Cities and Climate Change:

The role of institutions, governance and urban planning

Report prepared for the World Bank Urban Symposium on Climate Change

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Part I: Introduction

It was in the early 1990s that municipal authorities first began to engage with the issue of climate change. In this first wave of activity, individual cities and transnational municipal networks – ICLEI’s Cities for Climate Protection (CCP), the Climate Alliance and Energie-Cities – started to mobilize action for reducing emissions of greenhouse gases (Kern and Bulkeley 2009). In the main, national governments and the emerging international regime for governing climate change showed little interest in these activities at this stage (Bulkeley and Betsill 2003; for an exception see Sugiyama and Takeuchi 2008: 425). This first wave of municipal action on climate change was dominated by the activities of a few pioneer cities, predominantly in North America and Europe, and focused on the challenge of climate change mitigation (Bulkeley and Betsill 2003; Bulkeley and Kern 2006; Alber and Kern 2008). The past decade has witnessed a new wave of municipal action on climate change mitigation in which transnational municipal networks have grown and multiplied, while a more geographically diverse range of cities have become involved in addressing this issue. In Australia and North America, the increasing mobilization of municipalities – through forums such as the US Mayors Climate Agreement and ICLEI’s CCP programme – has in part been due to dissatisfaction with the level of political engagement at a national level. The emergence of the C40 Cities Climate Leadership Group and the Rockefeller Foundation Climate Change Initiative, together with the continued work of ICLEI, is leading to the increasing involvement of global and mega-cities in the urban climate change agenda. At the same time, the predominant focus on mitigation is giving way to the emergence of municipal climate policy in which both mitigation and adaptation are considered significant.

The research and evidence base is lagging behind this new trend. The earliest work on local climate policy and governance was conducted in the mid-1990s (e.g Collier 1997; DeAngelo and Harvey 1998; Harvey 1993; Lambright et al. 1996;) and a large body of research work has now been accumulated (for a review see Betsill and Bulkeley 2007). However, this research has tended to focus on mitigation and on individual case-studies, predominantly in cities in the US, Canada, Europe and Australia (e.g. Allman et al. 2004; Betsill 2001; Bulkeley 2000; Bulkeley and Betsill 2003; Bulkeley and Kern 2006; Davies 2005; Lindseth 2004; Kousky and Schneider 2003; Yarnal et al. 2003), although there has been important work conducted in Asia, South Africa and Mexico (Bai 2007; Dhakhal 2004, 2006; Holgate 2007; Romero Lankao 2007) and the initiation of work on urban climate adaptation in the global south (e.g. Alam and Rabbani 2007; Huq et al. 2007; Satterthwaite et al. 2008). There has also been a tendency to focus on ‘leaders’, those cities which have been first-movers on the issue of climate change, whatever their significance in political and climate terms, with the result that we know little about the particular challenges
for global and mega-cities – which may be both the most significant in carbon terms and the most important in relation to the impacts of climate change – and how climate change is being addressed in ‘ordinary’ cities across the world. This research agenda may be particularly challenging for, as Bai and Imura (2000, cited in Bai 2007: 22) found, environmental issues facing today’s developing cities are complex in nature, as poverty related issues, industrial-pollution-related issues, and consumption- and lifestyle-related issues are manifesting themselves in a telescoped, compressed manner.”

In this context, the aim of this report is to provide an overview of the current state of knowledge about urban governance and planning for climate change. In undertaking this comparative review, the report provides a synopsis of the issues that are facing cities with respect to climate change mitigation and adaptation, in the north and in the south. While both rooted in the global problem of climate change, the challenges of mitigation and adaptation are significantly different. Mitigation – reducing emissions of greenhouse gases – has predominantly been driven by international and national policy agendas, and has focused on a few energy intensive sectors (e.g. energy, transportation). In contrast, adaptation is necessarily more locally differentiated, and involves a wider range of sectors and actors, operating across a range of timescales from very immediate issues of disaster relief to long term investment decisions (McEvoy et al. 2006: 188). While at the international level, countries in the global south have argued for adaptation to be placed higher up the climate change agenda, somewhat surprisingly at the municipal level mitigation has remained the priority for cities north and south. Recognizing these different agendas and the challenges they bring, in this report we first review the literature to ascertain the challenges of urban governance and planning for climate change mitigation (Part II), before considering those issues that have been documented in urban responses to adapting to climate change (Part III).

In Part IV, we examine the lessons that can be learnt for addressing mitigation and adaptation through original research on ten case-studies of climate change responses in cities in the “+8” countries – those countries regarded as most likely in the policy arena to be subject to some form of commitment to address climate change in any post-2012 international agreement. It is important to recognize at the outset that these industrializing countries do not serve as a proxy for all cities in the global south, and nor can the particular challenges facing each of these cities necessarily be translated into more generic lessons for cities worldwide. Nonetheless, given their potentially significant contribution to global greenhouse gases in the medium to long term, and their vulnerability to climate change, the responses of such cities to the climate change agenda represents an important but hitherto neglected area for research. Furthermore, as we discuss in detail below, some common trends can be discerned across these cities with
respect to the challenges of addressing climate change that will have relevance to other industrializing cities and which may have wider implications. The case-studies – of Beijing, Cape Town, Hong Kong, Yogyakarta, New Dehli, Melbourne, Mexico City, Mumbai, Sao Paulo, and Seoul – were conducted during the period May 2008 – January 2009. While previous case-studies of climate change responses have focused on ‘leaders’, our selection criteria – major cities in the +8 countries – means that this sample includes cities in which climate change is high on the agenda and cities in which climate change is a low priority. This range of cities therefore provides insights into both the drivers and the barriers of addressing climate change at the municipal level. In each case, extensive desk based research was undertaken, involving the review of policy documents, website materials and local press coverage. For five case-studies – Beijing, Hong Kong, Jogyakarta, Melbourne, and Mexico City – this was supplemented by field research, involving between twelve and twenty interviews with policy makers and other stakeholders in each case.

Drawing on this research, we examine climate change responses in three arenas; the built environment; urban infrastructures; and transportation. In each area of activity, we assess the different means through which governing climate change is being achieved. Research has shown that a range of modes, or ways, of governing are employed by cities to address climate change (Bulkeley and Kern 2006). Four modes appear to be particularly significant in terms of the role of municipal government: self-governing, the capacity of local government to govern its own activities; provision, the shaping of practice through the delivery of particular forms of service and resource; regulation, the use of traditional forms of authority such as regulation and planning law; and enabling, the role of local government in facilitating, co-ordinating and encouraging action through partnership with private and voluntary sector agencies, and to various forms of community engagement. Each mode is distinct in terms of the type of governing capacity bought to bear. Self-governing relies on processes of organisational management, governing by provision is accomplished through practical, material and infrastructural means, governing by regulation through the use of enforcement and sanction, and governing through enabling through persuasion, argument and incentives. In this report we identify an additional mode of governing, partnership, in which non-state actors work together with state actors in order to address climate change through providing information, undertaking voluntary action, and implementing projects. We examine the drivers and barriers of climate change responses in these cities, and consider their implications.

Part V concludes the report with an examination of the implications of our research review and case-studies for urban governance and planning for climate change. In summary, we find that, even amongst those cities in the global south for which research evidence is available, there
remains a strong bias in municipal action towards climate change mitigation rather than adaptation. This has been driven by international and transnational agendas, opportunities for demonstrable leadership, relevant municipal competencies, access to (external) funding, and opportunities to frame climate change as a means of addressing other local concerns (e.g. energy security, financial savings, urban air pollution). However, cities face considerable barriers in addressing climate change, notably in co-ordinating policy action, accessing sufficient resources, operating in the context of national frameworks which do not always facilitate local action, and in the often conflicting aims of climate protection and economic growth. Our case-studies reveal that while there is significant potential for addressing climate change across the built environment, transport and infrastructure sectors, in the main efforts to date have been piecemeal. That this is the case even in cities which have at least a minimal level of governance capacity and often quite significant resources for regulating, providing services and enabling stakeholder engagement is of evident concern. In low income countries and cities with minimal if any urban governance capacity, the challenges of addressing climate change will be of a different order. We close the report by offering some lessons which can be derived from our review and case-study research, primarily for rapidly industrialising cities in the global south, and recommendations for municipalities, national governments and external partners.
Part II: Urban Policy and Action for Climate Change Mitigation

The main focus of both urban policy and research with respect to climate change has been on the issue of climate change mitigation – that is, on the reduction of greenhouse gas emissions from urban activities. Cities represent concentrations of economic and social activity which produce emissions of greenhouse gases, in particular carbon dioxide. Given that “by some estimates, cities account for 78% of carbon emissions from human activities” (Stern Review 2006: 457), commentators and urban policy-makers have highlighted the potentially significant role that cities might play in addressing the mitigation challenge. Others have critiqued these figures, and the implicit arguments that all cities are equally culpable and that it is cities – rather than those that live in them – that are responsible for emissions of greenhouse gases (Satterthwaite 2008a). However, in an increasingly urbanizing world with emissions producing activities concentrated in cities, the question of how municipal authorities and other actors might intervene in order to reduce their impact remains a significant one.

If urban emissions of greenhouse gases can be considered part of the climate change problem, municipal action may also be part of the solution. Municipal governments have a (highly variable) level of influence over emissions of greenhouse gases through their roles in energy supply and management, transport, land-use planning, and waste management. Some local authorities focus on emissions over which they have direct control (municipal emissions) while others focus on so-called community-wide emissions. In general, municipal emissions account for only a small percentage of the overall greenhouse gas emissions from a city (in the order of 1-3%), though where a municipality owns the energy or water supply company, such as is the case in Los Angeles, this proportion can rise considerably. In the energy sector, emissions reductions have been achieved through retrofits in commercial, domestic and municipal buildings, by switching traffic lights to LEDs, improving street lighting, and purchasing green energy. In the transport sectors, municipalities have sought to increase the number of hybrid cars in their municipal fleets and in some places to implement transport planning policies which encourage alternatives to the private car. Land use planning has been used to promote the inclusion of renewable energy and energy efficiency measures in new buildings, and in some cases to mandate particular standards for domestic and commercial buildings. In the waste sector, municipal authorities have increased programs for recycling and composting and have developed projects to capture methane at landfills (Bulkeley and Betsill 2003; Bulkeley and Kern 2006). Of all these possibilities, Schreurs (2008: 353) finds that:
“the kind of climate change initiatives that local governments can most easily do appear to be such activities as climate change and renewable energy target setting, energy efficiency incentive programs, educational efforts, green local government procurement standards, public transportation policies, public–private partnership agreements with local businesses, and tree planting.”

While some municipalities have developed a systematic approach to climate policy, through the stages of undertaking inventories of GHG emissions, determining emissions reduction targets, climate change action plans and various implementation plans, “numerous cities, which have adopted GHG reduction targets, have failed to pursue such a systematic and structured approach and, instead, prefer to implement no-regret measures on a case by case basis” (Alber and Kern 2008:4; see also Jollands 2008). Despite the range of GHG emissions reductions activities that municipalities could engage with, research has found that “attention remains fixed on issues of energy demand reduction” (Betsill and Bulkeley 2007: 450; see also Bulkeley and Kern 2006), and primarily orientated around municipal emissions. The remainder of this section reviews the research evidence as to why this is the case, and examines the factors that are important in influencing the development and implementation of urban governance and planning for climate change mitigation.

2.1 Science and knowledge for urban climate change mitigation

The development of the science of climate change has been a critical factor shaping the involvement of municipal authorities in mitigation efforts. In the main it has been the developing international scientific consensus on climate change and the consequent international and national targets for emissions reductions that have been most important for local authorities. For example, in Sweden approximately “half of all municipalities have adopted climate mitigation goals in accordance with the national objective of reduced climate impact as formulated in the Swedish climate strategy” (Granberg and Elander 2007: 545), while in Japan “about one third of the local governments adopted the national reduction target of the Kyoto Protocol (a 6% reduction of 1990 CO2 levels by the period 2008-2012)” (Sugiyama and Takeuchi 2008: 433). Transnational municipal networks, such as ICLEI CCP, C40 and the Climate Alliance, have also promoted international norms regarding climate science and the need for significant cuts in emissions of greenhouse gases. The ‘trickle down’ of climate science and policy targets to the local level has been important in giving municipal authorities a sense of being part of a broader movement for addressing climate change. However, whether such targets are feasible
locally is rarely questioned, potentially leading to a situation in which strategic ambition is not met by action on the ground and resulting accusations of policy failure.

In contrast, for some local authorities, the development of ‘local’ knowledge about the impact of urban activities on the global climate has been important. Local emissions inventories and scenarios have been an important element of urban climate change mitigation efforts, and given impetus by transnational municipal networks such as ICLEI CCP, the Climate Alliance and most recently C40 for whom such inventories are often the first stage of a process of developing local climate change action plans and measures (Betsill and Bulkeley 2007). While the methodology varies between networks, and between municipalities, the predominant approach has been one of down scaling national emissions profiles to the local level to reflect the make-up of local populations, infrastructures and economic activity. While such an approach can give a broad-brush picture of where concentrations of GHG emissions originate locally – and therefore where effort for reducing emissions might be concentrated – national data can have limited validity in some local circumstances, due to its very nature as ‘average’ data. An alternative approach involves the gathering of local data (e.g. on energy supply and use, transport patterns, building stock) and the ‘bottom-up’ development of an emissions inventory. Several local authorities have developed this approach for their municipal emissions, but the challenges of gathering this sort of data at the community-wide level have been regarded as intractable by the majority of municipalities. One exception is Newcastle, Australia (see Bulkeley 2000; Bulkeley and Betsill 2003), where real-time data on community-wide GHG emissions is provided on the internet, on a billboard in the city and in a weekly news report (see Box 1).

