version)

Processes of elite power and low-carbon pathways: Experimentation, financialisation, and dispossession

Benjamin K. Sovacool*[12], Lucy Baker[1], Mari Martiskainen[1], and Andrew Hook[1]

[*] Corresponding Author, Science Policy Research Unit (SPRU), University of Sussex Jubilee Building, Room 367, Falmer, East Sussex, BN1 9SL
Phone: +44 1273 877128 Email: B.Sovacool@sussex.ac.uk

[1] Science Policy Research Unit (SPRU), School of Business, Management, and Economics, University of Sussex, United Kingdom

[2] Center for Energy Technologies, Department of Business Development and Technology, Aarhus University, Denmark

Abstract: What is a low-carbon pathway? To many, it is a way of mitigating climate change. To others, it is about addressing market failure or capturing the co-benefits attached to low-carbon systems, such as jobs or improved health. To still others, it represents building adaptive capacity and resilience in the face of climate change. However, these interpretations can fail to acknowledge how pathways of low-carbon transitions can also become intertwined with processes and structures of inequality, exclusion and injustice. Using a critical lens that draws from a variety of disciplines, this article explores three ways through which responses to climate change can entrench, exacerbate or reconfigure the power of *elites*. As society attempts to create a low-carbon society, including for example via coastal protection efforts, disaster recovery, or climate change mitigation and renewable energy, these efforts intersect with at least three processes of elite power: experimentation, financialisation, and dispossession. Experimentation is when elites use the world as a laboratory to test or pilot low-carbon technologies or policy models, transferring risks yet not always sharing benefits. Financialisation refers to the expansion and proliferation of finance, capital, and financial markets in the global economy and many national economies, processes of which have recently extended to renewable energy. Dispossession is when elites use decarbonisation as a process through which to appropriate land, wealth, or other assets (and in the process make society more majoritarian and/or unequal). We explore these three themes using a variety of evidence across illustrative case studies, including hard and soft coastal protection measures (Bangladesh, Netherlands), climate risk insurance (Malawi), and renewable energy auctions and associated processes of finance and investment (South Africa and Mexico).

Keywords: low-carbon transitions; elites; power; financialisation; dispossession; experimentation

Acknowledgments: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730403 "Innovation pathways, strategies and policies for the Low-Carbon Transition in Europe (INNOPATHS)". The content of this deliverable does not reflect the official opinion of the European Union. Responsibility for the information and views expressed herein lies entirely with the author(s). The authors are also grateful to helpful comments offered by Karoline Rogge at Sussex University, Frank Geels at Manchester University, and Marie Claire Brisbois at Utrecht University that have invariably improved the draft.

Processes of elite power and low-carbon pathways: Experimentation, financialisation, and dispossession

1. Introduction

Avoiding dangerous climate change will require a transformation of national and global energy systems by 2030, if not earlier (Rockström et al. 2017). As many have argued, this will involve far-reaching social and economic changes, including disruption to transport systems, decarbonizing electricity generation, reducing consumption, and shifting economic activity towards the delivery of services rather than products (Green and Denniss 2018; Creutzig et al. 2018; Geels et al. 2018). The rate and scale of change required is best described as revolutionary: there are few historical precedents and progress to date has been limited (Geels et al. 2017). This transformation will require large institutions, industrial players, systemic structures, governments, households and individuals to: adopt a range of low-carbon technologies (e.g. electric vehicles, energy storage, heat pumps, smart homes); reduce and change energy-consuming behaviors and lifestyles in significant ways (e.g. in transport and food choices); support ambitious climate policies (e.g. carbon pricing, material efficiency measures and stringent energy efficiency standards, and geoengineering projects); and accept far-reaching changes in local and national energy systems (e.g. widespread diffusion of wind turbines, district heating, solar farms).

Using a critical lens that draws from political ecology, political economy, and other disciplines, this article explores how low-carbon measures—such as coastal protection, climate risk insurance, and climate change mitigation via renewable energy—can end up being guided, shaped, and coopted by elite processes and institutions in positions of socio-economic, technocratic and/or political dominance (Bonds 2016). In this way, low-carbon measures and the pathways they promote can compound existing injustices and inequalities and consolidate wealth. In particular our analysis focuses on the following three elite processes:

- *Experimentation*: using peripheral spaces (geographically, socio-economically, or politically) as a laboratory to test climate change solutions or low-carbon technologies, transferring risks there but not always the benefits (Paprocki 2018);
- *Financialisation*: the expansion and proliferation of financial instruments, innovations, logics, and markets within the global economy and many national economies. Commonly described as "the increasing role of financial motives,

financial markets, financial actors and financial institutions in the operation of the domestic and international economies" (Epstein 2005:3), we examine how financialisation has extended into the realm of climate change adaptation and mitigation.

- *Dispossession*: often an outcome of experimentation and financialisation, this sees climate change measures as dispossessing others of their land, wealth, political and economic participation or other assets, exacerbating inequalities in the process (Paprocki 2018; Sovacool 2018).

After describing our conceptual approach and explaining our methods, we explore these three processes at both national and global levels. Firstly, we examine the implementation of coastal protection measures in Bangladesh and the Netherlands. Secondly, we analyze climate risk insurance as a mechanism of climate change adaptation, with Malawi as a case study. Thirdly, we look at processes of renewable energy finance, drawing from case studies in Mexico and South Africa.

In pursuing this approach, our aim is to make at least two contributions. First, we both integrate and extend beyond existing discussions of elites or inequality that often center importantly, but more narrowly, on the politics of knowledge production or technology transfer. Demeritt (2001) and Friman and Linner (2008) for example note how climate science has political undertones and has tended to privilege European and North American institutions but not ways of knowing in the Global South. Bonds (2010) explores how elites in the United States shape the environmental policy process by funding institutions or suppressing and manipulating information. Another body of scholarship focuses on inequality and elitism within international climate negotiations under efforts such as the United Nations Framework Convention on Climate Change (Najam et al. 2003; Gordon 2007; Schroeder et al. 2012). Others discuss patterns of technology transfer that cement unequal positions in the world economy, as they consolidate expertise among wealthy countries, and hamper the rate of technical development on things like climate change adaptation (Baumgartner et al. 2015; Callaway 2014), or act as an instrument for pollution and resource extraction (Jorgenson et al. 2014). One very recent study discusses how elites can come to view vulnerable groups as threats and then weaponize and securitize social responses to them (Thomas and Warner 2019). These threads are all salient yet seemingly disparate and disconnected—we seek to offer a more holistic discussion of elites which centers on active *pathways* as well as varying *types*. In doing so we make an empirical contribution in showing the roles of elites within different climate change sectors, as well as making a conceptual contribution highlighting the role of different elites.

Second, we seek to insert a degree of caution and restraint amidst narratives of climate urgency (Partridge et al. 2018; Baumler et al. 2012; Kerr 2007) and climate emergency (Kunstler, 2007; Markusson et al. 2014). While a case can be made that climate change *is* urgent, we must be perpetually aware that the social responses to it can also entrench elitism and generate "sacrifice zones" (Healy et al. 2019). In the rush to combat climate change, especially amidst calls to mobilize action similar to war (Delina and Diesendorf 2013; Delina 2016), we must be cognizant of shifting power and control in ways we may not otherwise allow (Kester and Sovacool 2017). Our discussion of elites and low-carbon pathways is expressly intended to shape more reflective and socially just responses, to ensure urgency is matched with considerations of equity.

2. Conceptualizing elite individuals, institutions, and processes in climate change pathways

At the center of our conceptual approach is the notion of elites. By elites, we mean individuals, institutions or processes that have significant power and/or exert dominance in society. Scott (2008: 30) argues that "elites are those groups that hold or exercise domination within a society or within a particular area of social life." Weiss (2005) offers a spatial categorization of elites based on their mobility or scale: transnational elites are spatially autonomous and have the capacity to move seamlessly around the world and profit from global flows of capital. An example here would be the financial investor George Soros or Microsoft founder Bill Gates. National elites are more dependent on institutions of the nation state and its systems of regulation or lack thereof and profit mostly from institutional and/or physical infrastructure within a country. An example here would be national parliamentarians. Local elites have varying access to national or global flows of wealth but still retain authority or hegemony within a smaller community or region, e.g. a tribal elder or village leader.

In his comprehensive volumes on the history of power, Mann (2012a, 2012b) classifies four processes, or sources, of power - ideological, economic, military, and political. Drawing on and extending this logic, we argue that such categories can be tied to four categories of *elite power* as follows:

- Technical elites (scientists, engineers, researchers) can use the values of progress or technical innovation and advancement as an underlying inform of ideological power;

- Financial elites (property owners, local businesspersons, corporate directors, investors) can use monetary and fiscal resources as an underlying form of economic power;
- Physical elites (soldiers, police officers, organized criminals) can use physical violence or force as a form of military power;
- Regulatory elites (lawyers, national planners, political representatives, members of a political party) can use the legal system as a form of political power.

This integrated framework supposes that the way that elites will likely exercise their power across low-carbon pathways will differ—based not only on context and country, but also their type (technical, financial, physical, and regulatory) and scale (local, national, transnational).

The need to understand the role that elites, power relations and political economy play in energy transitions for climate change mitigation is now well-rehearsed (e.g. Meadowcroft 2011, Kern & Markard, 2016), including in low and middle-income countries (Baptista & Plananska 2017) and in relation to renewable energy (Baker, L. 2015). Our study therefore chimes with broader analysis of the justice dimensions of "green" transitions, (Newell & Mulvaney 2013, Scoones et al 2015), as well as work which contains explicit discussion of elites (Sovacool et al 2017; Sovacool and Brisbois 2019).

For the purposes of this study we identify three separate elite processes or responses: *experimentation*, *financialisation*, and *dispossession*. We call these processes rather than merely consequences, impacts, or outcomes to imply that they often (though not always) embody *intent*, and the *active*, and often strategic, role that elites perform in climate responses. Our elaboration of elite processes is significantly inspired by Paprocki (2018), who also identified two of the three pathways we examine (*experimentation*, *dispossession*) but only in Bangladesh. We draw from her arguments and build on these latter two concepts together with a third one, that of *financialisation*. Though like Paprocki (2018) we also explore these processes in Bangladesh, but extend such thinking across a broader array of low-carbon pathways with case examples (i.e. coastal protection, climate risk insurance and climate change mitigation) from other geographical settings from Africa, Europe and North America.

2.1 Experimentation

Following Paprocki's (2018) work, the elite process of "experimentation" envisions low-carbon pathways, often deployed in more social, economic, or geographically peripheral areas, as an arena where technical elites can pilot new, novel, or risky technologies. She gives multiple examples of climate smart homes, protective dykes, shrimp aquaculture, and even drinking wells. The "laboratory" for these experiments is essentially the world itself (sometimes specific countries or locations, other times the entire planet), a place where real life experiments are located and where particular methodologies to understanding risk are put into practice (Knorr-Cetina 1992; Voytenko et al. 2016). Experiments are a form of "anticipatory action" (Anderson 2010) that seek to use countries as a "development laboratory" (Cons 2018) or "living laboratory" (Tilley 2011).

In particular, Paprocki (2018) frames experimentation as a North-South phenomenon, with technical elites—scientists, engineers, consultants, and researchers—in industrialized countries using Bangladesh as a low-income country, for the piloting or testing of new innovations and technologies. Such technical elites justify these processes of experimentation, especially those with problematic cultural and socioeconomic consequences, because they will lead to "new ideas and technologies" for fighting climate change (Paprocki 2018: 6).

Another feature of experimentation can be that of "epistemic supremacy" (Rodriguez 2017) that privileges Western science, technology and knowledge and discounts objections and other ways of knowing. Edwards and Bulkeley (2018: 3) add that "experimentation entails an ambivalence to both the possibilities of the present and the potential of the future," reshaping approaches to experimentation as well as the subjects of experiments to meet the needs of the experimenter.

