Climate Change Management

Jörg Knieling
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Climate Change Governance

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Climate Change Governance: The Challenge for Politics and Public Administration, Enterprises and Civil Society

Jörg Knieling and Walter Leal Filho

Introduction

Climate change is a cause for concern both globally and locally. In order for it to be tackled holistically, its governance is an important topic needing scientific and practical consideration. Climate change governance is an emerging area, and one which is closely related to state and public administrative systems and the behaviour of private actors, including the business sector, as well as the civil society and non-governmental organisations. Questions of climate change governance deal both with mitigation and adaptation whilst at the same time trying to devise effective ways of managing the consequences of these measures across the different sectors.

Climate change governance takes into account principles of accountability, management and institutional strengthening, which are applied when tackling the various challenges posed by climate change. It includes a wide range of steering mechanisms ranging from informal cooperation between different institutions and actors to hierarchical forms of regulation. The governance of climate change can also be approached by applying economic models used in change management, which enable organisational structures to be developed for public administration, contractors or private bodies. Therefore, climate change governance can be described as a wide variety of coordinating methods contributing to the adaptation and mitigation of climate change.

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The broad nature of climate change governance makes it difficult to explain and to conceptualise, since the complexity of climate change and the many ecological, economic and social variables with which it is associated extend beyond the scope of traditional governance processes. Indeed, as stated by Meadowcroft (2009: p. 28), "climate change governance requires governments to take an active role in bringing about shifts in interest perceptions so that stable societal majorities in favour of deploying an active mitigation and adaptation policy regime can be maintained." Effective climate change governance depends on collaboration between governments and other non-governmental organisations. Against the backdrop of cooperative governance, the business sector must take on an active role. On the one hand, mitigation and adaptation support economic interests by promising new technological innovations as well as offering potential in the marketplace. On the other hand, climate change governance requires a collaborative approach in order to find suitable solutions fitting the requirements of private participants, and appropriate for businesses as well as the civil society, the latter in its role as a tenant or home owner. This encompasses energy efficiency, commuter routines and lifestyle choices in private homes.

Therefore, the need to engage different sectors of society in the climate change debate has become increasingly apparent in recent years. In order to conceptualise climate change governance, it is utterly relevant to identify and analyse the interests and motivations of private participants, whilst also bearing in mind any conflicts and limitations that may affect their behaviour, willingness to cooperate and internal decision-making.

As well as the perspectives of the various stakeholders, the spatial dimension of climate change governance should be inspected more closely. Decisions made by the United Nations and inter-governmental politics are expected to be key to developing solutions to the problem of climate change. Nevertheless, local government has an impressive record in tackling climate change. Local initiatives can work as a testbed for assessing the feasibility of climate-related measures and can also offer new approaches for setting and implementing climate goals. Furthermore, in the field of climate adaptation, local administration has become a focal point as issues surrounding adaptation and the capacity to act are more easily met at a local level. Against this background, local and regional climate change governance appear worthy of further examination in order to develop the dialogue around mitigation and adaptation. It is a core task to identify and disseminate mechanisms of climate change governance that may assist in finding regional and local solutions for what is a global problem.

However, at present there is still a paucity of publications addressing these matters. Many books have been produced on general matters related to climate change, such as climate modelling, temperature variations, sea level rise, but, to date, very few publications have addressed the political, economic and social elements of climate change and their links with governance. This book will address this gap. Furthermore, a particular feature of this book is that it not only presents different perspectives on climate change governance, but it also introduces theoretical approaches and brings these together with practical examples which show how main principles may be implemented in practice.

The book is divided into three main parts. Part I sets the stage and provides a theoretical and conceptual framework of climate change governance. *Fröhlich* and *Knieling* present an overview of existing governance approaches and concepts applicable to climate change. Based on the specific problem structure of climate change, i.e., its cross-boundary, multi-level, -sector, -actor and long-term nature, as well as the uncertainties surrounding it, they explore contours of climate change governance and discuss correlating policy and planning instruments. *Termeer*, *Dewulf* and *Breeman* shed light on the issue of climate change as a wicked policy problem. The authors review existing theories about resilience, responsiveness and revitalisation that are suitable for addressing wicked climate adaptation problems. They propose to exploit this theoretical multiplicity rather than to develop one integrated governance approach. *Bruneniece* and *Klavins* suggest a theoretical framework for policy design and decision-making practice supplemented with experiences from Latvian climate change policy. The analysis explores risks and benefits related to climate change and points out why a more systematic approach for addressing these topics is necessary. *Brunnengräber* deals with multi-level climate governance processes and structures. His contribution illustrates that climate change is characterised by considerable interest-led governance interdependencies. In this context, the author analyses five dimensions of climate governance and how they may counteract successful regulation on an international level. *McCarney* maps core risks for cities associated with climate change, such as extreme weather events and sea level rise. She shows how a set of indicators concerning these matters can help to build empowered decision-making and lead to more informed planning norms and practices, and more inclusive urban governance. *Schröder* and *Walk* concentrate on a specific actor by covering current and future roles of cooperatives as one possibility for providing innovative, collective approaches to local climate governance strategies. The article emphasises the importance of bottom-up strategies for a transition towards climate friendliness. *Daim*, *Cowan*, *Wakeland*, *Fallah* and *Holahan* present a conceptual model built on technical, organisational and personal perspectives, targeting an informed energy policy and the management of energy resources. Factors enabling better adoption by consumers and efficient development by organisations are evaluated with regard to potential technological improvements.

Part II contains case studies on climate change governance, in particular, policy-related and governmental approaches. *Al-Amin*, *Jaafar*, *Azam*, *Kari* and *Agil* describe Malaysian climate change experiences and obstacles to establishing a national policy on climate change. The study emphasises that sustainable, long-term economic policy requires a workable framework for climate change, and highlights the necessity of national initiatives for planning strategies to reduce vulnerabilities. *Davoudi* outlines the role of English spatial planning. Based on the key areas of energy supply, energy demand and adaptation, she provides a conceptual framework by mapping the most relevant related policy areas against the different forms of planning interventions, such as regulatory interventions or strategic coordination. *Diaz* and *Hurlbert* evaluate institutional learning and water governance in both Chile and Canada, based on the findings of vulnerability assessments and interviews with related key stakeholders. They conclude that water governance cannot be left to private actors, and that government has an important role to play. *Obeng* and *Agyenim* analyse the institutional development approaches that may be adopted to enhance the capacity of developing countries to adapt to the consequences of climate change. The chapter dwells on experiences in Ghana to discuss national and local institutional reforms as well as international cooperation.

Examining climate adaptive planning at the local level, *Rosenthal* and *Brechwald* describe formal strategies that have developed for coping with the current problem of heat-related ailments in New York City and for reducing future impact. In particular, they discuss the policy-making process and the work of the NYC Climate Adaptation Task Force during their initial planning from 2008 through to the spring of 2010. Focusing on the goal of local energy autonomy, *Radzi* and *Droege* consider ways in which local communities can act through local government and public authorities. Based on three case studies, they identify factors that are fundamental to achieving common energy goals. These are: individuals organising themselves to adopt a lifestyle based on renewable energy, local authority and legislative frameworks fostering and supporting these efforts, community involvement, public–private partnership and powerful research evidence combined with a strong regional commitment. Against the background of the case studies presented in the different chapters, *Stead's* contribution examines the validity and function of best practice for urban policies on climate change and sustainability. On the basis of a survey of four European cities, his conclusions review evaluation techniques, transferability and the presentation of best practice. He suggests that, as an alternative to best practice, common principles, such as strengthening the multi-level governance of climate change, may be worthy of examination and testing.

Finally, Part III involves a set of case studies on climate change governance, with an emphasis on business-related and technical approaches. *Karakosta*, *Doukas* and *Psarras* focus on energy technology transfer in Kenya. The authors present a decision support methodological approach, which enhances the technological needs assessments already applied, as well as the results obtained from detailed stakeholders' assessments in Kenya. *Jallow* assesses the mechanisms that allow companies to manage and then report on their climate change activities and emissions. The chapter is a review of current processes in climate change management and reporting, and discusses options available to companies, particularly in Europe and North America. *Ioannis*, *Konstantinos* and *Leal Filho* explore the strategies adopted by a sample of Greek businesses in relation to climate change mitigation and adaptation issues, such as voluntary involvement, emission trading, technical solutions and carbon reduction management. The findings are based on an analysis of Corporate Social Responsibility (CSR) reports. *Gil-Saura*, *Ruiz-Molina* and *Berenguer-Contrí* present findings on the subject of environmentally friendly technologies in hotels. A description of the actions implemented by different Spanish governance institutions is provided. This is discussed in the context of tourism in Spain.

We would like to thank all authors for making their experiences available in these chapters and their willingness to share their ideas. The authors have, by documenting and sharing their knowledge, provided an important contribution towards the debate on climate change governance, a matter of great relevance to countries, regions and cities alike. We hope that providing this platform for the debate on climate change governance may contribute to a broader debate on these issues.

This book is meant to inform, inspire and engage not only members of the scientific community, but also local authorities and practitioners, in the debate on how the principles of climate change governance may be related to implementation in cities and regions as well as initiatives for businesses and individuals. We hope that this book will serve the purpose of documenting and disseminating current initiatives in climate change governance, and also pave the way for creative new ways of tackling climate change.

Reference

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Part I
Theoretical and Conceptual Framing of Climate Change Governance

Conceptualising Climate Change Governance

Jannes Fröhlich and Jörg Knieling

Abstract The projected impacts of climate change, not only flooding and the urban heat island, but also gradual changes, such as biodiversity loss or a reduction in the groundwater level, can become societal problems. The complex inter-relationships between stakeholders and societal coordination can be included under the term "governance". The attributes of climate change governance will be outlined in this chapter. Attention is focused on societal scopes for designing and regulating climate change. Firstly, the specific demands for climate change governance are presented. Subsequently, the term governance is introduced, together with its various applications, and the different approaches and concepts regarding climate change governance are discussed. The conceptualisation of climate change governance is based on this spectrum. As this paper discusses, climate change governance is not an entirely new concept, but one that has many parallels with existing models for governance in other settings. Nevertheless, a re-evaluation of its role in this context still appears reasonable since climate change-related measures are characterised by specific features requiring their own regulatory framework. This includes the cooperation of different institutions and actors in addition to hierarchical forms of regulation, and describes the development of self-organising structures. Climate change governance can therefore be described as a broad range of options of coordination concerning climate change adaptation and mitigation.

Keywords Climate change governance · Attributes of climate change · Governance concepts · Spatial planning · Regional planning

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1 Introduction

Public and political interest in climate change has increased in recent years. The fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC) emphasises that severe consequences for humanity and nature in miscellaneous areas are to be anticipated (cf. IPCC 2007). The prevention of greenhouse gas emissions (mitigation) as well as adaptation to the impact of climate change is as significant as each other. The necessity for mitigation, which is widely accepted in society and the management of the impact of climate change, should be treated as an increasingly coequal challenge, since the existing capabilities for adaptation to climate change are unsustainable in the long term. Therefore, action needs to be taken to improve society's resilience to climate change (cf. Adger et al. 2005; Adger and Vincent 2005: 400; Folke et al. 2002: 438).

The possible impacts of climate change may lead to societal problems, especially where homes, industries, harbours or other developed areas are located. The multitude of possible impacts and their effects reveal the number of stakeholders, spheres of activity and interests affected by climate change. As a result, climate change policies require cooperation between different parties, and extend across several policy and sectoral planning areas (cf. Winsvold et al. 2009: 477f). Flooding and coastal protection, urban planning, nature conservation and agriculture—to name just a few important fields—are facing the challenge of developing strategies for coping with the wide-ranging anticipated future impacts of climate change.

The complex inter-relationships between stakeholders and societal coordination processes can be classified under the term "governance" (cf. Benz 2004: 12; regarding climate change, see Dietz 2007: 162). In this process, the role of state, civil society and economy, as well as forms of coordination and regulation, need to be aligned alongside sector-specific perspectives on varied policy areas and corresponding sectors (cf. Benz 2004: 14, 2005: 405; Olsen 2009: 257–258). Therefore, it emerges that governance of climate change incorporates a multitude of structural and regulatory forms across a variety of different stakeholders (cf. Mayntz 2004b; Benz 2005; Heinelt and Kübler 2005; Kooiman 2003).

The attributes of climate change governance will be outlined in this chapter. Which features are characteristic for the approaches and strategies of climate change governance? Attention is focused on societal scopes for the design and regulation of climate change. Firstly, the specific demands for climate change governance will be presented (Sect. 2). Subsequently, the term governance will be analysed across its various applications with a review of the current discussion around different approaches and concepts regarding climate change governance (Sect. 3). This spectrum is the basis for a conceptualisation of climate change governance (Sect. 4).

2 Specific Demands for Climate Change Governance

A profound understanding of climate change as a global environmental and societal challenge is the central requirement of climate change governance. Solutions in the field of mitigation and adaptation to climate change can hardly be successful without an understanding of the structure of the problem. This hints at the prerequisites, namely collaborative and logical actions by participating stakeholders and policy-makers who shape mitigation and adaptation. This context of climate change governance refers not primarily to the natural sciences, but to the socio-scientific dimensions of climate change (cf. Jänicke et al. 2000: 81; Foxon et al. 2008: 3), and will be more clearly outlined in its requirements in the following sections.

Boundary-, level- and sector-comprehensive requirements: Organisational expertise does not usually match climate and geographic units. Therefore, climate change governance needs to shift away from existing norms and adopt an overarching perspective of the contributory factors (cf. Greiving and Fleischhauer 2008: 62; Ritter 2007: 535; Frommer 2009: 129). Moreover, the interaction of different geographical areas and their policy-makers needs to be considered. Important frameworks for initiatives at regional and local levels are being established both globally (e.g., the United Nations Framework Convention on Climate Change) and nationally (mitigation and adaptation programmes and strategies). At the local level, planning and implementation competencies frequently converge. As a result, the coordination and acceptance of mitigation and adaptation are essential. Climate change governance requires a coordinated approach at various levels (cf. Ostrom 2010), in which the typical communication problems between levels need to be tackled. Mitigation and adaptation affect multiple sectors. Mitigation, defined as the prevention of greenhouse gas emissions, is a responsibility for various sectors, especially energy, traffic and agriculture. Adaptation particularly affects health (urban heat island effect), water management and flood protection (precipitation, flooding and storm surges) and urban development (overheating, lack of aeration). Climate change considerations, therefore, do not sit neatly within one specific area of expertise. Comprehensive, coordinated strategic approaches are necessary in order to balance and integrate different claims and to avoid or minimise conflicts of aims.

Diversity of stakeholders: As might be expected with the multi-level, cross-sectoral nature of climate change, multiple stakeholders are involved. A key characteristic of climate change is its multiplicity of different perspectives and interests. This variety implies that there cannot possibly be just *one* adequate form of governance, nor can there be just *one* ideological programme or *one* ideal policy, but rather a broad variety of approaches and solutions. This variety can constrain the options for action, impede consensus and lead to suboptimal outcomes of negotiations (Gupta 2007: 461). However, the discussion about the allocation of responsibilities and duties among governmental, private and civil societal stakeholders in terms of the implementation of mitigation and adaptation has already begun (e.g. Storbjörk 2007; Lemos and Agarwal 2006: 315). Within this, private households need to contribute as well as local authorities and businesses (cf. Hecht 2009: 162; Ostrom 2010: 27ff). Beyond that, non-governmental organisation (NGO) stakeholders play an important role by communicating with the public and informing policy, for example, through the media or awareness-raising, and can work as advocates of climate change initiatives. Acknowledging this potential, NGOs should be integrated and utilised. Climate mitigation and adaptation calls for new state, economic and civil society structuring.

Longevity: Any broad-based awareness-raising issues regarding the process of climate change are frequently thwarted by the long-term nature of the impact of climate change. Long-term guidance requires intergenerational thinking (cf. Biermann 2007: 330). A time frame of as many as several decades, or even centuries, between emissions and consequences and impacts can exceed existing planning and decision-making periods. This long-term thinking is at odds "with a 4 year electoral cycle, the 2 or 3 year tenure of ministers and senior officials, and the daily or weekly rhythms of everyday politics" (Meadowcroft 2009: 4). In spatial planning, for instance, regional and land use plans have a validity period of 10 to 15 years, while climate projections mostly refer to a timeframe of 50 to 100 years (cf. Ritter 2007: 537; Fleischhauer and Bornefeld 2006: 169). This indicates that established planning instruments and regulatory arrangements do not match the time horizons used for model calculation in climate research. This poses, amongst others, the question of democratic legitimacy in intergenerational policies, in other words, what authority and responsibility do current generations have over future generations (cf. Biermann 2007: 330). To prepare for these long-term consequences, increased efforts in "proactive" mitigation and adaptation, in which climate change is not reacted upon in a reactive, but in an anticipatory manner, are necessary (cf. Kropp and Daschkeit 2008: 356).

Uncertainty: The particular challenge in formulating and implementing mitigation and adaptation strategies and measures is due to its considerable uncertainty. Although there is an understanding of climate change, uncertainties concerning the sensitivity of the climate system, regional climate impacts and the consequences for socio-economic and ecosystems still remain (Meadowcroft 2009: 4). Thus climate research, as well as politics and administrations, frequently refer to this fact. Nonetheless, decision-makers frequently lack knowledge of systematic and intentional decision-making in face of uncertainty (cf. Zebisch et al. 2005: 175). This is due to both the multifaceted options for action and the frequent vagueness of climate projections (cf. Kropp and Daschkeit 2008: 357). This scope of climate projections and the subsequent disparity in scientific climate opinion are in conflict with the logic and formality of decision-making (cf. Fröhlich 2009: 332–345). Consequently, a process-oriented approach that is sufficiently flexible to adapt to modified knowledge and changing framework conditions is required (cf. Biermann 2007: 330). The implementation of a comprehensive concept with definite proposals is no longer the focus. In fact, the aim is to "make a range of subsequent strategic decisions, which offer respectively different solutions" (Ritter 2007: 536).

3 Understanding of Governance

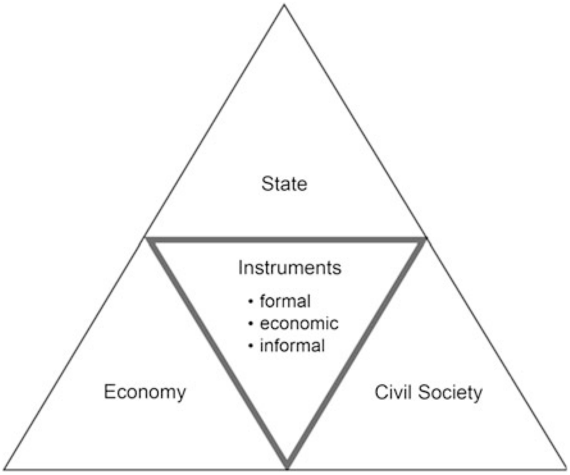
What exactly is meant by the term governance? This question arises because governance is both a "dazzling" (Benz et al. 2007: 10) and an "acknowledged ambiguous term" (Blumenthal 2005: 1149). In many cases, the meaning of governance remains unclear. In a narrower use of the term, governance is the antonym of government and signifies "softer" forms of regulation (see, for example, Pierre 2002) that are not characterised by hierarchical government decisions, but through the inclusion of private stakeholders in problem resolution processes. Governance, in this narrower definition, stands for the blurring of boundaries between state and society (cf. Benz 2004; Bröchler and Blumenthal 2006; Mayntz 2006; Schuppert 2008).

In a wider use, the term governance is not the antonym of government, but a generic term defining the entity of "all co-existing forms of collective regulation of societal circumstances: from institutionalized civil society self-regulation through various forms of cooperation between public and private stakeholders to sovereign action by governmental stakeholders" (Mayntz 2006: 15). In this broad definition, governance is seen as a generic term for the coordination of social actions and not as a distinction from hierarchical regulation or control (cf. Mayntz 2004a; Benz 2005; Heinelt and Kübler 2005; Schuppert 2008).

Based on this broad understanding of governance—from an analytical point of view—the term governance is a perspective on a complex reality (cf. Benz 2004: 12; Benz et al. 2007: 13). This perspective helps to facilitate the survey of multi-layered political and social contexts, as they can be observed in the field of mitigation and adaptation to climate change (cf. Dietz 2007: 162). In addition to this analytical understanding, the concept of governance is also used as a basis for normative statements. This "good" governance refers to societal norms and values, such as the democratic responsibility of governments or the transparency and independence of politics and administration towards interest groups. Governance is frequently used as an applied concept when it comes to governing techniques. These techniques can be derived from normative criteria, but are primarily described in connection with the management of interdependencies, networks and negotiation systems, and less formal decision-making competencies (cf. Benz et al. 2007: 14f).

The term governance refers in many cases to the instruments of an arrangement (cf. Zürn 2008: 556); wherein instruments can be defined as the options available for the realisation of societal aims (cf. Jänicke et al. 2000: 99). The state is not the only stakeholder in the creation, determination and implementation of instruments in governance arrangements, but civil society and/or private actors are involved in the regulation of societal circumstances as well (Fig. 1). Governance, therefore, is connected with a wide range of regulatory and non-regulatory instruments that are being proposed and initiated by non-state actors (cf. Jordan et al. 2007: 285). A basic distinction is made between formal and informal instruments, especially within planning sciences. Classic formal planning tools, such as land use and

Fig. 1 Stakeholders and instruments as dimensions of governance (adapted from Jordan et al. 2007: 285; Zürn 2008: 556)



development plans, are opposed to informal—or "soft"—instruments like regional conferences (cf., for example, Knieling 2003; Danielzyk and Knieling 2011: 466; Priebs 1998: 206, 212). Informal instruments frequently rely on communication (information, participation, cooperation) and are conducive to comprehension and mediation (cf. Selle 2000: 98; Sinning 2003: 56). The range of formal or regulative instruments includes sovereign/legal instruments, such as coordinating and integrating spatial planning, landscape planning and sectoral planning, as well as aims methods and arrangements based on laws, programmes and concepts. Economic instruments, such as taxes and subsidies, are another group of instruments that can be considered competitive (cf. Soltwedel 2005: 627; Braun and Giraud 2009: 178). Unlike formal and informal instruments, there is an additional control effect due to competitive and economic incentives (cf. Stavins 2000: 33; Eising and Lenschow 2007: 332; Braun and Giraud 2009: 165f).

In conclusion, the outlines of the concept of governance emerge on an abstract level. However, due to various aspects of existing knowledge, governance is a fuzzy concept. Within this vagueness lies opportunity, as the term is sufficiently indistinct, allowing it to be used in a variety of disciplines and contexts.

4 Climate Change Governance

There is a multitude of analytical, normative and practical governance approaches in social and planning science literature (e.g., Benz et al. 2007: 13). Connecting factors for climate change are, amongst others, found in the works of Adger (2001); Betsill and Bulkeley (2006); Adger et al. (2009) and van Nieuwaal et al. (2009). Other approaches focus on implementation in consideration of certain levels and territories, such as regional or local governance, or in matters of certain functions or issues, including environmental governance, earth system governance or risk governance (cf. Jänicke and Jörgens 2009: 156; Biermann 2007: 329; Renn 2008a). All governance and management approaches mentioned here focus on the complex and unpredictable contexts and the change processes of social, ecological and atmospheric systems. In the following, selected governance concepts that can be applied to the challenges of mitigation and adaptation to climate change shall be discussed. For this purpose, the characteristics of climate change governance, as presented in this chapter, will be used as an assessment framework. These characteristics represent normative points of reference along which contours of climate change governance appear.

4.1 Cross-Boundary, Multi-Level and Multi-Sector Requirements

Climate change makes cross-boundary demands on its governance. Approaches, which refer to complex, generally global environmental problems with cross-boundary impacts, have been discussed as *environmental governance* (e.g., Lemos and Agarwal 2006; Jänicke and Jörgens 2009). As an approach for analysis, environmental governance is favoured because of the necessary consideration of the territorial or spatial reach of the examined environmental issues. In practical terms, instruments, processes, mechanisms and organisations can be used as part of environmental governance in order to improve the environmental conditions, in conjunction with public, private and civil society stakeholders (cf. Lemos and Agarwal 2006: 298).

Coastal governance focuses on the coast as a geographical area. In connection with the concept of Integrated Coastal Zone Management (ICZM) (e.g., Kannen 2000; Daschkeit 2007), institutional processes and structures can serve as a basis for planning and decision-making processes in coastal areas or river estuaries. In order to reduce negative environmental impacts, coastal governance is seen as a framework for the coordination of human activities in the coastal zone (cf. Olsen 2009: 263). This applies to both mitigation and adaptation. Coastal governance is based on a cross-sectoral and cross-level, as well as a process-oriented approach, since the problems of coastal zones are being observed integratively and across the borders of certain planning professions. The integrated and process-oriented approach is significant for climate change governance. In addition to sovereign-legal instruments, informal instruments gain relevance when it comes to bringing interests in line within the coastal zone or estuary (cf. Olsen 2009: 259f).

Besides the cross-border impacts of climate change governance, there are also the different forms of regulation on political and administrative (planning) levels (global to local). The concept of *multi-level governance* depicts the fact that "in an institutionally differentiated political system, different levels are interdependent and their decisions need to be coordinated" (Benz 2007: 297 with reference to

Scharpf 2000). The term level usually refers to territorial units, such as communities, regions and federal or national states. The view on climate change and climate policy from the perspective of multi-level governance can highlight the interwoven multi-level processes and structures in the field of conflicts regarding climate change (cf. Brunnengräber 2007: 208; see also Brunnengräber in this book).

Multi-level governance thus includes not only the structure of multi-level organisation, but also the patterns of interaction and coordination systems within and between different levels (cf. Benz 2007: 298). Especially in environmental and climate policy, a mutual dependence between policy levels has emerged through international agreements, such as EU law, which acts at the nation state level and, consequently, at the country, region and municipality level, too. Climate change governance therefore occurs within a complex web of stakeholders, governmental as well as private, operating at different levels and with their mutual influence (cf. Jänicke and Jörgens 2009: 160).

Although climate change affects different levels, the role of local and regional contexts in the successful development of mitigation and adaptation strategies is regarded as highly important (cf. Adger et al. 2007: 728). Local governance arrangements boost the commitment and participation of stakeholders, in particular, in coping with communal tasks and problems (cf. Schwalb and Walk 2007: 7). However, adaptation and mitigation take place in an overlying regional context of geographical, political, economic and social conditions. In addition to the local level, the region, therefore, offers an appropriate complementary level for the implementation of adaptation strategies (e.g., German Bundestag 2008: 4f; RPV 2011).

The approach of *regional governance* focuses on the question of how developmental processes at a regional level can be realised in an increasingly fragmented world (cf. Fürst 2004: 351, Fürst 2007: 354f; Knieling 2006: 72). The region is considered as a link between different levels, sectors and between public and private actors (cf. Schmitz 2005: 965). The term regional governance depicts “complex regional control and coordination structures and incorporates formal and informal elements, governmental and private stakeholders, and hierarchical, competitive and cooperative stakeholder relations” (Benz 2001: 55). Examples of corresponding regional cooperation include inter-municipal cooperation, urban networks, regional Agenda 21 processes, regional development concepts, regional innovation strategies, and so on (cf. Knieling 2006: 72).

Furthermore, multi-sectoral governance approaches are used in the management of cross-sectoral issues. Climate change is meaningful for different policy sectors and sectoral planning. The integration of mitigation and adaptation issues in different sectors and the accordant polices is a central mechanism of climate change governance. It was indicated as early as the 1970 s (under the keyword “cross-sectoral policy”) that there is a demand for the integration of environmental issues into other sectors. In recent years, similar demands have been discussed under the concept of “mainstreaming”, meaning that climate issues have to become integral aspects of sectoral policies (e.g., Swart and Raes, 2007).

Cooperative forms of control can account for this since they improve horizontal policy integration (cf. Jänicke and Jörgens 2009: 169, 171f.). Integration of climate concerns is about the internalisation of responsibilities in the relevant policy sectors. The sectors need not necessarily be the perpetrators of climate change, but, due to their sectoral expertise (e.g., in urban development, energy, water management, agriculture, health) and resources, they are in a position to develop mitigation and adaptation strategies and to both measure and implement them.

4.2 Multi-Agency Setting

Another relevant feature of climate change is the variety of actors and spheres of activity. Governance approaches related to climate change refer to the cooperation of versatile actors. Different approaches, such as earth system governance, environmental governance and participative governance, identify the cooperation of stakeholders in handling environmental issues (cf., for example, Biermann 2007: 328, p. 23; Walk 2008: 14; Jänicke and Jörgens 2009: 169, 171f).

Earth system governance aims at influencing human-environment relations. The approach identifies suitable forms of regulation in addition to traditional hierarchical state activity. It implies private–public cooperation and new forms of multi-level policy in solving societal problems. Earth system governance "is marked by the participation of a myriad of public and private non-state actors at all levels of decision making." This actor constellation ranges from "networks of experts, environmentalists and multinational corporations to agencies set up by governments" (Biermann 2007: 329).

Furthermore, the debate around *environmental governance* indicates that environmental problems are identified by social perception and definition. Alongside this, the discourse between science, policy and media is relevant for the perception of the environmental problem (cf. Biermann 2008: 23). In the context of mitigation and adaptation to climate change and demands on governance arrangements, attention is also drawn to the interaction between different groups of actors: "This will require a partnership model of governance combining public, private and civil society into new coordinating arrangements, which will help to address the tension between national strategic frameworks, and local flexibility for delivery" (Nicholson-Cole and O'Riordan 2009: 380). For instance, as pointed out earlier, this partnership is manifested in coalitions of NGOs and media actors campaigning for climate change.

The participation of various civil society groups is particularly being pointed out in *participatory governance* approaches (cf. Walk 2008: 14). The underlying assumption is that participatory governance arrangements improve the quality of policies and their implementation. However, they cannot be a substitute for political decision-making. Furthermore, a necessary outcome is for cooperative forms of regulation to create a sense of higher legitimacy and effectiveness in the decision-making process and results achieved through the involvement of private stakeholders and the civil society in addition to the public sector. As well as the benefits associated with participatory forms of governance (e.g., transparency, grass-root connections, legitimacy, adequacy to the problem), sceptical questions about the actual effectiveness of different forms of governance and the conditions for success and legitimacy of governance are on the research agenda. It often remains unclear from an empirical perspective how legitimate, imputable and fair different participatory governance forms actually are (cf. Zürn 2008: 577; Offe 2008: 71; Palumbo 2010: xii). Accordingly, it must be identified for the individual case how participation processes can make a contribution and how they can be designed to improve the development and implementation of mitigation and adaptation measures.

4.3 Long-Term Challenges and Uncertainty

Long periods of time pass between the origins of anthropogenic climate change, greenhouse gas emissions and actual changes in the climate and their consequences. Therefore, climate change governance requires cross-generational thinking, which usually surpasses the existing responsibilities and decision periods in policy and planning, and therefore poses a significant challenge (cf. Biermann 2007: 330).

The *earth system governance* approach draws on the aspect of interdependence between generations as the challenges in dealing with environmental change. Due to the long-term nature of climate change, climate change governance is also required to offer a stable planning horizon for several decades, and often generations (cf. Biermann 2007: 330f). However, there lies a tension between requirements for stability and the need for flexibility and ability to take action. The latter are classified as the most important requirements of climate change governance due to its uncertainty. Governance arrangements should therefore be able to react flexibly to new scientific findings and changing stakeholder relationships, and consider these in spite of the long-term nature of climate-related planning (cf. Biermann 2007: 331).

The *risk governance* approach deals with the characteristics of complexity, uncertainty and ambiguity (Renn 2008a, b) which exist with regard to the possible, but not exactly predictable, future impacts of climate change. Uncertainties may complicate decision-making, and this underlines the importance of cooperation and coordination in the public and private sectors. Risk governance aims to make collective decisions about risks, brought about through interactions between science, politics, administration and society (cf. Renn 2008b: 9). Policy-makers and administrators are not the only participants in mitigation and adaptation, but also additional institutions, both public and private, enter into a preferably non-hierarchical discourse in order to be accepted and achieve decisions supported by all parties (cf. Greiving and Fleischhauer 2008: 65).

Further concepts that relate to the adaptive capacity with regard to modified overall conditions are *adaptive governance* (cf. Brunner et al. 2005; Guerin 2007; Nelson et al. 2008) and *adaptive (co-)management* (cf. Jiggins and Röling 2000; Olsson and Folke 2004; Arvai et al. 2006). Central to these concepts are societal, self-organised processes that occur within an overreaching framework of rules and incentives (cf. Olsson and Folke 2004: 87). An important assumption of adaptive management is that the ability to predict future changes in ecological systems is limited. Management practices should therefore be flexible and adaptable, while past experiences and learning processes (cf. Pahl-Wostl 2007: 51) and local context-related knowledge should be taken into account (cf. Nelson et al. 2008: 589f). Adaptive management also aims to strengthen the relationship between science and decision-making in order to facilitate evaluative questions that relate to complex problems with high levels of uncertainty (cf. Arvai et al. 2006: 218).

4.4 Attributes of Climate Change Governance

Climate change governance is not aligned to administrative boundaries; instead it is structured around geographical characteristics. Appropriate regulatory arrangements and instruments are often based on landscapes (e.g., coastal zones, estuaries) and cultural areas. Often they are located on or between different political and administrative levels (e.g., municipalities, regions, nation states and at international level). Climate change governance is also characterised by a multi-sectoral approach.

The integration of climate adaptation and mitigation in different sectors (e.g., energy, urban planning, water management, agriculture, health) takes places in different ways. It can occur through dialogue, financial incentives or coercion. The resulting interaction and coordination requirements between different actors within and between activity levels and disciplines need different forms of regulation and instrument types (Fig. 2). Therefore, one can characterise climate change governance through a regulatory mix, which includes statutory hierarchical forms of regulation as CO_2 emission limits, zoning maps, planning approval procedures or city development contracts contributing to a climate-sensitive form of governing (cf. Fleischhauer and Bornefeld 2006: 161). Economic and competitive forms of regulation are also capable of influencing the behaviour of actors towards climate-friendly development and sustainable orientation. Competition can both mobilise actors through financial incentives and trigger regional dialogue and cooperation. Informal instruments, such as regional competitions, contribute to awareness-raising and the mobilisation of local actors (cf. Buchholz and Riechel 2009: 147f). As a result, competition can be both an informal tool and an economic strategy. In addition to the hybrid form of competition, other informal instruments, such as municipal and regional adaptation and mitigation strategies and programmes, regional conferences, urban and regional development forums and workshops, enhance problem-solving capacity and the quality of implementation of societal

Formal instruments	Economic instruments	Informal instruments
for instance:	*for instance:*	*for instance:*
Regional development plans	Land use taxes	Development concepts (local, regional)
Land use plans	Soil sealing charges	Development scenarios
Zoning plans	Water charges	Mission statements (*Leitbilder*)
Urban planning agreements	Tradeable land use rights	Area management (local, regional)
Plan approval procedures	Certificates	Networks
Environmental impact assessments	Climate standards	Aggregate liability indices
Strategic environmental audits	Incentive systems	Climate proofing
	Climate labels	Climate agencies
		Flood protection associations

Fig. 2 Instruments of climate change governance (own illustration 2010)

mitigation and adaptation processes. They contribute to accounting for different perceptions and the conflicting interpretations of actors. They also contribute towards improving understanding and communication between actors (cf. Sinning, 2003: 56). Exemplary in the field of adaptation are the specific organisational groups, such as flood protection groups or neighbourhood communities in flood-prone areas. They increase the awareness of the affected population in terms of flood prevention, such as structural adjustment, private provision and participation in the planning of flood protection measures (cf. Schaerffer 2009: 263).

A long-term, intergenerational perspective is an essential feature of climate change governance, since periods of 50–100 years and more are taken into account. Today's generations take precautions for future generations (cf. Biermann 2007: 330f.) and thus have the responsibility for mitigating and adapting to climate change in the future. Therefore, governance structures and planning horizons must be stable, while mitigation and adaptation strategies need to be sufficiently flexible and revisable, because the scope of decisions are subject to considerable uncertainty. Multi-functional land use (e.g., the joint use of green areas for water retention during heavy rain events) can be implemented with the help of determination in formal development plans. But at the same time, they offer the possibility of reacting flexibly and dynamically to changes by providing buffer capacities.

In addition to risk maps, development scenarios and models, which support formal planning processes in this regard, "climate proofing" of development proposals are currently being discussed in order to promote the resilience and adaptive capacity of climate change impacts. As a procedural instrument, climate proofing aims to consider possible future climate changes concerning the development and approval of programmes, plans and projects (cf. Birkmann and Fleischhauer 2009: 123). In doing so, climate proofing fosters an integrated view of climate concerns in development planning.

In summary, climate change governance includes a wide spectrum of steering mechanisms. It includes the cooperation of different institutions and actors in addition to hierarchical forms of regulation, and describes the development of self-organising structures. Climate change governance can therefore be described as a broad range of forms of coordination concerning climate change adaptation and mitigation (cf. Mayntz 2004b; Benz 2005; Heinelt and Kübler 2005; Kooiman 2003; Olsen 2009: 257f).

5 Conclusion

Mitigation and adaptation to climate change are a cross-boundary, multi-level, multi-sectoral and multi-actor challenge with the specific characteristics of longevity and uncertainty. Therefore, many different sectors, strategies, actors and interests are affected. Through the term "governance," these complex relationships of levels, sectors and stakeholders can be analysed as well as described and conceptualised through normative statements and practical solutions. With regard to the characteristics of climate change, contours of climate change governance can be appointed based on the concepts discussed.

In light of these theoretically obtained derivations, further research might examine the mix of policy and planning instruments for climate change governance based on the example of specific regional and local contexts. It is of particular interest how various forms of regulation interact and what interdependencies may be revealed. In addition, the empirical analysis should explore the different interests and logic behind the actions of affected stakeholders to identify and categorise options for future mitigation and adaptation strategies and measures.

As this chapter shows, climate change governance is not an entirely new concept, but includes many parallels to existing governance approaches referring to other policy fields. Nevertheless, separate consideration still appears reasonable since climate change-related governance approaches are characterised by specific features, requiring a fresh look at regulatory arrangements.

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Governance of Wicked Climate Adaptation Problems

Catrien Termeer, Art Dewulf and Gerard Breeman

Abstract Climate change adaptation has been called a "wicked problem par excellence." Wicked problems are hard to define because 'the formulation of the problem is the problem; they are considered a symptom of another problem; they are highly resistant to solutions and extremely interconnected with other problems. Climate change problems are even more complex because they lack a well-structured policy domain, and knowledge about climate change is uncertain and contested. Given the wicked characteristics of the climate issue and its particular challenges, the question is which theories are useful starting points for the governance of climate adaptation? The chapter distinguishes between theories and concepts that focus on reflexivity, on resilience, on responsiveness and on revitalisation. Instead of integrating these theories in one overarching governance approach, the chapter suggests an approach of theoretical multiplicity. It proposes that exploiting the variety of concepts and strategies based on the different theories can increase the governance capacity to deal with climate change. Finally, it addresses the moral dimension of wicked problems, which suggests that it is unacceptable to treat a wicked problem as though it were a tame one. Governance scholars nowadays risk raising expectations far beyond their ability to deliver, and thus enhance confusions over whether wicked problems are in fact tame ones.

Keywords Adaptation · Climate change · Wicked problems · Governance · Strategies

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1 Introduction

There is increasing recognition of the need for society to adapt to the impacts of climate change. Climate change adaptation is defined as “the adjustment in natural or human systems in response to actual or expected stimuli, which moderates harm or exploits beneficial opportunities” (IPCC 2007). Adaptation to climatic impact involves both infrastructural adjustments, such as enhancing dykes or creating water storage capacity, and broader processes of societal change, such as adjusting land use planning, more efficient water use or agricultural transitions. Because of the many uncertainties surrounding climate change issues, actors are facing the challenge of developing and implementing adjustments and transitions, and of increasing the adaptive capacity of society to deal with unexpected future changes.

Climate change adaptation poses many complex governance questions and has therefore been called a “wicked problem par excellence” (Davoudi et al. 2009; Jordan et al. 2010). This has serious consequences for the governance questions that emerge in connection with climate change. This chapter provides a theoretical analysis of the governance of wicked climate problems. It describes the characteristics of wicked problems and the specific challenges of climate adaption policies. Subsequently, a broad overview of theories is given that are useful for addressing wicked climate problems. It concludes with reflections on selecting theories and with addressing the moral responsibilities of scholars.

Rittel and Webber (1973) introduced the concept of wicked problems to distinguish between problems that are tameable and those that are intractable. The adjective ‘wicked’ does not refer to witches with malicious intentions, but is used to characterise a problem, in a meaning akin to malignant, vicious, tricky or aggressive (Rittel and Webber 1973: 160). The concept has been used and elaborated upon by many governance scholars (Head 2008; Roberts 2000; Van Bueren et al. 2003; Weber and Khademian 2008; Wexler 2009). They developed a number of characteristics that can be summarised in four main categories (Rittel and Webber 1973):

First, wicked problems are hard to pin down because “the formulation of the problem is the problem” (Rittel and Webber 1973: 161). There is no consensus on how to frame the problem or the solution. Rather than being a single problem, a confusing mess of inter-related problems presents itself. Depending on how you look at the situation, different aspects of this “mess” emerge as triggers, root causes, effects, priorities, side effects or leverages for intervention. The clarity created by one analysis of the problem can easily be blurred by new developments or by asking other actors to present their analysis of it. Paradoxically, each attempt at creating a solution changes the understanding of the problem.

Second, every wicked problem can be considered a symptom of another problem (Rittel and Webber 1973: 165). Through their multi-dimensional and interconnected characteristics, wicked problems involve causes and effects at multiple scales of time and space. These waves of consequences cannot be anticipated beforehand, and correcting their negative effects can become a wicked problem in itself. Every action can have unpredictable consequences due to the inherent incomplete understanding of problems. Surprises, fluctuating conditions, sudden changes and irreducible uncertainties are fundamental aspects of wicked problems.

Third, wicked problems are highly resistant to solutions. New problems and solutions will emerge continuously. Often, today's wicked problems emerge as a result of trying to understand and solve yesterday's problems. The speed and the amount of topics discussed in wicked problem domains has been increasing due to the onset of the 'information era' in which the media appears to be a major player.

Fourth, wicked problems can induce wicked experiences amongst ambitious governance actors that aim at influencing societal problems. The messiness, uncertainties, interconnectivities and the endless associations that can be made with wicked problems can be overwhelming (Weber and Khademian 2008: 336) and may be experienced as being "frustrating as hell" (Roberts 2000: 2). Governance actors see themselves confronted with wicked problems to which a single solution is the answer. They never know if they are doing well because wicked problems have no stopping rules, and actors can always try to do better. Especially when the situation becomes stressful, actors can revert to more defensive patterns and strategies. This can be counterproductive because strategies that fit within existing policy routines may have served their purpose for tame problems, but do not result in lasting solutions for wicked problems. Instead, they can even result in making things worse.

2 Complicating Characteristics of the Climate Adaptation Problem

Governance of adaptation faces all the usual difficulties, hindrances and opportunities involved in dealing with wicked problems. On top of that, however, adaptation to climate change poses some specific, particularly demanding governance challenges and dilemmas (see, for example, Stripple et al. 2009; Termeer et al. 2011).

2.1 A Context of Fragmentation

Realising successful adaptation strategies depends upon the involvement and collaboration of many interdependent actors with their own ambitions and preferences, responsibilities, problem framings and resources. These actors are to be found in various policy sectors, because climate adaptation affects many different domains as varied as water management, spatial planning, infrastructure, agriculture, energy supply, industry and other economic activities, and in the domains of nature and health. If changing local climates push certain species into new territories, activities such as nature conservation policies, spatial planning and agricultural practices may all be significantly affected. Climate change impacts provoke new interdependencies between these domains. The problem of heat stress in cities, for example, induces new linkages between urban planning and urban health care. A confounding complexity is that climate vulnerabilities are often not easily separated from economic or social vulnerabilities and therefore need to be linked to other societal domains. Furthermore, because climate adaptation cannot be neatly packaged as a uniquely local, national or international task, actors at different administrative levels have to be mobilised. Whilst the variety of local conditions and impacts point towards a prime role for local authorities and regions in climate change adaptation, many impacts require national or international responses as well. Changes in peak discharge levels of transboundary river basins are a case in point.

A dilemma arises when the involvement of an array of stakeholder networks is perceived as giving rise to opposition or delay. In response, more centralised and top-down forms of governance may appear attractive. The key argument in their favour is that fragmented governance structures will never be able to provide the capacity required to tackle such an important issue as climate change. However, this multi-actor, multi-sector and multi-level governance world forms the inescapable context for climate adaptation, because the ramifications of climate adaptation stretch across different policy domains and institutional levels. Furthermore, fragmented networks can also provide the governance capacity to enable climate adaptation (Huitema et al. 2008). Where hierarchical arrangements may ignore bottom-up approaches, and horizontal arrangements may lack the authority to accelerate adaptation processes, operating in the 'shadow of hierarchy' might be a promising concept (Scharpf 1997: 202). This implicates that central government influences the policy processes of decentralised decision-making without being actively involved in it (Gupta et al. 2010).

2.2 The Lack of a Well-Structured Policy Domain

The emergence of adaptation as a new domain of policy and practice is in itself an important process. The emerging field of climate adaptation lacks a well-institutionalised policy domain. Within this institutional void, adaptation is an emerging field with, at least for the time being, only weakly-defined ambitions, responsibilities, procedures, routines and solutions. As a result, a series of basic governance dilemmas have to be (re)addressed in developing the governance of adaptation to climate change. Which ministry or agency is given the responsibility for climate policy in general, and climate adaptation policy in particular? Are existing divisions of responsibilities adequate for tackling climate adaptation issues? Do we need national, international or locally formulated adaptation strategies, or all of these? Is climate adaptation defined as an urgent problem that requires immediate action or as a long-term issue that can be tackled in a step-by-step approach while learning along the way? Should it wait until more knowledge becomes available? These kinds of questions play a role in establishing the emerging policy domain of climate adaptation, and can become the object of bureaucratic struggles about jurisdictions and budget allocations.

Calls for improved policy integration or 'mainstreaming' provoke the question of whether a separate adaptation policy domain is necessary, or whether it is more effective to align adaptation ambitions with existing policy domains and strategies. A related question is whether adaptation programmes are temporary, or whether they have to be structurally anchored and embedded within public bureaucracies. Both seem to be true: specific adaptation policies are necessary, especially to tackle the backlog that has built up in recent years (in, for example, urban retention capacity, river discharge capacity and fresh water supply), but much has also to be invested in making existing policies with regard to mobility, transport, housing, and so on, 'climate proof'.

2.3 Inherent Uncertainty in a Knowledge-Intensive Domain

Decision-making in relation to climate change is knowledge-intensive, and important uncertainties about the nature and scale of risks, and about the effectiveness of solutions will persist. In addition, controversy is inevitable when the many actors involved bring with them a variety of perspectives to make sense of an issue like climate change where the stakes are high (Hulme 2009).

Without systematic observations and advanced mathematical models, awareness of climate change would be very limited. At the same time, important uncertainties about the nature and scale of risks and the effectiveness of solutions will persist (Arvai et al. 2006). Climate change knowledge has, due to its complexity and uncertainty, a particular feature: as data and models are mainly gathered and constructed at a global, or in some cases, at continental or national level, applying this to the level of affected regions requires a huge effort in which one risks multiplying the uncertainties, which can lead to either over-reaction or insufficient action.

As noted above, the many actors involved bring with them a variety of perspectives or frames. Their backgrounds cause them to differ in their overall causal conception of climate change; the assessment of its seriousness and urgency; its risks and impacts at the geographical and political level concerned; the burdens and benefits it may cause, and the normative and political questions of how to legitimately pool or allocate these risks, burdens and benefits. Conflicting frames were thrown into particularly sharp relief in the recent international climate science controversies dubbed 'climategate' (Nerlich 2010), which affected national climate debate and potentially complicated regional climate policies. Both traditional and new media played an important role in giving voice to climate sceptics (called climate 'deniers' by their opponents), creating the particularly challenging situation for climate adaptation policy that the very existence of climate change and/or human influence were called into question.

Clearly, both the uncertainties and ambiguities ascribed to the climate change issue affect the perceived legitimacy of climate science and climate adaptation policy in particularly challenging ways. In spite of these inherent uncertainties, decisions about adaptation strategies need to be taken or prepared now. This may be referred to as the timescale dilemma. On the one hand, it is necessary to anticipate future developments, which are (highly) uncertain. On the other hand, there are strong pressures to give priority to economic interests in the short term. Therefore, to combine long-term ambitions with short-term urgencies is an important challenge. A further complication is the different timeframes of physical, economic and political processes, which are difficult to align. And, finally, short-term interventions based on a long-term vision demand a specific and enduring commitment by taxpayers, politicians or residents.

3 Useful Theories for Addressing Wicked Climate Adaptation Problems

Given the wicked characteristics of the climate issue, and the particular challenges of dealing with fragmentation, an emerging policy domain and unpredictable changes, which theories are useful starting points for the governance of climate adaptation? In the realm of academia, there has been a sizeable growth in the number of publications dealing with wicked problems (Head 2008; Klijn and Koppenjan 2000; Roberts 2000; Termeer and Kessener 2007; Weber and Khademian 2008) and on the governance of adaptation to climate change (for an overview, see Nieuwaal et al. 2009, Termeer et al., 2011). We distinguish between theories and concepts that focus on reflexivity, on resilience, on responsiveness and on revitalisation. These four concepts address the four different aspects of wicked problems.

3.1 Theories About Reflexivity

Reflexivity refers to evaluating the variety of problem perspectives, to continuously reconsidering dominant problem frames and to bringing about a redefinition of action perspectives. Without reflexivity and, thus, without addressing this variety, there is a risk of tunnel vision further contributing to the wickedness of the situation (Gray 1989).

Framing theories provide insights into reflexivity. Framing studies the process by which decisions, policy issues or events acquire different meanings from different perspectives (Schön and Rein 1994; Chong and Druckman 2007; Dewulf et al. 2009). By highlighting certain aspects of the situation at the expense of others, by drawing different boundaries around the issue and by putting different elements at the core of the issue, people from different backgrounds construct frames about the situation that may differ considerably from how others frame the issues. Confusion, misunderstanding, disagreement or even intractable controversy (Schön and Rein 1994) are likely in situations where participants frame the issues in divergent ways.

Theories like collaborative governance (Gray 1989; Huxham 2000) and network governance (Klijn and Koppenjan 2000; Van Bueren et al. 2003; Roberts 2000) explicitly pay attention to the diversity of perspectives, and both aim to provide strategies to find workable techniques for taking these multiple positions into account and thus to prevent intractable controversies.

Network governance stems from public management, and is defined as governing with and through networks. Networks had been frequently evaluated as barriers to effective, innovative and democratically legitimised policies. The concept of network governance advocates that the potentials of networks could also be used in order to arrive at better policies (Klijn and Koppenjan 2000). Therefore it devised a set of strategies to do so: process management and network constitution. Process management focuses on improving the process within the network, by organising interactions between actors, by seeking the convergence of frames and perceptions, creating temporary organisational arrangements or by managing conflict. Network constitution focuses on changing the institutional characteristics of the network, by changing the actor constellation, redistributing resources, changing the network rules or reframing dominant ideas.

Multi-actor collaboration theory is rooted in organisational theory (Gray 1989; Huxham 2000), and addresses cooperation and negotiation between multiple interdependent actors in the context of a 'wicked' problem domain in which they all have a stake. Gray (1989) defines collaboration as "a process through which parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible" (p. 5). It shares some features with process management, but provides much more detailed and advanced insights on how to facilitate collaborative processes.

3.2 Theories About Resilience

Resilience refers to adapting to changing and highly unpredictable circumstances, without losing identity and reliability. Without resilience, the governance system can be eroded to the point that a small disturbance provokes a failure to keep fulfilling basic functions. Resilience is a central concept in theories of adaptive governance (Brunner et al. 2005; Folke et al. 2005); resilience management (Walker et al. 2002); adaptive management (Arvai et al. 2006; Pahl-Wostl 2007) and high-reliability organisations (La Porte 1996, Weick and Sutcliffe 2001). These theories assume a world that changes continuously in unpredictable directions. Therefore, the ability to observe well and in a timely fashion is considered as key to governance, as weak signals can predict upcoming disturbance. Through a combination of different types of knowledge (scientific, professional, experiential, indigenous, and so on) and multiple ways of understanding, the awareness of the unexpected can be improved (Brugnach et al. 2009: 3–4, 9).

Adaptive management literature has the ambitious goal of accounting for the inherent complexity and unpredictability of ecosystem dynamics in new governance or management concepts (Folke et al. 2005; Pahl-Wostl 2007). Attempts at managing or steering have to take into account uncertainties and both gradual and abrupt changes. Therefore, learning plays a central role in adaptive management, as a way of keeping knowledge up to date with continuously changing conditions. As not all uncertainties can be 'learned away', another focus of adaptive management is on devising measures or strategies that are robust (remaining functional under a range of different scenarios) or flexible (can be adjusted as needed, or applied only when necessary). Adaptive governance can be seen as the governance context that enables, or at least legitimises, adaptive management strategies. Much attention is paid to improving the adaptive capacity of such governance systems (Gupta et al. 2010). Critical factors for adaptive governance include social networks, social memory, learning to live with change and uncertainty, combining different types of knowledge for learning, creating opportunities for self-organisation and nurturing sources of resilience for renewal and reorganisation (Folke et al. 2005).

3.3 Theories About Responsiveness

Responsiveness refers to dealing with continuously changing policy demands wisely. Applying wisdom means that actors have to balance their responses between different values, such as democracy, effectiveness, continuity, integrity and fairness. Without responsiveness, though, governance actors run the risk of not addressing citizens' concerns and losing their legitimacy.

Responsiveness is a key concept in agenda-setting theories. These theories show that popular interest in policy issues is usually stable and does not change much, but they also show that these stable periods are occasionally interrupted by abrupt major policy changes (True et al. 2007). Although agenda-setting theory highlights the largely unpredictable nature of these fluctuations, they also show some regularity. A sudden rise of attention in media or politics about a certain issue is very often caused by a so-called focusing event, such as a crisis or big organisational failure. Once the policy is changed, or other issues have captured the attention of media and politics, the policy is likely to be drawn back into a new period of stability and incremental adjustments.

If certain issues appear more often in the media and move from the inner pages to the front page, the pressure on politicians to take action increases, and new actors may be mobilised to attack existing policies. However, responding to all kinds of calls for attention, or trying to please all parties in one round of deliberation only increases the input to the policy process, which in turn does not help to cope with the wickedness of the policy problem. It is a challenge to governance actors to discern substantive policy problems, behind the dramatised stories in media and the one-liners in political debates (Stone 2002).

3.4 Theories About Revitalisation

Revitalisation refers to recognising and unblocking counterproductive patterns in policy processes, and thus re-animating actors and enhancing the innovative process needed to cope with wicked problems. Without revitalisation, there is the risk of regression, of futile attempts to apply "more of the same" solutions, and of escalating discussions between people who stick to their own routines (Termeer and Kessener 2007).

Weick's work on sensemaking offers interesting starting points for understanding how governance actors can become stranded in their attempts to cope with wicked problems differently. He considers sensemaking as the root activity when people are dealing with an unknowable and unpredictable world (Weick and Sutcliffe 2001). Faced with wicked problems, people collectively try to understand what is happening, adopt some ideas to deal with it, start to act, create experience through these actions, make sense of it, and so on. However, these social and ongoing processes of sensemaking can become disrupted. Meanings and rules can become self-evident so that it is no longer possible to reflect on them, and we talk about fixations.

Revitalisation is a painstaking process, above all because actors are often not even aware of the stagnated pattern they have fallen into. It requires a systemic perspective to understand patterns, and where they come from, with a focus on details of actual interactions (Putnam 1993). Such patterns can be detected by studying how actors deal with the process, what they say about other actors or groups, what they do not say, who they include and exclude, and how they act towards other groups. This information can be used to construct cause maps (Weick and Westley 1996) or action maps (Putnam 1993) that display the—intended and unintended—interlocking interactions and how mutual actions reinforce each other. Symptoms of stagnation are, for instance, the presence of taboos, repetition of moves, vicious circles, exasperating delays or escalated conflicts.

4 The Value of Theoretical Multiplicity

The aforementioned theories cover a broad terrain, where they partially overlap and potentially conflict. A logical next step would be to try and integrate this variety into a single theory, thereby drawing upon concepts and methods from each of the theories. However, a very complex theory would seem to be needed to face the enormous challenge of coping with the overwhelming wicked problems. We question whether trying to integrate everything into one theory is feasible or desirable. Another option we would like to put forward is an approach that rests on the multiplicity of theories (Termeer and Dewulf 2012). The basic argument is that multiple theories (the ones we discussed here and others) will continue to be needed simultaneously for dealing with the complex societal sustainability issues. Only variety beats variety, also at the theoretical level, which functions as a box of conceptual tools to analyse situations and to design interventions. This does not mean that each of the theories should proceed as if the others did not exist.

This approach can be understood as a meta-paradigmatic approach (Gioia and Pitre 1990) which recognises the value of the distinctiveness of each individual theory and the value of exploring zones where theories overlap or can inform each other, but does not try to integrate everything into one paradigm. We propose that exploiting the variety of roles and strategies based within the different (and partially overlapping) theories can increase the capacity to deal with climate change. This perspective relates to the writing on clumsy solutions that rests on the idea that more ways of organising and thinking exist: each with its particular strengths and weaknesses, none of which should ever be allowed to gain the upper hand" (Verweij et al. 2006: 840).

After all, wicked problems cannot be solved and have no stopping rules. No non-governmental organisation (NGO), business or government will ever be able to definitively solve the climate problem. More realistically, we expect continuous policy change in the climate problem domain with delays and acceleration, with barriers and small wins, rather than sudden change. Accordingly, we believe that the theoretical multiplicity we propose can help to achieve clumsy solutions or small wins, which in the end can transform old routines into new learning (Weick and Westely 1996: 454).

4.1 Reflective Conclusions

This paper conceptualised climate adaptation as a wicked problem par excellence. It showed how many governance scholars (including ourselves) try to develop devices to cope with the wicked climate change problems. However, this development of theories and concepts risks violating the moral principle of wicked problems. This principle reads that it is unacceptable for policy-makers to treat a wicked problem as though it were a tame one or to refuse to recognise the inherent wickedness of a social problem (Rittel and Webber 1973: 161).

The climate change issue shows similarities with what Wexler called the development of a knowledge market surrounding the hype of wicked problems. Building upon Churchman's (1969) work on the moral dimensions of wicked problems, Wexler (2009) argues that these moral aspects are increasingly neglected in this market. Governance scholars nowadays risk causing more confusion in practice over whether wicked problems are in fact tame. They can raise expectations far beyond their ability to deliver. Therefore Wexler (2009: 539) pleads for more responsibility from these scholars who can pose additional risks through false assurances and for more humility regarding the claim of being on the frontier of knowledge.

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Normative Principles for Adaptation to Climate Change Policy Design and Governance

Ieva Bruneniece and Maris Klavins

Abstract Recognising climate change as a highly complicated and basically unstructured problem, the purpose of this paper is to suggest a theoretical frame supplemented with practical elements for adaptation to climate change policy design in the context of the requirements of sustainable development normative principles and criteria. The paper attempts to break the *business-as-usual* approach to policy design and decision-making practice concerning complicated and unstructured problems. The first recommendation for achieving that purpose is the application of a systemic and analytical approach to the elaboration process of adaptation policy, required by the United Nations' Framework Convention on Climate Change (UNFCCC), and reflecting the systemic nature of climate systems and climate change. The second recommendation touches on sustainable development principles, as well as appropriate criteria to be taken into account when proceeding from one policy cycle stage to another. Analysis of experiences from international and Latvian climate change and adaptation policy led to the conclusion of the necessity for a more systemic approach to exploring and managing the risks and benefits related to climate change. It also concluded that an adequate database should be established for assessing socio-economic effects and improving the system of forecast models, including systems related to natural ecosystems and human welfare. Addressing adaptation to climate change from the social dimension and emphasising the national (state) level as the foundation for resolving the issue in a systemic way (minimising risks and maximising benefits), the paper

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suggests a new approach for practical analysis and preparation of a set of policies employing cause and effect cognition.

Keywords Climate change · Sustainability · Adaptation · Policy design · Unstructured problem · Normative principles and criteria · Systemic approach · Latvia

1 Introduction

The paper aims to describe theoretical considerations and practical approaches used in the preparation of Latvian adaptation to climate change policy. The cornerstones of the theoretical framework for policy design encompass a systemic approach to resolving complex unstructured problems and designing appropriate normative criteria based on principles of sustainable development. An enhanced scheme for designing policy development cycles is offered for the practical implementation of the proposed theoretical approach, with particular emphasis on decision-making criteria throughout all stages of the cycle.

The first part of the paper describes the overall context and adaptation to the climate change policy development process in Latvia, pointing out the necessity of defining normative criteria for setting up a structured approach for policy design and governance.

The second part offers a methodological approach for use in designing practical policies, i.e., when preparing Latvian national strategy for adaptation to climate change. Recent advances in overall development policy with a focus on climate change are summarised. Main principles identified as being fundamental in high-level policy documents are also highlighted. Principles of sustainable development are further used to set up a framework for the analysis of major issues raised by climate change in Latvia. Theoretical frameworks and analytical approaches, policy instruments and normative criteria, applicable for decision-making, are proposed for each particular issue.

The third part includes a detailed description of the socio-economic consequences of climate change in Latvia, as well as characterising the capacity of Latvian administrative and research institutions for providing reliable data for policy development.

The fourth part summarises principles in the system of analytical approaches and decision-making criteria to be used in policy cycle. Risk minimisation and polluter (user) pays principles are chosen as being the most fundamental. Further information available on risks caused by climate change is provided, and the costs and benefits arising from climate change impacts and policy response alternatives are considered.

In the final part, practical recommendations for the further development of adaptation to climate change policy are given.

2 Arguments for Normative Principles and Criteria

As indicated in the United Nations' (UN) Framework Convention on Climate Change (UNFCCC 1992),[1] parties should take precautionary measures (according to sustainable development principles) to anticipate, prevent or minimise the causes of climate change and mitigate its adverse effects. The Convention also specifies that the parties should cooperate in preparing for adaptation to the impacts of climate change, develop appropriate and integrated plans for coastal zone management, water resources and the use of agricultural land, and for the protection and rehabilitation of areas affected by drought, as well as floods. Establishment of funding, insurance and transfer of technology are among the issues to be considered.

Similarly, impact assessment, formulated and determined nationally with a view to minimising the potential adverse effects of adaptation projects on the economy, on public health and on the quality of the environment, should be implemented to a feasible extent. At the same time, promotion of new innovative measures and development of technologies (including policy and decision-making technologies), along with the adaptation measures already approved, are prescribed in the UN Decision 1/CP.10 regarding the Buenos Aires programme of work on adaptation and response processes (UNFCCC 2005).

Furthermore, as it was stressed in the 2006 Nairobi UNFCCC conference, climate change is an issue directly related to United Nations' Millennium Development Goals: starting from the eradication of extreme poverty and hunger, ensuring environmental sustainability to the development of a global partnership for development (UNFCCC 2000). As stated by the UN Secretary-General: "We will have time to reach the Millennium Development Goals—worldwide and in most, or even all, individual countries—but only if we break with business-as-usual". Chair of the International Panel on Climate Change (IPCC), Rajendra K. Pachauri,[2] said on 25 March 2010, visiting the European Parliament: "We need policies to promote the development of new technologies or the employment of the existing ones. We (the IPCC–I.B.) have clearly stated in our report that the technologies needed are already available or on the verge of being commercialised. These technologies will only be used if we have the right set of policies."[3]

But breaking with business-as-usual refers to the necessity for a radical new attitude (approach) to designing policy for such complicated and usually unstructured problems like climate change mitigation or adaptation to it; this new

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[1] Adopted at the national level as "Law on the framework Convention on Climate Change of the United Nations Organisation", by the national parliament *Saeima* of Latvia on 23 February 1995.

[2] Dr. Rajendra K. Pachauri, (1940) has been elected as Chairman of Intergovernmental Panel on Climate Change (IPCC) from 20 April 2002 onwards. He has been active in several international forums dealing with the subject of climate change and its policy dimensions.

[3] Source: http://www.europarl.europa.eu/news/public/story_page/064-24711-084-03-13-911-20080319STO24704-2008-24-03-2008/default_en.htm.

attitude requires a much more systemic approach if we want to find common points, borders or parts therefore—to take the correct and, even more importantly, effective actions.

One of the key conclusions from the European Union (EU) project "Adaptation and Mitigation Strategies: Supporting European Climate Policy" (ADAM project) stated: "Global climate policy beyond 2012 requires a strong, integrated governance architecture that involves both public and private actors and that provides a regulatory framework on both mitigation and adaptation. Highly fragmented global climate governance is likely to be more costly, less effective in terms of environmental goals, and less equitable regarding smaller countries, particularly in the global South" (Hulme et al. 2009).

The conclusion about fragmented adaptation governance is also recognised in the EU's White Paper on Adaptation: "Adaptation is already taking place but in a piecemeal manner" (Commission 2009: p. 2).

For ensuring successful and systemic adaptation policy design, it is crucial to remember that the climate change issue is part of sustainable development and, as already concluded in the report of the Bellagio project (Hardi and Zdan 1997) regarding the practice of sustainable development, for that the entire process is normative. The same approach is required for solving such a huge and unstructured problem as climate change risks and adaptation to it and, for that purpose, it is required that all relevant principles and criteria in a full policy cycle should be assessed.

The national/state level (as a basic area for adaptation policy design and governance) is where overall political responsibility is located in all the stages involved in elaborating new policy during the complete policy cycle. At state level, government sets policy planning documents; formulates national positions on EU legislative acts in its drafting stage; fosters national legislation and regulations, many of which directly or indirectly affect the climate change risks the country and sectors are facing, or creates the incentives (or disincentives) for exploring climate change adaptation opportunities and advantages. This is also the main level for coordinating sectoral policies and branches, including many cross-cutting responsibilities and functions (e.g. risk assessment and management; *polluter (user) pays* principle; the security dimension; integrated assessment (welfare, etc.), as well as providing the overall policy guiding framework within which lower levels (sectoral, municipal, communities) operate. The state also manages international (bilateral, multilateral) relations with other countries; cross-border aspects of climate change and international financing and cooperative mechanisms; participation in multilateral environmental agreements such as the UNFCCC, and its Kyoto Protocol, where political *consensus* could be reached only through successful policy dialogues and compromise between policy options.

The strong topic for discussion about normative principles and criteria is the evidence of risks and losses from climate-related natural hazards increasing year by year (USD 100 billion per annum in the last decade alone[4]). Thereby, climate-change related risk insurance is one of the policy instruments, being a strong complementary aspect of a wider adaptation framework that can, and should, provide financial security against natural disasters, such as floods, droughts, heat waves, forest fires and peat bog fires, windstorms, intense cold, snowstorms, and so on.

At the global level, the Bali Action Plan, adopted by UNFCCC Parties in Bali, Indonesia in December 2007, in this context calls for the "consideration of risk sharing and transfer mechanisms, such as insurance" to address loss and damage. For that, talking about the post-2012 adaptation regime, the potential role of risk-pooling and risk-transfer systems must be firmly established (Bali Action Plan, UNFCCC 2007).