However, despite a handful of examples that demonstrate that it is possible to create localised models of GHG emissions, problems remain significant for most local authorities, and particularly those in the global south (Allman et al. 2004; Lebel et al. 2007; Sugiyama and Takeuchi 2008: 432). One critical issue is the availability of data. In many cities, data concerning the nature of the energy standards of buildings, daily travel patterns, and energy consumption are not routinely collected. In cities where a large proportion of the population live in informal or illegal settlements, the lack of data will be acute. For example, in a study of the implications of urbanization for the carbon

**Box 1 – ClimateCam, Newcastle, Australia**

“The world’s first greenhouse gas speedometer, ClimateCam was created by Newcastle City Council in 2001 and measures the greenhouse gas emissions in the Newcastle local government area. Consumption data and the equivalent greenhouse emissions from electricity are updated hourly and reported online at ClimateCam.com and on the ClimateCam Billboard.” (NCC 2008a and NCC2008b).
footprint of Chiang Mai, Lebel et al. (2007: 111) found that “the consequence of these various processes on overall carbon stocks, fluxes and balances could not be estimated with much precision in this study, because of limitations of adequately disaggregated or relevant local data on emission factors.” Nonetheless, they were able to identify trends of a decreasing role of methane locally with the decline in rice growing, and an increasing proportion of emissions from the energy and transport sectors. One area in which data availability may be improving is with respect to air pollution, as cities seek to provide daily information and forecasting of air pollution levels. In some cases, this could act as a proxy for levels of GHG emissions from the transport sector. Even where data is collected, much of it is not available in the public realm as it is held by private utility companies who regard it as commercially sensitive. This has been a critical issue for local authorities in the UK, who have long campaigned for access to locally relevant data on energy supply and consumption (Allman et al. 2004).

The sheer variety of approaches being developed to profile and forecast emissions of GHG locally mean that it is difficult to compare the activities of one city (or set of cities) with another, or to reach general conclusions about the efficacy of municipal action (Alber and Kern 2008; Jollands 2008). At the same time, the emphasis on emissions inventories as the first step for climate change strategies and action locally may be misplaced. While many municipalities have, understandably, placed an emphasis on the importance of being able to measure progress and demonstrate results, the actions required to reduce emissions of GHG locally – increasing energy efficiency, switching energy sources, and reducing demand for energy (in both buildings and for travel) – are well known. In this regard, municipal authorities could be secure in the knowledge that interventions to address these three issues will have an effect on local emissions of GHG, without undertaking complex, lengthy and costly processes of data collection and analysis. At the same time, focusing attention on the technical challenges of addressing climate change locally – of acquiring more data and more local knowledge – may distract from the deeper challenges of building local capacity to develop and implement policy to which we now turn.

2.2 Local governance capacity for urban climate change mitigation

The factors which shape local capacity to address climate change have been documented by a range of authors (Betsill and Bulkeley 2007; Bulkeley and Betsill 2003; Bulkeley and Kern 2006; Collier 1997; Alber and Kern 2003; Schreurs 2008). The four factors most commonly identified are: leadership; municipal competencies; resources; and urban political economies. Here, we review each in turn.
2.2.1 Leadership

Leadership has been identified as a key factor shaping local capacity to act on climate change in two ways. First, in terms of the role of individuals as leaders within a municipality. Studies of municipal climate change mitigation have frequently pointed to the roles of policy entrepreneurs and political champions in establishing climate change as an issue on municipal agendas and taking forward innovative action (Bulkeley and Betsill 2003; Bulkeley and Kern 2006; Qi et al. 2008; Schreurs 2008). However, these studies also suggest that individuals can only take climate change action so far, for “while policy entrepreneurs are critical at the start of a policy process, in order to overcome the constraints of administrative structures, party politics and political timetables, and to survive the loss of particular individuals, a broader institutional capacity for climate protection is necessary (Bulkeley and Kern 2006: 2253). This suggests that the degree to which policy entrepreneurs and political champions can institutionalize the climate change agenda is critical to local governance capacity.

The second way in which leadership has been an important factor shaping municipal responses relates to the opportunities available for municipalities to perform leadership roles with respect to their peer communities. For example, the ability of London to position itself at the forefront of the movement of ‘global’ cities to address climate change through the formation of the C40 network gave strength to internal policy commitments to address climate change (Bulkeley and Schroeder 2008). Likewise, transnational municipal networks such as ICLEI CCP or the Climate Alliance have provided opportunities for municipalities to lead – for example, to be the first to complete a particular performance measure, or to develop particular projects – and have also developed means of recognizing and rewarding leadership – including the Climate Alliance Climate Star award and CCP Australia’s ‘outstanding council initiative’ award. These opportunities and means of recognition provide both the incentives and reward for municipalities to take action, and serve to embed responses to climate change within a wider municipal culture.

2.2.2 Municipal government competencies and responsibilities

The competencies of municipal government – their powers and duties - in the key sectors of energy, transport, planning and waste have been found by most authors to be critical in shaping the capacity for local climate change policy and action (Betsill and Bulkeley 2007). In
many countries, these competencies are defined by central or regional governments and are
delegated to local authorities. In the main, local governments have limited powers and
responsibilities with respect to environmental taxation, energy supply and the supply of
transport infrastructures (Jollands 2008; Lebel et al. 2007; Schreurs 2008: 353; Sugiyama and
Takeuchi 2008: 425). The role of national government, and of relations between local and
national government, in shaping urban climate governance can therefore be critical. For
example, the introduction by Japan of a mandate for local and regional governments to create
climate change action plans (Sugiyama and Takeuchi 2008: 426) and the devolution of
responsibilities for urban transportation in both the Netherlands and in France (Crass 2008: 7-8)
have built local capacity for acting on climate change. We return to this issue in our discussion
of multilevel governance below (Section 2.4).

The importance of national policy, and of central-local relations, does not mean that municipal
governments lack any significant competencies with respect to climate change. As Sari (2007:
150) argues, while “the Governor of Jakarta and the Mayors of the municipalities in Jakarta
have no say in … energy policy … [they] may be able to take on some measures that lead to
increased efficiency. For example, they can set energy standards for buildings in the city at
certain level of efficiency, or the public use of energy.” In China, “for more than a decade, local
governments have possessed primary responsibility for the enforcement of environmental-
protection regulations. A wide range of environmental-policy measures, including authority to
levy taxes on coal burning, to subsidize cleaner energy sources, and to issue local regulations
that supplement national laws and administrative regulations, are at their disposal” (Koehn
2008: 59). These examples demonstrate that municipalities have competencies both to shape
their own emissions profiles, and through the use of a ‘regulation’ mode of governance can
affect the emissions generated at the local level by a range of actors and activities.

Municipalities that have specific competencies for the direct provision of waste, transport, or
energy services, such as is the case in many northern European countries, can have significant
capacity to address climate change that other local authorities lack (Bai 2007: 21; see also
Bulkeley and Kern 2006; Granberg and Elander 2007). However, there is evidence that many
local authorities go beyond their delegated competencies in taking on responsibilities for the
provision of services for their residents and businesses. For example, Melbourne, Australia, has
been involved in ‘Community Power’, a purchasing scheme involving five local authorities in the
north Melbourne suburbs making green power (supplied by renewable sources of energy)
available for residents at a subsidized rate. In London, the Greater London Authority has
established a Green Concierge service which supplies advice and assistance with domestic
energy efficiency measures (Bulkeley and Schroeder 2008). These forms of ‘provision’ intersect
with the ‘enabling’ mode of governance, in which municipalities seek to facilitate the actions of others in order, in this case, to reduce emissions of greenhouse gases. Research in the UK and Germany found that this mode of governing climate change locally was dominant amongst municipalities, and that this in turn created “particular capacity challenges for local government: to create financial incentives for action; to persuade others of the need for action; and to co-ordinate action across different arenas and sectors in order to generate new governing capacities.” The capacity challenges facing municipalities with respect to their competencies and responsibilities are therefore only partially derived from their relation with national government, but also dependent on their relation with other partners, and on the ability for local governments to create an “enabling environment for local civil-society action” (Satterthwaite 2008b: 9). Box 2, which profiles the case of Rizhao City in China, demonstrates that high levels of capacity to act on climate change can be achieved when competencies for regulation, provision and enabling coincide.

\[ \text{Box 2 – Developing Capacity in China} \]
“Rizhao City in China started introducing solar water heaters in the early 1990s. After 15 years, 99% of households in the central districts of the city use solar water heaters ... Seizing the opportunity of rapid growth of the city, the city government has made it mandatory for all new buildings to install solar water heaters at the design and construction stage, in addition to its efforts in enhancing and showcasing awareness.” (Bai 2007: 24)

2.2.3 Resources

A third set of issues which have been related to municipal capacity for governing climate change locally relates to resources – the financial and human assets which local authorities can deploy in relation to addressing climate change. In many municipalities, the officer responsible for climate change policy carries a large portfolio of environmental issues. Holgate’s (2007) study of climate change policy and action in Johannesburg and Cape Town demonstrates how limited human resources can make a significant difference to the extent and efficacy of measures to address climate change. In Cape Town, the comparatively well-resourced municipality was able, with the help of additional resources from outside the local authority, to make significant advances in tackling the issues while in Johannesburg one officer was responsible for addressing the range of environmental challenges facing the city, and, at least partly as a result, the response to climate change was minimal.

Financial resources are also critical. At the most basic level, whether local authorities have sufficient resources to provide the services for which they are responsible can be a critical issue.
Satterthwaite (2008b) draws attention to the problem of a lack of municipal finance for providing basic infrastructures and the consequent implications for adaptation. This lack of service provision, he goes on to argue, reflects “local governments lacking the resources to meet their responsibilities – and often with very limited capacities to invest (as almost all local revenues go to recurrent expenditures or debt repayment). These inadequacies often reflect local governments that are unrepresentative, unaccountable and anti-poor – as they regard the population living in informal settlements and working within the informal economy as ‘the problem.’” (Satterthwaite 2008b: 11). While adequate and resilient infrastructures are, as we discuss below, critical for adaptation, this is also a key issue in relation to the mitigation of climate change for investment in low carbon energy and transport infrastructures is a critical challenge for most cities. Equally, while this problem of a lack of finance for basic service provision is acute in many cities in the global south, it is also a challenge confronted by municipal governments in the north. For example, in the UK, local authorities are bound by strict central government controls over their finances and their ability to provide capital for infrastructure projects and service provision is limited. At the same time, as Bulkeley and Kern (2006: 2251) argue, increasing pressure on local government finances in Germany and the UK has meant limited funding is available for even small-scale projects.

In this context, several studies of climate change policy and action in cities in the north have demonstrated the critical role of being able to secure additional funding in providing the impetus from a shift from good intentions and strategic objectives to action on the ground (Bulkeley and Betsill 2003; Bulkeley and Kern 2006; Granberg and Elander 2007). Two sources of funding have been critical here – external and internal. The ability to secure funding from external sources – from national governments, the European Union, or charitable foundations – has been shown to make a significant difference in the local capacity to address climate change. Granberg and Elander (2007) in their study of Swedish municipalities and climate change policy found that such funding was easier to secure for those authorities that already had significant capacity (in the form of human resources) in place. As a result, both positive and negative cycles can be established so that those municipalities who have secured external funding are able to continue to win resources, while those without remain outside of the climate policy loop. In terms of securing internal funding, here the key factors seem to be the presence and ability of individual political champions or policy entrepreneurs. These individuals have often been responsible for establishing novel financial mechanisms within municipalities. Such schemes, such as revolving energy funds (where financial savings from energy efficiency are reinvested in energy conservation or other climate change projects) or energy performance contracting (where external organizations invest in energy efficiency measures and profit from the financial savings made) (see e.g. Bulkeley and Kern 2006, Bulkeley and Schroeder 2008) can
be invaluable in overcoming the “inflexible budgetary structures” (Jollands 2008: 5) for which municipal authorities are usually renowned.

2.3.4 Urban political economies

Analyses of the factors shaping local responses to climate change have shown that rather than being reducible to the factors of committed individuals, municipal competencies and resources, local capacities to respond are also a matter of political economies and of political will. This is because “rather than being a technical issue ... the interpretation and implementation of climate protection locally is a political issue, where different actors and groups seek to have their understanding of the problem, and its solutions, acted upon” (Bulkeley and Betsill 2003: 185).

A key aspect of the urban political economy of climate change mitigation relates to the priority which it is accorded locally, an issue which is regarded as being particularly significant in the context of the global south due first to the limited resources and pressing agendas of meeting basic needs (Bai 2007; Jollands 2008; Romero Lankao 2007) and second to broader questions of responsibilities and of development. As Lasco et al. (2007: 84) explain, “for many developing countries GHG mitigation has a negative connotation because of the perception that this will deny them of their basic right to growth in human services and economic activities; the prospects of “reduced growth” or “no growth” are not feasible.” Such tensions are, however, also discernible in the politics of addressing climate change within cities in the north. In the US, for example, Zahran et al. 2008 observe that it is communities most likely to be affected by the impacts of climate change, and those with a ‘liberal’ political constituency in which climate change mitigation is likely to be prioritized. In their study of climate mitigation and transport policy in Cambridgeshire, Bulkeley and Betsill (2003) found that efforts to reduce the demand for travel and hence of GHG emissions locally had been confounded by the priority given to economic considerations within transport and land use planning and the stress on the need for increasing travel demand in the county.