Smart technology and satellite imagery are increasingly playing a role in the construction of hegemonic narratives on climate change, serving as powerful signifiers of the Global North's superior ability to examine global challenges from a 'bird's eye' perspective. Moreover, as Potapov et al (2014) explore, it is countries such as the United States and Japan that effectively conduct surveillance of the Global South via remote sensing, frequently using forest surveys and assessments to monitor activities that could emit carbon in the South, such as tropical deforestation in Peru.

Experimentation, of course, need not be limited to North-South exchanges. There are numerous examples of where elites within Northern countries also use experiments to gain competitive advantage over each other. In the North, scientific elites have used experiments to observe "action oriented research" on land use planning and "Green/Blue Cities" as well as "New Forms of Urban Governance," "Experimental Cities," and "Urban Experiments" (Voytenko et al. 2016; Edwards and Bulkeley 2018). Even if such experiments or tests marginalize consumers, or produce externalities, they may still be seen as a success if they benefit elite power via technology transfer, the development of intellectual property, or validation of a new prototype.

We observe the hegemonic features of experimentation at play in numerous low-carbon pathways. The international Roundtable on Sustainable Palm Oil, which experimented with new crops and strands for biofuel, for example, underscores the hegemonic side of experimentation and it has been criticized for pushing industry interests over local stakeholder interests and for contributing to the degradation of carbon-intensive peat forests (Laurance et al. 2010; Schouten and Glasbergen 2011). Similar experiments with afforestation and hybrid crops throughout Africa have been attacked for worsening social, political, and gender inequality (Anderson et al. 2011; Prouty 2009; Sovacool et al. 2015).

2.2 Financialisation

Financialisation is an increasingly amorphous term across the social sciences concerned with critiques of contemporary capitalism and now subject to a growing diversity of empirical and theoretical interpretations. Taking its origins from Marxist heterodox economics (Bayliss et al 2018, Fine 2013) the term "financialisation" has latterly, though less commonly, emerged as a concept within economic geography (Pike and Pollard 2010) and development studies (Mawdsley 2018, Bracking 2012, 2016).

The growing literature on financialisation is wide-ranging and often contested (Epstein 2005; Fine 2013; Leyshon and Thrift 2007; Jerneck 2017). At its most simple financialisation can be described as the expansion and proliferation of financial markets in general (Fine 2013: 56), in light of the increasing and integral role that finance has played in the global economy and in many national economies since 1970, particularly those with highly developed capital markets. A broad definition would thus be: the process through which financial interests, markets, or institutions expand in terms of size, value, or influence. More specifically, we use it here to refer to (a) the expansion of financial markets into previously public or non-market dimensions, (b) the growing financial activities of non-financial firms as compared to their productive activities, and (c) the increasing share of GDP and national income from the financial sector which has seen the incorporation of national economies and firms into global circuits of financial capital as an indicator of economic maturity.

Although financialisation is celebrated by many as the "democratization of finance" – through which a range of new actors at multiple scales can access finance to fund entrepreneurial investment – there are two main negative implications of greater financialisation that are relevant to our analysis. Firstly, financialisation has been increasingly associated with growing global inequality (e.g. Piketty 2015). Secondly, it may increase the exposure of newly incorporated economic actors and regions to the systemic risks inherent to financial markets, potentially creating new vulnerabilities (Mawdsley 2018).

Until recently the literature on financialisation has tended to focus on advanced and liberal market-based economies, particularly the United States and United Kingdom. However, emerging markets or "frontier economies" offer increasing research opportunities for global capital flows (Mawdsley 2018:267). Moreover, given that "theorizing financialisation requires global perspectives" (Christophers 2012), any analysis must go beyond the scale of national boundaries in order to examine the ever-shifting dynamic international circuits and networks of debt, equity and ownership. There is therefore significant opportunity to examine its expansion into new global assets for speculation, such as renewable energy as a rapidly expanding infrastructural sector as we discuss in Section 5.

The expansion of financialisation into development finance is a further focus of our analysis, particularly in Section 4 which explores climate risk insurance as a new financialised form of climate change adaptation. As Mawdsley explores, in recent decades there has been "a distinctive acceleration and deepening of the financialisation-development nexus" (Mawdsely 2016:265) resulting in significant shifts in the models and types of development finance. These shifts have seen the evolution of an industry that previously provided the majority of assistance via loans and grants, to one that is now acting in partnership with institutions "which are themselves increasingly governed by financial logics", such as venture capital, hedge funds, sovereign wealth funds and global accountancy firms (Ibid page 267). This "re-configuration of parts of the 'developing world' as the risky frontiers of profitable investment" (Mawdsley 2016:271), with financial institutions providing "the institutional and material basis for capital penetration, financialisation, market development and a more orderly set of practices for the management of risk to capital" (Carroll and Jarvis 2014:535).

2.3 Dispossession

Dispossession is associated with processes through which market elites effectively come to possess the assets of others, and is a central theme in political ecology research (Sovacool 2016; Paprocki 2018). "Dispossession" has its roots in Marxist- inspired political economy and theorizes that the capitalist system is constantly striving for profits and capital accumulation in a competitive market economy so that labor, land, and other assets become "dispossessed" and treated as commodity, subject to the same pricing mechanisms (Gilpin, 1987: 36-38). In this sense dispossession is sometimes a consequence of financialisation and experimentation. Drawing from these antecedents, Harvey (2004: 66) elaborates the concept of "accumulation by dispossession," defined as the "centralization of wealth and power in the hands of a few by dispossessing the public of their wealth or land." Accumulation by dispossession can take a variety of forms, including the privatization of land and forcible relocation of people residing there, the establishment of property rights or suppression of rights to the commons, and the process of appropriating assets such as natural resources or land (Harvey 2003, 2006). Political dispossession has been defined as the (neoliberal) restructuring of the state by finance through the privatization of profits, and the socialization of losses (Keucheyan 2018:498).

Dispossession, however, can also be intentional rather than merely consequential, and it can have many causal mechanisms. The most direct is simply stealing or "grabbing" of land. When an area already owned or controlled by a group is taken over by others, it is known as land seizure (White et al. 2012). When a group is prevented from acquiring or accessing land to which it is entitled, it is known as land denial (Adnan 2013). *Ex situ* displacement or dispossession is a process whereby people are directly and forcibly removed from their land; *in situ* displacement or dispossession is when struggles for or regulation of land indirectly leads to expulsion, such as through higher prices or changes in the law (Feldman and Geisler 2011).

Bernstein (2010) has developed a typology of land dispossession. Sometimes, farmers or peasants are displaced by local elites that own property or agrarian capital; or, they are displaced by their neighbors who begin to accumulate wealth and differentiate themselves by class. In other times, dispossession can be more a national and international phenomena, with pressures coming from political elites in urban areas or even transnational flows of capital. Increasingly, dispossession has involved corporate actors investing in genetically engineered crops or the growing of feedstocks that end up displacing people from their land (McMichael 2012; Lambin and Meyfroidt 2011). In others cases, national or corporate "land deals" may legally set aside land for other uses such as economic development or the creation of jobs. Anguelovski et al. (2017) frame this as land grabbing via "selective land use regulations and resettlement." Fairhead et al. (2012), conceptualize these processes as "green grabbing," where physical or regulatory elites "grab" an area in order to protect and preserve it for conservation or other reasons.

As well as land, elites can also dispossess people of their wealth or financial assets through processes enabled by markets, technology, and (lax) regulation. In his critique of neoliberalism and privatization, Harvey (2003) discusses how the privatization and commodification of public assets has essentially transferred property from public ownership to private ownership, moving capital from national governments to private parties. These elites can then (perversely) sell or rent back to the public what used to be theirs, using capital to earn more capital. Examples of such instances include the dispossession of assets (the raiding of pension funds and their decimation by stock and corporate collapses) by credit and stock manipulations (Harvey 2004: 74-75). The collapse of United States-based energy company Enron, for example, dispossessed many employees of their livelihoods and their pension rights. In other cases, Harvey (2004) documents how regulatory or financial elites suddenly raise interest rates to force poorer nations into bankruptcy. In neo-Marxist terms, these are instances of the capitalist class gaining power at the expense of the labor class.

There are numerous examples of where climate change measures or efforts have perpetuated dispossession. Solar energy parks developed by international companies in India have been prone to exclusion and land grabbing (Yenneti et al. 2016). Biofuel cultivation for private firms has also been prone to grabbing land from local communities, farmer, or pastoralists across Ghana, Kenya, Madagascar, Senegal, South Sudan, Tanzania, and Uganda (Temper 2018). The Roundtable on Sustainable Biofuels, an international forum, has been similarly accused of facilitating land grabbing—often converting land needed by rural pastoralists or subsistence farmers into assets for elites (Fortin and Richardson 2013). In Australia, the construction of the Wonthaggi desalinization plant, an attempt to adapt to declining natural rainfall, resulted in the enclosure of thirteen sites of land of "significant value" to the Bunurong Aboriginal community (Barnett and O'Neil 2010).

3. Case study selection, research methods and limitations

As our aim in the paper is to provide a multidimensional and interdisciplinary understanding of elite involvement in responses to climate change, we have selected cases that reflected a diversity of core elements. We decided on three key criteria for case study selection:

- *Technological diversity* or different types of carbon measures and pathways, including building resilience and capacity to climate change (coastal protection and adaptation), climate risk insurance (responding to major disasters or catastrophes), and mitigation (stopping greenhouse gas emissions);
- *Geographic and economic diversity* to encompass low income, lower middle income and high income countries;

- *Involvement of different elites and processes* (at least two distinct types or more) with different resources and power dynamics as well as impacts on particular communities or stakeholders.

As Table 1 shows—and as will be elaborated further below—Bangladesh and the Netherlands were our cases for adaptation, Malawi our case for climate risk insurance, and South Africa and Mexico our cases for mitigation. These cases were chosen because they cover a diverse mix of technologies, market economies and national contexts, and types of elites.

Table 1: Overview and selection criteria for our five case studies

Case study	**Technological type**	**Level of development***	**Elite types**
Bangladesh	Adaptation (coastal protection)	Lower middle income	Technical, financial, regulatory, physical
Netherlands	Adaptation (coastal protection)	High income	Technical, financial, regulatory, physical
Malawi	Climate risk insurance	Low income	Technical, financial
South Africa	Mitigation (renewable energy financing)	Upper middle income	Technical, financial, regulatory
Mexico	Mitigation (renewable energy financing)	Upper middle income	Technical, financial, regulatory, physical

Source: Authors. "Type" of country taken from the 2018 World Bank classifications for "country and lending groups."

To collect data for our five cases, we sought to conduct a comprehensive but timely literature review. The selection of literature and information sources was done along the following three dimensions:

- Technical, social, political, and economic dimensions of the five cases represented in peer-reviewed academic publications and journals, across all disciplines;
- Public reports and papers released by the governmental bodies, industry, finance and civil society, which observe and investigate the current state of climate change and policy trends and drivers in each of the five countries;
- Sector specific online and print media, including newspapers, magazines, and websites with very up to date articles in the climate field, often used when the academic peer-reviewed or governmental and civil society literature was sparse.

All in all, we cite many of these works in the reference list of the study.

Notwithstanding our selection of cases and interdisciplinary literature review, our approach does have a number of limitations. Our broad-based, multi-scalar definition of elites, while inclusive, does group technical elites (who tend to have elevated knowledge) alongside physical elites (commanders of large militaries, captains of the police), regulatory elites (those making policies, standards, and regulations) and financial elites (those with control and influence over large flows of finance capital). They all meet our definition of an elite, but express their elitism in qualitatively different ways that are only partially captured in the study. Secondly, is it not our contention that the three pathways—experimentation, financialisation, and dispossession—are the *only* ways elites respond to climate change. Bonds (2010) for instance identified another pathway of "elite mobilization" rooted on knowledge production, and Paprocki (2018), whom we build on, had another pathway of "imagination," of connecting elite efforts to strong positive vision of the future or a variety of futures. So our three pathways are meant to be illustrative rather than fully representative or exhaustive.