The second extremely important policy planning document in the global context is the Hyogo Framework for Action 2005–2015[5]: "Building the Resilience of Nations and Communities to Disasters" which considers *inter alia* the integration of risk considerations into the sustainable development and the development of institutions, mechanisms and capacities at all levels to systematically build resilience against hazards. The Hyogo Framework specifically identifies the need to "promote the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change…" The implementation of the Hyogo Framework therefore provides a powerful tool to support adaptation, through building resilience and reducing vulnerability to climate-related hazards. The Hyogo Framework sets out strategies for reducing disaster risks through the five priorities for action needed: (1) ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation; (2) identify, assess and monitor disaster risks and enhance early warning; (3) use knowledge, innovation and education to build a culture of safety and resilience at all levels; (4) reduce the underlying risk factors; and (5) strengthen disaster preparedness for effective response[6] (UN 2005).

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4 Source: Munich Climate Insurance Initiative.

5 Agreed at the World Conference on Disaster Reduction in January 2005, in Kobe, Japan, by 168 governments and endorsed by the United Nations General Assembly, the Hyogo Framework for Action 2005–2015: Building the resilience of nations and communities to disasters, provides the foundation for the global implementation of disaster risk reduction. See: http://www.unisdr.org/eng/hfa/hfa.htm.

6 Disaster risk reduction strategies and risk management practices: critical elements for adaptation to climate change. Submission to the UNFCCC Ad Hoc working group on long-term cooperative action by the informal task force on climate change of the inter-agency standing committee 1 and the International Strategy for Disaster Reduction (ISDR), 11 November 2008. This paper was prepared as a submission to the UNFCCC parties on the risk-related matters identified in the Bali Action Plan (1/CP.13, paragraph 1. (c)). The paper provides further background in respect to the submission to the AWG-LCA on 29 September 2008 from the ISDR entitled "Proposals for the AWG-LCA chair's assembly document on enhanced action on adaptation", and includes specific information from the humanitarian perspective.

Demonstrators of best practice in the field of climate change risk at an international level (Mills 2007) are the Arkwright Mutual Insurance Company, which examines climate change and trends in flooding (Zeng and Kelly 1997), the Insurance Australia Group[7] which, together with the University of Oklahoma, is working on high-resolution climate modelling, and Willis (a leading broker) collaborating with researchers in the UK and Japan on next-generation climate modelling, with greater resolution for enabling the evaluation of changing typhoon risks and associated insurance implications (McLeod 2007). Swiss Re (2006) and the Association of British Insurers (2005) have also coupled climate models with insurance loss models. Swiss Re projected an average increase in losses from 16 to 68 % from European winter storms (and significantly higher for some individual countries) between 1975 and 2085, excluding the associated effects of storm surge and flooding and socio-economic factors (inflation, insurance penetration, settlement patterns) that would further compound losses (Swiss Re 2006). Munich Re takes the leading role in the insurance of natural catastrophes and, as the world's largest re-insurer, is incorporating the physical effects of climate change into hurricane models (wind and storm surge), and associated economic effects such as the surge in demand (and prices) for construction materials following such events (Höeppe, n.y.). With support from AIG and Lloyds of London, Harvard University and the Insurance Information Institute are collaborating to better integrate climate change factors into insurance loss models.

Adaptation to climate change was put on the EU policy agenda on 29 June 2007 in the EU Green Paper on Adaptation. In response, Latvia has realised separate sectoral adaptation policies (e.g., flood risk prevention with technical solutions, risk management and insurance in agriculture, rural development, coastal zone management, etc.) as well as research on narrow or specific themes of climate change impacts, vulnerability and adaptation possibilities. A coordinated process of elaborating on the adaptation policy in a systemic manner started in 2008 upon the acceptance of the report on adaptation to climate change by the Latvian government.

This report deals with climate change impacts and vulnerabilities in different sectors, and gives an overview of relevant research work at international and national levels. It also presents the most important policy initiatives, both globally and at EU level, in relation to adaptation. The main finding was the identification of the set of risks caused by climate change. The report also describes the situation in Latvia until the beginning of 2008, presenting what has already been done concerning adaptation, and outlines recommendations for future adaptation policies and measures to be taken. It also identifies the need to prepare a national strategy on adaptation with scenarios on development, to be produced within 1 year after the delivery of the white paper on adaptation by European Commission, i.e., by 1 April 2010 (MoE 2008).

[7] http://www.iag.com.au/

3 A Methodological Approach to the Design of Adaptation to Climate Change Policy

Unfortunately, it sometimes seems that we are forgetting about the concept of dematerialisation, which is fundamental for sustainable development, and brings about the de-coupling of economic or welfare development and consumption of natural resources and waste (also greenhouse gas (GHG) emissions) production. It can be resolved only by qualitative progress or development, and clarification of the strength or weakness of our development according to sustainability (sometimes recognisable as ecoefficiency) principles and criteria.

Sustainable development principles such as (i) solidarity and cooperation (intra-generational equity, inter-generational equity, international equity); (ii) dematerialisation; (iii) caution; (iv) sustainable resource use; (v) polluter (user) pays or full-cost recovery; (vi) the triple bottom line (for societal or human plus social capital,[8] nature capital, man-made or economic capital); and (vii) diversity (diversification) should be taken as a basis for adaptation to climate change policy design and implementation with clear conclusions from certain scientific studies, appropriate legislative acts, policy planning documents, public awareness campaigns, technologies, and so on.

The essence of these principles has been postulated in the Delhi ministerial declaration on climate change and sustainable development: climate change could endanger future well-being, ecosystems and economic progress in all regions, and that in order to respond to the challenges faced now and in the future, climate change and its adverse effects should be addressed while meeting the requirements of sustainable development. Parties have a right to, and should, promote sustainable development (UNFCCC 2002).

The EU has declared sustainable development as a fundamental objective [see EU Sustainable Development Strategy (SDS)]. In the EU's integrated climate and energy policy, an integrated approach to the sustainable management of natural resources, the protection of biodiversity and ecosystem services and sustainable production and consumption are listed among the drivers for achieving objectives under both this strategy and the Lisbon strategy (Presidency 2007).

In Latvia, a reasonably used and preserved natural environment is listed as one of the preconditions for safe and stable development in the "National Development Plan 2007–2013" (MoRDLG 2006); however, one of the tasks is the promotion of the assessment, reduction and monitoring of natural, including climate change, and industrial risks. Political objectives for reducing the adverse effects of global climate change have been specified in the "Environmental Policy Guidelines for 2009–2015" (MoE 2009).

Preparation of the national strategy for adaptation to climate change has begun and is in line with strategic goals set in the long-term development strategy for

[8] For principles used to introduce notions of three, four or five capitals, see part II "A framework for sustainable capitalism" in (Porritt 2007, pp. 137–212).

Latvia "Sustainable Development Strategy Latvia—2030" (MoRDLG 2010). Experts from the Ministry of the Environment were involved in the preparation of parts of the strategy devoted to the natural capital. Concerning environmental issues, this strategy proposes several goals for Latvia: (1) to become a leading EU Member State in terms of preserving and enlarging the natural capital and using it in a sustainable manner; (2) to retain a leading position in the EU in terms of utilisation of renewable energy resources and to fully evolve the potential of "green economics"; and (3) to make a living and natural environment that is attractive for people, and capable of promoting development in the entire country, as well as strengthening the development of the country and the whole Baltic Sea region. The Strategy proposes several directions for priority actions. Firstly, management of the natural capital, which should include (i) the natural capital approach; (ii) the Green Budget Reform; (iii) the Nature preservation plan; and (iv) the establishment of a Nature Restoration Fund. Secondly, the development of market-based instruments through (i) the assessment of the value of nature capital for land; (ii) the introduction of a tendering process for ecosystem services; (iii) the introduction of fees on natural capital; and (iv) the introduction of the programme of "eco-gifts". Thirdly, capitalisation of environmental activities, which means (i) establishing the Investment Fund for the Green Economy; (ii) creating networks for knowledge transfer; (iii) establishing the "Green innovation programme"; and (iv) developing the programme for "digitalisation of the environment". Fourthly, activities to support sustainable living with (i) environmental education programmes, promoting change; (ii) the introduction of "ecological footprint accounts"; and (iii), the creation of a database for national heritage. A fifth area in which this would be achieved would be through the widescale use of renewable energy resources and innovation, e.g., promoting the use of wind and solar energy, measures to promote energy efficiency, diversification of the rural economy, and the maintenance and promotion of the spatial identity.

The principle of sustainability, which compels ensuring "a qualitative environment, balanced economic development, rational utilisation of natural, human and material resources, development and preservation of the natural and cultural heritage for the present and next generations", as well as the task "of creating preconditions for ensuring environmental quality and rational utilisation of the territory, and the prevention of industrial and environmental risks" is specified in the "Spatial Planning Law" (2002), among other basic principles of sustainable development (MoE 2008).

With respect to practical policy design, the authors wish to clarify the definition and essence of adaptation or what constitutes the subject of policy design. Although numerous definitions and explanatory articles on adaptation to climate change *anatomy* exist in policy design space (UNFCCC 1992; Smit et al. 2000 etc.), authors agree with a point of view that we have to discuss the adaptation issue, which is a problem for us, people, society and mankind. Therefore we, as human beings, are responsible for solving it to ensure our own well-being, and also to maintain the natural balance for the planet as a whole. It is not nature that is the problem, therefore we have to address adaptation to climate change from the position of the social dimension, fundamental policy options, or a response strategy concerning climate change (Frankhauser 1996; Smith 1996).

For that reason, authors see adaptation to climate change as an issue which requires a logical set of policies and measures, or PAMs, designed in a systemic way that takes into consideration normative principles and appropriate criteria in all stages of the policy cycle, making decisions. At the same time, this well-structured process is expected to be coordinated by state government, which would allow for proper cost-effective and responsible management of social development, consumption of natural resources and use of technology at all levels (state, regional, municipality, enterprise, individual) in order to prevent natural disasters and threats, or to use all opportunities and advantages offered by climate change. In cases where threat or real damage has occurred because of climate change, appropriate technical, financial or other assistance should be available to individuals, particular species or ecosystems, thereby promoting the system's (society's, community's, dwelling's) preservation or minimising unacceptable consequences or, again, taking advantage of climate change impacts.

Unfortunately, to date, too many policy evaluations at basic political strategic levels (both globally and nationally) have often been applied in an *ad hoc* and unsystematic way due to (i) uncertain knowledge; (ii) disagreement about normative elements (e.g., values, norms or objectives); and (iii) disagreement about cognitive elements (e.g., research or information) (Hisschemöller and Hoppe 2001). It has been evident in international negotiations in the attempt to prepare new political agreements during the post-Kyoto period (e.g., on financial architecture for adaptation to climate change, new market-based policy instruments, intellectual property in technology transfer, and so on). Thus, it is an obvious necessity to design adaptation to climate change policy and to ensure solutions according to the full policy cycle (assessing *ex-ante* and *ex-post* phases in it), and every decision made, descending from one policy cycle stage to another, should be based on taking note of the *spectrum* of normative principles and appropriate criteria.

There are three components we should take into account for every decision discussed: (1) criteria—the standards by which decision-makers evaluate alternatives (sometimes referred to as "interests", after Fisher and William 1983); (2) alternatives—specific courses of action or options, being considered as positions; and (3) cause and effect beliefs—cognitions linking specific alternatives to specific criteria (University of Rhode Island 2007). Criteria for choosing policy instruments in the certain policy development cycle stage can be: (i) causal—as answers to the basic question, for example, whether or not the policy instrument addresses the underlying economic failure; (ii) efficiency e.g., economic efficiency criteria include costs and benefits, public opinion, etc.; (iii) equity; (iv) macro-economic; and (v) legal—this criteria concentrates on the issue of subsidiarity, i.e., where policy is located most effectively, (there are three main criteria upon which levels of subsidiarity can be assessed: gains from cooperation, gains from harmonisation, gains from sustainability). Having a clear vision on the policy cycle, the main actors, principles, transparent criteria, and so on, help to resolve the aforementioned difficulties when dealing with the complex unstructured problem.

4 Consequences of Climate Change Impacts in Latvia and Data Providers

Latvia's territory is 64,589 km^2, with a population of 2.3 million inhabitants. It has a flat surface topography—57 % of Latvia's territory is below 100 m above sea level. The climate is mainly humid (the mean precipitation ranges from 600 to 850 mm per year) and comparatively cold—the mean annual air temperature in Latvia is +5.8 °C (in 2008: +7.6 °C!). Latvia is rich in waters and forest—the mean density of the river network is 588 m per km^2, but forests cover—54 % of the territory (Klavins et al. 2007).

Latvia's coastal zone is sensitive to erosion—approximately 67 % of the 496 km coastline is vulnerable to erosion during storms. Over the last 70 years, Latvia has lost 1,000 hectares in storms with a 50–200 m wide area of the basic coast having been washed away (Eberhards and Lapinskis 2008).

Over the last century, the average air temperature has increased by 0.5 °C in Latvia as a whole, and by 1 °C in the capital Riga. The process of global warming and related changes in atmospheric circulation have led to higher air temperatures and greater cloudiness, leading to less sunshine and greater precipitation (higher values are observed in the western part of Latvia). It has been found that the variability of annual mean temperatures of the Baltic Sea region is about five times larger than the variability of global mean temperatures.

The Climate Change Vulnerability Index for Latvia is determined at 26.0–30.0 on average in a range between 0 and 100. As defined in the Stern Review, "vulnerability to climate change can be classified as *exposure* to changes in the climate, *sensitivity*—the degree to which a system is affected by, or responsive to, climate stimuli, and *adaptive capacity*—the ability to prepare for, respond to and tackle the effects of climate change" (Stern 2007). This index reflects exposure more than vulnerability.[9]

Eastern Europe is highly vulnerable to the risk of flood. In many of the newer EU Member States (Poland, Romania, Bulgaria, Slovakia, Lithuania), annual flood risk has exceeded 1 % of the Gross Domestic Product (GDP). In some events, national authorities have had severe fiscal problems in financing the recovery process (Hulme et al. 2009). Latvia is among those flood-prone countries, and it is at similar risk, both in terms of the great fiscal deficit and options for the realisation of efficient adaptation policy actions.

In the last 20 years, the water discharge from rivers in Central and Eastern Latvia has increased by ~4 % and in the western part of the country by ~6 %. The ice cover period has been decreasing—the reduction of the ice-cover period

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[9] Choice of individual indicators included in the CC vulnerability index is determined by: (a) change in population affected by river floods; (b) population in areas below 5 m; (c) potential drought hazard; and (d) vulnerability of fisheries, agriculture and tourism to changes in temperature and precipitation. We have to note, for example, that economic benefits of climate change, ecological effects or effects on health are not included in this indicator.

for the last 30 years is from 2.8 up to 5.1 days every 10 years. The change in the river break-up towards earlier in the year can explain the increase in winter run-off in Latvian rivers (Klavins et al. 2007).

Spring and summer phases in Latvia have occurred, on average, 4 days earlier over the past 50 years; the most recent changes were observed for early spring phases (the most significant shift has happened in the last 15 years). The flowering phase has advanced by 1.6 days per decade for the bird cherry (Padus racemosa) and 0.9 days per decade for the linden (Tilia cordata). The autumn phases in Latvia have started 2.8 days per decade earlier in contrast to Europe where autumn phases have started later. The length of the growing season, determined by the vegetation of birch and maple species, has increased by 9.8 days (3.3 days per decade) for the birch (Betula pendula) and 18.5 days (6.2 days per decade) for the maple (Acer platanoides) (Grisule and Briede 2007).

The scale of economic losses brought about by climate change is illustrated well by compensation for the damages caused by agro-climatic conditions in agriculture, which were EUR 887,687[10] in 2000; compensation for damage caused by natural phenomena and accidents (in storm, flood, fire) to persons engaged in coastal fishing and in internal waters or fish farming were EUR 26,910.74 in 2001; the total compensation for the damage caused by agro-climatic conditions was EUR 312,635 in 2004 and EUR 620,797.32 in 2005 (including compensation for animals which have died from gnat bites—EUR 184,687.94, for covering of material losses caused by floods—EUR 436,109.38).[11]

Due to unfavourable agro-climatic conditions in 2006, more substantial losses were inflicted on agricultural producers. In order to ensure the disbursement of compensation for the losses caused by drought in agriculture and forestry, the Cabinet granted additional financing of EUR 36.35 million to the subsidy programme on the basis of the information notice "On the Emergency Situation in Agriculture", approved on 19 September 2006. The following support costs in relation to the losses caused by the drought were made in 2006: (1) financing of EUR 26.50 million was disbursed in the field of crop farming; (2) EUR 8.11 million in the field of agriculture; and (3) EUR 0.68 million in forestry.[12]

The amount of subsidies in agriculture for risk decrease measurement (including compensation on insurance premiums) has a decreasing trend: in 2007 it was EUR 692,654, in 2008 it amounted to EUR 380,884 and EUR 260,729 in 2008.

Excessive drought and strong winds significantly increase the likelihood of forest combustibility or the outbreak of fire. For example, the largest number of forest fires in the State—1929 (the total calculated losses from forest fires were EUR 2.77 million)—was registered in 2006, which was one of the most critical years in protection against forest fire. Artificially restored forest plantations suffer

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[10] LVL 1 = EUR 0.7098.

[11] Source: Rural Support Service, reports from 2000 to 2009.

[12] Publication of the Ministry of Agriculture of the Republic of Latvia (2007) "Agriculture and Fields of Latvia" (in Latvian).

due to extreme natural conditions—fire destroyed 564 hectares of young forest stands in 2006,[13] the spring drought and summer heat of 2006 were the main reasons for the replanting of approximately 25 % of plantations set that year.[14]

The storm of January 2005 affected not only Latvia, but also all of Northern Europe, causing great damage. According to the EU criteria defined in Council Regulation (EC) No. 2012/2002 of 11 November 2002 establishing the European Union Solidarity Fund,[15] or EUSF, the total losses inflicted on Latvia were assessed to be approximately EUR 192 million (the ESF granted EUR 9.487 million), EUR 48 million for Estonia (the ESF granted EUR 1.29 million), and approximately EUR 15 million for Lithuania (the ESF granted EUR 0.379 million). Particularly significant damage was inflicted on Sweden—their evaluation amounted to almost EUR 2.3 billion (the ESF granted EUR 81.725 million).

In the informative report "On Damage Inflicted by Storms According to the Fields in the Public, Local Government and Private Sector on 8–9 January 2005", developed by the Ministry of Finance and approved by the Cabinet of Ministers of Latvia, in 2005 total losses amounted to EUR 217.2 million (MoF 2005). The total damage inflicted by the storm to various interests, including damage to the public sector, was indicated in this report. The costs for liquidation of the consequences of the storm were separated, also indicating the resources for the immediate restoration of the infrastructure and facilities for energy, water supply and sewerage, telecommunications, transport, health care and education. The financing necessary for the provision of shelter to affected residents, provision of activities required by the responsible rescue services, immediate restoration of the protective infrastructure, immediate rescue of cultural heritage and immediate clean-up of the territories polluted by the natural disaster were also clarified.

On 11 April 2007, the Cabinet adopted the "Information Notice on Granting Resources from the State Budget to Local Governments for Liquidation of Consequences of the Storm of 14 and 15 January 2007 at Schools and Kindergartens, as well as Local Government Objects, which are Necessary for Provision of Execution of Significant Functions of Municipalities", developed by the Ministry of Regional Development and Local Government. It is mentioned therein that documents confirmed the damage that had been incurred by local government in 69 objects of infrastructure totalled EUR 1.178 million (EUR 444,232.2 were granted), which was received from municipalities by 16 March 2007 (MoRDLG 2007).

In order to reduce scientific uncertainties regarding the effects of climate change and to find specific solutions for adaptation policy, several important international projects have taken, or are taking, place in the Baltic Sea Region: the project "Sea Level Change Affecting the Spatial Development in the Baltic Sea Region" (SEAREG, 2002–2005; Baltic Sea Region INTERREG IIIB programme; 2000–2006); "Project of the Baltic Sea Region" (2005–2007), in which Finland,

[13] Source: State Forestry Service.

[14] Source: JSC "Latvia's State Forests".

[15] OJ C 283, 20 November 2002.

Germany, Estonia, Lithuania, Poland, Sweden and Latvia participated, "Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region" (ASTRA)—the ASTRA project was a follow-up to the INTERREG IIIB project SEAREG (Sea Level Change Affecting the Spatial Development of the Baltic Sea Region); an international project "Climate Impact Research Co-ordination for a Larger Europe" (CIRCLE ERA-NET) within the framework of the Sixth Framework Programme for Research and Technological Development of the European Commission; the new one—"Climate Change: Impacts, Costs and Adaptation in the Baltic sea region"(BaltCICA 2009–2012) is now running, involving Finland, Estonia, Lithuania, Germany, Denmark, Norway, Sweden and Latvia. Sea level changes and coastal vulnerability for Latvia are modelled and being calculated by the Potsdam Institute for Climate Impact Research as part of the ASTRA project; but monthly average temperature changes up to 2100 are being calculated within the Swedish Regional Climate Modelling Programme (SWECLIM).

Latvia is participating as an observer in the EU project CIRCLE ERA-NET, in EPA IG on adaptation, as well as in the work of the European Environment Information Observation Network (EIONET) expert group regarding climate change vulnerability and adaptation. Latvia had also prepared information (submissions) on national adaptation policies and measures to the Nairobi Work Programme on socio-economic aspects of impact vulnerability assessments, and adaptive capacity (2007) and to the Nairobi Work Programme on impacts, vulnerability and adaptation to climate change (2009).

The main scientific authorities researching climate change impacts and consequences in Latvia are: the researchers of the Faculty of Geography and Earth Sciences of the University of Latvia (research on climate change impacts), the Faculty of Biology of the University of Latvia,[16] the Institute of Biology of the University of Latvia,[17] the Latvian State Forest Research Institute "Silava",[18] the Physical Energetic Institute (research on renewable energy or RES resources), the Institute of Solid State Physics (hydrogen technologies), Riga Technical Institute (climate change technologies) and the Agricultural University of Latvia.

In close cooperation with scientists and other stakeholders, the National Research Programme "Impact of Climate Change on the Water Environment of Latvia" (KALME 2006–2009) is being undertaken to assist in the development of

[16] Examples of research projects are "Biological Diversity of Swamp Woods under the Impact of Climate Changes" (2006) and "Changes in the Growing of Trees under the Impact of Climate and Environmental Changes and Connection Thereof with Indicators of Biological Diversity" (2007).

[17] Examples of research projects are "Variability of Global Climate and Actions for Reduction of Impact thereof in Latvia" (2005) and "National Adaptation Strategy for the Management of the Risk Caused by Variability of Climate: Extreme Climatic Phenomena and Effects Thereof" (2006).

[18] An example of a research project is "Impact Assessment of Extreme Wind Velocity on the Stability of Forest Stand, Development of System for Support of Decision-making" (2006).

the adaptation policy. The general goal of this program is to assess the short-, medium- and long-term impacts of climate change on the environment and the ecosystems of the inland waters of Latvia and the Baltic Sea, and to create a scientific basis for the adaptation of the environmental and sectoral policies of Latvia to climate change. Specific goals are to (i) create several mutually non-controversial scenarios of regime-determining parameters; (ii) assess possible climate change impacts on the quality of inland waters of Latvia, their availability, flood and drought risk, to facilitate adaptation of drainage basin management and secure the protection and sustainable use of water resources; and (iii) forecast possible climate change impacts on the physical regime coastal dynamics, biogeochemical regime, and ecosystems of the Baltic Sea, as well as to facilitate the protection of the quality of the marine environment, biological diversity and the sustainable use of its resources and services.

Many institutions and informative modes provide network systems for producing and distributing climate information and monitoring, covering all Latvian territories, including big cities, located on the coastal zone area and near river estuaries, e.g. Riga (722,485 inhabitants in 2007), Liepaja (85,477 inhabitants in 2007), Ventspils (43,544 inhabitants in 2007), Jurmala (55,408 inhabitants in 2007) or Daugavpils city (108,091 inhabitants in 2007),[19] by the river Daugava.

Primary data on the direct impact of climate change (air temperatures, precipitation, changes in river discharge, ice regime, wind regime, etc.) as well on GHG emissions are gathered and distributed by the Latvian Environmental, Geological and Meteorological Agency (LEGMA); data on public and environmental health by the Public Health Agency; data on forests, including CO_2 removals, by the "Silava" scientific research institute; monitoring of the geological processes of the sea coast by the University of Latvia, Faculty of Geography and Earth Science; geographic information systems or GIS maps of the surface of the territory of the State across different scales for modelling flood and other risks by Latvian Geospatial Information Agency.

Responsibility for resolving the problem of common financing and institutional responsibility using well-structured mechanisms and observing political requirements is stated in "Environmental Protection Law" (2007) and in Regulations of the Cabinet of Ministers of Latvia "On the Programme for Environmental Monitoring 2009–2012" (2009). The aim of the Monitoring Programme is to ensure complete data and information has been obtained in order to assess trends and perspectives, develop new environmental policy measures and evaluate the effectiveness of already existing measures (in policy cycle *ex-post* stage). Cooperation criteria are taken into account in the financing mechanism for this environmental monitoring: financing from the State budget (including the Latvian Environmental Protection Fund (LEPF), which is a separate state financial programme) *plus* financing from the European Reconstruction and Development Fund, or ERDF. For example, in 2009 the applicable financing is estimated at EUR

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[19] Source: Central Statistical Bureau of Latvia.

3,958,200 (*inter alia* EUR 425,900 from the LEPF, EUR 315,000 from other state budget funds, and EUR 1,785,200 from the ERDF).[20] The State Forest Monitoring Programme is exploring the impact of climate changes upon forest ecosystems, forest biodiversity status and also changes to forest soils. Responsible institutions for this Programme are the Ministry of Agriculture, the State Forest Service and the Latvian State Forestry Research Institute "Silava".

The State Regional Development Agency of Latvia, among other functions, performs the assessment and analysis of regional development, including the preparation and publication of analytical materials. One of the most recent studies was devoted to socio-economic development tendencies in Latvian towns, including the ecological footprint in the context of land use and land use change as a sink of CO_2 and energy consumption.

Latvia has good experience in the development of a sustainable development indicators system and the assessment of economy-wide natural resources flow, showing an accounting scheme for natural material flows (direct and indirect flows, material accumulation, recycling, emissions, domestic extraction, exports, etc., LEA 2004), reflecting the sustainable development dematerialisation principle. For example, the Latvian report "Report on environmental indicators in Latvia 2002" (LEA 2002) was drawn up according to the causal chain principle, i.e., by grouping the data into five (Driving force—Pressure—State—Impact—Response) logical phases. In fact, all three sustainable development capitals were identified there, and indicators were connected in a unified cause-response chain, showing: (a) what causes the environmental problem; (b) why it originated; (c) what effect it caused; and (d) how, or with what instruments (tools, options), a solution can be found. In this way, normative principles and criteria in full policy cycle were taken into consideration.

The next step in mainstreaming development, not only essential for the State, but also for adapting and elaborating a new methodological approach for sustainable development evaluation in Latvia, was the "Latvian sustainable development indicators report 2003" in which an eco-efficiency indicator, amongst others, acted as a central axis measuring de-coupling and this level of dematerialisation (LEA 2003).

The project "Detection of Building and Coastal Erosion in the Protective Zone of the Coastal Dunes of the Baltic Sea and the Gulf of Riga, Recording it in Orthophoto Maps," implemented by the survey and spatial planning company "Metrum" (with the support of the LEPF) will facilitate planning, detecting the main zones at risk of erosion, as well as problematic areas for building. The data obtained will be usable in the development of spatial plans and monitoring of implementation thereof; in specifying protective zones and property boundaries, in managing specially protected nature areas, in planning port developments, for

[20] Regulations of the Cabinet of Ministers of Latvia No. 187 (11 March 2009) "On the Programme for Environmental Monitoring 2009–2012"include a wide spectrum of indicators reflecting climate change impacts (air temperature, precipitation, wind strength, etc.)

further monitoring of building changes, and so on. Significant support in the formation of risk zoning could also be provided by the Latvian Geospatial Information Agency in developing a digital model of the surface of State territory for modelling flood and other risks.

5 Risk Minimisation and *Polluter Pays* Principles as a Basis for Decision-Making Criteria

Designing systems with analytical approaches and decision-making criteria, to be used in the policy cycle, risk minimisation—i.e., assessment and management and polluter (user) pays principles—have been identified as being fundamental. For this reason, risks had been identified in the Report on Adaptation in Latvia before starting to work on the development of the adaptation policy system, as well as considering the costs and benefits arising from climate change impacts and policy response alternatives.

1. For the damages and losses caused by negative impacts of climate change, the State may be forced to pay high levels of compensation to both individual sectors (particularly in agriculture and forestry) and to residents for the damage caused by natural phenomena to their property, health or even life. From the socio-economic perspective, such risks may distort natural competition in the market economy and pose serious threats to individual sectors of the national economy or sub-sectors thereof (agriculture, forestry, fisheries, sea port sector).

At the same time, the potential benefits to the energy sector (in relation to the installed generating powers), which would be initiated by such direct manifestations of climate change, such as the rise in air temperature, the increase in the average flow rate of water due to increased rainfall, should also be noted. It would bring a reduction in the consumption of energy resources for heating (in the context of energy efficiency measures). Increasing hydropower potential in rivers would ensure a higher generation of electricity and reduce dependence on imported energy resources.

Criteria for biofuel sustainability have been determined in the Directive on renewable energy sources (meaning that these criteria have to be implemented): (a) GHG saving at a minimum of 35 %; (b) no raw material from undisturbed forests, biodiverse grassland, nature protection areas (unless taken harmlessly); (c) no conversion of wetlands and continuously forested areas for biofuel production; and (d) all EU biofuels must meet "cross compliance" environmental rules. In order to provide through monitoring and reporting requirements every two years, EU Member States (including Latvia) will have to analyse land use changes, commodity price changes and the availability of foodstuffs, a cost-benefit analysis of different biofuels and import policy, and an analysis of sustainable development issues.

Positive effects from climate change impacts are also related to temperature changes and effects thereof on the biosphere: the increase in temperature will firstly affect the reduction of frost probability and cause a significant increase in the length of the growing season. In addition, mortality of people from cold will decrease in temperate degrees of latitude due to a milder climate during winter months (Klavins et al. 2008).

In Latvia, the first attempt to develop policy in the direction of climate change risk insurance was for agriculture. The first step was to adopt the Cabinet of Ministers of Latvia's "Conception on Risk Management Policy in Agriculture" (MoA 2007) with appropriate Regulations, which foresees the administration and supervision of an agricultural risk fund, dealing with the compensation mechanism for damage inflicted by natural factors to producers (MoA 2008), thereby reducing direct State payments and involving farmers themselves in risk insurance and covering of losses.

2. Climate change may affect the distribution of invasive species and the migration of agricultural crop pests. In the field of public and environmental health, such changes may call forth the occurrence of diseases that are not typical to the region, for example, malaria, as well as a possible increase in the frequency and spread of diseases carried by ticks. The number of cases of health disorders related to the impact of excessive summer "heat waves" may rise, including serious illness from cardiovascular diseases and chronic respiratory diseases, particularly amongst vulnerable groups of the population (chronic patients, children and elderly people who are frequently also amongst the poorest group), and the mortality rate may also increase due to these factors.

A warmer climate will strengthen the eutrophication processes of waters not only in the Baltic Sea, but also in inland waters (one of the most negative forms is the "blossoming" of *cyanobacteria*), deteriorating the recreation potential of such waters (at first in relation to bathing waters). It is very hazardous for Latvia's inland waters—one of the most sensitive ecosystems.

3. Climate change has many impacts on biological diversity, which is very rich in Latvia. One example of evidence of this is in "A Climatic Atlas of European Breeding Birds" regarding the forecast reduction of bird diversity in Latvia in the 21st century (Huntley et al. 2007). Many special protected natural territories are directly exposed to sea storm overflowing and wash-off and erosion processes. A huge diversity of species and natural biotypes is characteristic of the Baltic Sea coast (dunes, bluffs, coastal pools, etc.). Approximately 90 % of this coastal zone comprises natural biotypes. Sandy beaches (Latvia also has gravel and pebble beaches, high boulder beaches, etc.) are the most typical beaches in Latvia. Their length is approximately 240 km (of 496.5 in total sea coast in Latvia).

The aim of the "Protection Zone Law" has hitherto been "to decrease or eliminate the effects of the anthropogenic negative impact on the objects for which the protection zones have been determined." At present, an intermediate solution for reduction of the effects of climate change is being introduced in relation to the protective zone of the Baltic Sea and the Gulf of Riga.

4. More frequent natural disasters (storms, floods) may cause industrial accidents, for example, the discharge of dangerous chemical substances, which may cause public health and environment threats. Prevention of the risks caused by

climate change is particularly urgent in the River Daugava because the Daugava hydropower plants or HPPs cascade (Plavinas HPP, Kegums HPP and Riga HPP), are recognised as being a Flood Risk Territory of National Significance. Thus an important factor of flood risk prevention is the proper monitoring of hydrotechnical structures and technical maintenance, as well as strict observation of its exploitation of resources.

According to the Latvian "Law on Environmental Impact Assessment" (it also includes a Strategic Environmental Impact Assessment procedure), all risks should be forecast and assessed. An incompleteness is the fact that these procedures (according to appropriate EU Directives) do not require natural disaster assessment (including climate change impacts). The positive trend is that in several cases in Latvia (in development programmes and plans) these risks already have been assessed.

"The Latvian Rural Development National Strategy Plan for 2007–2013" (2006) foresees risk management, including risks caused by climate change (flooding, draught and killing frost) (MoA 2009).

The National Programme for Acquisition of the European Regional Development Fund in the activity of the Reduction of Environmental Risk for the financial planning period 2007–2013 of the EU provides EUR 15 million financing for measures to improve existing infrastructure and to establish new infrastructure for the prevention of flooding in increased flood risk territories of national significance.

Regarding specific flood risk management, the approach in relation to the water environment is integrated, adopting Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risk, which determines that the component of flood should be included in intended plans for the management of river basins provided for in Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000, establishing a framework for Community action in the field of water policy (requirements thereof at a national level are included in the Water Management Law). The new Directive provides for the performance of the initial risk assessment of flood throughout the State territory, specifying on the basis thereof the territories endangered by flooding, and for the preparation of a flood risk management plan for each river basin region.

According to these new requirements, all flood risk territories and criteria for them at national level are defined in the "National Flood Risk Assessment and Management Program for 2008–2015" (2007), based on two research studies. The Program deals with risk management, the establishment of priority risk territories, for prevention—real-time schedule and financing, flood risk impact assessment (*ex post*), elaboration of maps for risk territories, plans' elaboration of plans for risk territories, including CC risk management incorporation into already existing protection plans for individual territories, etc. The Program also categorises three scenarios (with appropriate criteria and financing): (1) areas with a low likelihood of flooding; (2) medium-risk flood areas (possible recurrence period: 100 years or more); and (3) areas with a high likelihood of flooding.

5. Conflicts regarding non-renewable resources will intensify under the general impact of climate change, particularly in locations where access to such resources is related to State policy. Great changes in global land territory may take place this century, thus possibly causing more disputes regarding land and sea borders and other rights to territory.

"Conception on the coastal zone of the Baltic Sea and the Gulf of Riga registration in the Land Register on the name of State" (2008) foresees coastal zone systemic legal protection and management, avoiding ineffective management in a piecemeal manner (zoning of territories according to risk level criteria).

6. As adaptation to climate change is closely related to development and the welfare of society (inter alia, energy security and independence), adaptation should be based on the security concept and risk management related to climate change. These socio-economic problems, which may be caused by the migration of residents from climatically unfavourable world regions (which are usually the poorest regions) to regions where the manifestations of climate change will not be so sudden or unfavourable, may arise.

The "National Security Concept" is a policy planning document developed on the basis of the analysis of danger to the State, which determines the basic strategic principles, priorities and measures for the prevention of danger (including climate change risks) to the State. The concept of National Security, besides other threats (e.g., military), predicts responses required to react to environmental risks, including those caused by climate change, and asks for appropriate policy-making and development of tools to enable these responses to be possible. The goal of the Concept is to take into account not only risks caused by anthropogenic actions, but also (at the same level) natural disasters, and to predict those risks and be able to adapt to them. National Civil Protection is a well-functioning sub-system, which aims to include measures and responsible institutions, and to provide preventative, readiness and response measures intended for states of emergency, and measures for the elimination of consequences of such situations, and determines the actions of the civil protection system also in the case of damage and risks caused by climate change (MoD 2007).

Natural disasters, according to the risk level criteria and likelihood of damage criteria and actions, as well as the functions of institutions involved in the management of such disasters. are described (defined) most completely in "Civil Protection Law" (2006) and the "National Civil Protection Plan" (2007). All cities in Latvia have their own civil protection plans, where natural disasters and action plans, as well as the functions of institutions concerning climate change risks and its management, are defined. Pursuant to the requirements of the "Law on State Material Reserves" (2007), there is a duty to form and store State material reserves within the framework of the system of civil protection in order to use them in the case of national threat.[21] It is important that the planning of material reserves falls

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[21] State material reserves are understood to be the aggregate of material and financial resources formed in accordance with the procedures specified in this Law, which is used by the institutions

under the jurisdiction of ministries (involving institutions subordinate thereto), local government institutions and merchants.

The polluter (user) pays principle (or full cost recovery principle) at national level is transposed in the "Law on Pollution", which determines how to prevent or reduce harm caused to human health, property or to the environment due to pollution. This law lays down conditions for GHG emissions, taking into account cost-effectiveness, and to ensure participation in the EU emission quota trading system. The overall conditions of the EU ETS[22] have been incorporated into the Law, particularly, the rights and responsibilities of State authorities and operators, the issuing of GHG emissions permits, the preparation of annual reports, procedures for the preparation and approval of a national allocation plan, the principles of allowance allocation, conditions for the creation and maintenance of a register of GHG emission units and operations with allowances as well as conditions for the creation of an installations pool. The law lists those polluting activities for which a GHG emissions permit is necessary, and thus are obliged to participate in the EU ETS. The law also prescribes the procedure for community involvement in decision-making based on an allowance allocation and the issuing of GHG emissions permits.

A new financial mechanism, also based on the *polluter pays* principle, has been developed in Latvia with regard to flexible mechanisms under Article 17 of the Kyoto Protocol. The Cabinet of Ministers made a decision on 12 April 2006 on participation in International Emission Trading (IET) under Article 17 of the Kyoto Protocol. It provided the possibility of earmarking 40 million of Assigned Amount Units (AAUs) to be made potentially available during the first commitment period 2008–2012. The Mandate to the Ministry of the Environment to design the legal, institutional system of IET was given in November 2007. The Green Investment Options study completed the Financial Implementation of the Kyoto Protocol by Latvia. "The Law on Latvia's Participation in the Kyoto Protocol Flexible Mechanisms" (2007) foresees the development of the Climate Change Financial Instrument, and strictly defines that every AAU sold will be used for *greening* purposes, including adaptation policy and measures.

The Latvian government is responsible for ensuring that all revenues are being earmarked for "greening" purposes which means: (a) climate change mitigation and adaptation measures; (b) promotion of low-carbon economic development by application of innovative environmental technologies; (c) increase of renewable energy use and improvement of energy efficiency; and (d) capacity building for climate change policy design and implementation.

(Footnote 21 continued)
involved in the management of disasters; the resources at their disposal are insufficient for the implementation of measures.

[22] Conditions of the EU ETS are described in the Directive 2004/101/EC of European Parliament and Council of 27 October 2004 amending the Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms.

Latvia is positioned to be a fast-track provider of AAUs with green credentials and low risk and low transaction costs. Latvia's market position could be characterised by such comparative strengths: low risk of non-delivery of AAUs, robust surplus estimates, advanced in compliance with Kyoto eligibility criteria, low reputational risk, solid legal background and strong political commitment to an efficient, transparent and accountable Green Investment Scheme, efficient public and private sector institutions, and terms tailored to buyer expectations. Comparative weaknesses of Latvia should also be specified: relatively small size of tradeable headroom and limited opportunities for greening with direct reductions of GHG (Latvian Green Investment Scheme may need to include the relatively high share of the greening measures that do not generate an immediate and easily measurable reduction in GHGs[23]).

Key elements of the "Law on Latvia's Participation in the Kyoto Protocol Flexible Mechanisms" are postulated as: (1) ownership of AAUs; (2) authority of the Cabinet of Ministers to make decisions on each sale of AAUs, including the price and specific conditions; (3) authority of the Ministry of Environment and Ministry of Finance to prepare and sign the sale of AAUs; (4) principles for using the revenues from the sale of AAUs, including a clear provision stating that all income from the sale of AAUs shall be earmarked for "greening" projects; (5) special budgetary arrangement defining that money from the sale of AAUs is transferred to a special account in State Treasury, with disbursements being organised under the budget programme "Climate change financial instrument" from a special account in the State Treasury, in the annual budget, the financing for the Climate Change financial instrument is ensured in the amount of received and unused proceeds from AAU sales in previous years; (6) principles for environmental and financial monitoring, verification and reporting.

Latvia proposes a programmatic model for the Green Investment Scheme in which most programmes now consist of a large number of small projects related to energy-efficiency savings in public buildings. Therefore Latvia would propose to buyers "wholesale" greening programmes backed by a credible and accountable national mechanism to "retail" AAU revenues to multiple project owners. Latvia can offer a robust Green Investment Scheme implemented by competent national institutions that require only minor and targeted institutional strengthening.

The Latvian government allocated around 40 million AAUs for a GIS, out of which 18.5 million AAUs have already been sold to Austria, the Netherlands, Spain, Japan, Portugal and a Japanese private buyer (Tuerk et al. 2010).

The dematerialisation principle of sustainable development underpins the Natural Resources Tax (NRT) (in our specific case—carbon tax as a component of the NRT system) which is aimed at reducing the ineffective use of natural resources and pollution of the environment; reducing the manufacture and sale of environment-polluting substances (including GHGs), at the same time promoting

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[23] ECSSD Sustainable Development Department and ENVCF Carbon Finance Unit (2007). "Latvia's Participation in International Emissions Trading". Options Study, p. 136.

the implementation of new and improved technology with less pollution load and increasing energy efficiency and the share of renewable and local energy sources (wood, straw and peat), thus reducing air pollution. The “Law on Natural Resource Tax” states that (from 1 July 2005) a fee of EUR 0.14 for each emitted tonne of CO_2 shall be paid by all combustion installations, except those using peat or renewable energy sources and those that are involved in the EU ETS. Carbon tax increased to EUR 0.42 per tonne CO_2 after 1 July 2008. However, this tax rate is low and extremely ineffective, and should be revised.

In Latvia, the Excise Tax, besides other product categories, is applied to oil products that are imported, exported, produced, processed, stored, sold, received or sent. A feed-in tariff support has been provided for electricity production from renewable energy resources (energy from small HPPs, biogas production and wind power). However, the conditions for receiving the support have changed frequently and do not correspond with sustainable development criteria.

6 Recommendations

The attitude and methodological approach applied to policy design for climate change adaptation should be perceived as being equal in importance to the policy for mitigation of climate change. It is not an issue (problem) where attitude and methodology should be considered separately, but should be solved as an integral part of sustainable development according to all principles and criteria upon which sustainable development is based. Thus it should be included in policy planning documents and sectoral policies with innovative approaches to the formulation and implementation of such policies, involving all kinds of partners at national and global level, as well as at EU level.

The national state level is the basic one upon which adaptation to climate change (e.g., establishment of funding, insurance and transfer of technology) should be designed as part of the full policy cycle and in every decision-making process.

As risk minimisation and polluter (user) pays principles are amongst the most important ones, serving as a basis for the decision-making criteria of sustainable development, in order to ensure the prevention and reduction of the potential risks to the business and national economy at large and to adapt rational economic activities, it is required that the private sector also develops strategies for the prevention or reduction of such risks in cooperation with specialists of state administrative institutions, local governments and foreign specialists, adapting technologies and anticipating the potential risks related to climate change. Although such management of risks will initially require certain investments, it will reduce the damages inflicted to undertakings or the national economy and welfare at large, in the long term. It is intended to develop the potential forms of cooperation and development in the work groups referred to in the Protocol decision. Much attention should be paid to educating and informing the public regarding climate change, the threats it presents, as well as the readiness to act in a situation of disaster or crises.

The roles of regional and local level government should be emphasised in relation to adaptation to climate change because they will have the most accurate information regarding the local environment and the living conditions of residents, as well as regarding conditions hindering or promoting environmental changes. This makes it easier to produce a detailed assessment of the consequences caused by climate change and the foreseeable consequences. This, in turn, presents an opportunity for developing plans of measures on a local scale and spatial plans, which would ensure adaptation of the particular territories to climate change, as well as preparing for risks caused by climate change expected in the future. Spatial planning (including spatial plans of local governments), which determines the establishment of population structure, has a significant role, thus it is essential to take into account the foreseeable effects and the potential risks of climate change to infrastructure and built-up areas in the process of spatial planning.

Exploration and management of the risks related to climate change, concurrently establishing or improving the necessary databases, ensuring that adequate monitoring systems are in place, regularly renewing maps of risk objects and assessing the socio-economic effects from the point of view of cost-benefit analysis, would facilitate the process of the identification and evaluation (including financial) of risks. It would also improve the establishment of a system of different forecast and development models, including such systems which are related to the assessment of the effects of climate change on different natural ecosystems and biological diversity, human health and welfare at large.

It is important that the measures implemented for the reduction of the impacts of climate change (flood control, changes in agriculture or output of energy resources), at the same time would not harm ecosystems and biological diversity. It should be taken into account that natural biotopes (particularly forests and bogs) serve as carbon dioxide sinks. If such biotopes are significantly disturbed (even if it is done for the purpose of mitigation of climate change), the total benefit may not counterbalance the loss of the biotope as a carbon dioxide sinks. The usefulness of biofuel and the impact of production thereof on ecosystems should be carefully balanced. It is necessary to organise scientific research and monitoring in order to trace the changes of biological diversity caused by climate change.

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Multi-Level Climate Governance: Strategic Selectivities in International Politics

Achim Brunnengräber

Abstract This chapter deals with the challenge of policy definition, cooperation and coordination in a complex system of multi-level governance faced by decision-makers in international politics today, using the example of international climate governance. The practical, as well as the analytical challenge, of said system of multi-level governance lies in its dynamic structure, which includes the vertical (i.e. domestic and foreign; subnational, national, and international) and horizontal levels (structure of decision-making processes in international institutions) of international politics, the participation of non-state actors, and the interlinkages and interdependencies between all policy fields and levels involved. More often than not, intentions and interests on the different levels are disparate and difficult to harmonise, which can result in less than ideal policy strategies, are likely to "get lost" in the multi-level governance system. International climate governance and the difficulties with institutionalising an all-encompassing climate protection strategy can be seen as an example of a policy field that is "lost in multi-level governance." This will be illustrated in the following chapter by analysing five dimensions of climate governance and how they hamper successful climate governance—and thus climate protection—at the international level.

Keywords: Climate governance · Multi-level governance · Energy security · Neo-liberalism · Fossilism

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1 Introduction

Despite the Kyoto Protocol and the climate protection measures it contains, an international breakthrough towards far-reaching climate protection measures has not yet been achieved. Key emission countries still refuse to participate, and the adopted targets and market-based mechanisms have made it less successful than it was envisaged to be. And despite the numerous scientific studies on the dramatic effects of climate change, despite the attention of the public and the media, and regardless of all the ecological moral appeals for countermeasures, the situation has worsened rather than improved in recent years (UNDP 2007/2008). This has been accompanied by clear tendencies towards re-nationalisation. As a consequence, the international climate negotiations as the central location of environmental multilateralism have decreased in importance. Because the world community in the foreseeable future, however, will have neither other institutions nor alternative solution instruments at its disposal, the slow pace of the negotiations and the inadequate application of measures is criticised, but attention is concentrated on adherence to the Kyoto Protocol and its further development in the period after 2012. After all, the process of establishing this agreement in the chorus of the international community—and also of defending it against all the attempts to politically dismantle it, which have accompanied climate policy ever since the first climate conference in 1995 (Conference of the Parties, COP)—was protracted and beset with conflict enough. In view of this, a new beginning or a fundamental reform of the agreement is not a political option.

This does not suffice, however, to explain the re-nationalisation and the fundamental problems that have characterised the climate negotiations in recent years. Why is the basic consensus of the international community so fragile despite the effects of climate change and the existence of the Kyoto Protocol, which is binding in international law? Why do national interests increasingly define the climate policy field of conflict? In order to answer these questions it is not enough, we shall argue in this chapter, simply to look at the international climate negotiations and at climate governance. The analysis of "climate as a field of conflict" must examine other dimensions. In particular, the blindness to power, of which governance research was accused early on (Mayntz 1993, 2005, cf. also Grande 2009), must be overcome. This requires that climate policy interests are placed in relation to politico-economic interests and, in particular, to the situation in the world fossil energy market, to the dominant ideology of neo-liberalism and to the specific societal relationships with nature (Brunnengräber 2006). Only the bringing together of these dimensions within the framework of a multi-level governance analysis[1] can explain why international climate policy in the foreseeable future will

[1] There is neither a clear definition nor a general typology of multi-level governance. There is also no theory which can explain the structural characteristics, functioning or effect of multi-level governance (Benz 2007). Despite this, the discussion of the concept in the social sciences is continually increasing. For a proposal regarding the construction of a theory, see Scharpf (2001).

take second place to the priority of national competitiveness and national location policy.

This chapter will deal to a lesser extent with the empirical aspects of international climate policy (that has been done in detail elsewhere, cf. Brunnengräber et al. 2008b; Brunnengräber 2009) but, rather, with fundamental considerations. Central dimensions of the closely interwoven multi-level governance processes and structures will be elucidated and the necessity of an integrative analysis of the climate regime explained. This chapter will thus focus more strongly on interdependencies and interactions between the different governance dimensions in order to illustrate why climate change does not represent a classical environmental problem that could be regulated in specific fields of policy by state actors. Climate change is characterised, rather, by considerable interest-led governance interdependencies, which counteract successful regulation. This approach not only examines the different functional logics of national and international policy, of politico-economic systems of regulation and relationships of power, which would be ignored by a strict orientation towards negotiations and the set of regulations of the climate regime, but also illustrates the contradictions and incompatibilities of climate policy regulations vis-à-vis other international institutions.

Five dimensions of governance will be examined below. The first dimension places the international climate negotiations between multilateralism and re-nationalisation as well as in the context of the world market. Cooperation, conflicts and the diverse strategies within the international community are examined, as are the reasons for counter-movements by individual states. The second governance dimension is the output side of the fossil energy system. It is shown that attempts to solve the problem deal only with harmful emissions. This is characterised as strategic selectivity. The third governance dimension relates to the real-economy side of the fossil energy system, i.e. the input side of the economy. It is argued that climate policy finds itself in the shadow of the hierarchy and is always further down the line than fossil energy policy. Fourthly, the special characteristics of societal relationships with nature are put in the context of climate change in order to explain why the perception of the problem and its interpretation are preconditions for the specific national and international regulation of the problem. The neo-liberal system of regulation is identified as the fifth and final dimension, and the peculiarities of the political economy of the climate are examined. The neo-liberal discourse is regarded as a central frame of reference for international climate policy and as a form of "meta-governance." Finally, an overview and estimation of the governance interdependencies is presented from which the outlines of multi-level governance can be derived.

(Footnote 1 continued)
On the problem of the transferability of the concept that stems from European research to a global context and the potential which the concept possesses, see Brunnengräber et al.'s anthology (Brunnengräber et al. 2008aa). For a first approach to multi-level climate governance and the basis for this article, see Brunnengräber (2007).

2 From Multilateralism to Re-Nationalisation

The first World Climate Conference in Geneva in 1979 is regarded as the starting-point of international climate policy. Climate policy was not institutionalised until 15 years later, however, at the Conference on Environment and Development in Rio de Janeiro in 1992. The United Nations Framework Convention on Climate Change (UNFCCC), which came into force in 1994, was signed there. This was followed by the first Conference of the Parties (COP) in 1995 in Berlin. Since then, the climate conferences have taken place annually. Up to the present, three phases of regulation can be identified. The *first phase* can be described as the consolidation of international climate policy, and covers the years from 1992 to 1997. The third COP in Kyoto, in particular, is regarded as a symbol for the international community that the climate should be dealt with by a multilateral set of regulations. Following this agreement, in 1997, the *second phase* began, which can also be described as an in-between phase. In the years 1997–2005, greater attention was paid, on the one hand, to the concerns of the developing countries, and, on the other hand, it was hoped that the Kyoto Protocol would come into force. This did not happen until 16 February 2005. That same year, the *third phase* began, the implementation phase of climate policy, a phase, which continues up to the present and is fraught with considerable difficulties.

The agreement, in contrast to the ozone regime, is hardly a good example of international problem-solving; the interests involved were, and are, too contradictory. Because the initial situation in the industrialised countries with regard to the strength of their economies varied widely, different reduction objectives were formulated for individual countries or country groups. At the same time, flexible instruments were defined, which did not fundamentally curtail national governments' and economies' room for manoeuvre. This is shown, in particular, by the fact that the reduction objectives are not to be achieved in absolute values, but are calculated via the certificate trade within the framework of the emissions trading system, via trade within the framework of the clean development mechanism (CDM) or via sink projects (Altvater and Brunnengräber 2008). This leads to a considerable loss of trust on the part of the developing and emerging countries which, because of the inadequate preliminary achievements of the industrialised countries, do not wish to make any reduction commitments themselves.

Against this background, international climate policy can be seen from a realistic perspective as a domain of international relationships in which the states attempt to push through their own individual interests in the handling of the global problem of climate change. In the final analysis, national interests and preferences, e.g. in transport, industrial and energy policy, dominate the international negotiations and the climate strategies of the various countries. Of course, changes in national or supra-state preferences do take place. The European Union (EU)—just like Germany—for a long time spoke out against emissions trading as an instrument of climate protection, in contrast to the USA. Today it is regarded as historical irony that the USA has not ratified the Protocol and the EU has introduced emissions trading. But that does not mean that climate change leads to a significant loss of decision-making power on the part of national governments. Rather, the flexible instruments are integrated into national policy in a complex—and increasingly opaque—way, without leading to a reduction of the pollutant greenhouse gases or to extensive structural changes (Hallström et al. 2006).

The internal problems had been known for a long time, but were always dismissed as teething troubles that could be overcome. The fact that the Kyoto Protocol, in contrast to what would be expected from environmental multilateralism, had already been systematically pervaded by national interests was rarely mentioned. The COPs in Copenhagen (2009) and Cancún (2010) represented a turning point in international climate policy because the problems regarding the implementation of the Kyoto mechanisms and the fragility of the cooperation in the international community became obvious. Never before had the limits to the functioning of a multilateral climate policy aimed at consensus been so clear as in these tough negotiations which failed to achieve results (Altvater and Brunnengräber 2011). The insoluble conflicts of interest for which Copenhagen and Cancún will remain in our memories were caused, however, not by the adversities of the climate negotiations themselves, which had become much too complex, but by at least three external "effects" which together are an indication of the re-nationalisation of climate policy.

2.1 The BRIC States

The upsurge of the BRIC states—Brazil, Russia, India and China—in the world economy has considerable consequences for the conflict terrain of climate policy. Above all, India and China, with 40 % of the world's population, have long since stepped out of the shadow of Europe, Japan and the USA, and are now powerful negotiation partners (Flavin and Gardner 2006). The expansion of the G8 to the G20 in the course of the financial markets crisis is only one political sign of this development, albeit a clear one. Another is the effect on climate change: growth in the BRIC states leads to an increased demand for fossil fuels and, via their combustion, to a global increase in greenhouse gases. When the industrial countries now demand that the emerging economies should also make a contribution to climate protection, this appears to be more than justified. From a realistic perspective, however, it can also be interpreted as putting self-assertion in the foreground. After all, if the industrial countries implement expensive climate protection measures and the BRIC states are exempted from these, then the industrial countries are threatened with national competitive disadvantages and the questioning of their economic power basis. For the BRIC states, on the other hand, it would be disadvantageous if they were unable to use cheap, fossil fuels in the phase of their economic advancement, just as the industrial countries did.

2.2 The Financial Market Crisis

In 2008, the financial market crisis erupted—and as a result the economic crisis—and brought with it considerable consequences for the climate negotiations. For one thing, the BRIC states were hit to a lesser extent by the crisis. At the climate negotiations in Copenhagen in 2009, and even more clearly in Cancún in 2010, they were more self-confident and more demanding than ever before. With certain justification, they made accusations against the industrial countries, the great majority of which find it difficult to fulfil in absolute terms the reduction targets of the Kyoto Protocol, which they themselves had set. For another, it became clear that in times of crisis, the readiness to make financial transfers to developing countries and the readiness to accept climate policy regulations, which could possibly hinder fresh growth impulses, is less than low. The industrial countries' outlay of billions for economic packages, rescue operations, and stability measures for their own national banking and business sectors also meant that there is presently little room for manoeuvre for specific financial concessions.

2.3 The Position of the USA

From 2001 at the latest, due to the critical position of the Bush government at that time, the USA has acted as a brake on the climate negotiations. With the change of government in 2008/2009, and the new enthusiasm which US President Obama and the Democrats brought with them, especially regarding climate policy, hopes arose initially that a breakthrough could be achieved in the international climate negotiations. It became obvious early on, however, that the law on climate, the *American Clean Energy and Security Act*, which was put before the House of Representatives at the beginning of 2009, would have no chance of surviving in Congress. Following the mid-term elections in 2010 and the new majority in the House of Representatives, as well as the new distribution of seats in the Senate, it is out of the question that the Clean Energy and Security Act in its present form will survive the political process and be passed. The brief, supposedly climate-friendly period, which began with the accession to office of the Obama administration, came to an end all too quickly.

3 Flexibility in Global Competition

The trend in emissions reflects, so to speak, these new international relationships of power and interests. The objective of the Kyoto Protocol is the reduction of greenhouse gas emissions by 5.2 % by 2012 compared to the base year, 1990. The formulation of this objective is aimed at the *output* side of the fossil energy regime and not, as we shall expound below, at the *input* side, i.e. the fossil fuels. In the international climate negotiations, the focus is not on the reduction of the absolute use of fossil fuels, but on the reduction of emissions. It was the achievement of this strategic selection which created the conditions necessary for the adoption of the Kyoto Protocol and the debates on technological solutions, such as efficiency strategies and sequestration (CCS, Carbon Capture and Storage).

The central elements of the Kyoto Protocol are primarily emissions trading, a specific form of which has been applied *de jure* in the Member States of the European Union since 1 January 2005, through the CDM and *Joint Implementation* (JI). None of these instruments has a direct effect on the consumption of the fossil fuels oil, gas or coal. Nor is the promotion of renewable energies a specific objective of emissions trade (Schüle 2008). Furthermore, certain sectors such as transport and private households have been largely exempted from the European emissions trading scheme. That was necessary to prevent incalculable "risks" in emission reduction (due, for example, to higher growth rates, delays in the application of technological solutions and inadequate efficiency strategies). But that was not the only reason. The creation of an *output* regime also reduces the conflicts which the problem of climate change would have caused in relation to other regimes in international trade and financial market policy (on the relationship of climate policy to the World Trade Organisation (WTO) see, for example, Santarius et al. 2003). This strategic selectivity in dealing with the problem, which was due to politico-economic interests, was enough to show not only that climate policy was a low-priority policy area (with minor changes since 2009/2010 in the debate on the Green New Deal), but also that it was already designed as such in the organisation of the proceedings.

At the present time, the emission of greenhouse gases continues to increase, together with the growing worldwide consumption of fossil fuels (see below). There are considerable differences between countries, however (for more details, see Ziesing 2010). Whereas Germany and the UK have already achieved their reduction objectives, many other industrial countries are nowhere near to this. India and China play a central role. If they follow the fossilistic development model of the industrial countries, this would lead to a dramatic acceleration of the greenhouse effect. In contrast, the emissions of most of the Latin American and African countries are relatively low, corresponding to their low economic output. The historical responsibility for high emissions in the industrial countries and the (attempted) economic catch-up process in the developing countries—with increasing emissions on both sides—not only points to the existing injustice of global relationships, however, which it has also proved impossible to remove in other areas: social, ecological and economic. It also makes clear why the mechanisms of the Kyoto Protocol have to be flexible enough for them to be accepted by both private enterprise and the individual states. Otherwise, there is the threat of disadvantages in global locational competition.

4 Climate Policy in the Shadow of Energy Security

Locational competition is dependent to a considerable extent on the availability of cheap raw materials, particularly fossil fuels. The forecasts of future demand for fossil fuels and worldwide energy requirements, which are growing rapidly by 1.8 % per annum, or up to 50 %(!) by the year 2030 (compared to 2005), also do not indicate in any way a transformation of the dominant energy system in the near future (IEA 2010). Even if the G8 governments kept their promises regarding the saving of energy and the development of new technologies in the field of renewable energy, which they repeatedly make at their summit meetings, consumption will still have grown by 37 % by 2030. For decades, the share of fossil fuels in the production of energy worldwide has stood at over 80 %, and in 2030 it will even, according to the forecasts of the European Commission, be at 88 %, of which oil, at 34 %, will still have the greatest share. Demand for gas and coal will also increase rapidly, however: gas consumption, particularly for the production of electricity and heating, will increase worldwide by 2–3 % per year and the consumption of coal will grow by 2–2.5 % up to 2030 (European Commission 2003; IEA 2010).

Although this increase would have dramatic effects on the growth rates of greenhouse gases, the real problem lies in the availability of, i.e. access to, and the security of the remaining resources of fossil fuels. Distributional conflicts are already taking place. They are the reason for the geo-strategies and wars over oil and the military presence of the Western world in the oil-exporting countries, which is planned long term. In the foreign policy of the USA, but also in that of the EU, the security of energy supplies has a higher priority than climate protection, especially as the supply of the industrial countries' own resources is decreasing and energy consumption is growing (Altvater and Mahnkopf 2007). Western countries pay considerably more attention to the military securing and control of access to oil than they do to climate protection. Instead of producing a secure supply situation, however, there are permanent supply uncertainties, due not least to uncertainties in the financial centres in which there is speculation over raw materials and the occurrence of scarcities. The consequence of this is that national competition on the world fossil energy market is continuously increasing while, at the same time, the price level remains high over a long period.

The price level is, however, just as decisive for the development of a country as the available quantity. Here, we have to differentiate between two groups of countries. Oil-exporting countries and oil companies profit from increasing prices. They have less interest in another energy path than the fossil one. At the same time, in the import-dependent emerging and industrial countries there is a re-orientation of energy policy towards more climate protection, the importance of which is primarily symbolic-discursive. Thus, the construction of new atomic power stations, or longer operating times of existing power plants, are presented as part of a forward-looking climate strategy. Coal-fired power stations (and the subsidising of them) are regarded as necessary for independence from oil imports. This makes the CCS technology so important, without which the coal-fired power stations are harmful emission centrifuges. The transport routes via ships and pipelines are diversified primarily in order to improve the supply situation with regard to gas, which is less harmful to the climate than oil. Of course, renewable energies are also already part of this strategic energy mix today and they will continue their triumphant advance, but according to all the forecasts, their share in relation to coal, gas and oil will remain low. Their share in total energy consumption will be largely compensated for by the forecast growth rates of the fossil fuels unless more fundamental steps towards a low-carbon energy system are taken. The EU Commission estimates the increase in the share of renewable energy in total energy consumption by the year 2030 to be just 8 % (European Commission 2003).

In order to achieve the Kyoto objective, the *input* side of the consumption of coal, gas and oil—in other words, the *lubricant* which keeps the capitalist system functioning—would now have to be dramatically reduced. The extraction and supply side would therefore be crucial. The forecasts of future global energy requirements and the geo-strategies of the Western world to secure its requirements make it plain, however, that the abandonment of the fossilistic growth path is hardly likely. The inherited structures, forces opposed to change and the specific interests of the fossil energy system are responsible for the fact that international climate policy takes place in the shadow of energy security. That is why in the USA, as in many other Western countries, the reaction to climate change is the one we know. The main political focus is not preventative climate protection in order to avoid emissions, but the political or, if necessary, military securing of access to the resources while at the same time adjusting to the effects of climate change (on this, see the study for the BMBF 2010).[2]

5 Climate Change, Nature and Society

How climate change is politically and economically regulated always depends on the interpretation of the problem. These changes—the "interpretation" of climate change—is increasingly being transferred from the global to the individual national levels of action. When the international climate negotiations began, the situation was different. Climate change was described as a global environmental problem and as the central problem of humanity, which was to be conquered "in the century of the environment" (Weizsäcker 1999). This limited the perception of climate change in two ways. First, climate change became a classical, policy field-specific problem, which was to be solved using the tried and tested instruments of environmental policy. Second, the approach to the problem was conceptualised as

[2] For example, the expected "migration flows" are to be prevented in good time, if necessary using military means, as is stated in the so-called Pentagon or Solana study (Schwartz and Randall 2003, European Commission 2008).

a *top–down* strategy in which international relationships were the primary addressee. This shows a specific way of dealing with nature which disregards complexities and prefers interpretations that are easy to handle. Nature and society cannot be separated from each other, however, and nature does not exist independently of its societal definition.

The greenhouse gas effect, which is caused by humans, and the resulting climate change show this clearly in a very particular way. The ecological problems in turn affect humans in the form of the destruction of the basis of life (e.g. by the expansion of deserts), of health (e.g. by an increased risk of malaria) or in the form of additional costs (e.g. for the increased use of air conditioning). These changes, as well as catastrophes, to which particular attention is paid by the media (e.g. because people in the industrial countries are among those affected), do not necessarily lead to the right climate policy. Reactions to catastrophes can vary considerably. And at the same time, catastrophes have both political and socio-economic dimensions. Not every social stratum is affected by the catastrophe to the same degree, or can participate in overcoming the catastrophe to the same degree. After all, the contradictory societal relationships with nature include not only the option of reacting to, but also of ignoring, certain problematical societal situations.[3]

Different interests, different socio-economic situations and the different factors in the climate perception system therefore mean that the ways in which societies react and their development potentials are not unequivocally determined by "nature." This is important in order to be able to understand why climate protection since the financial market crisis has increasingly no longer been interpreted as a global problem but, rather, as a national economic opportunity (Edenhofer and Stern 2009). This is particularly clear in connection with the debates on a Green New Deal, the objective of which is the ecological modernisation of the national economies (GND-Group 2008). It is therefore possible to derive neither an unequivocal concept of crisis from climate change, nor a societal reaction that is appropriate to the problem and unequivocally definable. The reaction can change, and is determined by the dominant ideological context of neo-liberalism, economic system, state and international system. In other words, the prevailing systems of perception and interpretation, and the corresponding, powerful forms of dealing with *external* nature which structure society's relationships with nature—especially in their changeableness—must be understood as the central dimension of the ecological crisis.