In contexts of ambiguous or overtly hostile responses to local climate change mitigation initiatives, a key factor in building capacity has been the ability of municipalities and other local actors to reframe climate change as a ‘local’ problem and/or one that will have significant additional benefits (Betsill 2001). One explicit example of this process can be drawn from China, where until recently addressing climate change was “not a factor in the performance evaluation system” of local officials and “mitigation efforts were believed to slow economic growth” so
that it was “no wonder that local governments had no interest in taking serious actions to address rising greenhouse gas emissions (Qi et al. 2007: 380; see also Koehn 2008: 60). However, recent reforms have involved provincial governments establishing performance evaluation systems with respect to carbon emissions reduction and energy conservation and linking “performance evaluation to the promotion of local government officials and even leaders of state-owned enterprises (SOEs) (Qi et al. 2007: 385). This ‘reframing’ of the climate change problem as one of immediate interest to state officials demonstrates the potential for ‘localising’ climate change. Bai (2007: 26) argues that there are plenty of ‘local’ hooks upon which responding to climate change might be hung within cities in the global south, including “air pollution control, solid waste management, urban development and growth management, transportation and other infrastructure development, to name a few.” Other studies suggest that is this process of reframing, ‘localising’ or ‘issue bundling’ (Koehn 2008: 61) that has been effective in mobilising local action on climate change in cities in the global south, and that this will remain an important aspect of building local capacity to act (Lasco et al. 2007; Romero Lankao 2007). Historically, this process of linking climate change to other pertinent local issues – air quality and urban ‘liveability’ – was also significant for cities in the north, and formed the basis for the approach of transnational municipal networks such as ICLEI during the 1990s and early 2000s. However, such a strategy is not without its limitations. Framing climate change with respect to particular local problems can be a means for narrowing the agenda in such a way that only those aspects of the issue on which consensus can be reached – for example energy efficiency – are addressed and more fundamental issues – often connected to the need to reduce demand – are ignored. This may provide a short-term means by which to get climate change on the agenda and pick the ‘low hanging fruit’, but this may in turn rule out more controversial, and perhaps fundamental, areas of emissions generation from consideration. More recently it appears that municipalities in the north may be signing up to address climate change for its own sake, with less emphasis on the other local benefits it can bring. This strategy may place more fundamental questions of growth, demand and consumption on the agenda, but whether or not it can be effective in achieving action on the ground remains to be seen.

2.3 Urban development and the challenges of planning for climate change mitigation

In addition to the general issues of local capacity for governing climate change, particular challenges arise for climate change mitigation with respect to urban planning: addressing
patterns of urban development (including sprawl and illegal and informal housing settlements), and developing low carbon infrastructures.

2.3.1 Urban development patterns

The geographies of urban sprawl, and in particular the increasing distances between work and living in the city, is seen to be contributing, alongside rising affluence and changing expectations, to the growth in the use of private motorized transport in cities across the world. For example, in Chiang Mai, Lebel et al. (2007: 101) found that “The ribbon and spike sprawl pattern of urban and commercial development … together with growing economic prosperity, has … created a surge in personal vehicle use for going to and from work and markets. Motorcycle and passenger vehicle registrations have soared for three consecutive decades as households pass the thresholds where they can afford or expect the convenience of personal vehicles … between 1970 and 2000 the number of both registered passenger cars and motorcycles increased more than twenty-fold while population only doubled. The number of pick-up’s, minivans and light trucks increased more than forty times”. In Yogyakarta, “the transport sector emerges to become the “carbon time bomb”, being the fastest growing fossil fuel consuming sector in the city”.(Sari 2007:129), in a context where “non-motorized transport modes such as the “becaks” (peddycabs) have been banned” due to their perception as insufficiently ‘modern’ for municipal aspirations for the city (Sari 2007: 137). However, a new ‘busway’ system has been developed in Yogyakarta along the north-south corridor, on the initiative of the municipal government. As these examples show, despite the seemingly unstoppable tide of urban sprawl, municipal governments do still retain some transport and land use planning powers that can effect urban emissions of GHG, in both a positive and negative manner. We return to how issues of transportation are being addressed with respect to climate change below (Section 4.2).

In both the north and south, it is clear that land use planning, urban sprawl and the growth of GHG emissions from transport are a critical issue. However, the contribution of sprawl to the growth of GHG emissions may also be exacerbated by the types of housing that are being built. For example, in Melbourne the urban fringe is dominated by large, detached dwellings. While the energy efficiency standards for such houses may be more stringent than their inner-suburban counterparts, the size of the dwellings, combined by the facilities that they offer (number of bathrooms, for example) means that each household has a higher level of emissions of greenhouse gases than older properties in inner-Melbourne which are frequently smaller or terraced properties. At the same time, the lack of building standards within illegal and informal
settlements means that housing is frequently of a poor standard, with significant implications for health and well-being as well as for energy efficiency with many households unable to heat or cool their dwellings effectively and experiencing fuel poverty.

2.3.2 Low carbon infrastructure

The patterns of urban development are, however, far from the only planning challenge for addressing climate change mitigation in cities. In the global south, the growth of informal and illegal settlements is a significant challenge in terms of providing adequate infrastructures, such as water, energy and sanitation services. With respect to climate change, these challenges are most significant in relation to adaptation, as we discuss below (Section 3.2), but also pose issues for the provision of low carbon energy services, which may also have added health benefits (e.g. with respect to cooking stoves) and for developing energy efficient housing. Interestingly, it has been the growth of the voluntary carbon offset market, and the resulting search for carbon reduction projects which are seen to have a sustainable development benefit, which may to date be the factor leading to increased capacity in this area. For example, ClimateCare, one of the largest carbon offset organizations, are involved with a project to develop energy efficient lighting in South African townships (Climate Care 2009). In cities in the north, alongside the problem of reducing sprawl and the demand for travel, the planning challenges for climate change also revolve around the provision of low carbon sources of energy (e.g. renewable) and improving the energy efficiency of the built environment. We discuss these issues and the ways in which they are being tackled in more depth below (Sections 4.1 and 4.3).

2.3.3 Urban planning capacity for climate change

Research suggests that, in addition to the broader factors shaping local capacity discussed above, there are two sets of factors which have shaped the capacity of urban planning systems to address climate change mitigation.

The first set relate to the national and local frameworks within which planning is conducted. Planning frameworks need to enable local

### Box 3 – Planning Frameworks

‘Regional planning bodies and local planning authorities should ensure that development plans contribute to global sustainability by addressing the causes and potential impacts of climate change – through policies which reduce energy use, reduce emissions (for example, by encouraging patterns of development which reduce the need to travel by private car, or reduce the impact of moving freight), promote the development of renewable energy resources, and take climate change impacts into account in the location and design of development’ (ODPM 2005: 13).
authorities to address climate change within the planning system. For example, recent reforms to planning guidance in the UK now mandate local action for mitigation and adaptation (Box 3), enabling planning authorities to take climate change into account in their decision-making and reducing the likelihood of challenges to planning decisions or regulations from land developers and the building industry. However, the appropriateness and implementation of planning is also critical. Satterthwaite (2008b: 12) argues that in many cases in the global south “the application of imported models of urban planning and government that proved inappropriate to local contexts and possibilities” have served to limit the access of poor communities to land for housing, in turn provoking the emergence of illegal settlements. At the same time, planning frameworks that are in place may not always be implemented in the way that they are intended. Sari (2007: 141) found that “while zoning permit is theoretically supposed to be a tool to control land use, in reality corrupt practices have rendered it ineffective. A 1993 study under the Jabotabek Management Development Project shows that there are many developers that are not in compliance with the existing land use allocation” (Sari 2007: 141). More appropriate planning frameworks may therefore be required that work with the realities of daily life in such cities to improve living conditions while at the same time promoting low carbon development.

The second set of issues that can limit or enhance local planning capacity with respect to climate change mitigation is the degree to which institutional responsibilities, jurisdictional boundaries, and the planning issue in question are commensurate in scale – a problem sometimes described in the literature as the problem of “fit”. In Thailand, Lebel et al. (2007: 117) suggest that the “jurisdictional areas of the current municipal boundary of Chiang Mai is way too small to be relevant to affectively govern the urbanization process” given the interplay between urban and rural processes in shaping urbanization. Similarly, in her study of climate responses in Mexico City, Romero-Lankao (2007: 529) finds that:

> “the administrative structure of city’s governance differs from its boundaries and carbon-relevant socioeconomic and ecological functioning. Administratively, the city is managed by diverse federal, state and local tiers of government. Yet, the city functions as a complex system; its core area and localities, activities and households are interlinked by economic interchanges and transportation activities, by fluxes of materials and energy.”

Establishing institutions at the appropriate scales to address the challenges of planning for climate change may be difficult to achieve within the historical context of city administrations. Another means through which such challenges, together with issues of establishing appropriate planning frameworks and building the competencies and resources of municipal authorities,
might be achieved is through various strategies of multi-level governance, and it is to these issues that we turn next.

2.4 Multilevel governance and urban climate change mitigation

The capacities of local governance and planning for climate change are significantly affected by the relations between municipalities, regional authorities and national governments (vertical co-ordination) and between different agencies and policy divisions within municipal governments (horizontal co-ordination). The importance of vertical and horizontal co-ordination, or multilevel governance as it is referred to in the literature, has increasingly been highlighted by authors in the context of “the dispersed nature of climate change governance” (Betsill and Bulkeley, 2007:448; see also DeAngelo and Harvey 1998; Knuth et al. 2007). Here, we review the evidence concerning the importance of horizontal and vertical co-ordination in turn, recognising that both are required for addressing the capacity challenges outlined above (OECD 2008).

2.4.1 Horizontal co-ordination

Research has found that in “many cities expertise on these questions [of climate change] is still concentrated in the environmental department” (Alber and Kern 2008: 6). However, the cross cutting nature of climate change governance means that environment departments or agencies are frequently not able to implement the policies (for transportation or finance for example) that are required to address the problem. Furthermore, environmental agencies and departments are frequently marginalized within municipal bureaucracies so that they lack the power and authority needed to co-ordinate policy across a municipality. As a result, strategies and action for climate change mitigation are often deployed in a highly fragmented manner. The sorts of institutional changes experienced by many local governments in the wake of neoliberal reforms can exacerbate this problem. In the UK, the privatization and ‘contracting out’ large elements of municipal service delivery (e.g. public housing, municipal waste services), has meant that local authorities have limited direct powers over the provision of services with significant GHG emissions implications (Bulkeley and Kern 2006). In Johannesburg a process of ‘semi-privatisation’ has occurred within the local authority that ‘creates a silo effect where communication between different agencies, utilities and the city administration are fragmented’ (Holgate 2007: 481).
Given this context, and because climate change mitigation cuts across many sectors such as transport, planning, economic development, procurement, finance, education and public health, analysts are increasingly calling for greater co-ordination within municipalities (Bai 2007:24; Crass, 2008:7; Alber and Kern 2008:6;). As a recent OECD (2008: 24) report argues, “mainstreaming, coordination, and cooperation across government agencies is vital.” The integration of climate change policies with other policy issues is being achieved in some places. For example, with respect to energy efficiency in China or job creation through the retrofitting of buildings in German cities (Schreurs, 2008: 353). Elsewhere, administrative structures are being put in place in order to co-ordinate municipal climate policy (Box 4). However, research has found that “where there is a lack of capacity to do this joining up it is clear that the potential of local climate change strategies is curtailed.” (Betsill and Bulkeley 2007: 450).

### 2.4.2 Vertical coordination

The relation between local, regional and national government can be enabling or constraining for municipal responses to climate change mitigation (Betsill and Bulkeley 2007). Two aspects of these relationships have been identified in the literature as particularly important – the extent to which higher tiers of government establish appropriate contexts for municipal action, and the co-ordination of competencies and resources for addressing climate change.

As Jollands (2008: 5) argues “the lack of acknowledgement, encouragement and clear national-level guidance on climate change for local governments” can act as a barrier to local action on climate change. In the main, researchers have identified national government support – in the form of stated ambitions to address climate change as well as enabling frameworks of policy and planning – as critical for achieving action on the ground within municipalities. However, the cases of the US and Australia provide some food for thought here, given that extensive municipal action has taken place without national level commitment to international norms of
implementing the Kyoto Protocol and, in the case of the US, no explicit support for municipal level action (Betsill 2001; Bulkeley 2000; Koehn, 2008: 58). These cases suggest that an absence of political leadership at higher levels of government can create the opportunity for municipalities to demonstrate leadership, and hence enhance their capacity to act (Section 2.2.1). It may however be the case that as declarations of intent are translated into actual policies and programmes, the support of regional and national authorities becomes more important. As Bai (2007: 21) argues, in the US cities may fail to achieve their targets unless “their efforts are accompanied by complementary state and federal policies.”

Vertical co-ordination of competencies and resources to address climate change is therefore also critical (Crass 2008; OECD 2008). In Sweden, the national government has created an enabling context for local action through the provision of dedicated funds for municipalities (Granberg and Elander 2007). In the Netherlands, local government was also given funding directly targeted at climate change mitigation. The Klimaatcovenant is a multi-level arrangement involving local government, provinces and several ministries at the national level (Jollands 2008). Cities are given funding on the basis of their population/area and in return have to present a comprehensive action plan based on a common methodology (Climate Menu) (Jollands 2008). In the absence of direct funding schemes, the ability for municipalities to raise climate funds through permissive structures of local government finances, as well as broad remits to address sustainability have been important. In the UK, the duty on local governments to improve the social, economic and environmental ‘well-being’ of their constituents has been important in opening up a window through which municipalities can engage with climate change, which until recently has not been part of their specific remit.

In summary, the research reviewed suggests that multi-level governance in the form of vertical and horizontal co-ordination is important for addressing some of the capacity challenges – of leadership, competencies, resources, and political will – identified above. Evidence to date presents a mixed picture as to whether this is being achieved, with the majority of studies suggesting that municipal climate change mitigation policy remains concentrated in environmental departments, fragmented, and often isolated from national and regional climate change policy (Betsill and Bulkeley 2007; Kern and Abler 2008).