Furthermore, at moment while our analysis reveals how elites can coopt or capture climate change responses, the analysis does not fully reveal how elites are shaped by *specific* forms of capitalism within each context we look at. We are unable to show for example how the experimentation of climate change elites differs from experimentation that elites carry out in non-climate change policy arenas. Although our analysis reveals the people who are being affected, the elite actions themselves (both external and local actors) and some of the specific capitalist relations within each case (dependent on factors such as property rights, unions, political parties, economic dependency of states on external funding etc.), it does not necessarily show how this inequality and wealth concentration is distinct from other processes of uneven development that define capitalism. Lastly, as a starting point for our analysis, the study focuses more on sets of actors as analytical categories, rather than privileging an analysis of capitalist relations and discreet power operating through markets and institutions, which we encourage others to do after our analysis, perhaps following some of the actors we identify.

Nonetheless, as we will see in the next three sections of the paper, the three processes of experimentation, financialisation, and dispossession operate across the five selected cases of coastal protection measures in Bangladesh and the Netherlands, climate risk insurance in Malawi, and climate change mitigation and renewable energy financing in Mexico and South Africa—despite their differing local contexts. As we will see in our case studies, *experimentation* involves not only pilots, such as microfinance in Bangladesh, or new technologies, such as reversible seawalls in the Netherlands, but also forms of monitoring, simulation, policy experimentation, and feedback and learning that help advance elite interests. In Malawi, experimentation occurs at the nexus of sophisticated computing and insurance algorithms used by the financing community, and in South Africa and Mexico, it relates to policy experimentation with different types of auctions mechanisms and designs.

Financialisation in Bangladesh relates to the integration and bundling of microfinance and household debt into global microfinance investment vehicles. In the Netherlands, it involves Dutch construction, engineering, dredging, and marine industry firms building equity through stocks, mergers and acquisitions, and venture capital. Malawi, South Africa, and Mexico exhibit more definitive characteristics such as the use of financial instruments (e.g., risk insurance) or increasing incomes from the investment and financial sectors.

We will see *dispossession* related to the relocation of communities along the floodplains of Bangladesh as well as the exclusion of fishers and recreational users of watersheds from the Dutch coast, as well as considerable destruction of the environment. In Malawi, it is vulnerable farmers and communities who bear the brunt of insurance premiums (insured as a last resort). In South Africa, community benefit funds have been mismanaged to the detriment of local groups, and in Mexico, social protests and opposition to renewable energy has been met with force and violence from the state.

4. Coastal protection: The elite processes of afforestation, micro-finance and seawalls

Coastal protection efforts deal primarily with attempts to mitigate the risks of severe weather along coastal areas, especially storm surges and damage from hurricanes and typhoons. They can include "soft" measures using natural capital such as afforestation and mangrove restoration, or "hard" measures such as seawall construction or reinforcement (Sovacool 2011; Dolšak and Prakash 2018). Annual weather-related disasters have increased fourfold in the past forty years, and insurance payouts have increased by a factor of eleven over the same period, rising by $10 billion per *year* for most of the past decade (Reddy and Assensa 2009). One team of researchers even found that due to climate change, average storm surge damage will likely rise from $10 to $40 billion per year in 2014 to possibly $100 *trillion* by 2100, affecting up to 600 million people (Hinkel et al. 2014). Indeed, by combining future global sea level rise with tide gauge water levels, another research team expects that today's "once in a century" storm surges might become "once in a decade" storms in the future (Tebaldi et al. 2012). We see elites and our processes at work across hard and soft coastal protection measures in both Bangladesh and the Netherlands.

4.1 Bangladesh

Given that Bangladesh is arguably one of the countries most at risk to climate change, *experimentation* is strongly present in Bangladesh as it constitutes an ideal laboratory for technical elites to trial different coastal protection measures. As Paprocki (2018) and Cons (2018) have documented, Bangladesh, especially its southwestern borderlands where sea level rise, salt-water intrusion, and cyclones occur, has become a ground zero laboratory for so-called "resilient development." Experiments include training programs sponsored by the United Sates or European Union that seek to educate farmers on new ways of growing vegetables, planting trees, and erecting single-family rainwater collection wells, as well as schemes to build flood defenses, mounds, domes, and shelters. Capital intensive dykes, erected by the technical elites at the Bangladesh Water Development Board, have become a particularly popular measure (Sovacool 2018). These experiments, however, have often occurred without adequate or full community consent, and in some cases have even resulted in maladaptation, such as when Bangladeshi dykes have been flooded and thereby acted as buffers that *prevent* proper drainage rather than facilitated it (Sovacool 2018).

We also see a link between other technical elites (such as experts in satellite imagery, remote sensing, and digital forest management) and climate change-informed experimentation in Bangladesh. There, systems such as Landsat (Patapov et al. 2017), Linear Imaging Self Scanner (LISS), and Advanced Wide Field Sensor (AWiFS) satellite data (Reddy et al. 2016) are used to monitor and track the extent of deforestation linked to carbon emissions. Scientific and technical institutes such as the Indian National Remote Sensing Centre, Bangladesh Forest Department, USAID, the Food and Agricultural Organization, and World Bank all conduct these types of remote assessments (Rahman et al. 2017), which have become integrated into Bangladesh's Forestry Master Plan from 2017 to 2036 (Bangladesh Forest Department. 2016). These technical elites entrench "epistemic supremacy" by imposing a new (and supposedly superior) way of seeing and governing a policy problem to local agencies. Physical elites, such as forest patrols or the police, then enforce policies relating to experiments, and detain those who encroach on protected areas (Rahman et al. 2017; Sarker et al. 2011).

Efforts at experimentation have been coupled with *financialisation*, often beginning with the integration of local communities into global commodity markets and financing mechanisms. For example, community-based adaptation measures supported by USAID and the World Bank have focused on community and social responsiveness by offering market-based incentives to vulnerable communities who are interested in diversifying their economic activities into new forestry, fishing and farming sectors. These programs include incorporating non-monetary farming practices into a "Triple F" model of "Forestry, Fisheries, and Food" that seeks to create local economies of exchange and trade and then connect them to the commodity markets in Dhaka. One aspect of the program even disbursed mobile phones so sellers could check global commodity prices. The central premise behind FFF activities is that adaptation efforts must also generate a continuous flow of income for local communities (Rawlani et al. 2011). The problem with such efforts is that they fold local communities into a market economy, often at the global scale, and then use financial tools—often microfinancing loans—to keep them permanently trapped in debt (Cons and Paprocki 2010). Communities then struggle to pay off the interest – let alone the principal – and borrow perpetually until some households lose their collateral. Karim (2011) similarly warns that microfinance lending in Bangladesh leads to increasing levels of indebtedness among rural poor communities and frequently worsens economic, social, and even environmental vulnerabilities. Banerjee and Jackson (2017) critique Bangladeshi microfinance for escalating levels of indebtedness as well, but also aggressive and predatory repayment efforts (such as shaming those who are late paying or showing up at funerals to collect). They warn such efforts can lead to an "inescapable debt spiral" where borrowers take out multiple loans from different microfinance banks to repay previous loans.

Financialisation explicitly occurs when this microfinance debt behind FFF and other community investments for adaptation becomes packaged and resold into speculative assets and financial vehicles. Bateman (2010) argues that Bangladeshi microfinance institutions are commercial entities primarily concerned with their financial self-sufficiency and profits, not necessarily poverty reduction. Consequently, under this "new wave" of lending, vendors become a for-profit industry with promising returns that are then invested in from international backers, many of them corporate, linking Bangladeshi microfinance with Wall Street (Bateman 2010). Whereas most microfinance lending used to be provided by development banks and donor organizations, this is no longer the case, as the sector has shifted to a more commercialized model that is linked to microfinance investment vehicles, or MIVs (Convergences 2018). These MIVs are open to multiple investors and since the late 1990s, when they were created, they have grown in number to 127 with $13.5 billion in total assets under management globally. MIVs remain "the primary gateway for private investors looking to invest in emerging and frontier markets mainly because of their expertise over the whole value chain" and are largely financed by pension funds, global banks such as BNP Paribas, foundations, retail investors and high-net-worth individuals (Convergences 2018). Indeed, as of 2016, only 20% of microfinance capital came from public investors. (Convergences 2018)

The financialisation of Bangladesh is connected to experimentation as well, as national and international financial elites frequently use digitization, computer technologies, and social monitoring to aggressively track local lenders (Karim 2011).). Another part is placing borrowers into groups of five members to make them jointly responsible for loans, meaning members of the group police each other and report any aberrant behavior to the financial institutions that could lead to a default, including sickness or alcoholism. Microfinance lending thus leads to an increase in moneylending and further expansion of the microfinance industry.

Bangladesh has lastly been prone to strong forms of *dispossession*, in particular numerous types of land grabbing associated with the development of seawalls and embankments. Sovacool (2018) documents the direct displacement of vulnerable communities alongside roads or dykes intended to protect urban areas. In some gases, gangs of bandits employed by criminal bosses or local strongmen yielding bamboo clubs use threats of violence, or violence itself, to appropriate land. Seawalls and dykes intended to help predominately poor populations have instead, at times, been plagued by land predation and land grabbing, with *khas* (public) and (coastal island) lands most at risk (Islam 2006a; Rashid 2014; Paul and Islam 2015). The most active agencies in these practices have been government departments and military forces as well as private interest groups inclusive of commercial land dealers and speculators, and civil officials in their personal capacities (Feldman and Geisler 2012). Anguelovski et al. (2017) have similarly noted how the government-sponsored Greater Dhaka Integrated Flood Protection Project, intended to reduce flooding in the city, disproportionately burdened the urban poor. The siting of embankments, designed with little consultation of residents, has caused major disruptions to adjacent communities and their livelihoods. Initial designs have also excluded substantial areas of low-income settlement and caused widespread waterlogging inside the protected zone. We thus see three of Bernstein's (2010) types of dispossession—farmers and peasants, indigenous classes, and emergent capitalists—operating.

4.2 The Netherlands

These elite processes are not limited to only developing countries such as Bangladesh. In the Netherlands, technical elites have been strongly *experimenting* with coastal protection measures for more than a millennium, with the more recent Dutch Delta Works an illustrative example of coordinated efforts to build tidal barriers, locks, flood barriers and storm surge barriers. The Delta Works, from the 1950s to the 1980s, were supported on the grounds that they would protect against a 1 in 10,000 years storm surge event for the provinces of Holland,

and 1 in 4,000 years storm surge event for the provinces of Zeeland, Friesland, and Groningen (McRobie et al. 2015). Their design, construction, and maintenance involved extensive scientific experimentation and advances in physics, biology, ecology, materials, and modelling (to name a few) (d'Angremond & Kooman 1986; Leemans 1986). The elites behind these experiments included the government department Rijkswaterstaat (translated as the Directorate-General for Public Works and Water Management), scientists at the Delft Hydraulics Laboratory, and a consortium of major engineering firms such as Ballast Nedam, Boskalis Westminster, Baggermaatschappij Breejenhout, Hollandse Aanneming Maatschappij, Hollandse Beton Maatschappij, Van Oord-Utrecht, Stevin Baggeren, Stevin Beton en Waterbouw, Adriaan Volker Baggermaatschappij, Adriaan Volker Beton en Waterbouw and Aannemerscombinatie Zinkwerken (Sovacool and Linner 2015). The *Rijkswaterstaat* in particular considered themselves the "dike masters" of the world, and were modeled on the elite *Corps des Ponts et Chaussees* (Corps of Bridges, Waters, and Forests) in France (Sovacool and Linner 2015).