Yet this diagnosis of the crisis remains largely unarticulated in the framework of national and international climate negotiations. Climate change is interpreted by societal institutions such as state apparatuses, non-governmental organisations (NGOs), research institutions and, in particular, the media as a global environmental problem or—as we have shown—increasingly as an economic opportunity. If only the right course is set, efficient climate protection will become a national

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[3] This becomes a problem if the ability to articulate local, national and global questions varies. Local environmental problems can be "externalised" and become a "Nimby syndrome."

locational factor. It is obvious here that there has neither nationally nor internationally been a break with the fundamental conviction of modernisation theory that nature can be controlled (see flexible instruments or the debates on the Green New Deal). At the same time, however, climate change is making the limits to this control increasingly clear. The consequence is a "reflexively broken strategy of the control of nature" (Görg 2003: 190).

6 Neo-Liberalism and Climate Change

The Kyoto Protocol is regarded as one of the furthest-reaching economic agreements ever made under the auspices of the United Nations. State and economic interests work closely together. The Protocol is a clear expression of the fact that international climate policy is guided and determined by economic interests. The flexible mechanisms supply the necessary conditions so that profitability criteria, technology transfers to the South, locational security, and competitiveness are not fundamentally questioned. They are an expression of neo-liberal politics. In other words, climate change leads to the search for international answers, which can only be selective due to the political and economic determinacy of international negotiations.

"The market fix for global warming could not have become so dominant if it came out of nowhere. Part of its success is owed to the fact that it is part of a larger, more longstanding historical wave of neoliberalism" (Hallström et al. 2006: 54). Prohibitions, taxes and the reduction of climate-damaging subsidies are dispensed with. The dominant actors from governments and private industry, accompanied in cooperative conflict by NGOs, enforce the use of economic instruments. The market has been put in charge of dealing with the problem in the final instance (Stern 2006). The harmful greenhouse gases were integrated into the valorisation process via the politically determined allocation of economic pollution rights. The harmful emissions are given a price just like any other commodity and can now be traded, invested in, and—as has been reported with increasing frequency in recent times—even used for criminal practices. The policy convergence of international climate policy, which is adjusted to fit into the neo-liberal world economy, shows itself in this valorisation of pollutant gases.

The creation of the emissions trading system was accompanied by the parallel separation of international climate policy from other international treaties and organisations. Due to the fact that the Kyoto Protocol only defines a narrow corridor for dealing with the problem, its contemporaneity with other international agreements is kept as free from contradiction as possible. The fact that there is hardly any systematic connection between the UN Convention and Protocol on Climate Protection and the UN Convention on the Maintenance of Biodiversity can only be explained by differences of interest, strategies for avoiding conflicts, and political pragmatism. Particularly, however, the agreements aimed at growth and the free trade of goods and services, which have been made within the framework of the

International Monetary Fund (IMF) and the World Trade Organisation (WTO) in many respects, do not conform to the Kyoto objectives. Climate protection would mean the reduction of export-oriented, resource-intensive trade. The aim should be the socio-ecological transformation of the national and the global economy, connecting the elements of decentralised energy supplies, shorter transport routes, renewable energies and sustainability. However, the intensification of world trade via deregulation, liberalisation and privatisation, and aiming for profits in a growth-oriented society, point in precisely the opposite direction,

7 Multi-Level and Meta-Governance

The debate surrounding the various governance dimensions should make it clear that contending national interests and conflicts are reflected in international climate policy, which has led to the creation of a detailed set of regulations with numerous unsettled points and special national arrangements. As a precondition for the economic orientation of climate policy and in order to avoid conflicts, the regulations have concentrated on the *output* side of the fossilistic energy system. The strategic selection of climate governance from the other (opposing) governance regimes, e.g. in the areas of trade, transport and finance, could, therefore, take place successfully. The agreement on the flexible mechanisms, finally, made it possible to integrate private enterprise into the climate process not as a cause of the problem, but as a problem-solver, and not to fundamentally question the capitalist mode of production and consumption fixated on growth. That would be necessary, however, as the trends and forecasts with regard to the consumption of fossil energy clearly show, if climate protection were to be understood as the absolute (and not only the mathematical) reduction of emissions.

It is not surprising that energy governance is essentially determined by national competition policy, which has as its goal not only access to resources and the security of supplies, but also the affordability of energy. This is, after all, a major factor in the success of the nation state in the face of global competition. Dependency on imports and high energy costs can endanger economic growth and higher profits. That is also the reason why the climate policy regulations are of secondary importance compared to the security of the supply of fossil energy. The global dependency on fossil energy resources and the power structures on the energy market at the same time narrow—even more dramatically than the policies of the USA and Australia in the climate negotiations—the corridor in which international climate policy moves. It therefore falls short of the mark to explain the failure of Copenhagen and Cancún with the blockade by certain individual countries.

The market, competition and growth have priority over all climate policy misgivings and policy measures, which interfere with the functioning of the market. Instead, the framework for new valorisation conditions is created with the new pollution rights (emissions trade), the financial instruments and all the other climate policy instruments, and precisely this framework is experiencing a re-nationalisation through the Green Recovery and Green New Deal approaches. Neo-liberalism forms the ideological discourse arena for both the national and the international concepts, and can be described as a form of "meta-governance." This form of governance is not a peculiarity of climate policy, but characterises the processes and structures of international politics as a whole (Jessop 2004): international biodiversity policy is aimed at the right of access to, and exploitation of, genetic resources, and in the WTO new investment agreements are made and intellectual property rights are codified. On the international financial markets, new financial products promising new profit opportunities are being created daily. New markets are arising everywhere that are politically prepared, established and cultivated.

Because this increasingly takes place at the international level, the social construction of the problem is decisive. As has been shown in the discussion on society's relationship with nature, the interpretation of climate change as a "global environmental problem" is a precondition for the search for a solution to the problem to proceed from the international level. The instruments with which relationships between humans and nature can be influenced are often more easily enforceable there than in a national context. "Global environmental problems" and the *top-down* approach of neo-liberal politics are connected in that they legitimise each other (Brand 2009). At the same time, the levels at which action takes place can move if the conditions in the world economy change as a result of crisis situations. This happened in the course of the world financial market crisis, and has consequences for climate governance: national interests move further into the foreground.

Only the synopsis of the various governance dimensions and the taking into account of meta-governance can explain the fragility of the international regulations. *Governance failure* must therefore also be considered as an option. It is hardly a realistic assumption that CO_2 emissions will be reduced comprehensively in the foreseeable future if, at the same time, access to, and the availability of, fossil fuels has long become an integral part of national security and military policy. Here, climate governance "gets lost" in the disparate interests and solution strategies of climate, energy and security policy, which—as this chapter explains—cannot be considered or governed independently from each other in order to achieve the intended climate protection goals. The existing climate governance regime, so far, has failed to integrate these aspects, leading to a need for restructuring and reformulation in order to avoid the aforementioned *governance failure*. What theoretical conclusions can be drawn from this?

8 Conclusions

Political science approaches in governance research, which examine the policy field-specific (state) institutions, are inadequate for the analysis of the multi-level governance of climate change and climate policy. The global conflicts over fossil resources, the specific dealing with apparently *external* nature and neo-liberal politics must also, in order to present a comprehensive perspective, be regarded as part of the problem.[4] This raises new questions with regard to the relationships of power and dominance, which permeate climate policy.

An integrated picture of the problem is obtained when the states, the *output* and the *input* side of the fossilistic energy regime, the economy and the constitution of the problem itself, in other words, the governance dimensions described above, are brought together. The fragility of the climate regime does not consist in its internal dynamics, which are characterised by contradictory interests and the heterogeneity of its actors, so that we can hardly speak of control in the sense of a goal-oriented process capable of being planned. The multi-level system "climate" must, rather, be understood as a dynamic and discontinuous structure, which is considerably influenced by its governance environments. If there is a trading or financial market crisis, this is connected directly with the climate regime. Locational competition, competitiveness and growth are the paradigms to which climate protection must adjust.

Thus, not only the "blind spots," or deficits of international climate policy, can be derived from this multi-level examination, but also a pattern for the regulation of the socio-ecological crisis: international climate policy is not directed towards a radical societal transformation focused on renewable energies and sustainability; the objective is, rather, the regulation of the harmful capitalist mode of consumption and production in order to defuse the crisis at warrantable economic cost. That is why a neo-liberal policy is followed by an alliance of the state and society, which deliberately hands over responsibility for problem-solving to the market. At the same time, strategic islands of regulation are created. It is therefore true what Lorraine Elliott writes concerning global environmental governance: "It is a political practice which simultaneously reflects, constitutes *and masks* global relations of power and powerlessness. It is neither normatively neutral nor materially benign. In practice, it has come to legitimise a neo-liberal ecopolitics, characterised by a rehabilitation of the state, liberal-individual notions of justice, and a technocratic emphasis on managerialism, standard setting and rules-based behaviour" (Elliott 2002: 58).

With regard to climate policy, this means that the forces in favour of adhering to the fossilistic energy system and the state's geo-strategies for the avoidance of resource scarcity must be regarded to a far greater extent than until now as a part of the problem. The specific modes of regulation, i.e. the structures, institutions, norms and forms of dealing with contradictions, cannot be examined separately from one another, but must be examined with regard to their interdependencies. Only then can it be explained why the harmonisation of climate protection, supply security and competitiveness has failed so far. Other political and economic governance systems (WTO, IMF, etc.) exist which are not only in contradiction to climate policy, but are also more stable and better able to prevail. However, by

[4] Regarding multi-level governance, Benz focuses on non-hierarchical, network-like structures, but also notes that the definitions to date, which stem primarily from the context of European institution research, are inadequate for further-reaching differentiations (Benz 2004: 144).

means of strategic selectivity it has been possible to temporarily "freeze" the conflicts existing between the institutions. As more recent developments have shown, though, climate as an area of conflict is increasingly coming under pressure to legitimise itself because of "internal" and "external" changes. At present, the pendulum between multilateralism and re-nationalisation is tending to swing towards the latter.

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Cities and Governance: Coming to Terms with Climate Challenges

Patricia McCarney

Abstract If cities are to meet the challenges of climate change, effective solutions must be anchored in an empowered city governance approach. Empowered city governance depends on building effective decision-making in this volatile policy field, in developing evidence-based policy-making, and in building strong city governments capable of performing as new sites of governance in global negotiations on climate change. The objectives of this paper are twofold: first, to map the core risks for cities associated with climate change; second, as a governance response, to build a more informed set of planning norms and practices, more effective infrastructure investment and urban management, and a more inclusive urban governance.

Keywords Cities · Inclusive Governance · Planning · Intergovernmental · Risks (in Cities)

1 Introduction

Risks associated with climate change are increasingly finding expression in cities. Issues of greenhouse gas emissions, sea temperature change, sea level change, land and air temperature adjustments, air quality deterioration, shifting rain, wind and snow patterns, and other unstable climate shifts, while global in nature, find particular expression in the world's cities. These phenomena serve to introduce new layers in our interpretation of urban risk, new complexities in governing cities and

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new research challenges to measure and monitor these risks in order to inform policy, planning, and management. How do we address this multiple layering and new complexity?

Effective and long-term solutions must be anchored in an empowered city governance approach which acknowledges the respective roles and contributions of a wide array of actors (McCarney 2011; Tanner et al. 2008). Addressing climate change risk in cities (Hunt and Watkiss, 2007) must be considered in a broader framework of risks confronting cities. The centrality of cities in global governance is beginning to be recognized (Amen et al. 2011a, b). Cities in the 21st century are facing unprecedented challenges. The world's urban population is likely to reach 4.2 billion by 2020, and the urban slum population is expected to increase to 1.4 billion by 2020, meaning one out of every three people living in cities will live in impoverished, over-crowded and insecure living conditions (United Nations 2008a). Social cohesion, safety, security, and stability are being tested by social exclusion, inequities, and shortfalls in basic services.

2 Mapping Climate Change Risks in Cities: Core Risks and Urban Vulnerabilities

2.1 Urban Vulnerabilities Associated with Climate Change—Categorizing Risks

While assessment internationally on climate change and risks to cities is quite diverse and varied, for the purposes of this paper, four broad categories for considering urban vulnerabilities associated with climate change are here identified. These are: alterations in temperature; alterations in precipitation; alterations in storm intensity; and sea level change.

The first three, associated with extreme weather events, and the fourth, associated with sea level change, are not easily measured as discrete phenomena in terms of cities. For example, we do know that there has been a 50 % rise in extreme weather events associated with climate change from the 1950 to the 1990s, but we do not know how many cities were impacted by these events. We also know that there have been alterations in global precipitation levels, but we do not know the spatial aspects of this phenomenon with respect to the world's cities.

A further problem encountered in surveying the field of work on climate change is the coupling of natural disasters with climate change recordings. For example, we do know that between 1974 and 2003, 6,367 natural disasters occurred globally, causing the death of 2 million people and affecting 5.1 billion people (United Nations 2007). Global increases in those natural disasters specifically associated with climate change, however, are not well disaggregated. Natural disasters associated with climate change can be identified as having direct consequences for cities, but again these measures are not disaggregated. We also know, both through informed professionals and broad ratings, that poorer urban households are usually at higher risk due to weaker structures, less safe city locations and building sites, and weaker resilience of infrastructure in poorer cities to withstand damage. Similarly, the relation between urban health and climate change risks is particularly heightened under conditions of urban poverty in cities. When basic infrastructure is inadequate, existing conditions of poor sanitation and drainage and impure drinking water are further stressed under conditions of extreme weather events and flooding, leading to the transmission of infectious diseases, which puts poor urban households at high risk.

This situation is worsened under circumstances of higher densities in urban areas. For example, in Dhaka approximately 80 % of the slum population lives in dense slum clusters with more than 90 % of slum residents sharing a single room with three or more people. A recent census in Dhaka, done by the Centre for Urban Studies, reveals that nearly 60 % of slums lack basic drainage and are prone to flooding. Flooding in slums can have serious impacts on the health of poor residents. Floodwaters in slums mix with raw sewage and breed water-borne diseases such as diarrhea, typhoid and scabies. Floods can also reduce the water supply due to contamination and infrastructure damage. As a result of the frequent flooding in Dhaka, the government has attempted to relieve some of the stresses on densely populated slums by completing construction of embankments, concrete reinforced walls and pumping stations (United Nations 2008a).

Cities in developing countries are disproportionately affected for similar reasons of vulnerability and weak institutional support and infrastructure systems. For example, many developing countries lack the health facilities to deal with large numbers of injured patients, resulting in higher death tolls than in countries better equipped for disaster. Disasters associated with climate change can paralyze entire cities and regions, and permanently destroy their social and economic assets. Creating measures and indicators across this spectrum of vulnerabilities, however, is required for informed decision-making, improved policy on climate resilience in cities, more effective urban management of risks, and a more empowered governance at the city level.

As a way forward to assessing urban vulnerabilities associated with climate change, the four categories here identified—alterations in temperature; alterations in precipitation; alterations in storm intensity, and; sea level change—can help to establish a framework for mapping and measuring climate risks in cities.

2.1.1 Assessing Urban Vulnerabilities Associated with Climate Change: Category One—Alterations in Temperature

Key consequences for cities associated with *alterations in temperature* include warmer and more frequent hot days and nights in cities and more extreme events such as heat waves, together creating a cluster of impacts that confront city governments. Alterations in temperature produce increased demand for cooling, declining air quality in cities, energy shortages, heat island effects, increased water demand and water quality problems, human health effects, and increased risk of heat-related mortality. Each of these five vulnerabilities helps us identify specific measurement needs and core indicators for assessing urban vulnerabilities associated with alterations in temperature.

2.1.2 Assessing Urban Vulnerabilities Associated with Climate Change: Category Two—Alterations in Precipitation

With regard to the second category of urban vulnerabilities associated with climate change—alterations in precipitation—the consequences for governing, planning, and managing cities are far-reaching.

Increasing frequency and intensity of precipitation in cities and more extreme precipitation events can cause pressure on, and deterioration of, water and sanitation infrastructure, particularly where there are weak and/or aging municipal infrastructure facilities. In addition, these alterations create adverse effects on the quality of surface and groundwater; contaminate water supply; create waterborne diseases; increase risk of deaths, infectious respiratory and skin diseases; disrupt settlements, commerce and transport due to flooding, and; cause large displacements of people together with loss of property.

By contrast, alterations in precipitation leading to drought also lead to adverse effects in cities, such as escalating costs of food in cities and food crises and increased migration into cities from drought-affected regions. Lowered precipitation levels also lead to increases in migration into cities from climate change-affected areas. Water shortages in cities are also a consequence of alterations in precipitation linked to climate change that pose serious risks for the general urban population and, particularly, for the more vulnerable groups, such as the elderly, the young, and the chronically sick. These consequences and related vulnerabilities help us identify specific measurement needs and core indicators for assessing urban vulnerabilities associated with alterations in precipitation.

2.1.3 Assessing Urban Vulnerabilities Associated with Climate Change: Category Three—Alterations in Storm Frequency and Intensity

With regard to the third category of urban vulnerabilities associated with climate change—alterations in storm frequency and intensity—consequences for cities include power outages and disruption to the public water supply; disruptions to settlements associated with flood and high winds; migration of population under stress; loss of property; withdrawal of risk coverage or cost escalation of insurance by private insurers, and; more generally, increased risks of deaths, injuries, and water and food-borne diseases and post-traumatic stress disorders. While global and national data on storms is being generated, city level measures assessing these vulnerabilities are not yet well formulated. Categorizing these vulnerabilities helps us identify specific measurement needs and core indicators for assessing urban vulnerabilities associated with alterations in storm frequency and intensity.

2.1.4 Assessing Urban Vulnerabilities Associated with Climate Change: Category Four—Sea Level Change

Key consequences associated with sea level change include permanent erosion and submersion of urban land and settlements; loss of property and livelihood; costs of coastal protection; costs of land use relocation; decreased freshwater availability due to saltwater intrusion and salinity in estuaries and coastal aquifers; increased risks of deaths and injuries by drowning in floods; rising water tables and impeded drainage; destruction of urban infrastructure, and; long-term effects on economic growth. Each of these vulnerabilities helps us identify specific measurement needs and core indicators for assessing urban vulnerabilities associated with sea level change. This framework of vulnerabilities can help to direct research towards identifying what city level measures already exist across this list of core vulnerabilities and then identifying gaps in our current information.

City leaders are not at the table when international protocols and agreements on climate change are discussed by member states and when states decide on whether to sign and support these international agreements (McCarney 2011). The vulnerability of cities to climate change risks is largely underestimated. There is no established set of city indicators on climate change that is globally standardized and comparable. With increasing urban vulnerability, however, estimated simply by the fact of the increasing dominance of city dwellers worldwide, city governments need to be considered as new sites of governance in global negotiations on climate change and be included in decision-making related to risk assessments.

With national governments increasingly confronting new and emerging global agendas on climate change—and because these agendas all place cities at risk—national governments while negotiating global commitments must also initiate dialogue and consensus at the city level to ensure that local authorities are part of the decision-making (Amen et al. 2011a, b) and, as importantly, integral parts of mitigation, adaptation, and implementation processes.

2.2 *Mapping Cities and Climate Change*

2.2.1 Cities and Greenhouse Gas Emissions

Cites are key actors in producing carbon emissions that contribute to climate change. According to the Clinton Foundation, large cities are responsible for about 75 % of the greenhouse gases (GHGs) released into our atmosphere. GHG emissions are usually under the control or influence of local governments since a majority of these emissions are linked to the urban form that affects transportation and energy consumption. The World Bank estimates that the transport sector alone accounts for a third or more of total GHG emissions in metropolitan areas. For example, according to a recent calculation in Canada by the Province of British Columbia, 43 % of its provincial GHG emissions are under the control of local governments (Miller et al. 2008).

Cities can make a positive contribution to the climate change agenda by consciously making urban related decisions that are informed by a clear understanding of their contribution to the problem and finding ways to mitigate and adapt to it. However, measurements of emissions by cities are as yet uneven in both their development and application, which needs to be addressed before they can guide city mitigation strategies.

Several indicators are available to estimate a city's overall GHG emissions. The indicator of 'GHG emissions measured in tons per capita,' currently in use by the Global City Indicators Facility (GCIF), is based on existing methodologies in current use by the Intergovernmental Panel on Climate Change (IPCC) and the methodology adopted in the International Council for Local Environmental Initiatives' (ICLEI) Harmonized Emissions Analysis Tool (HEAT). This GCIF indicator measures the total tonnage of GHGs (equivalent carbon dioxide units) generated over the past year by all activities within the city (the numerator) divided by the current city population (the denominator) expressed as a per capita figure. A working group with the GCIF and World Bank participation is reviewing existing methodology and intends to propose a more comprehensive methodology for use in future data submissions (ERM 2007).

Various protocols exist for GHG emissions calculations. ICLEI's Local Government GHG Emissions Analysis Protocol is a two-pronged analysis in which local government emissions are a component of community emissions, together forming a complete GHG emissions inventory. Both the government and community scopes include measures for stationary combustion, mobile combustion, fugitive emissions, product use, other land use, and waste. Another protocol developed to calculate GHG emissions for cities (Kennedy et.al 2009) uses seven components: electricity, heating and industrial fuels, direct industrial emissions, ground transportation, air, marine and waste. Air and marine travel represents the main differences between the Kennedy and ICLEI's protocols. According to Kennedy, these emissions reflect a city's "gateway status," contributing to its economy, providing jobs and agglomeration effects.

2.2.2 City Mitigation Strategies on Climate Change

Given the global estimates that energy for heating and lighting residential and commercial buildings generates nearly a quarter of GHG emissions globally, and that transport contributes 13.5 % (of which 10 % is attributed to road transport), we can assume a sizeable portion of this volume of emissions is generated in cities. It is therefore reasonable to also assume that cities have the potential and, indeed, are becoming the key actors in global mitigation efforts. City governments can influence patterns of energy and land use through important interventions under their control, including land use planning, urban design, zoning and local by-laws, including building codes and height by-laws and transport planning including transit planning road networks, master plan, and subdivision controls.

Kessler et al. (2009) have identified points of intervention by cities for climate change mitigation, suggesting available technologies and policy instruments available to cities. A few examples of city action in the field of climate change mitigation can assist us in considering measurements for targeting and monitoring mitigation efforts.

The Vienna City Council adopted the city's Climate Protection Programme as a framework for its Eco-Business plan and, as a result, the city has reduced its solid waste output by 109,300 tons, toxic solid wastes by 1,325 tons and carbon dioxide emissions by 42,765 tons. This Eco-Business plan has saved a total of 138.7 million KWh of energy and 1,325,000 cubic meters of drinking water. The Eco-Business plan is also now being implemented in Chennai, India, and Athens, Greece (United Nations 2008a).

In the building sector, improvements to building codes and certification processes for greener buildings are being adopted by a number of cities. The City of Johannesburg, South Africa, has implemented mitigation measures which include retrofitting of council buildings, energy savings in water pump installations, and methane gas recovery. One set of measures already well established is the Leadership in Energy and Environmental Design (LEED) certification framework that ensures a building is environmentally responsible by providing independent, third-party verification. LEED certification seeks to ensure that a building project meets the highest green building and performance measures. The average LEEDs building uses 30 % less energy, 30–50 % less water, and diverts up to 97 % of its waste from the landfill (U.S. Environmental Protection Agency 2007).

Portland has been a key player in adopting strategies to address climate change. In 2000, the Portland Office of Sustainable Development (OSD) launched a program to support the design and development of green buildings in the city. The program offers technical assistance, education and financial incentives, and has so far supported more than 300 local buildings. The City of Portland has taken various measures in order to reduce energy use by using renewable sources and making technological improvements. Technological improvements made by the City have reduced energy use by 80 %. For example, all traffic signals were converted to highly efficient LED bulbs and, by doing so, have saved the City almost five million kWh per year and over USD 500,000 annually in energy and maintenance costs (The City of Portland and Multnomah Country 2005).

When it comes to establishing GHG reduction targets, cities have an important role to play in helping to determine an equitable distribution of these targets, which will help to frame mitigation strategies on climate change. For example, current debates between per capita emissions of inner city residents versus suburban residents, between large city residents versus smaller city residents, and between wealthy cities versus poorer ones, raises issues of equity in sharing the burden in meeting reduction targets. Measures are weak and no methodology for determining an equitable distribution of high-level GHG reduction targets has been established (Miller et al. 2008).

While it is generally assumed that suburban residents emit significantly more carbon dioxide than inner city residents, it could thus be concluded that it would be more equitable to require suburban communities to shoulder the largest burdens for reductions. However, indicators on this question are still weak. For example, while some estimate that suburban dwellers produce up to three times more GHGs per capita than inner city dwellers, recent data (Glaeser and Mathew 2008) suggest that this dichotomy is not so simple. They report that, indeed, while per capita emissions rise as you move away from the urban core of Boston, they level off once you are more than ten miles from downtown. Another exception they have found is with respect to Los Angeles, where emissions are actually lower in suburban LA than they are in the central cities of that metropolitan area.

Such issues are complicated further by considering the challenges and opportunities of high-growth versus low-growth communities, as well as questions of per capita versus total reduction targets. In the case of British Columbia, the Province plans to negotiate with local governments with the intention of arriving at an equitable allocation on a municipality by municipality basis.

Finally, a new set of indicators on climate change mitigation are also needed if policy-makers are to assess the capacity in communities for GHG reductions and what costs related changes would generate—physically, socially and economically—before they can act. Policy-makers need to know, for example, how redesign, urban form, and rebuilding of the suburbs might overcome, for example, car dependency (Miller et al. 2008).

2.2.3 City Adaptation Strategies on Climate Change

Indicators can help cities understand the problem of climate change and inform city managers and leaders in their role in building resilience to its adverse impacts. A number of adaptation measures to climate change in cities are largely made up of individual choices so knowledge through public education, research, and publicly accessible data on indicators can assist citizens towards action. Collective action at the community and municipal level carries potential for appropriate responses for climate change adaptation in an urban context.

Adaptation measures can take several forms: some actions are taken to reduce vulnerability to climate change; some involve spreading risk among a wider population (insurance); some involve eliminating activity or behavior that causes climate change; and some involve moving vulnerable populations away from hazards.

Many cities are developing strategic plans for climate adaptation. For example, strategies to adapt New York City (NYC) to “the unavoidable climate shifts ahead” (The City of New York 2007, p. 136) are included in PlaNYC 2030. NYC’s plan for climate change adaptation focuses on securing the city’s existing infrastructure, identifying and protecting floodplain zones and specific at-risk communities, and establishing a citywide strategic planning process with emphasis on tracking emerging climate change data and its potential impacts on the city.

3 Using Indicators to Assess and Address Deeper and Enduring Risks and Long-Term Vulnerabilities in Cities

The severe consequences and threats that cities are now facing as a result of climate change, the pressing shortfalls in urban water, sanitation, and waste management services (Kurian and McCarney 2010), inadequate housing and insecurity of shelter, and the deteriorating quality of air and water in city environments, are being experienced in a context of intense urban growth of cities that increasingly manifests deepening poverty and income inequities, socio-economic exclusion, and socio-economic dualism (McCarney and Stren 2003).

The adoption, in the year 2000, of the Millennium Development Goals (MDGs) by the UN Member States, registers a commitment by the international community to development of the poorest regions of the world and to assist the most vulnerable. From this agreement, the UN Secretariat established eight goals, each with a set of quantitative targets and indicators, to ensure a common assessment and to track progress at global, national, and local levels towards achievement of the MDGs.

All eight of the MDGs can be directly connected to the theme of vulnerability in the world's cities. Indeed, it is the world's cities and the slums within them that are pivotal platforms for the successful achievement of each MDG. Each of the eight goals finds expression in cities as they relate to poverty, education, gender, child mortality, maternal health, diseases, environment, and global partnerships. In addition, meeting the time frame and the numerical targets of the MDGs will require a determined focus on cities since the majority of affected women, men, and children will be living in urban and peri-urban areas by the target dates of 2015 and 2020.

Goal 7—to "Ensure Environmental Sustainability"—sets out three targets: to reverse the loss of environmental resources; to improve access to safe drinking water, and; to improve the lives of slum dwellers. Linking these three targets helps to frame the challenges cities face in addressing climate change in a context of poverty.

The United Nations System assigned UN-Habitat responsibility to assist Member States in monitoring and gradually attaining "Goal 7 Target 11", which is referred to as the "Cities without Slums" target. Roughly 80 % of urban residents in the lowest-income countries are already living in slum conditions and, based upon projected demographic trends, the number of slum dwellers is expected to double by 2030. Given this twin problem of the existence of massive slums and the projected growth of slums worldwide, meeting the MDG 7 Target 11 must entail a two-pronged approach: upgrading today's slums to improve the living conditions and the conditions for meeting most of the MDGs, and planning alternatives to slums for the future.

International development assistance, national and local governments and the private sector must be mobilized to partner with the urban poor to support their ongoing efforts and scale up urban poor-led upgrading. Addressing the deficiencies in urban infrastructure and services and sub-standard housing of slum dwellers is central to climate change adaptation.

Social cohesion, safety, security, and stability are being tested by social exclusion, inequities, and shortfalls in housing and basic services. Risks associated with each of these conditions are critical factors in the ongoing discussion on urban risks associated with climate change across the four categories identified in the foregoing. The situation of poverty in cities worldwide, but in particular in the less developed regions, must be recognized as a core conditioning factor in addressing climate change and building more climate-resilient cities. This means explicitly recognizing that climate change adaptation must in tandem reduce the vulnerability of the poor in cities. To do so, however, depends on meaningful data on city slums and indicators that track density; water and sanitation infrastructure inadequacies relative to climate change risks, particularly alterations in precipitation and sea level change, and; structural qualities of housing at increased risk from alterations in storm intensity and temperature change.

4 Cities at Risk: Emerging Approaches to Safer Cities

4.1 From Indicators to Governance—Evidence-Based Policy Formulation

The World Bank defines indicators as performance measures that aggregate information into a usable form. Indicators provide a useful tool in the prospective sense for policy-making and also in the retrospective sense for assessing policy implementation. Indicators offer assistance to policy-makers by aiding in comparison, evaluation, and prediction.

While country-level data and analysis on climate change have improved in recent years, serious gaps exist at the city level. Quantitative city data on climate change is being developed by cities in a discrete form that is often adapted from broadly accepted national level methods. Serious gaps and the lack of time series data on cities and climate change hamper efforts to diagnose emerging risks and problems, to assess policy options in terms of both mitigation and adaption strategies, and to gauge the effectiveness of their city-level programs.

Globally comparative, indicator-based knowledge on cities and climate change has become increasingly more important as national measures evolve and country-level policy positions emerge. City-level indicators that have a globally standardized methodology are important, not for purposes of numerical ranking of cities, but for informing policy decision-making through comparative city data that provides policy leverage for city leaders locally, nationally, and globally. The GCIF provides a system for cities to use globally standardized indicators as a tool for informing policy-making through the use of international comparisons. For example, the Secretariat of Finance in Bogota uses indicators from the GCIF as a way to track the city's investments and to compare their city's performance relative to other international cities. By using indicators and drawing global comparisons, the Secretariat of Finance "is able to evaluate and monitor performance on their investments and to benchmark their performance in comparison to other cities" (City of Bogota—Finance Secretary 2009[1]).

As informational policy instruments, indicators provide more and better knowledge to local decision-makers and offer a methodical system of informing decisions. For example, the City of Sao Paulo, a member of the GCIF, recognizes the need for indicators as a tool for increasing transparency and accountability within their government. Sao Paulo is an important demonstration of how municipal governments can use indicators to enhance governance and institute evidence-based policy development in the City (City of Sao Paulo 2009[2]). The City of Sao Paulo has recently prepared its Plan—"Agenda 2012"—and states that the plan preparation is "a concrete example of how indicators improve governance, establish evidence-based policy making and promote civic engagement."

When indicators are well developed and soundly articulated, they can also influence how issues are constructed in the public realm. This is an important lesson related to cities and climate change since information can help to direct behavior in building climate action. Behavioral change can result from publicly accessible information by becoming embedded in the thoughts and practices, and institutions of users (Innes 1998, p. 84). Hezri and Dovers argue, for example, that "as a source of policy change, learning is dependent on the presence of appropriate information with the capacity to change society's behavior" (2006, p. 11) and "community indicator programs, or, state-of-the environment reporting, are usually aimed at influencing the social construction of the policy problem" (2006: 12). In addition, in a review on urban sustainability indicators, Mega and Pedersen (1998) suggest that indicators should aid in decision-making at various levels to promote local information, empowerment, and democracy.

City indicators on climate change can enhance understanding of the risks associated with climate change, influence opinion and behavior, shape policy, determine priorities, and thereby impact on a city's relative contribution to global climate change.

[1] Interview and case study material gathered from the City of Bogota—Finance Secretary 2009.

[2] Interview and case study material gathered from the City of Sao Paulo 2009.

4.2 The Role of City Indicators on Climate Change for Effective Planning and Management

When local government is recognized as a legitimate tier in the governance structure of a country, and when financial powers to raise revenues and responsibilities to deliver services are commensurate with the growth and expansion of cities, then the planning and management functions in cities take on meaning, and develop influence. Cities worldwide are entering into renewed dialogues with provincial and national governments to discuss this urban agenda. In this context, more rigorous data-driven policy analysis by cities creates leverage in intergovernmental relations. Moreover, indicators can help to build more effective planning and efficient management for climate action in cities.

Indicators on climate change at the city level can inform city officials and support their existing, and indeed potentially far-reaching, powers of planning, aimed at climate change adaptation and mitigation. For example, cities have the power to pass legislation related to GHG emissions; cities have the capacity to encourage participation and engage with related governmental agencies and local corporate organizations on climate change mitigation; to build more inclusive institutions in cities for achieving environmental objectives; cities have the power to plan and design transportation systems that support access by all citizens and rational choices on where to live and work that is in keeping with a climate change agenda for the city; cities have the power to ensure strong and robust local economic development patterns that build economic opportunity for all citizens while addressing climate change; cities have the power to address land tenure and land rights in the city and can thereby adopt a pro-poor set of policies governing access to and, environmentally safe use of, land in the city; cities have important powers over building codes and zoning by-laws and can adopt flexible standards governing safer construction of housing, buildings, and infrastructure that are more resilient to climate change risk and to adopt standards on greener buildings, and; cities have the power to develop creative financing tools for mobilizing investments that help to overcome climate-related threats derived from a lack of basic infrastructure and environmental amenities for all, and especially the poorest urban residents in cities.

However, there is an information crisis that seriously undermines effective urban planning on climate action. The lack of monitoring structures and standardized city indicators weakens the power of good planning decisions in cities, particularly cities of the developing world concerned with reducing vulnerability to climate change.

4.3 Addressing Risk and Vulnerability in Cities Through a More Empowered, Cohesive, and Inclusive Governance

Over the past few decades, efforts to improve and strengthen urban governance have focused on the essential first step of devolution of power, authority, and resources from the central to municipal level. Governed by the principle of subsidiarity, decentralization processes seek to ensure that decisions are taken, and services delivered, at the sphere of government closest to the people, while remaining consistent with the nature of the decisions and services involved. A responsible fiscal federalism that positions cities as critical partners in the governing relationship is now being recognized as a pivotal policy platform for global action on climate change and local responsibility for mitigating climate change and building climate-resilient cities.

World trends in urbanization are causing urban populations to spread out beyond their old city limits, rendering the traditional municipal boundaries and, by extension, the traditional governing structures and institutions, outdated. Single city jurisdictions of the past are being made more complex by multiple city jurisdictions that spread outward and build large and complex metropolitan governance systems.

As urban areas around the world continue to expand both in terms of density and horizontal space (Angel et al. 2005), there is a need to govern these large areas in a coherent fashion. Highly fragmented governance arrangements in many metropolitan areas make efficient planning, management, and urban financing for area-wide service provision a difficult and on-going challenge (Klink 2007; Lefèvre 2007). Climate change action, however, requires coherence and integration across these jurisdictions.

This metropolitan expansion is not just in terms of population settlement and spatial sprawl but, perhaps more importantly, in terms of their social and economic spheres of influence (McCarney and Stren 2008). The functional area of cities has extended beyond the jurisdictional boundaries. Cities have extensive labor markets, real estate markets, financial and business markets, and service markets that spread over the jurisdictional territories of several municipalities and, in some cases, over more than one state or provincial boundary. In a number of cases, cities have spread across international boundaries. This expansion is taking place regardless of municipal jurisdictional boundaries. Increasingly, effective climate change action demands more integrated planning, service delivery, and policy decisions than these multiple but individually bounded cities can provide. A decision taken in one municipality that is part of the larger city affects the whole city. This phenomenon introduces new challenges of governance and, in particular, metropolitan governance on climate change. There is a need to govern these large areas in a coherent fashion since they are the staging sites for meeting the serious challenges of climate change in the future.

Building effective and long-term solutions to climate change requires a city governance approach which acknowledges the respective roles and contributions of a wide array of actors. An inclusive city government that involves long-term residents, international migrants, the poor, marginalized groups, national minorities, and indigenous peoples is fundamental to building safe, livable, and climate-resilient cities. The development of new policies and mechanisms for local governance is rooted in strong grassroots participation, that citizens and community groups are equipped with the understanding of democratic governance to hold local and more senior levels of government accountable, and that the poorest and most isolated communities are represented in the public debate. Addressing climate change risk in cities thus depends on the availability and accessibility of information on climate risks and an engaged, informed urban citizenry involved in the formulation of climate action plans.

Tanner et al. (2008) identify specific characteristics of good urban governance that improve urban climate resilience. The authors stress that improving citizens' access to information and maintaining a relationship of accountability between local governments and their citizens are key to improving cities' climate resilience (2008: 21). Participation and inclusion are closely related to the need for transparency, accountability, and information disclosure for good urban governance. Publishing information on official websites and providing procedures for citizens to request information ensures access to information for urban residents. Media and internet access, education levels, income levels, and local government's information disclosure culture determine the success of participatory and inclusive processes (2008: 26).

Engaging citizens in the running of their city can take many forms, and experiences in cities worldwide are being well documented. Typical steps include public consultations, public hearings and meetings, appointing citizens to advisory bodies inside municipal authorities, and designing community councils with stakeholder voice at municipal council sessions. Valuable research and evaluations have been undertaken of recent experiments involving citizen engagement in environmental and neighborhood impact studies, in the establishment of people's councils, in the inclusion of NGOs and other representatives from the private sector on local service boards and development councils in preparing development programs, allocating funds, and participating in planning and design initiatives for communities, in popular initiatives to put forward urban laws, and in the practice of participatory budgeting (McCarney 1996).

5 Conclusion

This paper has mapped the core risks for cities associated with climate change through literature review and city case studies, and has examined the use of city indicators in assessing and addressing these risks and vulnerabilities in cities. The paper has explored how knowledge derived from city indicators on climate change could help to direct a more informed set of planning norms and practices, more effective infrastructure investment and urban management, and a more inclusive urban governance.

An argument has been put forward that indicators on cities and climate change can add new policy leverage for local governments, in terms of building empowered decision-making in this volatile policy field, in developing evidence-based policy-making, and in building strong city governments capable of performing as new sites of governance in global negotiations on climate change and in decision-making related to risk assessments.

In building this argument and identifying the potentials and opportunities for cities to increasingly play an active and, indeed, critical role on the global climate agenda, a core set of challenges are here recognized. First, research challenges in this emerging field of cities and climate change can be identified. Based on the mapping of risks in Part I of this paper, gaps in city indicators and/or weaknesses in methodologies for comparative indicators on cities and climate change pose important challenges for researchers, international agencies, and cities and their communities globally. Second, governance challenges for cities that arise as a result of new risks and vulnerabilities associated with climate change can be identified. Based on the mapping of governance, planning and management responsibilities in Part II, new challenges emerge for city governments in addressing climate change and developing climate action plans. This dual set of challenges will be presented here by way of conclusion, but more importantly to serve as a roadmap for next steps if cities are to be successful in confronting climate change risks and building more climate-resilient cities in the future.

The governance of cities is pivotal in confronting the challenges of climate change. City governments are constrained, however, on a number of fronts when it comes to formulating and implementing climate action. Many city governments are weakened due to only limited power and responsibility over key public services, including planning, housing, roads and transit, water, land use, drainage, waste management, and building standards. In many of the poorest cities of Asia, Africa, and Latin America, under-serviced informal areas of the city do not have basic services such as waste collection, piped water, storm and surface drains, and sanitation systems, placing large portions of cities at even higher risk of climate change impacts, particularly from storms, flooding and heat waves. City governments often lack powers (with respect to higher orders of government—state and national) to raise the revenues required to finance infrastructure investments and address climate change challenges. When governance capacity is weak and constrained, cities are limited in their abilities to take action on climate change.

Deficient intergovernmental relations, inadequate popular local representation processes, weak sub-national institutions, and poor financing mechanisms to support these sub-national government forms pose critical questions for policymakers and leaders at all levels of government, as well as for researchers, planners, and international agencies concerned with climate change.

Addressing climate change risk in cities must also be considered in a broader framework of risks associated with poverty. Cities in the 21st century are facing unprecedented challenges. The world's urban population is likely to reach 4.2

billion by 2020, and the urban slum population is expected to increase to 1.4 billion by 2020, meaning one out of every three people living in cities will live in impoverished, over-crowded, and insecure living conditions. The situation of poverty in cities worldwide, but in particular in the less developed regions, must be recognized as a core conditioning factor in addressing climate change and building more climate-resilient cities. This means explicitly recognizing that climate change adaptation must in tandem reduce the vulnerability of the poor in cities.

A significant challenge confronting the larger metropolitan centers in addressing climate change is that associated with fragmentation. As urban populations grow and spread out beyond the old city limits, the traditional municipal boundaries and, by extension, the traditional governing structures and institutions are increasingly outdated. Highly fragmented governance arrangements in many metropolitan areas make efficient planning, management, and urban financing for climate action planning a difficult challenge. Climate change action requires coherence and integration across these jurisdictions.

When considering climate action in these large metropolitan areas, whether in terms of measuring risks, establishing indicators, creating mitigation or adaptation strategies, the challenges of metropolitan governance and the contexts of administrative, management, and political fragmentation are critical to confront.

Urban metropolitan areas demand and consume vast amounts of energy, water, and other material resources that impact on climate change. Cities are both victims and perpetrators of climate change. They generate the lion's share of solid waste, electricity demand, transport-related emissions, and space-heating and cooling demand. On the other hand, cities and local governments are well positioned to set the enabling framework for climate change mitigation strategies, as well for taking a leadership role in addressing the challenges related to hazard management as countries adapt to climate change. For cities to effectively address climate change, coordination and overcoming the problems of fragmentation in political institutions locally is a core requirement.

Five core governance challenges can be identified that are at the base of successful climate action:

1. *Effective leadership* is critical for overcoming fragmentation and building consensus in cities if effective climate action planning is to be achieved. Strong leadership can overcome individualism and competition across political 'turf' and build recognition that more metropolitan-wide collective action on climate change is empowering at both national and international levels. The ability to build consensus and coordination better facilitates investments in infrastructure and amenities that make the metropolis more resilient to climate change. Strong leadership in the affairs of metropolitan governance means not only building consensus, but also aggregating these fragmented interests in a way that builds legitimacy and accountability to stakeholders in the process.
2. *Efficient financing* is a core requirement for climate action by cities. Success to date with efforts to confront climate change challenges in cities has been hampered due to deficient financing tools at local levels of government. The

redistribution of responsibilities between different levels of government has not always been sustained by a corresponding allocation of resources or empowerment to adopt adequate financing tools needed to raise these resources. If these weaknesses are common at the level of individual municipalities, then the problems of raising finance to support the broader metropolitan areas are compounded. Highly fragmented governance arrangements in many metropolitan areas makes efficient financing for area-wide climate mitigation and adaptation strategies a difficult and on-going challenge. As witnessed in the Chicago Climate Action Plan, raising funds to support the initiative required substantial effort and collaborative work. Without a clear, permanent, and sufficient financial mechanism, it is indeed quite difficult to implement planning for more climate-resilient cities.

3. *Effective citizen participation and access to information.* Improving citizens' access to information and maintaining a relationship of accountability between local governments and their citizens are critical to improving a city's climate resilience. Principles of transparency and democracy require that the mechanisms of participation are accessible, easily understood, and with simple forms of representation. Addressing climate change risk in cities depends on the availability and accessibility of information on climate risks and an engaged, informed urban citizenry involved in the formulation of climate action plans.
4. *Jurisdictional coordination* is one of the most pressing governance challenges common to cities worldwide. This challenge takes two forms: multi-level jurisdictional coordination of services vertically across multiple levels of government, and inter-jurisdictional coordination of services horizontally across the metropolitan area. In the case of the former, the inter-governmental relations involved in the governance of cities are often in flux with extensive and complex decentralization processes in motion in many countries worldwide. Multiple tiers of government and various levels of state agencies are involved in the climate change agenda, and vertical coordination is often weak or non-existent. In the case of the latter, existing governing institutions are often horizontally fragmented, uncoordinated and, in many cases, ad-hoc when it comes to climate change strategy, due to multiple jurisdictional and electoral boundaries that span the territories of vast metropolitan areas. Coordination is fundamental not only in basic sectoral areas such as land, transport, energy, emergency preparedness, and related fiscal and funding solutions, but in addressing issues of poverty and social exclusion through innovative mechanisms of inter-territorial solidarity.
5. *Land use planning* is a key criterion for effective city governance in the arena of climate change strategies. Territorial and spatial strategies are key to addressing climate change risks and building effective mitigation and adaptation strategies. Land use planning in cities and their peri-urban areas and the broader hinterland of cities and transport and related infrastructure planning at urban and regional levels are core requirements in addressing climate change in cities worldwide. Managing transportation and infrastructure investments in large metropolitan areas is essential for the advancement of the climate change agenda and

addressing GHG emission targets. These investments and services, however, are often implemented, financed, managed, and regulated by different governing institutions and levels of government. Coordination of these processes relies on complex intergovernmental policy networks and organizational management. This coordination is an essential basis for making progress on the climate change agenda in cities globally.

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Local Climate Governance and the Role of Cooperatives

Carolin Schröder and Heike Walk

Abstract Global climate change and its consequences have led to a wide-ranging re-evaluation process in political and business circles. Two prominent reports—the Stern Review from 2006 and the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007)—underscore the fact that the impact of global warming can no longer be contained at an acceptable level unless emissions are reduced dramatically. Hence, the pressure to act is quite high: comprehensive technical, political and societal innovations have to be implemented within a very short timeframe at global, regional and local levels. But this can only happen if a fundamental re-orientation also takes place within society. At the same time, and due to recent economic crises, sustainable forms of entrepreneurship have returned to the public agenda. One promising form of sustainable social and economic organisation is the cooperative (*Genossenschaft*): for their members, cooperatives represent an opportunity to shape their local communities and environments while sharing resources, knowledge and economic power to their benefit. With a rising number of new cooperatives in the sectors of energy/water, housing/construction, consumption and mobility explicitly referring to climate protection, climate-related activities, in turn, have the potential to inject new life into the cooperative movement and to provide innovative, collective approaches to local climate governance. This following article analyses and discusses the current and potential future roles of cooperatives in the development of local, climate-friendly governance strategies. After a short description of the concept of local climate governance and an introductory definition of cooperatives, the authors will outline research gaps in both fields, and finish with some thoughts on the future role of cooperatives. In addition, the authors aim to make a

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substantial contribution to discussions about the importance of the role of bottom-up strategies in the transition towards a climate-friendly society.

Keywords Urban solidarity · Cooperatives · Societal strategies for sustainability · Collective behaviour · Democratic and climate-friendly economy

1 Local Climate Governance

At the local level, both the relationship between state and society, and the scope of political design possibilities, have changed drastically. This can be ascribed to decreasing public budgets on the one hand, and to changing labour divisions between public, private and third sector on the other. In consequence, local governance studies refer primarily to pluralistic constellations of stakeholders and changed modes of administration. Thus, not only the relevant institutions and stakeholders (individuals, groups, associations, businesses, organisations) have to be taken into account, but also the actual implementation of policies in local decision-making processes, modes of cooperation, the overall context of governance processes (Benz 2004) and a high degree of complexity exacerbated by social, political and economic globalisation.[1] The fundamental acceptance of local governance approaches in science and in practice stems from the fact that public and private participation (citizens, small and medium-sized enterprises—SME) in local organisations and institutions, as well as the political and social reactions to these, are assumed to contribute to proliferating governance mechanisms (Walk 2008; Heinelt 2004). Nonetheless, the actual requirements for democratic legitimisation are being questioned. Empirical results vary widely in focus and methods from, for example, quantitative evaluations of public–private cooperation and of tools for fostering participation (see also Bogumil and Vogel 1999) to qualitative comparative case studies on cooperative arrangements in various political fields.

With climate protection being a comparatively new area for research and activity, one focus of qualitative research has been on the analysis of climate programmes at the local level since the mid 1990s. These early municipal climate programmes obviously concentrated on a "learning by doing" approach, since there was little scientific data available regarding the consequences of climate change (Kern and Alber 2008). And, if representative, these results are mainly available for the global and national levels. Soon after this, networks of municipalities were established in order to cooperate or to exchange knowledge on

[1] These vary from informal forms of cooperation (discussion groups, workshops, forums, etc.) to mainly economically oriented approaches (public limited companies, public–private partnerships) and to formalised networks (special-purpose associations, planning associations, municipal consortia).

climate protection at the local level (e.g. Cities for Climate Protection Campaign, Climate Alliance, Energie-Cités).

At around the same time in the 1990s and early 2000s, in the wake of the 1992 Rio Summit, the quest was for all local governments to initiate Local Agenda 21 (LA21) programmes for their communities, and several comparative European studies of joint local efforts on sustainable development were carried out. These studies stressed the impact of governing structures on the mobilisation of stakeholders, and cooperative management regimes as, for example, the degree of support from central governments to LA21—in addition to the legacy of pre-existing social partnerships—were found to be one of the main explanatory variables for differences in national civil society's activity patterns across different countries (Lafferty and Eckerberg 1998; Lafferty 2001). In particular, the successful interaction between high levels of institutional, social and policy capacity characterised the most dynamic and active local communities across Europe (Evans et al. 2005).

As, initially, mainly smaller municipal entities implemented climate programmes, research also concentrated on these (Adger 2001: 9), for example, studies of "Bioenergiedörfer" [bioenergy villages] in Germany or "solar villages" in England. In that context, innovative approaches and structures aimed at the participation of public and private actors (citizens and SME) have developed (Kern and Bulkeley 2009; Kern et al. 2007; Brand and Warsewa 2003; Heinelt 2000). Only in recent years has social research extended to regional climate protection strategies where public, economic and non-professional actors have established various forms of regional governance to promote the issue and to develop action and activities (see, for example, Keppler et al. 2009; Tischer et al. 2006; Späth et al. 2007; Smith 2006; Projekt 100 %-Erneuerbare-Energie-Regionen 2009). But fewer empirical results are available regarding climate protection and climate governance in larger cities and city regions.

Nonetheless, large cities are increasingly implementing integrated approaches, combining strategies of avoidance and adaptation, and attempting to create various synergy effects (Bulkeley and Betsill 2005; Klimzug-Nord (TuTech Innovation GmbH) 2009). Again, the findings available in this area focus on changes in governance structures in the context of climate change at national and international levels (e.g. Foxon and Parrish 2009 for the UK; Tanner et al. 2008 for Japan; Aall et al. 2007 for Norway; Kern and Alber 2008 for OECD countries and the programme "Sustainable Cities" (Villes Durables) founded by the French National Research Agency; see also Caulfield and Larsen 2002). Further scientific findings for the German context are available for the thematic areas of housing/construction, energy/water, consumption and mobility, for example, from the research programme "Klimazwei" of the German Federal Ministry of Education and Research, and from the "Sustainable consumption" focus of that ministry's Socio-Ecological Research programme.

2 Cooperatives as Local Actors

Cooperatives represent a well-established and institutionalised form of civil organisation with a diverse presence worldwide. They are institutionalised forms of collective self-help (Müller 1980). Scientific studies have shown that cooperatives have been particularly effective in times of rapid economic, social and technical change (Röpke 1992), as the general objective of any cooperative is to actively support their members through common efforts across various aims. Their specific logic of collective action is characterised by an appreciation of (internal) democracy and solidarity with a local bearing (Atmaca 2007; Brockmeier and Fehl 2007). And, according to the International Cooperative Association (a non-governmental association currently representing 233 cooperative organisations in 89 countries worldwide), cooperatives "are based on the values of self-help, self-responsibility, democracy, equality, equity and solidarity" while their "members believe in the ethical values of honesty, openness, social responsibility and caring for others" (ICA 1995).

While the first cooperative-like structures evolved within the agrarian sector, cooperatives became especially popular in the late nineteenth and early twentieth centuries when, for example, workers, middle-class craftsmen or retailers founded credit cooperatives in order to cope with the challenges of industrialisation and economic liberalisation and when, for example, citizens founded housing cooperatives all over Europe as a means of overcoming poor housing conditions and to provide affordable accommodation for their members.[2] After a few decades of popularity, the cooperative sector had to cope with both concentration processes and new forms of socio-economic organisation: between 1950 and 1970, the number of registered cooperatives in Germany declined by almost a third (from more than 26,000 down to about 18,500), and in the three subsequent decades by another 50 % (with only 9,500 registered cooperatives by the end of 1999, and a mere 7,500 since 2006; Stappel 2009). This is not necessarily a sign of growing unpopularity, as many cooperatives from all sectors have been turned into non-cooperative forms of organisation, not necessarily losing their objectives (as GmbH, GmbH & Co. KG or AG).

Despite declining absolute figures, in Germany, registered cooperatives still have more members than any other form of organisation (some 20.5 million out of 80 million inhabitants) and with a large variety of areas of activity. Almost every farmer is still a member of at least one cooperative. Also, more than 90 % of all bakers and butchers, an average 60 % of all craftsmen and an average 75 % of all retailers are still organised in cooperatives. However, in the financial sector, in particular, a

[2] From that time, two basic types existed: cooperatives with a mainly economic orientation, primarily supporting the mutual self-help of their members (e.g. Germany, the United Kingdom, Sweden) and cooperatives also oriented towards political/social aspects or even resistance, such as in France, where cooperatives have been an integral component of what was termed the "économie sociale" (Ehm 1983: 20).

concentration process of (credit and savings) cooperatives has been observed. Housing cooperatives in Germany are still a major factor, with three million members and 2.2 million units to take care of—which is a good 10 % of the entire national housing market. Nonetheless, the number of new cooperatives remains small, with just 60 newly registered cooperatives in 2003 in Germany (74 in 2006), compared to more than 5,00,000 new businesses being registered (Atmaca 2007).

According to the previously mentioned principle of collective self-help, members of cooperatives aim to make their own decisions, and have their own responsibilities and autonomies while choosing collective ways of problem-solving. While each member is formally a co-entrepreneur with one vote in the obligatory cooperative general assembly, and is independent from their actual monetary contribution to the cooperative, an additional supervisory board and an executive board have to be elected whose activities are based on the general assembly's decisions and the general aims of their respective cooperative. Further characteristics define cooperatives: the voluntary nature of membership, equal rights of all members, internal democracy, participation, solidarity and autonomy of the internal organisation, as well as the general objectives and their implementation (Hanel 1992, cf. Flieger 1996: 33). Patera even describes cooperatives as an "emancipatory social system" (1990: 287). In addition, cooperatives are inextricably linked to the sustainable functioning of local communities and markets. According to Braudel's (1979) three spheres concept of economic activity, cooperatives are important for the production and maintenance of local economies and markets, and are particularly significant from the point of view of building and maintaining trust and reciprocity in local markets and cooperative networks.

But until 2006, it was quite difficult to establish a cooperative.[3] With new national and European laws on cooperatives, the minimum number of members was reduced from seven to three, a facultative advisory board (for small cooperatives) was installed, a facultatively smaller executive board, investing membership and multiple voting rights for members, was introduced—if agreed in the general assembly. At the same time, possible plans for action were expanded. Since then, registered cooperatives in Europe have been free to pursue not only economic, but also social or cultural, including environmental aims, and to establish transnational cooperatives.

3 Local Climate Governance and Cooperatives

While the absolute number of new cooperatives has not increased since 2006—neither in Germany nor in many other countries—the objectives of both existing and newly founded cooperatives are becoming increasingly diverse. As a

[3] In France, a new statute for societies was adopted in 2001 to promote cooperative action between the private and public sector and sustainable economic and social innovation. In the field of housing, this new statute revived the dynamic of social accession to propriety and the local strategy for low-energy housing (Denèfle et al. 2006).

consequence of the changed law, some cooperatives even address sustainable development and climate protection measures explicitly, for example, by declaring climate protection as one of their main objectives, by providing low-energy houses, car-sharing, organic food coops or information and advice on energy-saving and sustainable consumption. Another explanation for the recent small boom in cooperatives in Europe is derived from the consequences of decade-long privatisations and a growing mistrust in the established forms of (capitalist) economy. New cooperatives, mainly in the energy and water sector (e.g. operating local power plants in Austria and Spain), but also in the housing (e.g. in Scandinavia) and consumption (e.g. Switzerland, Italy, Sweden and Denmark) sectors are being formed, again, some with the explicit intention of making a collective contribution to sustainability and climate protection. Not surprisingly, the majority of recently formed cooperatives in Germany are energy cooperatives, as 23 % of all new cooperatives are founded in this sector (Pollich 2009). These mainly operate local or regional solar plants, wind farms and bioenergy plants. Volz (2010) writes that there were about one to two new formations per month in 2010, and around 70 new formations of energy cooperatives for the years 2000–2008 in Germany. Of course, the popularity of small- to medium-scale solutions is not restricted to cooperatives alone; it can rather be seen as part of a larger trend that hungers for economically and socially sustainable organisations.[4]

The authors argue that cooperatives will become increasingly important for sustainable and cooperative solutions at the local level as they have the potential to spearhead new behavioural and social patterns of action, oriented towards more sustainable paths: cooperatives address everyday needs (for housing, community, mobility, consumption and sustainable provision of resources). And, increasingly, cooperatives are being conceived of as a viable counter-strategy to the privatisation of municipal enterprises. In addition, cooperatives in principle allow for the greatest possible civic involvement in decision-making processes, with value creation remaining citizen-centric and communally available. The cooperative movement—and especially the formation of new cooperatives—thus has the potential to inject new life into the mobilisation of individuals, civil society, policy-makers and economic actors by actively supporting a transition to sustainable practice in Europe. Although not all cooperatives can necessarily be associated with the civil society (Atmaca 2002, 2007), many cooperatives exist that unite ethical arguments with economically viable and sustainable aspects.

While there is a large variety of formal and informal structures that can be implemented to facilitate urban sustainability, the specific appeal of cooperatives

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[4] Flieger (2009) differentiates between four types of energy cooperatives: first, the energy consumer cooperatives concerned primarily with trading and selling energy; second, energy production cooperatives whose members jointly produce energy; third, energy generator consumer cooperatives that pursue integrated solutions, e.g. municipalities that are self-contained in terms of energy (bioenergy villages), and; fourth, energy service cooperatives that offer consultation and procure and purchase energy. The majority of newly established energy cooperatives are in the photovoltaic sector.

lies for one in their integrated sustainability, and for another in their democratic capacities. Based on the aforementioned research results, it can be seen that cooperatives:

- address various social, cultural, ecological and economic aims in order to come up with long-term solutions to the benefit of their members;
- facilitate both individual and collective transitions towards sustainability and resilience as some are already engaged in implementing local green infrastructures, shared use of resources, economically feasible, socially responsible and ecologically sustainable services.

Regarding their long-term focus, they have the capacity to address a variety of social aims as well as everyday needs, to be economically effective in the long term, while combining small-scale economic institutions with social organisation. In addition, they have the potential to add an emancipatory dimension to sustainable action due to their democratic and collective decision-making processes. Some indications can be found, as well, regarding their stabilising influence on local communities and environments.

While there are still some large traditional cooperatives, especially in the energy and water sectors, housing and maybe even mobility sectors, new small cooperatives are being founded as a means for their members to shape their local environments. But it can be assumed that different cooperatives adapt in different ways to those potentials. As the cooperative landscape is quite diverse, any cooperative needs to work economically and efficiently in order to obtain legal status. And they need to implement the decisions made by their members.

With respect to the emancipatory dimension to sustainable action, another specific appeal of cooperatives, often alluded to, is their successful adoption of various forms of collective decision-making. Although the actual extent and structure of participation in cooperatives may vary, many cooperatives have implemented working groups that are entitled to prepare or even take decisions on specific topics (cf. Hanel, 1992; cf. Flieger 1996: 33). In the context of sustainable urban development and climate change, involvement in collective structures such as cooperatives can be seen as a practical opportunity to break down global problems into collective and local ones. For example, if citizens set up their own energy cooperative, they counteract feelings of powerlessness by organising the generation or provision of energy locally as they hope to benefit from their own collective action.

4 The Möckernkiez Initiative

Two of the many types of cooperatives aiming at actively supporting solidarity and sustainable structures are neighbourhood cooperatives and housing cooperatives (or residential building cooperatives). In addition to the cooperative's characteristics already mentioned, they aim to establish networks within their local surroundings (neighbourhood cooperatives). One such cooperative is the Möckernkiez Initiative in Berlin, Germany. It explicitly targets both the provision of affordable housing and the establishment of good neighbourly relations. Founded in 2007, the Initiative is a registered cooperative with some 500 members in 2011. On their own initiative, their goal is to build and inhabit a new neighbourhood in the inner city. According to their shared visions, they will realise an intergenerational residential area which is, in addition, ecologically sustainable, accessible for people with disabilities, multicultural and socially integrative. They plan to build 10–12 apartment blocks with just under 400 flats and business units. Although still in the planning stages, the members of the cooperative have initiated various work groups in order to develop and discuss their concepts and ideas, as well as their implementation, sometimes with the support of external experts. In addition, regular members' meetings, with discussions on various topics (design of the collective spaces, sustainable mobility concept, structure of participatory processes within the cooperative, etc.) are already on the agenda.

By enhancing each member's participation in the planning process, they hope to include individual ideas. This initiative explicitly considers itself not only as a cooperative for building and administrating flats and business units, but also as a network of civil society members, based on various other associations and institutions, who have an active role in shaping their neighbourhood and improving the quality of life locally.

Since the cooperative has not yet started to build the quarter, the extent to which its ambitious aims will be realised is unclear at present. According to the statements of members of the cooperative, however, the many possibilities for communication have already triggered learning processes among members and the executive board, as well as among political representatives of the neighbourhood in such a way that there is plenty of dedication and expertise within the discussions. Furthermore, the general public's reception of their project can be described as positive. As informal networks and media spread the idea as well, there seems to be a real opportunity for promoting local sustainability and solidarity through the implementation of cooperative projects.

5 Empirical Flaws

Although cooperatives have gained some attention in the media recently, their potential role in local climate protection activities has not yet been acknowledged sufficiently within the scientific community or among the civic society or political leaders. For example, many topics are rarely discussed, such as local collective approaches to climate protection and energy saving; local networks and cooperations between committed individuals; initiatives and local administration; as well as forms of collective action directed towards local sustainable development and climate protection. Some detailed, but not systematic, insight into the importance of supporting social solidarity can be gained from the experiences of member cities of the Climate Alliance and of ICLEI Local Governments for Sustainability.

Another research gap can be identified when it comes to relating collective action with climate protection. Climate-related research on lifestyles and consumption, however, has primarily drawn upon findings from environmental sociology and environmental psychology (Spaargaren and Mol 2008). It has concentrated either on everyday life (overview in Rhein 2006; cf. Huber 2001; Reinhardt 2007) or on specific behaviour such as mobility (Hunecke 2000) or consumption (Stieß and Hayn 2005), but has focused primarily on the observation of one individual in his or her specific life situation and not on the possibilities of, and for, collective action. A significant weakness of these more individual, lifestyle-oriented approaches, however, is the lack of clarity regarding units of analysis and difficulties with validation of the findings, given the challenges of trying to distinguish concrete social groups and the common lack of stability of life patterns (Michailow 1994; Müller 1989 and others).[5] Furthermore, solidarity-oriented constellations of actors and activity contexts have been given almost no attention in environment-related lifestyle research, which until now has been primarily oriented at the level of the individual citizen (see, for instance, Wolf 2009). But solidarity-oriented actors deserve further systematic research from a European comparative perspective, especially regarding their potential to shape society, and given their demands for “far-reaching and sometimes total change” (Rucht 2000: 51). Scholars have observed that many grassroots social movement organisations involved in the so-called global justice movement, for example, have developed an interest in “local sustainable economic development projects” and hence propose “viable alternatives to dominant economic practices and lifestyles” (della Porta and Diani 2006: 78). What is missing, though, are empirical results regarding collective-based action and specifics of cooperatives in (larger) cities and regions.

While the local level in general has received more attention in urban research, the relationship between urban research and climate protection is vague. Some authors suggest that the local level will be of particularly great significance in the context of climate change. They argue that an issue as comprehensive as climate change can only be solved through individual and collective contributions (Satterthwaite 2008; Caulfield and Larsen 2002), within their specific construction/spatial social, political and economic structures, and must be supported by local

[5] A particular challenge for this field of research is that most individuals pursue ecologically ambivalent “patchwork” lifestyles (Reusswig, 1994), and individual contributions to environmental protection frequently differ in scope even within individual lifestyle groups. The latter challenge is rendered even greater by the fact that individuals frequently think of possible action options available to them only in combination with their resources and the objective and subjective scope of options or action (Tanner, 1998). Environmental action is thus always situation- and context-specific (on inconsistent environmental behaviour, see Tully, 2000; see also Schultz, 1998; Slovic, 1995; Preisendörfer, 1993) and, according to Tully (2008), also regional-specific.

politics (Bardou 2009) as well as participatory decision-making processes (Bacqué et al. 2005; Sintomer et al. 2009). Adger (2001: 1) even assumes that collective action for local climate protection is one of the essential, as-yet unexploited capacities of human societies. In this context, he describes local characteristics, size and structure of a group, availability of resources, collective access to resources as well as the desired respectively actual distribution of individual advantages as major influencing factors (ibid.: 11; cf. Geißel 2006; Pelling and High 2005; Pretty 2003). Nevertheless, two areas with a need for further research can be identified from these studies: first, there is a lack of fitting participation strategies for this level. The question of how to mobilise the civil society for climate-friendly, energy-efficient and renewable energy activities is left open. Second, most of the former research focuses on rural regions; metropolitan regions and larger cities have been neglected up until now.

When focusing on local climate strategies, practice and scientific research also need to connect to—and solve—complex issues, such as economic efficiency, the organisation and allocation of infrastructures and resources in cities, societal and political aspects of actual urban lifestyles, communication and education, and their accumulative, reinforcing and neutralising effects at a local level.

6 Conclusion: The Potential Roles of Cooperatives in a Climate-friendly Society

With their large number of members all over the world, cooperatives have the potential to support a transition towards sustainable and resilient practice and to contribute to local adaptations to the "grand urban challenges". Accepting what has been written here before, three aspects are to be considered when researching potential future roles of cooperatives in the context of local climate governance:

1. Parallelling a still ongoing trend of centralisation, there is a trend towards smaller cooperatives. With new legal frameworks, cooperatives' foci might be expanded and the implementation of a variety of locally adapted cooperatives can be imagined. So, if there is to be a "new localism" of sustainable, climate-oriented urban development (cf. Bulkeley & Kern 2006; Collier and Löfstedt 1997), cooperatives could be one element of combining positive local social and economic effects within this process. Political support will be crucial and may open up to forms of local governance that actively promote sustainable development and local climate governance.