2.5 Networks and partnerships

While horizontal and vertical co-ordination among state actors remains the background of what scholars call ‘Type I’ multi-level governance, the importance of ‘Type II’ multilevel governance –
involving new governance arrangements such as networks and partnerships that operate between and across political levels – has also been identified as critical to the governing of climate change at the municipal level (Betsill and Bulkeley 2006; Hooghe and Marks 2003). This section discusses two such arrangements: transnational municipal networks; and sub-national networks and partnerships.

### 2.5.1 Transnational municipal networks

Transnational municipal networks – such as ICLEI CCP, Climate Alliance, energie-cities, C40 - have been an important driver for municipal action on climate change mitigation since their inception in the early 1990s (Bulkeley and Betsill 2003; Bulkeley and Kern 2006; Bulkeley et al. 2005; Collier 1997; Granberg and Elander 2007; Holgate 2007; Kern and Bulkeley 2009). This literature suggests that transnational networks are important for municipalities because they facilitate the exchange of information and experiences, provide access to expertise and external funding, and can provide political kudos to individuals and administrations seeking to promote climate action internally.

There is some evidence to suggest that transnational municipal networks are most significant for ‘leaders’ on municipal climate action (Kern and Bulkeley 2009), and that they me be most important in the earliest stages of climate policy development as local policy actors seek ideas from cities and countries with similar politics globally (Schreurs 2008). Once examples of climate change strategy and action have developed nationally, some authors suggest that “attention shifts to these cases” (Schreurs 2008: 353). For example, in Sweden, of 184 responding municipalities, “72% stated that they cooperate with other actors in networks dedicated specifically to climate issues or where climate was included as one issue among others … [and] networking was most frequent among towns and cities within Sweden” (Granberg and Elander 2007:542).

On the other hand, the trend for involvement with transnational municipal networks has increased over the past decade, both within existing networks and through the formation of new networks such as the C40 Cities Climate Leadership Group and the Rockefeller Foundation Climate Change Initiative. These new networks represent a different approach to transnational networking, focusing not on accumulating an ever-larger membership and hence jurisdiction over an increasing proportion of global GHG emissions, but on the development of specific ‘clubs’ of cities which can gain privileged access to information, funding and project implementation, in return for specific actions. This new model may be effective in promoting
climate leadership amongst specific groups of cities, but it may also serve to exclude other cities – particularly in the global south – from participating in climate mitigation efforts and the potential side-benefits in terms of energy efficiency, reduced air pollution, and financial benefits that might accrue. While the impact of these new networks is difficult to ascertain at this stage, the long-standing influence of other transnational networks suggests that they may have a significant role in shaping the nature of municipal climate change policy.

2.5.2 Sub-national networks and partnerships

Sub-national networks and partnerships involving municipal authorities can evolve at multiple scales. One notable feature of the past decade has been the ‘nationalisation’ of transnational networks, such as CCP, with specific national campaigns in countries such as the Canada, Australia, Mexico, and India. Equally, national networks of municipalities have been established in the US, through both CCP and the US Mayors Agreement, which now has over 900 members.¹ These networks function in much the same way as the transnational networks discussed above, providing access to information, resources and political recognition for local governments taking action on climate change.

At more regional and urban scales, partnerships between state and non-state actors have proved to be critical in building the resources and capacities of municipal governments to address climate change. In Mexico City, Romero Lankao (2007) argues that the presence of influential scientists together with the CCP network was instrumental in establishing climate change on the policy agenda, though could not overcome greater institutional barriers to action such as the availability of resources and the co-ordination within and between relevant government bodies. Another interesting example of non-state actor networks and partnerships can be drawn from the Holgate (2007) study of two cities in South Africa – Cape Town and Johannesburg. Although both cities have similar socio-economic and institutional challenges, the implementation of GHG mitigation policies has differed greatly. Cape Town has successfully implemented GHG mitigation measures because of cooperation with external institutions, including ICLEI, NGO’s, Eskom (the local utility) and academic institutions. In contrast, Johannesburg has been less successful due to lack of institutional capacity, a fragmented structure and privatized utilities, all of which reduced the cities ability to implement climate change initiatives (Holgate 2007). “Climate orientated hubs” (Granberg and Elander 2007:543) whereby partnerships between public and private actors focus around a particular project are

¹ For more information, see: http://www.usmayors.org/climateprotection/list.asp (accessed April 2009).
also becoming a key feature of local climate change policy. One example is Malmo, Sweden’s third-largest city:

“In spring 2004, the city invited almost 40 local actors to a climate forum. Among the invited were state authorities, municipal departments, construction companies, housing companies, energy producers and voluntary associations. The objective of the climate forum is to enhance the knowledge of climate change and to streamline the information on different projects related to climate change in the city of Malmo in order to strengthen the coordination and cooperation among actors relevant to combating climate change. The idea is that all partners in the network can contribute to this on the basis of their own special knowledge and experiences”. (Granberg and Elander 2007: 543).

2.6 Engaging communities

In addition to engaging a range of stakeholders and partners in addressing climate change locally, municipalities have, sometimes, also sought to involve communities in responding to the challenges of reducing GHG emissions. While research suggests that, in the main, municipal strategies for climate change mitigation are driven from the ‘top-down’ through involvement with (transnational) networks, on the basis of individual policy entrepreneurs, or on the basis of local scientific assessments, for most municipal governments involving the public becomes an important issue in terms of implementing action plans and projects. Two strategies can be identified from the literature. The first involves various forms of public education, designed to promote individual actions and behavioral change in line with municipal climate change strategies. The second focuses on the provision of incentives, services or implementation of specific projects and entails a higher degree of involvement on the part of both the municipality and the community.

2.6.1 Educating the public

Public education has been a strategy deployed at all levels of government to inform the public about the nature of the climate change problem and how individuals might change their behavior in order to address this challenge. As a key element of ‘enabling’ modes of governing used by municipalities, public education has been a popular means of seeking community engagement at the local level. For example, in China municipal authorities have established
websites, hotlines and educational programmes about climate change (Koehn 2008: 60), while also launching public education campaigns, a “green-schools initiative and funding appeals” to inform the public “that there is a link between air pollution, lung cancer and other respiratory diseases” (Koehn 2008: 68), and promote the reduction of motor-vehicle use with knock-on implications for reducing urban GHG emissions. In Japan, national government has mandated the creation of local action plans with the expectation that cities and towns will educate and provide information to their citizens (Sugiyama and Takeuchi 2008: 429). In Sweden, there are also efforts to inform and educate citizens about climate change. In particular, “schools are regarded as crucial in increasing ecological knowledge and understanding. The intention is that knowledge about climate change will spread like ripples on water to children, parents and school staff” (Granberg and Elander 2007: 543).

However, and despite the frequency with which this approach is deployed by authorities at all levels, recent studies have sustained the argument that public engagement in environmental issues, and climate change in particular, is shaped by a range of individual and social factors and that the provision of information, alone, is unlikely to have much effect on behavior (Bickerstaff et al. 2008; Lorenzoni et al. 2007). On this basis, it seems that different approaches will be required to enable communities to respond to climate change.

2.6.2 Involving communities

In addition to public education, there are several approaches to involving communities more directly in addressing climate change. One approach is through the provision of ‘low carbon’ services. For example, Schreurs (2008: 352) reports that Shanghai (with assistance from the World Bank, the Energy Sector Management Assistance Program and the Asia Sustainable and Alternative Energy Program) has developed a “green electricity scheme (Jade Electricity), allowing consumers to voluntarily purchase electricity from renewable energy sources.” In Japan, legislation, in this case the Law Concerning the Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities (2000) has meant that many local and regional governments now promote green purchasing (Sugiyama and Takeuchi, 2008). For example, “Several local governments now provide subsidies for the installation of photovoltaic equipment... [and] Kawasaki City provides subsidies for roof-top gardening” (Sugiyama and Takeuchi 2008: 430). In addition, to promote energy efficiency Japanese local governments have introduced various innovative measures such as the Friends of the Earth Japan’s Fifty-fifty programme. The Fifty-fifty programme enables schools, hospitals and other institutions to reduce emissions. For example, the city government gave a subsidy to schools in Ube City in
Yamaguchi Prefecture “which is equal to half of the money they save by their efforts to reduce utility costs….about thirty cities have introduced the Fifty-fifty programme….the programmes have had good results” (Sugiyama and Takeuchi 2008: 430). Such initiatives show that municipal authorities can undertake a range of innovative schemes for involving communities in reducing their emissions of GHG that – by providing incentives or alternative forms of infrastructure and services – can overcome some of the barriers to changing behavior at the local level.

2.7 Summary

Our review of the research suggests that municipal authorities face numerous challenges in terms of addressing climate change mitigation at the local level. The literature suggests that factors of knowledge, leadership, competencies, resources, politics, planning frameworks, jurisdictional ‘fit’, vertical and horizontal integration between government agencies, networking, partnership and public involvement have all been important in shaping the landscape of municipal climate change mitigation governance. Particularly significant are issues of governance capacity, in terms of the ability to regulate greenhouse gas emissions, to provide services and infrastructure, and to work with others enabling action to take place. We find that the literature suggests that it is policy entrepreneurs, access to additional sources of finance, municipal competencies, the framework established by national (and regional) levels of government, the support offered by transnational networks and the ability to reframe the issue of climate change within the local context that are most critical in building this governance capacity. These factors vary in their significance in relation to the different ‘modes’ of governance under consideration. For example, municipal competencies are critical with respect to the regulating and provision modes, while sources of additional finance and involvement with transnational networks are critical in terms of an enabling mode of climate governance. In the case-studies that follow we consider how these different ‘modes’ of governing climate change have been deployed, and with what effect.

While the research base upon which this review of the challenges for urban governance and planning in the field of climate change mitigation is based has predominantly been developed in the context of cities in the north, it has demonstrated that the research that has been conducted on climate change mitigation in cities in the global south (e.g. Bai 2007; Dhakal 2004; Holgate 2007; Romero Lankao 2007) suggests that some of the challenges are similar. In particular, this literature suggests that for cities in industrializing countries, challenges of leadership, municipal competencies, finance, political economy and working in partnership are similar to those encountered in cities in the north. However, there is at present limited research
concerning the challenges facing cities in low-income countries with respect to the mitigation of climate change. Given that the levels of greenhouse gas emissions in such cities are likely to be so low as to have a minimal impact on the atmosphere (Dodman 2009), and that the sources of current and future climate change lies predominantly in cities in the north and (by virtue of global patterns of consumption and production) in mega- and global cities in the rapidly industrializing countries, there is perhaps limited merit in pursuing research in such contexts. However, as donor organizations and private sector companies seek to take climate change into account in decision-making over infrastructure, and with growing markets in carbon finance, it may be important to understand the particular issues facing cities in low income countries in order that they do not get bypassed in the development of low carbon energy, transport and waste infrastructures. In Part IV below we examine the extent to which the drivers and challenges for governing climate change identified in this review hold true in relation to ten case-study cities drawn from the “+8” countries. Before moving to the results of this empirical research, in Part III we consider in detail what the evidence base suggests might be the key challenges in responding to climate change adaptation in the urban setting.
Part III: Urban Policy and Action for Climate Change Adaptation

Adaptation policy is crucial for dealing with the unavoidable impacts of climate change, but this has so far been under-emphasised at the urban level in many countries around the world. The economic cost of the effects from climate change will be significant; in OECD countries alone, making new infrastructure and buildings resilient to climate change is estimated to cost around $15-150 billion a year (0.05-0.5 percent of GDP) (Stern 2006). Adaptation focuses on expanding the capacity to cope with changes in climate, (OECD 2008) and adaptive capacity can be defined as the ability of a system to adjust to climate change. The determining factors of adaptive capacity may include technological options, economic resources, human and social capital and governance (McEvoy et al. 2006).

Urban areas are particularly vulnerable to the effects of climate change. Half of the global population currently lives in urban areas and by 2050 this proportion is estimated to increase to 70 percent (UN DESA 2008). Moreover, some 80 percent of cities are located on coasts and rivers, making them susceptible to increased storms, floods and sea-level rise. Continual urbanization will make their inhabitants more vulnerable also to changes in the supply of water, food, energy and other resources as well as to the urban heat-island effect. Given that central political and financial capacities are located in cities adverse impacts from climate change could extend beyond city boundaries.

Impacts from climate change are projected to be severe for rapidly growing cities in particular. Many of these populations reside in burgeoning megacities - defined as cities with more than five million inhabitants - as driving forces such as population growth, urbanization and globalization continue to prevail (Wenzel et al. 2007). The fast pace of development, land-use change and socio-economic inequality observed in many developing cities means that vulnerability exists regardless of climate change (Woodward et al. 1998). Impacts from water, agriculture and health stresses are expected to heighten such vulnerability (Lu 2007). The IPCC (2007) anticipates that precipitation will become more variable, with increased risks of both droughts and tropical storms. While the impetus for economic development has traditionally been viewed as incompatible with considerations for environmental protection or climate change policies, mitigation and adaptation are increasingly being reframed as economic opportunities (Hay and Mimura 2006; Tanner et al. 2008; Halsnaes and Verhagen 2007; UK WGCCD 2007).
Up until now, mitigation has received much more attention than adaptation in climate change policy at all levels of governance, including international, national and local. This may not be surprising given that for a long time the response to climate change was framed as if mitigation and adaptation were substitutable strategies, rather than complementary approaches (Verheyen 2002). At the international level, the parties to the UNFCCC in 2005 took a first important step on adaptation by adopting two funds, a Least Developed Countries Fund and a Special Climate Change Fund. The parties to the Kyoto Protocol in 2007 then adopted an Adaptation Fund, funded through proceeds from the Clean Development Mechanism. Despite these first steps, financing adaptation is all but settled as the needs by far exceed the currently available funding. According to UN estimates, $50 - $80 billion a year is needed, while the current funds collect only around $200 - $300 million annually (Okereke and Schroeder 2009).