Collectively, these government, scientific, and corporate actors ran hundreds of experiments and simulations to assess the integrity and performance of building materials such as natural rock, sand, and clay. As a result of the new knowledge gleaned from these experiments, a number of new construction methods for pylons and vessels were designed, new dredging techniques were invented, ballasted bases and block mattresses perfected, and artificial islands were created (Sovacool and Linner 2015). One of the largest pieces of the Delta Works, the Eastern Scheldt Storm Surge Barrier, was even designed to open and close; and to protect the parts of the storm surge barrier exposed to seawater, unique polypropylene and concrete-block mats, asphalt slabs and graded-filter mattresses had to be invented and installed (van Noortwijk and Klatter 1999). More recently, in the digital era, the Delta Works have facilitated numerous ways to experiment with what the Government of Netherlands (2016: 2) calls "high tech flood protection." One is the novel use of radar images from earth observation satellites to enhance the monitoring of dykes via remote sensing imagery and digital sensors. Another is the use of "intelligent geotextiles" to provide early warning of deformations in floodwall structures, embankments, and dykes (Government of Netherland 2016). The culmination of these experiments is proprietary (and likely valuable) data that give Dutch actors a competitive advantage when they seek to monetize their expertise.

As such, moving from experimentation to *financialisation*, the perceived success of the Delta Works did not rest solely on its functional ability to provide flood control and enhance safety; there was also a connection to profit making from infrastructure and global markets. Initially, in the 1960s and 1970s, the Delta Works were funded almost entirely by public money (a "Delta Fund" to guarantee long term financial stability, raising about €1 billion per year) (Kompier 2012). Yet after the 1990s, particularly after the completion of the Eastern Scheldt Storm Surge Barrier, technical and financial elites at large Dutch engineering firms were able to utilize the threats from climate change and rising sea levels around the world—because of their links to government—to generate significant revenues and earnings from designing surge barriers based on its design around the world (Corvers 2009). The knowledge from the Delta Works was financially appropriated in the 2000s, mostly by private engineering, procurement, and construction (EPC) companies, in at least five large-scale storm surge barriers totaling almost $11 billion of collective investment in the Netherlands as well as in Germany, Italy, the UK and the US, all done with expensive Dutch consultants (Hillen et al. 2010). One textbook suggested that more money can be made, given that innovations such as the Eastern Scheldt Storm Surge Barrier are a necessary component of "next generation infrastructure" to be considered by every city as postindustrial society confronts climate change (Brown 2014). According to this logic, the Delta Works becomes its own brand; and coastal protection is not done for social obligation, but for profit, becoming a magnet for finance.

The financialisation of storm surge protection not only accrues wealth to these modern-day financial elites investing in EPC firms and consultants, it also seeks to replicate the Dutch experience in international markets. Dutch seawalls have thus become intertwined with shareholder value, corporate ownership, and the separation of productive activities (dredging, building dams) from accumulative activities (building equity, growing pensions, making connections with venture capital). Royal Boskalis Westminster N.V., a Dutch dredging and marine heavy-lifting company involved in the Delta Works, began to earn more from shares, stocks and dividends than on direct profits from construction in the 2000s (Royal Boskalis Westminster N.V. 2010; 2017). Royal Van Oord, another Dutch maritime company involved in the Delta Works which specializes in land reclamation and artificial islands, also receives almost as much value from its equity and stocks as it does its construction business in dredging and offshore wind energy, its two leading markets (Van Ord 2019). Royal VolkerWessels Stevin N.V., a major Dutch construction business involved in the Delta Works, expanded into venture capital markets over the past decade to supplement its construction efforts, and it returned to the stock market in 2017 (Volkerwessels, 2018).

Lastly, the Dutch Delta Works perpetuated strong forms of *dispossession* across three dimensions: exclusionary forms of bidding and firm involvement; exclusionary forms of planning; and the physical dispossession of fishers and other recreational users of the watershed. Firstly, due to the size and capital intensity of the project, the *Rijkswaterstaat* presumed that contracting private construction companies, especially small and medium enterprises, would not work (Bijker 1993; Bijker 2002). Thus, only a select number of construction companies were invited to participate, with the final consortium consisting of a mere eleven entities. Secondly, the decision-making and planning process was exclusionary and limited to the financial, regulatory, and technical elite. Though the *Rijkswaterstaat* featured well trained civil engineers, the project tended to ignore contrary viewpoints coming from ecologists and biologists; creating a "highly closed system" with a "monopoly on knowledge" (Leemans 1986). Thus, for decades the views of oppositional saltwater fishers, environmentalists and conservation scientists, civil society members, and even local planners were marginalised (Sovacool and Linner 2015). Finally, the Delta Works as a whole displaced fishers and local recreational users of waterways, and it led to severely degraded fishing areas, eroded biodiversity and ecosystem vitality, and led to a massive die-off of non-human species. As Eelkema (2013: ix) declared when reviewing the environmental impacts of the project: "it has become clear that the Eastern Scheldt is a basin that has been shaped strongly by a multitude of human interventions… It will take in the order of centuries before the morphological effects of these interventions will have leveled out."

5. Disaster recovery and climate risk insurance

While there is little consolidated evidence to date on emerging processes of climate risk insurance (Weingärtner 2017), as we now discuss, such processes offer examples of experimentation, financialisation and dispossession, at the same time as potential significant benefits for climate change adaptation finance.

Climate risk insurance is taken out by – or on behalf of – regions or countries against natural disasters and extreme weather events such as droughts, hurricanes and floods, as a mechanism for climate change adaptation. The insurance is index-based or parametric, meaning that payouts are triggered when certain parameters fall within certain values as opposed to being based on assessments of actual loss (Reeves 2016). A key rationale put forward for climate risk insurance is that it offers a more efficient and rapid response to natural disasters than the current humanitarian system is able to.

Sovereign climate risk insurance is based on a similar model to that of catastrophe bonds, a relatively recent innovation which began in 2000 and which has grown rapidly since the 2008 financial crisis (Ralph 2017), partly in response to the rise in weather disasters such as hurricanes Matthew (Haiti and Florida) in 2016, and Irma (Florida) and Maria (Dominica and Puerto Rico) in 2017 (Gray et al 2018). Considered an "innovative risk transfer product" by the insurance industry (Insurance Information Institute 2018), catastrophe bonds are used by insurers as an alternative to conventional insurance and reinsurance products as they allow insurers to pass the risk of natural disasters onto investors in the global capital markets (WSJ 2016). The bonds pay out subject to a variety of triggers that have in turn been determined by a variety of complex metrics including wind speeds and storm surges and cover a specified period, usually between one and three years (WSJ 2016). As with any bond, a catastrophe bond is a type of debt security and therefore a tradable financial asset (Phillips 2014).

Catastrophe bonds are one of the fastest growing parts of the global insurance market and the most visible form of insurance linked security (ILS), now increasingly popular with pension funds, hedge funds, big investors and sovereign wealth funds. While there are several ILS fund managers and investors based in the City of London, until very recently there was no legal regime in the UK under which catastrophe bonds could be issued. For this reason, most have been issued in Bermuda, the Cayman Islands and Dublin, in turn raising questions of transparency and accountability (Ralph and Binham 2017). Risk analysis is undertaken by independent firms such as Applied Insurance Research and Eqecat who undertake climatic modelling.

Various justifications are given for the promotion of climate risk insurance as a tool for climate change adaptation. These include firstly the inadequate, fragmented and unreliable nature of the dispersal of humanitarian assistance, including mismatches between the way it is provided and how it should be used, the tardiness of international aid appeals and the failure of patterns of disbursement to meet patterns of need (Talbot and Barder 2016). As a result, survivors of humanitarian disasters lose their livelihoods, resorting for instance to the sale of livestock and tools, and taking their children out of school. This is compounded by the reallocation of public resources by governments away from essential services such as health and education in order to respond to the crisis. A second justification is the inability of many states to fulfil their traditional function as insurer of last resort, particularly in the case of fiscal instability (Ibid).

For many development finance institutions such as the UK's Department for International Development (DfID) and the World Bank, as well as the IPCC, the United

Nations Development Programme (UNDP) (World Bank 2018) and a collaboration of insurers called the Insurance Development Forum (IDF), climate risk insurance is viewed as something of a panacea to disaster response. In addition, the InsuResilience Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions, launched in 2017 with the collaboration of the G20, the V20 (a group of 20 of the world's most vulnerable countries) civil society organizations, the private sector and academia, aims to bring climate insurance to 400 million people in the developing world by 2020 (Llull 2016). In this sense, insurance contracts are seen as a technical solution that can override the collective action problems of the geopolitics of donors and development finance. This is accompanied by an unwavering belief that the tools of the financial industry, together with the power of global capital markets can be channeled for the benefit of the global public good.

However thus far, catastrophe bonds have been a mechanism largely deployed in wealthy countries, particularly the United States (Insurance Information Institute 2018). It is only recently that the catastrophe bond model has been applied to expand to low and middle-income countries, including through the Caribbean Catastrophe Risk Insurance Facility, set up in 2014 by the World Bank (Allianz 2016:12); the Pacific Catastrophe Risk Insurance Facility; and the African Risk Capacity (ARC).

5.1 Malawi

Malawi's climate risk insurance can be seen as a moderately strong example of *experimentation*, in that it brings together the latest and highly sophisticated innovations in climate and catastrophe modelling and financial risk analysis, thereby merging what Keucheyan (2018:496) refers to as "big data, insurance and nature." Malawi's insurance was a part of the African Risk Capacity (ARC) which was established in early 2012 by the African Union to pool risk across the continent (OPM 2017). ARC is owned by its member states and capital contributors: at its inception Germany's state-owned development bank KfW and the UK's DfID provided "repayable capital" of €50 million and £90 million commitments respectively to be repaid after 20 years with no interest (ARC 2018). Since October 2016, ARC has signed MoUs with 17 countries (ARC 2017). ARC uses its own dedicated risk-modelling software, Africa Risk View (ARV) which is currently focused on drought. This software is proprietary and therefore not accessible to the public but concerns have still been raised over the reliability, complexity and accuracy of this model have been raised (Reeves 2017, OPM 2017:v).

However, the ability to experiment and monitor risks has only occurred to the detriment of Malawi itself. The ARC and ARV failed to function effectively however during a severe drought in Malawi in May 2016 which affected 6.7 million people (OPM 2017b:vi). In this case, despite Malawi having purchased a $5 million premium for 2015/6 agricultural season, the ARC's model did not initially yield a pay-out, as a result of discrepancies between the outputs of the ARV model and the reality of the situation in-country. This led to a national and international outcry and subsequently a technical investigation (OPM 2017b). The main reason put forward by ARC for the failure of the ARV model was due to the modelling using a different maize variety with a longer maturation period than that which was actually used by farmers. It was also argued that the modelers failed to incorporate inputs from agronomists, agro-meteorologists and other experts and were simply "too far removed 'from the ground'" (OPM 2017b:34). By November 2016 ARC agreed to pay Malawi $8 million, a fraction of the total estimated drought response cost of $395 million (Reeves 2017:3). Moreover, the payment did not arrive until January 2017, long after funding was urgently needed to respond to the country's humanitarian crisis. Subsequently Malawi did not renew its policy.

Reeves (2017:3) even aptly describes ARC as "an experiment that failed Malawi" because of its inadequate and flawed design. The case has also raised significant questions as to whether this model can be effectively customized for individual country contexts (OPM 2017b) and increased concerns over the accuracy, transparency and reliability of the ARV model. This, in addition to the fact that the ability to understand and operate it rests with a small number of individuals (OPM 2017b:14).