2. Nonetheless, the structure of cooperatives can still be considered as somewhat restrictive, as members have to pay a membership fee and any cooperative is subject to its economic efficiency. Jobs created so far are mostly limited to executive boards and a few members of administrative staff (if any). If there is to be a more prominent role for cooperatives in the future, it is, for one, important to note that most cooperatives so far handle shared, but not public, property, and

for another, to reflect on how, and in what terms, cooperative structures could be implemented locally to benefit a wider circle of citizens and consumers. This has been considered in some of the literature on multi-stakeholder cooperatives, posing the question: which forms of local solidarity do they actually implement, and what social and economic models can be developed from these? And if an increasingly important role for cooperation between private and civil-societal forms of engagement at the local level can be assumed, then such cooperatives could take on a leading role in mobilising social capital at local and regional levels, especially if economic interests are one, but not the most prominent, motivation.

3. The question of climate justice and/or fairness at the local level remains unexplored. Although several scientific studies address that question at the global level (Barker et al. 2008; Adger et al. 2006), it has yet to be determined how individual and collective action in the context of climate change affects the management and distribution of local (material and immaterial) resources. If innovative forms of local solidarity can be implemented, maybe intra-urban partnerships, intra-cooperative and multicultural partnerships or local networks could work with similar models; maybe they would devise innovative (or long-lost) ideas for including various groups of citizens, political and economic actors into the shaping of their local and global sustainable futures.

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Forecasting the Adoption of Emerging Energy Technologies: Managing Climate Change, Governance and Evolving Social Values

Tugrul Daim, Kelly Cowan, Wayne Wakeland, Hosein Fallah and Patricia Holahan

Abstract With the link between fossil fuel use and climate change now almost universally accepted, tackling greenhouse gas emissions (GHG) has become a subject of great social urgency and technological challenge. A variety of models exist, or are under development, for analyzing the role of more sustainable systems, such as renewable energy technologies, in mitigating climate change. However, the direct cost of these technologies is generally higher than that of fossil fuel systems. Methods are needed to more fully account for external factors, societal impacts, and social values associated with fossil fuels versus sustainable energy systems. This paper presents a conceptual model targeted at informing energy policy in order to bring about improvements to inform the management of energy resources so that they can be optimized for climate change. This would then yield a set of governance actions. The model builds on Linstone's multiple perspectives: technical, organizational, and personal, by attempting to forecast technology development along these perspectives. Thus, factors enabling faster and better adoption by consumers, and faster and more efficient development by organizations are evaluated by taking the potential technological improvements into account.

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1 Introduction

Addressing greenhouse gas emissions (GHG) has become a subject of great social urgency and technological challenge. A variety of models exist, or are under development, for analyzing the role of more sustainable systems—such as renewable energy technologies—in mitigating climate change. However, the costs associated with these technologies are generally higher than those of fossil fuel systems, at least in the short term. Methods are needed to more fully account for the societal impacts and social values related to fossil fuels versus sustainable energy systems. These methods can inform better energy policy and management of energy resources. Mitigation of climate change also presents significant opportunities in the emerging "Clean Technology" industries. Evolving values can lead to changes in customer preferences towards the adoption of new products, like hybrid and electric vehicles, or the purchase of "green" electricity from companies that generate it using wind power or solar energy Fig. 1.

Whilst there will be many policy and legislative actions establishing targets and directions, meeting the anticipated emission requirements in the U.S. will depend on advancements in energy generation and consumption technologies. Energy sources consist of primary sources, or "raw energy," and secondary sources, which are created from the primary sources. The primary sources include fossil fuels, like natural gas, oil, and coal, as well as solar, wind, and geothermal. The secondary sources include energy carriers, like electricity, and refined fuels. These sources of energy in various forms and extents provide for the energy needs of industries, businesses, and residential communities. At national level, energy consumption consists of 28 % for transportation; 33 % for industrial use, and; 39 % for residential and commercial applications (2008). Electricity has become one of the most versatile and sought-after energy carriers in the modern economy, as it has potential uses in all of the above sectors. It can be produced readily through renewable and non-renewable technologies. However, approximately 50 % of U.S. electrical generation currently comes from coal-fired power plants, which produce the most GHG pollutants of any of the major generation options. The primary focus of this study will be on electrical power generation that has a minimum impact on the environment. The main objective is to identify the critical perspectives and a process to develop models to create technology roadmaps for better forecasting the evolution of new technologies to meet the challenges of climate change. In particular, the project is focused on technologies that are intended to:

1. reduce GHG emissions in electrical power generation;
2. improve efficiency in the management of transmission and distribution;
3. increase energy efficiency and conservation.

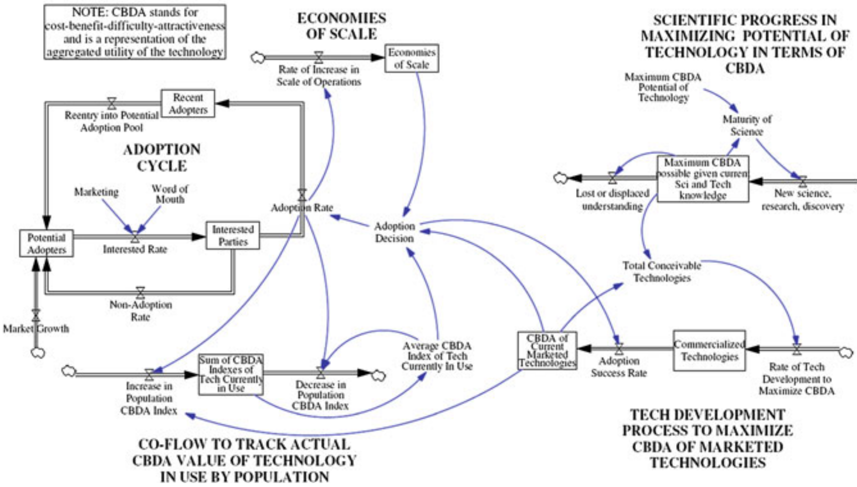

Fig. 1 A conceptual model demonstrating the basic concepts of the process (Ingle et al. 2009)

The models developed in this study will inform industry practitioners and policy-makers on how to prioritize investment in new technologies based on their potential impact in both the short and long term and, as a result, yield a set of governance actions. Models are typically categorized as either *normative*, which create prescriptions for dealing with problems in theoretical optimum conditions, or *descriptive*, defining real-world problems in specific cases, but not necessarily being able to generalize solutions to other, additional cases. In the energy sector, there is a strong need for models which can bridge between the many complex criteria in both normative and descriptive models, dealing with situation-specific factors, but also offering general policy guidance, substantiated by a sound theoretical basis involving technological foresight and decision-making. The advent of modern computing has produced a variety of multi-criteria decision-making (MCDM) methods for consolidating and attempting to optimize the results of numerous inputs. However, in real-world technology management problems, conflicting or overlapping factors often prevent true optimization (Roy 1968; Figueira 2005). The concept of *satisficing*, or satisfying, one or more goals to the greatest extent possible, given the various constraints, must often be used instead (Simon 1976, 1991). But, if goals are only satisfied for short-term benefit, at the expense of long-term benefit, to the overall system, this leads to *suboptimization* (Baird 1989). Much of the current planning for fossil fuel energy systems has placed an emphasis on short-term economic gain for certain elements within the energy system, and this constitutes a suboptimization of the long-term benefits available under sustainable energy systems. In particular, social factors, values, and ethical concerns have been suboptimized. There is a need to develop better models which can deal with the complex, dynamic, and often overlapping factors involved with problems, like energy generation and climate change, and societal impacts. Fuzzy logic, data mining, and data visualization are just a few of the methods which could be used to create models appropriate for energy-climate-technology problems.

2 Literature Review

2.1 Technology Assessment and Governance

Technology Assessment (TA) is a key methodology for research in this area. TA has been in use for over 40 years. The concept was first formalized with the establishment of the Office of Technology Assessment in 1969. Its objective was to understand the social, economic, political, ethical, and other consequences of the introduction of a new technology into society. Thus, TA was conceived to assist in public policy decision-making, which is also a critical element of governance. The literature contains several definitions for TA. Coates (1973) defined it as "a term applied to a class of studies intended to illuminate and hence influence public policy decision-making in the Executive and Legislative Branches of the Government." He then updated his definition as "a policy study designed to better understand the consequences across society of the extension of the existing technology or the introduction of a new technology with emphasis on the effects that would normally be unplanned and unanticipated" (Coates 2001). Another definition calls TA "an attempt to establish an early warning system to detect, control, and direct technological changes and developments so as to maximize the public good while minimizing the public risks" (Kiefer 1973).

Several frameworks to deal with different aspects of TA were developed and adopted over the years. Ethical Technology Assessment (eTA), a new form of TA, focused on the ethical implications of new technologies. Another major application of TA has been in the health care industry (Palm and Hansson 2006). Constructive Technology Assessment (cTA) is an emerging approach to TA, based on the assumption that technological development is driven by society. Those using this approach try to integrate many facets from society into their assessment processes. The underlying objective is to create a better technology for the betterment of society (Genus 2006). Participatory Technology Assessment (pTA) strives to include all participants who contribute to the innovation process through the use of workshops or meetings (Van den Ende et al. 1998). Real-time Technology Assessment (real-time TA), which integrates natural science and engineering analysis with social science and policy development, is an expanded version of cTA (Guston and Sarewitz 2002). The Multiple Perspectives framework (MP), put forward by Linstone et al. (1981, 1984, 1999), called for careful examination of the available technology from three perspectives, including an organizational/societal perspective, a personal/individual perspective, and the conventional technical perspective. The field of health Technology Assessment (hTA) is still relatively new, but has shown remarkable growth over the last decade. The initial focus of hTA was efficacy and cost-effectiveness of health care interventions. Recently, more attention has been paid to effective dissemination and implementation in order to influence administrators and clinicians (Banta 2003; McDaid 2003). Coates and Fabian (1982) found that many companies viewed TA solely in terms of trying to anticipate the effects of the outside world on their own activities, rather than anticipating the effects of their activities on external factors. They called this approach "inverted Technology Assessment".

TA has been a key part of Science, Technology and Society (STS) research. The approaches discussed above have been used to evaluate the impacts of numerous technologies. Brooks (1976) and Shrader-Frechette (1980) provided some of the initial building blocks for this research stream in STS. Others evaluated the use of different approaches. Hildebrandt and Gutwirth (2008); Marris et al. (2008); Guston and Sarewitz (2002) and Lengwiler (2008) explored different uses and perspectives of pTA. Stirling (2008) explored "appraisal" and "commitment" in technology choice, and concluded that greater appreciation is required—in both analytic and participatory appraisal—to facilitate the opening up (rather than the closing down) of governance commitments in science and technology. Other STS researchers explored policy implications. Grin and van de Graaf (1996) explored how policy-makers could influence the processes of technology development. Herrick and Sarewitz (2000) proposed a more effective role for scientific assessments in environmental policy formulation.

There has also been specific interest in STS research regarding the assessment of energy-related technologies. Schot (1992) used cTA to evaluate clean energy technologies. However, the study was limited to the demonstration of a methodology. Climate change has also been of interest to the STS field. Shackley and Wynne (1996) explored uncertainty in climate change science and its impact on related policy-making. Grundmann (2006) explored the role of expert opinion on cases such as climate change. Agrawala et al. (2001) explored impacts of climate predictions on societal decisions.

By studying technological development, societal perceptions, and consequential adoption or non-adoption concurrently, this research will identify how these factors interact with governance. Linstone's MP framework, discussed above, has proved to be a very successful technique for dealing with complex techno-social problems, decisions, and business cases. Coates et al. evaluated the future of technology forecasting and assessment using MP (Coates et al. 2001). One conclusion from this work is that an MP approach is particularly useful for addressing complex issues, such as the energy crisis. A number of recent case studies have focused on the growth of green energy programs from a government policy, or organizational (O), point of view (van Rooijen and van Wees 2006; Coates et al. 2001; Ek 2005), as well as from a technical (T) point of view (Stadler et al. 2007). These studies explored the impact of regulations and incentives in national and regional green energy programs in Europe. Due to situation-specific factors, it is unclear how generalizable European case studies will be for North America or elsewhere. Other studies have addressed government policy (O) efforts in the United States to develop green energy programs at the national, state, and local levels (Vachon and Menz 2006; Menz and Vachon 2006; Menz 2005). These studies highlight a complex and confusing mass of policy differences in various jurisdictions, and have largely ignored market-based initiatives. Attempts have been made to tie together various aspects of the TOP viewpoints with energy issues. A study by Harmon and Cowan examined the market for green energy using an MP framework (Harmon and Cowan 2009). Daim et al. have shown that TOP factors can be used for forecasting the emergence of new technologies ranging from fuel cells to optical storage (Daim et al. 2006). Astrand and Neij used a "socio-technical systems approach" (O and T) to evaluate green energy technologies (Astrand and Neij 2006). This case documents how early insistence by the Swedish government on a two-bladed wind turbine design, and the decision to limit supplier choice to only the country's largest energy providers, may have severely stunted the growth of the country's wind power program. Although Sweden had set aggressive goals for wind power development, they were far less successful in terms of investment returns from deploying wind power than in nearby Denmark and Germany (Richey and Grinnell 2004).

2.2 Forecasting Technology Diffusion and Adoption

Technology forecasting experts generally agree that models should be used in combination (Millett and Honton 1991; Martino 1983). With complex consumer technologies there are usually several organizational factors—political, cultural, etc.—that influence the rate of diffusion for a commercial technology. Technical trend analyses alone cannot incorporate the organizational and political scenarios that will influence future technologies. Systems Dynamics (SD) is an integrating methodology for incorporating many variables into a single numerical model that represents complex feedback loops and generates projected "S-curves," which show anticipated trends in market penetration. It is an approach to modeling complex systems that was developed in the early 1960s by Forrester (1961). Traditional SD models used in technology forecasting incorporate historical data for calibration and validation. Models here also integrate the use of scenarios, bibliometrics, and patent trend analysis. SD models have typically not been viewed as appropriate forecasting tools, but are used primarily to uncover feedback loops to show how factors interrelate for strategic analysis (Millett and Honton 1991). Patents are used for competitive analysis and technology trend analysis (Abraham and Moitra 2001; Liu and Shyu 1997). Patents are analyzed in R&D project management to assess competitive position and to avoid infringement. Patent analysis is also a valuable approach for deriving information about the growth of an industry and/or diffusion of a particular technology. Patent growth generally follows a similar trend that can resemble an S-shaped growth curve. In the early stages of a technology, the number of patents issued is very limited. A period of rapid growth then follows when the number of patents filed and issued increases, until a plateau is reached (Abraham and Moitra 2001). Because the patent process is costly, and can take several years, filing a patent generally means there is optimism in the economic or technical contribution (Basberg 1987). Several indices have been introduced to measure technological strength as a function of patent quantity or quality. Some examples include patent citation indices and regression models (Abraham and Moitra 2001; Wang et al. 1998). Because the total number of patents over time for a technology has a saturation point, growth curves can also be used (Bengisu and Nekhili 2006). Other models aim to describe the relationship between patents using citation networks (Brinn 2003). Patent analysis has been shown to be valuable in planning technology development from analysis of strategy at national level (Liu and Shyu 1997) to modeling specific emerging technologies (Ashton and Sen 1988; Bengisu and Nekhili 2006) (Abraham and Moitra 2001). Patent data is usually freely accessible in most countries, and several guidelines have been introduced to enhance the technique using keywords and categorization. Much like text and journal information, very few patents actually develop into something of commercial value. However, most are technically significant because they encourage or lead to follow-on developments in technology (Ashton and Sen 1988). Understanding growth in an area of technology and measuring the use of keywords or phrases can provide insights into developing an overall technology forecasting model.

Bibliometrics is defined by Norton (2000) as the measurement of texts and information. Historically, bibliometric methods have been used to trace back academic journal citations. However, today, bibliometrics can be used to understand the past and even potentially to forecast the future (Morris et al. 2002). Bibliometrics help us to explore, organize, and analyze large amounts of historical data, allowing researchers to identify "hidden patterns" that may provide insights into the decision-making process. Some common tools that have been used in bibliometrics include the study of authors, affiliations, conceptual maps, cluster and factor analysis, and citation and co-citation analysis, to mention but a few. Important works have been presented by Morris (Morris et al. 2002) using the Database Information Visualization and Analysis system (DIVA), where documents are visualized as clusters on a two-dimensional map. Kostoff et al. (2001) have presented database tomography for textual database analysis, extracting multiword phrase frequencies and determining phrase proximities using the Science Citation Index (SCI) and the Engineering Compendex (EC) databases. Bibliometric analysis helps to identify: (1) the most prolific topical area authors; (2) the journals that contain numerous topical area papers; (3) the institutions that produce numerous topical area papers; (4) the keywords specified most frequently by the topical area authors and the authors whose work is cited most frequently. Also, (Porter and Watts 2003, 2005; Porter 2003) have presented relevant papers in data mining using a proprietary software called VantagePoint. Porter developed a technique called Innovation Forecasting, which combines bibliometrics with other forms of technological evidence. Porter and Watts (2005, 2003) and (Pilkington

2003; Pilkington and Teichert 2005) have demonstrated significant bibliometric applications for the management fields of engineering and technology. Both study how bibliometrics help to identify and classify patterns of innovation.

SD is another well-established methodology for dealing with complex problems, strategy and policy decisions, models with unintended side-effects, delay times, and problems for which prior attempts to solve them have failed (Wakeland 2006; Sterman 2000). Much of the SD method relies upon concepts such as feedback loops, time delays, and non-linearity effects, which determine the dynamics of a system. Dynamics arise from the multiple interactions of two types of feedback loops: (1) positive, or reinforcing loops; and (2) negative, or balancing loops. Positive loops amplify the behavior of the system, while negative loops counteract and oppose change. Growth curves represent growth in performance over time. They were created making an analogy to the growth of a living organism (Warr and Ayres 2006; Carrillo and González 2002; Young 1993). Growth curves are frequently used to forecast the substitution of one technology for another (Martino 1983). In the Gompertz model, however, assumptions are different. This model is often referred to in technology forecasting as the "*mortality model*." The Gompertz model produces an S-curve which rises more sharply, but begins to taper off earlier than the Fisher-Pry model (Porter 1991). The Fisher-Pry model predicts characteristics very similar to those of biological system growth. For this reason, it is commonly referred to as the "*substitution model*," due to its application in forecasting the rate at which a new technology will replace an existent technology. Fisher-Pry presents a slow beginning, a rapid slope, and tapers off at the end.

There are also several diffusion theories that could be used for understanding the adoption of new technologies. Diffusion of Innovations (DoI) is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers 1962). Rogers (1995) defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption." According to Rogers, communication is "the process by which participants create and share information with one another in order to reach a mutual understanding," and communication channels are "the means by which messages get from one individual to another." Bass (2004) proposed and tested an epidemiological model for the diffusion of consumer durables and other innovations. The Bass Model shows how a new product or idea spreads through the user community by quantifying the introduction of new technologies depending on the take-up by innovators and imitators. The model is used to predict technology introduction rates from a set of estimated values for the innovation and imitation factors. According to the Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (1975), the main determinant of an individual's behavior is the individual's intention, which is influenced jointly by the individual's attitude and subjective social norms. In TRA, attitude towards the behavior is defined as "the individual's positive or negative feelings about performing a behavior." It is determined through an assessment of one's beliefs regarding the consequences arising from a behavior and an evaluation of the desirability of these consequences. The Technology Acceptance Model (TAM) developed by Davis (1985) can be accepted as an adaptation of TRA. This model defines the perceived ease of use and perceived usefulness as two determinants of attitude towards behavioral intention and usage. In TAM, perceived ease of use is defined as "the degree to which a person believes that using the system will be free of effort," whereas perceived usefulness is defined as "the degree to which a person believes that use of the system will enhance his or her performance" (Davis 1985). The Theory of Planned Behavior (TPB) developed by Ajzen (1991) is another variant of TRA that also takes into account the perceived behavioral control as a third determinant of an individual's behavioral intention to use a new system. In TPB, perceived behavioral control is defined as "one's perception of the difficulty of performing a behavior." TPB views the control that people have over their behavior as a continuum ranging from behaviors that are easily performed to those requiring considerable effort, resources, and so on.

To advance the understanding of emerging energy technologies, both in terms of their adoption by individuals in society, and management strategies for their adoption by industries, new models must combine behavioral theory and strategic problem-solving methods. The Unified Theory of Technology Acceptance and Use (UTTAU) (Venkatesh et al. 2003) builds upon DoI, TRA, and TPB. However, it lacks a high-level organizing framework that would categorize its many disparate factors into coherent perspectives.

2.3 Case Analysis: Climate Change and Electric Power Generation

With the 141-nation Kyoto Protocol entering into force in February 2005 and the updated Bali Roadmap on climate change in 2007, fossil fuel-based power systems face a worldwide trend toward GHG restrictions (Clemencon 2008). The expectation of emissions restrictions is already making it difficult for companies to obtain permits for the development of conventional power plants, such as coal plants, even though legislation has yet to outlaw them. Available low-emission power generation technologies, like wind power and hydroelectric, will likely meet only a portion of future power demand. Therefore, development of new low-emission generation technologies is necessary to meet future requirements. There is a need for improved load management in electrical systems operations, additional energy efficiency measures, and technologies for smart grid applications. Many of the long-term solutions proposed to fill gaps between low-carbon power supply and demand are in their early stages of development or adoption. Emerging generation options that are "carbon-free,[1]" meaning they do not directly add

[1] Using full life cycle analysis, most forms of power generation are responsible for some amount of energy expenditure, such as fossil fuels used in the creation of parts or components of the

emissions of CO_2 to the atmosphere, include: biomass, geothermal and enhanced geothermal technologies (EGT), solar photovoltaic (PV), concentrating solar power (CSP), hydrokinetic energy (including wave power and tidal power), wind power, as well as next-generation nuclear power (Gen-IV). For low-carbon power generation, technologies such as coal gasification, integrated gasification combined cycle (IGCC), and natural gas combined cycle with carbon storage, or "sequestration," are also under development. Increased efficiency in power transmission, demand sensing, and load management are additional demand-side options. Each of the above-mentioned technologies must also be evaluated in specific national and regional contexts to be consistent with local needs and goals (Gerdsri and Kocaoglu 2007). Further research on societal impacts is also essential to determine where and how these technologies would be best implemented.

In order to reduce CO_2 emissions for the utility industry while maintaining economic growth, work will need to be done to identify and deploy solutions for efficient use of energy. In all likelihood, loads will eventually be added to the system beyond that which can be attributed to economic or population growth. For instance, loads from the transportation sector may begin to switch to electric power: plug-in hybrid electric vehicles (PHEVs) are being used and General Motors has announced that it is investigating the commercial release of its extended range electric vehicle, the Dodge Volt, by 2012. As the industrial sector moves to more sustainable business practices, the reliance on electricity could rise dramatically, further increasing system load. 'Smart Grid' technologies will be necessary to ensure proper grid operations into the next few decades. Several factors are contributing to the dramatic increase in system complexity: increasing amounts of wind power and other renewable energy generation with intermittent generation profiles, increases in system demand, increasing distance between generation sites and loads, and demand response schemes that require bi-directional, real-time communications between end-use equipment and the control system. In order to handle this additional complexity, electronic switches, bi-directional communication capabilities, and both centralized and decentralized control schemes are needed. It is anticipated that these web-enabled, digitally controlled, intelligent delivery systems will allow power systems to operate with more stability and be able to self-correct before problems arise (Blankinship 2006). This can allow grid operators to take advantage of system capacity that is currently forfeited in order to allow the current system to respond to unanticipated issues. To create a roadmap to optimize integration of these many evolving technologies in ways that maximize efficiency and result in an effective transition plan to meet the challenges of climate change, development and enhancement of technology forecasting models is needed.

(Footnote 1 continued)
system. The PV manufacturing process, for example, typically emits an amount of carbon equivalent to about 25 g of CO_2 per kilowatt hour of electricity produced (25 gCO_2/kWh). By contrast, coal emits about 950 gCO_2/kWh.

3 Conceptual Process

The following four-level method of analysis is proposed:

3.1 Identification of Factors and Relationships in Multiple Perspectives

Scientific understanding of the technologies necessary to address global warming has progressed to the point where the barriers to solving the problem of climate change are no longer technically insurmountable, but questions remain about their feasibility in financial, political, and social terms. While certain technologies may not be suitable simply from one point of view, considering them from several perspectives may make them, in fact, some of the only acceptable solutions to the urgent and potentially catastrophic problem of climate change. Also, as mentioned in previous sections, when technologies like fossil fuels are understood in a full systems context, it becomes clear that they suboptimize the solution to the energy problem by focusing only on what is economically expedient at the expense of damage to human health, ecosystems, and climate (Baird 1989). They also result in strategic energy dependency to fossil fuel-exporting nations. Thus, more comprehensive models are necessary which specifically consider issues like human values and do not simply solve one small part of the energy problem at the expense of the overall social system. Although no model can consider an infinite chain of causal factors, which are in turn related to other factors, technology research has shown that methodologies like SD and the MP framework can aid decision-makers.

3.2 Identification of Alternative and Complementary Technologies

The growth in electric power demand and the need to reduce GHG from electric power generation will create challenges for new and enhanced technologies, and will fuel the drive for innovation. We need to leverage existing knowledge and develop new knowledge on embryonic and emerging technologies to characterize and baseline the technology landscape. This process may follow these steps:

Firstly, identify known and evolving technologies from sources such as government and industry studies, association reports, technical and trade publications, product prototypes and demonstrations. Secondly, identify embryonic and emerging technologies from university research programs, analysis of patent applications, starting with the US and Europe, and characterize major innovation networks and technology clusters. Patent analysis can provide information about emerging technologies in several ways:

- Patent applications and their forward citations will be studied as a source of information on new technologies. Given that it takes at least 18 months before a patent is published, knowledge of the new discovery does not emerge for a few years. As the new technology evolves, new patent applications are filed citing the original patent. Forward citations will be examined to provide information about the speed of the evolution of the new inventions, as well as spillovers into other technology classes. Such information will help in forecasting growth, enhancement, and adoption of the new technologies.
- Patent data will also be used to examine information about the networks of inventors and relationships among the R&D organizations, as well as the emergence of technology clusters, in particular, technological areas. Applying social network theory to such patent data can provide insight into technology forecasting models.

The data can be augmented with information gathered through interviewing leading inventors and experts (T). To create a structure for the baseline data, the technologies can be grouped according to life cycle stage: embryonic, emergent, growing, mature, and declining. Embryonic technologies are targeted for longer-term (10 years or more) deployment. Mature and declining technologies, such as current coal- or gas-fired power plants, may need to be significantly refurbished in order to reduce GHG emissions and power generation efficiency, or be earmarked for replacement. Furthermore, one can organize technologies by: (1) type of application, such as electric power generation, transmission, and load management; (2) risk of development and deployment; (3) current cost per kWh, and potential for cost reduction; (4) contribution to electric supply in 10 and 20 years; and (5) the effect on reduction of GHG emissions.

To incorporate the MP framework, methods such as Delphi can be used to convene a panel of experts in energy technologies (T) to review and improve knowledge of the technology landscape. Additional expert panels can include industry and government leaders (O), as well as consumer and social behavior experts (P), to review and refine the baseline process. Although it is possible to combine experts from all three perspectives into one panel, capturing the multiple perspectives separately at first is likely to be the best method for the development and calibration of the reusable forecasting models.

3.3 Model Building, Scenario Development, Validation

A variety of computer models can be used to integrate key concepts and data, to clarify inter-relationships, and to anticipate behavior over time. Although SD models are expected to be quite useful in accounting for the impacts of complex feedback loops, discrete system simulation models are needed to analyze uncertainties in these manifold impacts. To study the technology diffusion processes at the level of the individual, agent-oriented simulation may also be employed. Once promising models have been developed, they need to be thoroughly tested. Once the testing has been completed, then the models can be confidently relied upon to produce useful inferences. The models can be used to evaluate a variety of scenarios in order to identify strategies and policies for "optimizing" the diffusion of technologies for clean electricity generation, and for efficiently distributing that electricity to the point of use. It is possible to find robust solutions that provide the best possible outcomes over a reasonably broad and plausible search space. At the heart of these models will be several diffusion models that depict both the adoption of new technologies—for which these types of models have been classically used—as well as the spread of the social innovations and changes that will be needed to facilitate the rapid adoption of these new technologies. The necessary social innovations may include such things as the acceptance of: (1) smaller and perhaps very different-looking types of vehicles; (2) wind turbines located in heretofore pristine locations; (3) solar panels attached to the roofs of houses, and so on. The dynamic models will also reflect the status of fossil fuel reserves and discovery rates, as well as changes in efficiency over time. Demand for electricity should also be represented in the model, as driven by population growth and increases in the overall standard of living per capita. As the demand for power and mobility increases and outstrips supply, pressures will mount to accelerate the development and implementation of alternative means for generating electricity from both renewable and non-renewable sources, for both home use and transportation use. These models can be designed to explain recent trends, and to estimate the likely future trends under various assumptions regarding the cost sensitivity and public acceptance of different technologies. Contributions to knowledge will include the models, the explanations of past trends, and the estimates regarding likely future trends.

3.4 Policy Recommendations

The process of technology implementation is based on the development paths enabled by government policy at the federal and at the state level. Local government action can block development at key points of the implementation process. Split payments for technology changes have led to suboptimal solutions as the cost-benefit analysis is incomplete or biased. Side payments for technology development can lead to spiraling costs, as has happened in the nuclear industry, when future taxes were earmarked for unknown technology solutions.

Customers fail to implement energy efficiency projects when the cost savings are obscure, or too far into the future. As noted by Friedman, the problem is with the price signals. Government has to focus on changes in technology as a complete picture with clear economic comparisons. Government then has to clearly show citizens the cost of each path with incentives and with disincentives to bring the future impacts into the present. Insurance for nuclear waste transportation, processing, and long-term storage are one such cost. Carbon emissions are one such future impact which will have to be reduced through open and transparent market allocations established by governments. The intended and the unintended impacts have to be embedded into the previous models for a fully developed simulation to include price signals established at the federal, state, and local levels.

As outlined throughout the paper, by modeling all the adoption processes through multiple perspectives, this approach covers all governance elements and, therefore, the results would provide an appropriate set of actions for all elements of governance.

4 Discussion and Conclusions

By studying how to synchronize the spread and adoption of facilitative social changes to coincide with processes that are developing and deploying new technologies, the proposed process will reveal high leverage points for accelerating the overall acceptance rates for clean energy sources. Technical strengths of the proposed process include the synthesis of multiple methods and the creation of operational models of the processes that drive technological and social innovation. Although these methodologies, models, and validation approaches will represent an important scientific contribution in their own right, they will also, and perhaps more importantly, open up new lines of research and development, and enhance the scientific basis for further research in the long-term development and deployment of sustainable energy technologies. Follow-up studies by researchers and others are likely to include: (1) field research to better understand and validate assumptions and model attributes on the mechanisms which accelerate or impede the spread of social innovations and to identify the most effective types and magnitudes of incentives/interventions for stimulating these particular social changes; (2) quantitative studies to determine specific parameter values and sensitivities; (3) the development of monitoring processes and systems; and (4) the creation of educational and motivational materials that show how technological and social processes interact and complement each other.

The proposed process will also assist policy-makers at the DoE and other agencies focused on energy efficiency and conservation by providing them with configurable models and specific strategies and tactics for accelerating the transition to alternative energies, reducing fossil fuel consumption, and slowing the pace of adverse climate change. Specific interventions will be needed to provide high leverage means for accelerating the adoption of beneficial technologies, with particular emphasis on how to amplify complimentary social trends regarding the acceptance of smaller and possibly less convenient vehicles, increased tolerance for the visual impacts associated with wind and solar technology, and greater willingness to use virtual communication technologies in place of in-person communications.

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Part II
Case Studies I: Policy-Related and Governmental Approaches

Climate Change Issues and Malaysian Initiatives

Abul Quasem Al-Amin, Abdul Hamid Jaafar, Mohammad Nurul Azam, Fatimah Kari and Syed Omar Syed Agil

Abstract The purpose of this paper is to describe Malaysian climate change experiences, to highlight the lack of Malaysian initiatives in drafting a national policy on climate change, the structures, activities and national agenda of climate change issues. A description of possible climate change impacts on Malaysia, some facts and figures together with activities, structures and the national agenda are provided in this study. This study emphasises that sustainable long-term economic policy requires a workable framework for climate change and vulnerabilities that have not yet been covered in the national economy. Malaysia must visualise appropriate futures and frameworks on climate change issues, potential changes and national initiatives for planning strategies to reduce vulnerabilities. This study draws attention to the fact that Malaysia ranked 52 out of 57 in the Climate Change Performance Index (CCPI) in 2009. Malaysian climate protection performance still lags behind other countries in the region. This study evaluates and discusses current information about on-going policy preparations on climate change issues, and provides a critical review to improve Malaysian climate change-related initiatives.

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1 Introduction

Current regional climatic trends, with an increase in average surface temperature, are now very evident in Malaysia (NAHRIM 2006). Past and present records of Malaysian climate data show evidence of climate change that has been voiced globally, having been established in the Intergovernmental Panel on Climate Change (IPCC) assessments report (IPCC 2007). Information on a considerable fluctuation of temperature has been published recently, showing a very strong correlation between climate change and a significant annual average temperature increase, where record fluctuation is simulated for Malaysia up to 2079 (MMD 2009). The highest and lowest projected seasonal average temperature towards the end of the century for Peninsular Malaysia was found to be during the months of December, January and February (3.7 °C) and September, October and November (3.3 °C) respectively (MMD 2009). Based on three emission scenarios, designated by the Malaysian Metrological Department (MMD) as A2, A1B and B2, the projected range of the highest temperature increase is between 2.3 °C and 3.6 °C for Peninsular Malaysia and 2.4 °C–3.7 °C for East Malaysia (MMD 2009).

NAHRIM (2006) revealed the possible vulnerable regions based on temperature fluctuations up to 2050 and severe impacts based on scenario projections. The initial simulated outcomes indicate uncertainty in rainfall (±30 %) in the surrounding sub-tropics, where an increase in temperature of 4.5 °C would be very noticeable (MMD 2009). If the current scenario projections turn out to be accurate, then the Malaysian economy would be more vulnerable due to its lack of adaptive capacity and proper policy-relevant technical foundations (Siwar et al. 2009). Results of modelling estimate that Malaysia may be warmer by the end of the century. A substantial amplification of climate change would make Malaysia a vulnerable economy. The impacts can be classified as: (a) food insecurity; (b) vulnerability of agriculture, biodiversity and the ecosystem; (c) costal and sea level rise; (d) vulnerability of human health due to vector-borne diseases; (e) natural disasters, such as landslides, cyclones, flash floods, tsunamis, severe drought and peat fires; and (f) political instability due to international conflicts of interest. Indeed, national research findings and outcomes are too real, too important, too far-reaching, and require an immediate response in terms of mitigation and adaptation options. Following the cumulative scientific evidence compiled by the IPCC in its series of assessment reports since 1990, together with the Stern Review's study looking at the economic impact of climate change, Malaysian has started to rethink the stark reality that, if left unchecked, climate change will pose a risk in the future.

Whilst already faced with multiple stressors, the onset of climate change factors impinges on sustainable development that relies on climate-sensitive sectors and alters the distribution and quality of food, natural resources and the environment associated with urbanisation, industrialisation and economic development (Tan et al. 2009). Malaysia realises the importance of climate change efforts at a national and international level, and efforts are congruent with those of national interests. The current level of Malaysian development, national priorities, natural resources and its political structure influences whether the country will be able to implement climate change efforts. Since it is likely that climate change will occur over the next 50–100 years, following regional research findings on national climate change impacts, mitigation and adaptation options have primarily been suggested as the means to reduce the impact of climate change in Malaysia (MMD 2009; NAHRIM 2006). Insights into some potential implications were gained during the preparation of Malaysia's Initial National Communication (INC) and recent National Development Plans, where the sensitivity of several key economic and resource sectors was assessed against a range of plausible future climates. Some policies are currently under review, including 'The National Policy on the Environment, National Energy Policy, Third National Agricultural Policy, National Forest Policy, Biodiversity Policy and National Land Policy.'

This study describes Malaysian climate change experiences, several policies, its structures, activities and the national agenda on climate change. Our initiative in this study is to evaluate and discuss up-to-date information about on-going policy draft preparations and to provide a critical review.

2 National Policy on Climate Change

Since the Third Malaysia Plan (1976–1980), environmental concerns are progressively being emphasised in development plans (Hezri and Hasan 2006). Climate change is now on top of the agenda of national policy-makers worldwide, and also in multilateral institutions such as the United Nations. Following climate change research in Malaysia, the government has formulated several policies that have taken environmental concerns into account to different extents, as well as sectoral-specific contexts and needs, such as:

– building adaptation strategies to enhance the resilience of natural ecosystems against the impacts of climate change;
– working with business and industry to help reduce CO_2 emissions;
– reducing emissions from deforestation and degradation (REDD) through the WWF Forest-Based Carbon Network Initiative;
– the clean development mechanism (CDM);
– renewable energy power generation to offset CO_2 emissions.

Malaysia acknowledges that some level of climate change is inevitable irrespective of CO_2 emission reduction strategies. This is reflected in the conclusion of the IPCC in their 2001 Assessment Report (IPCC 2001). The Malaysian government is currently developing a national framework for climate change adaptation strategies that will strive to embed appropriate strategies within its target (Azrina 2007). The Forest-Based Carbon Network Initiative is spearheading efforts to reduce forest-based emissions, recognising the long-term imperative to address the root causes of deforestation at the national level and to raise the value of all the ecosystem services that forests afford. Malaysia recognises the important role of industry as a catalyst for reducing CO_2 emissions and, under the national agenda, business and industry become part of the solution to reduce CO_2 by becoming engaged in working towards changing practices as a response to climate change (PTM 2007).

Among the key initiatives recently taken by the Malaysian government against global warming is renewable energy (RE), which is Malaysia's future energy source. The policy of RE aims to encourage a generation of energy using biomass by providing companies that undertake such activities with tax incentives, while promoting the usage of renewable energy for power production. The government has established a programme called the Small Renewable Energy Program (SREP). Some policies put forward in Malaysia do not directly address climate change issues; however, some reviews on current policies suggest indirectly addressing climate change matters which are currently ongoing within national development plans, such as the Ninth Malaysia Plan (2006–2010), showing that several national programmes contribute indirectly to managing issues of climate change (Pereira and Tan 2008).

Efforts to promote the development of biofuel using palm oil as a renewable source of energy have been undertaken by the Malaysian government in line with other climate change-reducing initiatives. Under the Kyoto Protocol, Malaysia supports the implementation of environmentally sound projects leading to the reduction of greenhouse gases (GHG) and is encouraging the participation of Malaysian companies in Clean Development Mechanism (CDM) projects. Malaysia is committed to the implementation of sustainable forest management (SFM), as enshrined in the resolution of the United Nations Conference on Environment and Development (UNCED). In collaboration with other research institutes, such as the MMD, the National Hydraulic Research Institute of Malaysia (NAHRIM) and the Institute for Environment and Development (LESTARI), the Ministry of Natural Resources and Environment is currently conducting a policy study on climate change, following the second National Communication (NC2). The aim of this study is to develop a national policy and strategies on climate change that foster sustainable development in Malaysia to meet the country's needs and to respond to the United Nations Framework Convention on Climate Change (UNFCCC) (Tan et al. 2009).

Some recommendations called 'Towards Policy Changes' are also considered in future climate change policy after the UNFCCC's 13th Conference of the Parties summit scheduled for December 2007 in Bali, Indonesia. Country-level adaptation and feasible mitigation solutions to support the Ministry's many proactive steps to manage the consequences of climate change have recently been highly acknowledged in Malaysia (Pereira and Tan 2008). The Natural Resources and Environment Ministry recently announced a cut of 50 million tonnes of carbon dioxide equivalent per annum and a carbon emissions reduction from 187 million tonnes in 2005 to 74.8 million tonnes in 2020—a 40 % cut, with 20 % to be contributed by energy efficiency projects and renewable energy sources to offset future climate change (PTM 2007). Although the 40 % carbon emissions cut has attracted much attention in Malaysia following the COP-15 conference in December 2009, this dialogue requires enhanced interagency collaboration in addressing and adapting to climate change.

Other national policy studies adopted to support the identification of national positions with regard to the UNFCCC and Kyoto Protocol proposal, include the formulation of Malaysian national policy on climate change issues and the preparation of effective action plans, as well as delineation and collaboration of state-level responses to climate change adaptation and mitigation (Fig. 1). In the first to fourth clusters of the UNFCCC and Kyoto Protocol proposal, several local, international and public documents, including the national policy on climate change of stakeholder viewpoints, were critically reviewed. These documents are related to post-2012 responses, decision documents of the UNFCCC and Kyoto Protocol for climate change impacts, direct and indirect Malaysian climate change-related documents, Malaysia's Third Outline Perspective Plan (OPP3), Malaysia's Initial National Communication (NC) and the Ninth Malaysia Plan (RMK9) of Malaysia (Tan et al. 2009).

Malaysian climate change-related policies aim to facilitate the integration of climate change considerations into economic development decision-making processes and to foster sustainable economic and human development as environmental conservation for future generations (Azlina et al. 2007; Pereira and Subramaniam 2007; Raja Zaharaton et al. 2008). Recent policies advocate formulating climate change policy to harmonise and provide guidance to existing policies. Other recent policies complement existing ones, and take cognisance of international conventions on global concerns (Pereira and Subramaniam 2007). The draft national policy on climate change issues in Malaysia consists of several key elements including objectives, principles, strategic thrusts and key actions, and is aimed at ensuring a climate-resilient development and low-carbon economy that fulfils national aspirations for sustainability (Pereira 2008).

Table 1 briefly summarises the objectives, principles and strategic thrusts of the draft policy for integrating responses into national policies and programmes to strengthen the resilience of development from future impacts of climate change for sustainable development. The draft national policy on climate change issues in Malaysia consists of several key elements, including the following key objectives:

- mainstreaming measures to address climate change challenges through strengthened economic competitiveness, environmental conservation, wise management of resources and enhanced quality of life for sustainable development;
- strengthening institutional capacity and capability for better implementation and to enhance opportunities in reducing the negative impacts of climate change;

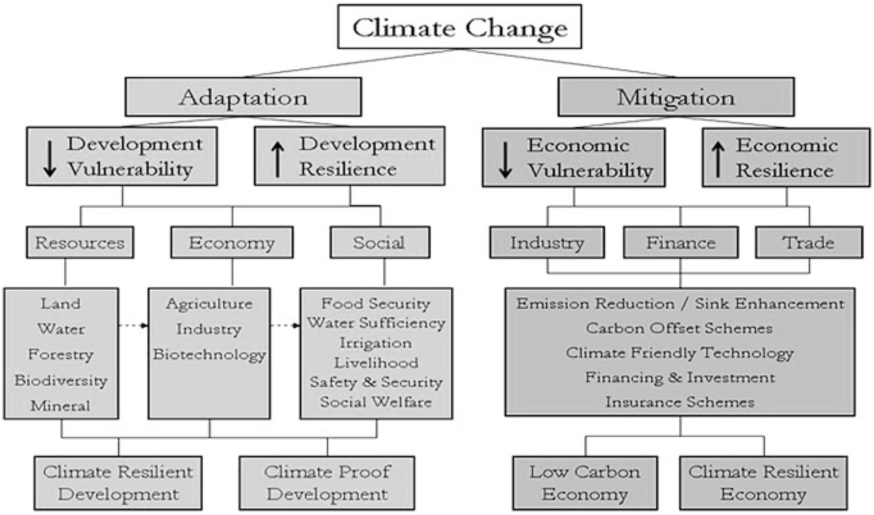

Fig. 1 Overall framework of a national climate change policy. Source: (Tan et al. 2009)

– integrating responses into national development plans and policy plans or programmes to strengthen the resilience of development from the future impacts of climate change.

The draft national policy on climate change issues in Malaysia formulates strategic principles and directions on Development on a Sustainable Path: integrate climate change responses in national development plans to fulfil the country's aspiration for sustainable development; Sustainability of Environment and Natural Resources: initiate actions on climate change issues that contribute to environmental conservation and the sustainable use of natural resources while enhancing energy efficiency and sufficiency as well as water and food security; Integrated Planning and Implementation: integrate planning and implementation to climate-proof development; effective participation: improve participation of stakeholders and major groups to bring about the effective implementation of climate change responses; and, finally, Common but Differentiated Responsibility: international involvement in climate change will be based on the principle of common but differentiated responsibility (Pereira 2008; Tan et al. 2009).

3 Implementation of Malaysian Climate Change Initiatives:Some of Which are Lacking

Malaysia's obligations to the UNFCCC, national policy and action plans, in particular, are repeatedly judged, recognised and considered as functional and practical process to capitalise on, identifying the country's own concerns about climate

Table 1 The draft national policy on climate change—objectives, principles and strategic thrusts

Objectives
• Mainstreaming measures to address climate change challenges through strengthened economic competitiveness, wise management of resources, environmental conservation and enhanced quality of life for sustainable development
• Integrating responses into national policy plans and programmes to strengthen the resilience of development from future impacts of climate change
• Strengthening institutional and implementation capacity to better harness opportunities in reducing negative impacts of climate change
Principles/Strategic thrusts
Principle 1. Development on a Sustainable Path: Integrate climate change responses in national development plans to fulfil the country's aspiration for sustainable development.
• Strategic thrust 1: Facilitate the harmonisation of existing policies to address climate change adaptation and mitigation in a balanced manner
• Strategic thrust 2: Institute measures to make development climate-resilient through a low-carbon economy to enhance global competitiveness and attain environmentally sustainable socio-economic growth
• Strategic thrust 3: Support climate-resilient industrial development and investment in pursuit of sustainable socio-economic growth
Principle 2: Sustainability of Environment and Natural Resources: Initiate actions on climate change issues that contribute to environmental conservation and the sustainable use of natural resources while enhancing energy efficiency and sufficiency as well as water and food security.
• Strategic thrust 1: Adopt balanced adaptation and mitigation measures for climate-proof development, strengthen environmental conservation and promote the sustainability of natural resources
Principle 3: Integrated Planning and Implementation: Integrate planning and implementation to climate-proof development.
• Strategic thrust 1: Institute measures to integrate cross-cutting issues in policies, plans, programmes and projects to increase resilience to and minimise negative impacts of climate change
• Strategic thrust 2: Support knowledge-based decision-making through intensive climate-related research and development and capacity-building of human resources
Principle 4: Effective Participation: Improve participation of stakeholders and major groups for effective implementation of climate change responses.
• Strategic thrust 1: Improve collaboration through efficient communication and coordination among all stakeholders for the effective implementation of climate change responses
• Strategic thrust 2: Raise awareness and increase public participation to promote behavioural responses to climate change
Principle 5: Common but Differentiated Responsibility: International involvement in climate change will be based on the principle of common but differentiated responsibility.
• Strategic thrust 1: Strengthen involvement in international activities on climate change based on the principle of common but differentiated responsibility

[*Source* adapted from Pereira (2008)]

change, building capacity and formulating potential climate change policy (Tan et al. 2009; EPU 2006). Nevertheless, as climate change is a rather new issue in this country, shortcomings and technological barriers in the mainstreaming policy have been recognised (Anon 2007).

Many proposals have been formulated to ensure effective mechanism for the implementation of international conventions and national policies across the whole spectrum of government structures, from national to state and local levels. However, they suffer due to coordination and harmonisation (Anon 2007). Some research findings divulge conflict between national future energy policy and climate change issues and emission scenarios (Abdul Hamid et al. 2008). Some research findings reveal disharmony with existing policies when formulating climate change policy and guidance and in integrating planning and implementation with climate-proof development. Furthermore, there can be poor participation from stakeholders and major groups which obstruct the effective implementation of climate change responses. Some research findings disclose a conflict between efficient environmental conservation and sustainable use of natural resources while enhancing energy efficiency and sufficiency as well as water and food security (Raja Zaharaton et al. 2008), while others find disharmony with incorporating mainstream climate change into national policies, technical barriers, programmes and plans (Tan et al. 2009).

Despite the national initiatives and following the Kyoto Protocol, Malaysia ranked 52 out of 57 in the CCPI table of climate protection performances of the 57 countries that are responsible for more than 90 % of global energy-related carbon emissions (CCPI 2010). Malaysian GHG emissions have been increasing over the years, with the industrial and transport sectors being the biggest emitters. Efforts have been made to reduce GHG emissions through CDM, even though the intention may not be noble or altruistic (PTM 2008). Recently, Malaysia has been applying climate change research to mitigate impacts at the national level. The field of renewable energy has been among the key initiatives taken by the Malaysian government in the fight against global warming (Tick Hui 2010). However, per capita, energy use in Malaysia surpasses that of other ASEAN countries such as Vietnam, Philippines, Indonesia and Thailand. As Malaysia continues to develop and grow economically, it will be expected to make a greater commitment to global mitigation actions (Tan et al. 2009). The industrial sector, which is the main implementer of most such mitigation efforts, needs to be engaged continuously to ensure awareness is raised, and capacity building is required for climate change issues and challenges.

4 What Should Malaysia Do?

Climate change is a timely issue. The scientific evidence is now striking, based on a recently published report by the IPCC and national documents. A current concern is to strike a healthy balance between achieving sustainable economic growth and managing climate change issues. The failure to adopt an appropriate long-term climate policy regime would signify the imbalance of a delicate ecosystem, rich biodiversity and economic potential. Over the years, the Malaysian economy has inevitably been linked closely to its unique natural resources, such as land, forestry, water, biodiversity, marine and coastal resources. The failure of appropriate climate change-related issues concerning socio-economic development activities would severely impact on Malaysia. A proper, relevant policy with an adaptive framework to climate change, networking and communication among stakeholders and policy-makers is vital to help shape nationally appropriate policies, which are apparently absent in Malaysia.

Sustainable long-term economic policy requires a workable framework for climate change and the highlighting of vulnerabilities still uncovered in the national economy. There is a need to visualise futures and frameworks on Malaysian climate change vulnerability issues, potential changes, uncertainties and national initiatives for planning strategies to reduce vulnerabilities and promote sustainable development. Beyond principles, however, the post-Kyoto or COP-15 framework can only be successful if Malaysia works speedily with many decentralised groupings to generate momentum. As climate change is a global issue, decentralised groupings, such as the Asia–Pacific Partnership on Clean Development and Climate, the Asia Pacific Economic Cooperation (APEC) and a gathering of major emitters which involve only a handful of countries around the world, can meet and elaborate proposals on climate change. Although country-specific adaptation or mitigation would not be a solution for climate change issues, environmental concerns are progressively being emphasised in national development plans. Country-specific adaptation and mitigation proposals would then have to be brought to the UNFCCC for agreement or partner countries notified. Such a process can help speed up the development of concrete proposals for the consideration of global climate change for next generations.

5 Conclusion

Malaysia is one of the few developing countries in the world that recognised at an early stage the positive contribution of a clean environment on economic development. Malaysia began to place an emphasis on environmental concerns in its development plans as long ago as the mid 1970s. In 1994, Malaysia ratified the United Nations Framework Convention on Climate Change, or UNFCCC. Subsequent to the ratification, Malaysia also put into place emission mitigation strategies, such as working with businesses and industries to help reduce carbon emissions, reducing emissions from deforestation and degradation through the WWF Forest-based Carbon Network Initiative, participating in clean development mechanisms, carbon trading, and renewable energy power generation.

In spite of all the aforementioned initiatives, in terms of the Climate Change Performance Index, Malaysia still ranks 52 out of 57 countries, which are responsible for more than 90 % of global energy-related carbon emissions. The main contributing factor to this lies in the fact that Malaysian's largest emitters are the industrial and transportation sectors, whose activities are linked directly to economic activities. As such, two future directions are essential in Malaysian sustainable economic development. First, there must be a move towards a low-carbon economy; second, economic growth must be decoupled from energy consumption. To conclude this paper, we stress that as an immediate step after the National Policy on Climate Change, Malaysia needs to develop a realistic roadmap for moving towards a low-carbon economy and to devise strategies that will lead to the decoupling of energy consumption from economic growth.

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Climate Change and the Role of Spatial Planning in England

Simin Davoudi

Abstract The evidence gathered from academic literature and policy sources leave little doubt that the planning system has a major part to play in climate change policy agenda. However, the extent to which spatial planning in England has leverage in tackling climate change depends largely on how broadly it is defined and what level and types of interventions, tools and resources are available to it. Adopting a broader definition of spatial planning, its place-shaping role can be practised in three interrelated ways: *proactive interventions* in the way places are developed; *regulatory interventions* in how others undertake their own activities; and *strategic coordination,* which enables participation and policy integration. Over the past decade, national policy expectations from planning to respond to climate change have grown considerably, and the role of planning has been elevated from promoting climate protection to ensuring policy delivery. However, less attention has been paid to how its role can be framed. The bewildering array of tasks allocated to planning in both policy documents and academic literature can take away the urgency of the response and the need to focus on critical climate policies in which planning can be most effective. Hence, by classifying climate policies into the three key areas of *energy supply, energy demand and adaptation,* this chapter aims to identify policy areas that are most relevant to planning intervention for each category. Based on this approach, the chapter provides a conceptual framework by mapping the three policy areas against the three types of planning interventions mentioned above.

Keywords Spatial planning · Climate change mitigation · Climate change adaptation · Governance · England

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1 Introduction

In its broader definition, planning is often understood as place governance. As such, there is little doubt that it has an important part to play in climate change policy agenda. Over the past decade in England, national policy expectations from planning to respond to climate change challenges have grown considerably, and the role of planning has been elevated from merely *promoting* climate protection to *delivering* governments' wider climate policy objectives. Spatial planning is considered to be one of the policy areas with leverage in both mitigation and adaptation to climate change. Indeed, some argue that spatial planning can be the strategic framework through which both are positioned in the broader perspective of sustainable development (Davoudi et al. 2009; Biesbroek et al. 2009). Such a role has been formalised through a series of national policies, which have made the planning delivery of the UK government's climate change strategies a statutory requirement. However, the bewildering array of tasks allocated to planning in both policy documents and academic literature has created a large degree of confusion about what is critical and where the focus should be placed. The aim of this chapter is to provide a framework for better understanding of the role of spatial planning in the mitigation and adaptation to climate change. The framework (see Table 1) is developed by mapping three aspects of planning interventions (proactive, regulatory and strategic coordination) against the three critical climate policies in which planning can be most effective (energy supply, energy demand and adaptation).

2 The UK Climate Policy Context

In responding to international targets, the UK has cut its emissions to 21 % below 1990 levels. Furthermore, the UK Climate Change Act 2008 has set a statutory target to reduce greenhouse gas (GHG) emissions by 80 % below 1990 levels by 2050. Since the 1990s, spatial planning has been expected to play a significant role in the delivery of sustainable development through policies such as: mixed use development, better design standards and reducing the need to travel, all of which were justified in terms of their potential for GHG reduction. However, even as late as 2008, progress on integrating climate change considerations into planning was slow and limited to some specific sites, leading to "a sense of implementation deficit" (Owen and Cowell 2002), which was partly due to the lack of a clear and explicit national policy. In the mid 2000s, legislative changes to the planning system placed climate change more firmly at the centre of the spatial planning agenda. However, emphasis remained on 'softer' measures of, for example, "promoting or encouraging the use of renewable energy in new developments and reducing the use of non-renewable resources" (DEFRA 2005a: 88–89), in line with the negotiation mode of governance. This softer language was later

Table 1 Spatial planning interventions and critical climate change policies

			Types of planning interventions		
			Proactive tools Plans, strategies, guidelines; resource mobilisation	*Regulatory tools* Development control/ planning gain negotiation	*Strategic coordination tools* Consultation/ collaboration
Key climate change policies	*Energy supply (mitigation)*	Large renewables	Site allocation/identification	Infrastructure Planning Commission	Renewable energy industry/ local communities, etc.
		Small renewables and micros	Specific requirements (e.g. Merton Rule)	Permitted development	
	Energy demand (mitigation)	Reducing travel	Settlement size, density, mixed use location and accessibility, parking		Developers/transport authorities, etc.
		Energy efficiency		Planning conditions Code for Sustainable Homes	
	Adaptation	Flood risk	Protecting flood plains from development		Environment agency/ developers
		Heat wave	Protecting and enhancing green infrastructure	Planning conditions Design standards	

strengthened by the more robust vocabulary of the subsequent national planning guideline, which stated that: "local planning authorities should *ensure* that development plans contribute to global sustainability by addressing the causes and potential impacts of climate change" (ODPM 2005a: 13). The explicit expectation from planning has since been recognised in the UK Climate Impact Programme 2006 (DEFRA 2006) and heightened by the subsequent national planning guidelines to stress that, if planning is used positively, it can play a pivotal and significant role in the climate change agenda (DCLG 2007). Overall, not only the expectations from planning have increased, but also its role has been elevated from being a *facilitator* and promoter of climate protection to one which should ensure policy *delivery*. However, the extent to which spatial planning can play a role in tackling climate change depends largely on how broadly it is defined, and what level and types of interventions, tools and resources are available to it to pursue the tasks expected from it, and how well its measures are integrated and coordinated with other policy areas.

3 The English Planning System

The planning system in England (and the rest of the UK) has evolved considerably since the introduction of the 1947 Town and Country Planning Act. As a result, the balance between proactive, strategic and forward-looking dimensions of planning (often represented by the development plan system) and its site-specific, regulatory dimension (often represented by the development control system) has fluctuated over time. In the late 1990s, this balance shifted towards the former and, in 2004, after a legislative change, the pursuit of sustainable development became a statutory purpose of the planning system. At the time, the scope of planning was also extended from a narrow *land use* regulation to the broader *spatial* planning with a focus on place governance.

3.1 Planning Interventions

In analysing the role of the planning system in climate protection, this chapter, in line with the UK government policy and the broader governance literature (see Davoudi et al. 2008), defines planning as place governance; as an activity engaged in collaborative actions to make better and more sustainable places. Adopting this broader definition of planning implies that its place-shaping role can be practised in three interrelated ways (see UN-Habitat 2009, Chap. 4):

- proactive interventions in the way places are developed;
- regulatory interventions in how others undertake their own activities;
- strategic coordination that enables participation and policy integration.

Planning's *proactive interventions* use mechanisms, such as identifying spatial opportunities and constraints for land allocation for specific uses and/or land assembly for major development projects. Planning's *regulatory interventions,* although often portrayed as negative restriction, have both protective and developmental intent. *Protective* regulation is justified on the basis of safeguarding assets, social opportunities and environmental resources, and reducing vulnerability to climate change risks; all of which would otherwise be squeezed out in the rush to develop. The justification for *developmental* regulation is to: promote better standards of building and area design; enhance quality of life and public realm, introduce a degree of stabilisation in the urban development process and; deliver the required infrastructures for transition to a low-carbon economy and adaptation to climate change. However, in social democratic societies such as the UK, where a free market economy prevails, government's and, by extension, planning interventions can succeed in delivering change only if they are undertaken in partnership with the private sector and through public engagement. The need for such partnership and for considering the implications of individual policy sectors for the quality of specific places provides the justification for planning's *strategic coordination.* This is about bringing together multiple policies and stakeholders, and coordinating their activities in specific places. Assigning such a strategic role to planning was reflected in the mid 2000s' reforms of the planning system.[1]

3.2 Planning Tools and Resources

The various forms of planning interventions mentioned above are achieved by drawing on a set of tools (Vigar et al. 2000). These tools can be consolidated into four types: strategies and plans; regulatory measures (in line with formal, hierarchical mode of governance); resource mobilisation (in line with market stimulation mode of governance) and; consultation and collaborative practices (in line with negotiation mode of governance).

As suggested by Hopkins (2001, Chap. 3), plans can perform tasks such as providing: a list of actions to be undertaken (an agenda); principles or rules to guide subsequent actions (a policy statement); an image of what could come about (a vision); a fully-worked out development scheme (a design); and/or guidance on sets of interrelated decisions about current action linked to specific contingencies anticipated in the future (a strategy). The power of a plan has a lot to do with the authority accorded to it in formal law or through national government policy. Hence, in planning systems where the right to develop is enshrined in a zoning

[1] It should be noted that in 2011 the UK Coalition government reformed the planning system through the Localism Act, 2011. This reduced the strategic capacity of spatial planning in line with the abolition of the regional tier of planning and all key performance targets which local authorities had to produce with regard to a number of national policy priorities including climate change adaptation.

ordinance (such as parts of the United States), those plans that express this carry a lot of weight in deciding what can take place on an individual plot. In more discretionary systems (such as in the UK), plans are more of a statement of what the local government wishes to see happen in a place. This, however, can be an important point of reference for shaping the decision of those involved in development.

The effectiveness of spatial planning is often dependent on the careful linkage between actions indicated in plans and strategies, the use of regulatory instruments, and the provision and mobilisation of human and other resources that are needed to carry a strategy forward. Weakness in such linkages has, in the past, led to inadequate policy implementation. As a result, although sustainable development has been adopted on a statutory basis in the planning system, this has not always been matched by its outcomes in terms of dominant development processes (Davoudi and Layard 2001).

The discursive shift from sustainability to climate change has once again encouraged planners to re-think their processes, methods, skills and even perception of what constitute 'good places' (Davoudi 2012). Consecutive national policy changes and the introduction of mechanisms, such as sustainability appraisal of plans, have also helped embedding sustainability and, increasingly, climate change issues into the planning framework (Davoudi et al. 2009). However, the growing range of issues with which planning has to grapple has not been matched with the level of resources allocated to it. This is particularly the case in terms of insufficient numbers of appropriately trained planners (DCLG 2004). One area which is reportedly under-resourced is enforcement and monitoring (Rydin 2009), both of which are crucial for implementation.

4 The Role of Spatial Planning in Climate Change

Since the mid 2000s, a number of national guidelines have been issued, each prescribing a new set of roles for planning in relation to climate change. For example, in 2007 a national policy guideline considered the role of planning to be five-fold: "secure enduring progress against the UK's emissions targets […]; deliver the government's ambition of zero carbon development; shape sustainable communities that are resilient […]; create an attractive environment for innovation […] in renewable and low-carbon technologies […]; and capture local enthusiasm and give local communities real opportunities to influence and take action on climate change" (DCLG 2007: 7). An earlier government's best practice advice had identified a longer list of actions for planning related to: the built environment (six actions); infrastructure (five actions); location (two actions) and; rural environment and land use (eight actions). The actions range from consideration of passive solar gain, through flood risk and water resources as well as local food markets (ODPM 2004: 29–31). While these indicate the breadth of the planning role in the climate change agenda, their sheer volume and their seemingly random selection makes it difficult to understand what planning can exactly achieve and in which areas of climate policy planning interventions can be most effective. Following Bulkeley (2006), this chapter attempts to group the wide range of actions and tasks—which are expected to be delivered or enabled by the planning system—into three broad and critical climate policy areas, including: energy supply, energy demand and adaptation. In discussing these areas, references will be made to the three types of planning interventions, discussed above, in order to provide a better understanding of which type of intervention may be used in which area of climate policy to produce more effective results (see also Table 1 for summary).

4.1 Planning and Renewable Energy Supply

Mitigating climate change requires a shift in the balance of energy supply from fossil fuels towards other sources, notably the renewable energy sources covering electricity, heat and transport. Under the agreement to drive the uptake of renewable energy across Europe, 15 % of energy in the UK must be renewable by 2020. It is in this area of climate policy where the planning system has a particularly proactive role. But, paradoxically, it is also here that the planning system has been framed as 'part of the problem.' For example, the UK Renewable Energy Strategy, which sets out the path to meet the legally-binding targets, discusses the role of planning under the heading of "drive delivery and clear away *barriers*" (HM Government 2009a, emphasis added). This echoes previous perceptions of planning as a barrier, as reflected in the Energy White Paper (DTI 2003), which called for planning to be 'streamlined and simplified' as well as a follow-on national planning guideline which required that, "local development documents should contain policies designed to promote and encourage, rather than *restrict*, the development of renewable energy sources" (ODPM 2005b, 1.2, emphasis added).

4.1.1 Large-Scale Renewable Energy Supply

The framing of the planning system as a barrier has largely been due to delays in processing and often rejection of planning applications for larger renewable energy facilities, notably wind farms. This in turn has been due to local opposition and spatial disputes. The success rate for wind farm application in England and Wales is only 40 % (Toke 2003). While local opposition is often dismissed as 'Nimbyism,' numerous academic studies have suggested that the reasons for protest are not straightforward and depend on where, when and how people have been engaged in decision-making processes (Wolsink 2007). Similar conclusions are derived from research on other forms of renewable energies as well as other major infrastructure developments, notably those related to waste management (Davoudi and Evans 2005). They all highlight that framing the role of spatial planning as a top-down delivery system for national policy objectives and targets is inadequate.

They argue that, in practice, local planning is enmeshed in a complex process of negotiation with multiple stakeholders and balancing of multiple and often competing policy interests (Haggett 2009). Partly due to perceived failure of local planning in delivering renewable energy, decisions on major infrastructures, including large renewable energy facilities,[2] are now dealt with at the national level.

To ensure a proactive approach to renewable energy supply, a multi-level governance arrangement has been enacted where regions are expected to set targets in line with national targets or better. Similarly, local planning authorities are expected to go beyond encouraging the development of renewable energies to meet specific targets for new capacities. These provisions have been strengthened by the UK Renewable Energy Strategy (HM Government 2009a), which put forward a number of measures aimed at "swifter delivery"[3]; i.e. mainly focusing on providing more flexibility in planning's regulatory interventions. As regards strengthening planning's proactive interventions, the Strategy emphasises that "effective and proactive strategic planning […] is […] vital if we are to capitalise on the renewable opportunities" (ibid.: 78). Mindful of the contested nature of local planning decisions and the continuing conflict of interests over the right balance of local and national priorities as well as costs and benefits of development, the Strategy then goes on to stress that, "key to this will be a transparent, robust and evidence-based process in which individuals, communities, developers and planners can engage" (ibid.). This not only shows that strategic planning is a collaborative process, but also reveals the limitation to its proactive capacity.

4.1.2 Small-Scale Renewable Energy Supply

As regards smaller, on-site, renewable energy facilities, in the 2000s the local government has been the most proactive level of governance in initiating innovative planning responses and in drawing explicitly on the strategic *coordination and enabling* role of spatial planning. Such innovations have challenged the framing of the planning system as a mere delivery mechanism for national policy. The bottom-up initiatives have used the developmental intent of planning's regulatory interventions to generate renewable energy, focusing on specific sites and technologies. The most notable example is 'The Merton Rule,'[4] which requires the incorporation of at least 10 % (of estimated energy requirement) in developments of over 1,000 m^2. The Rule has been implemented by an estimated 100 local

[2] This includes renewable electricity generating plants of over 50 MW onshore and 100 MW offshore in England and the adjacent offshore Renewable Energy Zone (HM Government 2009b: 73).

[3] This is the title of Chap.4 of the Strategy, which deals with planning issues on p. 70.

[4] This was devised by planners in the London Borough of Merton as a form of planning condition for new developments of over 1,000 m^2.

authorities (LGA 2007: 34), with more signing up to its dedicated website[5] and some (notably London) raising their target to 20 %. These local initiatives went beyond the national guideline, which required for an undefined percentage of the energy to be used in new developments and only if it does not put "undue burden on developers" (ODPM 2005b: 8). However, national policy has since been widened, and there is also a wealth of local planning guidelines, which provides advice on climate change mitigation measures to planning applicants (see Rydin 2009 for a list).