Adaptation addresses the consequences of climate change, such as heavy rainfall, flooding or extreme temperatures. These are issues already affecting societies, independent of their role in causing climate change. As a result the benefits from urban adaptation can be direct for the city, in contrast to the rather indirect benefits felt in the case of mitigation, in the form of political or economic gains or improvements in the local environment,. Not only does adaptation provide many local benefits, it can also be realized without long lead times (Stern 2006). It is therefore somewhat surprising that cities have focused much more on mitigation than adaptation and still do, although this is slowly changing. Granberg and Elander (2007: 545) refer to this as a “paradox, since the tangible effects on global warming of reducing GHG emissions in a single locality are microscopic, whereas measures of adaptation are crucial for preventing potential flooding and related natural catastrophes.”

In seeking to explain this paradox, we are confronted by a limited evidence base. A major hurdle for urban adaptation policy is that research on adaptation is still in its infancy (Alber and Kern 2008; Lindseth 2005; Storbjörk 2007; Zahran et al. 2007). There are very few studies that go beyond a limited number of city case studies or consider multi-level systems (Alber and Kern 2008). Granberg and Elander (2007) call for approaches that take local policy and planning more into account when addressing adaptation and highlight issues of conflict between competing goals, interests and actors. Such potential areas of conflict could be the incompatibility of different agendas on development and adaptation within a city, such as improving attractiveness through developing spectacular waterfront architecture, on the one hand, and the need to adapt to rising sea levels or heavy rainfall, on the other. The remainder of this section reviews the research evidence in order to explain why adaptation has to date been such a low priority on urban agendas, examining the factors that are seen as important in influencing the development and implementation of urban governance and planning for
climate change adaptation. They include (1) science and knowledge, (2) local governance capacity, (3) multilevel governance, (4) networks and partnerships and (5) engaging communities and education. We consider the same range of factors as with mitigation in order to determine their relative importance in shaping each climate change agenda.

3.1 Science and knowledge for urban climate change adaptation

As mentioned above, one hurdle in advancing adaptation to climate change is a lack of availability of local data on the direct and indirect impacts of climate change on individual urban areas (Satterthwaite 2008: 14). A good science and knowledge base is a prerequisite for designing and implementing effective adaptation measures for aspects such as long-term protection, pre-disaster damage limitation, immediate post-disaster response and rebuilding (Satterthwaite 2008: 13). Therefore, what is essential to adapt to climate risks is to develop an information base on current conditions and to undertake risk and vulnerability assessments for the city (Satterthwaite 2008: 15-16).

Thus far capacity for climate change research and adaptation is generally low at the local level and is often concentrated at the national level (Qi et al. 2008). For example, Ho-Chi-Minh City has no unified information centre and poor data collection and storage. In the area of disaster management, it is very difficult to access information and despite public debates demanding more transparency there has been little progress. Important information is only available through informal channels. (Tanner et al. 2008, 23) Furthermore, research has shown that officials and their assistants at the urban level are often not familiar with the issue of climate change. Thus, capacity building is very much in need, and international assistance has been important for the establishment of offices on climate change research at the provincial or
regional level. For example, in Guangdong Province, the Southern China Branch of the Chinese Academy of Science is located in the capital city of Guangzhou, which helped the province to conduct regional assessments of climate change for the Pearl River Delta. (Qi et al. 2008)

There are a handful of cases where cities have explicitly followed a more comprehensive and systematic approach to climate adaptation, based on a sound local evidence base. The South African city of Durban has emerged as a leader on institutionalizing adaptation through incorporating science and knowledge creation into its approach (Box 5). In Ningxia province, China, the provincial Science and Technology Department plans to invest in improved climate forecasting and studies of agricultural adaptation (changing crop choice and water-saving cultivation methods). Although some kinds of adaptation on storm protection have been adopted, there are still large knowledge and action gaps on how to respond to and manage the uncertainties. (Schroeder et al. forthcoming)

3.2 Local governance and planning capacity for urban climate change adaptation

In addition to issues of scientific knowledge, expertise and the capacity of local authority staff, research suggests that there are two critical factors that shape urban capacity for adaptation – good governance and the availability of resources (IPCC 2007). While our review of the literature on climate mitigation found specific additional factors affecting the capacity for urban planning for climate change, with respect to climate adaptation we find that no clear distinction is made between general capacity to govern climate change adaptation at the local level, and the particular sector of urban planning. This may reflect the integral role that urban planning has in addressing climate change adaptation, especially over the longer term, such that governance challenges are necessarily also challenges of planning capacity.

3.2.1 Good governance

Good governance is a crucial determining factor of effective adaptation as the level of vulnerability to climate change, especially for the urban poor, is directly related to the quality of national and local government (Satterthwaite 2008b: 9) Adaptation measures thus need to encompass all areas of a city and all sectors of society. This includes provision of infrastructure for all areas, for example, to limit the risk of flooding for the whole city area; provision of disaster preparedness, for example, warnings and measures to limit damage that reach
everyone; planning for and coordinating disaster response, for example, rescue services and emergency and health-care services for all; availability of relatively safe housing in relatively safe sites for all urban dwellers, for example through investment to make the whole city relatively safe; and the provision by local government of an enabling environment for local civil society action to help address and implement the aims addressed above. (Satterthwaite 2008b: 9). The key to adaptation is thus competent, capable, accountable urban governments that understand how to incorporate adaptation measures into most aspects of their work and departments. (Satterthwaite 2008b: 15). This requires a different form of leadership than that witnessed in the context of mitigation. Rather than leadership based on the pioneering of new urban policies, leadership for adaptation requires a focus on the needs of communities across the city, as opposed to particular sectors or elites, and in which scarce resources are deployed for the common good. It also suggests that adaptation at the city level requires municipal competencies in critical areas such as infrastructure provision, an issue to which we return below in the context of our discussion of the importance of multilevel governance.

In addition to specific municipal competencies, delivering on urban adaptation requires the capacity for both micro and macro-level interventions. Micro-level interventions may include revising building codes, land sub-division regulations, land-use management and infrastructure standards. Such interventions are aimed at improving the day to day workings of government across the city. The sum of such minor interventions over time can build greater resilience without high costs. (Satterthwaite 2008b) The most relevant macro-level interventions that might be required include enhancing transparency, accountability and democratization through direct election of city officials and the capacity of citizens to hold their elected representatives to account. (Tanner et al. 2008 21). In this manner, such interventions could improve the leadership capacity of municipal governments with respect to addressing climate change across the city.

Improving the quality of governance in cities as a means of addressing adaptation is especially significant as the urban areas which face the greatest challenges are those in the more vulnerable and high-risk sites that also lack competent, capable, accountable local and/or national governments, and very often lag far behind in providing or upgrading protective infrastructure and services, and may remain outside any land-use plan or public provision of infrastructure and services, such as those living in squatter settlements (Satterthwaite 2008, 15). New Orleans, which was hit by Hurricane Katrina in September 2005, is a well-documented example (see, for example, Burby 2006; Sobel and Leeson 2006). Squatter settlements, which can make up as much as half of an urban population, are usually not at all integrated into the municipal web of institutions, infrastructure, services and protective
regulations. These areas are often most at risk from extreme weather and they tend to be located where the value of the land is the lowest, reflecting the higher level of vulnerability. These populations living in informal settlements and working within the informal economy are oftentimes seen as ‘the problem’ by their local governments (Satterthwaite 2008, 11; Crawford 2009). But there are also other examples of where more accountable national governments and more democratic local authorities have managed to improve the coverage of water and sanitation provision. Some countries have also enacted constitutional or legal changes that have increased the revenues of city and municipal governments and strengthened local democracies or have developed successful partnerships with low-income groups and their community organizations to provide infrastructure and services more cheaply (Satterthwaite 2008b: 11). This suggests that in order to address adaptation within the municipality, good governance is required not only within the municipality but also by the national government.

3.2.2 Resources

Beyond the capacity for good governance, the other great struggle facing municipal governments in the south in particular is a lack of financial and human capacity and control (Tanner et al. 2008). Just as with mitigation, local governments often lack the financial and human resources to meet their responsibilities and to invest in changing infrastructures or practices (Satterthwaite 2008b: 11).

While lack of resources is almost always a barrier to more action, the level of insufficiency varies considerably from city to city. For example, while Ho-Chi-Minh City is required to submit most of its revenues to central government, the Bangkok Municipal Authority has a high level of fiscal autonomy, collecting regular revenues from taxes, licence fees, etc. There are also examples of cases where urban projects needed the financial help of their national governments to order to be implemented, such as the Brihanmumbai Storm Water Drainage Project in Mumbai. This was initially started in 1985 by the Mumbai Metropolitan Region Development Authority but abandoned due to lack of funding, was reinvigorated with receipt of full funding by India’s Prime Minister in 2006. The project’s aim is to replace age-old drainage systems in several cities including Mumbai to prevent future flooding (Gupta 2007). The failure to provide urban infrastructure and services often reflects the local government’s lack of resources and capacity to invest, as almost all local revenues go to recurrent expenditures or debt repayment. (Satterthwaite 2008b: 11). As with mitigation, the ability to access additional and external sources of funding for adaptation therefore appears critical.
3.3 Multilevel governance and climate change adaptation

Adaptation to climate change has been shown to be carried out both at different levels of governance and in a variety of government agencies and sectors (Kwok 2008; McEvoy et al. 2006; Adger et al. 2005). This can be explained by the fact that actors at different levels of governance have different priorities and mandates that influence the activities they undertake. Access to resources, especially to funding, decision-making powers and the extent of influence play important roles in how a climate-related stressor (e.g. flooding) is responded to, at what level and by which sector (Ziervogel and Taylor 2008, 37). Responses may range from short-term coping mechanisms to longer-term, sustainable ways to deal with the stress (Ziervogel and Taylor 2008: 37). According to Adger et al. (2005), adapting to the effects from climate change requires “cascading decisions across a landscape made up of agents from individuals, firms and civil society, to public bodies and governments at local, regional and national scales, and international agencies.” In this section we provide an overview of the extent to which adaptation activities involve horizontal and vertical co-ordination.

3.3.1 Horizontal co-ordination

Cross-ministerial interactions are rare and easily overlooked but may determine if and how adaptation occurs at a particular level of governance (Satterthwaite et al. 2007; Kwok 2008). Climate adaptation involves actors that come from a variety of sectors that are sensitive to the impacts of climate change, such as water provision, coastal defense, and urban planning. As a result, the implementation of adaptation measures is likely to encounter greater institutional complexity than is the case even for climate mitigation (McEvoy et al. 2006: 188). However, this is gradually changing. In certain cities, such as in Hong Kong, where a recently formed Interdepartmental Working Group on Climate Change (IWGCC) now liaises across 16 government departments and 5-6 bureaus. It offers the institutional platform to formulate future adaptation policies (EPD 2008).

3.3.2 Vertical co-ordination

Local, national and international authorities are all responsible for distinct sets of functions. At the city level, this includes urban planning, service delivery and infrastructure development. However, other important sectors – such as coastal management and agriculture – are rarely within the direct remit of city governments. This means that a need for vertical co-ordination is
built into the adaptation issue. Furthermore, those functions for which municipalities do have competencies are not always delivered autonomously. This may constrain municipal governments in adapting to climate change. Tanner et al. (2008: 18) identify the following constraints: (1) heavy top-down decision-making structures; (2) a lack of clarity between city, state and national-level bodies, leading to inefficiencies and conflict; (3) poor co-ordination between departments and agencies; and (4) severe financial constraints, especially in Southern municipal governments. Tanner et al. (2008: 18) point to the need “for greater federal action which facilitates greater legal, institutional and financial space for cities in order for municipal governments to be more effective and more accountable to their citizens”. Indeed, adaptation to climate change is more often taken up by central government, such as is the case in India, South Korea, Indonesia and Mexico, rather than municipalities. For example, South Korea has explicitly come up with policy directives for adaptation in its White Paper on Adaptation published in 2008, and China’s Adaptation scoping study in September 2008 identified “densely populated peri-urban coastal zones” as one of the four regions in China with highest vulnerability to climate change.

South Korea offers an example of such top-down adaptation measures and measures that go beyond traditional disaster risk management. At the national level, under its 4th National Action Plan on Climate Change, South Korea established a water management bureau to overlook all tasks related to water “in preparation of water shortages in the future” (SMG 2008). The Korean government also collaborated with other Asian countries in 2004 to conduct flood hazard mappings of their respective river basins, which has significantly strengthened the ability to map flood prone areas and integrate flood risks into land-use planning (Lee 2006). Nonetheless, there is good coherence between national and city level climate change governance. Seoul therefore benefits from a clear national-to-city consensus on the economic opportunities arising from climate change mitigation and adaptation and possesses political motivations to redesign Seoul as a green and forward-looking global city (SMG 2006; SMG News, August 2008; Shin and Timberlake 2006). Structurally, Seoul appears to foster good relationships with the private sector and leverage funding from businesses for climate change related investments (Oh 2008; GoRK 2008). In India, the National Disaster Management Authority Act of 2005 is the umbrella of sub-national actions. The State of Kerala, for example, established a state-level Disaster Management Authority, whereas the urban administration of Cochin has not been very active on the issue of climate risk reduction. However, many civil society groups are preparing to work more systematically on the issue (Tanner et al. 2008: 20). These examples show that where a national strategy for adaptation proactively engages with local issues, adaptation to climate change within municipalities can be fostered.
3.4 Networks and partnerships

The existence of networks and partnerships that focus on adaptation is minimal in comparison to climate change mitigation. In the transnational arena, municipal networks are just beginning to develop work in the sphere of adaptation and additional networks, such as the Asian Cities Climate Change Resilience Network, are being formed. At the sub-national level, partnerships between state and non-state actors have not been forthcoming. Some reasons for this, especially amongst vulnerable groups of the population, are an ingrained culture of bureaucracy, a lack of access to information, low levels of education, low income and disinterest (Tanner et al. 2008: 26).