In addition to the experimentation, Malawi offers a compelling example of how climate risk insurance is tied into the elite processes of *financialisation*, where it converts disaster recovery into a speculative asset. Such climate risk insurance has been described by Johnson (2014:157) as "securitization of the geophysical effects of climate change", particularly through insurance-linked securities and in this sense, has facilitated the creation of "socioecological fixes" for capital through the "reconfiguration of hazard risk into asset class" (Ibid). In setting up an ILS, an insurance firm creates a special purpose vehicle (SPV) on behalf of a government or public agency in order to sell the bonds to investors and hold the risk. Investors pay into the SPV that pays out to insurers should certain predefined events take place. Therefore, in the event that the natural hazard specified in the bond contract takes place and an insurer's losses pile up, the investors risk losing their principal. But otherwise, investors benefit from a relatively lucrative revenue stream in the form of insurance premiums from the bonds (Talbot and Barder 2018:20). Despite having extremely poor credit ratings, ILSs were considered an attractive prospect for investors (and Malawi) as they offer relatively high annual returns of between 5 to 15 per cent, as compared to corporate or government bonds (FT 2017).

Lastly, Malawi's climate risk insurance arguably constitutes *dispossession* in that it compounds inequality and dispossesses households or farmers of their capital (Duus-Otterström and Jagers 2011). Indeed, contrary to the "polluter-pays principle," such schemes require the most vulnerable countries who have least contributed to climate change "to co-finance the costs that others have unilaterally imposed on them, whereas it would seem that they ought to have no part of that cost" (Ibid). They effectively shift risk from the emitters of carbon dioxide to poor Malawi farmers at the frontlines of climate change (Reeves 2017 and Ralph and Aglionby 2017). As Malawi illustrates, despite having taken out a private plan it is still the government who ends up being the insurer of last resort (Johnson 2015, Isakson 2015).

6. Climate change mitigation: renewable energy auctions

This final section examines the elite-driven processes that characterize the implementation of renewable energy auctions, drawing on examples from South Africa and Mexico. While renewable energy auctions have become something of a success story across the globe for the investment and projects they have helped to facilitate (Eberhard 2018) such investment has also led to the financialisation of renewable energy. Renewable energy auctions have become the preferred mechanism for the procurement of utility-scale renewable energy under which independent power producers (IPPs) typically submit a bid with a price per unit of electricity at which they would sell electricity to the grid. Between 2005 and 2016 the number of countries implementing renewable energy auctions grew from six to 67 (IRENA 2016), including various upper middle-income countries worldwide such as Mexico and South Africa. In Mexico, such competition has also raised concerns over both the long-term sustainability of renewable energy (Radowitz 2017) and the extent to which local communities have been able to participate and benefit (REN 21 2017). As we will see in South Africa and Mexico, the fierce and growing competition generated by renewable energy auctions has contributed to a significant and unanticipated reduction in the electricity tariffs submitted by project bidders and a rapidly evolving wind and solar PV market dominated by fewer and bigger players and highly globalized production chains.

The growing success of the deployment of renewable energy has nonetheless been determined by the frameworks and logics of finance and investment, including its increasing financialisation via processes of securitization, on-selling and the creation of a secondary market (Baker, L. 2015). Finance has played an integral role in shaping the way in which renewable energy infrastructures, technologies and their ownership are emerging. In this sense, renewable energy is situated in the context of its inseparable, mutually co-constitutive relationship with the finance that shapes and supports it and therefore becomes "a particular historical phenomenon inextricably tied up with unequal exchange" (Lohmann and Hildyard 2014:10).

6.1 South Africa

We do see a link between renewable energy auctions in South Africa and our core concept of *experimentation*. There, technical, financial, and regulatory elites—a coalition of national and global renewable energy industries, government departments, and international investors—negotiated reforms to enable competitive procurement under a renewable energy auction program (Rennkamp et al. 2017). Although it was highly contested (Baker et al 2014), the auction program marked the first time that electricity was procured from IPPs and from renewable energy. The involvement of IPPs provoked Bayer et al. (2018: 306) to describe the program as an important "regulatory novelty,". Under South Africa's renewable energy auction program, in order for the bid to be successful project companies are required to submit a competitive bid below a certain tariff cap and also to commit to socio-economic criteria. These socio-economic criteria include that developers procure a certain percentage of locally sourced and manufactured components (Rennkamp et al. 2017) and that local communities hold a minimum ownership shareholding of 2.5 % of the project. This shareholding has to be allocated to a legally established community trust, which is tasked with representing the local community and managing the dividend which will eventually accrue to the community after the project has paid off its debt by about year 15 of project operation (Baker L. and Wlokas 2015). These unique attributes of the South African auction program were heralded by some as a model for other countries to learn from and replicate. Eberhard and Kåberger (2016: 190) write that because South Africa occupies "a central position in the global debate regarding the most effective policy instruments to accelerate and sustain private investment in renewable energy," it offers "important lessons" for many other emerging global markets. We interpret this to potentially mean places where critical infrastructure investments are sought by the financial elite.

However, some of the lessons learned from the South African experiment may not be positive (Baker and Sovacool 2017). For example, in some of the approved projects approved, community trusts have been established by project developers without participation by the actual community. Not only do community trusts lack capacity, but conflicts have also ensued within the trusts over how the anticipated revenue streams should be spent and distributed (Wlokas et al 2017). Poorly designed local content legislation led to gaming of the system including through transfer pricing, which has counter intuitively resulted in higher project costs without meaningful local value added (Matsuo and Schmidt (2019: 24).

Moving to *financialisation,* commercial priorities for “bankability” and the reduction of investor risk in South Africa as well as elsewhere are highly deterministic over the nature of a project’s development and its contractual arrangements (Eberhard and Kåberger 2016, Baker 2015). The extent that the competitive nature of the auction program put downward pressure on renewable energy prices was also confirmed in the first segments of the program, with the first three bidding rounds all seeing falling prices motivated by increased competition (Eberhard and Kåberger 2016: 193)—this also occurred in Mexico. in South Africa, involving the community within structures of project ownership is often perceived as an investment risk (Baker L, 2015). There are therefore serious tensions between the increasingly complex financial and investment arrangements for renewable energy projects, and any socioeconomic co-benefits that may be required under national frameworks for renewable energy procurement.

With this in mind, the way in which communities have been included in and affected by utility-scale renewable energy development has not always resulted in positive socio-economic outcomes (Baker, L. 2015) and in this sense has arguably resulted in processes of *dispossession* in some cases. Despite its potential for socio-economic development, renewable energy development in South Africa is being implemented within a national context of inequality along racial divisions. This is as a result of the country’s apartheid legacy, despite attempts at land restitution and legislation for the economic empowerment of historically marginalized individuals, known as black economic empowerment. Many of the country’s renewable energy projects are located in rural areas with high levels of poverty and unemployment which has resulted in the mismanagement of community benefit funds and has put pressure on the limited planning capacity of municipal and provincial governments (Wlokas 2015). Indeed, early evidence suggests that despite their pro-environmental outcomes, many auction programs and the projects that they facilitate have resulted in exclusionary and/or exploitative outcomes for those living in the national and local vicinity of these developments.

6.2 Mexico

Experimentation plays a prominent role in the Mexican procurement program for renewables as well. This may be partly explained by the strong role regulatory elites play generally in the policy sphere, with domestic renewable energy policies in Mexico often determined and coordinated by the federal government in a top-down fashion (Pischke et al. 2019). Regulatory elites nonetheless sought to test or experiment with a number of distinct designs within the auction program. del Río (2017) notes that first and foremost policy was designed to explicitly minimize electricity transmission congestion and to adjust bid packages to incentivize "good" locations (to benefit the efficiency of the transmission or distribution network) and offer fewer rewards for "bad" locations (where prices were low). They determined the location for these systems using complex long-term system simulations of the Mexican grid. Secondly, del Río (2017) adds that the Mexican auction program has a unique "bonus system" where electricity from variable renewable resources is paid at a price that adjusts tariffs by "hourly adjustment factors," to better reflect real time prices and times of higher and lower demand. Matsuo and Schmidt (2019) note a final experimental feature of the auction program in Mexico, that it is continuously calibrated to maximize commercial participation and to increase the attractiveness for foreign investors. For instance, the regulatory elite behind the Mexican program relaxed requirements regarding bid qualification and commercial operation dates in order to allow early-stage projects to bid into the auction, and they permitted the indexing of 15-year power purchasing agreements to Mexican pesos *or* United States dollars. All three of these experimental features—locational nodal pricing, the bonus system, and commercial calibration—were intended to maximize investment returns and also improve the efficiency of the grid, although in reality they have often led to incomplete projects and high incompletion rates.

Moving to *financialisation*, Matsuo and Schmidt (2019) emphasize a starting point - the central financial goals inherent in the Mexican programme - by noting the entire bid evaluation scheme is intended to optimize "economic surplus" and "minimize bid costs" so as to attract financial flows. The Mexican program therefore has a number of determined attributes to maximize revenues and financial attractiveness. The auctions are technology neutral with cost as the most important determinant (rather than a diversity of options), this is why it unusually includes nuclear power and natural gas as eligible under the program. It also has Clean Energy Certificates, which can be traded, and long-term contracts granted in 20-year cycles (Matsuo and Schmidt 2019). These elements have resulted in the benefits from the auction program accruing not only to Mexican debt providers and commercial banks, but largely to international technical elites including foreign developers such as Enel (Italy), Engie (France and United Kingdom) or EDF (France), who have all invested heavily in the Mexican market (Matsuo and Schmidt 2019). The same is true of South Africa. Rennkamp et al. (2017) also frame the Mexican renewable policy regime as one in which technical, regulatory and financial elites, i.e. international renewable energy equipment providers, government bureaucracies, and domestic renewable energy industry associations, have played an important influencing role. The same is true of South Africa

Dispossession dynamics in renewable energy auctions have been similarly observed in Mexico, where 70 % of indigenous peoples are poor and 40 % of indigenous language speakers live in extreme poverty (CONEVAL 2016). Large-scale renewable energy generation projects are being built disproportionately in indigenous areas, notably Oaxaca, Yucatán and Puebla, where the most competitive renewable energy resources are located. Consequently, indigenous communities have endured significant negative impacts, including being drawn into conflicts over land tenure and corruption; while the extent of the benefits that they enjoy has so far been limited (Business & Human Rights Resource Centre et al. 2017). In some cases, resistance has resulted in community blockades, extensive protests, and protracted litigation (Baker, S. 2012). State police have even been called in repeatedly to quash protests and try to quell dissent—with 12 injured during one violent clash, and the governor of Oaxaca promising that "blood would flow" if a wind project was cancelled due to community opposition (Jung 2017: 14). Zárate-Toledo et al. (2019: 1) also note that on the Isthmus of Tehuantepec, wind energy development has proceeded with "no consideration of local cultures or organizations, or the potential for joint ventures with local stakeholders that would treat rural indigenous populations as assets in the national energy transition."

7. Conclusion and Policy Implications

The preceding examination of elite processes across our five case studies leads us to make six conclusions. First, elite processes are occurring within the climate change pathways of coastal protection, climate risk insurance, and renewable energy auctions. As Table 2 indicates, their presence is not uniformly strong across these cases, but most processes are present most of the time.

Table 2: Degrees of Experimentation, Financialisation, and Dispossession in Climate Change Pathways

Climate pathway	Case study	Experimentation	Financialisation	Dispossession

Coastal protection	Bangladesh	Strong	Moderate	Strong
	Netherlands	Strong	Weak	Strong
Climate risk insurance	Malawi	Moderate	Strong	Moderate
Renewable energy auctions	Mexico	Moderate	Moderate	Moderate
	South Africa	Moderate	Strong	Moderate

Source: Authors

Second, the *types* of elites at work are dynamic, falling into the technical, financial, regulatory, and physical categories described in the paper. Table 3 offers a summary of these different types of elites with examples from each case study, with most elites operating in most cases (with some exceptions, notably the lack of physical elites in Malawi since refusal to disburse insurance claims does not require direct violence, or South Africa using community trusts). This evidence underscores the sheer diversity of different elites involved in, or shaping, each low-carbon pathway and case study. Future work—which we could not conduct here due to lack of space—ought to consider how these different elites interact, enable, reinforce, and/or simply assemble opportunity in the context of climate related development. Elite interaction across these types certainly deserves to be explored in greater detail.