To sum up, attempts at tapping into the *proactive* potential of the planning system have been hampered by its limited leverage in bringing forward development projects to meet the national or local targets for renewable energy. Key decisions over energy infrastructure are taken nationally so, without a strong national and local coalition of values in favour of decarbonising the UK economy, planning's proactive interventions will continue to face challenges from other competing demands.

4.2 Planning and Efficiency in Energy Demand

Transforming the UK into a low-carbon economy requires policies and actions that are aimed at not only increasing the supply of low carbon and renewable energy, but also substantially reducing energy demand. Managing energy demand through land use policies has been a major part of planning's sustainable development objective since the 1990s, as mentioned earlier. Two areas in particular have been at the centre of attention. One is the need to reduce car travel through policies on the location of new development and accessibility, and the other is to increase energy efficiency of the built environment through design policies and the layout of new developments.

4.2.1 Reducing Car Travel

Numerous studies have tried to establish the link between urban form, land use and travel patterns. While socio-economic variables often explain the variation in trip-making more significantly than the land use factors (Hickman and Banister 2005), evidence shows that at the regional and city levels, three land use characteristics have major impacts on travel behaviour. These are density of development, settlement size and access to facilities and services (Banister and Anable 2009), with density having a greater impact than settlement size in encouraging walking and cycling. The much-cited research by Newman and Kenworthy (1999), which

5 www.themertonrule.org.uk.

compared 84 cities, has shown that density has an important impact on the distances travelled, too.

The main conclusions with regard to the impacts of land use factors on travel behaviour is that, although planning may have a limited role in the short term, compared with fiscal measures, it certainly has a more significant role in the longer term. This can be achieved through: fostering sustainable location choices; facilitating other policy areas and; acting as a complementary policy for technologically-driven and demand-management policies so that their benefits are locked in. Furthermore, given the unequal distribution of GHG emissions from personal travel in the UK (Brand and Boardman 2008), the role of planning in providing for local services and access to them by sustainable modes of transport is pivotal to ensure accessibility for lower income groups. Overall, there is now compelling evidence which shows that the future location of new housing and other developments in the UK has substantial implications for: the level of demand on transport systems, journey distances and the use of different modes of transport (Banister and Anable 2009).

4.2.2 Increasing Energy Efficiency of the Built Environment

Here, the role of spatial planning relates to three areas: firstly, the location, layout, landscaping and site design for new development; secondly, the design of individual buildings and; thirdly, the environmental standards of larger developments, such as the ecotowns.

Planning provisions for increasing the efficiency of new buildings date back to the late 1990s when pioneering local authorities (such as Newcastle) incorporated energy efficiency measures in their development plans. Such practices became more widespread across the UK following publication of a national planning guideline on housing, which suggested that planning authorities should "promote the energy efficiency of new housing where possible" (DETR 2000: 3). However, the scope for planning intervention in this area remained limited, as the standards of design in new buildings are controlled by the Building Regulations. While steps have been taken to revise the Regulations to achieve more sustainable design and construction, until recently progress has been limited.[6] Hence, this has left a regulatory gap into which the planning system has gradually moved. The main shift came in 2006 when the government introduced a package of measures aimed at achieving zero-carbon homes by 2016. Part of this package was the Code for Sustainable Homes.[7] Although achieving specific rating of the Code is voluntary, all new buildings have to be assessed against the Code as part of the planning

[6] A new version with more stringent energy efficiency measures in Part L took effect in 2006. These increase the efficiency standards by 40 % over 2002 levels.

[7] A government-endorsed rating system for new housing with the sixth star of rating awarded to zero-carbon development (DCLG 2006).

permission process. This has signalled the recognition of the regulatory potential of spatial planning, which can go beyond the provisions of the Building Regulations and can also be extended to issues such as connection to Combined Heat and Power schemes. Furthermore, the critical role of the planning system is strategic coordination to bring together interested parties to facilitate the establishment of decentralised energy systems.

New developments with major planning inputs are also being piloted to meet the highest environmental standards on a large scale, notably: the ecotowns, the Thames Gateway ecoregion and the London Olympic Park. Ecotowns are new settlements,[8] promoted primarily as part of meeting the government target to build 240,000 new homes per annum by 2016. In doing so, they are required to achieve zero-carbon emission. Whilst there are some concerns over the proposed location of ecotowns, they will provide learning for planners and others involved about new ways of decarbonising existing communities.

The preceding account shows that attentions so far have been put largely on new development. It may be true that, "if we build the houses we need, then by 2050 as much as one-third of the total housing stock will have been built between now and then" (DCLG 2007: 5), but this means that two-thirds of the dwellings in 2050 have already been built. Improving the energy efficiency of the existing building stock is therefore paramount. As the government's statistics show,[9] there is a long way to go in making progress to 2020 and beyond. Planning's regulatory intervention along with the appropriate financial incentives can be drawn upon to move this agenda forward. This is already taking place at the local level, where cost-effective energy efficiency measures are carried out for the existing building as a condition of planning consent for a home extension. Others have suggested more drastic measures, arguing that meeting the national target for GHG emissions in the housing sector requires demolition of 80,000 dwellings per year (Boardman 2007). The role of spatial planning in this area is not limited to regulatory measures deployed at the point of planning consents. It also extends to more strategic interventions within the framework of urban regeneration. In fact, "there may be scope for returning to some of the ideas of the 1970s concerned with housing improvement and bringing together housing and planning policy in new ways" (Rydin 2009). Similar place-making endeavours can be sought in commercial areas in the context of town centre management.

However, the potential for spatial planning to reduce emissions, or indeed achieve other sustainability objectives, has been persistently undermined by an overriding expectation from the planning system to provide for predicted demand for growth of: housing, economic activity, traffic volume, waste generation, construction activity, out-of-town shopping, and so on (Davoudi et al. 2009). Such

[8] For pros and cons of new settlement versus other forms of accommodating growth (such as urban infill and urban extension), see Green and Handley (2009).

[9] Almost two-thirds of cavity walls are filled in the UK and only 35 % of lofts are insulated to at least 150 mm, with the figures in private rented sector as low as 21 % (HM Government 2009b: 83).

potential may be further hampered as a result of the current economic recession, as the emphasis is not just on providing for, but also stimulating, demand.

5 Planning and Adaptation to Climate Change

The UK is already experiencing the impacts of climate change, including extreme weather events, such as the 2007 summer floods, the 2004–2006 drought and the 2003 heat wave. The Association of British Insurers has estimated that claims for storm and flood damages in the UK doubled to over £ 6 billion over the period 1998–2003, with the prospect of a further tripling by 2050 (ABI 2004). Adapting to these inevitable impacts of climate change is another area in which spatial planning has a significant role to play. Evidence on the extent to which planning has become engaged with adaptation is mixed. While some criticise planners for being fixated on mitigation to the near exclusion of adaptation (LGA 2007), others disapprove of them for not paying enough attention to mitigation policies (Howard 2009). However, the emerging consensus is that emphasis should be placed on integrating both measures and ensuring that adaptation policies do not jeopardise, in the long term, the efforts for mitigating the causes of climate change.

Four areas of climate risk have been at the centre of adaptation efforts. These are related to the risk of: flooding; coastal erosion; heat waves and; drought (particularly in the south of England). The role of spatial planning has been mainly related to: (a) the location of new development away from the areas of risk; (b) the design and layout of buildings and urban areas which are resilient, and; (c) the promotion of sustainable water management in new developments. The focus here will be on issues around flood risks and heat waves, which have attracted substantial attention.

5.1 Flood Risks

In England, planning policy on flood risk was first introduced in 1992. Its subsequent revision in 2001 made it clear that "the susceptibility to flooding is material planning consideration" and planners should "consider how a changing climate is expected to affect the risk of flooding over the lifetime of developments" (DETR 2001: 4). This was issued well before the Foresight Future Flooding study (DTI 2004), which led to a major reframing of government's long-term strategy for flood risks and coastal erosion. Instead of focusing only on building flood defences, attentions were placed on recognising the need for *Making Space for Water* (DEFRA 2005b) and protecting floodplains from development. Spatial planning decisions can influence both the probability of flooding and its consequences. As regards the former, planners are required to adopt a 'risk-based' approach "to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk," (DCLG 2010). Development plans have to conduct a sequential test to steer new development towards the lowest probability flood zones, identified in Strategic Flood Risk Assessment (SFRA) based on the Environment Agency Flood Maps. Also, planning applications have to be supported by flood risk assessment. By 2009, 85 % of local authorities had completed a SFRA and, in over 96 % of cases where the Environment Agency has objected to planning applications on flood risk grounds, the final decision was in line with the Agency advice.

Despite all this, development still occurs in 'at-risk' areas. While some criticise local planning decisions for allowing development to go ahead on floodplains, others criticise national planning policy for being too "restrictive" and inflexible in "areas that have limited land available for development" (DCLG 2006) particularly for the provision of much-needed housing. This clearly shows the contested context within which planning decisions have to be made. It also shows that planning can not only use its regulatory tools to protect 'at-risk' areas, but also its collaborative practices to provide arenas for discussing different sides of the arguments, and negotiating the terms upon which trade-offs need to be made.

5.2 Heat Waves

As regards the risk of heat waves, the headline for spatial planning is the urban heat islands. This refers to the several degrees warmer air temperature in urban areas compared with the countryside, due partly to the surface cover. The urban heat island effect in turn has a major impact on human health, energy use and biodiversity. According to the Urban Environment Report (RCEP 2007), urban heat islands can be classed as 'systemic' rather than 'cumulative' issues; the distinction being centred on whether the issues apply to all settlements or mainly to towns and cities. As a systemic issue, tackling urban heat islands "requires significant local powers in terms of planning and design" (ibid.: 83). This reinforces the Urban Task Force's (1999) recommendations that called for an integrated approach to planning, urban design and management with a view to enhance the potential amenity value of public realm. Multi-functional green networks or 'green infrastructure' can provide cooler microclimates, reduce surface water runoffs and help urban areas better adapt to climate change. Protecting local amenities, notably green areas, has been an integral part of the planning system. However, the rationale for it has changed over time (see Davoudi 2012). Today, the need to adapt to climate change has renewed the functional rationale for protection of green spaces. It has also extended their functional values from aesthetic to biodiversity and ecosystem. The green infrastructure resources need to be strategically planned, at both regional and local planning levels, and designed and managed to maximise their climate-related functionality (Gill et al. 2009). Planning's proactive and regulatory interventions provide critical means for achieving this.

Overall, the role of spatial planning in adapting to climate change is still at the developmental stage. Some even argue that it is taking place "on the fringes of the spatial planning system" (Bulkeley 2009: 293). Institutionally, this is because the growing stakeholder-based Climate Change Partnerships that were set up across the UK to pursue local adaptation strategies were operating largely outside the formal arenas of the planning system. However, the situation is dynamic, and a whole host of new climate protection policies (such as surface water management plans) are on the horizon, whereby the planning system has been earmarked to deliver.

6 Concluding Remarks

Responding to climate change is a challenge not just for the planning system, but also across the policy sectors and for the government as a whole. There has been a proliferation of governmental reports, national planning policy statements, emerging legislation at both national and international levels, as well as academic literature, which demonstrate a widespread recognition of the pivotal role of spatial planning not just as a technical means by which climate change policies can be delivered, but also as a democratic arena through which negotiations over seemingly conflicting goals can take place, diverse voices can be heard and place-based synergies can be aimed for.

Much has already been delivered through all three types of planning interventions. However, there are limits to how much planning can do. Its effectiveness clearly depends on the extent to which it works in harmony with other policy instruments, such as green taxation, other regulatory measures, education and awareness raising programmes, direct construction and/or subsidisation of development projects and promotion of behavioural change. Furthermore, planners are faced with a number of challenges which are arising from the inherent complexity of dealing with climate change issues, such as: the interaction between energy, transport and settlement pattern and between energy and building performance; transition from the current state of the built environment to one which is less dependent on fossil fuel; timescale and dynamics of change (e.g. extended, sometimes millennial, timescale of climate change and the traditional planning timescale of 10–20 years); interactions of various spatial scales (e.g. mitigation of GHG emissions has aggregate effects at a global level, but derives from cumulative actions at smaller spatial scales); evolving policy context and the need for adaptive management; and, potential conflicts between adaptation and mitigation measures. These complexities coupled with climate change uncertainties require a portfolio of governance responses of which planning is only one area.

A further point worth mentioning is that most of the progress so far has been made in a long period of unprecedented economic growth fuelled by an incredibly buoyant property and, particularly, housing market. This period has now come to a halt. Thus, the critical question is how the economic downturn will affect the balance of priorities in spatial planning decisions. If history is anything to go by, the answer may not be promising. That is why professional planners are increasingly concerned that sustainability goals may be perceived as "luxurious embellishments to developments" (Hartley 2009: 16). In 2011, the neo-liberal reform of the planning system began to swing the pendulum sharply towards the relaxation of planning regulations in the name of economic growth, at the time when the urgency of actions on climate change should be the key priority. If this priority is acknowledged, then attempts should be made to capitalise on planning's proactive and regulatory interventions and its strategic coordination capacity at the local level by taking actions at the national level and on a number of fronts, including:

- policy prioritisation in favour of environmental sustainability and climate protection instead of an overriding presumption in favour of development;
- better institutional coordination between and within central government departments on critical climate change issues;
- enhancement of the quality and quantity of skilled human resources through, for example, making climate change a core subject in planning education and;
- allocating more resources to planning authorities (commensurate with their growing responsibilities) to enable them to deliver national policy goals and offer innovate local responses to climate change challenges.

The latter is particularly important in the context of adaptation responses because they need to be tailored-made and fine-tuned to suit the specific socio-economic and geophysical circumstances of localities. Hence, the local and regional planning bodies with their local knowledge are in a better position to deliver them.

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The Need for Adaptive Water Governance: Lessons from Canada and Chile

Harry P. Diaz and Margot Hurlbert

Abstract This chapter assesses institutional learning and water governance in both Chile and Canada. This chapter is based on the findings of vulnerability assessments and interviews with key stakeholders and people employed in water governance in Chile and Canada. In order to support adaptive water governance, learning must be nurtured. This requires better vertical and horizontal institutional coordination and integration to facilitate dissemination of findings and data as well as improved clarity of roles in water governance. Government has an important role to play; this cannot be left to private actors. This chapter presents findings from an institutional adaptation to climate change project conducted in both Chile and Canada. This study is important as Chile and Canada have very different water governance regimes; the former is privatized and the latter publicly owned and privately licensed.

Keywords Water governance · Climate vulnerability to climate change · Institutional learning

1 Introduction

Climate change is perhaps the most dramatic dimension of global change that we face. Carbon dioxide, the most important greenhouse gas (GHG), is at its highest level of concentration in the atmosphere since the beginning of human history and it continues accumulating at a high rate. Global warming is an unequivocal process

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that cannot be ignored. It is already affecting the dynamics of local natural and social systems and their interrelationships. The speed of the process of change shows no signs of abatement. The inability to reach an international agreement to reduce the concentration of GHGs, among other factors, is leading to increasing global temperatures, changes in regional climate systems, and associated impacts that could bring serious risks and damages to ecosystems and livelihoods, disrupting the precarious balance between people and their environment.

Society has had a long history of accommodation to climate conditions. Our activities, practices, organizations, and institutions have developed an adaptive capacity that, within certain limits—the coping range—has made us resilient to the ups and downs of climate. Climate change, however, is already altering climate conditions, increasing the range of climate events at a pace that was never expected. In this context, the most fundamental policy challenges are, on one side, to mitigate the production of GHGs and, on the other side, to increase the resiliency of society. These challenges require changes to our institutional systems, changes that could ensure the development of a coping range more in tune with the new climate conditions.

Within the context of water governance, this chapter discusses the process of climate change as a source of risks, arguing the need to assume climate change in all its complexity. Drawing from insights from an emerging literature focused on the relationships between the state and the process of global change, this chapter advances ideas for substantial changes to the existing government institutional water systems that could contribute to increasing their adaptive capacity—the capacity to be effective within a range of climate conditions—and their ability to support civil society. Based on an empirical assessment of water governance networks in Canada and Chile, this chapter ends by discussing important water governance modifications required to improve adaptive capacity.

2 The Threat of Climate Change and Water Supply

It has been normally expected that climate change will have a uniform effect—a warming of the whole planet—and that it will follow a linear, gradual process where the different components of the climate system continue more or less in equilibrium. In this view, the transformations of climate conditions do not involve a radical change. There is not a significant urgency in dealing with the issue, given that a gradual process of climate change provides society with the possibility of slowly adjusting to the emerging conditions. These assumptions have fed what Giddens (2009) called a paradox: given the measured pace of the process and the idea that climate change is something of the future, present societies have been reticent to act.

There is, however, an increasing consensus that climate change will involve more than a gradual increase of warming with associated changes in other climate variables. It will certainly bring a readjustment among the components of regional climate systems, creating conditions that may increase or decrease existing regional climate variables or, even worse, bring unexpected climate patterns. According to the 2007 report of the Intergovernmental Panel on Climate Change (IPCC), these readjustments will produce a variety of effects, including changes in sea levels, precipitation patterns, river floods, water scarcities, and significant transformations in regional ecosystems, including the disappearance of many species and the invasion of non-native species (Parry et al. 2007). In the study area of Canada, drier conditions, with more extreme weather events, and increasing climatic uncertainty is expected with climate change (Sauchyn et al. 2002); as well, there will be impacts on water resources in terms of quantity and quality (Lapp et al. 2009). Increased periods of water scarcity are anticipated (Sauchyn and Kulshreshtha 2007).

In Chile, a significant reduction in precipitation over the past century has already been noted close to the coast (Chilean Integration Report 2009), which will continue into the future with higher minimum and maximum temperatures (Fiebig-Wittmaack et al. 2008). In these terms, climate change may involve a qualitative change in the equilibrium of climate systems with unexpected consequences for the delicate balance of local ecosystems and for people's livelihoods.

The last IPCC report includes other aspects that are undoubtedly unsettling. One of them is that fierce weather events and extremes will become more frequent and more intense. The widespread melting of ice due to warmer global temperatures in the Arctic, Greenland and West Antarctic could bring major changes to coastlines and their related natural ecosystems and human settings. It will affect especially low-lying islands and countries with low-level coasts, such as Bangladesh. More intensive and longer droughts are expected in many world regions, including large sections of Africa, Australia, North America, South America, and Europe. Heat waves, a long number of days with unusually high temperatures, are expected to impact people, animals, and plants, especially in large urban centers that have been built for cooler times (Parry et al. 2007; Brown 2007; Henson 2006). These and other severe consequences of climate change create conditions of risk for millions of people around the world that could cause large financial losses, severe societal stress, and severe humanitarian disasters.

The IPCC report adds more complexity to these increasingly risky conditions when it states that vulnerability to climate change can be exacerbated by the presence of other non-climate stresses. Climate in itself is not a serious hazard for most people, but when it is coupled with other stressors—such as an economic crisis or a civil war—it could be highly problematic. Climate could either exacerbate the already negative impacts of non-climate stressors, such as the absence of proper health services, or it could contribute to increasing people's sensitivity to already existing risky economic or political conditions. In this vein, the fact that most of the world population lives in poverty is an important indicator of the proportion of human beings that are in an extremely vulnerable situation in the context of climate change (Parry et al. 2007: 19; Timmons Roberts 2009; Christoplos et al. 2009).

The arguments about a potential "tipping point" in the near future add another level of complexity to our understanding of climate change. A tipping point is a threshold beyond which global warming could be potentially very dangerous due to positive-feedback processes which intensify changes, making them worse. Examples are the water evaporation from the oceans, which increases water vapour in the high atmosphere, producing an enhanced greenhouse effect that results in higher surface temperatures and more water evaporation, or changes in the amplitude and frequency of El Nino-Southern Oscillation (ENSO), which could increase the frequency of extreme climate events in many regions of the world. Given that each positive feedback has its own tipping point, there is not a definitive agreement about a single temperature change as a global tipping point. Many scientists believe that an increase of 2 °C above pre-industrial levels is the threatening threshold. This tipping point could be reached when the concentration of carbon dioxide arrives at a level of 450 ppm in the atmosphere. By 2007, the level of concentration was already 380 ppm, getting very close to this threshold (Henson 2006: 16; Brown 2007: 42–45). Some authors (Pearce 2007; Lovelock 2007) embrace this idea of the process of climate change as non-gradual and potentially dangerous, arguing that climate change could involve a radical process that brings sudden and abrupt changes to natural and social systems and their equilibriums.

There is also the issue of climate change as a dual spatial process. In opposition to highly specific environmental problems, climate change is global in nature. The atmospheric concentration of GHGs is leading the process, but the subsequent stages of this process—the transformation of climate systems—take place at regional and local levels. Impacts of global warming are determined by regional climate and weather patterns and by local conditions that define the degrees of local exposures and sensitivities to climate conditions. Any intent to deal with climate change must recognize this dual expression of the phenomenon.

Climate change, as an environmental and social problem, has a unique singularity. Its dual nature (global and local), the threat of increasing extreme climate events, the not-well-understood relationships between climate stressors and other forms of stress and their concomitant impacts on water, the impacts of global warming on the qualitative dimensions of regional climate systems, and the possibility of abrupt radical changes to these systems, make prediction a futile exercise. There are few certainties in the process of climate change, other than that it is a human product and no simple cause-effect can be used to understand its dynamics and its impacts on society. Rather, it is a process plagued with uncertainties and volatility, where opportunities may exist, but are accompanied by significant risks.

If global warming is creating qualitatively different regional climate systems, we must ask ourselves if our institutional systems have the capacity to match these new biophysical systems, or if these new conditions are likely to exceed the capacity of institutions to adapt. Our existing social institutional systems have learned to operate within a specific coping range, a given variation of climate stimuli that we can absorb without significant problems (Smit and Pilifosova 2003). New regional climate systems will have new conditions, some of them anticipated and some others unanticipated, and many of them outside the coping range that we currently experience. This mismatch between the new climate systems and our institutional systems will reduce the adaptive capacity of institutions to reduce the vulnerability of society to climate and exacerbate the negative impacts of other stressors (Galaz et al. 2008).

The methodological framework for this study was established in a document defining institutions and the main dimension of a governance assessment (Diaz and Rojas 2006), together with a baseline description of water governance in Canada (Corkal et al. 2006) and Chile (Diaz et al. 2005). Interviews were conducted in both Chile and Canada exploring dimensions of water governance facilitating or hindering adaptive capacity. Reports were prepared in Canada and Chile, respectively by the separate teams conducting the research (Diaz et al. 2009; Reyes et al. 2009). Based on this assessment of vulnerability in Chile and Canada—countries with very different water governance regimes—the following conclusions were drawn.

3 The Need for a New Institutional Approach

The uncontrolled process of climate change and its increasing uncertainties have taken us to a climate change crisis point. The assumption that high-carbon economic growth is a viable alternative (it could bring a process of ecological modernization in the near future) is undoubtedly false, given that it only contributes to speeding up the process of global warming. The action of mitigation and its associated technologies—such as sequestration of GHGs—is a step in the right direction, but technological limitations and the lack of political enthusiasm for full commitment to reduce or stabilize the production of GHGs impose limits to this choice.

There is an increasing urgency to act now in order to deter the dangerous path of global warming and improve the capacities of society—especially of those who are most vulnerable—to build resiliency to the impacts of climate change. Climate change has to be a front-of-the-mind issue for society if we want to manage the uncertainties of the near future, so that we could increase the positive dimensions of climate change and reduce the negatives. To be able to do this, we need qualitative changes in the institutional approach to climate change, so that our institutional systems could fit with the new biophysical systems emerging from the process of climate change.

Two basic changes are a must. First, we need to abandon the neo-liberal idea that the private sector has to be the central core of the organization of society. The private sector, for the purpose of leading the climate change effort, is too amorphous. It contains a diversity of interests, and many of them are in contradiction with that effort. Moreover, its rationality is not directed to the common welfare, but to the specific economic interests of private companies. A second change involves a more direct intervention of the state in organizing and leading the climate change effort. The state is the only actor, at the national level, that has the capacity and resources to address the failures of markets, to lead the private sector and civil society, to facilitate the production and delivery of resources, and make possible the implementation of climate change policies, programs, and approaches at regional and local levels (Giddens 2009; World Bank 2010). Local institutions are also important—they integrate the interests and concerns of local people—and cannot be ignored (Agrawal 2010; Christoplos et al. 2009; Ensor and Berger 2009), but their resources are limited. They must be part of what Adger (2003) refers to as synergistic social capital, where local institutions link with a larger institutional framework (mainly public institutions) that could provide access to larger and better resources and the necessary coordination.

Addressing the climate change challenge, however, also requires changes to the traditional approach of the public sector to environmental problems. There is growing literature in different areas related to global change, sustainable development, natural resources management, and climate change that provides important insights into the nature of these changes. Building on these experiences, we emphasize the need for two important transformations of the state: the collaboration of the civil society, and modifications to the action and the instruments of the state.

A necessary change involves the integration of non-public actors in the process, a process that takes us from government to governance. It is necessary to avoid the traditional top-down process, where the state dictates strategies and defines conditions and norms. Rather, it is fundamental to pursue collaborative institutional arrangements that incorporate local governments, community organizations, and the private sector. This is what Giddens calls "the enabling state," which has as "its prime role … to help energize a diversity of groups to reach solutions to collective problems" (2009: 69). These collaborative arrangements are not only important to secure political agreement around the climate change agenda but also to establish forms of governance that could channel the participation of civil society in the implementation of collective tasks oriented to secure the resiliency of society.

The World Bank (2003: 44–58) provides some significant ideas about the relevance of these collaborative institutional arrangements in attaining sustainable development, a task clearly related to the development of resiliency. In this perspective, three main functions of these collaborative arrangements are identified.

- The first function is the early identification of problems and issues. This enables society not only to detect potential problems, but also to uncover gaps in the capacity for resiliency of regions, communities, and groups. The integration of non-public stakeholders strengthens the existence of appropriate information systems that allow for making reasonable and pertinent decisions. Moreover, the integration of local stakeholders contributes not only to a stronger capacity to collect information, but also to provide a voice to these stakeholders within government institutions. The early identification of problems imposes the need to find a solution to them.
- The existence of collaborative institutional arrangements facilitates the second function: to resolve the problems in a way that balances the interests and points of view of the diversity of stakeholders. Two elements are relevant in this

process of balancing interests: getting everyone truly represented in the decision-making process and facilitating the negotiation process by the timely distribution of credible, easy-to-access and understandable information and by making sure that all stakeholders' problems and interests are heard (World Bank 2003: 187).

- The third function involves the implementation of the merging solutions to problems. The process of implementing solutions is facilitated by the existence of these collaborative arrangements to the extent that local stakeholders contribute to the local understanding of the solutions. Finally, the existence of mechanisms for the participation of stakeholders could provide feedback on the implementation and outcomes of the solutions, facilitating an institutional learning process and adjustments to policies and programs.

Collaborative institutional arrangements employing integrated watershed management through local water advisory committees have emerged for consideration in both Chile and Canada, which is consistent with its adoption as a best practice (GWP 2009). Canada is significantly more advanced than Chile in this regard; Chile is really only in the pilot project stage. This may be in part due to the strong centralized nature of Chile's water governance and the more decentralized nature of Canada's. Decentralization is more in keeping with local groups managing local water. The "Water Dialogues" are a pilot project for integrated watershed management attempting to include a diverse set of institutions and multiple stakeholders in developing a common regional water agenda (GORE 2007). Even with Canada's greater experience with watershed groups and integrated watershed management planning, firm conclusions on the longevity and success of this initiative would be premature. However, this process is just commencing and its ability to address the issues of coordination and poor local capacity to manage water issues has yet to be seen. It may be several years before a watershed authority in the study region is established, as only three pilot projects are currently commencing in Chile. Integration of information and meaningful participation of different stakeholders will be a challenge. Climate change concerns still do not permeate government water policy concerns, and it is too premature to know if these concerns will be raised in this process. These watershed groups have the potential to integrate and coordinate impacts of climate on water, leveraging local government action closer to the people affected by the changed climate and increased water stress. Both enabling measures which transfer knowledge and best practice can occur through these groups (World Bank 2010: 335).

Modifications to the organizational features of the state, such as policy processes, administrative structures and communication channels, are also necessary to strengthen the adaptive capacity of public organizations, including these emerging local water advisory committees. To begin with, there is a need for a clear insertion of climate change to the policy agenda. It is not only necessary to allocate more resources to deal with the climate change problems, but also to develop a more comprehensive policy strategy that involves:

- A proper combination of both mitigation and adaptation activities in a single policy direction. Mitigation activities are undoubtedly important, but they do not constitute a solution in themselves. Given the political challenges to establishing a global control on the reduction of emissions of GHGs and the already high concentration of these gases in the atmosphere, it is fundamental to consider the development and implementation of adaptive strategies without abandoning mitigation efforts. As emphasized in the 2007 IPCC report, a portfolio of adaptation and mitigation policies and programs can diminish the risks associated with the process of climate change (Parry et al. 2007).
- The development of strategies that adopt an anticipatory instead of a traditional reactive or "crisis management" approach. Longer-term policy strategies are needed that are not purely reactive; strategies need to consider longer-term scenario planning and must involve not only government agencies, but also organizations and groups of civil society, as previously discussed. These strategies, however, must have the necessary flexibility to deal with uncertainty, with a range of anticipated and unanticipated conditions that could emerge from the changes to the natural and social systems (IISD 2006).
- The need to implement a process of mainstreaming climate policy into several policy fields, especially into those that are highly sensitive to climate. As stated by Roche Kelly (2009), climate change is an issue relevant to a variety of policy sectors, and not only to public environmental agencies. In these terms, it is fundamental to embrace the idea of a climate policy integration that could raise the issue of climate change in several sectoral policy agendas. This process of policy integration could foster a more comprehensive policy approach.

Changes to the instruments of the state—policies and programs—should be complemented with changes to the organizational processes that inform the actions of the state—its internal decision-making and managerial processes. These changes are directly related to the development of new collaborative partnerships between the government and civil society and to the development and implementation of comprehensive climate policies and climate policy integration. Given the short history of the emerging collaborative institutional arrangements of local water advisory groups, these changes and recommendations have yet to be implemented. The focus of these groups has been on local water quality; expansion and integration with climate policies and programs has yet to occur. Climate is managed in both Chile and Canada by another branch of government with weak ties to the water advisory groups.

Some of the changes are necessary to improve the operational capacities of the state in terms of its internal efficiency. These changes should be oriented to secure proper levels of human capital or human resources; to improve the ability of the state to gather and evaluate information relevant to their interests and to make reasoned decisions maximizing their utility; having a purposeful mandate where there is coherence between a long-term vision and a set of goals and methods; having the necessary legal basis to ensure transparency and accountability; and establishing a degree of independence from short-term political pressures. It is especially important to develop a decision-making process able to recognize and evaluate the risks posed by climate change and its impacts, and to develop appropriate adaptive responses. This involves identifying problems and objectives, establishing decision-making criteria, assessing risk, identifying and appraising options, making and implementing decisions, and, finally, monitoring and evaluating (Homer-Dixon 1999; Willows and Connell 2003).

One of the most important changes that are required, and a challenge in itself, is the development of flexible or adaptive policies, those "that can anticipate and respond to an array of conditions that lie ahead, and can navigate towards successful outcomes when surprised by the unforeseen" (Venema and Drexhage 2009: 1). Rigid policies that are unable to cope efficiently with the uncertainties and dynamics of new climate conditions are obviously a serious obstacle that has to be overcome. Adaptive policies, to be effective, must be supported by a public institutional system that is able to learn constantly from those other systems with which it interacts. Institutional learning increases the capacity of public organizations to learn from experience, and change trajectories and practices as required. Implicit in institutional learning is a preparedness to experiment, preventing rigid persistence and purposefulness of practice (Goodin 1996).

Learning institutional systems must also comply with two necessary and coupled institutional conditions. The first condition is the capacity to collect and process information about key components of systems (in our case, climate events and their impacts) where policies and programs are being applied, so that we are able to know the pace of change of these components and the degree of success of these policies and programs in coping with change. This information, of course, must be managed properly to reduce its complexity, and made available to a variety of stakeholders. Data collection and data management systems are not only an indicator of a healthy institutional system, they are also the fundamental components of informational capital (which is an important determinant of adaptive capacity). As relevant as other forms of capital—economic, social, and human—informational capital contributes to a better knowledge of the existing resources, facilitating their management in situations of uncertainty and surprise. The existence of a solid accumulation and good use of information capital is a must in ensuring the social and economic sustainability of livelihoods and productive sectors.

Both Chile and Canada have gaps in climate and water quantity and quality data. Coordination of data bases and knowledge gaps of what data exists are issues. Funding of programs collecting, storing and sharing this data have been cut in past years, contributing to this issue rather than remedying it. This lack of information is detrimental to the development of policies able to foster adaptive capacity to climate variability and climate change.

In Canada, many water data collection issues were reported by interviewees. Identified gaps in the data pool (water quality, quantity and use, and climate data) were identified. Uncertainty exists about what data is available, what can be accessed by whom, and who is responsible for collecting and sharing (Diaz et al. 2009: 53). If the status of the water resource is currently uncertain, it is difficult to make determinations about resilience and adaptation in the face of climate change. Challenges surrounding data availability have contributed to a deficit in long-term planning. No concerted and collaborative effort exists in respect of future climate change, and often planning is limited by the election cycle. No drought plan exists in Saskatchewan (Hurlbert et al. 2009), and Alberta's plan focuses on short-term coping strategies at the producer level. There is a need for a plan addressing the larger picture of water allocation during times of surface water shortage (Wandel 2009). Mechanisms to address issues beyond provincial borders, and an appropriate federal water policy and plan, are lacking.

In Chile, water quality, quantity and climatic data gaps exist which affect modeling capacities able to analyze future climate scenarios and even make projections on how ground reservoirs and glaciers will be affected. This inhibits the medium- and long-term planning capacities of the water governance institutions, both regionally and nationally (Chilean Integration Report 2009).

The second condition that contributes to learning and the processing and dissemination of the information is vertical and horizontal institutional coordination and integration. The integration of civil society into governance networks should improve the capacity of public organizations to learn, to obtain information and to disseminate it. However, there is also the need to strengthen the linkages among different levels of public organizations, and among organizations at the same level, to avoid the problems of institutional silos (uncommunicative, non-interactive organizations and practices). The existence of these linkages allows for the flow of information, resources and knowledge in multi-sectorial and multi-level governance processes, creating the conditions for learning and adaptiveness.

This coordination and integration is a challenge in both Canada and Chile. The centralized decision-making of the Chilean government limits the activities of regional water agencies and local governments. Regional agencies have limited discretionary power to change water policies and resourcing such that centralization is a recurrent complaint among regional agencies associated with water (Reyes et al. 2009). At the regional and national level, multi-agency coordination and planning is weak (Salas et al. 2009: 19). Planning is reactive, not proactive (ibid. 2009). Local governments are first responders for climatic events, but lack the capacity to respond to water contamination or other management issues, and are left with trucking in water. Local governments also could pass environmental by-laws, but apparently lack the capacity to do so (Chilean Integration Report 2009).

In Canada, a multitude of water organizations exists at the provincial and municipal level, making interagency coordination an issue. Complexity creates confusion even amongst government officials themselves, let alone stakeholders and the general public. A need to establish clear roles and coordinate water activities was discovered in participant interviews and focus groups. A further constraint of “first in time/first in right” licensing exists. Although water transfers are allowed in Alberta, Canada, the construction of further irrigation and rural residents (including some municipalities) is constrained by this system.

Currently, most water supply and infrastructure challenges in Saskatchewan, Canada, are met by municipal governments and individual farm operators. The government agencies with experience and capacity to deliver rural water programming solutions to water-stressed communities and farmsteads are facing uncertain futures due to institutional rearrangements and decades of government attrition through neo-liberal policies. If the two institutions of the Agri-Environment Services Branch and SaskWater were to disappear, a deficit in capacity and a major vulnerability would result. Alberta faces similar challenges with the threat to long-time Alberta Environment and Alberta Agriculture employees who may eventually retire or be replaced with people of lesser knowledge.

4 Conclusion

Climate change is increasingly understood to entail more than a gradual, uniform increase in global temperatures; it entails unexpected climate patterns, potential tipping points, and greater variability and significant climate events. As an environmental and social problem, climate change has unique global and local issues. This chapter has focused on impacts of climate change on water, adaptive capacity, and governance informed by an empirical assessment of water governance networks in Canada and Chile. Both study regions in Chile and Canada face risk and future uncertainty surrounding climate. This will have a real impact on communities' and people's livelihoods. This changing climate will also bring certain opportunities, and lessons can be learned from both the Chilean and Canadian case study on the reduction of vulnerabilities and the improvement of resiliency in the future through improved climate governance arrangements.

Global economic forces appear to affect both countries, resulting in vulnerability for lower socio-economic people and people without access to water and water infrastructure. Adaptive capacity is unequally distributed in both countries. It is by far the lower socio-economic communities and individuals with higher vulnerability whose livelihoods are more at risk as a result of climate change. Both countries face uncertainty about the resolution of water conflicts between water rights holders in a future with more constrained water availability, data availability challenges, and risk of loss of institutional capacity.

This study concludes that the neo-liberal notion that the private sector is the central core of the organization of society must be abandoned. The government must be involved in direct intervention in respect of climate change. A leadership role in responding to the risk of climate change and its impacts must be taken on by government. However, this differs from the traditional government role, a role in governance, not government, a role in developing collaborative institutional arrangements, not in authoritative top-down government policy-making.

Collaborative institutional arrangements of governance help identify and resolve problems, and implement solutions. These collaborative institutional arrangements are emerging in Chile and Canada through the development of local water advisory groups, which are in their formative stages. Further funding and support to these institutions is needed so that the benefits of this collaborative arrangement can be achieved. In addition, further modification of organizational features needs to occur to support this different role of government in climate change. To support adaptive governance, able to respond quickly and efficiently to highly variable climate conditions at all levels of government, learning needs to be nurtured. This learning requires exceptional data availability, sharing, and dissemination. The case studies of Chile and Canada confirm that progress is needed in this regard. Further, better vertical and horizontal institutional coordination and integration to facilitate and disseminate learning is required. Currently, institutional arrangements in both Chile and Canada require improved inter-linkages. Combining the exchange of data required and the integration of water and climate institutions through improved clarity in roles and mandates could occur in an integrative process such that the learning process is optimized.

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Climate Change Adaptation: Institutional Approaches for Developing Countries

Peter Appiah Obeng and Joseph Boateng Agyenim

Abstract The purpose of this chapter is to analyse the institutional development approaches that may be adopted to enhance the capacity of developing countries to adapt to the consequences of climate change. The approach of the chapter is to reflect on the impacts of climate change on developing countries in the context of their peculiar vulnerabilities as a step towards identifying the institutional development approaches which could adequately respond to those vulnerabilities and support climate change adaptation mechanisms in those countries. The chapter argues that the impact of climate change in the developing world would be exacerbated by excessive reliance on natural resources, poverty, weak technical and organisational capacity and a potential socio-cultural resistance to scientific and technical adaptation mechanisms. To respond to these challenges, the chapter dwells on experiences in Ghana to discuss national- and local-level institutional reforms as well as international cooperation that could be adopted by developing countries to enhance their resilience to the impacts of climate change, with an emphasis on sustainable agriculture and food security. The chapter would be a useful guide to governments in the developing world in preparing their nations to adapt to climate change, as well as non-governmental and international organisations involved in supporting developing countries in that pursuit.

Keywords Climate change · Adaptation · Institutions · Institutional development · Developing countries

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1 Introduction

Two broad issues dominate the global debate on climate change; these are prevention and adaptation. The world is giving much attention to the development and use of sustainable energy options and industrial practices that would lead to cuts in greenhouse gas emissions. This is expected to slow down, if not reverse, the rate at which the global environment is changing. Equal attention is being given—or perhaps should be given—to preparing the world, especially the most vulnerable, to cope with the harm that climate change has already caused and is expected to cause (UNFCCC 2007). The latter (adaptation to climate change), which is now recognised as a fundamental response to the threat of current and anticipated global change (IPCC 2007; UNFCCC 2007), is the course which this chapter seeks to contribute to.

The main objective of the chapter is to discuss some institutional development approaches developing nations may adopt to build up a strong adaptive capacity or resilience to the impacts of climate change. Emphasis is laid on adaptation to sustainable agriculture and food security, which is of high priority to governments in developing countries. Specific institutional approaches from Ghana are discussed to draw lessons for other developing countries. To make the discussion of the institutional approaches more responsive than generic, it is preceded with an analysis of the peculiar challenges which make developing nations more vulnerable to climate change in order to highlight the basis of potential institutional interventions.

1.1 What is Adaptation?

The climate change literature is full of diverse definitions of the term *adaptation*, the origin of which has been traced to the natural sciences, particularly evolutionary biology (Smit and Wandel 2006). In relation to climate change, adaptation has been explained to reflect a rational adjustment in the genetic or behavioural make-up of organisms or systems, driven by a survival instinct, to cope with variations in the global climate or minimise the ensuing impacts (Pielke 1998; Smit et al. 2000; Kitano 2002; Brooks 2003; TCCC 2004).

Brooks (2003, p. 8) defines adaptation as “adjustments in a system’s behaviour and characteristics that enhance its ability to cope with external stress.” In their definition, Smit et al. (2000) indicate what kind of systems may undergo adjustments to cope with variations in the environment. They define climate change-induced adaptation as “adjustments in ecological-socio-economic systems in response to actual or expected climate stimuli, their effects or impacts” (ibid., p. 225). Thus, it can be inferred that an adaptation process may be initiated in anticipation of some “expected climate stimuli”, which may never occur after all. Dwelling more within the social interface, Pielke (1998, p. 159) defines adaptation in the context of climate change as "adjustments in individual groups and institutional behaviour in order to reduce society's vulnerability to climate change."

Adjustments are bound to lead to the development of new traits that differ from those previously existing. It is those emergent traits (genetic or behavioural), which result from the rationally selected adjustment process to enhance the survival of the individual organism or system, that have been commonly referred to as *adaptation features* (Dobzhansky et al. 1977; O'Brien and Holland 1992). Since adjustments are made in "response to actual or expected climate stimuli", as in Smit et al. (2000, p. 225), the resulting adaptation features cannot be delinked from the actual or anticipated stimuli. In other words, adaptation features are directly related to an expected or experienced environmental stimulus.

Perhaps the most important benefit derived from the successful development of adaptation features is that they make the impacts less noticeable. Dietz and Ruben (2004) found that, although empirical evidence indicates the late 1980s to be the worst climatic years in northern Burkina Faso, according to local perception, the 1970s and early 1980s were the worst. They argue that by the late 1980s, people had already adapted to harsh climatic conditions and so did not feel the impacts of "bad" climate as much as they did in the 1970s and early 1980s.

1.2 Adaptive Capacity and Vulnerability

Closely associated with *adaptation* are the terms *adaptive capacity* and *vulnerability*. Adaptive capacity is a term used to indicate the ability of a system, say a community or an ecosystem, to cope with new (usually adverse) conditions (IPCC 2001; TCCC 2004; Nielsen and Reenberg 2010). The International Panel on Climate Change (IPCC) defines adaptive capacity in the context of climate change as "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (IPCC 2001, p. 982). Thus the adaptive capacity of a system is a measure of the ability of the system to cope with climate risks. The concept of resilience is frequently used in place of adaptive capacity, just like a host of others, including adaptability, robustness, coping ability and stability (Jones 2001; Brooks 2003; Fraser et al. 2003; TCCC 2004; Thompkins and Adger 2004; Füssel and Klein 2006).

In a community or locality, a number of factors combine to determine the adaptive capacity to climate change; these include "management ability, access to finance, technological and information resources, infrastructure, the institutional environment within which adaptation occurs, political influence, kinship networks, etc." (Smit and Wandel 2006, p. 287).

Vulnerability to climate change, on the other hand, is a measure of a system's susceptibility to adverse climatic conditions (IPCC 2001; TCCC 2004). The IPCC defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes” (IPCC 2001, p. 995). For a given severity of climate change, different systems would experience different impacts within a given period of time, while the impact felt by a particular system may vary with time. Such differences in the felt impact of the change are reflective of the differences in the vulnerability of the different systems or variations in the vulnerability of any particular system with time (Brooks et al. 2004; Smit and Wandel 2006).

Primarily, a system’s vulnerability to the impacts of climate change is consistently treated in the climate change literature as a function of the sensitivity of the elements of the system to the particular change in climatic conditions and the adaptive capacity of the system (IPCC 2001; Brooks et al. 2004; Smit and Wandel 2006). “Generally, a system (e.g. a community) that is more exposed and sensitive to a climate stimulus, condition or hazard will be more vulnerable, ceteris paribus, and a system that has more adaptive capacity will tend to be less vulnerable, ceteris paribus” (Smit and Wandel 2006, p. 286). For instance, a community that is heavily dependent on rain-fed agriculture is sensitive to variations in rainfall intensity and would be more vulnerable to drought, but the level of vulnerability would reduce, should such a community develop an irrigation system with adequate water storage capacity.

It has been observed that many of the determinants of sensitivity are similar to those that constrain the adaptive capacity of a system (Smit and Wandel 2006), while many synergies exist between those actions which reduce climate change risk and the development of adaptive capacity (Harmeling 2009).

2 Challenges of Developing Countries

The consequence of climate change is largely “global” in character but, as noted earlier, the adaptive capacity and, for that matter, vulnerability to the impacts of a particular adverse phenomenon are system-specific (Brooks et al. 2004; Smit and Wandel 2006). Between developing countries and their developed counterparts, it is generally upheld that the former have a lower adaptive capacity and tend to be more vulnerable to climate change (Harmeling 2009; UNDESA 2007; UNFCCC 2007; Brooks et al. 2004). For instance, the Germanwatch Global Climate Risk Index 2010 (Harmeling 2009) ranks countries according to their exposure and vulnerability to extreme weather events for the period between 1990 and 2008. The rankings reveal that “the ten most affected countries were developing countries in the low-income or lower-middle income country group” (ibid., p. 5). Indeed, developing countries are projected to experience a disproportional impact of climate change (Ludwig et al. 2007; Stern 2007).

An attempt to develop institutions to prepare developing countries to deal with the effects of climate change needs to be preceded with an analysis of the factors which make them more vulnerable in order to make the outcome of the institutional development exercise responsive to the peculiar challenges and realities of those countries. While admitting that vulnerability is context-specific, some common trends are observed in developing countries.

The vulnerabilities of developing countries are rooted in a number of socio-economic factors and constraints commonly associated with them. These include, but are not limited to:

- dependence on natural resources;
- poverty;
- weak technical and organisational capacity;
- informal social constraints.

2.1 Dependence on Natural Resources

Developing countries tend to depend more on natural resources than developed countries (UNFCCC 2007; Thomas and Twyman 2005; World Bank 2000). In other words, livelihoods in developing countries are more closely linked to natural resources. In Africa, for example, it is estimated that about 75 % of the population live in rural areas, where almost all of the labour force is engaged in agricultural production (WRI 1994; IPCC 1997). Consequently, about a third of Africa's land area is used permanently for agricultural production, which accounts for about 30 % of the continent's gross domestic product (GDP) (ibid.). Land products are estimated to account for up to 60 % of rural African income (Ellis 1998).

However, resource-dependent industries and, for that matter, nations are more vulnerable due to the high sensitivity of natural resources to climate variability (Marshall 2010). The high sensitivity of natural resources to environmental change implies livelihoods in developing countries are highly susceptible to shocks and stresses resulting from changes in the natural environment. Such susceptibility of livelihoods to shocks and stresses is generally regarded as the most significant form of vulnerability to climate change impacts (Beg et al. 2002; Metz et al. 2002; Sokona and Denton 2001; Adger 2000; Moser 1998).

Hence, it is commonly agreed that the tropical and sub-tropical agricultural systems in the developing world are the most vulnerable to the impacts of global temperature and climate changes during the twenty-first century (Kasei 2009; Tol et al. 2000), with Western and Southern Africa noted to be among the most vulnerable (Denton et al. 2000; Kikar 2000).

Most rural communities in West Africa, for example, practise rain-fed agriculture (Kasei 2009) as a primary means of livelihood. Niasse et al. (2004) underscore the significant contribution rain-fed agriculture makes to the economy of the sub-region. However, agricultural productivity within the Volta Basin, as in other parts of the sub-region, is said to be highly dependent on the available soil moisture (Rockström and Falkenmark 2000). Consequently, any climate variation that leads to drought could have far-reaching implications for food security in the sub-region. It is estimated that by the year 2020, the Volta Basin's yield from rain-fed agriculture could be reduced by up to 50 % (Kasei 2009). This dependence on rain-fed agriculture is certainly one of the reasons why West Africa is regarded as one of the most vulnerable regions in the world as far as climate change is concerned.

2.2 Poverty

The income disparity between the richest and the poorest nations continues to widen, reflecting an increasing disparity in their capabilities to respond to the effects of global change. As shown in Fig. 1, the ratio of the income shares of the richest 20 % to the poorest 20 % of the world's population increased from 32:1 in 1960 to 45:1 in 1980 and 74:1 in 1999 (UNDP 1992, 1999). It must be stated, however, that another school of thought argues that if adjustments are made for the low cost of living in the poorest countries, the disparity in income shares will rather be diminished with increased globalisation over the past two decades.

Although the sudden provision of financial and material resources to developing countries will not automatically translate into the same level of adaptive capacity as in the developed world, the absence of it is recognised as a key factor that makes developing countries more vulnerable (UNFCCC 2007; Harmeling 2009).

The concept of external and internal sides of vulnerability put forth by Chambers (1989) offers a basis for explaining the relationship between poverty and vulnerability in developing countries. Chambers argues that vulnerability has both external and internal sides. The external side of vulnerability consists of risks, shocks and stresses, while the internal side consists of a lack of defence or a means to cope with the external side. Lack of financial resources to develop the kind of infrastructure required to cope with the impacts of climate change is an example of the internal side of vulnerability. The experience of drought or delayed rains in rain-fed agriculture-dependent communities, for instance, poses a serious risk to food security, which can be managed through the development of irrigation schemes to tide farmers over until the next rains come. But pressure on the national purse in many developing countries often makes such a solution far-fetched.

Thus poverty exacerbates vulnerability in developing nations by denying them a means to develop resilience to cope with climate change, thus making them defenceless.

2.3 Weak Technical and Organisational Capacity

The ability to respond rapidly to climate change can be greatly affected by the capacity of a nation to accomplish at least two important tasks. These are the capability to:

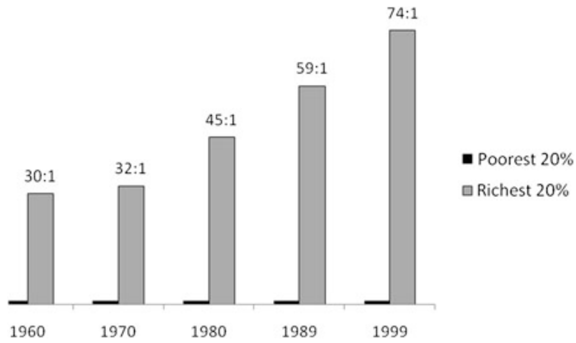

Fig. 1 Income disparity between the world's richest 20 % and poorest 20 %. *Source* UNDP (1992, 1999)

- gather relevant data about climate change and its impacts on its people to guide planning and policy formulation; and
- undertake research to develop new technologies to support local industries/ entities that are sensitive to climate change.

Developing nations lag behind their developed counterparts in the ability to accomplish both tasks. The capacity to gather relevant data, such as temperature, rainfall and the frequency of extreme events, is critical to planning, capacity building and climate policy formulation. This is because a strong database is required to assess the impacts of and vulnerability to climate change and to determine the requirements for adaptation (UNFCCC 2007). The United Nations Framework Convention on Climate Change (UNFCCC) notes that "if the capacity for assessing climate change is not there, countries are limited in their ability to plan adaptation measures and adapt effectively" (ibid., p. 13). The low capacity of developing countries to maintain a strong database for development planning and policy formulation is a major setback in international cooperation.

The commitment and capacity to undertake research and understand climate-related issues have been used among other variables for assessing vulnerability of nations to climate change (Brooks et al. 2004). Brooks et al. used the percentage of GNP spent on research and development as a proxy for commitment and resources for research. They also used the number of scientists and engineers in research and development per million populations as a proxy for the capacity to undertake research and understand issues. The result of that study, like those of Harmeling (2009) and a host of others, found developing countries to be the most vulnerable. Recognising the weak capacity of developing countries to undertake cutting-edge research, Article 5 of the UNFCCC urges the international community to support developing countries to develop climate research and systematic observation systems.

2.4 Socio-Cultural Constraints

In developing adaptation mechanisms for developing countries, some critical questions need to be answered, such as the following:

- Will access to technology and climate change adaptation techniques in developing countries necessarily imply the acceptance and use of them?
- Will traditions, beliefs and practices in developing countries support climate change adaptation technologies?
- Would the peasant farmer in Africa whose farming practices are rooted in some age-long traditional beliefs heed technical advice that suggests the thinking of his ancestors is no longer valid because of a so-called climate change?

In the developing world, Africa for example, informal institutions (traditions, beliefs, practices, etc.) have a large impact on the social and economic life of the people. While some informal institutions tend to promote best technical practices, others have a tendency to interfere with them (Alaerts 1997). Thus the promotion of technologies that conflict with informal institutions could encounter significant resistance. This is because informal institutions and constraints are the major determinants of the commitments of various stakeholders to the success of formal institutions or technologies (Vogler 2003). For instance, where the planting or harvesting season is sanctioned by a traditional authority after the observance of one festival or another, the mere availability of technology to forecast earlier rains than expected may not be very useful if the traditional authority does not openly support the alteration of the traditional farming calendar. Similarly, where cultural or religious values insist on a given standard of decency in dressing, adaptation mechanisms to high temperatures would attract the wrath of the cultural or religious authority if they promote what may be perceived as indecent dressing. Consequently, a conservative society would ignore such adaptation mechanisms.

The opposition of informal institutions or socio-cultural constraints could pose a formidable challenge to the dissemination of climate change adaptation technologies in developing countries and, consequently, affect their adoption. That would lead to a weak defence and, hence, high vulnerability.

3 Institutions and Adaptations

3.1 What are Institutions?

Institutions are often confused with organisations. Though the two terminologies may be used interchangeably under some conditions, they are not necessarily the same. A widely accepted definition of institutions is found in North (1990). North defines institutions as "formal rules, informal constraints—norms of behaviour, conventions and self imposed codes of conduct—and their enforcement characteristics." Institutions, thus, comprise rules or norms of behaviour, on the one hand, and their enforcement agencies or organisations on the other. Institutions, defined as rules and norms of behaviour, are referred to as "the rules of the game", while organisations are said to be "how we structure ourselves to play" (DFID 2003). Where mention is made of institutions and organisations, institutions specifically refer to rules or norms of behaviour, which are not the same as organisations.

Both institutions and organisations may be formal or informal. Formal institutions come in the form of laws, policies, regulations, guidelines, bureaucracies, codes and standards, etc., while informal institutions exist as customs, traditions, beliefs, values and cultural practices, etc. Informal institutions are the unofficial arrangements in societies or organisations. They can be described as the *unwritten rules* that govern behaviour (Helmke and Levitsky 2004).

Organisations, in general, are groups of individuals engaged in purposive activity (North 1990; Saleth 2006). Formal organisations are those with some form of officially recognised authority. Government ministries and agencies, municipal authorities, non-governmental organisations (NGOs), etc., are among the formal organisations that play one role or another in climate change adaptation. They are the primary custodians of formal institutions. On the other hand, informal organisations constitute the enforcement characteristics of informal institutions. They comprise community-based organisations, opinion leaders, traditional leaders, gender groups, local religious bodies, etc.

3.2 Relationship Between Institutions and Adaptation

A reflection on some cornucopian views of sustainable development reveals a relationship between institutions and adaptation to climate change. In simple terms, the cornucopian view of sustainable development argues that there could ever exist a blissful planet earth with unlimited resources provided man would not fail to apply ingenuity to get his institutions right (Beckerman 2003; Simon 1981). This view is contrary to the proposition of Thomas Malthus that if population explosions and human consumption are left unchecked, the earth would run out of resources (Malthus 1798; Meadows et al. 1972). Proponents of the cornucopian view, including Boserup (1981), believe "necessity is the mother of invention" so if the earth's population increases, human ingenuity will rise to the challenge to develop new technologies to produce more food. In relation to climate change, a nation develops adaptive capacity when it develops institutions (organisations, systems, procedures, etc.) to rapidly respond to the challenges posed by climate variableness.

The proposition that the future is only limited by human ability to get its institutions right is, to a large extent, affirmed by the difference exhibited by the developed world and the developing world in the management of municipal waste. While the developed world generates more waste than the developing world, the former does not have as much problem managing its waste as the latter because developed countries have developed strong institutions to manage their waste, while the developing world appears to have failed to get its waste management institutions right (Ogawa 2000; GDRC, undated).

Thus, the institutional endowment to deal with developmental issues like climate change constitutes a key difference between the developed and developing worlds, quite apart from the strengths of their economies. In fact, from the cornucopian viewpoint, it may be argued that many nations in the developing world are poor because they lack the right institutions (political, economic and cultural) to create worth. The same reason may account for why developing nations are lagging behind developed nations in climate change adaptation.

4 Responsible Institutional Approaches

This section dwells on institutional approaches adopted by Ghana, a developing country in Sub-Saharan Africa, to adapt to climate change in its agricultural sector. In Ghana, the effects of climate change are seen in:

- an irregular rainfall pattern;
- a long draught period, especially in the northern part of the country; and
- an increase in flooding, which destroys crops and other landed properties.

Diverse institutional approaches are employed in mitigating these effects. Some are national whilst others are local; there are public as well as private institutional changes to adapting to climate change.

4.1 National-Level Policy Formulation and Legislation

Ghana's agricultural policy has five key objectives:

- ensuring food security and adequate nutrition for the population;
- promoting supply of raw materials for other sectors of the economy;
- contributing to export earnings;
- increasing employment opportunities and incomes of the rural population; and
- generating resources for general economic development.

The relevance of irrigation water management in the realisation of these objectives is a well-established fact (FAO 2005). The key issue in the development and utilisation of water resources is to ensure sustainability, while giving preference to domestic water requirements in case there are competing uses of the resource.

The policy reform strategy within the irrigation sub-sector is to increase agricultural production through development and management of water resources for irrigation to combat the adverse effects of climate change. The reforms include:

- limiting the cost of irrigation projects to not more than USD 600/ha;
- recovery of at least operation and maintenance costs;
- handing over the management of projects to farmers' associations;
- involving farmers from the inception, selection of technologies through to the decision-making stages of irrigation projects, unlike in the past when management was largely in the hands of the Ghana Irrigation Development Authority (GIDA); and
- contribution of between 10 and 25 % of project costs by beneficiary communities or associations for small-scale projects.

The National Water Policy (MWRWH 2007) acknowledges that the availability and ease of access to water in sufficient quantities for the cultivation of food crops, watering of livestock and sustainable freshwater fisheries is a precondition for the achievement of food security and self-sufficiency in food production to meet the nutritional needs of the population. To accomplish this, the government has committed itself to:

- support the establishment of micro-irrigation and valley bottom irrigation schemes among rural communities;
- strengthen district assemblies to assume a central role in supporting community operation and maintenance of small-scale irrigation and other food production facilities;
- promote partnership between the public and private sector in the provision of large commercial irrigation infrastructure;
- encourage the efficient use of fertilisers to reduce pollution of water bodies, as well as high-yielding crop species and agricultural extension services to ensure conservation of water;
- promote and encourage water use efficiency techniques in agriculture and reduce transmission losses of irrigation water in irrigation schemes;
- manage land use and control land degradation, including bush fires, to reduce soil loss and siltation of water bodies;
- develop a pricing system and a mechanism for delivering irrigation water that is affordable to farmers and also ensure cost recovery on investments made in infrastructure; and
- utilise data and information on water cycle, land cover/use, soils and socio-economic elements for the planning, design and development of agricultural schemes.

The Ghana Irrigation Development Authority (GIDA) is directly responsible for regulating irrigation systems in the White Volta Basin of Ghana. The regulatory activities of GIDA are dictated by the Irrigation Development Authority Regulation, 1987 (Legislative Instrument (L.I.) 1350). This L.I. provides the procedure for managing irrigation projects as well as water management within such projects.

In addition, the GIDA's Technical Guidelines for Irrigated Agriculture (2004) gives further details on how to effectively manage water for irrigated agriculture, including water supply, distribution and application management.

In 2006, amendments were made to the L.I. 1350 to make it more responsive to the needs of the sector in the face of changing demands due to climate change. The passing of this legislative instrument promoted farmer participation in the management of irrigation projects, and also legalised and streamlined the GIDA staff management role in project management. The L.I. stipulates that "there shall be established on each irrigation project a project management" which shall ensure the implementation of the policies of the GIDA. Section 6 of the amended version makes room for the formation of Farmers' Cooperative Societies which shall be subject to the provisions of the Cooperatives Society Decree, 1968 (N.L.C.D. 252) as far as its administration and financial management are concerned. Thus community participation became a critical issue in the institutional adaptations to managing water for rural livelihoods. Subsection 3 of Sect. 1 provides for the inclusion of at least two of the users' representatives in the management of a project. This is an attempt to allow for representative participation of the user group in management decisions.

The L.I. further makes room for the formation of a Land Allocation Committee (LAC) (Sect. 3) and the establishment of a Disciplinary Committee by the management of the project (Sect. 9). The LAC is meant to find solutions to land conflicts in project areas. It is also meant to minimise the interference of the traditional landlords in land allocation. The Disciplinary Committee is responsible for investigating any infringement or alleged infringements of any rules issued by the management and imposing the appropriate sanctions, when necessary. These are meant to address the principles of justice, equity, participation and transparency in the management of water for irrigated agriculture.

The farmers' cooperatives philosophy has led to the establishment of Water User Associations (WUAs) at the irrigation project sites. The WUAs were formed as the water resources management component of the Land Conservation and Small Holder Development Project (LACOSREP). These are working groups at the dam sites whose activities are monitored by the Ministry of Food and Agriculture (MOFA) extension department. These WUAs are responsible for the day-to-day management of the dams/dug outs. They have their own internal arrangement for the benefit of their group members.

4.2 Local-Level Action: Introduction of the Third Cropping Season

The discussions here are limited to the White Volta Basin. The area is characterised by an erratic rainfall pattern and other natural hazards like floods as a result of climate change. This situation has kept food production far behind the consumption requirements of the people, thus creating a longer period of hunger and intense poverty. This necessitated the placement of emphasis on the development of small-scale dams for irrigated agriculture to ensure efficient use of water bodies within the White Volta Basin. This is part of the reason for the introduction of the LACOSREP by the MOFA, supported by the International Fund for Agricultural Development (MOFA/IFAD 2003).

Under LACOSREP I and II, 73 small dams were constructed to aid dry season farming. This was a strategy for promoting dam reservoir construction as a means of improving incomes and the general livelihood of farmers in the face of the adverse effects of climate change. These were meant to enhance irrigation and livestock production. Table 1 gives an indication of the spread of dams within the Upper East Region of Ghana, which is located within the Basin. It shows the number of dams constructed by the District Assembly and NGOs combined, and those constructed by LACOSREP I and II, as well as the total number of dams existing in each district of the region.

These dam sites are noted for vegetable production (okra, onions, tomatoes, etc.). For the efficient and profitable utilisation of these dams, a dry season second cropping scheme was introduced by the Ministry of Agriculture in 2003. A dry season third cropping scheme was subsequently introduced in the basin in 2008 to promote the production of 90-day early-maturing high-protein quality maize cultivation.

Rain-fed agriculture is referred to as the first cropping season, the normal cropping season (May/June to September). This is followed by the second cropping scheme from October to December/January in the dry season, using water from the White Volta Basin and dam sites. The crops usually cultivated in the second cropping period are largely for commercial purposes. These crops include onion, tomato, pepper, okra, leafy vegetables, rice, water melon and garden eggs. After the droughts and floods which occurred in the region in 2007, this second cropping scheme was strengthened by collaboration between the Ministry of Food and Agriculture and FAO to support farmers with inputs for intensive cultivation of the second crop.

The period between March and early June is considered as the “hunger period” of the region, when most farm families would have exhausted their food items from the harvest of the previous year. This was considered a “resting” period by the people, but in reality it is a wasted (unproductive) period since no work goes on among the predominantly farming families. The hunger period is sometimes a result of crop failures due to drought and/or floods.

As a strategy for achieving all-year-round food security and improving incomes during this slag period, MOFA decided to promote the production of a 90-day early-maturing high-protein quality maize cultivation using pump irrigation. Thus pump-irrigated agriculture was introduced as a measure to ensure efficient and maximum utilisation of water from the White Volta and other streams within the region. MOFA assisted some farmer groups to acquire pump machines for pumping water directly from the river for irrigation. This ushered in the dry season third cropping scheme between March and June.

Table 1 Total number of small dams by district in the Upper East Region of Ghana, 2008

Districts	Small-scale dams				Area under cropping (hectares)
	District assemblies and NGOs	LACOSREP I	LACOSREP II	Total no. of dams	
Bolgatanga	–	5	4	9	81.35
Bongo	–	8	2	10	89.5
Talensi Nabdam	19	1	1	21	161.7
Bawku 277.8	Municipal	3	8	6	17
Bawku West	14	8	4	26	385.1
Garu 523.0	Tempane	5	4	2	11
Kassena Nankani	1	5	4	10	74.5
Builsa	–	5	6	11	109.7
Total	42	44	29	115	1,702.65

Source MOFA, Regional Office [Bolgatanga, Ghana [(2008)]

The input support provided by MOFA with assistance from FAO includes water pumps, pipes, maize seed and fertiliser. A significant effect of the support increased the area under cultivation, for example, from 29 hectares in 2007 to 146.4 hectares in 2008. This policy direction has drastically increased the use of pumps in the basin from just 20 pumps in 2002 to 165 in 2008.

The increase in cultivated acreage and subsequent output increases translate into increased income for the households within the basin. Farmers in vegetable production, such as tomatoes and onions, during the third cropping period receive more than twice the prices of the normal season's produce. This period directly precedes the main farming season. Farmers obtain a lot of investment money from these activities, making the outlook brighter for farming households in the basin.

There is an estimated irrigable area of 1,702.65 hectares for the small-scale dams. Together with pump irrigation, the dams have yielded the outputs indicated in Table 2. The outputs of these vegetable crops for a 4-year period have had a significant impact on the lives of the people of the Upper East Region.

The increase in output has contributed considerably to incomes, which households indicate they use to help pay children's school fees, meet health needs and buy grain to supplement losses for the rain-fed crops and take care of other household needs. These adaptations are well accepted by the communities because they are seen to promote their livelihoods.