Nonetheless, here too there are exceptions. For example, in Chennai, India, civil society groups have played an important role in assisting urban governance. With the capacity to work closely with communities, to fully understand needs and priorities and to facilitate participatory approaches, civil society organisations can strengthen service provision, environmental management and the livelihoods of the most vulnerable people (Tanner et al. 2008: 29).

3.5 Engaging communities and educating the public

A hurdle in terms of fostering public engagement in the governing of adaptation is its lack of a sense of disaster emergency, given that most people are oblivious to long-term, slow burn consequences of climate change such as sea-level rise (HKO 2007). In some places, local governments have successfully worked with informal settlement dwellers to provide infrastructure and services and improve the quality of housing (Boonyabancha 2005). But often donor support is instrumental in initiating any kind of grassroots initiative (Satterthwaite 2008a: 17). Therefore, adaptation to climate change requires access to financial systems and mechanisms that provide support for a variety of municipal innovations by local governments and grassroots groups, which, in turn, reinforces the goals of ‘good local development’ and ‘good local governance’. The current focus on National Adaptation Programmes for Action (NAPAs) and on community-based adaptation leaves out the key role of local government. There is a need for local and city adaptation programmes (LAPAs and CAPAs) to underpin and drive innovations in NAPAs. It is also important to stress that in most instances there needs to be a combined approach to addressing development and adaptation at the same time. It is so

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much easier to get the buy-in if development goals are achieved simultaneously (Satterthwaite 2008a: 17).

3.6 Summary

Our review of the literature on urban governance for adaptation shows that despite its pressing importance, particularly for vulnerable cities and for cities in the global south, climate change adaptation remains a marginal issue. In part this can be attributed to the historical dominance of the mitigation agenda within the international arena, and especially among countries in the north and in transnational municipal networks which have been the main motors of municipal climate action. While the notion that adaptation and mitigation can be pursued simultaneously is increasingly being advocated, there are also important trade-offs to be aware of when devising mitigation and adaptation strategies. Some mitigation options may exacerbate urban vulnerability to climate change. For example, while increasing urban density may contribute toward reducing emissions from transport, this will have negative implications for adaptation, such as intensifying the urban heat-island effect and posing problems for urban drainage. Improving our understanding of the synergies, conflicts and trade-offs between mitigation and adaptation measures would enable more integrated and effective urban climate policy (McEvoy et al. 2006).

In addition, our review finds that there are adaptation-specific challenges which make urban governance and planning in this area particularly challenging. The lack of data and expertise at the local level is perhaps even more critical when it comes to adaptation than mitigation. There is a lack of scientific assessment as to what impacts might be expected, and of social, economic and scientific research as to what the impacts and implications of different measures to adapt to climate change in cities might be. There is a lack of municipal capacity with respect to the most vulnerable populations in cities, because such groups tend to live outside of the formal jurisdictions of municipal governments, are ill-served by urban infrastructures, and may be subject to forms of discrimination and exclusion. At the same time, municipal governments have lacked the resources and the wherewithal to fund projects, engage partners and involve communities in responses to climate change. We find a lack of co-ordination between departments at the municipal level, and a strong dependence of local government on the policies and actions in this field by national authorities.

These specific challenges mean that as well as similarities, there are crucial differences between the drivers and challenges for adaptation and mitigation at the urban level. Most importantly,
while leadership has been identified by the literature as critical for municipal action on mitigation, this is not the same for adaptation. While municipal leaders can create significant political capital on the issue of mitigation, addressing adaptation requires a different kind of leadership – based on inclusive or good governance, i.e. foresight and the willingness to develop a safety net for citizens, especially for the urban poor. In adaption, as with mitigation, we see find that access to resources to make the necessary structural and capacity investments is crucial. However, as far as adaptation is concerned municipalities are often starting from an infrastructure deficit – of basic provision, especially to the urban poor – which greatly exacerbates the challenge of adapting to climate change. Rather than being framed as an opportunity – for green growth or addressing other urban environmental problems – we find that adaptation is often a marginal concern on the political agenda, given the challenges of meeting basic needs and everyday survival. At the same time, with limited implementation of adaptation policies and measures documented in the literature, there is to date little evidence of political conflicts emerging over climate adaption in the same manner as is the case for mitigation. However, the research community acknowledges that the ‘political economy’ of adapting to climate change may soon become a critical factor, as contests emerge about how, and for whom, climate change adaptation should take place (Huq et al. 2007).

In Part V, we return to consider what the contrasting issues of climate mitigation and adaptation indicate about the prospects for urban climate change governance. Before doing so, however, in Part IV, we draw on our reviews of climate change mitigation and adaption to examine the experience of ten case-study cities drawn from the “+8” countries in order to assess what lessons we might be able to take forward for fostering urban climate change governance.
Part IV: Urban Climate Change Policy and Action in Cities in the +8 Countries

In this section, we examine the current state of urban climate change policy and action by drawing on ten case-studies of cities in the “+8” countries – those considered most likely in academic and policy circles to be faced with some form of emissions reduction target in the post-2012 era and where many of the world’s largest and potentially most vulnerable cities are located. This focus directs our attention to what is taking place in cities in industrialising countries in the global south (Brazil, China, India, Indonesia, Mexico, South Africa, South Korea), as well as in a country that has to date been outside of the Kyoto framework (Australia). The case-studies – Beijing, Cape Town, Hong Kong, Yogyakarta, New Dehli, Melbourne, Mexico City, Mumbai, Sao Paulo, and Seoul – therefore provide important evidence about the drivers and challenges facing cities in rapidly industrializing countries in addressing climate change. Given the range of cities included, and the differences in socio-economic context between them, some insights can be gained from these cases that have broader applicability, though it is recognized that these may have limited validity for cities in low income countries. The evidence presented here has been gathered through literature and web searches, and in some cases (Beijing, Hong Kong, Yogyakarta, Melbourne, Mexico City) additional field research conducted between May 2008 and January 2009.

In order to understand how the climate change agenda is developing in these critical cities, we bring together issues of mitigation and adaptation and consider how urban governance and planning is taking place with respect to the built environment, transport, and infrastructures sectors in turn. We consider the different approaches – self-governing, regulation, provision, enabling, partnership – that are being developed in each sector, and provide examples of the sorts of policies and measures that are being adopted. In the final section, we consider the drivers and barriers to urban climate change governance in these cases, and the consequent implications for cities elsewhere in the world.

4.1 Climate change and the Built Environment

The built environment is a significant contributor to global emissions of greenhouse gases. The building sector consumes roughly one-third of the final energy used in most countries, and it absorbs an even more significant share of electricity. Electricity use in commercial buildings is
driving peak demand in the United States, Japan, and in some of the wealthier countries in the
global south. As a result of concerns about the implications for climate change, and historical
concerns about energy costs and security of supply, governments in both industrialized
countries and in the global south have initiated policies to reduce energy consumption in
buildings. Most of these policies can be grouped into one of the following three categories:
economic incentives (e.g., taxes, energy pricing); regulatory requirements (e.g., codes or
standards); or informational programs (e.g., energy awareness campaigns, energy audits).
More recently, growth in voluntary public-private partnerships (e.g., Energy Star in the US and
the Carbon Trust Standard in the UK) and the role of private actors (e.g., the C40 and Clinton
Climate Programme) have changed the landscape for improvement by setting stretch goals for
the building industry and its clients, and by resetting norms for how energy is used in buildings.

While historically the main focus of action with respect to climate change and the built
environment has been on issues of mitigation, the challenges posed by adaptation are
increasingly being recognised. Such challenges are usually framed in terms of ‘resilient’
buildings. One such example are buildings designed recover quickly from the impacts of
flooding through ensuring that essential services (power, water, sanitation) experience minimal
disruption (e.g. by placing power sockets above likely flooding levels). While to date there is
little literature on resilient buildings, what such buildings might involve is subject to significant
debate. Current discussions amongst architects can be split into two camps. The first argues for
passive, low-energy buildings that can operate as independently as possible from commercial
energy sources (e.g., Roaf, Crichton, and Nicol 2005). The second places its faith in
technological advances, such as “smart” or kinetic buildings that are designed to change
physically in response to environmental stimuli (Adaptive Building Initiative 2009). While to
date there have been minimal policy initiatives to realise either of these approaches, in
common with the general approaches to mitigation described above, achieving adaptation to
climate change in the built environment is likely to involve a combination of regulation,
financial incentives, information and voluntary approaches.

In the remainder of this section, we discuss the mixture of approaches adopted in the case-
study cities (self-governing, regulation, provision, enabling, partnerships) for governing climate
change mitigation and adaptation in the built environment. We provide examples from across
the case-studies (Figure 1) and examine the similarities and differences between cities. We
summarise our findings, and identify the drivers and barriers for policy and action, in Section
4.4.
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<td><strong>Beijing</strong></td>
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<tr>
<td>Municipal assets and operations</td>
<td>A programme to improve energy efficiency in government buildings is due to be completed by 2010</td>
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<td>Friends of Nature Beijing campaign to maintain a 26°C room temperature</td>
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<td>Regulation</td>
<td>All new buildings are required to improve their energy efficiency by 65%</td>
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<td><strong>Cape Town</strong></td>
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<td>Municipal assets and operations</td>
<td>Target of 12% increase in energy efficiency municipal buildings by 2010.</td>
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<td>Regulation</td>
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<td><strong>Delhi</strong></td>
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<tr>
<td>Municipal assets and operations</td>
<td>New government buildings must adopt green building technology including efficient lighting, HVAC and water usage</td>
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<tr>
<td>Regulation</td>
<td>Solar water heating systems are mandatory in government offices, hospitals, educational institutions and the hospitality sector.</td>
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<td>Provision of infrastructure and services</td>
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<td>Enabling</td>
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<td>Information and awareness raising</td>
<td>Grants for the installation of domestic solar water heating systems</td>
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<td><strong>Hong Kong</strong></td>
<td>Municipal assets and operations</td>
<td>Regulation</td>
<td>Provision of infrastructure and services</td>
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<td></td>
<td>Hong Kong Energy Efficiency Registration Scheme for Buildings (voluntary)</td>
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<tr>
<td><strong>Jogjakarta</strong></td>
<td>Since 2003, a programme to retrofit lights and reduce air-conditioning hours and bulbs in government buildings has been undertaken.</td>
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<td><strong>Melbourne</strong></td>
<td>Employees to receive a 0.5% performance-related pay increase if environmental targets are met. 6* Council House 2 building</td>
<td>Mandatory energy performance requirement of 4.5* for office developments greater than 2,500m²</td>
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<td>Municipal assets and operations</td>
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<td><strong>Mexico City</strong></td>
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<td>“Clean Building Label” required for all new construction.</td>
<td>Installation of 30,000 square meters of green roofs per year until 2012.</td>
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<td><strong>Mumbai</strong></td>
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<td><strong>Sao Paulo</strong></td>
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<td>Since 2007, buildings with more than three bathrooms must use solar water heating systems</td>
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<td><strong>Seoul</strong></td>
<td>New City Hall (to be completed in 2010) to be an exemplar project for recycled energy</td>
<td></td>
<td>Provides incentives to buildings with high energy-efficiency.</td>
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4.1.1 Self-governing

As discussed above, the mode of ‘self-governing’ has been central to municipal efforts to address climate change, particularly in cities in the north. In the sector of the built environment one popular approach has been to increase the energy efficiency of municipal operations, either through retrofitting buildings or through improving the energy efficiency of appliances (e.g. office equipment, lighting) used by the municipality. In Cape Town, a target of increasing energy efficiency within the municipality by 12% by 2010 has been set. In Yogyakarta, since 2003 a programme to retrofit lights and reduce air-conditioning hours and bulbs in government buildings has been undertaken, and in Beijing a programme of energy efficiency improvements to government buildings is due to be completed by 2010. In Melbourne, energy saving behaviour amongst municipal staff has been encouraged by the promise of a 0.5% performance-related pay increase if environmental targets are met, demonstrating that climate change issues are being mainstreamed within the local authority. In contrast, action in Delhi has primarily driven by power shortages in the city rather than concerns for climate change per se. Nonetheless, this has led to a comprehensive effort at energy conservation, including the banning of incandescent lighting in government buildings and a mandatory requirement for new government buildings to adopt green building technology including efficient lighting, HVAC and water usage (DTL 2008). These initiatives demonstrate the potentially powerful effect that reframing climate change concerns with respect to other issues affecting energy conservation in the built environment can have in motivating action at the local level.

As research elsewhere has found, our case-studies demonstrate that municipal initiatives in the self-governing mode have also involved the development of ‘exemplar’ or best practice buildings, to showcase the possibilities of new technologies and of energy efficiency standards. In Seoul, the municipal government is is consulting the German Fraunhofer Solar Research Institute (FSRI) on recycled heat in the new 26-storeyed city hall. This project is expected to be completed by September 2010. In Melbourne, the recently completed Council House 2 (CH2) building has been recognised as a leading example of what can be achieved within the confines of inner-city building sites, reaching the top 6* rating on the Green Star rating scheme.

4.1.2 Regulation

Across different countries, research suggests that the built environment is one sector in which the regulatory mode of governing climate change is prominent (Janda and Busch 1993, 1994).
Energy standards for buildings\(^3\) range from voluntary guidelines to mandatory requirements, which may apply to one or many building types. While mandatory standards are embedded in structures of formal regulation, voluntary standards provide a form of ‘soft’ regulation, often used to direct changes in practice on the implicit or explicit assumption that without such improvements mandatory measures will be implemented. Such standards are usually set at the regional or national level. In order to understand the potential for action with respect to energy standards in the built environment in our case-study cities a literature review and an online survey were conducted to gather information on standards in 81 countries\(^4\). In total, 61 countries have some form of mandatory and/or voluntary existing standard, eleven countries had proposed standards, and nine countries did not have standards. Figure 2 shows the status of standards in these 81 countries.