Table 3: Summary of elite processes of power and types of elites

Case(s)	**Technical elites**	**Financial elites**	**Regulatory elites**	**Physical elites**
Bangladesh (coastal protection)	Experiment with community afforestation pilots and dyke design (e.g., World Bank and USAID)	Invest in infrastructure and valuable land (e.g. microfinance institutions, global banks)	Erect planning processes and policies to exclude others	Use physical force to evict the landless from *char* and *khas* land
Netherlands (coastal protection	Experiment with dredging, materials, vessels, and storm surge barrier design (e.g. Delft Laboratory and a consortium of Dutch engineering conglomerates)	Configure the Delta Works as a profit making entity via consulting contracts overseas, (e.g. Royal Boskalis Westminster N.V, Royal Van Oord, Royal VolkerWessels Stevin N.V)	*Rijkswaterstaat* ignore local and environmental concerns	Physically evict fishers and recreational users from estuaries and coastal areas

Malawi (climate insurance)	ARV; World Bank; DfID; InsuResilience, IPCC, World Bank	Investors; fund-managers; ARC Limited; Applied Insurance Research; Eqecat		
South Africa (renewable energy financing)	Domestic renewable energy firms and manufactures; local branches or subsidiaries of international technology and engineering firms	Banks; Equity investors; Project developers	Managers of the national renewable energy procurement programme	
Mexico (renewable energy financing)	International engineering and technology firms including Enel, Engie and EDF	Banks; Equity investors; Project developers	Renewable energy auction regulatory frameworks, state government (i.e., governor of Oaxaca)	Local, state and regional authorities threatening violence and disrupting counter-insurgency

Source: Authors

Third, elite responses involve not just different elite types, but also compelling interactions within and between pathways and responses. We have treated them as analytically distinct here, but there are cases where experimentation, financialisation, and dispossession reinforce each other. For example, the experimentation currently embodied in the South African and Mexican renewable energy auction programs results in data, and insights, that can (and likely are) used by financial elites looking to further processes of financialisation. The financialisation inherent in Malawi climate risk and disaster insurance focuses on least-cost strategies of diffusing risk that intertwine with processes of dispossession, with shifting risk from financial institutions into farmers and communities themselves, who must bear potential losses. The dispossession present in both the Bangladeshi and Dutch coastal protection regimes makes it easier for elites to both conduct experiments (as elites achieve greater control over resources including land) and reap the benefits of financialisation (as they can then convert unproductive or non-productive assets into financial rewards). The contours of Bangladeshi microfinance are also explicitly connected to forms of experimentation with big data and computerization, and novel yet invasive ways of socially monitoring borrowers.

Fourth, elite power is a multi-scalar process. Our cases reveal locally embedded elites operating alongside national elites and even globally circulating, transnational elites. In Bangladesh, for instance, national policies have reoriented efforts towards boosting resilience and enhancing exports and economic development, practices that protect some—notably wealthy land owners—but exclude others—notably the landless and displaced peasants. At the level of cities and communities, we see bandits roaming the countryside on behalf of elites in order to stealing land or appropriating resources for development or coastal development projects. Similarly, in the Netherlands, the local processes facilitating the Delta Works, especially the consolidation of expertise and power within the *Rijkswaterstaat*, enabled a power elite to emerge which utilized its monopoly on information to exclude and marginalize opponents, and ultimately collapse multiple ecosystems across the Dutch coast. In the case of climate risk insurance in Malawi, investors and fund managers who are disconnected from realities on the ground monitor financial flows while sophisticated risk modelling determines disbursement. Utility-scale renewable energy projects, in Mexico and South Africa meanwhile become conduits for global flows of finance and investment. Critically, while responses to climate change are in theory state-based, this research demonstrates the influence of forces and processes that go far beyond the jurisdiction of the nation state.

Our study thus shows that there are direct linkages between elites and climate policy. Therefore, we ought to consider *how* policies addressing climate change are designed, and *who* is involved in such policy making processes. Kern and Rogge (2018), for example, argue that the long-term nature of transitions requires a more explicit focus on the policy making process, and more importantly, on its outcomes. If national climate policy, for example, is designed at the state level, but then enacted on by transnational elites that may cause harm at local level, this causes questions over the transparency of the policy process itself. We therefore need to pay attention and unveil who the potentially invisible elites are that may have influence on, and benefit unfairly from, climate policy processes.

Fifth, our analysis reveals why some low-carbon pathways or transitions are so contested and conflicted. To many commentators and institutions such as the Intergovernmental Panel on Climate Change (IPCC) or International Energy Agency (IEA), a low-carbon transition is a way of rapidly achieving social or policy goals towards addressing climate change. To others, it is a way of addressing market failure or capturing co-benefits such as jobs or improved health attached to low-carbon systems. However, these interpretations have often failed to show how processes and pathways of low-carbon transitions (mitigation, adaptation) can become intertwined with elite responses and practices that contribute to inequality, exclusion and injustice. Low-carbon transitions can become experiments that socialize risks to the vulnerable, conduits of capital, and tools of dispossession as much as they can be mechanisms for mitigating emissions or building human capacity to climate change. Very simply put: elites may approach low-carbon transitions not as a way to mitigate emissions, but instead as something to experiment and learn from, something to make money from, or a way to dispossess communities of their wealth or resources.

Lastly, our study reveals how elites grapple with responses to climate change, how they view it and attempt to respond to it. For some elites, climate change offers a justification for conducting pilots, trials, and experiments, sold on the grounds of urgency but ultimately transferring risks to those being experimented on and benefits (in the form of data, knowledge, potential patents, etc.) to the experimenters. To others, climate change is an opportunity to create lucrative markets for bonds or reinsurance. Within these complex and adaptive pathways, better understanding how elites decide to engage with a phenomenon as all-encompassing and significant as climate change can help ensure not only that elite processes are identified, but perhaps understood and then transformed into more equitable and egalitarian low-carbon futures.

8. References

Adnan, S. (2013). Land grabs and primitive accumulation in deltaic Bangladesh: interactions between neoliberal globalization, state interventions, power relations and peasant resistance. The Journal of Peasant Studies, 40(1), 87-128.

African Risk Capacity (ARC) (2018) 'About ARC Limited' [available at: http://www.africanriskcapacity.org/arcltd/]

African Risk Capacity (ARC) (2017) 'Memorandum of understanding countries', [available at: http://www.africanriskcapacity.org/2016/10/29/memorandum-of-understanding/]

Anderson B (2010) Preemption, precaution, preparedness: Anticipatory action and future geographies. Progress in Human Geography 34: 777–798

Anderson, Patrick. Free, Prior, and Informed Consent: Principles and Approaches for Policy and Project Development (Bangkok: RECOFTC and GIZ, February 2011

Anguelovski, Isabelle et al.. 2017. Equity Impacts of Urban Land Use Planning for Climate Adaptation: Critical Perspectives from the Global North and South, Journal of Planning Education and Research, 1-16

Baeumler, Axel, Ede Ijjasz-Vasquez and Shomik Mehndiratta. 2012. Cities and climate change: An urgent agenda. In Sustainable Low-Carbon City Development in China. Washington, DC: World Bank Group.

Baker, L and BK Sovacool. "The political economy of technological capabilities and global production networks in South Africa's wind and solar photovoltaic (PV) industries," Political Geography 60 (September, 2017), pp. 1-12.

Baker, L. (2015) 'The evolving role of finance in South Africa's renewable energy sector', *Geoforum* 64: 146-156

Baker L. and Wlokas H. (2015) 'South Africa's renewable energy procurement: a new frontier?' Project Report, Energy Research Centre, Cape Town

Baker, L., Newell, P. and Phillips, J. (2014) 'The political economy of energy transitions: the case of South Africa. *New Political Economy* 19, 791-818

Baker, S. H (2015). 'Project finance and sustainable development in the global south', in Shawkat Alam et al. eds. *International Law: Perspectives from the Global South*, Cambridge University Press 2015

Baker, S. H. (2012) 'Why the IFC's free, prior, and informed consent policy does not matter (yet) to indigenous communities affected by development projects', *Wisconsin International Law Journal*, vol 30 (3), 668-705

Banerjee, Subhabrata Bobby and Laurel Jackson, "Microfinance and the business of poverty reduction: Critical perspectives from rural Bangladesh," Human Relations, Vol 70, Issue 1, 2017, pp. 63-91

Bangladesh Forest Department. 2016. Bangladesh Forestry Master Plan 2017-2036. December. Climate Resilient Participatory Afforestation and Reforestation Project, Updating Forestry Master Plan for Bangladesh.

Baptista, I. and Plananska, J., 2017. The landscape of energy initiatives in sub-Saharan Africa: Going for systemic change or reinforcing the status quo?. *Energy Policy*, *110*, pp.1-8.

Bateman, Milford (2010) Why Doesn't Microfinance Work? The Destructive Rise of Local Neoliberalism. London–New Jersey: Zed Books.

Baumgartner, T., Burns, T.R., & Deville, P. (2015). The shaping of socio-economic systems: The application of the theory of actor-system dynamics to conflict, social power, and institutional innovation in economic life. New York, NY: Routledge.

Bayer, Benjamin, Dominik Schäuble, Michele Ferrari. International experiences with tender procedures for renewable energy – A comparison of current developments in Brazil, France, Italy and South Africa, Renewable and Sustainable Energy Reviews, Volume 95, November 2018, Pages 305-327

Bayliss, K. and Van Waeyenberge, E. (2018) 'Unpacking the Public Private Partnership Revival', *The Journal of Development Studies* 54(4): 577-593

Bernstein, Henry. 2010. Class Dynamics of Agrarian Change, Fernwood Press & Kumarian Press, 2010, pp. 460-465.

Bijker, W.E. (1993). Dutch, dikes and democracy. An argument against democratic, authoritarian, and neutral technologies. *Technology Assessment Texts no. 11*. Lyngby, Denmark: Unit of Technology Assessment, Technical University of Denmark.

Bijker, W.E. (2002). The Oosterschelde storm surge barrier. A test case for Dutch water technology, management, and politics. *Technology and Culture, 43*(3), 569-584.

Bonds, Eric. 2010. The Knowledge-Shaping Process: Elite Mobilization and Environmental Policy. Critical Sociology, 37(4) 429–446

Bonds, Eric. 2016. "Beyond Denialism: Think Tank Approaches to Climate Change." Sociology Compass 10(4):306–17.

Bracking, S. (2016) *The Financialisation of Power: How Financiers Rule Africa*, Abingdon: Routledge.

Bracking, S. (2012) 'How do investors value environmental harm/care? Private equity funds, development finance institutions and the partial financialisation of nature-based industries' *Development and Change* 43(1): 271-293

Bridge, G., Bulkeley, H., Langley, P. and van Veelen, B., 2019. Pluralizing and problematizing carbon finance. *Progress in human geography.*

Brown, H. (2014). *Next generation infrastructure: Principles for post-industrial public works*. Washington, DC: Island Press.

Callaway, J.M. (2014). The role of technology in adaptation. In I. Galarraga, A. Markandya, & E. Sainz de Murieta (Eds.), Routledge handbook of the economics of climate change adaptation. New York, NY: Routledge.