Table 2 Area and production figures for irrigated crops for 4 years

Crop	Area cultivated (hectares) and crop production (metric tonnes) per year							
	2003/2004		2004/2005		2005/2006		2006/2007	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.
Tomato	879	1063	628	6594	655.89	7805	1085	12,478
Onion	63	625	50	420	207.9	1892	211.6	2,010
Pepper	38.5	89	45.4	11.34	57.8	109.8	65.8	170.0
Okra	4.9	4.41	8.1	16.2	4.7	10.34	10.5	22.1
Leafy vegetables	10.4	20.8	18.6	29.76	15.4	12.32	25.6	35.84
Rice	1091	4910	900	3660	896.5	3407	623.0	2804
Maize	–	–	8.0	30	71.0	85.2	678.0	1492

Source MOFA, Bolgatanga (2008)

4.3 Citizen (Community) Participation

To ensure effective running of the irrigation facilities, the LACOSREP project encouraged and facilitated the formation of WUAs at all the dam sites. The beneficiaries of these dam sites became one of the stakeholders in managing the water resources. This was done for the purposes of instilling the concept of community ownership and management of the irrigation facilities to ensure sustainability and profitability of the irrigation facilities. The activities involving this concept have been extended to cover other small dams constructed prior to the LACOSREP project.

The WUAs are responsible for protecting the catchment areas of the dams, resolving conflicts among WUA members, controlling the use of irrigation water, generating revenue to support the routine maintenance of irrigation facilities, as well as offering members the opportunity to access services provided by development partners, such as District Assemblies and NGOs.

The WUAs have been developed into cooperatives with the assistance of the Department of Cooperatives, registering them as limited liability business enterprises under the cooperative societies law NLCD 252. Based on the recommendation of the Department of Cooperatives in 2002 after undertaking an assessment of the operations of the WUAs, the formation of District WUA councils was brought into the arrangement for the management of the resources. These councils are the mouthpiece of WUAs to liaise with District Assemblies, the Regional Coordinating Council and other development partners for the proper functioning of these groups.

4.4 International Cooperation

It is admissible that successful adaptation to climate change, like the Millennium Development Goals (MDGs), cannot be achieved by developing countries without international aid and cooperation (UNDESA 2007) due to poverty and weak technical capacity. There is the need for international support to augment the effort of developing countries. One of the problems facing farmers and communities in the Northern, Upper East and Upper West Regions of Ghana has been the incidence of floods on a virtually annual basis, especially when the spillways of the Bagre Dam at upstream Burkina Faso are opened. What makes matters worse is the low capacity for the collection of hydrological data to provide early warning systems.

To help address this problem, the Canadian International Development Agency (CIDA) is assisting both Ghana and Burkina Faso to establish a gauging system along the White Volta to collect hydrological data to give early warning to downstream communities. While the north–south cooperation between Canada and the two West African states is commendable, other developing countries can also emulate the south–south cooperation between Ghana and Burkina Faso in the area of information sharing.

5 Conclusion

We conclude that developing countries are more vulnerable to the impacts of climate change due to factors including their excessive reliance on natural resources, poverty, weak technical and organisational capacity and socio-cultural resistance to scientific and technical adaptation mechanisms. By developing strong institutions, developing countries stand the chance of enhancing their adaptive capacity and resilience to climate change. There is the need for national-level leadership in formulating policies and legislation to provide a framework for dealing with the impacts of climate change. Community-level strategies should also be developed with the full participation of community members in order to commit the grass root citizenry to take their survival into their own hands by cooperating with formal and informal arrangements put in place by their governments and non-governmental organisations. There is also the need for developing countries to cooperate with each other in sharing information while they engage their developed counterparts in collaborations that would build their organisational and technical capacity to deal with the impacts of climate change.

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Climate Adaptive Planning for Preventing Heat-Related Health Impacts in New York City

Joyce Klein Rosenthal and Dana Brechwald

Abstract This paper explores the formal planning processes used by cities and local governments to adapt to and mitigate the hazards associated with current climate variability and expected climate change. Increased rates of mortality and morbidity due to summertime heat are a significant problem in New York City (NYC) and for many cities around the world, and are expected to increase with a warming climate. Populations may be at increased risk because of greater heat exposure—for example, due to the urban heat island (UHI)—or by virtue of demographic, social, or medical risk factors. Those at greater risk for heat-related health impacts in American cities include the elderly, low-income and communities of color, those with limited mobility and little social contact, those with pre-existing health conditions, and those lacking access to public facilities and public transportation. A case study describes the initial work of the NYC Climate Adaptation Task Force and the formal planning undertaken by the city to prevent heat-related health effects from excessive summertime heat. A community-based adaptation planning process may help address the social justice dimension of the impacts of extreme events and climate change in NYC while increasing the effectiveness of adaptive programs and policies. This paper represents primary research into the climate adaptation strategies of municipalities and could be useful for a range of urban actors.

Keywords Climate adaptation · Climate change · Urban planning · Planning for public health · New York city

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Democracy is the worst form of government, except for all those others.

Winston Churchill, 1947.

1 Introduction

Temperature extremes and variability are important determinants of health in American cities (O'Neill and Ebi 2009). In New York City (NYC), as in other cities around the world, excessive heat can lead to general elevations in mortality and morbidity rates across a range of causes (Ellis et al. 1975; Marmor 1975; Kalkstein and Greene 1997; McGeehin and Mirabelli 2001; Basu and Samet 2002; Metzger et al. 2009). Exposure to heat is the number one weather-related cause of death in American cities, causing more fatalities on average per year than floods, lightning, tornadoes, hurricanes, and extreme cold combined (Gaffen and Ross 1998; NOAA 2009). Heat-associated mortality is typically seen as excess mortality due to cardiovascular or respiratory causes during hot weather (that is, conditions above the norm for a given location). Because heat is rarely coded as a contributing cause on death certificates, health researchers examine baseline mortality rates during abnormally warm weather and compare these rates to those of a comparable reference time period in previous years (Hoshiko et al. 2010).

Awareness of heat-related mortality has increased as a result of extreme events, such as the premature deaths of 14,800 people in France in August 1–20, 2003 due to a severe heat wave. Analysis of mortality data in France indicates that these deaths were disproportionately concentrated in poorer neighborhoods with higher levels of immigrants and substandard housing (ORS 2003). Prevention of disasters such as the European 2003 heat wave mortality can involve social, behavioral and structural adaptations.

As in other temperate zone cities, high summertime temperatures are a public health stressor in NYC, the largest city in the United States, with a population over 8 million in 2010. In New York, the effects of temperature on mortality are observable currently in excess mortality below the extreme temperatures that trigger public heat alerts (Curriero et al. 2002; Knowlton et al. 2007). As excessive summertime heat and heat waves are expected to increase in frequency, intensity, and duration in NYC in the coming decades (NPCC 2009), planning to prevent the public health impacts of extreme heat has emerged as a priority for the city's climate adaptation planning.

This chapter describes the formal strategies that have developed for coping with the current problem of heat-related health effects in NYC and for reducing future impacts. We discuss the policy-making process and the work of the NYC Climate Adaptation Task Force (ATF) during their initial planning from 2008 through spring 2010. A formal planning process for reducing the public health impacts of climate variability and change started during 2009 in NYC and New York State

(NYS), following on the initial ATF work on climate adaptation strategies for critical infrastructure. First, we begin with an overview of some frameworks and principles developed by local governments for climate adaptation planning that, while not created explicitly for public health effects, have been applied to climate-related hazards. We then briefly describe NYC's programs for addressing excessive heat events, through emergency planning and preventive programs adopted by the New York City Department of Health and Mental Hygiene (DOHMH) and the NYC Office of Emergency Management (OEM). We then provide an overview of the initial planning practices undertaken by the City of New York for climate adaptation between 2008 through spring 2010. Finally, we make suggestions for incorporating public health concerns and community-based approaches within the urban climate planning process. Returning to the equity norms of the sustainable development and environmental justice movements, the case for greater inclusion and a community-based approach in NYC's environmental planning are discussed. By providing a snapshot of the early stages of climate adaptive planning in NYC up to the summer of 2010, we hope to illuminate opportunities for further development of what is necessarily a dynamic and iterative approach. We note at the outset that climate adaptive planning in NYC is in progress and under considerable development, and much activity in these areas is expected following the writing of this chapter in spring 2010. While the City has deservedly received public recognition as a leader in proactive, anticipatory planning for climate adaptation, this chapter will argue that greater inclusion in the planning process may yet yield substantive and normative benefits.

Climate influences urban health through several pathways that raise concern for warming trends. Rates of contaminated drinking water and water-borne diseases may increase through changes in precipitation patterns, variability, and extreme events; changes in vector habitats and increased incidence of vector-borne diseases; and the direct impacts of flooding and damage to infrastructure and residences (Patz and Kovats 2002). The focus of this chapter is on urban adaptive planning focused on heat-related health impacts.

2 Climate Adaptation Planning: Some Frameworks and Principles

At its core, municipal programs for addressing excessive heat events and current climate variability are also adaptive for climate change-related temperature increases. Tools for implementing adaptation processes have been developed by a range of local governments, regional planning agencies, and cities to address a number of climate impacts, including sea-level rise and extreme weather events. These tools and the general frameworks developed for adaptive planning can be used for a number of hazards within different systems—including the threat of extreme heat for urban populations.

While there are many definitions of adaptability in the context of climate change (Burton 1992; Smit 1993; Stakhiv 1993; Smith and Lenhart 1996; Watson et al. 1996), for the purposes of this discussion, we choose the definition of adaptation agreed upon by the Intergovernmental Panel on Climate Change (IPCC) and Smit et al. (1999) as "adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts" (Smit and Pilifosova 2001: 200). In analyzing adaptability, Smit et al. (2000: 230) state that there are three important questions to ask:

(1) Adapt to what? What are the consequences of climate change that will necessitate adaptive strategies?
(2) Who or what adapts? What is the system that is being adapted?
(3) How does adaptation occur? What is the process of adaptation? What are the decision-making parameters?

A fourth question is the evaluation of the outcome—how good is the adaptation? This can be based on a variety of criteria, such as cost/benefit, urgency, efficiency, and implementability. Defining and answering these four questions can serve as the basis of creating an adaptation process.

Others have further defined the adaptive planning process by elaborating on these four basic tenets. Schroter et al. (2005: 579) presents a general eight-step model for assessing vulnerabilities that can guide adaptation planning that also includes first defining the study area with stakeholder input, understanding the system over time so as to fully identify all factors, creating a vulnerability analysis through hypothesis, assessing relationships, and aggregating indicators of vulnerability; and then projecting and communicating this vulnerability based on a range of scenarios. This process is focused on identifying the vulnerability of the system, but does not provide assistance in developing a process for the actual adaptive actions, interventions, and tools.

Other researchers have elaborated on frameworks that can help develop anticipatory adaptation tools. Klein and Tol (1997: 6) outline four basic objectives of anticipatory planned adaptation, which include increasing the robustness of a system by increasing its adaptive capacity range, increasing flexibility by allowing mid-course corrections, enhancing adaptability by reducing other stressors, or reducing trends that increase vulnerability. Moser and Luers (2008: 312) further the development of adaptation tools by defining the three critical dimensions of adaptation as "awareness—analytic capacity—action." Action, however, comes from a combination of the willingness, incentives, and ability to translate awareness and analytic capacity into actions (Moser and Luers 2008). Often, action may be impeded by existing policy, market barriers, and disincentives, through externalities such as when the market ignores the full costs of certain activities (e.g. the price of land in flood-prone areas) (Fankhauser et al. 1999). When policy and market systems are set up to reduce barriers and unseen subsidies, actions are likelier to take place.

In 2009, NYC started an adaptation planning process that combines many of the concepts discussed above and translates theory to policy actions. The process is

Table 1 NPCC's eight assessment steps (2010)

Identify current and future climate hazards
Conduct inventory of infrastructure and assets
Characterize risk of climate change on infrastructure
Develop initial adaptation strategies
Identify opportunities for coordination
Link strategies to capital and rehabilitation cycles
Prepare and implement adaptation plans

described in the New York City Panel on Climate Change's (NPCC) New York City Panel on Climate Change 2010 Report. The Report's Adaptation Assessment Guidebook presents eight assessment steps (Major and O'Grady 2010: 235) as an iterative process building from one another and leading to a new cycle of examination (Table 1).

The NPCC process focuses on climate change impacts on infrastructure; tools for stakeholders (2010) include sector-specific questionnaires to help stakeholders identify key infrastructure and its climate-related risks, a risk matrix that categorizes at-risk infrastructure based on the probability of the climate hazard, likelihood of impact, and magnitude of consequence, and a framework that adds criteria to help prioritize adaptation strategies.

King County in Washington State has also outlined a process for adaptive planning, along with the international non-profit organization ICLEI, Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments (2007). The report offers five milestones to reach during the planning process, similar to NPCC's steps (p. 7). Actions to be taken by government follow the basic format and spirit of a comprehensive plan. Starting with the project's initiation, a climate preparedness team is organized and the locality passes a formal resolution (in the form of a regulation or administrative order) to direct the government to prepare for climate change. A "climate resiliency" study is prepared, including a vulnerability and risk assessment, with prioritized areas for action. The government is then tasked with setting preparedness goals, developing the plan based on a vision and principles for climate resilience, which guide the prioritization of actions. Implementation, progress reporting, and analysis precede updates of the plan (King County/CIG/ICLEI 2007).

Both the NYC and ICLEI/King County tools assume that local governments are the main authority leading the climate adaptation planning process. While other constituents may have interest and/or resources to devote to adaptation planning, local governments have the authority to craft place-based policies and implement city-wide programs to turn adaptation plans into actionable items. As the leader in adaptation efforts, the local government also signals commitment towards residents and their well-being, and places themselves at the forefront of progressive governance. The locality can also act as an umbrella organization for non-governmental organizations (NGOs) and faith-based organizations acting towards similar goals, coordinating and validating their adaptation and resiliency efforts, ensuring more effective response to climate-health issues.

3 New York City's Programs for Excessive Heat Events

In 2010, NYC's efforts to reduce the risk of heat-related injury and death included two main approaches: (1) preventive measures, such as public and health care provider of education and outreach and provision of free air conditioners, as well as (2) emergency response measures during extreme heat events, such as the opening of public cooling centers and enhanced outreach to vulnerable populations. A third approach, the deployment of large-scale urban heat island mitigation techniques (i.e. cool roofs) targeted to vulnerable populations was being planned by the Mayor's Office of Sustainability and Long-Term Planning and the NYC Buildings Department during the spring of 2010.

3.1 Emergency Planning: Cooling Centers and Media Outreach

In NYC, excessively hot and humid weather is considered an emergency, given the potential for increased morbidity and mortality. The National Weather Service provides 24–48 h forecasts of the maximum Heat Index (HI), a measure that combines relative humidity and ambient temperature (Steadman 1979). The NYC Office of Emergency Management (OEM) activates the citywide heat emergency plan and declares a Heat Advisory when the 24–48 h forecast predicts an HI of equal to or above 95 °F (35 °C) for 2 days or more, or equal to or above 100 °F (about 38 °C) for 1 day (DOHMH, Preventing Heat Illness for the General Public website, 2010). An Excessive Heat Watch is triggered by a forecast of at least 105 °F (40.5 °C) for over 3 h per day for two consecutive days, or a forecast of at least 115 °F (46 °C) for any period of time within 24–48 h; an Excessive Heat Warning is issued for the same criteria as the Heat Watch, but for an onset within 24 h.

The issuance of any of these public alerts triggers a number of actions, including the opening of public cooling centers—air conditioned spaces—in community centers, senior centers, and libraries. Information on the location and hours of centers is provided via the city's information phone line and the OEM website. In past heat waves, opening hours of city pools have been extended and fees dropped for visits to state park beaches. Other actions include daily conference calls of the interagency Heat Emergency Steering Committee to assess the impact of the hot weather on health and infrastructure and to coordinate the response to the heat emergency, and activation of public information strategies, such as informing broadcast media through press releases (NYCOEM, NYC Hazards: Heat Emergencies website, 2010).

3.2 *Surveillance and Research*

The NYC DOHMH established a syndromic surveillance system that monitors emergency department (ED) visits and Emergency Medical Service (EMS) calls for early detection of disease outbreaks (Heffernan et al. 2004). During a Heat Emergency, DOHMH analyzes data from the ED and EMS syndromic systems to detect increases or spatial aberrations in heat-related illness.

During and following a heat event, data on heat-stroke deaths are provided to the DOHMH by the Office of the Chief Medical Examiner. The temporal analyses for heat-related ED visits and EMS calls provide information on whether the observed number of ED visits or EMS calls on a hot day is unusual (Metzger, personal communication 1:2009; Rosenthal et al. 2009). Spatial analysis of the heat-related EMS calls may provide supplementary information as to whether a specific geographic area is unusually impacted by the heat. In addition to syndromic surveillance research, the DOHMH's Bureau of Environmental Surveillance & Policy (BESP) maintains an active research program on climate and health in NYC, advising and working with city agencies and staff on an ongoing basis on health promotion and disease prevention in regard to climate-health effects.

3.3 *Adaptive Strategies to Prevent Heat-Related Mortality Among Vulnerable Populations*

DOHMH also maintains ongoing efforts to prevent the heat-associated morbidity and mortality that can occur not only on heat alert days, but also on summer days with heat indices below the heat alert threshold. The agency notes that its strategies are focused on priority areas based on "health status, poverty, and other indicators of risk from the US Census and the DOHMH Community Health Survey data" (Graber et al. 2009).

Outreach to the media and health care providers about heat-health effects and their prevention is a key approach. Educational materials are distributed to health care providers and to faith leaders, and presentations made around the city to community organizations. The DOHMH notes that over 65,000 materials, including cards on heat-health effects translated into five languages, were distributed during 2008 and 2009; health care providers already on citywide contact lists were contacted pre-warm season and pre-extreme heat events (Graber et al. 2009).

A core component of the City's efforts to avoid heat injury and mortality is the distribution of free air conditioners (AC) to low-income at-risk senior citizens aged 65 and over. The NYC Cooling Assistance Program (CAP) is supported through the federal Home Energy Assistance Program. The AC distribution started in the summer of 2008 following an earlier pilot program. Eligibility criteria include documented pre-existing medical or mental health conditions, lack of a functioning air conditioner in the home, and an income threshold. During 2008 and

2009, over 5,000 ACs were distributed and installed; however, the agency notes that they do not have the funding to offset the increased utility bills that might deter recipients from using their AC (Graber et al. 2009). Higher electricity costs may inhibit the use of ACs by some of the low-income seniors that receive them. Another issue is that use of air conditioning increases electrical demand during the time of highest peak demand, on hot summer days, representing a conflict, however unavoidable, between the goals of climate adaptation and carbon mitigation.[1]

4 New York City's Climate Change Adaptation Task Force

There is an active planning process in NYC for both short-term and long-range adaptation to climate change and variability, as discussed earlier. In August 2008, Mayor Bloomberg announced the formation of the Climate Change Adaptation Task Force (ATF) and the NYC Panel on Climate Change (NYCPCC). The initial work of the City's ATF is focused on identifying the city's critical infrastructure—including roads, bridges, tunnels, water and sewage systems, electrical, gas and steam production and distribution systems, telecommunication networks, subways and other mass-transit networks and nodes—that could be at risk from the effects of climate change, and to develop coordinated adaptation strategies to secure those assets with a risk assessment-based, "science-based approach" (Freed 2008, 2009a). In this initial work, the Task Force explicitly excludes health-related issues, and residential and commercial buildings, which City officials note are addressed by other initiatives (Freed 2008, 2009a). The work of the ATF and NYCPCC are supported by a grant from and collaboration with the Rockefeller Foundation's Climate Change Resilience program.

Members include city, state and federal agencies, and private sector stakeholders. The largest proportion of the ATF stakeholders are private sector companies; 17 of the 40 ATF partners are business members (Freed 2009b). The remaining stakeholders are city, state and federal government representatives. Private sector stakeholders are primarily energy companies and communication companies; insurance companies are participants as well (Freed 2009b).[2]

[1] Although the use of air conditioning (AC) may pose a conflict between the goals of adaptation and carbon mitigation, two main points should be acknowledged in this regard; first, that access to AC saves lives during extreme summertime heat and, second, that whenever possible, adaptation measures that also are mitigative are the best approach. With regard to AC, the amount of electricity used by senior citizens during extremely hot days in New York City could possibly be more than compensated for by the use of several energy efficiency measures; for example, through the reduction of office air conditioning during heat events. Further research is needed on the energy savings that might accrue from small changes in air-conditioned indoor temperatures during heat events, and the deployment of other efficiency and green building measures.

By 2009, ATF stakeholders created an inventory of at-risk infrastructure and developed strategies to protect those from current or future climate impacts, especially rising sea levels and extreme precipitation or heat events (Freed 2009a, b). Working Groups help the ATF stakeholders coordinate with each other on strategies to develop new design guidelines for critical infrastructure and identify citywide concerns for further study; the entire planning process is guided by a set of uniform climate change projections for NYC (Freed 2009a, b). Stakeholders work with each other to create cross-sector stakeholder strategies.

In December 2009, the New York Academy of Sciences (NYAS) held a closed-door meeting for stakeholders on the work of the ATF; they and the expert Panel on Climate Change previewed their report, Climate Change Adaptation in New York City: Building a Risk Management Response, published in 2010 as a volume of the Annals of the NYAS. A public discussion on cities and climate change was held that night at NYAS. Although public health concerns are not part of the formal ATF planning process, the DOHMH was included as a stakeholder in the ATF meetings and at the NYAS event. In response to a query at the NYAS event, the ATF Chair reported that planning for the public health sector is being addressed in NYS's current climate adaptation planning effort, justifying its exclusion from their process. ClimAid, NYS's adaptation planning process, is analyzing vulnerability to climate change and the development of adaptation policies in six sectors—energy, public health, transportation/communication, water resources, coastal zones, and agriculture/ecosystems—and is expected to issue a report on its work late in 2010.

5 PlaNYC and Other Climate Adaptive Initiatives

The City's long-term sustainability plan, PlaNYC, was launched in 2007 to achieve an ambitious list of 10 major goals to prepare the city for an additional million residents and achieve environmental progress by 2030 (New York City 2007). These goals, incorporated into a list of 127 specific objectives, include creation of housing, park accessibility, cleaning up of brownfield sites, opening waterways to the public, adding transit capacity and improving travel times, upgrading energy infrastructure, improving air quality and, for climate change mitigation, reducing carbon emissions by 30% (New York City 2007).

PlaNYC announced three major climate adaptation initiatives in its 2007 master plan: (1) to create an intergovernmental Task Force to protect vital infrastructure; (2) to work with vulnerable neighborhoods to develop site-specific strategies, and; (3) to launch a citywide strategic planning process for climate change adaptation.

[2] Energy companies include Con Edison, Astoria Energy LLC, CSX, NRG Energy, National Grid, Suez Energy NA, USPowerGen, and TransCanada. Communication companies include Cablevision, Sprint Nextel, T-Mobile, Verizon, and AT&T.

The August 2008 launch and work of the ATF through 2010 primarily addresses the first and third of these PlaNYC's climate change goals.

To address the goal of working with vulnerable neighborhoods, the City has five pilot programs to begin the community planning process, largely in environmental justice (EJ) neighborhoods, and the ATF has an ongoing engagement with the community in Sunset Park through UPROSE, and in West Harlem with WEACT (Freed 2009a). These two EJ organizations were selected based on the City's assessment of where flooding would occur and where there was an active community organization who was a credible partner for this effort (Freed 2009a).

The ATF's focus within community-based engagement is on building resilience, rather than discussing adaptation and climate change impacts per se (Freed 2009a). For adaptive planning, this focus on resilience was a necessary paradigm shift from discussing climate change in their pilot community planning projects. Because NYC neighborhoods are burdened today with health disparities and health problems, such as high asthma rates, these and economic issues often tend to be residents' central concerns—rather than longer-term concerns, such as rising sea levels, that might manifest in years ahead. Therefore, enhancing resiliency is the better frame for neighborhood engagement than climate adaptation, and fits within the effort to build adaptive capacity.

NYC's 2008 progress report on PlaNYC also reports that the City is "developing and undertaking a neighborhood-based education effort in 40 communities around the city most vulnerable to climate change impacts" (New York City 2010a). Workshops in Sunset Park, Brooklyn, and Broad Channel, Queens, piloted the approach, with a focus on potential flooding issues (National Research Council 2009). The City's progress report notes that work with EJ group UPROSE in Sunset Park will develop and release a community planning toolkit and create a climate change adaptation plan by December 2009 (New York City 2010a), and a recent National Research Council (NRC) report (2009) notes that feedback from the work in Sunset Park and Broad Channel will "inform a larger program of engagement" with the 40 communities in NYC selected as most vulnerable to the impacts of climate change (National Research Council 2009: 177). According to the NRC report, "the goal of the citywide strategic planning process is to update the Federal Emergency Management Administration 100-year floodplain maps" (National Research Council 2009: 177).

NYC has also organized other PlaNYC initiatives that can assist with climate adaptation. These include:

- MillionTrees NYC: The City's goal to plant one million additional trees in the five boroughs accomplished over 300,000 plantings as of March 2010, including the planting of new street trees and trees on public land. Trees are planted in response to requests by NYC residents and in low-income areas that were previously identified as "trees for public health neighborhoods", or areas with low canopy cover and high rates of public health problems, mainly based on asthma (Lu, personal communication 19:2010). The NYC Parks Department has worked with several communities to produce locally-based Urban Forest

Management Plans, available on the NYC Department of Parks & Recreation website (New York City 2010b).

- A new Cool Roof Program initiative was announced in May 2010; the City's goal is to coat one million square feet of rooftops each year (Grillo, personal communication 8:2010). Cool roofs are reflective, highly emissive rooftop coatings that can reduce heating of the building fabric, reduce indoor temperatures, and potentially decrease the urban heat island effect if used on a large scale (Akbari et al. 2001; Rosenthal et al. 2008). NYC is partnering with the Community Environmental Center (CEC), a non-profit organization based in Long Island City, to implement the program and plan its long-term objectives. The NYC Building Code was revised in 2008 to require cool roofs on new structures and during roof renovations. In order to serve as an adaptive response that might minimize the public health impacts of excessive summertime heat, the NYC Buildings Department staff were also advised by public health researchers that the Cool Roofs Program should seek to identify low-rise residential buildings of low-income senior citizens in low-income areas with a relatively low degree of air conditioning prevalence, incorporating remotely-sensed surface temperature data of NYC's surface urban heat island into their spatial analysis to identify hotter residential lots.

Other PlaNYC initiatives to increase the use of vegetation and reduce impervious cover have been deployed mainly for better stormwater drainage and for neighborhood access to green spaces, and are also potentially useful for cooling inner-city places.

6 Discussion and Recommendations

NYC's planning to reduce heat exposures and heat-related death and injury may benefit from considering two closely connected suggestions:

- incorporate public health concerns into the stakeholder work and goal-setting of the New York City Climate Adaptation Task Force; and
- initiate and support community-based adaptation planning for health using an inclusive and proactive approach to stakeholder involvement in adaptive planning.

6.1 Public Health Objectives into Climate Adaptation Planning in New York City

As of spring 2010, formal climate adaptation planning in NYC was focused on critical infrastructure. It did not consider planning to prevent the public health effects of extreme heat events, while in terms of human disease and mortality, heat may well be the greatest current risk to New Yorkers, and health impacts are presently occurring. Although DOHMH has an active educational program for health care providers and community groups on recognizing the hazards of excess heat and an air conditioner distribution program, its resources are limited, and heat-associated morbidity and mortality remains a problem. This section discusses the possible merits of including the public health sector in NYC's climate adaptation planning process.

The ATF has a clear and essential mission to plan for critical infrastructure and its adaptability to climate change and variability to protect the daily functioning of the city. The continued operation of all forms of infrastructure—communications, mass transit, bridges and tunnels, sewage treatment plants, and electrical facilities, etc.—is vital to public health, and the failure of infrastructure during extreme climate events or faulty functioning on any basis is a potential hazard and expense to all New Yorkers.

The ATF has already accomplished much with its mandate, and NYC has emerged as a global leader in climate adaptation planning for urban infrastructure. Expert professional knowledge is the core knowledge basis that informs many regulatory areas with which the ATF deals: e.g. design standards for waterfront construction; long-term capital expenditures and operational issues, and; sensitivity analysis for infrastructure operational thresholds. In some of these areas, a top-down approach may be the only expedient or feasible way that the City is able to plan.

However, a risk-based planning process that addresses social issues, such as priorities for public investment and the costs and benefits of adapting to climate risks, could be improved by including health objectives and community planners as part of adaptation planning and work group discussions. There are three main reasons why including the public health sector in the formal NYC adaptive planning process might provide opportunities and better inform the resultant plans.

The first is the opportunity for cross-sector collaboration. The ATF states that the particular strengths of its stakeholder process is the opportunity for cross-sector informing, sharing of ideas, collaboration, and identification of opportunities for joint action, and coordination and sharing of best practices. Planning for public health objectives might also benefit from these particular strengths. Sharing knowledge between stakeholders in these domains, including health, can lead to better and more thoroughly informed outcomes.

For example, the DOHMH notes that one of its adaptive strategies—the AC distribution program—is limited by lack of funding resources to offset the cost of increased use of AC by low-income seniors (Graber et al. 2009). Research by the Community Health Survey has established that senior citizens concerned over the increased costs associated with higher electrical bills may not use their home air conditioning, even if they have the equipment, leaving seniors unprotected from extreme heat. It is easy to imagine a situation where, if this agency-specific knowledge was shared with stakeholders from Con Edison or other agencies involved in the ATF, innovative solutions might emerge and be considered to alleviate the problem. Similarly, given the presence of major communication companies on the ATF, there might be creative ideas on public health messaging both at the start of the warm season and during extreme heat events that could emerge from cross-sector discussions.

Without the issue of climate-health effects on the table as a consideration, however, creative gains from sharing information and resources between stakeholder partners will not materialize to help solve the challenges of current health problems. Other climate-health impacts that may bear a direct correspondence to infrastructural issues—especially, the potential for water-borne diseases during extreme precipitation events—serve as additional reasons to fully incorporate the public health sector in NYC's formal climate adaptation planning process.

The second opportunity is the use of local knowledge. The inclusion of citizens' groups and local residents in a climate adaptation process focused on the infrastructure located in neighborhoods across NYC could provide useful insights into issues of concern and raise acceptance of planned initiatives (Ebi and Semenza 2008). A neighborhood-based approach that encouraged the sharing of local with expert knowledge could be useful to the adaptive planning by providing a forum to integrate contextual with professional knowledge in initiatives. Residents have unique place-based knowledge of their specific circumstance, events, and relationships, and the meaning of those things in their lives (Corburn 2005). In regards to environmental exposures like heat, these local factors and lived experience are what structure and mediate patterns of exposures, despite limitations in the generalizability of local knowledge. As such, adaptation planning in NYC should strive for the creation of "usable knowledge," as the exclusive use of expert professional knowledge to characterize climate adaptation priorities and investments may miss relevant climate-health risks to New Yorkers (Corburn 2005: 39) and relevant solutions.

Finally, greater legitimacy could accrue to a risk-based process that includes consideration of one of the greatest risks posed by climate and extreme heat events. In public and private discussions with ATF members, all agree that heat-related health effects pose a significant risk to New Yorkers today due to the current climate and projected changes in climate. Per Iris Marion Young, "The normative legitimacy of a democratic decision depends on the degree to which those affected by it have had the opportunity to influence the outcomes" (Young 2002). A risk-based process informed by the neighborhood and citizens' group perspective may well address the core health challenges of climate change most effectively. Presumably for these reasons, public health has been included as a sector in many of the climate adaptation plans published by regional and local governments to date, including the 2009 California Climate Adaptation Strategy and the City of London's Climate Change Adaptation Strategy (2007 report and 2010 update).

6.2 Arguments for Greater Inclusion in the Climate Planning Process

Opening up the formal planning process to social actors from the non-profit sector, community NGOs and citizens' groups could increase the knowledge, acceptance, and ease of implementation of planned initiatives, such as the Cool Roofs Program, and help to address the equity dimensions of planning outcomes (Ebi and Semenza 2008). This may be accomplished by a community-based adaptation planning process for the health sector that is integrated into current DOHMH institutional resources and efforts to reduce health disparities, and/or by incorporating health planning into the existing adaptation task force and stakeholder process, if it is to continue. This section discusses these points and elaborates on why inclusiveness is important for climate and environmental health planning.

If the goals are for greater social justice in a diverse multi-ethnic and multicultural city, and to support procedural and distributive equity in decision-making, then planning for climate adaptation will benefit from an inclusive approach that not only permits but invites community stakeholders, interested New Yorkers, and citizens' groups to join the discussions and planning process that thus far is largely limited to government representatives, private sector companies, and academic scientists.

Many of the populations that are disproportionately vulnerable to heat-health effects include groups that are often marginalized in policy-making processes; including low-income and communities of color, and people with pre-existing health conditions and disabilities (Ebi 2009). Efforts to engage these stakeholder groups in the planning process and in outreach on environmental health can help to ensure that the appropriate information on these hazards reach the most vulnerable groups in a manner in which it can be used, increasing the effectiveness of adaptive planning while building social capital (Ebi 2009; Ebi and Semenza 2008). Per Kris Ebi, epidemiologist and leading climate-health scientist, "Public health interventions designed and deployed in conjunction with these groups and other relevant stakeholders increase individual and community acceptance of, and the success of, the intervention, along with reducing constraints to implementation. Community based adaptations that address the societal, cultural, environmental, political and economic contexts that increase vulnerability enhance community resilience to climate change as well as other stressors, providing multiple benefits" (Ebi 2009: 191).

A bottom-up approach that does not originate in government but is supported by it may ultimately prove beneficial for community-based adaptive planning for health; for example, as an extension of the current grassroots EJ groups organizing for Climate Justice.[3] Given that low-income populations and communities of color

[3] The Climate Justice Policy Recommendations produced by the EJ Leadership Forum in 2009 focus on public health as a central component of climate mitigation and adaptation, and call for public "funding for training and placement for health professionals in low-income communities of color" (WEACT 2009, p. 8).

are often at greater risk of health disparities and heat-health impacts, the "Principles of Climate Justice" articulated by the EJ Leadership Forum are especially apt; they call for ensuring that "People-of-color, Indigenous Peoples and low-income communities, who are and continue to be disproportionately impacted by climate change, have the inalienable right to have our voices shape what is the most significant policy debate of the twenty-first century" (WEACT 2009: 9). The California adaptation plan presents similar principles; according to Tony Brunello, California's Deputy Secretary for Energy and Climate Change, their key recommendations include developing tools and offering guidance for local communities to improve public health as part of local adaptation planning, making research and monitoring more accessible, and identifying the most vulnerable communities to develop climate hazard mitigation plans (Brunello, personal communication 14:2009). Brunello noted in an October 2009 discussion that California's EJ organizations are directly involved in the state's adaptation planning process "and making sure that neighborhoods that have high impacts are part of the solution" (Brunello, personal communication 14:2009).

To encourage the locally-based approach, climate-health scientists Kris Ebi and Jan Semenza (European Centre for Disease Prevention and Control) proposed (2008) an eight-stage framework for community-based adaptation to climate change. Their typology begins with community outreach to invite participation from major stakeholders, assess concerns, and determine the broad outlines and objectives of the planning process. Identification and mapping of community assets that may enhance resilience, and vulnerable populations, is a key pre-condition to a broader stakeholder involvement and prioritization of possible interventions based on criteria selected by the stakeholders (Ebi and Semenza 2008: 504). After creating plans for implementation and associated mobilization of resources, the implementation of selected activities occurs. As adaptive planning is always an iterative process, the process concludes with monitoring and evaluation processes, with feedback from community members engaged in the process. As such, this process aims to develop social capital through discussion within communities, and may help to address some of the vulnerabilities experienced by urban low-income communities—the inadequate access to resources and assets (economic, institutional, biophysical, and social) that underlies some of population vulnerability to climate-health impacts.

7 Theoretical Considerations: The Practice and Function of Inclusion in Public Planning

Environmental planning has a long history in the United States of technocratic planning, and the community-based planning suggested here attempts to redress embedded imbalances. Similar to the rest of the United States, environmental planning in NYC has often resulted in exclusionary practices, due in part to the effect of legal requirements for environmental review on public participation. Given the type of scientific analysis required for assessment of harm to human health under the Clean Air Act, under water quality standards required in the Safe Drinking Water Act and, in general, the type of analysis required under state law, an expert-driven technical process and planning practice dominated by lawyers and scientists was created that, in practice, often devalued local knowledge and discouraged citizen input into decision-making processes, creating a 'science vs. democracy' dilemma (Corburn 2005; Fischer 1991; Tesh 2000).

In particular, the risk assessment methodology is a technical analysis that incorporates several subjective decisions. It is used to guide many planning decisions, and has been adopted as the basis for climate planning in NYC (Fischer 1991; Corburn 2005, NPCC 2009). The assumptions and normative judgments underlying risk assessment have often been downplayed by the state under the mantle of technical impartiality to promote planning decisions (Fischer 1991; Corburn 2005). Similar to the regressive impacts of zoning, the result of technocratic regulation has been increased concentrations of noxious uses in minority neighborhoods that have been historically less able to resist these facilities (Maantay 2001; Northridge et al. 2003). Minority communities are often poor, marginalized in public decision-making processes and deliberations through conventions of discourse (Young 2002), and often less able to join in or access the expert analysis required to provide input into regulatory processes based on professional science (Young 2002; Corburn 2005). In this way, existing patterns of privilege and exclusion can be reinforced through environmental regulation and planning.

8 Social Justice in the City: In Support of the Deliberative Democratic Model

While neo-liberal globalisation during the past two decades has led to a subordination of social policies by the state, it has also fostered an 'enlarged sphere' of local political action and a more central role for negotiation and collaboration at the local level amongst all political actors, public and private (Meyer 1994). In this context of greater mobilization of urban citizens' groups and local agencies, participatory planning initiatives are central to entrepreneurial collaborations and social movements variously seeking to sponsor initiatives or resist inequitable policies (Sandercock 2003).

Efforts by planners to assert an ethical framework for urban justice have focused on the deliberative democratic model, which emphasizes increased participation in public decision-making by diverse social actors, including frequently marginalized low-income and communities of color. In the context of social and economic divisions within cities, social justice may be best served when a mobilized public realm engages in an expanded deliberative democracy, and relatively powerless groups are able to participate fully in decision-making. Structural differences in individuals and groups in society produce ideas, perspectives and communications that can provide new sources of social knowledge for participants in deliberation, which can lead to decision-making based on more objective claims to social justice. This is a creative outcome of the transformational qualities of communication based on inclusion of structured differentiation (Young 2002). Partnerships by the entrepreneurial state with private capital may not always support substantive justice goals for urban populations; Fainstein (2000) notes that although the emerging vision of urban social justice involves economic growth and "material well-being … it relies on a more pluralistic, cooperative and decentralized form of welfare provision than the state-centered model of the bureaucratic welfare state" (Fainstein 2000: 473). Given the contextual nature of relationships of power, some planners emphasize more of a procedural than substantive practice, as the locally constituted practices of resisting injustice serve as the basis for building capacity for collective action.

9 Conclusion for Adaptation Planning in New York City

In 2008, NYC's municipal government began an ambitious long-range climate adaptation planning effort for critical infrastructure. As of 2010, the stakeholder work started a process for the private sector and government agencies to work together with climate scientists to sustain the city's infrastructure, vital for the well-being of all New Yorkers. NYC's DOHMH has organized a comprehensive educational outreach effort to prevent heat-related health effects, providing cooling services to thousands of at-risk New Yorkers, maintaining an active syndromic surveillance and research program on climate and health, and advising city agencies on how best to promote health and reduce disparities.

However, neighborhood resilience planning and climate-heath impacts are not fully addressed under this existing structure and by current programs. DOHMH's resources are limited. While ultimately it may prove impossible, no matter how many resources are invested, to fully change behavior and eliminate heat-related deaths in any city, a more comprehensive neighborhood approach may best address current climate-health impacts and those in coming years. The admirable and energetic efforts to "do for" NYC communities by the NYC government might be enhanced by "doing with" local residents. Caught in between emergency planning for extreme events and the infrastructure-focused climate adaptation planning, long-term and community-based approaches for addressing key vulnerabilities are just beginning to be planned.

There are compelling equity dimensions to climate-health effects in NYC which may be best served by long-term neighborhood organizing efforts involving outreach to residents, community organizations and institutions, and additional citizen stakeholders. Including additional EJ organizations in the adaptive planning process may be a helpful start. A more inclusive community-based approach to resilience planning and research may provide multiple benefits: increase community acceptance and implementation of planning objectives; add to the knowledge base by including local knowledge; provide experience for community residents and groups with long-range planning, and; increase the democratic legitimacy of the planning objectives.[4]

There is no need to reinvent the wheel; both community groups and staff within NYC agencies have significant experience in working on community-based plans. The DOHMH has three District Public Health Offices (DPHOs), whose mission is to reduce health inequalities in the South Bronx, North and Central Brooklyn, East and Central Harlem. Given their experience in addressing neighborhood health problems with active programs and educational outreach, which include home environmental assessments, these offices may be a natural place to start with community-based outreach on climate and health. Another good example is the neighborhood-based forestry initiatives planning process that is part of the MillionTrees effort, which included work with residents to envision specific changes in the built environment and to outline the steps necessary to implement it.

Rather than creating new mechanisms for implementing community-based climate adaptation, work with existing public health institutions and other organizations can initiate and advance the type of neighborhood and citizens' engagement that will be useful for improving climate-health outcomes now and in the future. Neighborhood and civic groups have organized creative sustainability, carbon mitigation, and climate adaptation projects in recent years in NYC, such as Sustainable South Bronx's Smart Roofs Demonstration Project, and the Municipal Art Society's Planning Center; some of these may serve as a means of incorporating enhanced health outreach and education in the broader sustainability framework. More work on connecting these neighborhood projects with formal planning to incorporate the economic, social, and equity components of sustainable development in locally responsive and climate adaptive initiatives is needed.

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[4] PlaNYC announced in 2007 that a neighborhood-based planning effort is a priority for the city's climate adaptation efforts. In writing about these topics, we note that it is a quickly evolving arena, as several organizations and agencies are planning increased community outreach on climate adaptation and mitigation as of the writing of this chapter in spring 2010.

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Governance Tools for Local Energy Autonomy

Anis Radzi and Peter Droege

Abstract Central to the very idea of 'climate change governance' is the aim of mitigation through the removal of fossil fuel content in energy supplies, the source of 85 % of all anthropogenic greenhouse gas (GHG) emissions (IPCC 2007). An understanding that all societal institutions are historically formed is also useful to this concept. Public administrative institutions, too, reflect their times and circumstances; to adapt them effectively, they must first be appreciated as social constructs, in turn serving to determine social reality. The past century of institutional evolution developed in a time of escalating and now near-total reliance on seemingly abundant fossil fuels and uranium, another non-renewable and destructive energy source. Energy issues were of little relevance at local level until the age of oil crises and climate change. Today, local and regional autonomy in renewable and broadly carbon-free energy supplies emerges as a central aim in the struggle to escape fossil fuel and nuclear dependency, with national and supra-regional renewable supply networks serving as support. This chapter examines major ways in which local communities can act through their government and administrative apparatus—effectively, efficiently and persuasively. We learn here from three successful attempts to gain substantial levels of local renewable energy autonomy.

Keywords Renewable energy autonomy · Energy-independent communities · Organisational change · Local government · Renewable energy institutions

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1 Context

Cities, towns and urban areas are fossil fuel-dependent constructs by definition, physically, culturally and in their governance structure. Change in both policy and practice is called for in this model, ranging from societal to technological agendas (Droege 2006, 2008, 2009). For the purpose of this discussion, it is important to recognise that the very organisation of public administrative systems, across executive, legislative and judicial branches of government, was shaped in an age when fossil fuels prevailed. Hence today's governance structures are not designed to cope with the provision of decentralised, locally sourced renewable energy, which is critical to the rapid and broad conversion, away from the current fossil-fuel suffused model based on remote sources, controlled by a relatively small number of all-powerful suppliers.

Consider the striking facts of the current dependence on fossil fuel: half of the commercial energy supplied worldwide is used for urban areas. The vast majority of this unsustainable resource flow consists of fossil fuel: almost all of global mechanised transport depends on petroleum (EIA 2006; IPCC 2007). The burning of coal and oil helped to boost atmospheric CO_2 concentrations by almost 40 % beyond their long-stable level of 280 parts per million. Given such shocking statistics, the immediate curtailment of new emissions and the biological re-sequestration of existing concentrations are of critical importance. The present occurrence of a global peak in the capacity to source fossil fuel cheaply only adds to the need for massive change: the staggering degree of global oil dependence at a time of peaking production capacity without any significant mitigating action in sight makes even the short-term prospects for global economic viability look grim (IEA 2010). Emergency actions are called for at all levels of society and economy, without precedence in the evolution of our civilisation. Central roles in this historical struggle fall to the governance of local communities: the very logic of renewable energy implies that a large degree of the required energy transformation is accomplished locally and regionally.

Local communities, no matter how small, can be purposeful and effective agents in the development of greater energy autonomy. For example, they can change their governance structure, develop and deploy special-purpose external organisations, or simply use their existing capacities more effectively and with a new purpose. And yet, although local governments have extraordinary powers of influence, they habitually use merely a fraction of this potential, especially in energy matters in which most have traditionally been passive stakeholders. Using all public administrative tools at their disposal, local governments can become effective in implementing even so-called 100 % renewable strategies—attaining full direct energy independence—using a set of five tools.[1]

[1] The loose framework of 'things government can do' is in part built on ideas developed at the Massachusetts Institute of Technology two decades ago. These related to the policy instruments available to local governments to improve urban quality and economic strength through cultural

Tales of three towns

We have chosen three small local communities—each with fewer than 5,000 inhabitants—to demonstrate the extraordinary power of control, change and purposeful innovation available to even small towns. The powerful tools presented here are those developed by three local authorities that have achieved autonomy in the supply of direct—non-embodied or imported—energy for all purposes, except for all of their transportation needs. Each tool is discussed in relation to specific projects undertaken by each of the local authorities, each with the expressed aim of escaping fossil—and nuclear—fuel dependency through locally generated renewable energy. This discussion concludes with a summary of the lessons learnt.

Wildpoldsried is a small municipality (population in 2009: 2,548) in Oberallgäu (www.sisby.de), an agricultural region in the Free State of Bavaria, Germany. The municipality meets all of its electricity and heating requirements from its own renewable resources based on wind power and photovoltaic systems for electricity, and on biomass for a local heating network. The village exports nearly three times its own electricity use as excess production into the power grid, realising healthy revenues, thanks to Germany's renewable energy feed-in legislation. Seeking to go beyond renewable energy redemption, it advocates the use of 'ecological' materials for building construction and has established a wetland waterscape project as a water remediation facility as an integral part of its 'ecological energy plan' (www.wildpoldsried.de). Its journey to energy autonomy commenced in 1999.

Güssing is a small town in the Burgenland region of southeast Austria, which had a population of 4,337 in 2010 (www.guessing.co.at); it is the administrative centre of the Güssing district. By implementing an energy plan based on the principles of energy conservation, the creation of value and environmental protection, it has been able to produce all of its own fuel and energy for heating, electricity and transportation from local biomass. In operation are a district heating system, a biomass-gasification facility, several biomass co-generators, a rapeseed oil refinery, and a photovoltaic and solar thermal plant. Profits earned from its energy services are reinvested in renewable energy projects, creating new jobs and attracting companies to the town and surrounding region. The community even generates renewable power for industrial production. It is the veteran of our three cases, having officially changed direction in 1990.

Samsø, an independent island municipality located 15 km off the Jutland Peninsula in Denmark, had a population of 4,300 in 2009 (www.energiakademiet.dk). In

(Footnote 1 continued)
development (Schuster et al. 1997). And for those interested in the theory of institutional change or evolutionary governance: in order to posit the possibility of purposeful change action, we found it useful to position thought and analysis between the system-critical ideas of 'new institutionalism' founded in part on the work of Peter L. Berger and Thomas Luckmann (1966), the more traditional view on institutional determination espousing the role of purpose and volition in action such as the thinking of Donald Davidson (2001)—going back to the writings of Dewey (1933) or Veblen (1915)—and the observations on learning organisations and change founded on reflective action presented by Donald B. Schön (1983).

1997, Samsø won a government competition to become a model renewable energy community. Today, the island produces all of its electricity and almost all of its heat from entirely renewable sources of energy—100 % of its electricity needs from wind power, and 75 % of its heating requirements from photovoltaics and biomass. It has achieved this by means of several land-based and offshore wind power plants and several heating plants via a district heating network. Its success was the result of a 'socially integrated energy development planning process', mobilising its community and relevant stakeholders to form energy development cooperatives (www.samsoe.dk). Its new planning processes were launched in 1997.

2 The 100 % Renewable Energy Governance Tool Kit

2.1 Regulation, Legislation and Standards

Although setting rules is a traditional role of government, they are not always applied with as purposeful a focus or conviction as might be necessary. For example, communities can strengthen and enforce building efficiency standards and mandatory renewable energy provisions for new buildings and renovations. They could even make full renewable energy self-sufficiency mandatory where climate, resource and national legal and pricing support mechanisms allow this. Regulations and standards can also be provided in cooperation with state and national governments, where municipal discretion to regulate is limited.

Despite being small, the three local governments have all embraced significant regulations for building and construction; area and land use planning; and renewable energy production management, monitoring and pricing. In Wildpoldsried, it is a requirement that energy performance certificates are issued for the retrofitting of old buildings and construction of new ones. The local government also recommends that new buildings are oriented to optimise solar gain by at least 15 °, and recommends angles for roof pitches between 26 ° and 32 °. The village's procurement policies also define energy and 'climate-friendly' purchasing principles, especially in the construction sector.

The municipality of Güssing not only mandates the use of renewable energy in all of its public buildings (see also Sect. 4 below), it also gives preference to renewable energy installations elsewhere, permitting the construction of larger-scale biomass and biogas plants on municipal land and facilitating contracts with local energy installers for small-scale renewable energy systems, and local farmers for the sourcing of locally produced biomass. Since consistency of supply is critical, the local authority insists that the construction of large-scale renewable energy installations is based on long-term financial contracts: facilities have to be operation for at least 15 years. Samsø also applies specific planning rules that assist renewable energy installation. In relation to wind power, landowner agreements were created which led to private owners of individual wind turbines agreeing to allow space on their land to erect collectively owned turbines. By boldly advancing a district-heating network that runs on biomass, the local authority extended the infrastructure even to homes that had not yet agreed to become members of the new heating scheme. Although it was compulsory for residents living within the range of the existing district to agree to new heating contracts at a discounted rate, those connected to the new lines were given the option to join later, but with a considerably higher connection fee—a powerful incentive, as also discussed in the next section.

In all three local authorities, renewable energy conversion required a structured, accountable and reportable framework. The authorities of Wildpoldsried relied on municipal energy management guidelines set by the "Energie- und Umweltzentrum Allgäu" (Energy and Environment Center, EZA), a research and advisory facility that focuses on energy and environmental matters for the wider Allgäu region in which the village is located. These guidelines enabled the village authority to create its own energy inventory; manage and control its own energy supplies on a monthly basis; and even to regulate energy use by monitoring systems that could immediately notify users of spiking energy consumption. Municipal management costs were covered by local government funds, with support from the Bavarian Ministry of the Environment. In Güssing, renewable energy facilities are also guided by a network managed by an external institution, the regional competence 'centre' Renewable Energy Network Austria (RENET). The centre is operated by the local government's European Center for Renewable Energy (Europäisches Zentrum für erneuerbare Energien—EEE). Samsø's energy production is guided by distinct operational entities, also created by government: the various energy supply companies and the research and development centre of the Samsø Energy Academy based in the municipality.

Legislation established by national and state governments also greatly boosted the implementation of renewable energy in these municipalities. The EZA assisted Wildpoldsried in the deployment of a municipal energy management system based on the ISO 14000 Environmental management standard; and advised the municipality on issuing energy certificates for various types of buildings based also on a German industrial standard (DIN V 18599 Energy performance of buildings standard). These provisions are designed to work together to regulate electricity and heat consumption as well as control local renewable energy supply. Development and pursuit of these standards are structured within an overall policy framework, provided by the local authority's Agenda 21 strategy. The policy represents a response to the Bavarian Climate Protection Policy, conceived by the state government, which aims to double the share of renewable energies in the production of primary energy to 16 % by 2020 and fund low-energy construction and the energetic refurbishment of buildings. The policy also outlines an integrated climate protection concept specifically for municipalities, which includes directives on providing financial assistance to all energy-related areas of the municipality (Free State of Bavaria 2007).

Güssing's success in becoming an energy-autonomous community was published in the State Energy Concept 2003, issued by Burgenland Energy Agency. It includes revisions to its Housing Assistance Act 2005 and other state laws, which mandates the promotion of renewable energy sources, the promotion of new technologies for 'green energy' production and the increase of energy efficiency. The Act stipulates that there should be subsidies to contribute up to 30 % of the cost of a range of energy installations, such as water pumps, thermal solar installations for hot water, heat pumps, solar thermal systems, household central heating systems with biomass and connection to biomass-powered district heating network. It also contains guidelines for the promotion of businesses in the fields of environment, ecology and energy.

Samsø's success was also driven by regulations at different government levels. Its initial impetus to become energy autonomous was triggered by a national Renewable Energy Island Competition in 1997—the original brief was based on recommendations of the national government's Energy 21 Plan (1997), aiming at 35 % of gross energy being supplied renewably by the year 2030 for Denmark as a whole. Since then, the conception of the national government's Renewable Energy Act has articulated the deployment of a range of renewable energy technologies in all municipalities. One example is the provision of areas reserved for wind power generation in municipal plans. The Act also stipulates the various subsidies available, such as the "green scheme" grant, which finances activities carried out by municipalities to encourage local community acceptance of renewable energy.

2.2 *Carrots and Sticks*

Incentives—rewards, or 'carrots'—for taking efficiency measures and developing renewable energy installations, or for setting up renewable energy service companies (RESCOs), can be provided through taxation and pricing policies.

The feed-in tariff is a guiding model used in over fifty countries at national or state level. Feed-in tariffs provide a pricing, or market, incentive, setting the price per kilowatt-hour (kWh) that an electricity utility has to pay to a private, independent producer of renewable power fed into the grid. All three local authorities discussed in this chapter have benefited from their national feed-in tariff systems. The German feed-in tariff for example, enabled Wildpoldsried's wind and solar electricity assets to secure income for the local community by generating over 100 % of its own demand in renewable power annually (321 % in 2011). Similarly, the cost of energy from the renewable energy plants in Güssing has increased in competitiveness against conventional fuels due to a high feed-in tariff. In Samsø, community stakeholders co-operatives or private wind turbines are rendered more economically viable thanks to the guarantee of a generous 10-year feed-in tariff for wind power.

But our communities also deploy renewable energy carrots of their own: in Wildpoldsried, for example, the installation of wind turbines and other renewable energy technologies above a certain scale are eligible for more favourable planning standards. Reimbursements are also provided for the construction of zero energy or energy neutral buildings. In Güssing, government lands are earmarked for renewable energy plants and planning approvals are fast-tracked for their construction. In Samsø, ownership schemes outline provisions that allow the general public to reserve future shares in wind turbine sites, within areas which are privately owned. (PlanEnergi and Samsø Energy Academy 2007)

All three energy-autonomous communities were supported by financial incentives provided at almost every level of government, from the local, regional and national bodies to the European Union. Financial investments also came from many private companies and industries. In all cases, a comprehensive energy and financial model helped secure further grants.

The energy projects in Wildpoldsried were largely funded by the local community co-operative and private individuals. Financial asistance from the regional and state governments enabled the municipality to subsidise programs such as providing households access to energy consultants, or share the costs of thermographic imaging and subsequent advice on insulation options for households according to the mapped heat losses in buildings. In Güssing, research subsidies and favourable leasing arrangements were provided for renewable energy companies who wished to set up premises in the local area. Fees charged to buildings connected to the district heating network helped guarantee on-going finance of the renewable energy facilities. In Samsø, grants from the Danish Energy Authority helped fund free energy appraisals for homeowners and subsidise investments into energy savings installations across the community such as the subsidy program to help pensioners make home improvements to save energy. By acting as guarantor for grant application to banks for the district heating stations and wind turbine installations, Samsø local authority was able to secure a very low interest rate for its community.

Energy awards won were also used as a financial leverage, besides boosting general interest in renewable energy in the community. The Bavarian State Ministry of the Environment and Public Health (StMUG) promoted Wildpoldsried's participation and the eventual award of the European Energy Award® (eea®). The fact that Güssing won Energy Globe and Eurosolar awards gave it credibility in securing funds for further research. Samsø's award-winning 10-year 'Renewable Energy Island' plan was behind its success in several funding applications. And labels and thematic strategies such as ecotourism have boosted the image of these communities.

Raw material for authentic renewable energy production is sourced locally. Incentives are therefore critical to maintaining the availability of local material and human resources. For example, Wildpoldsried supports only the use of wood pellets, which are produced from waste wood by the wood industry within the region. Güssing guarantees stable energy prices for local farmers as bioenergy croppers through the use of 10-year contracts at a fixed price, generally above market values, enabling farmers to generate income, both in the raw material supply to the plants and in the energy delivery from them. Samsø meanwhile stipulates that straw and wood chips for the district heating stations should be produced only by local farmers.

Incentives were also accompanied by certain disincentives. In all three local authorities, the presence of an infrastructure for district heating powered by bioenergy installations helped motivate communities to change their existing systems. It helped them to visualise both heating price reductions as well as a dramatic lowering of emissions from oil boilers. In Güssing and Samsø, all homeowners whose houses were already connected to the district-heating network were asked to voluntarily sign up by a certain date and to pay a very small membership fee. However, in order to provide a disincentive to postponing this change, the cost after that date was dramatically raised—in Samsø from USD 20 to nearly USD 8,000 (www.energiakademiet.dk).

2.3 From Information to Knowledge Networks

Local communities can boost the degree to which they provide information and advice. Advisory services to residents, local industries and incoming companies are an important change driver within all three local authorities. In Wildpoldsried, the community-funded Energy Advice Centre (EZA) provides professional, independent advice on energy conservation and the increased use of renewable energies by local households. With the help of EZA, building managers are supported and trained in local energy management; and, in cooperation with the regional energy provider, the "Allgäu Überlandwerk" (AÜW), green power certification, energy consulting for households and businesses, power meters for hire as well as regular energy-saving recommendations are among the regular services available. Similarly, the EEE Association in Güssing, established by its local authority, not only manages the various renewable energy facilities operationally, but also provides the framework for research and development in renewable energy and incentives to enlarge the knowledge network to include industries and suppliers. The Samsø Energy Academy also supports expertise and promotes its renewable energy projects, providing assistance for further research and development. The free technical advice on renewable energy installations provided by the municipality is greatly appreciated by the citizens of Samsø. .

Community information networks are essential in all three communities: the local energy facilities require not only local manpower and resources, but also insight into the means of implementation and management. In the three communities, an awareness of the energy plan, goals, policies and projects was essential for all stakeholders, from the municipal councillors and employees themselves to the local resident community, and private companies and industry. New concepts were to be communicated early, and often long before any project was implemented or facility constructed. In all three towns, working groups consisted of local citizens whose responsibility was to understand and communicate the resources available or the technologies selected by the local authority. This also meant informing the rest of the population about initiatives through public hearings, and creating acceptance of the proposed implementations: sometimes to directly lobby and collect signatures. With the support of the local government, these supporters were even involved in looking for other potential investors.

Engagement and cross-fertilisation of ideas with other communities takes place through established frameworks, such as the European Energy Award® and EZA in Wildpoldsried; the EEE Association in Güssing; and the Samsø Energy Academy in Samsø. All play host to many visiting groups from around the world. In the case of Güssing, the Association's growing reputation as a leading centre for renewable energy research has attracted solar energy companies interested in powering their manufacturing facilities with renewable energy, removing embedded dirty energy content. The success of the EEE Association in transforming the municipality into a centre for energy autonomy has attracted local government delegations from all over the world. The Samsø Energy Academy also plays host to many research and governmental delegations and represents Denmark in promoting its renewable energy agenda abroad. They have created a communication platform to encourage innovation and the dissemination of ideas through 'cultural intelligence gathering', recognising not only local traditions and culture but knowledge brought in from international partners (www.energiakademiet.dk).

Local information centres advise households and companies on energy conservation and the installation of renewable energy technology in all three local authorities. Wildpoldsried's Energy Advice Centre helps run 'energy days' in schools. The local energy projects are presented on the municipal website, and the community's energy initiatives are documented in the district newspaper and in professional journals. In Güssing, a motel has been built near the EEE Association, heated and powered exclusively by renewable energy, and there are guided tours of its various renewable energy installations. In Samsø, the promotion of renewable energy by public campaigns and local efforts has helped increase the rate of renewable energy installations, such as solar installations in ports, at a youth hostel and the local camping ground.

Samsø's Ecomuseum helps visitors explore the cultural history of the island and learn about the renewable energy island project. Cultural events with renewable energy as a central theme build on existing cultural traditions. Examples are the Wind Power Festival of Wildpoldsried, the Eco-Energy Land network showcasing regional produce, nature trails and the ecoenergy marathon in Güssing; and Samsø's Energy Safari conducted with the municipality of Skive. Boosting ecotourism also provides an added internal signal: to maintain renewable energy production to keep up with visitor expectations.

Small steps lead from valuing 'plain old information' to knowledge dissemination and public promotion, to learning through feedback and even the development of new intellectual capital. New research and development institutions are central in all three communities, established by, and answerable to, the local authority for the monitoring of existing projects and the guidance of future renewable energy development. In Güssing and Samsø, the role of such entities is extended to enable companies within the region to share and export their renewable energy technologies and expertise. The nurturing of knowledge networks—

research and development partnerships—was essential to the success of many established projects. Networks are manifest in three distinct types: the learning network, involving research institutions; the industry network, engaging private companies; and the political network, also among governmental entities. In our three communities, the combination of all three networks was present. Güssing for example took advantage of the structure set by the regional competence network, RENET, through a 'Competence Network for Energy and Biomass' linking industry, government and the community with educational institutions. Via RENET, Güssing was able to establish the world's first demonstration plant for the production of electricity and synthetic fuels using the Fischer–Tropsch process with the research and technical know-how provided by Vienna's Technical University and other industry partners. The RENET institution enables work to progress quickly, enhances knowledge development and provides funding. From here, new human resources are mobilized. The facilities in Güssing have themselves become laboratories, attracting various new research projects. The biomass plant, for example, helps conduct studies on the syntheses of methane, the operation of fuel cells and production of liquid fuels. Investigations into biofuel alternatives are underway in collaboration with Volkswagen, Daimler-Chrysler, Volvo, Renault, BP, EDF and other partners (RENEW).

2.4 Community Assets: From Public to Cooperative Ownership and Operation

The facilities owned, operated, managed and controlled by local government can also be readily available tools—from the urban infrastructure apparatus to the development of municipal buildings, streetlights, car fleets and undeveloped or underused property. Government has a higher degree of accountability and responsibility to do better—and certainly no worse—than the private sector. It can use its asset management, capital investment policy and practice to set a powerful example to the community. A typical example from our towns: Wildpoldsried and Güssing revised their own corporate standards, mandating renewable energy deployment in all municipal buildings for heating by installing full thermal insulation and better windows. Public land, intelligently used, can be a powerful change lever: in Samsø and Güssing, local authorities are able to control the price of renewable heating and electricity since biomass and biogas plants are owned and operated, either in part or entirely, by the local municipality.

But municipal assets also include institutional frameworks and organisations. To give an example: communities that own and operate power companies and other public utilities are considered fortunate; such institutions can be powerful agents in promoting renewable energy and efficiency policies, developing infrastructure and engaging in farsighted autonomy measures of all kind. Where no public power assets exist, these can be won back, or be newly acquired. They can also be substituted through financial and organisational means, through new, special purpose incorporated entities, such as the various organisational innovations of our three municipalities described in this chapter.

Ownership and control are also critical among the local population—the primary participants in change. A range of forms and styles of control over renewable energy production, facilities management and operations is present in all three local authorities. In Wildpoldsried, the district heating system is owned and operated by the municipality through a private limited company, while the local citizens cooperatively or privately own wind turbines, four biogas plants, 90 photovoltaic systems and three hydroelectric power plants—all generating an excess of 2.8 times the total electricity consumption within the municipality. In Güssing, too, renewable energy installations contain a mixture of owner-investment types. Its facilities management and energy monitoring body (EEE Association), district heating network and renewable energy power plants, are largely owned and operated by private limited companies, with the municipality as the main stakeholder (51 %). In Samsø, community working groups established with the support of the local authority determined the composition of ownership of the various installations, from individual wind turbines and large-scale wind fields to the district heating system. The island's large heating plants, for instance, are in three forms of ownership: one owned and operated by a local utility company; another by a private investor; and the third is cooperatively controlled. The range of ownership types reflects the local authority's insistence that all projects benefit the entire community. When the Shell Oil Company sought to impose the condition of becoming the sole owner of a wind power project in Samsø, the proposal was resoundingly rejected.

Renewable energy plans are usually implemented through cooperatives, supported by local and outside companies as co-investors, under the management of the local community. All three cases exhibit operating entities established outside of local government, yet are owned wholly, or partially controlled by it: planning coordination was conducted by the local government-owned town cooperative in Wildpoldsried; the EEE Association and EEE managed private limited companies in Güssing; and the Samsø Energy Supply Company and later the Samsø Energy Company in Samsø.

The energy cooperation model required a reliable financial model to be provided by the local authorities, in order to ensure the funding of larger-scale renewable energy facilities. In Wildpoldsried, the local government's village energy cooperative coordinates and manages almost all projects. Güssing's business plan stipulates a continued assessment of markets, available energy sources, and an optimised mix of technologies, to offer credibility and security for making the business case for projects with 15 to 20-year horizons. This attracted and helped successfully secure long-term partners. In Samsø's financial model, the inevitable complexity of energy structures was acknowledged, but at its core it retained the principle that a high degree of local ownership should prevail, be evenly distributed and not concentrated within one company. Such essential economic frameworks would help strengthen regional energy user-supplier chains.

Ongoing information feedback, learning-through-monitoring and accountability are common features of all three cases. In Wildpoldsried, the energy management systems in place led to the greater understanding of local consumption and production levels. Participation in the European Energy Award Scheme® has meant the implementation of municipal energy policies, structuring processes and rules for monitoring, auditing, reporting and certification. At the council administration level, future plans and projects, their implementation and alternative funding models now rely on statistical evaluations of energy activities, including yields of photovoltaic systems and heat consumption values. In Güssing, progress in energy development research through the EEE Association has meant increased efficiencies in energy generation and management of their renewable energy plants. Meanwhile, monitoring and research activities conducted by the Samsø Energy Academy provide progressive reports to its local authority. These help assess existing energy standards as well as inform the formulation of future energy policies. In our three local authorities, all energy activities—including operations, management and research—are accountable and report to the mayor: in Wildpoldsried via its Village Heating Company and EZA; in Güssing via the EEE Association; and in Samsø via the Samsø Energy Academy and Samsø Energy Company.

2.5 New Plans and Planning Skills

Globally, the ground is shifting for local planning organisations and their tools. Mapping renewable energy capacity, understanding energy flows, realising which roof and open space assets are available for renewable electricity and thermal energy conversion: such knowledge forms the basis for achieving renewable energy independence in an efficiently structured and purposeful manner. By generating a full picture of all energy streams, their sources and sinks, the foundation for successful strategies is formed. And by mapping the potential of the local area according to its physical ability to generate renewable power based on its built form and spatial patterns, the stage can be set for building an energy-autonomous community that optimises its own local potential first (Genske et al. 2009).