In terms of the countries in which these case-study cities are based, Australia, China and South Korea have mandatory standards for residential and commercial buildings, Mexico has mandatory standards for non-residential buildings, India, Indonesia and South Africa have voluntary standards for non-residential buildings and there are currently no standards in place in Brazil. With its historic independence, Hong Kong has been in a position to implement its own building energy standards. A decade ago, the voluntary Hong Kong Energy Efficiency Registration Scheme for Buildings (HKEERSB) was established which promotes the application of a comprehensive set of Building Energy Codes – for building energy services, setting efficiency standards for lighting, air conditioning, electrical, lift and escalator installations.\(^5\) In 2008, a public consultation for Mandatory Building Energy Code was conducted, and although the outcome is still pending it is expected that this will be implemented in 2009. Despite the prevalence of building energy standards, it is important to note that their effectiveness varies greatly from country to country (Koeppel and Ürge-Vorsatz 2007). Koeppel & Urge-Vorsatz (2007) suggest that effectiveness of energy standards may be particularly low in developing countries, given difficulties with enforcement and even corruption. Even in developed countries, the estimated savings from energy codes range from 15-16% in the US to 60% in some countries in the EU.

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\(^3\) We use the word “standard” to refer interchangeably to what also might be called codes, criteria, guidelines, norms, laws, protocols, provisions, recommendations, requirements, regulations, rules, or standards. Depending on the country, the “standard” may be contained in one document, be part of another larger document (such as a general building code), or comprise several documents.

\(^4\) This research updates a similar study completed in 1994 on the worldwide status of energy standards for buildings (Kathryn B Janda and Busch 1993; Kathryn B. Janda and Busch 1994).

\(^5\) See: \url{http://www.arch.hku.hk/research/BEER/besc.htm} (accessed April 2009)
Figure 2: Status of Energy Standards in 81 countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Status</th>
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<tr>
<td>Greece</td>
<td>Mandatory</td>
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<td>Ireland</td>
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<td>United Arab Emirates</td>
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<td>Mexico</td>
<td>Mixed and/or</td>
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<td>Singapore</td>
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<td>Vietnam</td>
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<td>Australia</td>
<td>Proposed</td>
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<td>Czech Republic</td>
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<td>Kazakhstan</td>
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<td>Korea, South</td>
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<td>Kuwait</td>
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<td>Russia</td>
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<td>United States</td>
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6 Primary data for the update was gathered through an online survey, reports and websites (e.g., RICS 2007; CLASP 2005; Koeppel and Ürge-Vorsatz 2007; IEA 2006; Deringer 2006).
One problem with national energy standards is that they are usually set at a level to avoid worst practice rather than to encourage best practices. While municipal governments usually have little influence over the levels of improvement set by national building energy standards, our case studies show that they can mandate additional measures for the built environment within their jurisdiction that can have an impact on emissions of greenhouse gases. In Melbourne, a mandatory energy performance requirement of 4.5* for office developments greater than 2,500m$^2$ has been bought in under the municipality’s planning powers. In New Delhi, solar water heating systems have been made mandatory in certain categories of buildings including government offices, hospitals, educational institutions and the hospitality sector, while the use of incandescent bulbs in all new and existing government establishments has been banned (DTL 2008). Similar standards have been established in Sao Paulo where, since 2007, buildings with more than three bathrooms, whether they are homes, apartments, trade, services or industrial buildings, must use solar water heating systems (TCG 2008). Mexico City has devised a new “Clean Building Label” for all new construction required as part of its Plan Verde (Mexico City 2008). These examples show that, even where direct municipal competencies for establishing building standards may be missing, for local governments motivated to go beyond standard practice, they have a range of tools at their disposal to augment the energy performance of the built environment.

4.1.3 Provision

In contrast to the use of a regulation mode of governing, we find that governing through ‘provision’ – of infrastructures or services which shape behavioural choices and restructure markets – has been limited with respect to the built environment. We find only one example across our case-studies where a municipal authority is involved in directly providing energy efficient infrastructures and services, and this is Mexico City. Here, the municipality is installing 30,000 square meters of green roofs per year until 2012. It is also launching a new social housing model that integrates green areas, public spaces and environmental design (Mexico City 2008). While formulated as mitigation strategies, they address adaptation as well through enabling to better cope with extreme temperature indoors, especially in housing that lacks heating or cooling devices or for residents with limited income. The lack of evidence from the other cases of municipalities adopting this role suggests either that municipal governments have a limited role in the provision of built environments (e.g. social housing) in these cities,
and/or that they are engaged in other means of providing low energy services, including enabling and partnership approaches which we discuss further below.

4.1.4 Enabling

Our case-studies show that providing information, reward and recognition are key means through which municipal governments can enable action by private sector organisations and by individuals. The Hong Kong government has been involved with a programme to promote energy efficiency in the home through reducing the demand for cooling by keeping indoor environments at 25.5 degrees. In Mumbai, an Eco-housing program has been introduced to encourage environmental efficiency in residential buildings. It is a voluntary building certification scheme for new and existing housing. It is proposed that developers as well as consumers participating in this program will be offered incentives, and while the incentivisation scheme is yet to be finalized with the state government, rebates in the form of reduced development charges and assessment taxes have been approved by the MCGM in principle (MCGM, 2008c). As this example demonstrates, financial incentives are also an important element of enabling action to reduce emissions of GHG from the built environment. In Delhi, the state government established an Energy Efficiency and Renewable Energy Management Centre which provides partial monetary aid to domestic users for the installation of solar water heating systems, while in Seoul incentives are offered to buildings with high levels of energy efficiency.

Our case-studies also show that other forms of reward and recognition can be successful in enabling other actors to respond to mitigating climate change in the built environment. In Melbourne, the ‘Savings in the City’ programme involved thirty city hotels in a milestone and reward programme to reduce energy and water use, and to avoid waste. By providing these businesses with independent recognition of their success – and setting up a degree of competition between them to achieve results – significant savings of GHG emissions have been achieved. This example shows that, in addition to providing information and financial incentives, establishing the right frameworks through which communities and businesses can act on climate change is an important aspect of the role of municipal governments.

4.1.5 Partnership
As well as enabling others to act, our case-studies suggest that increasingly acting on climate change in the city is dependent on a range of partnership and private sector initiatives. In Beijing, somewhat surprisingly given their otherwise limited role in climate change policy and the nature of the state, NGOs have been an important actor in raising awareness about the possibilities of behavioural change for reducing emissions of GHG from the built environment through a joint campaign to maintain a 26° C room temperature led by Friends of Nature Beijing. In 2008, the Environmental Protection Department and the Electrical and Mechanical Services Department in Hong Kong drew up a set of "Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for buildings (Commercial, Residential or Institutional Purpose) in Hong Kong" (EMSD and EPD 2008). These Guidelines will identify areas for energy efficiency improvement and conduct voluntary programmes to reduce and / or offset emissions arising from buildings. Since its introduction, 37 institutions have signed up as Carbon Audit Green Partners, including private corporations, public hospitals and universities. One further example of this sort of public-private partnership is in Mumbai, where in February 2008, Mumbai-based K. Raheja & Corp, one of the biggest real estate developers in India, signed the first agreement with Johnson Controls to retrofit the largest mall in Mumbai under the aegis of Mumbai’s membership of the C40 network and with funding provided through the Clinton Climate Initiative (Sinha, 2008).

Two projects from the case of Cape Town also illustrate the growing importance of non-governmental actors in addressing climate change in the built environment at the municipal level. The Kuyasa Low-Income Housing upgrade is the first African project under the Clean Development Mechanism and also attained the first Gold Standard status in the world (SSN, 2008). The project started in June 2008, with the intention of installing solar water heaters, efficient lamps and insulated ceilings in 2300 existing low-income housing in Khayelitsha, Cape Town over the next 21 years. These retrofits are expected to reduce about 2.85 tonnes of CO₂ per household per year and the revenue gained from the selling of emissions credits will be channelled back to setting community-owned energy services and micro-enterprises which in turn create local employment (SSN, 2008). At a smaller scale, Sustainable Energy Africa’s commercial office built in 2004 has demonstrated the potential of ‘green buildings’ in Cape Town. It was designed to incorporate passive solar design, low energy and water use considerations, and maximized recycled building materials, and has been positively evaluated for its low environmental footprint.⁷

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4.2 Transportation

The transport sector is a significant contributor to greenhouse gas emissions, representing 23% (worldwide) and 30% (OECD) of CO2 emissions from fossil fuel combustion in 2005 (Wagner et al. 2006). These shares have risen over the past three decades and are expected to continue to increase in the future. From 1990 to 2004, CO2 emissions from the transport sector rose by 36.5% (Wagner et al. 2006). In developing countries, especially China, India, and other Asian countries, although transport’s share of GHG emissions is low, the transport sector is growing much faster than other sectors (Karekezi et al. 2003). Increasing demand for fossil fuels and automobile-oriented infrastructure is leading to greater GHG emissions and deteriorating air quality. Thus, urban transport has become an important sector for achieving greenhouse gas emissions reductions targets, while issues of adapting transport infrastructures to climate change have yet to feature substantially on the urban policy agenda.

The mitigation strategies taken by cities that have reduced carbon emissions include promoting the capacity and quality of public transport systems, integrating transport and urban planning to facilitate efficient and low-carbon modes of transport, strengthening transport demand management, increasing investment in cleaner or alternative fuel vehicle technologies, tightening vehicle emissions and efficiency standards, and encouraging non-motorized transport, such as biking and walking. The governance approaches adopted by municipalities include forms of self-governing (e.g. staff travel planning, vehicle fleet fuel switching), regulatory (e.g. emissions standards, planning laws), provision (e.g. of public transport services or of infrastructures for alternative modes of travel), enabling (e.g. information) and partnerships (e.g. public-private financing for new modes of transportation). In the remainder of this section, we discuss the mixture of approaches adopted in the case-study cities. We provide examples from across the case-studies (Figure 3) and examine the similarities and differences between cities. We summarise our findings, and identify the drivers and barriers for policy and action, in Section 4.4.
Figure 3: Examples of climate change policy interventions for transport in the case-study cities

<table>
<thead>
<tr>
<th>City</th>
<th>Municipal government</th>
<th>Partnerships</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Reducing municipal emissions</strong></td>
<td></td>
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<tr>
<td>Beijing</td>
<td>Use of alternative fuels for bus fleet.</td>
<td></td>
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<tr>
<td></td>
<td>Vehicules control for government-owned vehicles during and after the Olympics.</td>
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<tr>
<td></td>
<td><strong>Regulation</strong></td>
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</tr>
<tr>
<td></td>
<td>Vehicle emissions and efficiency standards.</td>
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<tr>
<td></td>
<td>Restrictions on the number of days on which cars can be used.</td>
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<tr>
<td></td>
<td><strong>Provision of infrastructure and services</strong></td>
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<tr>
<td></td>
<td>Built more subways, BRT, and GPS for buses and taxis.</td>
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<tr>
<td></td>
<td><strong>Enabling</strong></td>
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<tr>
<td></td>
<td>No Car Day 2007</td>
<td></td>
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<tr>
<td></td>
<td>Discounted tickets for public transport use.</td>
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<tr>
<td>Cape Town</td>
<td>Plan to build BRT systems</td>
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<tr>
<td>Delhi</td>
<td>Use of modern low-floor CNG buses in fleet and conversion of taxis and auto-rickshaws</td>
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<tr>
<td></td>
<td>to CNG.</td>
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<tr>
<td></td>
<td><strong>Emissions standards for all new vehicles</strong></td>
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<tr>
<td></td>
<td>Delhi metropolitan railway system (Metro); Introduction of BRT</td>
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<tr>
<td></td>
<td>**A program to provide a 30% subsidy on the purchase of battery-operated vehicles in</td>
<td></td>
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<tr>
<td></td>
<td>the city</td>
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<tr>
<td></td>
<td><strong>Project implementation</strong></td>
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<td></td>
<td>The Delhi Metro Rail Corporation registered a CDM project in 2007.</td>
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<tr>
<td>Hong Kong</td>
<td>Planned extension to mass transit system</td>
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<td></td>
<td>Tax incentive scheme for cleaner vehicles</td>
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<tr>
<td>Municipal government</td>
<td>Partnerships</td>
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<tr>
<td><strong>Reducing municipal emissions</strong></td>
<td><strong>Regulation</strong></td>
<td><strong>Provision of infrastructure and services</strong></td>
</tr>
<tr>
<td>Jogjakarta</td>
<td>Ban on motor vehicle commuting for city employees living within 5 km of municipal buildings</td>
<td>Increased provision of public buses</td>
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<td>Melbourne</td>
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<tr>
<td>Mexico City</td>
<td>Plan to replace the city government car fleet in its entirety with low emission vehicles.</td>
<td>“Day without a car” programme limits car use one day a week. Mandatory private school bus use scheme</td>
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<tr>
<td>Mumbai</td>
<td>Emissions standards for all new vehicles</td>
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<tr>
<td>Sao Paulo</td>
<td>Emission control standards</td>
<td>Built cycling lanes and upgrade public transport infrastructure</td>
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<tr>
<td>Municipal government</td>
<td>Partnerships</td>
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<tr>
<td>Reducing municipal emissions</td>
<td>Project implementation</td>
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<td>Regulation</td>
<td>Voluntary agreements</td>
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<tr>
<td>Provision of infrastructure and services</td>
<td>Information and awareness raising</td>
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<tr>
<td>Enabling</td>
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<tr>
<td>Seoul</td>
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<tr>
<td>Alternative fuels for government vehicles</td>
<td>Car Free Day 2008</td>
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<tr>
<td>Free Bike Scheme; Installation of bus lanes and transfer system</td>
<td>Discounted public transport tickets</td>
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</table>
4.2.1 Self-governing