Carroll T and Jarvis DSL (2014) *Financialisation and Development in Asia*, London: Routledge

Christophers, B. (2012) 'Anaemic geographies of financialisation', *New Political Economy* 17, 271-291

Climate Bonds Initiative (2013) 'Bonds and climate change: the state of the market in 2013' [available at: http://www.unepfi.org/fileadmin/publications/Literature/Bonds_Climate_Change_2013_A4.pdf]

Cons, Jason. 2018. "Staging Climate Security: Resilience and Heterodystopia in the Bangladesh Borderlands, Cultural Anthropology 33(2), pp. 266–294.

Cons, J., and K. Paprocki. 2010. Contested credit landscapes: Microcredit, self-help and self-determination in rural Bangladesh. Third World Quarterly 31 (4):637–54.

Convergences. 2018. Microfinance Barometer 2018. http://www.convergences.org/wp-content/uploads/2018/09/BMF_2018_EN_VFINALE-1.pdf.

Corvers, R. (2009). Vulnerable to flooding? Nature development and 'room for the river: A governance perspective. In U.F. Paleo (Ed.), *Building safer communities: Risk governance, spatial planning, and responses to natural hazards* (pp. 125-135). Amsterdam, The Netherlands: Ios Press.

Creutzig, Felix et al., Towards demand-side solutions for mitigating climate change, Nature Climate Change 8 (April 2018), pp. 260-271.

d'Angremond, K., & Kooman, D. (1986). Eastern Scheldt storm surge barrier: Management aspects of a multibillion dollar project. *International Journal of Project Management, 4*(3), 149-157

del Río, Pablo. Designing auctions for renewable electricity support. Best practices from around the world, Energy for Sustainable Development, Volume 41, December 2017, Pages 1-13

Delina, L. L., & Diesendorf, M. (2013). Is wartime mobilisation a suitable policy model for rapid national climate mitigation? Energy Policy, 58, 371–380

Delina, L. L. (2016). Strategies for Rapid Climate Mitigation: Wartime Mobilisation as a Model for Action? Routledge.

Demeritt, D. (2001). The construction of global warming and the politics of science. Annals of the Association of American Geographers, 91(2), 307-337

Dolšak, Nives and Aseem Prakash. The Politics of Climate Change Adaptation. Annual Review of Environment and Resources (October, 2018, in press).

Dunlap, A. (2018). Counterinsurgency for wind energy: the Bíi Hioxo wind park in Juchitán, Mexico', *The Journal of Peasant Studies* 45(3): 630-652

Eberhard A, Kåberger T. Renewable energy auctions in South Africa outshine feed in tariffs. Energy Sci Eng 2016;4(3):190–3.

Edwards, Gareth A S and Harriet Bulkeley, Heterotopia and the urban politics of climate change experimentation, Environment and Planning D: Society and Space 2018, Vol. 36(2) 350–369

Eelkema, M. (2013). *Eastern Scheldt Inlet morphodynamics* (unpublished thesis). Haveka, The Netherlands: Delft University of Technology,

Epstein, Graham, Abigail Bennett , Rebecca Gruby , Leslie Acton , and Mateja Nenadovic, Studying Power with the Social-Ecological System Framework. In Understanding Society and Natural Resources (Springer, 2014), pp 111-135

Fairhead, J., M. Leach, and I. Scoones. 2012. Green grabbing: A new appropriation of nature? The Journal of Peasant Studies 39: 237–61

Feldman, S., & Geisler, C. (2011, April). Land grabbing in Bangladesh: In-situ displacement of peasant holdings. Paper presented at the International Conference on Global Land Grabbing at the Institute of Development Studies, University of Sussex.

Feldman, Shelley, and Charles Geisler. 2012. “Land Expropriation and Displacement in Bangladesh.” Journal of Peasant Studies 39 (3/4): 971–93

Fortin, Elizabeth & Ben Richardson (2013) Certification Schemes and the Governance of Land: Enforcing Standards or Enabling Scrutiny?, Globalizations, 10:1, 141-159

Friman, M., & Linnér, B.-O. (2008). Technology obscuring equity: Historical responsibilities in UNFCCC negotiations. Climate Policy, 8(4) (2008), 339-354.

Geels, FW, et al. “Sociotechnical transitions for deep decarbonisation,” Science 357 (6357) (September 22, 2017), pp. 1242-1244.

Geels FW et al. “Reducing energy demand through low carbon innovation: A sociotechnical transitions perspective and thirteen research debates,” Energy Research & Social Science 40 (June, 2018), pp. 23-35.

Green, Fergus and Richard Denniss, Cutting with both arms of the scissors: the economic and political case for restrictive supply-side climate policies, Climatic Change (in press 2018)

Giddens, A., (1979), Central Problems in Social Theory, London: Macmillan

Gilpin, R. (1987). The Political Economy of International Relations. Princeton: Princeton University Press.

Gordon, R. (2007). Climate change and the poorest nations: Further reflections on global inequality. University of Colorado Law Review, 78(2007), 1559-1624.

Government of Netherlands. 2016. Holland's high tech flood protection. Available at https://www.hollandtradeandinvest.com/feature-stories/hollands-high-tech-flood-protection

Gray, A. Fontanella-Khan, J. and Ralph, O. (2018) ‘Reinsurance pain could be M&A bankers’ gain’, *Financial Times,* 25 January

Håkansson, Irene. 2018. The socio-spatial politics of urban sustainability transitions: Grassroots initiatives in gentrifying Peckham, Environmental Innovation and Societal Transitions (in press).

Hall, D. (2015) ‘Why public-private partnerships don’t work: the many advantages of the public alternative’, PSIRU Research Report, London: University of Greenwich

Harrison, C. and Popke, J. (2018) ‘Geographies of renewable energy transition in the Caribbean: Reshaping the island energy metabolism’ *Energy Research and Social Science* 36: 165-174

Harvey, D. (2003). The New Imperialism. Oxford: Oxford University Press.

Harvey, D. (2004). The 'new' imperialism: accumulation by dispossession. Socialist Register 40: 63-87.

Harvey, D. (2006). Spaces of global capitalism: towards a theory of uneven geographical development. London: Verso.

Haugaard, M. (Ed.). (2002). Power: A reader. Manchester University Press.

Haugaard, M. (2012). Rethinking the four dimensions of power: domination and empowerment. Journal of Political Power, 5(1), 33-54.

Healy, N., Stephens, J. C., & Malin, S. A. (2018). Embodied energy injustices: Unveiling and politicizing the transboundary harms of fossil fuel extractivism and fossil fuel supply chains. Energy Research & Social Science, 48 (June), 219–234.

Hillen, M.M., Jonkman, S.N., Kanning, W., Kok, M., Geldenhuys, M.A., & Stive, M.J.F. (2010). Coastal defence cost estimates. Case study of the Netherlands, New Orleans and Vietnam. Delft, The Netherlands: Delft University of Technology (TU Delft).

Hinkel J., et al., (2014). Coastal flood damage and adaptation costs under 21st century sea-level rise. PNAS, 111(9),3292-3297.

Hobbes, T. 1655. The English works of Thomas Hobbes of Malmesbury. J. Bohn, London, UK

Hoffman J. 2013. Theorizing power in transition studies: the role of creativity and novel practices in structural change. Policy Sciences 46(3): 257–275.

Insurance Information Institute (2018) 'Facts + Statistics: Catastrophe bonds' [available at: https://www.iii.org/fact-statistic/facts-statistics-catastrophe-bonds]

Insureresilience. 2018. 'About' [available at: https://www.insuresilience.org/about/]

Isakson, S. R. (2015) 'Derivatives for Development? Small-Farmer Vulnerability and the Financialisation of Climate Risk Management', *Journal of Agrarian Change* 15(4): 569-580

Jerneck, M. (2017) 'Financialisation impedes climate change mitigation: Evidence from the early American solar industry' *Science Advances* 3(3)

Johnson, L. (2014) 'Geographies of Securitized Catastrophe Risk and the Implications of Climate Change', Economic Geography 90(2): 155-185.

Jorgenson, A.K., & Givens, J.E. (2014). The emergence of new World-Systems perspectives on global environmental change. In D.A. Sonnefeld, S. Lockie, & D.R. Fisher (Eds.), Routledge international handbook of social and environmental change New York, NY: Routledge.

Jung, Courtney. 2017. The politics of horizontal inequality Indigenous opposition to wind farm development in Mexico. WIDER Working Paper 2017/146. June.

Karim, Lamia. 2011. Microfinance and Its Discontents: Women in Debt in Bangladesh (Minneapolis: University of Minnesota Press)

Kartiki, K. (2011). Climate change and migration: A case study from rural Bangladesh. Gender & Development, 19(1), 23-38.

Kennedy, S. F. (2018) "Indonesia's energy transition and its contradictions: Emerging geographies of energy and finance," *Energy Research & Social Science* 41: 230-237

Kern, F. and Markard, J., 2016. Analysing energy transitions: combining insights from transition studies and international political economy. In *The Palgrave handbook of the international political economy of energy* (pp. 291-318). Palgrave Macmillan, London.

Kern, F., Rogge, K.S. 2018. Harnessing theories of the policy process for analysing the politics of sustainability transitions: A critical survey. Environmental Innovation and Societal Transitions, 27, pp. 102-117

Kerr, Richard A. 2007. How Urgent Is Climate Change? Science, Vol. 318, Issue 5854 (November 23), pp. 1230-1231

Kester, J and BK Sovacool. "Torn Between War and Peace: Critiquing the Use of War to Mobilize Peaceful Climate Action," Energy Policy 104 (May, 2017), pp. 50-55.

Kompier, Tom. The Dutch Delta Approach Introduction and background to the national programme for flood safety and freshwater supply Staff Government commissioner November 2012. Available at http://gfdrr.org/sites/gfdrr/files/The_Dutch_Delta_Approach.pdf.

Korsnes, Marius et al, Domestication, acceptance and zero emission ambitions: Insights from a mixed method, experimental research design in a Norwegian Living Lab, Energy Research & Social Science 39 (2018) 226–233

Knorr-Cetina, Karin. The Couch, the Cathedral, and the Laboratory: On the Relationship between Experiment and Laboratory in Science, Science as Practice and Culture (A. Pickering Ed), 1992, University of Chicago Press, pp. 113-138.

Knuth, S. (2018) "Breakthroughs" for a green economy? Financialisation and clean energy transition," *Energy Research & Social Science* 41: 220-229

Kunstler, James Howard. The Long Emergency. New York: Grove Press, 2007.

Lambin, Eric F.and Patrick Meyfroidt. Global land use change, economic globalization, and the looming land scarcity. PNAS March 1, 2011 108 (9) 3465-3472

Laurance, WF et al. 2010. Improving the Performance of the Roundtable on Sustainable Palm Oil for Nature Conservation. Conservation Biology, Volume 24, No. 2, 377–381

Leemans, A. (1986). Information as a factor of power and influence policymaking on the Delta/Oosterschelde Sea Defense Works. *Science Communication, 8*(1), 39-58

Llull, E. (2016) Insurers' pledge to help developing countries on climate change, *Financial Times,* 28 June [available at: https://www.ft.com/content/04d57130-274d-11e6-8ba3-cdd781d02d89]

Loftus, A. and March H. (2015). 'Financialising nature?', Geoforum 60(0): 172-175

Lohmann, L. and Hildyard, N. (2014) 'Energy, work and finance', Cornerhouse briefing, March 2014

Mann, Michael. 2012a. The Sources of Social Power: Volume 3, Global Empires and Revolution, 1890-1945, Cambridge University Press, 2012.

Mann, Michael. 2012b. The Sources of Social Power: Volume 4, Globalizations, 1945-2011, Cambridge University Press, 2012.

Markusson, Nils et al. 2014. 'In case of emergency press here': framing geoengineering as a response to dangerous climate change. WIREs Clim Change2014, 5:281–290.