These new tools and the planning scenarios they enable are a far cry from even recent climate governance practice in local planning. Many communities are engaged in target setting, as Eric Martinot has observed, aiming at a future amount of renewable electricity for local consumers; yields of renewable electricity for municipal operations and buildings; a percentage of biofuel use for publicly owned vehicles and for public transit; or CO_2 reduction targets, emulating, but also sometimes misunderstanding, the Kyoto processes of target setting. The limitations of these piecemeal efforts and fractional target setting exercises have become all too clear. Traditional local physical planning practice is being reformed: urban planning authorities regularly designate certain “green development” zones or infrastructure; anticipate electric vehicle infrastructure needs; engage renewable energy in public infrastructure in some systematic way, for street lighting, traffic lights, for example, or other infrastructures (Martinot 2009).

By contrast, in our three towns, energy plans lie at the heart of practice: the integrated energy plan—"Wildpoldsried Innovativ Richtungsweisend WIR" ('innovative, direction setting'—'WE'), the "Kreislauforienteierte Bedarfsdeckung" ('cyclical satisfaction of need') energy-cycle plan of Güssing, and the Renewable Energy Island plan of Samsø. Common to all is the order of priorities: to save energy and increase efficiency; expand the collective heating supply systems fuelled with renewable energy; expand individual heating systems; establish renewable energy facilities for energy production; and gradually convert the transport sector from petrol and oil to renewable electricity.

Plans were based on a similar resource analysis methodology: first, to ascertain the energy demand and availability of necessary land for energy crops and the like; second, to identify suitable technologies and develop energy supply scenarios for the district; third, to calculate the potential for emissions reduction; and, fourth, to perform cost/benefit analyses and develop an appropriate financing model. These plans formed the basis for the standards that were set in each of the local government's energy plans, with all models being based on the provision of heat, fuel and electrical power with renewable sources, in that order. All were focused on energy conservation, renewable energy generation, value creation and environmental protection. All planning projects mandate the support and diffusion of two main areas: first, large-scale renewable energy infrastructure planning and construction for bioenergy plants, district heating networks, solar fields and wind power plants; and, second, the diffusion of small-scale renewable energy systems—individual photovoltaic systems, biomass pellet heating systems; and local heat pumps installed by households.

The development of staff skills is essential for an aspiring and practicing energy-autonomous community. Wildpoldsried provides energy-relevant and targeted training programmes for municipal employees. Güssing operates the EEE association to run programmes to train energy managers who will be responsible for villages and towns in the greater Güssing region. The EEE association not only coordinates all demonstration plants, projects and research, but also programmes for further education in this field. Through the Association, the municipality hosts a team of highly trained technicians and international scientists, working to develop innovative technologies, solutions and patents. Extending this push into a burgeoning service industry, it has created teaching facilities for training solar technology installation technicians besides its municipal energy managers. Its solar school programme (Solarteur®) provides operational training for teachers, and runs a programme for secondary school students, teaching renewable energy practices and technical skills, such as the use of heat pumps, solar cells and solar panels. It includes practical workshops and site inspections of facilities. This learning programme now operates throughout Europe. Similarly, the Samsø Energy Academy functions as a meeting place and laboratory where the community can discuss and learn about energy and local development. Like the EEE Association, it also conducts research, organises workshops, conferences and exhibitions and run training programs for primary and secondary school children. Educational programs teach energy concepts by conducting hands-on experiments with energy in a variety of forms such as building models of wind turbines or electric motors. (PlanEnergi and Samsø Energy Academy 2007)

2.6 Augmenting Energy Autonomy with Ecological Regeneration

The energy plans of all three local authorities are embedded in or linked to other ecological aims and agendas. In Wildpoldsried, an ecological learning centre assisted the community in the establishment of their own wetlands, known as the "WiWALaMoor", a project funded by the European Union and the Free State of Bavaria as part of the LEADER+ programme. The wetlands concept is based on encouraging local rainwater retention and filtration measures, creating ponds as natural swimming pools for sport and recreation. Ecological cycles are supported by the creation of open meadow orchards, nature trails and an ecological treatment facility to convert sewage sludge into humus. In Güssing, the promotion of eco-tourism is based on renewable energy production and environmental preservation. Established nature and energy trails through the regional vineyards showcase local produce alongside local energy production. Samsø's original renewable energy plan envisioned lowered greenhouse gas emissions and improved local water systems by outlining a methane plant to extract energy from animal slurry and waste from agricultural processes, alongside planting projects of localised willow beds to clean low-nutrient wastewater. Although these plans have not come into fruition, the focus has not been entirely abandoned: smaller-scale biogas capture projects based on local farms have been highly successful.

3 Conclusion and Outlook

Communities cyclically using local resources can ensure a secure supply of energy, enhancing local prosperity and resilience, innovation and sustainable growth. In our three communities, citizens organised themselves to adopt a life-style based on renewable energy, fostered and supported by local authority and legislative frameworks. Community involvement, public–private partnership and powerful research support coupled with strong regional commitment were fundamental to achieving common energy goals. Because the energy supply cycle is of common local interest, political disputes proved rare. To make the local energy supply cycle work, it seemed essential to form organisations distinct from the core structure of the municipality whilst maintaining strong relations and cooperative agendas with it. The examples of these three local municipalities show that this leads to rapid development, strong innovation impulses and the broad uptake of fresh ideas on local renewable energy. And by establishing research and development bodies, local authorities became learning organisations, dynamically understanding the evolution of facilities and policies, constantly advising on necessary policy reforms, as supported by original research.

We showed that even small and seemingly less powerful communities can control their destiny in climate change governance. Setting a precedence for further research, small communities may well have something to teach even larger cities: communities of limited size, neighbourhood organisations, identifiable districts and their governance matter. Smaller communities may find it easier to become energy autonomous more quickly: a small group size makes it easier to find common ground and to reach an agreement. Having explored the world of small communities from its institutional capacity for effective climate change governance, we look forward to studying the impact of local renewable energy autonomy as a core feature of climate change governance on the organisation of large cities and metropolitan regions.

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Climate Change, Sustainability and Urban Policy: Examining the Validity and Function of Best Practices

Dominic Stead

Abstract Interest has been growing in recent decades about how governments learn from the experience of others, variously discussed in relation to policy transfer or 'lesson-drawing'. During the same period, there has also been a substantial increase in the identification and promotion of 'best practices' in most areas of policy, including climate change. Underlying these best practices is a frequently encountered assumption that these are effective mechanisms of promoting learning amongst policy-makers and of contributing to improvements and efficiencies of policy-making and practice (Bulkeley, Environ Plan A 38(6):1029–1044, 2006). However, the reality seems to be that best practices, especially examples from afar (and from different contexts), often have only a limited role in policy-making processes: other influences are more important (Wolman and Page, Governance 15(4):477–501, 2002). This paper critically examines the use of best practices in relation to climate change, sustainability and urban policy. It begins by reviewing recent European policy documents, and examines the importance that these documents attach to the identification and dissemination of best practices. Next, the paper identifies some of the main reasons why governments have been increasingly active in developing (or claiming) innovative policies that represent best practice: reasons include image, prestige, power and funding. The paper then reviews literature on how best practices are actually viewed and used by government officials, and examines the extent to which best practices are influential in changing the direction of policy. Information from the four case study cities is then presented and compared against the findings from a similar study carried out by Wolman and Page (Governance 15(4):477–501, 2002), which tried to uncover how local policy officials found out about policy

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experiences of other local authorities, how they assessed this information, and the extent to which they utilised it in their own decision-making processes.

Keywords Best practices · Climate change policy · Urban policy · Policy transfer · Sustainability

1 Introduction: The Rise of International Best Practices

> The prolonged quest for the best practice in international climate policy has long crowded out serious analysis of what constitutes politically, economically, and managerially viable climate governance at the national or subnational levels. (Rabe 2007: 442)

The concept of best practice (or good practice) is rife in European policies and programmes. In the area of climate change and urban policy, best practices have been developed under a range of international programmes and projects. The underlying belief is often that identifying, promoting and disseminating good practice will help contribute to transnational learning and lead to improvements in policy and practice. This chapter examines this underlying belief. To do so, it considers the *validity* of international best practices, particularly given the fact that there are huge differences in the technological, economic, political or social situation between countries across the world, and it investigates the *function* of international best practices in influencing policy-making processes. The paper then outlines some conclusions in the form of directions for future activity in the area of best practice. The paper begins by considering some of the key policies and programmes that promulgate the development or use of best practice in areas related to climate change and urban policy. The main focus of this review is at the European scale, although it is recognised that a range of national as well as international policies and programmes also promulgate the development or use of best practices.

Recent attention to best practice in European policy documents is undeniably high. Frequent mention of best practice can be found in policies such as the 1999 European Spatial Development Perspective, or ESDP (CSD 1999), the 2001 White Paper on European Governance (CEC 2001), the 2005 revised sustainable development strategy (CEC 2005), the 2006 Thematic Strategy on the Urban Environment (CEC 2006), the 2007 Green Paper on Urban Mobility (CEC 2007), the 2007 Leipzig Charter on Sustainable Urban Cities (German Federal Ministry of Transport, Building and Urban Affairs 2007b) and the 2007 Territorial Agenda of the European Union (German Federal Ministry of Transport, Building and Urban Affairs 2007b). The issue of climate change and urban policy is closely related to the content of many of these documents.

The ESDP's view on best practice is that '*the exchange of good practices in sustainable urban policy… offers an interesting approach for applying ESDP* *policy options*' (CSD 1999: 22). Meanwhile, the 2001 White Paper on European Governance highlights the role of the 'open method of coordination' (OMC) as a key factor in improving European governance, which involves activities such as '*encouraging co-operation, the exchange of best practice and agreeing common targets and guidelines*' (CEC 2001: 21). The 2005 revised sustainable development strategy considers '*the exchange of best practices*', together with the organisation of events and stakeholder meetings and the dissemination of new ideas, as important ways of mainstreaming sustainable development (CEC 2005: 25). The 2007 Green Paper on Urban Mobility asserts that '*European towns and cities are all different, but they face similar challenges and are trying to find common solutions*' (CEC 2007: 1) and argues that '*the exchange of good practice at all levels (local, regional or national)*' (CEC 2007: 5) provides an important way of finding common solutions to these challenges at the European level. The Leipzig Charter on Sustainable Urban Cities (German Federal Ministry of Transport, Building and Urban Affairs 2007a: 7) calls for '*a European platform to pool and develop best practice, statistics, benchmarking studies, evaluations, peer reviews and other urban research to support actors involved in urban development.*' The Territorial Agenda of the European Union (EU) contains a whole annex of examples of 'best practices of territorial cooperation' (German Federal Ministry of Transport, Building and Urban Affairs 2007b).

The EU's 2006 Thematic Strategy on the Urban Environment (CEC 2006) has perhaps the most to say about best practices concerning climate change and urban development. In fact, the exchange of best practices forms one of the four main actions of the strategy. The strategy states that '*many solutions already exist in certain cities but are not sufficiently disseminated or implemented*' and that '*the EU can best support Member States and local authorities by promoting Europe's best practices, facilitating their widespread use throughout Europe and encouraging effective networking and exchange of experiences between cities*' (CEC 2006: 3). The document argues that '*improving local authorities' access to existing solutions is important to allow them to learn from each other and develop solutions adapted to their specific situation*' and highlights that '*the Commission will offer support for the exchange of good practice and for demonstration projects on urban issues for local and regional authorities*' (CEC 2006: 6).

Examples of best practice in European research programmes and cooperation initiatives are widespread. Examples include programmes funded under the European Regional Development Fund (e.g. INTERACT, ETC./INTERREG, URBACT), pre-accession funding programmes (e.g. IPA—the successor of Phare, ISPA and SAPARD), research programmes, environmental programmes (e.g. LIFE+) and rural development programmes (e.g. LEADER+, which ran from 2000 to 2006). The European Research Framework Programme (and particularly the Energy, Environment and Sustainable Development thematic programme of the Fifth Framework Programme—EESD) have given rise to a number of projects that have developed best practice guides/comparisons (see Stead 2012). The extent to which these projects have considered the applicability of best practices in another context and the transferability of these examples, especially to different parts of the

EU, has, however, been rather limited. Much more attention has been focused on identifying and assembling examples of best practice rather than considering how best practice examples might be useful in influencing policy-making in other situations (Stead 2012).

Attention to best practice at the global level is also high. Publications on best practices can, for example, be found within the OECD and the World Bank. These include the OECD report 'Best Practices in Local Development' (OECD 2001) and the World Bank working paper entitled 'Local Economic Development: Good Practice from the European Union (and beyond)' (World Bank 2000). In addition, the UN-Habitat supports the Best Practices and Local Leadership Programme, '*dedicated to the identification and exchange of successful solutions for sustainable development*' (UN-Habitat 2008) and aims to '*raise awareness of decision-makers on critical social, economic and environmental issues and to better inform them of the practical means and policy options for improving the living environment… by identifying, disseminating and applying lessons learned from best practices to ongoing training, leadership and policy development activities*' (UN-Habitat 2008). Best practices are central to the 2010 OECD publication on Cities and Climate Change, which it claims was developed '*for countries to discuss and develop a shared understanding of <u>good practice</u> on climate policy issues*' (OECD 2010: 3; emphasis added) with the objective of enhancing '*the ability to identify and diffuse best practices*' (op cit.: 28).

These various European and global policies, programmes and initiatives are indicative of 'softer' forms of policy steering (based on voluntary cooperation), and all serve to illustrate that the development and dissemination of best practice is widely considered to be an effective means of promoting policy transfer and learning. According to Bulkeley (2006: 1030), the assumption that the dissemination of best practice can lead to policy change '*has become an accepted wisdom within national policies and programmes, as well as in international arenas and networks.*' The logic seems to be that, by providing information or knowledge about specific initiatives, other individuals and/or organisations will be able to undertake similar projects or processes, or learn from the experience, which will lead to policy change (Bulkeley 2006: 1030). However, despite the attention on best practice in policies, programmes and projects, little is known about the ways in which best practices are produced and used, and their function in processes of policy-making. This chapter seeks to explore these issues in more detail.

2 The Validity of Best Practices

> What becomes known as best practice may, in reality, be the manifestation of the best advertising and most effective programmatic or municipal spin doctoring. The danger is that falling for perception rather than reality can lead cities or states to adopt policies that might not work or to look for ways policies have been implemented where the implementation failed. (Wolman et al. 2004: 992)

A common assumption behind best practices is that they are equally applicable and effective in another setting. However, the large number and diversity of European Member States, where there are substantial differences in governance, administrative cultures and professional capacities, make such an assumption questionable. This assumption is particularly questionable in the case of transposing best practices between dissimilar countries, such as from Western to Eastern Europe ('old' to 'new' Member States of the EU), where the social and economic situation, as well as the institutional frameworks, are often very different in the 'borrowing' and 'lending' countries. Nevertheless, examples can certainly be found where countries in Eastern Europe have used best practices from Western Europe as a way of trying to catch up politically and/or economically (Rose 1993). Randma-Liiv (2005: 472) states that '*policy transfer has become a fact of everyday life in various countries*' and that '*post-communist countries have been especially willing to emulate the West*'.

Various factors, including European initiatives for research, territorial cooperation and development assistance (see above), have inspired these processes of policy transfer from Western to Eastern Europe. Politicians often see policy transfer as the quickest solution to many problems without having to reinvent the wheel (Rose 2005; Tavits 2003). In Eastern Europe, policy transfer is frequently regarded as a means of avoiding newcomer costs: using the experience of other countries is cheaper because they have already borne the costs of policy planning and analysis, whereas creating original policies requires substantial financial resources (Randma-Liiv 2005). The availability of financial resources to support these processes of west-east policy transfer is, of course, another (and perhaps the most important) factor behind these processes taking place, especially where funding from other levels is limited. However, as the OECD report 'Best Practices in Local Development' recognises, best practice is not without its complexities and challenges because '*the possibilities of what can be achieved by policy may vary between different areas and different times*' and because there is '*no single model of how to implement local development or of what strategies or actions to adopt*' (OECD 2001: 29).

There are also limitations of best practice in terms of the ability to transfer sufficient detailed knowledge and information in the form of case study reports, policy documents, policy guidance notes or databases. In effect, best practice seeks to make the contextual, or tacit, knowledge about a process or instrument explicit by means of codification (Bulkeley 2006). However, this process is not as straightforward as the production of best practices might make it seem because '*expressing tacit knowledge in formal language is often clumsy and imprecisely articulated*' (Hartley and Allison 2002: 105). Accounts of best practices are often condensed and sanitised, and lacking in detail for application elsewhere. In the words of Vettoretto (2009), '*good practice [or best practice] is cleansed of the political dimension of policy-making and of the historically defined local social and cultural differences*' (Vettoretto 2009) and the production of '*repertoires of good practices is usually associated with some degree of de-politicization and de-contextualization*' (Vettoretto 2009). Wolman et al. (1994) make a similar point in relation to the difficulty in conveying the full picture of best practice. They report that '*delegations from distressed cities are frequent visitors to … 'successful' cities, hoping to learn from them and to emulate their success*' but '*these visitors—and others who herald these 'urban success stories'—are frequently quite unclear about the nature of these successes and the benefits they produce*' (Wolman et al. 1994: 835). Clearly, the less detailed an example of best practice is (and the more sanitised the account of its design or implementation), the less likely it will be that the example can be replicated elsewhere.

In terms of the transferability of best practice, the OECD report on Best Practices in Local Development (OECD 2001) differentiates between various components of best practice and identifies the extent to which each of these can be transferred (Table 1). At one end of the spectrum of components are ideas, principles and philosophies which are considered to have low visibility (since they can be difficult for the outside to fully understand and specify) and are difficult to transfer because it can be difficult to make them relevant to other situations. At the other end of the spectrum are programmes, institutions, modes of organisation and practitioners which tend to have high visibility and are relatively easy to understand, but are not very transferable since they tend to be specific to particular areas or contexts. According to the OECD report, it is components, such as methods, techniques, know-how and operating rules, with medium visibility that make the most sense to exchange or transfer. Contrary to the OECD's classification, however, it could also be argued that policy ideas and principles may in fact be some of the most transferable components of exchange in relation to policy transfer processes.[1]

The OECD report on Best Practices in Local Development also highlights the need to examine who is involved in the process of transfer in order to gauge transferability of best practices. It distinguishes between top-down transfer processes initiated by promoters (e.g. national agencies) seeking to disseminate best practices and bottom-up processes initiated by 'recipients' in response to a need that they have recognised themselves. It argues that the latter is likely to work best. This is very much linked to the notions of demand-led and supply-led processes of policy transfer: demand-based policy transfer is based on the initiative and acknowledged need of a recipient administration, whilst supply-led policy transfer is based on the initiative of the donor and the donor's perception of the needs of the recipient, such as foreign aid initiatives (Randma-Liiv 2005).

Urban policy officials are now routinely involved in transboundary cooperation networks and inter-regional collaboration initiatives, and thus subject to foreign experiences and exposed to a variety of policy approaches from other Member

[1] The view that policy ideas and principles may be some of the most transferable components of policy is also reflected in the 2008 UNECE report on spatial planning, which is premised on the idea that, while spatial practices may substantially differ between countries, there are core principles of spatial planning that apply in all cases (UNECE 2008) and, to some degree, in the 2010 OECD report on Cities and Climate Change, which proposes a set of principles for strengthening the multi-level governance of climate change (OECD 2010).

Table 1 Components of local development practices and their transferability (*source* OECD 2001)

Visibility	Component for exchange	Transferability
Low	Ideas Principles for action Philosophy	Low[a]
Medium	Methods Techniques Know-how Operating rules	High
High	Programmes Institutions Modes of organisation Practitioners Joint projects	Low

[a] Contrary to the OECD's classification, it could also be argued that policy ideas and principles may, in fact, be some of the most transferable components of exchange in relation to policy transfer processes. See footnote 1

States (Dühr et al. 2007). Nevertheless, literature on the Europeanisation of spatial planning suggests that different policy concepts take root in different ways across the European territory (see, for example, Böhme and Waterhout 2007; Dabinett and Richardson 2005; Giannakourou 2005; Janin Rivolin and Faludi 2005; Tewdwr-Jones and Williams 2001), which means that it is unlikely that best practices will lead to the same outcomes across different European Member States, no matter how faithfully transferred.

Wolman et al. (2004) take a very critical view about how best practices are identified, arguing that best practice in urban public policy is frequently built around perceptions without much evaluation. They argue that both receivers and producers of best practices have virtually no means of assessing the validity of the information they receive, and that most do not even recognise this as a problem. They also contend that identifying best practice is often '*an exercise in informal polling*' (Wolman et al. 2004:992) and argue that the reputations of so-called best practice simply snowball as observers become self-referential. This is very much related to observations by Benz (2007), who argues that sub-national governments in Germany are becoming increasingly active in developing (or claiming) innovative policies, which they then try to sell as 'success stories' and best practices. According to Lidström (2007: 505), '*in this new competitive world of territorial governance, most units depict themselves as winners.*' To be highly ranked and used as a benchmark is not only a good image for the locality, it can also attract additional money from the federal government. It is equally likely that this is also the case in other countries and also at the EU level, with sub-national governments competing for EU funding by promoting 'success stories' and best practices. In so doing, they not only attract additional national and regional funding, they can also use EU funding to partly bypass traditional structures of domestic policy-making and vertical power relations, should they so wish (Carmichael 2005; Heinelt and Niederhafner 2008; Le Galès 2002).

The creation and use of best practices as a means of reward and recognition for particular initiatives, individuals and places means that it is often only the 'good news' stories that are disseminated, and that the sometimes murky details of how practices were put into place (and any difficulties or failures along the way) are obscured. This means that examples of unsuccessful practices rarely come to light in the same way as examples of 'success', despite the fact that negative lessons might be equally important to policy officials in learning about policies or practices that may not work and the reasons why (Rose 2005). Aware that best practices represent sanitised stories, practitioners often pursue their own networks of knowledge in order to gain an understanding of the processes involved (Bulkeley 2006).

3 The Function of Best Practices

> To what extent are… policy instruments, which have proved to be successful in one urban area, transferable to another, given that the latter has a different historical, cultural or political background, or is in another phase of economic development? Are there 'best practices' which are convertible like currencies? If not, how and to what extent must one take account of specific circumstances? (Güller 1996: 25)

Despite the proliferation of best practice examples, academic literature suggests that the practical use and usefulness of best practices may in fact be rather limited. While a high proportion of local authority actors agree that learning from the experience of others is important and indicate that they engage in such activity, only a small minority of officials believe that it plays a large or significant role in their decision-making (Wolman and Page 2002). In a study of urban regeneration policy, it is reported that officials generally find government documents and conversations with other officials more useful for finding out what is going on than from good practice guides (Fig. 1). The results also suggest that the majority of officials believe that information about other examples from the *same country* may have some effect on decisions within their own authority, although few think that the effects will be 'significant' or 'large' (Table 2). However, when questioned about the effect of examples from *abroad* on decisions within their own authority, most officials believe that the effects of these examples will be either 'little' or 'none'. Informal contacts with peers are reported to be the most trusted and useful sources of information among local government officials, while mechanisms such as seminars, conferences and good-practice guides are less useful. It is argued that one of the most important reasons for looking at examples from elsewhere is to gain information about what kind of proposals the government is likely to fund, rather than using best practices as inspiration for new policy or practice.

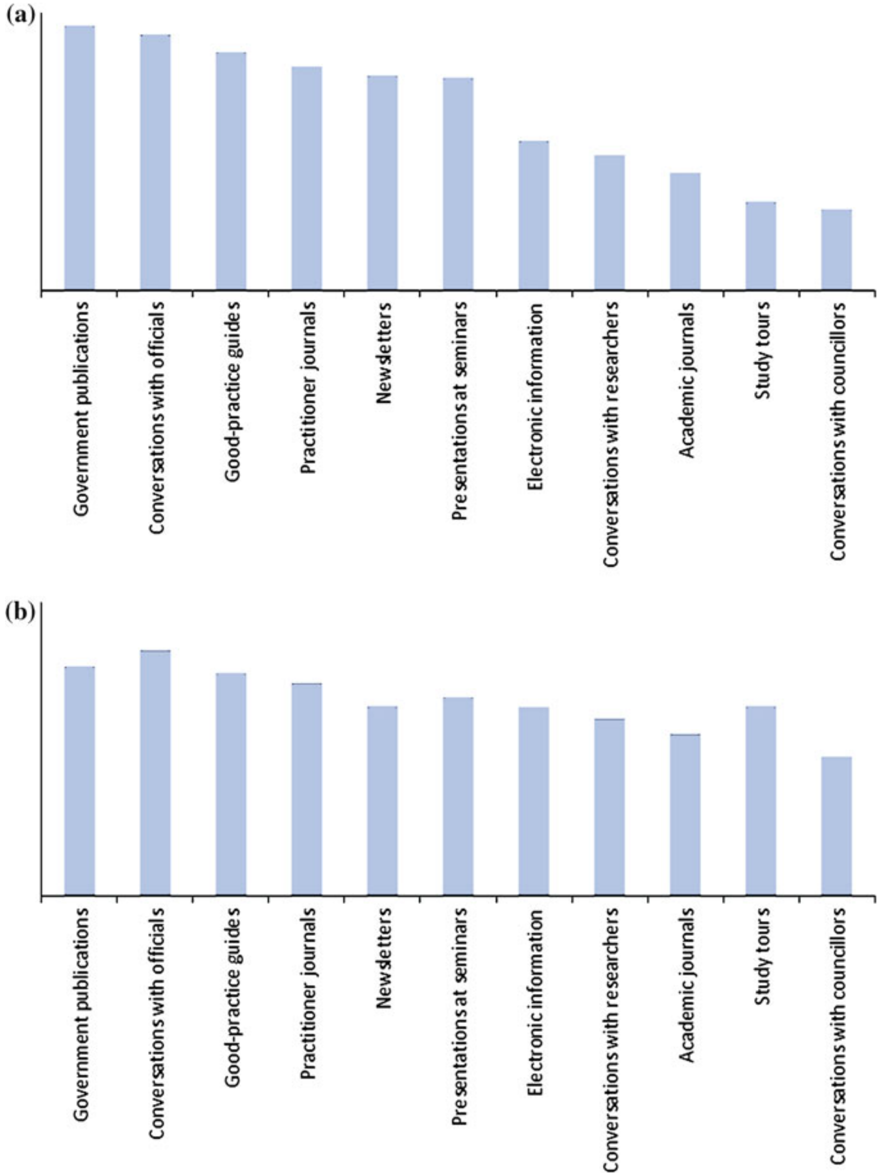

Fig. 1 Relative frequency of use and usefulness of different sources of information for policy-making (figures constructed using data from Wolman and Page 2002: 485). **a** Frequency of use of information from different sources. **b** Usefulness of information from different sources

This data leads Wolman and Page (2002) to conclude that, despite the enormous effort that has been devoted to disseminating 'good practice', their findings throw cold water over activities concerning the identification and dissemination of best

Table 2 Opinions of local authority officials about the effects of information from elsewhere on decisions in local authorities (*source* Wolman and Page 2002: 495–496)

	From national examples	From international examples
Big effect (%)	2	1
A significant effect (%)	11	1
Some effect (%)	69	21
Very little effect (%)	16	42
No effect (%)	1	35
Number of respondents	288	286

practice, at least in the area of urban regeneration. They acknowledge that the same is not necessarily true for other areas of policy, although there seems little reason to think that the situation may be much different in the area of climate change and urban policy. They also conclude that, even when well resourced and pursued actively, the effects of spreading lessons and 'good practice' are not very well understood by those involved in the processes of dissemination and that this observation is unlikely to be unique to the area of urban regeneration alone. Similarly, Bulkeley (2006) concludes that the impacts and implications of disseminating best practice on urban sustainability remain poorly understood.

3.1 Evidence from Four Case Study Cities

Some of the observations about the use and usefulness of best practices reported above have recently been tested as part of the EU-funded SUME project (Sustainable Urban Metabolism in Europe) in the area of sustainable urban development policy. Although the sample size is relatively small, the results help to confirm that Wolman & Page's findings from 2002 in the area of urban regeneration policy are more widely applicable (in this case to urban planning policy) and that their findings still generally hold true almost a decade later.

The relative use and usefulness of best practices were tested among a number of policy officials in four case study cities: Newcastle upon Tyne, Porto, Stockholm and Vienna. Information was gathered by means of questionnaires (in combination with workshops and interviews in some cases). While all four city regions are relatively similar in terms of area and population size (between 1 and 2 million inhabitants), the cities neatly illustrate a variety of different policy contexts. Each of the four case studies belongs to a distinct legal and administrative family and each of the countries where the four case studies are located have quite separate spatial planning traditions (CEC 1997), 'models of society' and welfare systems (Nadin and Stead 2008). These wide contextual differences between case studies offer the opportunity to test opinions and approaches concerning best practices across a broad range of institutional conditions.

Policy officials in the four case study cities were asked about their opinion on the extent to which policies and practice are influenced by examples elsewhere. Several questions were developed from an earlier study by Wolman & Page (see above) who investigated how local authority officials involved in urban regeneration policy learn from each other's experience.

Looking first at *local influences* on policy-making in the case study cities, a wide variation in opinions is apparent regarding the influence of practices in surrounding local authorities on policy decisions in the case study cities. Opinions greatly differ not only between case study cities but also between officials in the same city. For some officials, decisions in nearby local authorities rarely influence decision-making in their own authority, while others believe that decisions in nearby local authorities frequently influence decision-making in their own authority. On average, decisions in nearby local authorities are considered to influence decision-making occasionally in the case study cities.

In terms of *national influences* on policy-making in the case study cities, a wide variation in opinions is again apparent between the cities and also between officials within the same city. In general, national examples are considered to be more important than international examples (see below). Examples from other local authorities in the same country are generally considered to have a moderate effect on shaping planning policies and practices in the case study cities (in line with the results of Wolman & Page's study—see above).

A wide variation in opinions is again apparent concerning *international influences* on policy-making in the case study cities. However, opinions on this issue mainly differ between case study cities rather than between officials in the same city. International examples are generally considered to have only a small effect on planning policies and practices in the case study cities (also in line with the results of Wolman & Page's study). When officials make use of international examples, they mainly look to practice elsewhere in Europe rather than further afield. However, one respondent makes the point that, while international examples often have minimal direct effect, they can also have a more indirect effect. They can, for example, influence European guidelines and directives, which may then be translated into national law and policy, which in turn can have impacts for planning policies and practice.

The number of responses obtained from the case study cities is too low to make detailed quantitative comparisons. Nevertheless, some important conclusions can be drawn from the responses from the policy officials in the case study cities. In the case study cities, policy officials consider the most useful sources of information to be other policy officials, presentations at seminars and conferences and electronic information. In terms of frequency of use, conversations with officials, good practice guides and presentations at seminars and conferences score highly. On the other hand, academic journals and conversations with councillors are neither used frequently to inform policy-making nor are they considered to have much influence on policy. These observations from the case study cities are broadly in line with the results of the study by Wolman and Page (2002). One notable difference, however, is the frequency of use and level of importance attached to electronic information. As might be expected, given the fact that the research carried out by Wolman & Page took place more than a decade earlier (interviews were carried out in 1999 and 2000), the importance of electronic information was significantly lower for Wolman & Page's interviewees than for the policy officials interviewed in the four case study cities (in 2011). While government publications were considered to be one of the most regular and useful sources of information in Wolman & Page's study, they were considered less important, relative to other sources, by the policy officials interviewed in the four SUME case study cities, especially in Austria. This may be related to the federal system of government in Austria and the fact that central government is less involved in spatial planning issues, or it may simply be a more general reflection of the streamlining of planning regulations across all the case studies (and most of Europe), where fewer national government documents are being produced to guide and support policy-making at the local level.

4 Conclusions: The Need for a Reappraisal of Best Practice

The previous two sections of this paper have identified a number of issues and concerns related to the validity and function of best practice. In terms of *validity*, there are concerns about issues of transferability, especially between dissimilar situations (e.g. 'old' to 'new' Member States of the EU), the lack of detail that best practices are able to convey (and the fact that some are sanitised, good news stories without details of problems, difficulties or failures along the way), the lack of evaluation of many examples of best practice and a certain degree of distrust or scepticism in best practices on the part of practitioners. In practice, transfers of best practices are complex and certainly not merely a matter of copying or emulation: successful transfer also involves processes of learning and adaptation. Substantial differences in political and administrative cultures across Europe, to name just two factors, reduce the relevance and impede the applicability of best practices and their transfer. According to Wolman and Page (2002: 498), it is '*much easier to offer a compendium of practices and ideas and leave it up to the recipient to decide which is the most appealing than to offer an evaluation of what works best, let alone what works best for highly differentiated audiences.*'

In terms of the *function* of best practice, there are concerns about the proliferation of examples and the overload of information for policy officials, the low level of impact that these examples often have, especially in the case of international examples (compared to examples from the same country) and the lack of a wide and systematic assessment of the impacts and implications of disseminating best practice on policy-making. In many cases, the identification or use of best practices has more of a symbolic rather than functional purpose, and these best practices are generally not very central to policy-making processes. Given these issues and concerns, a reappraisal of the status and use of best practice seems to be necessary.

Table 3 Principles for strengthening the multi-level governance of climate change (OECD 2010: 175–176)

Participatory governance and strategic planning at relevant scale
An analytical foundation for short- and long-term planning
Cost-effectiveness and economic efficiency
Experimentation and innovation, particularly at local and regional levels of governance
Distributional consequences and procedural equity

First, it is time to reappraise the importance attached to best practice in policies, programmes and projects, particularly at the European level. There are substantial social, economic and institutional differences between EU Member States, but there is little recognition of the fact that policy options need to be differentiated: the underlying assumption of many European policies and programmes is that best practices are equally applicable and effective in another setting. A more detailed study of the way in which best practice examples of climate change and urban planning are used across Europe (building, for example, on the work of Wolman and Page 2002) would be instructive and would help to inform the way in which best practice examples are used in European policies and programmes.

Second, it is time to reappraise the way in which best practice examples are presented and to consider whether it would be better to differentiate between various components of best practice according to the extent to which these can be transferred (see also Table 2 above). Because of the diversity of Member States, institutions, planning instruments and cultures across Europe, it is perhaps more appropriate to consider a move away from the idea of best practice examples and refer instead simply to examples of practice, which policy officials can draw on and adapt to their own circumstances (as advocated in OECD 2001).

Third, there is substantial merit in carrying out more detailed examinations of the transferability of urban planning methods, techniques, operating rules, instruments, programmes, and so on. Detailed, systematic work is lacking in this area and research in this area would provide an interesting contribution to debates in both academia and in practice. Related to this, research on the processes of transfer of planning methods, techniques, operating rules, instruments, programmes, and so on, would be very instructive, particularly in cases where examples have been transferred between dissimilar situations (e.g. between 'old' to 'new' Member States of the EU). Such research could include theories and concepts from the policy transfer (and related) literature as well as literature on planning cultures (Sanyal 2005), social or welfare models (Nadin and Stead 2008) and path-dependency/path-shaping (Dabrowski 2010; Kazepov 2004).

Finally, one further direction for future work related to the area of best practice might be to examine and test the extent to which there are common *principles* (as opposed to best practices) across different contexts (e.g. scales and systems of governance). This could, for example, build on the 2010 OECD report on Cities and Climate Change, which identifies a set of principles for strengthening the multi-level governance of climate change (Table 3), and/or the 2008 UNECE report on spatial planning, which is premised on the idea that certain principles (democracy, subsidiarity, participation, policy integration, proportionality and the precautionary approach) are applicable and desirable for all planning systems, irrespective of differences, such as the economic and social situation, planning cultures and social or welfare models (UNECE 2008).

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Part III
Case Studies II: Business-Related and Technical Approaches

A Decision Support Approach Fostering Technology Transfer Towards Sustainable Energy Development in Kenya

Charikleia Karakosta, Haris Doukas and John Psarras

Abstract The exploration of the contribution of energy-related technology transfer (TT) to a developing country's sustainable development (SD) is thought to be of significant importance. Kenya has several renewable and energy efficiency options with significant potential for reducing greenhouse gas (GHG) emissions that are "waiting" to become financially and economically competitive. The aim of this paper is to assist Kenya's decision-making in finding ways to encourage the TT of energy technologies that would contribute to low-carbon sustainable energy development and poverty alleviation. This paper presents a decision support methodological approach that enhances the previously applied technology needs assessments (TNAs) and results obtained from stakeholders' assessments conducted in Kenya. In addition, the adopted approach contains a number of steps identified from a literature study of TNA approaches, developed and applied by the United Nations Development Programme (UNDP), the Climate Technology Initiative (CTI) and the United Nations Framework Convention on Climate Change (UNFCCC).Kenya's high-priority energy needs and the sustainable energy technologies that could meet them were identified to foster energy TT towards low-carbon sustainable energy development. In addition, stakeholder perceptions of the sustainability benefits to be delivered by the selected technologies were assessed. The paper provides useful results that could facilitate Kenya's Designated National Authority (DNA) and future project investors to implement the most suitable sustainable energy technologies, based on the country's SD needs and priorities, for TT via the clean development mechanism (CDM). The above is particularly important to Kenya because recent coal discoveries and a lack of supporting

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incentives and enabling structures for the market could cause the country to become “locked” in a high-carbon future.

Keywords Decision support · Energy sector · Sustainable development · Technology transfer · Kyoto protocol · Kenya

Abbreviations

CDM	Clean development mechanism
DNAs	Designated national authorities
ITDG EA	Intermediate technology development group East Africa
NEMA	National environment management authority
WCED	World commission on environment and development
ACP	Africa, Caribbean and Pacific
CERs	Certified emission reductions
CTI	Climate technology initiative
DFID	Department for international development
EPS	Environmental programme support
ESD	Education for sustainable development
GDP	Gross domestic product
GEF	Environment facility
GHGs	Greenhouse gases
KAM	Kenya association of manufacturers
KenGen	Kenya electricity generating company
KPLC	Kenya power and lighting company
MDG	Millennium development goal
NCH	National clearing house
NGOs	Non-governmental organisations
PDD	Project design documents
REEEP	Renewable energy and energy efficiency partnership
SD	Sustainable development
TNA	Technology needs assessments
TT	Technology transfer

1 Introduction

Climate change is a problem of global dimension that therefore requires a global solution. The key challenge is that low-carbon sustainable technologies need to be adopted both by developed and developing countries, in an effort to avoid past unsustainable practices and being locked into old, less sustainable technologies. Technology transfer (TT), as an important feature of both the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol can play a key role. TT enables countries to quickly adopt environmentally sound and sustainable practices, institutions and technologies. Indeed, the transfer or innovation process must be rapid enough to reduce global vulnerability to climate change. TT provides a golden opportunity for countries to create a new paradigm for sustainable development (SD).

The World Commission on Environment and Development (WCED) defined SD as 'development that meets the needs of the present generation without compromising the ability of future generations to meet their needs' (Brundtland 1987). The concept of SD emerged in the 1980s in response to a growing realisation that economic and social activities have the potential to compromise environmental quality, as well as lower the productive potential of natural resources. SD was a key issue at the Earth Summit, held in Rio de Janeiro in 1992 and further reinforced at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, where a new paradigm of SD was endorsed. It was declared that SD is built on three interdependent and mutually reinforcing pillars, namely: social development, economic development and environmental protection. SD takes into account society, environment and economic factors conceptualised as pillars in order to ensure a more balanced form of development. However, it is an evolving concept embracing emerging challenges and concerns.

Despite the numerous activities addressing global energy demand and security of supply issues as well as the issue of climate change (Baumert and Pershing 2004), there have been relatively few attempts to combine possible solutions into an integrated approach (Connolly et al. 2010). Poverty in developing countries could be alleviated by offering rural communities reliable, affordable and sustainable (with a view to local aspects) energy technologies, which would be in line with the Millennium Development Goals (MDGs) (UN 2006). As these technologies often reduce or avoid greenhouse gas (GHG) emissions (Doukas et al. 2009), such projects would also address the climate change issue (Karakosta and Psarras 2009; Schroeder 2009). Indeed, in the intergovernmental policy formulation process, the transfer of environmentally sound technologies has been recognised as one of the principal means for achieving SD. However, these kinds of practices are, unfortunately, rare.

In the context of the Marrakech Accords of 1991, a decision was adopted by the seventh Conference of the Parties to the UNFCCC (COP-7) on a framework for meaningful and effective actions to enhance the implementation of UNFCCC Article 4.5. As part of this decision, an expert group on TT was established with the objective to analyse ways to facilitate the transfer of environmentally sound technologies to developing countries. In this decision, COP-7 called upon assessments of technology needs in order to determine the mitigation and adaptation of the technology priorities of developing countries (and countries with economies in transition). The purpose of these technology needs assessments (TNAs) is to identify technologies that are required or prioritised to meet a country's SD needs (UNFCCC 2006).

In the above framework, the exploration of the contribution of energy TT to a developing country's SD is considered to be of significant importance. The identification of the host country's most important energy needs and priorities and the selection of the most appropriate technology alternatives to transfer and implement to the specific host country are seen as the first step towards achieving the above (Karakosta et al. 2008; Karakosta et al. 2009; Van der Gaast et al. 2009).

Another important issue is that of transfers of state-of-the-art environmentally efficient technology to developing countries, as many fear (TERI 2000) the possibility that old technology could be exported instead. Therefore, the status of the technology is also crucial. Ideally, the project should introduce the best available technology for the specific host country's circumstances (Karakosta et al. 2010).

Kenya has several renewable and energy efficiency energy options with significant potential for GHG emissions reduction that are "waiting" to become financially and economically competitive. TT could also contribute significantly to the country's SD and to poverty reduction. For TT to be meaningful, it is necessary to break down cultural barriers and to build expertise and capacity in the local community, so as to ensure local participation (Karakosta et al. 2010). Many TT projects have failed because the capacity for implementing the technology was lacking. Consequently, it would be in the national interest if appropriate policy decisions are taken to facilitate concerted efforts towards proactive involvement in TT activities.

The main aim of this paper is to present a decision support methodological approach that enhances the previously applied TNAs and the results obtained from stakeholder assessments for the case of Kenya. Kenya's high-priority energy needs and the sustainable energy technologies that meet them were identified in order to foster energy TT towards a low-carbon sustainable energy development. In addition, stakeholder perception of the sustainability benefits to be delivered by the selected technologies was assessed. The selected stakeholders from different energy sectors were contacted in the context of the project EC FP6 "ENTTRANS, The potential of transferring and implementing sustainable energy technologies through the Clean Development Mechanism of the Kyoto Protocol." This project, implemented between 2006 and 2008, aimed at supporting the host country's Designated National Authorities (DNAs) in building the capacity to explore which clean development mechanism (CDM) projects would contribute to each country's SD needs and priorities. The case study countries covered by the ENTTRANS project were Chile, China, Israel, Kenya and Thailand. The ENTTRANS consortium comprises 10 organisations from eight different countries, including the Intermediate Technology Development Group East Africa (ITDG EA)—Kenya.

In addition to the introduction, the paper contains five sections. The next section provides background information regarding Kenya's country context. The approach followed to elicit Kenyan stakeholders' preferences is introduced in the third section. The fourth section presents, analyses and discusses the main outcomes resulting from the stakeholder assessment. Finally, the last section contains the conclusions, summarising the main points of this paper.

2 Kenya's Context

2.1 Economic Development

Kenya's communities have generally relied on their vast indigenous knowledge and technology to interact with the environment. Traditional knowledge and technology was generally environmentally friendly. However, industrialisation, globalisation and a population increase (2.8 % growth rate in 2008) (CIA 2009) present new challenges in the sustainable utilisation of the country's natural resources. This has resulted in the disruption of natural and cultural systems. It is imperative, therefore, for capacity to be built to ensure the sustainable use of national resources.

Although the Kenyan economy has been growing favourably recently (5.7 in 2007 and 7 % in 2008), it is one of the worst performing economies in Africa, and is highly dependent on the agricultural sector and the performance of the tourism sector. Kenya is extremely vulnerable to climate change, as its economy is heavily reliant on climate vulnerable sectors, such as agriculture and tourism. Agriculture is an important economic sector in Kenya. In 2008, 75 % of the country's population was employed in agriculture, representing 23.8 % of the country's gross domestic product (GDP) (CIA 2009). However, the service sector (largely built around tourism) contributes about 60 % to Kenya's GDP. Recent improvements in economic performance have been supported by a strong performance in tourism, an increase in telecommunications and good results in, amongst other things, the tea sector. Kenya's economy is expected to grow by just over 4 % in 2009, as it continues its recovery from post-election violence early in 2008, which stalled activity (Duncan 2009).

Kenya has a modest industrial sector, responsible for 16.7 % of GDP (CIA 2009). Nevertheless, it is still larger than those of its East African neighbours. Important impediments to industrial sector growth are the limited supply of hydroelectric power, high energy costs, insufficient transport infrastructure, corruption and the relatively low prices of imported products, which puts pressure on the prices of domestically produced commodities. Nairobi, Mombasa and Kisumu are the large urban centres where most industrial activities take place (Library of Congress 2007). Kenya has been an active market for solar home systems for almost a decade, during which more than 150,000 units have been installed on a commercial basis and an estimated 15,000–25,000 new systems are being installed yearly.

2.2 Energy Sector

Kenya's total energy production is approximately 14.3, deriving mainly from biomass (93 %) and secondarily from geothermal, solar and wind energy (5 %) and hydro energy (2 %) (IEA 2009). The main power company is the state-owned

Kenya Electricity Generating Company (KenGen); Kenya Power and Lighting Company (KPLC) is responsible for the transmission and distribution of electricity. Hydro energy accounts for approximately 51 % of the country's total electricity production (6.5 TWh in 2006); oil, geothermal energy and biomass make up 30, 14 and 5 %, respectively (IEA 2009).

Most of Kenya's electricity supply comes from hydroelectric stations at dams along the upper Tana River, as well as the Turkwel Gorge Dam in the west. Kenya is located in a volcanic region, where water temperatures in aquifers in the earth crust are very high and suitable for electricity production through steam, which explains the country's geothermal energy production. The country also imports electricity from Uganda. A key problem concerning electricity supply in Kenya is the periodic outages due to drought, which causes a drop in hydropower. Kenya does not have any oil reserves (coal was discovered only recently) and, consequently, all of the oil required by the country is imported, making up about 20–25 % of Kenya's total imports (Library of Congress 2007). In Mombasa, a petroleum refinery is operational, supplying 60 % of local petroleum products.

The most energy-intensive sector is the residential sector, contributing to about 76 % of the country's total consumption; the transport sector and industrial sector make up 16 and 6 %, respectively. However, only 16 % of Kenyans have access to grid electricity (Obwocha 2007). The sectors outlining the picture of Kenya's total electricity consumption profile are the industrial sector, which makes up about 63 %, the residential sector with 25 % and the commercial and public services sector, amounting to 11 % (IEA 2009).

2.3 Climate Change Efforts

Kenya has been a Party to the UNFCCC since November 1994, and ratified the Kyoto Protocol in February 2005.

Up until November 2006 and the organisation of the second Conference of the Parties serving as the Meeting of Kyoto Protocol Parties in Nairobi (UNFCCC 2007), Kenya was not very active in the area of the CDM. However, the country was identified as a promising CDM destination, and attracted substantial capacity-building efforts from a very early stage. Such efforts include those funded by UNIDO—United Nations Industrial Development Organization (2000–2001), leading to the publication of a study on industrial projects, the Directorate General Development of the European Commission, CDM-Susac, Start-up CDM in Africa, Caribbean and Pacific (ACP) Countries (2000–2002), the UK Foreign Office (2000–2006) and Canadian Pembina Institute with its Small-Scale Project Facility (2001–2005) (Wücke and Michaelowa 2007). In June 2006, the government of Kenya established the country's DNA for the CDM under the National Environment Management Authority (NEMA).

The official Kenyan DNA, the NEMA at the Ministry of Environment and Natural Resources, has set up the National Focal Point for Climate Change as the competent agency for climate protection projects. This defines national CDM policy and formally issues project approvals (Ojoo-Massawa 2007). It operates as the secretariat of the National Clearing House (NCH), which appraises CDM project proposals and makes recommendations for project approval or rejection to the National Focal Point.

By July 2010, 16 projects had entered the CDM pipeline of projects in Kenya and are either being validated or have been registered. Two projects have already been registered: a biomass energy project based on using bagasse as a fuel source for a 35 MW co-generation plant and a geothermal project (Olkaria III) that aims to add 42.48 MW of gross power to an existing plant, which has been in continuous operation since 2001. Fourteen projects are in the validation pipeline (biomass, cement, geothermal, hydro, reforestation and wind power plants). Should these projects perform as planned in their Project Design Documents (PDD), they are expected to generate a total of 3.5 million Certified Emission Reductions (CERs) by 2012 and about 15.2 million CERs by 2020, which can then be transferred to industrialised countries with quantified commitments (Fenhann 2010). A striking aspect noted by Wücke and Michaelowa (2007) is that, due to the limited CDM activities in the country, no specialised CDM consultancy has been established yet. However, it should be noted that the only registered CDM project in Kenya involves TT (equipment and knowledge) (UNFCCC 2008).

2.4 Sustainable Development Efforts

The crucial challenges facing Kenya today, together with finding solutions to generate enough power, are poverty alleviation and unemployment reduction. Therefore, Kenya's SD priorities should be strongly linked to poverty eradication and unemployment reduction.

The establishment and enforcement of environmental standards and regulations is a major prerequisite for the maintenance of a sustainable environment. Kenya has been implementing a range of activities as a key means to achieving the sustainable utilisation of the country's resources. In this respect, NEMA supports the country's vision of becoming a newly industrialised country by encouraging use of sustainable practices in all socio-economic activities. One example is the Education for Sustainable Development (ESD) Implementation Strategy, which provides a mechanism for adopting a holistic approach to SD by engaging all sectors and stakeholders (NEMA 2007).

In October 2006, the government of Kenya, together with the governments of Denmark and Sweden, jointly initiated a 5-year Environmental Programme Support (EPS) project to assist the Kenyan government, civil society and communities in addressing the country's serious environmental and poverty issues (NEMA 2009). The project was officially launched in early 2007. The overall objective of the EPS is to create sustainable environmental management in support of improved livelihoods in Kenya. The programme will contribute to Kenya's Vision 2030, and the achievement of the MDG No. 7, being to ensure environmental sustainability (NESC 2007).

NEMA is also currently preparing the second National Environment Action Plan Framework. The framework proposes a strategy for achieving SD in line with Kenya's quest to meet the MDG and Vision 2030 (NESC 2007).

3 Methodological Procedure Adopted

The proposed decision support approach is built, to a large extent, on the emerging insights from the EC FP6 "ENTTRANS" project, which aims at supporting the host country's DNAs in building the capacity to explore which CDM projects would contribute to each country's SD needs and priorities. In addition, the adopted approach contains a number of steps, identified from a literature study of TNA approaches developed and applied by the United Nations Development Programme (UNDP), the Climate Technology Initiative (CTI) and UNFCCC (Bonduki 2003; CTI 2002; UNFCCC 2006). Figure 1 presents the stages followed to identify Kenya's energy needs and priorities, as well as the most suitable energy technologies to meet those needs, so as to facilitate SD through TT under the umbrella of CDM.

Step 1. An appropriate questionnaire was developed for the exploration of stakeholders' SD benefits in Kenya, given the CDM objective of maximising GHG emission reduction and the SD contribution target. This way, the technologies considered suitable for the case of Kenya were identified.

The first stage of the approach was to prepare a practical and effective questionnaire in order to consult the country's stakeholders and to try to identify how they perceive Kenya's energy service needs and to assess which technologies they consider to be ideal for meeting those needs. In addition, an indication of the perception of the sustainability benefits to be delivered by the selected technologies was explored. The main critical issues identified in order to specify and shape the questionnaire are shown in Table 1.

Step 2. Stakeholders for the interview procedure were selected, representing a cross-section of groups in Kenya's energy market. The stakeholders were selected from different levels of the country:

- A set of stakeholders at the *international* level: United Nations (UN) organisations relevant to the project, e.g. UNDP, United Nations Environment Programme (UNEP), UN, Global Environment Facility (GEF); bilateral partners, e.g. Kenyan government staff dealing with bilateral agreements with the EU; international donor organisations, such as the Renewable Energy and Energy Efficiency Partnership (REEEP), the Department for International Development (DFID), and so on.
- A set of stakeholders at the *national* level: representatives from central government departments involved in climate and energy policy, including

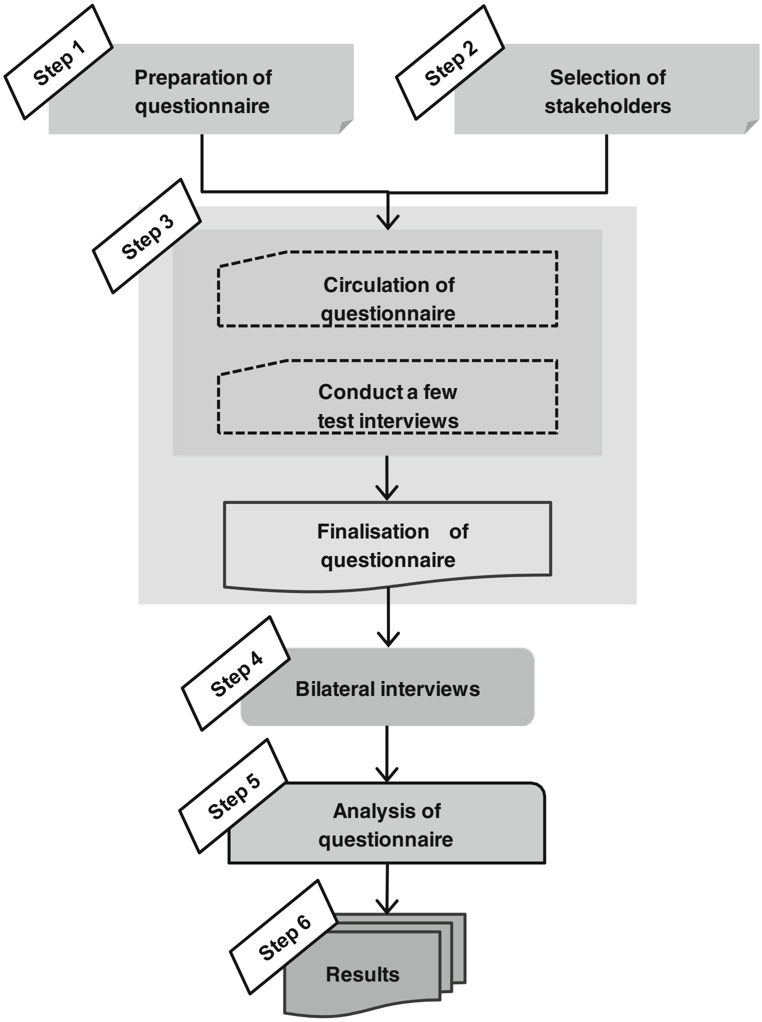


Fig. 1 Methodological approach. *5—very high, 4—high, 3—medium, 2—low, 1—very low, 0—not relevant to Kenya, n.a.—no opinion*

electricity, TT, environment, development, finance, industry, business council for sustainable development; representatives of national companies or industries involved in environmentally sound technologies; industry or trade associations at the national level; non-governmental organisations (NGOs); media.

– A *regional* level of stakeholders: government departments in related areas at the regional level; industry or trade associations at the regional level; regional NGOs; banks and other financial institutions, especially those with experience in foreign direct investments, rural and micro finance banking; universities and

Table 1 Questionnaire development: key considerations

Selection of target areas	• Adaptation or mitigation or both • Sectors (e.g. energy, transport, industry, waste management, agriculture, built environment) • Within these sectors, sub-sector or energy services (e.g. energy for urban population, energy for rural population, cooling for hospitals, cooling in buildings, cooking, etc.)
Criteria for selection of suitable technologies	• How would a technology match the objective of supporting the country's priority areas, sectors and/or sub-sectors and services, both with a view to the medium and to the long term? • A technology's overall contribution to sustainable development of the country: economic contribution, environmental and social contributions

other 'think tank' organisations; consumer groups and unions; media; chambers of commerce.

– *Local representatives* in the region: selected community groups; small businesses involved in the supply chain or those that experience climate change; local government representatives.

Around 35 stakeholders were selected for bilateral interviews, including representatives of NEMA; the Ministry of Energy, the Central Water Regulatory Board; the Central Agricultural Board; Kenya Association of Manufacturers (KAM); the Department of External Trade; the Investment Promotion Centre; the Federation of Kenya Employers; Kenya Chamber of Commerce; Nairobi Municipality; KenGen; KPLC; Bamburi Portland Cement; the University of Nairobi and UNEP/GEF. Efforts were made to cover almost all important stakeholders in the energy sector to ensure a comprehensive range of answers from the survey.

Step 3. After having selected the stakeholders, a brainstorming session was organised with them to introduce and discuss the study objectives and its framework. A few test interviews were conducted to examine the feasibility and flexibility of the questionnaire and to finalise it.

The amended questionnaire consisted of three questions relating to:

Question 1: Energy service needs and priorities;
Question 2: Technology appropriateness and suitability;
Question 3: Sustainability benefits from the selected technologies.

The questionnaire was developed to examine the main energy technology needs and priorities within Kenya for the medium- (up to 2012) to long-term (post-Kyoto; 2012–2020) period, the technologies that would be appropriate and suitable for meeting the needs and priorities identified in the first question (stakeholders were asked to rank technologies according to economic, environmental and social benefits) and the sustainability benefits expected to arise from these technologies related to their implementation. Each question could be answered by assigning values from 0—not relevant to the country to 5—very high priority, suitability (1—very low, 2—low, 3—medium, 4—high).

In particular, the questionnaire focused on mitigation types of action and, specifically, decentralised energy systems, the increased efficiency of fuel conversion activities, and carbon capture and storage. Within these three areas, a broad range of sub-sectors or energy services was identified for the study (Table 2) (JIN 2007).

The criteria for ranking these energy service needs and priorities were based on the need for increased access to energy, the need for reliable energy supplies and the greater need for affordable energy.

In Question 2, stakeholders assessed the suitability of clean energy technologies to meet the energy service needs and priorities addressed in Question 1. The selection of technologies in the questionnaire was rather broad, following the identification of potentially applicable clean, sustainable energy technologies from a range of literature sources (e.g. ESMAP 2007; Martinot 2006; Matysek et al. 2006; WADE 2003; WCI 2004). A total of 32 categories of alternative sustainable energy technologies were identified, comprising energy service categories, such as electricity generation, heating, cooking, cooling, energy efficiency, lighting, energy efficiency, municipal solid waste and methane capture (JIN 2008), as presented in Table 3.

The criteria for ranking the alternative technologies were:

- domestic availability of energy source;
- the technology's level of reliability;
- national source;
- dependence on foreign assistance;
- operation and maintenance (know-how, adequate experience with technologies or capacity-building opportunities, operational 'culture' for complex technologies).

The questionnaire also explored some of the economic, environmental and social benefits expected in the case of the effective implementation of the selected sustainable energy technologies (Table 4). This part of the questionnaire was based primarily on the NEMA's set of indicators for the contribution of projects to SD. These indicators were derived from a domestic assessment of Kenya's sustainability priorities (Ojoo-Massawa 2007).

Step 4. Bilateral interviews with stakeholders were conducted from September 2006 to March 2007, facilitated by the questionnaire. During the interviews, the stakeholders were provided with all the appropriate data, information, input and feedback.

Step 5. After the interviews had been conducted, the input gained from the responses was analysed, enabling "decision-makers" to get a concrete picture of how Kenya's SD needs could be fulfilled through effective TT.

Step 6. The questionnaire analysis resulted in the identification of priority energy services in Kenya, the suitability of low-carbon sustainable energy technologies and the SD contribution of each technology within the context of the specific case study.

Table 2 List of energy services needs and priorities

N1	Electricity for industry
N2	Electricity for agriculture
N3	Electricity for households—rural communities
N4	Electricity for households—urban communities
N5	Electricity for service sector
N6	Heat for industry
N7	Heat for households
N8	Heat for service sector
N9	Energy for cooling for all sectors
N10	Energy efficiency in industry
N11	Municipal solid waste management

4 Results and Discussion

The results gained from the bilateral interviews and the analysis of the responses given in the questionnaire are presented and discussed in the order in which the questions were asked in the questionnaire.

4.1 Energy Service Needs and Priorities

With respect to Question 1 on the energy service needs and priorities in Kenya, there was a common understanding among those stakeholders interviewed that energy is essential for day-to-day life. Figure 2 graphically illustrates the stakeholders' responses concerning energy service needs and priorities in terms of the average ranking for each need and priority. The priority range of interest in Fig. 2 spans 3 (medium relevancy), 4 (high relevancy) and 5 (very high relevancy). The graph, which is in descending order, shows that the range of scores is quite narrow, and that all of the energy needs identified are of medium relevancy and above.

The analysis illustrated that 8 out of 11 categories averaged above 4 (very high relevancy), whereby Energy Efficiency for Industry (N10) was identified as the key priority. Energy for Cooling (N9) was perceived to be related primarily to health centres, and was therefore also considered to be a high priority. Energy for the Service Sector (N5) reflects the importance of tourism in Kenya. Electricity for Urban Households (N4) had a slightly higher priority than for Rural Households (N3), due to the stakeholders' perception of larger populations in urban areas. Electricity for Industry (N1) and Agriculture (N2) were assigned a lower priority, due to a prevailing view among some stakeholders that these particular needs had already been addressed.

Heat applications were not considered to be of high priority, as Kenya has a very stable climate, and heat is considered to be necessary only in the mountains. In fact, Heat for Households—N7, mainly as hot water, was not considered a

Table 3 The alternative sustainable energy technologies

Technology alternatives	*Energy service*
T1 Clean coal; **T2** Steam boiler upgrading; **T3** Coal-to-gas; **T4** Oil steam improvement; **T5** Coal steam improvement; **T6** Natural gas from coal seams or oil; **T7a** Hydro (dams); **T7b** Run of river hydro; **T8** Geothermal energy	*Large-scale electricity supply*
T9 wind energy	*Large-scale electricity supply and community or small-scale electricity supply*
T10 Mini/Micro Hydro (rivers)	*Community and household-scale electricity supply*
T11 Biomass (forest/agriculture) boiler; **T12a** Biogas for generator	*Large-scale electricity supply*
T12b Biogas	*Heat for community, industry or households*
c Biogas	*Cooking for institutions and households*
d Biogas (anaerobic digestion from municipal solid waste)	*Large-scale electricity or local heat or both*
T13a Solar towers	*Large-scale electricity supply*
b Solar (pv)	*Large- and small-scale electricity supply*
c Solar thermal (e.g. in deserts)	*Large-scale electricity supply*
d Solar thermal	*Water and space heating at institution /household level*
e Solar coolers	*Cooling at institution/household level*
f Solar lanterns	*Lighting at household level*
g Solar cookers	*Cooking for households*
k Solar pods	*Electricity and heat supply*
T14 CMM for generator	*Large-scale electricity supply*
T15a Sustainable design buildings (orientation, design, insulation)	*Heat and light*
b Passive cooling through building design (shading, chilled beams, natural ventilation)	*cooling*
T16a Air water or ground source heat pumps on-grid	*Community heat and cooling or for industry*
b Air water or ground source heat pumps off-grid	*Heat and cooling for households or industry*
T17a CHP coal/gas-based	*Large-scale electricity and heat supply*
T17b Micro CHP small-scale (households/commercial level); **T17c** Biomass CHP (community or household level)	*Electricity and heat*
T18 Energy saving lamps	*Lighting end use in buildings*
T19 Efficient charcoal production; **T20** Improved cook stoves; **T21** LPG and LNG	*Households/commercial cooking*
T22 Cement industry; **T23** Iron & steel industry; **T24** Chemical industry; **T25** Agro & food industry (e.g. sugar)	*Energy efficiency/saving measures*
T26 Methane capture in landfills (MSW)	*Large scale electricity or heat or both*
T27 Combustion of municipal solid waste (MSW)	*District heat or electricity*

(continued)

Table 3 (continued)

Technology alternatives	*Energy service*
T28 Gasification of MSW	*Large-scale electricity or heat or both*
T29 Wave power	*Large- and small-scale electricity Supply*
T30 Tidal power	*Large-scale electricity supply*
T31 Ethanol stove (from sugar production, households/institutions);	*Efficient cooking*
T32 Biogasification Stove (wood or husks, etc., institution/level)	

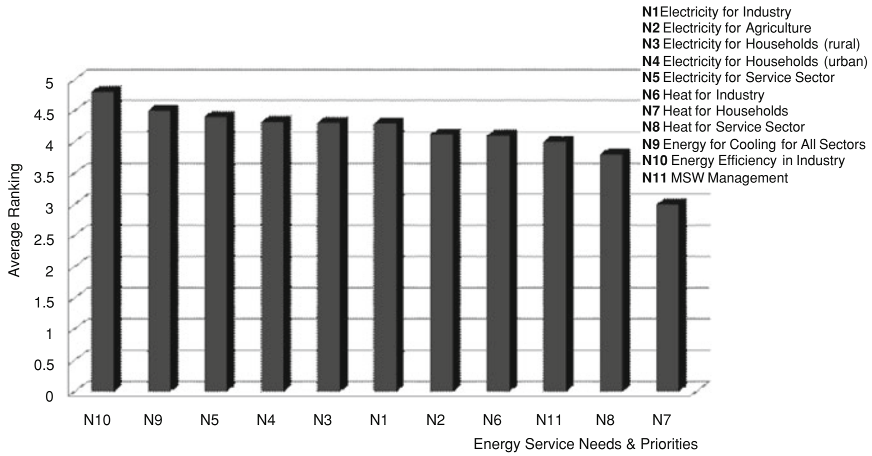
Table 4 Sustainability benefits

Economic benefits/impacts	*Environmental benefits*	*Social benefits*
1.1 Energy supply diversification	2.1 Local clean air	3.1 Socio-economic welfare, especially poverty alleviation
1.2 Replicability potential	2.2 Global CO_2 emission reduction	3.2 Health care
1.3 Lower dependency on imported fuels	2.3 Resource saving	3.3 Education
1.4 Energy supply/ transmission reliability	2.4 Land protection	3.4 Communication and transport
1.5 Energy price stability	2.5 Water management (quantity and quality)	3.5 Public governance
1.6 Contribution to Israel's economic development	2.6 Solid waste management	3.6 Empowerment, e.g. through participation in decision-making or training
1.7 Employment	2.7 Natural conservation	
	2.8 Reduction of environmental risks	

political issue and could be neglected, in contrast to the priority given to electricity supply. It should also be noted that the stakeholders had little understanding of the way electricity is often used inappropriately for heating and that proper management of the heat sector would be beneficial for electricity in addition to demand side management measures and for the general efficiency of the use of primary energy sources.

Finally, additional priority areas of interest identified include:

– Transport;
– Water for irrigation;
– Food processing;
– Energy for schools.