Matsuo, Tyeler, Tobias S. Schmidt. Managing tradeoffs in green industrial policies: The role of renewable energy policy design. World Development, Volume 122, October 2019, Pages 11-26

Mawdsley, E. (2018). Development geography II: Financialisation. *Progress in Human Geography*, 42(2), 264–274

McMichael, Philip (2012) The land grab and corporate food regime restructuring, The Journal of Peasant Studies, 39:3-4, 681-701.

McRobie, A., Spencer, T., & Gerritsen, H. (2005). The big flood: North sea storm surge. *Philosophical Transactions of the Royal Society A, 363*, 1263-1270.

Meadowcroft, J., 2011. Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions*, *1*(1), pp.70-75.

Najam, A., Huq, S., & Sokonae, Y. (2003). Climate negotiations beyond Kyoto: developing countries concerns and interests. Climate Policy, 3(3), 221-231.

Newell, P. and Mulvaney, D., 2013. The political economy of the 'just transition'. *The Geographical Journal*, *179*(2), pp.132-140.

Oceransky, Sergio . "Fighting the Enclosure of Wind: Indigenous Resistance to the Privatization of the Wind Resource in Southern Mexico," In Koyla Abramsky (Ed.) Sparking a Worldwide Energy Revolution: Social Struggles in the Transition to a Post-Petrol World (Oakland: AK Press, 2010), pp. 505-522.

Oxfam (2018) 'Facing risk: options and challenges in ensuring that climate/disaster risk finance and insurance deliver for poor people' [available at: https://policy-practice.oxfam.org.uk/publications/facing-risk-options-and-challenges-in-ensuring-that-climatedisaster-risk-financ-620457]

Oxford Policy Management (OPM) (2017a) ‘Independent evaluation of the African Risk Capacity (ARC) Annex C: Case studies’, 27 October [available at: https://www.opml.co.uk/files/Publications/a0603-independent-evaluation-african-risk-capacity/arc-evaluation-annex-c-case-study.pdf?noredirect=1]

Oxford Policy Management (OPM) (2017b)’ Independent evaluation of the African Risk Capacity (ARC): formative phase 1 report’, 27 October [available at: https://www.opml.co.uk/files/Publications/a0603-independent-evaluation-african-risk-capacity/arc-evaluation-report.pdf?noredirect=1]

Paprocki, Kasia. Threatening Dystopias: Development and Adaptation Regimes in Bangladesh, Annals of the American Association of Geographers, 0(0) 2018, pp. 1–19

Paprocki, K., & Cons, J. (2014). Life in a shrimp zone: aqua- and other cultures of Bangladesh’s coastal landscape. The Journal of Peasant Studies, 41(6), 1109-1130.

Partridge, T., Thomas, M., Pidgeon, N. and Harthorn, B.H., 2018. Urgency in energy justice: Contestation and time in prospective shale extraction in the United States and United Kingdom. Energy Research & Social Science, 42, pp.138-146.

Phillips, L. (2014) ‘Cat bonds: Cashing in on catastrophe’, [available at:] http://roadtoparis.info/2014/11/18/cat-bonds-cashing-catastrophe/

Pischke, Erin C., Barry Solomon, Adam Wellstead, Alberto Acevedo, Oswaldo Lucon. From Kyoto to Paris: Measuring renewable energy policy regimes in Argentina, Brazil, Canada, Mexico and the United States, Energy Research & Social Science, Volume 50, April 2019, Pages 82-91

Piketty, T., 2015. About capital in the twenty-first century. *American Economic Review*, *105*(5), pp.48-53.

Potapov P V et al 2014 National satellite-based humid tropical forest change assessment in Peru in support of REDD+ implementation Environ. Res. Lett. 9 124012

Potapov, P et al., Comprehensive monitoring of Bangladesh tree cover inside and outside of forests, 2000–2014, Environ. Res. Lett. 12 104015 (2017).

Prouty, Anne E. 2009. “The Clean Development Mechanisms and its Implications for Climate Justice,” Columbia Journal of Environmental Law 34(2) (2009), pp. 513-540.

Rahman, Md. Habibur et al., Are Protected Forests of Bangladesh Prepared for the Implementation of REDD+? A Forest Governance Analysis from Rema-Kalenga Wildlife Sanctuary, Environments 2017, 4, 43

Ralph, O. (2017) Singapore seeks to muscle in on market for catastrophe bonds, *Financial Times,* 1 November [available at: https://www.ft.com/content/55229b4c-befd-11e7-b8a3-38a6e068f464]

Ralph, O. and Aglionby J. (2017) ‘The push for faster aid to developing countries’, *Financial Times,* 15 August [available at: https://www.ft.com/content/cdd65f6e-7dc7-11e7-9108-edda0bcbc928]

Ralph, O. and Binham, C. (2017) ‘UK aims to capture catastrophe bond market’, *Financial Times,* 20 July [available at: https://www.ft.com/content/b9e8ec72-6d66-11e7-bfeb-33fe0c5b7eaa]

Rawlani, A and BK Sovacool. “Building Responsiveness to Climate Change through Community Based Adaptation in Bangladesh,” Mitigation and Adaptation Strategies for Global Change 16(8) (December, 2011), pp. 845-863.

Reddy C S, Pasha S V, Jha C S, Diwakar P G and Dadhwal V K 2016 Development of national database on long-term deforestation 1930–2014 in Bangladesh Glob. Planet. Change 139 173–82

Reeves, J. (2016) ‘Ten concerns about climate and disaster insurance schemes – and one rights-based alternative’, 24 May Action Aid [available at: http://actionaid.org/2016/05/ten-concerns-about-climate-and-disaster-insurance-schemes-and-one-rights-based-alternative]

Reddy, B. Sudhakara and Gaudenz B. Assenza, The Great Climate Debate, Energy Policy 37 (2009), pp. 2997-3008.

Rennkamp, Britta, Sebastian Haunss, Kridtiyaporn Wongsa, Araceli Ortega, Erika Casamadrid. Competing coalitions: The politics of renewable energy and fossil fuels in Mexico, South Africa and Thailand, Energy Research & Social Science, Volume 34, December 2017, Pages 214-223

Rockström, Johan et al., A roadmap for rapid decarbonisation, Science 355 (6331) (2017), pp. 1269-1271.

Rodriguez, I. 2017. Linking well-being with cultural revitalization for greater cognitive justice in conservation: lessons from Venezuela in Canaima National Park. Ecology and Society 22(4):24.

Rosenman, E., 2017. The geographies of social finance: Poverty regulation through the ‘invisible heart’of markets. *Progress in Human Geography*, p.0309132517739142.

Royal Boskalis Westminster N.V. Annual Report 2010.

Royal Boskalis Westminster N.V. Annual Report 2017.

Sarker, S.K. J.C. Deb and M.A. Halim, A Diagnosis of Existing Logging Bans in Bangladesh, International Forestry Review 13(4):461-475. 2011

Schouten, Greetje and Pieter Glasbergen, Creating legitimacy in global private governance: The case of the Roundtable on Sustainable Palm Oil, Ecological Economics 70 (2011) 1891–1899

Schroeder, H., Boykoff, M.T., & Spiers, L. (2012). Equity and state representations in climate negotiations. Nature Climate Change, 2(12), 834-836

Scoones, I., Leach, M. and Newell, P. eds., 2015. *The politics of green transformations*. Routledge.

Scott, John. 2008. "Modes of power and the conceptualisation of elites", in Michael Savage and Karel Williams (eds.), Bringing Elites Back, Oxford, Blackwell (Sociological Review Monographs).

Sovacool, BK. "Conceptualizing Hard and Soft Paths for Climate Change Adaptation," Climate Policy 11(4) (July, 2011), pp. 1177-1183.

Sovacool, BK, BO Linnér, and ME Goodsite. "The Political Economy of Climate Adaptation," Nature Climate Change 5 (7) (July, 2015), pp. 616-618.

Sovacool, BK and BO Linnér. The Political Economy of Climate Change Adaptation (Basingstoke UK/New York USA: Palgrave Macmillan and the Nature Publishing Group, 2015).

Sovacool, BK. "The Political Ecology and Justice of Energy." In T Van de Graaf, BK Sovacool, F Kern, A Ghosh, and MT Klare (Eds.) T*he Palgrave Handbook of the International Political Economy of Energy* (Basingstoke UK/New York USA: Palgrave, 2016), pp. 529-558.

Sovacool, BK. "Bamboo beating bandits: Conflict, inequality, and vulnerability in the political ecology of climate change adaptation in Bangladesh," World Development 102 (February, 2018), pp. 183-194.

Sovacool, B.K., Tan-Mullins, M., Ockwell, D. and Newell, P., 2017. Political economy, poverty, and polycentrism in the global environment facility's least developed countries fund (LDCF) for climate change adaptation. *Third World Quarterly*, *38*(6), pp.1249-1271.

Sovacool, BK and MC Brisbois. "Elite power in low-carbon transitions: A critical and interdisciplinary review," *Energy Research & Social Science* (in press, 2019)

Talbot, T. and Barder, O. (2018) 'Payouts for perils: why disaster aid is broken and how catastrophe aid can help fix it' [available at: https://www.cgdev.org/sites/default/files/payouts-perils-why-disaster-aid-broken-and-how-catastrophe-insurance-can-help-fix-it-0.pdf]

Tebaldi, C., Strauss, B.H., & Zervas, C.E. (2012). Modelling sea level rise impacts on storm surges along US coasts. Environmental Research Letters, 7(1), 014032.

Temper, Leah (2018): From boomerangs to minefields and catapults: dynamics of trans-local resistance to land-grabs, The Journal of Peasant Studies, DOI: 10.1080/03066150.2017.1398144

Thomas, KA and BP Warner. Weaponizing vulnerability to climate change. Global Environmental Change 57 (July 2019), 101928.

Tilley, H. 2011. Africa as a living laboratory. Chicago: University of Chicago Press

van Noortwijka, J.M., & Klatter, H.E. (1999). Optimal inspection decisions for the block mats of the Eastern-Scheldt Barrier. *Reliability Engineering and System Safety 65*, 203-211.

Van Oord. 2019. Recovery of revenue in 2018. https://www.vanoord.com/news/2019-recovery-revenue-2018

Volkerwessels. 2018. Annual Report. https://www.volkerwessels.com/dynamics/modules/SFIL0200/view.php?fil_Id=366346

Voytenko, Yuliya et al., Urban living labs for sustainability and low carbon cities in Europe: towards a research agenda, Journal of Cleaner Production 123 (2016) 45-54

Weiss, Anja. 2005. The Transnationalization of Social Inequality: Conceptualizing Social Positions on a World Scale, Current Sociology, July 2005, Vol. 53(4): 707–728

Weingärtner, L. Simonet, C. and Caravani, A. (2017) 'Disaster risk insurance and the triple dividend of resilience', Overseas Development Institute, Working Paper 515

White, B., Borras Jr., S.M., Hall, R., Scoones, I., & Wolford, W. (2012). The new enclosures: Critical perspectives on corporate land deals. The Journal of Peasant Studies, 39(3-4), 619-647

World Bank (2018) 'World Bank affirms position as largest sovereign risk insurance provider with multi-country earthquake bond', February 7 [available at: https://www.worldbank.org/en/news/press-release/2018/02/07/world-bank-affirms-position-as-largest-sovereign-risk-insurance-provider-with-multi-country-earthquake-bond]

Yenneti, Komali et al., Spatial justice and the land politics of renewables: Dispossessing vulnerable communities through solar energy mega-projects, Geoforum, Volume 76, November 2016, Pages 90–99

Zárate-Toledo, Ezequiel, Rodrigo Patiño, Julia Fraga, Justice, social exclusion and indigenous opposition: A case study of wind energy development on the Isthmus of Tehuantepec, Mexico, Energy Research & Social Science, Volume 54, August 2019, Pages 1-11