5 – very high, 4 – high, 3 – medium, 2 – low, 1 – very low, 0 – not relevant to Kenya, n.a. – no opinion

Fig. 2 Needs and priorities by stakeholders

4.2 Technology Appropriateness and Suitability

Kenya has only recently discovered coal reserves in the north of the country. This was not generally known by the respondents, and only a few were interested in any of the coal or other fossil fuel technologies listed. In addition, the interview process indicated that many respondents were unfamiliar with some of the technologies listed, e.g. clean coal, heat pumps, solar thermal for space heating and cooling and industrial (food applications), solar towers and solar thermal plants for electricity, boiler upgrades, municipal solid waste management, and biogas technologies. This unfamiliarity affected the stakeholders' perception and their ability to rank the technologies. Therefore, the respondents' individual priorities varied depending on their knowledge and experience and any particular interests and enthusiasms, e.g. for solar power.

The technology given the highest priority was Micro-Hydro power (T10). There are 14 technologies with an overall ranking above 4 (high), as illustrated in Fig. 3. Solar Thermal for heating (T13d) is the only technology not in line with the energy service priorities perceived in Fig. 2.

Figure 4 presents the extent to which the stakeholders considered the energy technologies to be most sustainable for Kenya, according to the energy services they deliver. It was very apparent that the stakeholders' focal point was to meet the need for electricity generation.

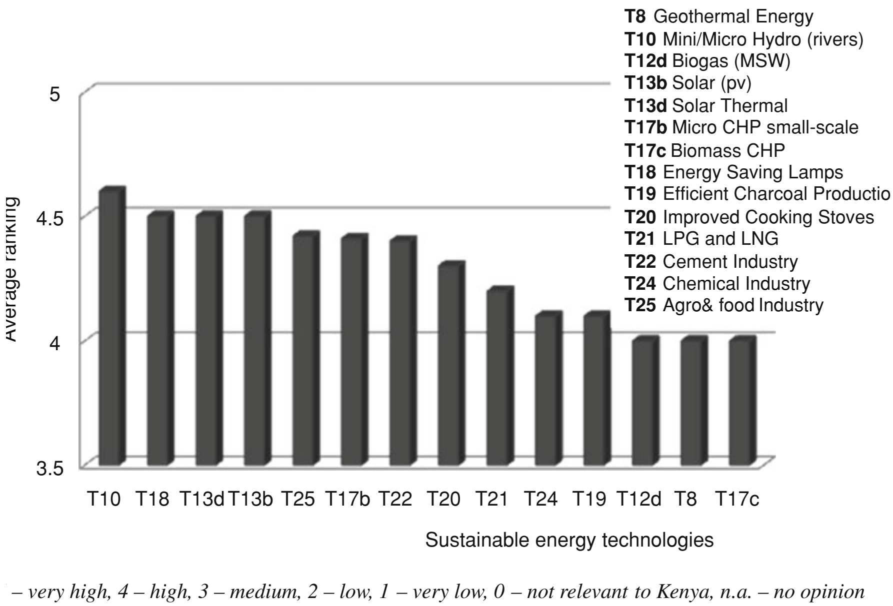


Fig. 3 Suitable sustainable energy technologies by stakeholders

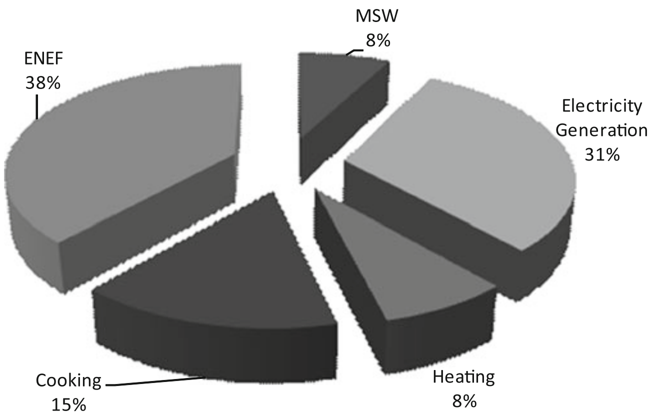
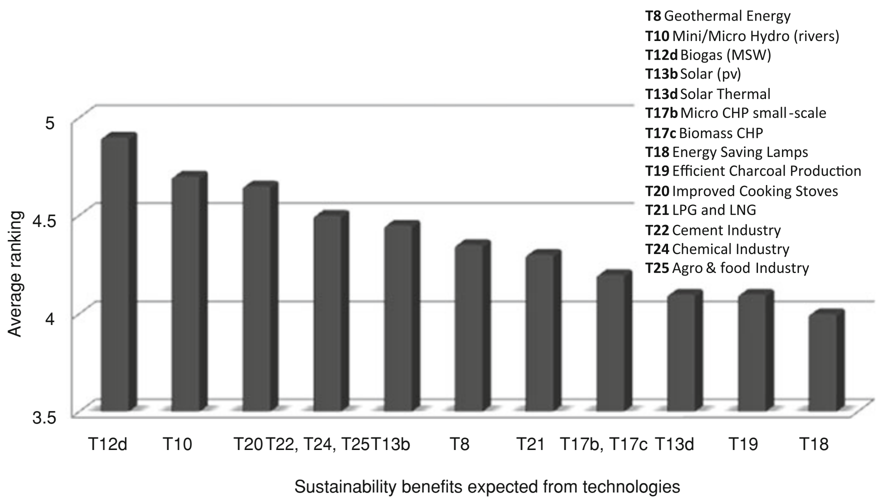


Fig. 4 Suitable energy technologies correlated to the energy services

4.3 Sustainability Benefits Identified by Stakeholders

In order to define a particular technology as suitable for a specific country, the sustainability benefits expected to be gained from the technology should also be examined. Therefore, the benefits (Table 4) obtained from the technologies



5 – very high, 4 – high, 3 – medium, 2 – low, 1 – very low, 0 – not relevant to Kenya, n.a. – no opinion

Fig. 5 Suitable energy technologies ranked by stakeholders based on their sustainability benefits

identified as promising were also assessed. The questionnaire explored some of the economic, environmental and social benefits that might be expected from the technologies considered to be most suitable for Kenya, provided they are implemented effectively. Figure 5 presents the economic, environmental and social benefits from the sustainable energy technology alternatives highly ranked by the stakeholders. None of the respondents who completed this section added any additional benefits, although some mentioned disadvantages.

Unexpectedly, the highest SD benefits were expected from Biogas for electricity (T12d), which was considered to be of medium importance in terms of fulfilling energy needs and priorities in Kenya. Generally, some technologies that were considered important for energy needs were ranked relatively low in terms of SD benefits, and vice versa. One explanation could be that stakeholders may consider only a few SD criteria to be important, so that a technology could score highly on these criteria, but low on others, but could still be viewed as delivering an important contribution to the country's needs and priorities. This indicates that a more detailed and comprehensive analysis is required, as the respondents had limited awareness of the possible implications of technologies. It depends on where projects are implemented, what benefits or disadvantages may be created, how they are implemented and whether or not these benefits are actually delivered.

Knowledge of potential benefits could affect the priority awarded to a technology. For a national strategy, many considerations have to be taken into account in terms of reliability, security of supply and demand needs and the possible sustainability benefits, which should be part of such an assessment.

4.4 Procedure Insights

It was noticeable in some cases that the results reflected the respondents' level of knowledge. The analysis of the questionnaire indicated that some respondents were unfamiliar with some of the technologies listed, such as solar towers. This unfamiliarity affected the stakeholders' perception and their ability to rank the technologies. For this reason, the stakeholders awarded a higher priority to technologies they were more familiar with, and there seemed to be a tendency for them to award lower scores to technologies with which they were unfamiliar.

In addition, the assessment of benefits from projects using some of these technologies is a major process and they do not always deliver the benefits expected. This assessment is therefore more of a reflection of people's knowledge and perceptions than of what is known in the literature and the extensive studies that have been carried out.

Cultural aspects are also important in the success of TT. To give an example, it was mentioned that a solar cooker pilot programme was a failure because people do not like to cook outdoors in Kenya. They do not want others to see what they are cooking, and there are problems of dust, dogs, and so on. What is more, people usually eat in the evening, so the timing of the availability of solar cooking technology is not compatible with their lifestyles.

Finally, coal has been discovered recently in Kenya, and the large utilities are planning to move to coal technology—not necessarily clean coal technology—as costs will be a major factor in their investment decisions. In addition, the picture emerging from Kenya was of weak supporting and enabling structures for the market from government incentives, standards and procedures (e.g. import), a lack of integration across policies to infrastructure, R&D and lack of local capacity and expertise. There is therefore little time left before Kenya is locked in a high-carbon future.

5 Conclusion

The challenges of how to respond to climate change and to ensure SD are high on the political agenda of the world's leading nations. However, it is uncritically assumed that there is an automatic synergy of climate and development policies. The key aspect is that low-carbon sustainable technologies need to be adopted by both developed and developing countries, in an effort to avoid past unsustainable practices and being locked in a less sustainable future.

This paper provided an analysis, based on an elaborated stakeholder assessment, that resulted in an overview of prioritised energy service needs and the identification of energy technologies that might be suitable for meeting these needs in Kenya. The high-priority technologies for TT in Kenya were also examined with regard to their sustainability benefits.

Energy service needs & priorities: Kenya has a broad range of priorities concerned with poverty alleviation, which may reflect the wide range of investments required in the country. In Kenya, Energy Efficiency for Industry was considered to be a service of very high priority. Energy for Cooling was given a high priority and was perceived to be related primarily to health centres. Energy for the Service Sector was particularly important for Kenya, reflecting the importance of tourism, which is a major economic driver. Electricity for Households and Municipal Solid Waste Management for Energy were high priorities for the country due to the country's electricity supply problems. Electricity for Agriculture was seen as a priority in Kenya due to the importance of this sector to the country's economy.

Suitable sustainable energy technologies: The emphasis was on a range of smaller-scale technologies for space and water heating, for cooking, lighting and distributed generation. Micro hydro energy for community- and household-scale electricity supply was considered to be the highest priority in Kenya, as the country's energy supply was based largely on hydropower. Biomass and Solar PV—due to their potential—and cooking technologies—due to the necessity for addressing specific needs—were given a high priority in Kenya. In addition, there is concern for technologies for Energy Efficiency for Industry but, generally, priority technologies cover a much broader range and are more concerned with poverty alleviation.

Sustainability benefits of sustainable energy technologies: The backdrop for CDM projects in Kenya is that GHG emissions in the country, as well as in the region, are low and that the CDM should contribute primarily to avoiding GHG emissions in the future rather than reducing present emissions. The DNA recognises food security and secure energy supply as the two major problems in the country and important causes of environmental degradation and social concern (extreme poverty, extensive farming, increasing demographic pressure, resource overuse, water management difficulties are common problems in many areas), and expects TT through the CDM to contribute to solving these problems.

The results from the proposed approach may help decision-makers and future project investors to identify the most suitable sustainable energy technologies to be transferred and implemented in Kenya, while contributing to the country's low-carbon sustainable energy development.

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Climate Change Governance and the Triple Bottom Line Model of Reporting: Delivering Accountability

Kumba Jallow

Abstract This chapter is designed to assess the mechanisms that allow companies to manage and then report on their climate change activities and emissions. This is to allow stakeholders to examine company disclosure to determine whether companies are applying a governance approach to this and whether this leads to accountability. The chapter is a review of current processes in climate change management and reporting. It discusses some of the options available to companies, particularly in Europe and North America. In particular, it assesses the notion of a triple bottom line. Companies have a range of options available to them which may not deliver stakeholder accountability. A set of questions is posed—encompassing emphasis, value of reporting and potential audiences for reporting—to enable stakeholders to critique both reporting in general and actual individual reports. The chapter brings together discussions concerning both management and accounting, and sets these in a governance context.

Keywords Climate change · Triple bottom line · Governance · Accountability

1 Introduction

Following COP-15 in December 2009 and the People's Summit on Climate Change in Bolivia in 2010, society is becoming well-versed in the details and effects of climate change through emissions, both natural and human-made. Governments across the globe are putting in place policies and fiscal mechanisms to mitigate

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against and adapt to climate change. The recent recession has challenged these measures as, paradoxically, the need to stimulate production and consumption has the potential to overcome the reductions in climate change emissions that are achieved in a downturn. Nevertheless, it is now widely recognised that action is needed to reduce the negative effects of climate change and that the private (industrial) sector has a major role to play, not just in reducing their own climate change impacts, but in providing the lead—through greater awareness of the issues—through improved governance and reporting. Private funding is also likely to be the major determinant of actions available, and a combination of investor pressure and societal demands will allow businesses to play an important role in finding solutions to the damage to the environment caused by climate change.

2 Business Responses to and Management of Climate Change

'The objective of society is to promote economic growth, but to decouple it from a carbon economy. In many ways, the corporation is the most important institution of the 21st century…giant corporations have declared their commitment to reducing climate change. This level of engagement of business with climate change shows that businesses can be part of the solution' (Paul Dickinson, CEO, Carbon Disclosure Project).

Business organisations first recognised the issue of climate change in the 1990s, and this period saw the development of strategic responses to it, both political and market-based. The more proactive companies developed emission reduction strategies to anticipate future legislation and societal demands, and identified the risks and opportunities in addressing climate change as a business issue (Kolk and Pinkse 2007a). The issue moved from a local context to a global one as it matured, leading to strategic convergence, especially across industrial sectors (Kolk and Levy 2003).

Organisations may respond in a variety and combinations of ways, and the following framework may be a useful way of explaining these. Proposed by Kolk and Levy (2001), it divides the possible responses into economic and market positioning (financial strength, competitiveness, availability of long-term planning); locational (societal concerns, regulation and national policies); and internal organisational factors (structure, culture, decision-making processes). More detail is provided below.

2.1 Economic and Market Positioning

Market stakeholders, such as customers and suppliers, and non-market stakeholders, such as government and non-governmental organisations (NGOs), all play a part in eliciting a response from organisations as more societal pressures are brought to bear

(Okerere 2007). Inevitably, the management of climate change will involve economic responses (Kolk and Pinkse 2004; Okerere 2007). There is also a recognised ‘green’ competitive advantage to managing climate change more proactively (Kolk and Pinkse, 2008). However, business organisations may prioritise salient stakeholders, which will determine management response (Kolk and Pinkse 2007b).

2.2 Locational Factors

Despite conflicting institutional pressures for action (from stakeholders who individually prioritise their requirements), this will reduce as the issues mature and local responses are replaced by global ones (Kolk and Levy 2003). This is also reflected in the nature of a globalised economy, where climate change strategies at the company level become embedded in the socio-political contexts (Levy and Kolk 2002). Companies may influence policy development to encourage market-based mechanisms, including the production of relevant information demonstrating how these strategies will work. In this way, disclosure mechanisms become important, in part to demonstrate that self-regulation is a workable alternative to legislation at the national and international level.

International differences exist in business approaches, where more advanced economies tend to examine partnerships with local NGOs and where home country governments are more likely to be engaged by companies than those of the host nation (Kolk and Pinkse 2007a). This makes business key to the process of global climate governance; but where the policy framework remains weak, this allows a more limited business response than is probably required (Jones and Levy 2007).

2.3 Internal Organisational Factors

At the management level, businesses are exploring different market-based strategies—individually or in partnership with supply chains—to take a compensatory approach (for instance, through emissions trading). Alternatively, they are creating more innovative improvements to their operations and facilities. The approaches vary because managerial discretion is possible (Kolk and Pinkse 2005; Jeswani et al. 2007). The threats and opportunities perceived and recognised by companies create the drivers for action (ibid.) as companies move from deniers to actors, replacing their erstwhile hesitant approach to a more proactive one (Kolk 2001). Larger companies, in particular, use their influence on others in their own sector and on industry generally (ibid.).

This framework of analysis highlights priorities of action in response to climate change, which are to: increase profits; influence government policy and; enhance corporate reputation. Hoffman (2004) originally recognised the following dimensions to climate change strategy:

- operational improvement;
- anticipating and influencing climate change regulations;
- accessing new financing schemes such as emission trading;
- improving risk management and corporate reputation;
- identifying new market opportunities;
- enhancing human resource management;

proposing that this integration of climate change strategy into general management practice is not because of the acceptance of the science of climate change or of a desire to be more socially responsible, but because it makes business sense (Hoffman 2004). Later, Hoffman (2007) suggests that the development of this strategy will take place in three stages: firstly, a commitment to strategy development; secondly, an inwardly-focused implementation involving financial mechanisms and the engagement of the organisation and; thirdly, the management of the company's external relations.

3 Policy Mechanisms Designed to Enhance Climate Change Governance

3.1 The European Union Emission Trading System (EU ETS)

This was introduced as part of the European Union's (EU) programme to reduce greenhouse gas (GHG) emissions and to promote reductions in individual businesses by allowing the trade of emissions within the business community. Individual business are allocated allowances (one allowance represents one tonne of carbon dioxide equivalent) and may emit up to their allowance limit or may trade some of their allowances to other business, reducing their own emissions—a 'cap-and-trade' system. The scheme is currently in phase II (1 January 2008–31 December 2012), with a third phase planned. The EU ETS originally covered electricity generation and the main energy-intensive industries—power stations, refineries and offshore, iron and steel, cement and lime, paper, food and drink, glass, ceramics, engineering and the manufacture of vehicles. Combined, these account for around 43 % of the United Kingdom's (UK) CO_2 emissions. EU ETS Phase II was broadened to cover CO_2 emissions from glass, mineral wool, gypsum, flaring from offshore oil and gas production, petrochemicals, carbon black and integrated steelworks.

The latest report from the UK government's Department of the Environment, Food and Rural Affairs (DEFRA 2008) showed that during 2006, EU ETS installations in the UK emitted a total of 251.0 million tonnes (Mt) of CO_2, some 33.3 Mt higher than the total number of allowances issued in 2006. This was mainly due to the increase in electricity generation from coal-fired powered stations, resulting from a positive price differential compared to gas-fired electricity generation. A combination of high gas prices and low carbon prices in this period prevented fuel switching away from coal-fired generation. Installations were therefore drawing on previously unused allocations from previous years.

All installations in the system must monitor and report emissions in accordance with EU guidelines. Each year, operators are required to submit an improvement plan to their sector regulator. It is envisaged that the accuracy of monitoring and reporting should improve year on year. In the UK, businesses have commented that their emissions reporting has improved, for example, with the installation of new gas metering and the use of site-specific emission factors.

3.2 The CRC Energy Efficiency Scheme

The UK has initiated a scheme to cover CO_2 emissions that are not included in the existing EU Emissions Trading Scheme and the Kyoto agreements. The CRC Energy Efficiency Scheme (formerly known as the Carbon Reduction Commitment) is the UK's mandatory climate change and energy saving scheme, which began in April 2010. It also acts as a 'cap-and-trade' mechanism by allowing organisations to buy allowances for emissions which have been capped for each group of CRC participants. This provides a limit within which each organisation can determine how to become more energy efficient and thus reduce their emissions. Therefore financial considerations are paired with the need to examine climate change activities, as organisations must find ways to reduce their demand for allowances or to fund the purchase of additional allowances from other organisations in the scheme.

The funds raised in this way will be available to participants at levels determined by their performance. The CRC scheme will publish a 'league table' of energy efficiency so that stakeholders can assess individual organisational performance. Hence it is hoped that the scheme will promote positive financial and reputational returns, as well as encouraging better energy management within participating organisations. The UK government estimates that the scheme will apply to large public and private sector organisations, which are responsible for about 10 % of the UK's emissions, affecting around 20,000 organisations.

Organisations are eligible for CRC if they (and their subsidiaries) have at least one half-hourly electricity meter (HHM) settled on the half-hourly market. They also qualify if their total half-hourly electricity consumption exceeded 6,000 megawatt-hours (MWh) in 2008. Initially, it is estimated that around 5,000 organisations will qualify, including supermarkets, water companies, banks, local authorities and all central UK government departments. Qualifying organisations will have to comply legally with the scheme or face financial and other penalties. Hence organisations will need to have adequate measurement and disclosure mechanisms in place in order to demonstrate compliance.

4 Climate Change Governance at the Organisational Level

Governance procedures and mechanisms in business organisations are well established in terms of financial and operational behaviour, and are codified in national and international policies. However, their impact is largely as a response to financial malpractice, and centres on the needs of shareholders. In other words, governance is a means of protecting the company against claims from its owners that their assets are not being safeguarded by management. In this sense, governance is narrowly construed as protection for both management and shareholders. Recently, demand for greater consideration of social and environmental issues to be included in governance mechanisms has meant that governance is viewed from a stakeholder rather than from a shareholder perspective. This is challenging to business and its management because it opens up what it means to be well governed and raises issues of accountability and transparency not hitherto addressed.

Governance of climate change issues by business has to develop from strategic thinking. Many large organisations have developed a climate change strategy with which to manage their climate change emissions, to examine ways to reduce and mitigate climate change activities and to show their discharge of responsibility to their stakeholders. This has evolved partly as a response to national and international legislation (such as the Kyoto treaties and the Copenhagen agreements) and partly as peer pressure has resulted in the recognition of competitive advantage and financial improvements. Less advanced company activity is in the area of climate change adaptation, which has not been viewed as a strategic issue, presumably because the main climate change mechanisms reward mitigation.

Climate change is often perceived as presenting an organisation with an additional source of risk—financially, as mitigation may result in costs, reputational damage as organisations are seen as being uncaring towards the environment—and also as an opportunity, where these risks are overcome. However, it is apparent that many companies view climate change as a set of risks to be managed rather than a set of opportunities which will create returns. This may be because many stakeholders also view climate change as a risk, something to be seen as damaging to society, and so to benefit from environmental damage is seen as unethical. However, as with earlier environmental issues, businesses move through a cycle of, firstly, externalising environmental problems, then dealing with them as expenses to be borne (thus negatively affecting their bottom line) and finally to seeing these as opportunities for competitive advantage, where stakeholders reward companies with a good environmental performance. Strategically, organisations need to consider how they deal with the issues generated by climate change to ensure that their responses are viewed positively by the market and by society.

5 The Link Between Governance and Accountability

Governance systems allow an organisation to be accountable for their actions. Accountability is reflected in two dimensions—the requirement to be responsible for actions undertaken and the requirement to account (provide a report) for those actions. Hence accountability is linked to transparency so that the organisation's actions are visible to the outside world. This activity of reporting has undergone development as companies have seen the advantage of raising their profile and improving their image; to some, this has extended to behavioural and management changes as the organisation has realigned itself to societal values, in a form of corporate citizen development.

5.1 Accountability

Benston argued that equity (fairness) is at the heart of any accountability relationship. Business may be challenged by society if its operations cause social or environmental damage. Society may then attempt to legislate for protection; a proactive business discloses its positive performance—in other words, a form of voluntary accountability.

Gray et al. (1996: 38) defined accountability as "the duty to provide an account (by no means necessarily a financial account) or reckoning of those actions for which one is held responsible." There are two responsibilities: the first is to undertake required actions and the second is to provide an account of those actions. Accountability is the requirement to report the extent to which the business has met its responsibilities.

Keasey and Wright (1993) extended the discussion on corporate accountability by drawing on the philosophy of Bentham (1748–1832) who described the link between the accountability process and the principle of publicity, i.e. the disclosure of information. Hence accounting to external stakeholders is integral to the discharge of accountability, rendering organisations and activities transparent. This was primarily applied to the publishing of financial information (as in the annual report), but the principle is the same for any information that is to be publicly available. The qualitative and non-financial information which an organisation can generate is also relevant to disclosure, and therefore to the accountability discharge, where this concerns the wider social and environmental performance of the organisation, including climate change impacts.

However, disclosure practice may fall short of 'true' accountability. Organisations may be attempting to legitimise their activities through disclosure, or may seek to manage risk by providing filtered information. Legitimacy is based upon the notion that the organisation operates in society via a social contract (Parker 2005). The organisation agrees to perform various socially desired actions in return for approval of its objectives, other rewards and its ultimate survival.

Organisations can only continue to exist if the society in which they are based perceive them to be operating to a value system which is congruent to society's own value system (Gray et al. 1996). At a time when the social performance and integrity of the firm may be under scrutiny, the firm will provide information to users of the accounts to justify, or legitimise, the firm's continued operation within that society (Deegan and Rankin 1996). Hence legitimacy may prevent full accountability; stakeholders may have to 'read between the lines' to discover what level of accountability is actually being offered.

5.2 The Triple Bottom Line: Delivering Accountability?

The idea of a triple bottom line was first proposed by Elkington (1998) as a means of demonstrating how the social and environmental impacts that a business has (whether negative or positive) affect the traditional measure of profit usually disclosed in business accounts. Often, this may be regarded as a deduction from profits as the negative effects of the externalities are internalised. In practice, of course, it is very difficult to measure these effects in monetary terms, so the triple bottom line is often a narrative attempt to reflect the totality of business impacts.

Companies disclose their climate change activities in a variety of ways, and there is no real regulation to enhance the consistency and comparability of such reporting practices. A study in 2008 showed that, in fact, only 58 % of UK FTSE-250 companies had provided climate change information to their investors, demonstrating how voluntary reporting is inconsistent and patchy (Guardian 2008). However, there are facilitating mechanisms which may see disclosure increase and take on a greater degree of reliance. These act as a form of triple bottom line reporting—or disclosure—with which stakeholders may assess business accountability.

5.2.1 The Carbon Disclosure Project (CDP)

The CDP is an independent organisation, launched in 2000, which focuses on the investment implications (that is, taking the shareholder perspective) of climate change. It generates support for dialogue and communication between investors and companies in order to develop responses to climate change which will benefit both. The CPD operates by requesting information on climate change activities from 'responding companies'—about 1,300 publicly listed companies—via a questionnaire. It gains support for this process by including the names of 'signatory investors'—about 534 institutional investors—who put their names to the request for information. Hence the CDP acts as a broker between business and investors in climate change issues. At the last reporting cycle, about 2,500 organisations gave data to CPD, which in turn made the information available to institutional investors, the business and policy-making community, and the wider public.

The questionnaire completed by each business contains sections on risks and opportunities, emissions accounting, emissions intensity, energy and trading, performance and governance. The latter requires companies to supply information regarding board level responsibilities for climate change activities, how these are reflected in individual manager performance measures, what measures are in place to communicate climate change activities and what engagement there is with public policy development. In 2009, responses were received from 409 of the top 500 global companies (82 %). The disclosure largely focused on Scope 1 and 2 emissions (direct fossil fuel burning or electricity purchase); disclosure of Scope 3—indirect emissions—was lower, at 37 %.

Increasingly, it seems, the CDP has an influence on company disclosure performance by harnessing the power of the institutional investor to bring about pressure for more reporting. What is not clear is whether such reporting can be said to be true accountability, since there is, as yet, no monitoring of information supplied to CPD. The next stage is surely an independent audit process, which allows the information to be scrutinised and verified.

5.2.2 The Greenhouse Gas Protocol

This was established as a result of the development of the Kyoto Protocol in 1997. Formed as a partnership between the World Resources Institute and the World Business Council for Sustainable Development, it provides mechanisms for reporting climate change emissions (as well as managing and understanding these) and, as with the CDP, breaks down emissions into Scopes 1, 2 and 3. It has provided a focus for each of these scopes, but is particularly important in attempting to introduce a greater understanding of Scope 3, or indirect, emissions. The Protocol is a framework allowing an individual organisation to understand where its boundaries may lie—extending these beyond the traditional structural boundary defined by legality, ownership and control to include activities and entities where control may be indirect. This makes the boundary ‘fuzzy’, but allows business to understand the wider issues of climate change, including along its supply and consumption chains.

The Protocol provides ‘Corporate accounting and reporting standards’ (‘Corporate Standards’) and ‘project accounting protocol and guidelines’. It is a multi-step approach to measuring emissions, and advises that an organisation needs to develop a GHG emissions inventory based on Protocol tools, themselves developed from best practice. In 2007, it was reported that 63 % of the Fortune 500 companies used the Protocol to measure and report their emissions, and emerging economies are embracing the Protocol—the Brazil GHG Protocol Programme included 30 companies, representing 20 % of the country’s energy and industry emissions, with disclosures from Petrobras, Whirlpool, Ford Brasil and Walmart Brasil.

The Protocol has been used as the basis for other reporting mechanisms, such as the Global Reporting Initiative’s Sustainability Reporting Guidelines and ISO

14064-I: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals.

5.3 A Criticism of Triple Bottom Line Reporting

As with any management initiative, there are difficulties in promoting a reporting mechanism which is designed by the preparers, but has to fulfil (or is required to fulfil) the needs of users. This is a constant dilemma in the financial accounting field, where the balance between the power held by the directors of a company—in relation to the release of information—and the potential sanctions levied by the stakeholders if the information is regarded as insufficient. True accountability requires a full disclosure of events whether this reflects a positive or a negative image of the organisation. The main criticism of many company reports is that they are one-sided, promoting an optimistically reassuring portrait of company activities. Hence they may provide a view of governance that is incomplete.

Can an individual organisation tell us about its relationship with the vast issues of climate change and its mitigation, as Gray (2010: 48) points out with reference to 'planetary sustainability'? This seems such a daunting task that it may be that only partial accountability can ever be delivered, despite such efforts to develop a triple bottom line form of reporting. The science of climate change, the differing effects felt in different parts of the globe, the different levels of understanding in society make climate change one of the most controversial current topics, and our demands for information from businesses on an individual basis may be unrealistic if it is unclear what information is relevant both to society's needs and to what can actually be provided by business.

What information does society require from organisations? The Association of Chartered Certified Accountants suggests that the following are important:

- suitability to audience—the audience should be defined ahead of report preparation;
- climate change should be recognised as a key business issue—context is important;
- if web-based materials are used, use of signposting is important;
- performance reporting is key—targets, benchmarking and best practice are all needed;
- appropriate reporting methods—an organisation should use a range of communication tools (ACCA 2007).

Derived from this, some key questions can be asked:

5.3.1 Where Should the Emphasis Lie: On the Past or the Future?

A company report may contain historical or future-oriented information (or a combination of both). It may show what actions it has taken to mitigate climate change or what measures it proposes to introduce in terms of energy efficiency and carbon reduction programmes. From a stakeholder perspective, there may be an advantage in looking to future actions rather than the backward view of what has already happened. Accountability is served by both to some degree, but is often linked with the historical idea of stewardship.

Disclosure may report what the company has done, what it plans to do or a combination of both. However, climate change is such an urgent issue that stakeholders need to know what a company is planning to do, because historical behaviour will not be sufficient to ameliorate climate change. Disclosure of future actions may also indicate how seriously the company takes the issue. These future activities can be termed 'transformational' activities—those strategies which will have a significant impact on reducing future climate change emissions. This could enable stakeholders to assess what future risks and opportunities the company faces. Examples of transformational initiatives include: fuel-switching, demand-side management, research and development in low-carbon technologies, carbon sequestration, production and/or product/service innovations and supply chain changes.

Future activities may be described as a fourth bottom line—that of perspective or resilience.

5.3.2 What is the Value of Reporting if Not All Companies Disclose?

Often, disclosure is lacking or partial. Hence there may be little value in voluntary disclosure even when models and standards exist to provide a level of comparability and consistency. Non-disclosure cannot be taken to mean non-management, but the accountability process requires an account of management actions to stakeholders. Stakeholders may assess non-disclosure as a lack of commitment on the part of the company to tackling climate change. Indeed, it may reflect the situation in the early 1990s when business felt that environmental problems were a cost to be borne by them and therefore attempts were made to externalise these issues. It may be that, as recessionary pressures appear again in the current century, climate change is viewed with the same perspective.

Hence non-disclosure may indicate a wider problem in that companies may be limiting their carbon management programmes in a time of economic pressure.

Voluntary disclosure will result in inconsistencies and a real lack of comparability. However, stakeholders can also use the variability of disclosure to assess how accountable a business is prepared to be—a lack of full reporting may indicate those areas where a business is not prepared to—or cannot—be fully accountable.

5.3.3 Where Should the Accent Lie: On Preparers or Users? Shareholders or Stakeholders?

The decision to use the triple bottom line lies with those who prepare the final account of climate change effects and, to this extent, so does the power. Agency requires that managers act on behalf of other stakeholders—traditionally shareholders—so that the information provided is of use to the latter. However, this is overcome if the user of the 'account' does not appreciate what can be reported or how important this may be. Hence it is through education and awareness that users of information become more aware of what they can demand in terms of information from the businesses in which they have a stake.

6 Final Thoughts

Is the triple bottom line the best way of judging accountability? The frameworks discussed in this information, the effect of all the business activities, wherever they lie within the fuzzy boundary chapter, are becoming very widely known in institutional investor circles and the large multinational corporation board rooms. But are they applied in such a way that they discharge the dual responsibilities of accountability? It may be that we need to look at a more integrated bottom line where, rather than disaggregating information into financial and non-financial aspects, the totality of the effects of business enterprise—whether market or non-market—are reflected in one measure. This would demonstrate the ability of business to deliver governance to all its stakeholders and to reveal the nature of its climate change strategy.

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Climate Change Strategies of Selected Greek Businesses: An Empirical Investigation

Nikolaou E. Ioannis, Evangelinos I. Konstantinos and Walter Leal Filho

Abstract This paper explores the strategies adopted by a sample of Greek businesses in relation to climate change mitigation and adaptation issues. In particular, the voluntary initiatives of a sample of Greek businesses with respect to climate change issues are examined, such as voluntary involvement in national and international associations on climate change, emission trading, the installation of low-carbon intensive equipment and carbon reduction management. An analysis of Corporate Social Responsibility (CSR) reports is presented. Specifically, the methodology used in this study is based mainly on a synthesis of methodologies previously used in other academic articles focusing on business climate change. The sample of businesses was selected using the following criteria: the existence of published CSR reports; the impact on the environment of the industry in which the selected businesses operate; and the environmental protection practices undertaken on climate change issues. It was discovered that the selected Greek businesses adopt either political or strategic actions to face climate change problems. The findings show that over half of the businesses adopt political actions, while the total sample implemented various types of strategies to respond to climate change problems. This paper represents primary research into the climate

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change strategies of a selected number of Greek businesses, and could be useful for a range of other national and international businesses and academics.

Keywords Global climate change · Governance · Business climate change management

1 Introduction

Today, climate change is considered a major environmental issue with significant influences on the economy and society (Martin & Rice 2010). In particular, various authors have recently argued that the daily operations of businesses increasingly contribute to climate change, and vice versa (Le Menestrel et al. 2002; Tyler & Chivaka 2009). On the one hand, businesses are directly responsible for high levels of CO_2 in their day-to-day operational and production processes, as well as indirectly from their decisions as investors, innovators, manufacturers and lobbyists (Jones & Levy 2007). On the other hand, the impacts of climate change affect business operations both directly and indirectly. A significant example of the direct risks of climate change may be the vulnerability of the ski industry due to the consequences of weather change on the quality and length of the ski season (Scott & McBoyle 2007). Conversely, some stakeholders such as banks and insurers may avoid doing business with companies that have high environmental liabilities (Sturm & Oh 2010).

To maintain societal and economic stability, governmental, non-governmental and inter-governmental organisations are developing global climate change policies to reduce the changes caused by different actors on climate. For example, the Intergovernmental Panel for Climate Change (IPCC) provides a set of policies to encourage governments to prepare climate change policies (IPCC 2001). The main categories of climate change policy can be classified as follows: a) to adapt, referring to the ability of a system to adjust to climate change to moderate potential damage; and b) to take advantage of opportunities, or to cope with the consequences and mitigation, that is, any action taken to permanently eliminate or reduce the long-term risk and hazards of climate change to human life and property. To transfer those policies to the business community, a series of measures have been developed, including legislation on CO_2 emissions (command and control instruments), energy taxes and tradable emission permits (market-based instruments) and proactive environmental management (voluntary instruments) (Goulder & Schneider 1999).

The results of both public policy instruments and voluntary initiatives are integrated by the business community with a series of adaptation and mitigation strategies. So far, some examples include agriculture and the mining industry in different countries (Kolk & Pinkse 2004; Scott et al. 2003; Weinhofer & Hoffman 2010). This paper aims to contribute to this debate by presenting the strategies adopted by a selected set of Greek businesses to face climate change challenges. The data was taken from CSR reports. The findings show that the businesses adopt a limited number of political actions, while also implementing a further number of strategic actions to address climate change challenges.

The remainder of the paper consists of four sections: the first section includes a review of previous experience in relation to businesses strategies in order to respond to Global Climate Change policies. The second section discusses the methodology, the third presents the results, and the final section includes discussions and conclusions.

2 Global Climate Governance

Today, governmental, non-governmental and inter-governmental organisations play a critical role in climate change policy. For example, the IPCC helps assess critical scientific, technical and socio-economic parameters to improve global understanding of climate change. In addition, several governmental organisations have developed climate change policies that can be divided into two general categories: legislation for climate change mitigation and adaptation (e.g. CO_2 emissions reduction) and market-based instruments (e.g. energy taxes). Some Non-Governmental Initiatives (NGIs), such as the International Institute for Sustainable Development (IISD), the World Business Council for Sustainable Development (WBCSD) and the Carbon Trust (CT), have developed policies for their members on climate change issues.

These policies are known as Global Governance on climate change, defined as *"the multiple channels through which economic activity and its impacts are ordered and regulated. It implies rule creation, institution building, monitoring and enforcement. But it also implies a soft infrastructure of norms, and expectations in processes that engage the participation of a broad range of stakeholders"* (Newell & Levy 2006: 149). The most important climate change policy that has arisen from the NGIs presented above is the Kyoto Protocol, which sets out requirements for different countries to reduce greenhouse gas (GHG) emissions.

However, it is important to highlight the fact that climate change policy has been translated into European climate policy almost only as mitigation issues. Today, it is increasingly clear that adaptation is an important issue and should be added to the policy agenda, and European Union (EU) Member States have started to develop National Adaptation Strategies (NASs) (Biesbroek et al. 2010). The policies of NGIs and the EU aim to make businesses accountable for GHG emission requirements. To analyse how Global Governance on Climate Change issues are introduced into the decisions of businesses, Griffiths et al. (2007) developed a framework by identifying four institutional governance systems: (a) market governance; (b) state governance; (c) joint governance; and (d) corporate governance.

3 Business Responses to Global Climate Change Governance at an International Level

A number of businesses are currently responding to climate change challenges in different countries. The responses of businesses are mainly affected by Global Climate Change Governance. There are a number of studies in different countries and sectors, such as the ski industry and the agricultural and mining industries (Paulsson & von Malmborg 2004; Rehan & Nehdi 2005; Scott & McBoyle 2007). In general, the responses of businesses can be classified into two major categories: political actions and strategic actions.

The first category includes various academic works that describe a number of political initiatives taken by businesses to tackle climate change. Kolk & Pinkse (2007) present some of the political climate change actions of Multinational Corporations (MNCs). For example, the voluntary participation of American businesses in the Chicago Climate Exchange is considered an important political action which provides a necessary signal to government for the agreement of businesses to climate change policies (Kolk & Pinkse 2007). Additionally, businesses contribute to and/or influence climate change policies by indirect involvement in international institutions and associations (e.g. the International Institute of Sustainable Development and Carbon Trust) and corporate lobbying with governments in relation to climate change policy. Kolk & Levy (2001) present the political actions of large businesses, such as BP, ExxonMobil, Shell and Texaco, which are members of the Global Climate Coalition. Similarly, Levy & Egan (2003) developed a framework, based on the Neo-Gramsian approach, to examine the political climate change actions of businesses.

The second category encompasses strategies of business in response to climate change problems. Kolk & Pinkse (2004) conducted an empirical investigation to examine the threats and opportunities experienced by some large multinational companies in adopting actions to address climate change. Similarly, Jeswani et al. (2008) examine the nine most energy-intensive and GHG-emitting industrial sectors in Pakistan and the UK, and identify how they respond to climate change challenges. Schultz & Williamson (2005) presented some common strategies used today by businesses to mitigate carbon exposure: investments to reduce emissions, new projects to offset emissions, the purchasing of tradable emission permits and the reporting of GHG performance. Boiral (2006) claims that businesses implement such strategies in order to meet market opportunities, reduce financial risks, gain competitive advantages (economic benefits), develop innovations, R&D (scientific and technical issues), eliminate external pressures and improve image and legitimacy, motivate employees (social issues), raise subsidies, reduce taxes and avoid new regulations (political and regulations issues).

To this end, a range of studies have been conducted focusing on different industrial sectors and countries. For instance, Galbreath (2009) presented an exploratory study on corporate governance measures associated with climate change practices. These measures include management execution, public disclosure, emission accounting and strategic planning. He concludes that businesses consider climate change as an opportunity for raising considerable economic benefits and reducing competitive risks. Weinhofer & Hoffmann (2010) examine the GHG strategies of 91 electricity producers. They identify a number of different strategy configurations, including emissions trading, compensation via projects, the installation of fewer carbon-intensive power plants, enhancing the efficiency of carbon-based power plants, changing fuel in existing carbon-based power plants, carbon-free power plants and enhancing the efficiency of existing carbon-free power plants.

Pinkse (2007) examines the association of some parameters, such as the country of origin, industry affiliation and companies' environmental strategy, with business responses to climate change. In a sample of 136 businesses, he identified that industrial pressure and product and process innovation are key driving forces affecting the decisions of businesses in relation to climate change responses. Conversely, the country of origin is not an important factor in business decision-making. Brouhle & Harrington (2009) show that a number of Canadian businesses took part in the Voluntary Climate Challenge and Registry (VCR) programme, but there was great variability in the commitment and response of businesses.

4 Sample and Research Method

The study is based on data from the CSR reports of selected Greek businesses. The majority of reports examined were developed according to the general principles of the GRI guidelines, and are classified into three sections: economic, environmental and social. In the environmental section, the businesses published information on energy consumption, CO_2 emissions, wastewater treatment, waste management and water consumption. This study uses only the data on climate change issues and the strategies employed by the businesses examined. The selected reports were compiled in 2008. Six businesses were examined in total, two from the petroleum industry, two from the aluminium industry and one each from the cement industry and the mining industry (Table 1). The categories of strategies examined are differentiated into two main types: political action and strategic action.

Political action includes the cooperation, involvement and initiative of businesses on climate change issues. Such action could be the involvement of businesses in national or international associations dealing with climate change issues, such as the World Business Summit on Climate Change. The work of Weinhofer & Hoffmann (2010) is utilised in the evaluation of the climate change strategies of the businesses examined. As mentioned above, they identify a number of different strategy configurations, including emissions trading, compensation via projects, the installation of less carbon-intensive power plants, enhancing the efficiency of carbon-based power plants, changing the fuel in existing carbon-based power plants, carbon-free power plants, and enhancing the efficiency of existing carbon-free power plants.

Table 1 Profile of the sample

Name	Industry	Type of report	Employees	Annual funds (m)
Halcor S.A.	Aluminum	CSR	742	€ 1.200
TITAN S.A.	Cement	CSR	6,504	€ 1.578
S&B S.A.	Mining	CSR	2,086	€ 0.456
Motor Oil S.A.	Oil	CSR	1,226	€ 5.505
ELPE S.A.	Oil	CSR	5,184	€ 6.757
ELVA S.A.	Aluminum	CSR	2,275	€ 0.9025

5 Results

Table 2 indicates the kind of strategies adopted by the Greek businesses selected to reduce CO_2 emissions and to respond generally to climate change issues. The column on political action records any measures, such as involvement in national or international climate change coalitions or other lobby groups. Half of the businesses examined (50 %) are members of a national or international association that develops voluntary strategies to manage climate change problems. For example, Titan S.A., a cement-producing company, is a member of the Cement Sustainability Initiative of the World Business Council of Sustainable Development, which provides a range of tools for handling climate change risks and challenges. Similarly, Motor Oil S.A. is a member of the Oil Companies International Marine Forum (OISM), which presents a range of strategies to reduce CO_2 emissions from their vessels. Halcor S.A. is a member of the National Institute of Aluminum, which offers energy conservation programmes.

According to the second category of measures, the sample of Greek businesses has adopted a range of strategic actions to address climate change problems. Firstly, it is very important to highlight that none of the selected businesses have adopted such strategies as emission trading and compensation via projects. However, all six businesses have adopted a mixture of the other strategies to reduce CO_2 and other GHG emissions.

For instance, even though Halcor S.A. considers itself responsible for only 0.01 % of all Greek CO_2 emissions, it has implemented a range of strategies to reduce its impact on climate change. The results show that the level of emissions is equal to that of the previous year. In particular, the emission level for 2008 is 18,400 tonnes of CO_2. Titan S.A. has adopted strategies to create less carbon-intensive power plants, carbon-free power plants and to enhance the efficiency of existing carbon-free power plants. In 2008, it emitted 10.2 million tonnes of CO_2, 20.9 million tonnes of NO_x and 3.5 SO_x. These strategies have succeeded in reducing total CO_2 emissions by 16 % and the total amount of NO_x emissions by 45 %.

The mining company S&B has achieved the following reductions of CO_2 emissions per mine site: 0.2 % in bentonite extractive activities; 10.3 % in perlite extractive activities and 20.9 % in voxite extractive activities. In addition, the petroleum company's motor oil emissions totalled 1.952 million tons in 2008, a

Table 2 Climate change strategies adopted by Greek businesses

Name of business	Political measures	Climate change strategies					
		Emission	trading	Compensation via projects	Installation of less carbon-intensive power plants	Enhanced efficiency of carbon-based power plants	Installation of carbon-free power plants
		Enhanced	efficiency of existing carbon-free power plants				
Halcor S.A.	√	–	–	√	√	√	√
TITAN S.A.	√	–	–	√	√	√	√
S&B S.A.	–	–	–	√	√	√	√
Motor Oil S.A.	√	–	–	√	√	√	√
ELPE S.A.	–	–	–	√	√	√	√
ELVA S.A.	–	–	–	√	√	√	√

reduction of 6 % from 2007. CO_2 emissions were reduced from 0.29 to 0.27 tonnes CO_2 per product. Additionally, energy consumption was reduced by 6 %, and renewable energy resources such as natural gas were used for some industrial activities. The other petroleum company included in the sample—ELPE S.A.—has invested EUR 130 million in environmental infrastructure. In particular, it achieved a 78 % reduction of CO_2 emissions and a 60 % reduction of SO_2 emissions from 2003 to 2008 in industrially utilised vehicles. It uses low-energy equipment with low CO_2 emissions, while also reducing NO_x emissions. Finally, ELVAL S.A. achieved a continuous 6.3 % reduction of energy consumed energy up to 2008. Additionally, it achieved a 1.9 % reduction per product and a 9.7 % reduction per factor on the total CO_2 emissions.

6 Discussion

This paper focus on analysing the current strategies pursued by a set of Greek businesses to address climate change challenges. This study offers some interesting findings. Firstly, it identifies that the businesses included in this study adopt similar climate change strategies to face current challenges. The majority of the businesses selected have adopted climate change strategies, such as the installation of less carbon-intensive power plants and carbon-free power plants, changing to a different fuel in existing carbon-based power plants and enhancing existing carbon-free power plants. For example, in its CSR report, ELPE S.A. states:

> *"We stopped producing lead gasoline in the year 2000, in line with other European countries even though Greece was excluded from this requirement. Furthermore, we provided LRP gasoline for old technology vehicles. Additionally, we supply fuels with low SO_2 (less than 50 ppm)".*

This finding is in line with the work of Weinhofer & Hoffmann (2010), which shows how various European businesses respond to climate change issues. Their work concludes that businesses of different sectors prefer a variety of strategies to address climate change issues. In addition, half of the businesses are members of national or international associations dealing with climate change reductions. This confirms the work of Kolk and Pinkse (2007, p. 255), which shows that the involvement of businesses in international climate change associations aim to *"respond to climate change policy by the adoption of an information strategy to influence policy makers that give direction to the climate change debate."*

The second finding indicates that none of the businesses examined have adopted any of the national or international trading emission mechanisms. This is due to the absence of such mechanisms and the institutions that would implement them in Greece. This finding contradicts the work of Martin & Rice (2010), which suggested that most businesses utilise the trading emission mechanism in order to deal with climate change issues. Similarly, none of the Greek businesses selected adopt such strategies as compensation via projects (e.g. participating in offsetting projects to increase carbon sinks by planting trees).

The third finding shows that, as in Clemens et al. (2008), Greek businesses adopt climate change strategies in order to gain competitive advantages and the *'social licence'* to operate. Most of the businesses believe that environmental strategies (including those dealing with climate change) will help their profile. The CEO of Halcor S.A. states in their CSR report that:

> *"The company's operation is based on the triple bottom line approach. This strategy leads to competitive advantage."*

As presented above, Greek businesses have proactively adopted climate change strategies, contrary to the study of Sullivan (2009) who, in his examination of 125 large European companies, identified that climate change policy was vague, hindering businesses from pursuing more proactive strategies to reduce their emissions. However, this difference could be explained by the fact that some manufacturers of selected businesses, such as Titan S.A. in the USA and Canada, operate in a stricter regulatory environment.

7 Conclusions: Further Research

A range of climate change strategies adopted by six Greek businesses is presented in this paper. The framework analysis is based on the previous literature of business climate change and, specifically, that of Kolk & Pinkse (2007) and Weihhofer & Hoffman (2010). The findings show that Greek businesses have adopted a range of strategies to face climate change issues. In addition, the findings are in line with present international literature.

However, this study provides a range of issues for future research. Some future research questions include:

- What are the cost savings from energy conservation, climate change mitigation and adaptation strategies?
- Would voluntary climate change strategies adopted by businesses reduce future relevant strict legislation?
- Are present institutional infrastructures adequate for businesses to adopt climate change strategies?

Finally, this study reveals that the Greek government does not pursue an innovative and proactive climate change policy. For this reason, the CSR reports published do not extensively discuss the commitments of businesses concerning climate change requirements.

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Facilitators and Inhibitors of Technologies to Tackle Climate Change: Opinions of Government and Private Actors

Irene Gil-Saura, María-Eugenia Ruiz-Molina and Gloria Berenguer-Contrí

Abstract The purpose of this paper is to analyse the facilitators and inhibitors of investing in environmentally friendly technologies from the Spanish hotel perspective as well as to describe the governance initiatives pertaining to this issue. A description of the actions implemented by different Spanish governance institutions is given. Additionally, a survey is conducted to compile information provided by hotel managers on facilitators and inhibitors regarding investments in environmentally friendly information and communication technology (ICT). The results are compared across hotel categories. National governance bodies focus on providing tourist companies with preferential credits, assuming that the main reason for investing in ICT is financing, while hotels point out the importance of several inhibitors against implementing technologies. Differences are found across hotel categories. Additional governance actions are inferred from the results of our research to pursue the sustainability of the Spanish hospitality industry.

Keywords Hospitality · Sustainability · Environmentally friendly practices · Information and communication technology · Governance · Spain

1 Introduction

International institutions, governments and economic agents are aware of the negative impact tourist activities have on the environment. In particular, since Spain is the second most popular tourism destination in the world (UNWTO 2009)

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and tourism development has been quite intensive, hospitality activities have been identified as negatively affecting the consumption of scarce and valuable resources. This is due to the occupation of valuable natural areas by buildings, pressure on natural and cultural heritage, landscape mutations (ecosystem crisis, desertification, forest fires, etc.), impact on water resources, oil consumption for local transportation, and use of materials and financial resources for building infrastructure and tourism equipment. Additionally, the polluting effect of hospitality activities in terms of air, noise and water pollution has been highlighted (Pulido 2004). However, there has been a tendency for tourism businesses to develop with weak strategies, or none at all, to address the issue of environmental sustainability (Hall et al. 2005).

The Davos Declaration, following the UNWTO's 2nd International Conference on Tourism and Climate Change held in 2007, highlighted the urgency for tourism to improve the use of technology (Becken 2008). Due to the magnitude and speed of environmental changes, several initiatives and strategies on climate change governance have been undertaken at the national and local level with a view to engaging different stakeholders on climate change. Notwithstanding, very few studies have addressed the economic, social and political elements of climate change and their links with governance in the tourism industry; little attention has been paid to the role of information and communication technology (ICT) in the tourism industry.

In the present chapter, we aim to explore the facilitators and inhibitors concerning investments in environmentally friendly technologies from the Spanish hotel perspective, as well as to describe the governance initiatives related to this issue. While national governance bodies focus on providing tourist companies with preferential credits, assuming that the main reason for investing in ICT is financing, the results obtained from a sample of Spanish hotels in the major cities show the presence of additional facilitators and inhibitors concerning hotel investments in ICT solutions. According to these results, we provide a set of recommendations for practitioners and policy-makers that may influence decisions on ICT taken by the hospitality industry.

2 Tourism Governance in Spain

Several articles have discussed the industry's applications of sustainable tourism, particularly with respect to environmental guidelines, accreditation programmes, "best practices" and policy creation and implementation (Knowles et al. 1999; Hobson and Essex 2001; Font 2002; Bendell and Font 2004; Tzschentke et al. 2004; Bohdanowicz 2006; Andereck 2009).

In the case of Spain, tourism governance is rather complex. While the Ministry of Industry, Tourism and Trade is in charge of developing strategic plans and implementing actions to promote the image of Spain as a tourist destination in the target markets, the 17 Spanish autonomous regions assume their own competencies in tourism, resulting in different regulations.

In tourism governance, sustainability has been related to quality. Regarding quality, Spain was one of the first European countries to try to provide evidence of hotel quality by regulating hotel categories in 1968. Notwithstanding, 40 years after its first regulation, Spain still classifies its hotels based on criteria that focus primarily on architectural, technical and structural aspects, whereas sustainability is not expressly considered (Hosteltur 2007).

Later, the Spanish Quality System (Q of Quality) was developed. Since 1996, the Q label has enabled specific quality systems to be developed for several tourism subsectors. This label, a visible instrument for tourist establishments in Spain, represents the main initiative for improving the quality of Spanish tourism. However, this quality system lacks an integrated vision for sustainability, and failed to consider the possibility of converging towards other international quality and environmental brands. The Institute for Spanish Tourism Quality is in charge of monitoring the performance of Spanish establishments in terms of quality, and awards the Q label to companies that achieve the appropriate standards (Institute for Spanish Tourism Quality 2010).

Furthermore, an Integral Plan of Spanish Tourism Quality was developed for the period 2000–2006. The objective of this plan was to ensure that Spain remains one of the world's most popular tourist destinations, conveying an image of service quality. Sustainable tourism is defined as one of the basic principles of tourism governance, but not the core principle.

Nevertheless, national plans for promoting the environmental sustainability of tourism companies in Spain are relatively recent, and limited attention has been paid to the role of governance on the implementation of ICT in the tourism industry. The plans proposed by the Ministry of Industry, Tourism and Trade are described below:

- Turismo 2020: This is the Strategic Plan of the Spanish Tourism Board, which is subordinated to the Ministry of Industry, Tourism and Trade, the aim of which is to ensure that the future development of tourism in Spain is based on competitiveness and environmental, social and economic sustainability.
- Plan FuturE Turismo 2010: As a continuation of the Plan Renove Turismo 2009, this is a flexible plan to promote the restoration of Spanish tourist establishments, which is expected to raise competitiveness and enable them to adapt to demand requirements. Special attention is paid to financing such investments, contributing to improving the environmental sustainability of hospitality establishments through energy savings and environmental preservation by implementing quality systems and technology solutions. This budget is earmarked for offering credits to tourism companies to finance their investments under preferential conditions. The Ministry Board approved the previous plan for EUR 400 million in November 2008. Due to huge demand, it was extended by an additional EUR 600 million in May, generating a total volume of investments of EUR 2.1 million.
- Avanza2 Plan: One of the main objectives of the Avanza2 Plan is to contribute to the economic recovery of Spain by the intensive and generalised use of ICT,

with special attention being paid to projects that additionally address sustainability and energy savings. Articulated through several sub-plans according to target beneficiaries (i.e. citizens, ICT companies, SME companies, public administrations, etc.), the funds to invest in ICT solutions offered by this plan are also available to tourist companies. This plan has helped to reduce the digital divide in Spain between urban and rural areas in the use of ICTs (OECD 2009). Indeed, these technologies can help overcome the barriers of physical distance, facilitating access to information and services and improving the quality of life for citizens, since, for instance, rural tourism depends heavily on the internet for communication and reservations.

In addition to these national plans, a number of regional and local initiatives have also been taken. In particular, the regional governments of the Balearic Islands, the Canary Islands, Catalonia and Andalusia have been most active of the 17 autonomous regions regarding governance on environmental sustainability. This is logical, since the Canary Islands and Catalonia are visited by 50 % of tourists to Spain. Aware of the importance of hotels, which accommodate 66 % of tourists, most regional regulations concentrate on restricting the number of hotels authorised to operate in order to guarantee the sustainable growth of the hospitality industry.[1]

By introducing these initiatives, the Spanish government aims to guarantee the environmental sustainability of hospitality companies and, at the same time, to improve the image of these establishments. Indeed, the literature reports wide evidence of the positive influence of environmental practices on customer perceptions of tourist businesses. In this sense, it has been pointed out that customers appreciate environmentally friendly efforts initiated by tourism businesses, such as composting toilet systems, energy-efficient systems, recycling programmes, renewable energy systems, grey-water systems, items made from recycled materials, items made from natural/organic materials and water use reduction programmes (Andereck 2009). Furthermore, 70 % of a sample of US travellers reported the likelihood of them staying at hotels with environmentally responsible practices (Watkins 1994). Some studies identify segments of customers willing to pay more for products and services from travel companies that engage in environmental protection innovations (Travel Industry Association 2003) and, in particular, for environmentally friendly accommodation (Fairweather et al. 2005).

Additionally, consumers from Western European countries (particularly Germany, the United Kingdom, Sweden and Norway) are specially concerned about environmental issues, having well-established programmes that deal with the life

[1] Further details about the main Spanish regional policies can be found at:
Andalusia Regional Government (2010). http://www.juntadeandalucia.es/turismocomercioydeporte
Balearic Islands Regional Government (2010). http://www.caib.es/portaldelciutada/materia.do?lang=es&codmat=5559
Canary Islands Regional Government (2010). http://www.gobiernodecanarias.org/es/temas/turismo/
Catalonia Regional Government (2010). http://www.gencat.cat/.

cycle assessment of products and ecolabelling (Carlson et al. 1996). Therefore, tourists from these countries are more likely to appreciate tourist companies' efforts to pursue sustainability and to demand sustainable tourism services (Tang et al. 2004; Mehmetoglu 2009). Since most tourists in Spain are from the United Kingdom (22 %), followed by Germany, France, Nordic countries and Italy (Ministry of Industry, Tourism and Trade 2010), they are expected to assess positively the efforts of Spanish hotels to implement environmentally friendly technology solutions. In this sense, encouraging this kind of investment means the promotion of tourism from these countries.

3 ICT and Hotels

As in other economic activities, many companies in the hospitality industry have implemented technology solutions to pursue the environmental sustainability of their activities and minimise their impact on climate change. Some applications of ICT may contribute to the reduction of the demand of resources in terms of supplies and energy by hotels, e.g. online promotion and booking, information analysis and report management systems, ERP systems, ICT systems connected to providers, GPS and ambient intelligence, etc., as well as a consequent reduction in pollution. While some of these technology solutions are widely applied by hotels (eBusiness W@tch 2006; Observatorio 2007a, 2007b), others such as ambient intelligence have not yet been intensively implemented.

Nevertheless, Olsen and Connolly (2000) highlight the fact that hospitality companies should use technology in an effective way to immediately satisfy constantly changing customer desires and needs, since companies that are unable to generate this added value across their information systems risk being relegated to price competition. In this sense, ICT can be considered as a source of differentiation. Consistently, Orfila-Sintes et al. (2006) provide evidence in the sense that higher-category hotels are more innovative than lower-category hotels. In this regard, Martínez et al. (2006) emphasise the need to explore in greater depth the current state of information systems in hotel establishments to define their standard and how they should be implemented.

Since more than 80 % of Spanish hotels are small independently owned and managed companies with less than 10 employees (Observatorio 2007a), environmental concern and willingness to act are strongly dependent on the hotel manager's attitude, knowledge and financial situation (Bohdanowicz 2006).

Owing to the small size of most Spanish hotels, tourism governance concentrates on providing financing under special conditions to encourage companies to invest in ICT, assuming that the most important pitfall of technology implementation is financial cost. Notwithstanding, hotel managers also perceive other drawbacks and advantages.

Thus, in order to analyse the facilitators and inhibitors concerning ICT as perceived by Spanish hotels and to test the differential ICT assessment across hotel

Table 1 Reasons for the hotel for using ICT: mean values and ANOVA analysis

	3 stars	4 stars	5 stars	Total	Differences across groups[a]
IT facilitates and expedites the purchase process (time convenience, time savings…)	4.43	4.40	4.11	4.37	3–5
IT solutions enable better monitoring and standardisation of purchasing and delivery processes	3.82	4.35	4.48	4.13	3–4, 3–5
I can access information anytime and anywhere	3.82	4.11	4.15	3.98	3–5
IT solutions provide the opportunity for more benefits (more access to information on special promotions…) than the traditional way with less effort	3.99	4.34	4.07	4.15	3–4
IT provides me with security, reliability and protection against risk	3.73	4.19	4.30	4.00	3–4, 3–5
I love having a choice (between using and not using IT solutions)	3.97	3.00	4.19	3.60	3–4, 4–5
I have a good time using IT solutions, they are good entertainment	3.84	3.01	4.04	3.52	3–4, 4–5
Using IT solutions, any task requires less effort	3.84	4.26	4.15	4.06	3–4, 3–5
IT allows me to obtain proof of the transaction to facilitate claims if necessary	3.76	4.20	4.07	3.98	3–4, 3–5
IT solutions allow me to avoid employee interaction	3.62	3.96	3.96	3.81	3–4

[a] The Tukey post-hoc multiple comparison test was used to test for the significance of differences between types of retailers. Only the statistically significant differences between groups at the 5 % level are shown

categories, we conducted a personal survey of managers of 3-, 4- and 5-star hotels in Spain. Hotels in the three biggest Spanish cities and main tourism destinations (i.e. Madrid, Barcelona, Valencia and Alicante) were identified in Visitingspain.es. 200 valid questionnaires were collected between June and September 2009.

The questionnaire includes reasons for and against implementing ICT solutions usually implemented by hotels, as identified by Weber and Kantamneni (2002), Dabholkar et al. (2003) and Observatorio (2007a, 2007b). Assessments are rated on a 5-point scale ranging from “strongly disagree” (1) to “strongly agree” (5).

To assess the differences in the importance of facilitators and inhibitors across 3-, 4- and 5-star hotels, mean values are calculated for each assessment in each hotel category and an analysis of variance through the Tukey post-hoc multiple comparison test is performed (Tables 1 and 2).

Regarding the reasons for the hotel for using ICT solutions, the most valued item is the efficiency gains offered by ICT (4.37), followed by the opportunity of greater benefits (4.15) and the monitoring and standardisation of purchasing and delivery processes (4.13). On the contrary, the hedonic value of ICT scores the lowest (3.52). All items show values above the midpoint of the scale, meaning that hotels managers consider many advantages in adopting ICT solutions.

As far as differences across hotel categories are concerned, there is a generally better assessment of the advantages of ICT solutions in upscale hotels (i.e. 4- and 5-star

Table 2 Reasons for hotels not to use ICT solutions: mean values and ANOVA analysis

	3 stars	4 stars	5 stars	Total	Differences across groups[a]
I am not familiar with technology in general	1.97	1.27	1.11	1.56	3–4, 3–5
I have to invest too much time in learning and managing IT solutions	2.16	1.32	1.19	1.68	3–4, 3–5
This technology is not yet available for all products	2.32	2.08	1.19	2.07	3–5; 4–5
I have difficulty in solving problems that may arise/ I do not feel confident	2.30	1.34	1.26	1.76	3–4, 3–5
I miss personal contact	2.63	3.42	2.11	2.89	3–4, 4–5

[a] The Tukey post-hoc multiple comparison test was used to test for the significance of differences between types of retailers. Only the statistically significant differences between groups at the 5 % level are shown

hotels) compared to in 3-star hotels. Therefore, the higher category hotels find it more useful to incorporate ICT and expect more benefits from it than lower category hotels.

Similarly, we examine the main reasons for not using ICT solutions, according to hotel manager perceptions (Table 2).

Regarding the reasons for the hotel not to use ICT solutions, the most important drawback is the lack of personal contact (2.89), followed by the unavailability of technology (2.07) and the difficulties in solving potential problems (1.76). In contrast, the lack of familiarity with ICT scores the lowest (1.56). Therefore, hotel managers are quite keen on ICT and do not have difficulties in dealing with such solutions. Most items show values below the midpoint of the scale, meaning that hotels managers experience no serious difficulties in adopting ICT solutions.

Again, and in line with the results obtained for the reasons for using ICT solutions, there are significant differences across hotel categories in the sense that lower category hotels are more concerned about the use of ICT solutions than upscale hotels.

4 Conclusions

The major and rapid changes taking place in Spain as a result of both internal dynamics and economic globalisation processes require specific and differentiated strategic action in the tourism sector regarding sustainability. Although sustainable tourism for the salvation of the coast is a priority for tourism governance in the short term, adaptation to climate change must also be considered to restructure the tourism industry and maintain leadership as one of the world's main tourist destinations.

To achieve these aims, ICTs are important in all business processes to gain competitiveness in an increasingly globalised market, as well as to guarantee sustainability. In particular, ICT solutions can be useful in managing waste, as well as concerning energy and water consumption. In this sense, tourism companies have at their disposal a wide range of technological solutions that can be used to improve the efficiency of their internal processes, as well as to increase customer satisfaction. Additionally, ICT solutions such as intranets and extranets allow hotels to monitor internal waste management and energy consumption, to improve communications with their stakeholders and to create communities to share information about successful environmental practices.

In general, there has been a remarkable effort made by Spanish tourism companies to invest in technology, adopting ICT before the other economic sectors (eBusiness W@tch 2006; Observatorio 2007a, 2007b). Thus, tourism hospitality companies have recognised the opportunities offered by ICT. Nevertheless, the implementation of technology by hotels differs across ICT solutions and, in this sense, tourism governance has assumed the role of encouraging hotel investments in technology through preferential financing conditions.

Notwithstanding, according to the results obtained from a survey among Spanish hotel managers, we propose a set of recommendations for tourism governance based on emphasising the benefits of ICT investments and reducing the negative perception of technology drawbacks:

– Disseminating information about public and private initiatives to encourage the implementation of environmentally friendly ICT by hotels (i.e. trade fairs on ICT, training and conferences). In this way, hotel managers would access further information about technology implementation and consider the possibility of taking advantage of these opportunities.
– Ecolabel recognition for Spanish environmentally friendly hotels: similarly to the Q label of quality, the creation of an ecolabel to be awarded to environmentally friendly hotels could be implemented. Special promotion actions could be developed for ecolabel hotels to target foreign markets highly concerned about environmental issues. On the other side, communication campaigns addressed to hotel managers concerning the advantages of targeting environmentally aware tourists from abroad (e.g. potentially higher purchasing power and willingness to pay more for a "green" hotel in comparison to conventional services) and the benefits of the ecolabel should be undertaken.
– Networking: in line with Wallis and Woodward (1997), hotel managers should keep in touch with providers and customers to find out about the latest ICT advancements and to solve the specific problems of environmental management ICT. In this sense, it makes sense for governance to stimulate such networks.

In general, due to the inherent complexity of some ICT solutions, there is a low level of understanding of the possibilities offered by these tools, the way they work and the value they can provide to hotel managers (Magnini et al. 2003), specially concerning environmentally friendly practices. In this regard, tourism governance should not only guarantee easy access to financing, but also provide information on training, concentrating on the lower hotel categories, which are more sensitive to ICT drawbacks and less able to appreciate the advantages of implementing the technology.

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