One of the most common policies with respect to transportation has been for municipalities to replace some or all of their own vehicle fleets with alternative fuels. Alternative fuel vehicles are vehicles powered by substantially non-petroleum based fuels, including compressed natural gas (CNG), methanol, ethanol, propane, liquefied petroleum gas (LPG), biodiesel, biofuel, and electricity. This approach has been popular amongst our case studies. Beijing has one of the largest CNG fleets of any city in the world; about one third (4,158) of 20,000 buses are powered by CNG. Three fuel cell buses began operations on 20 June, 2006, and a hydrogen refueling station began operating in November 2006 within the Beijing Hydro Demo Park. About 500 advanced alternative fuel vehicles were used by the Beijing Organizing Committee for the 2008 Beijing Olympic Games and Paralympics, including 20 fuel cell cars, 50 lithium-ion battery-powered electric buses, 25 hybrid buses, and 75 hybrid cars (Zhao 2008). The hybrid vehicles and natural gas powered vehicles around the village all meet Euro IV emission standards and helped achieve “zero emissions” in the central Olympic area. These vehicles were developed and supported by China’s national R&D program, for which the Beijing Olympics was used as a testing ground. In Seoul, the Seoul Metropolitan Government plans to replace government vehicles with hybrids and increase the number of compressed natural gas buses (SMG 2008; SMG News 2007), while in Mexico City there is a plan to replace the city government car fleet in its entirety with low emission vehicles. In Delhi, the government has also introduced new vehicles in its fleet, in the form of modern low-floor CNG buses in the city, with plans in place to phase out the existing bus fleet in the coming years (The Hindu 2008). This moves follows the 1998 order of the Supreme Court that all the buses in New Delhi be converted from diesel fuel to CNG, and its further decision, despite opposition by the Delhi government, that Delhi’s entire public transport fleet (buses, taxis and auto-rickshaws) should be converted to CNG by 2003 (Rosencranz and Jackson 2003). This was hailed as a major success for the environmental lobby. At present there are more than 130,000 vehicles running on CNG in the city (GoD 2008).

Municipal governments can also seek to improve their own impact on climate change through the transport sector by seeking to change the travel behaviour of employees. Usually, this is pursued through staff travel plans and/or education campaigns. One of our case-studies provides an example of a more rigorous approach. In early 2008, the Mayor of Yogyakarta

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8 In March 2003, the Global Environment Facility (GEF), UNDP and the Chinese Government launched this project in Beijing and Shanghai. The objective of this pilot project was to demonstrate the operational viability of FCBs in a developing country.
passed a resolution that forbids city workers living within 5 km vicinity of municipal buildings to commute to work in motor-vehicles, forcing them to adopt public transportation (Bailey 2008). This approach is unique amongst our case-studies, but points to the potential impact that municipalities might be able to have on the culture of transportation in their cities.

4.2.2 Regulation

The regulation of emissions and energy efficiency of vehicles is viewed as the most prominent and widely used tool to improve vehicle fuel consumption and reduce carbon emissions (Sperling and Cannon 2007:259). These standards focus on vehicle efficiency and emissions for traditional pollutants, such as PM, NOx, and CO, but do not include CO₂ explicitly. Nonetheless, reducing such air pollutants can have a positive effect on emissions of GHGs. Our case-studies show that this has been a popular regulatory measure, reflecting the connections between transportation, air quality and health. Since 2005, all new vehicles registered in Mumbai have to comply with Bharat Stage III (equal to Euro III) efficiency norms and by 2010 they will have to be Bharat Stage IV compliant (equal to Euro IV). Older vehicles are being taken off the road or being converted to CNG (Takeuchi et al. 2007). In Delhi, all new four-wheeled vehicles have to meet Bharat Stage III norms for emission control (similar to Euro III). From 2010 this bar will be raised and vehicles will have to meet Bharat Stage IV norms (similar to Euro IV). The implementation of these standards originates in the 1995 ‘Clean Air Campaign’ by the Centre for Science and Environment, one of the leading environmental NGOs of India (Véron 2006, with the result that, in compliance with Supreme Court orders, between 1994-1996 new fuel-quality standards were introduced in the four major cities of India including Delhi.

Beijing required all new light duty vehicles to meet Euro I emission standards in 1999, Euro II emission Standards in January 2003, Euro III emission standards in December 2005, and Euro IV emission standards in March 2008. These requirements were implemented one or two years ahead of other cities in China. In order to encourage the implementation of these regulations, programs such as labelling or incentive schemes have been adopted by city governments. Beijing started to implement a label system in 2005, providing yellow labels to vehicles that do not meet Euro I standards. Beijing has about 300,000 yellow-labeled vehicles which are not allowed to be driven on the roads in certain areas and hours.⁹ These vehicles were banned from the road between 1 July and 20 September 2008 for the Olympics and will be completely banned in 2009. In Hong Kong, vehicles meeting the energy efficiency and exhaust emission

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⁹ Du Shaozhong, Deputy Director of the Beijing Environmental Protection Bureau.
criteria can have the First Registration Tax reduced. In Delhi, there is a similar mixture of standard setting and incentives. The state government also has initiated a program to provide a 30% subsidy on the purchase of battery-operated vehicles in the city. The government is funding this subsidy from the diesel it has levied since early 2008. It is also supported by a subsidy provided by the central Ministry of New and Renewable Energy. The program was introduced at a time when the price of crude oil was sky-rocketing. The government is keen on encouraging the use of alternate fuel and is particularly eager to reduce the number of diesel vehicles which currently account for 30% of the automobile population of the city (The Times of India 2008; MNRE 2008). These examples suggest that regulation may be most effective when it is combined with other, more enabling, modes of governing.

Beyond regulating vehicle standards and emissions, there is little evidence that our case-study cities deploy the regulatory mode of governing in the transport sector. One exception is Mexico City, where restrictions are placed on car use such that they can be driven into the city on one day a week. The municipality is currently exploring the potential of extending this to also include Saturdays. Mexico City also introduced a pilot scheme for mandatory school bus transportation in 2008 with 34 schools, which will enforce the use of school buses for all private school students by the year 2012. Another example, is Beijing which had a two-month long vehicle control scheme in place based on odd-even license plate numbers for the Olympic Games in 2008, and beginning in October 2008 started a vehicle driving control based on the last digit number of license plate numbers so that each vehicle can only drive four days out of every five working days.

4.2.3 Provision

Improving the efficiency and coverage of public transportation is critical for encouraging the public to change their travel mode to reduce energy use and emissions associated with the growth of private motorized transport. If the share of buses in passenger transport were to increase by 5-10%, then CO2 emissions would fall by 4-9% (IPCC 2007: 51). In this context, many municipalities are playing critical roles in providing infrastructures that promote less carbon-intensive travel. For example, Large-capacity buses, light-rail transit and metro or suburban rail

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10 Eligible car list (subject to question because rely on automakers to provide information): http://www.epd.gov.hk/epd/english/environmentinhk/air/prob_solutions/environment_friendly_private_cars.html#3a (accessed April 2009)
are increasingly being used for the expansion of public transport. In some cases, municipalities are the direct providers of such services, while elsewhere they are critical actors in building the necessary infrastructure for their operation.

Providing a higher quality public transport system is regarded by our case cities as an efficient and effective approach to reducing traffic jams, air pollution and carbon emissions. Most cities have invested hugely in public transport infrastructure and plan to continue doing so in the future. Hong Kong enjoys a well-developed mass transit system; 90% of the 11 million commuter trips each day are made on the public transport system (EPD) and there are plans for 5 different extensions in the next 5 years. The State of Sao Paulo (SSP) is investing US$ 7.285 billion during 2007-2010 to upgrade the Metropolitan Subway and other public transport systems, using funds from the Inter-American Development Bank (SSP 2008). These investments will help modernize train lines and build 100 km of new lines for buses in the City of Sao Paulo (CSP), Santos and Campinãs (TCG 2008). By 2010, these upgrades are expected to have reduced 700,000 tons of GHGs that can be sold in the CDM markets (SSP 2008). Over the past decade, Beijing invested heavily in public transport infrastructure such as buses, Bus Rapid Transit (BRT) lines, subways, and public transport transfer systems to improve air quality to meet the requirements of the 2008 Olympic Games (Zhao 2008). Beijing had only two subway lines, 54km long, in 2001 when Beijing won its bid for the Olympics. In 2008, 6 more lines were built, extending the network to 200 km and establishing new subway networks in north and central Beijing. Three BRT lines have been built in Beijing to link the centre of the Beijing to the East and North (Greenpeace 2008). Similarly, in Delhi the first phase of the Delhi metropolitan railway system (Metro) came into operation in December 2002. Currently the second phase of the system is being constructed and is expected to be completed by 2010 in time for the Commonwealth Games. The project is a combination of surface and over-ground trains. At the same time, BRT lines also have been opened in some parts of Delhi. The BRT system has exclusive bus lanes operating in the central verge of the road. It also dedicates a lane for cyclists and improves pedestrian crossings and paths. Bus travelers, cyclists and pedestrians are reported to be satisfied with the new system, but there has been major criticism of severe traffic congestion in some areas caused by the reduction in the number of lanes for other vehicles (Centre for Science and Environment 2008). BRT systems are also due to be introduced in Cape Town, in order to reverse a recent trend towards the use of private motorized vehicles and informal minibus taxis in time for the 2010 World Cup. These last three examples demonstrate the importance of global events in shaping urban transport infrastructures, a point to which we return below.
As well as providing for public transport, municipalities can also develop infrastructures for alternative modes of transport. This is a less common approach in our case-studies. One example is in Seoul, where a free Bike Scheme was launched in August 2007 following the example of Paris (SMG 2008). Some 200 bike stations will be provided in the Songpa-gu area where cycle routes are well prepared with about 5,000 bikes. The project will be expanded to other areas of the city, but to a degree remains hampered by the lack of infrastructure such as cycle routes and bike racks. In Mexico City, there is a plan to build some 300km of bicycle highways by the year 2012 in order to help reach the government target of at least 5 percent of person-trips to be done by bike. In the main, though, it is clear that across our case-study cities, the provision of public forms of transportation is favoured over non-motorised alternatives.

4.2.4 Enabling

A key aspect of the enabling mode of governing for transportation has been the use of incentives. One approach has been to adopt economic incentive policies such as pricing policies to encourage the shift to public modes of transport. To resolve the problem of public transport use being well below capacity, the Beijing municipal government started an integrated circuit (IC) card ticket system, replacing the paper tickets used for more than 50 years (Li et al. 2008). The IC card can use for both buses and subways and there is discount for using IC cards on buses and BRT lines (60% discount for adults and a 20% discount for students). It currently costs 1 yuan (US$ 0.13) for a regularly priced bus ticket; therefore, with an IC card an adult only need pay 0.4 yuan (US$ 0.06) and a student 0.2 yuan (US$ 0.03) per trip. The price subsidies for public buses and subways are financed by the Beijing Municipal government and have led to increased the use of these services, especially by senior retired persons (Zhao 2008). The Seoul government encourages citizens to travel on public transport by charging a price for travel anywhere within Seoul of approximately USD1 (SMG 2008; SMG News 2007). Incentive schemes have also been used to encourage the use of alternative fuels. In 2000, Hong Kong introduced an incentive scheme to replace diesel with LPG and by the end of 2003 nearly all taxis has switched to LPG (EMSD 2008). A similar scheme was also adopted in 2002 for light buses to replace diesel with LPG or electricity and thus far 2,500 light buses have done so (EMSD 2008). In Mexico City, the use of non-motorized transport is also promoted through the use of incentives.

A second set of strategies for enabling the governance of transportation systems relies on information. Some cities, working with national governments or on their own, adopt public campaigns to increase public awareness and knowledge of cleaner transportation. China
launched its first nationwide urban public transport week on 16-22 September 2007, with 108 cities participating (including Beijing) and with a theme of "Green Transport and Health" to raise residents' awareness of energy saving and environmental protection. The campaign encouraged people to walk, ride bicycles and take public transport such as buses, subways and taxis rather than driving private cars. Along with other cities, Beijing set 22 September as a "No Car Day" for one area of the city, which was opened only to pedestrians, bicycle riders, taxi and bus passengers between 7 a.m. and 7 p.m. Seoul also held a Car Free Day on September 22, 2008, which was estimated to reduce CO₂ emissions by 10%. Similar awareness raising initiatives have also been developed in Melbourne, and in the Greater Melbourne area the City of Darebin promotes ‘living locally’ through informing residents of the services available locally in order to reduce demand for travel.

4.2.5 Partnership

In contrast to the built environment sector (Section 4.1), in the arena of transportation we find few examples of partnerships between municipalities and non-state actors seeking to address climate change. One exception is in the State of Sao Paulo, where the flex-fuel technology which enables vehicles to runs on either ethanol, gasoline or a mix, has been developed in collaboration with international manufacturers such as Volkswagen, Fiat, GM, Peugeot. On this basis, the State-led Motor Vehicle Pollution Control, PROCONVE 2009, sets standards for gasohol, ethanol, compressed natural gases and diesel vehicles. Although it does not cover CO₂, N₂O or SOₓ directly, between 2010 and 2020, cumulative CO₂ emission reductions in SSP resulting from this program are expected to be between 2.6 to 57.2 million tCO₂ (The Hewlett Foundation, 2005). Another case is that of the Delhi Metro Rail Corporation (DMRC), which has registered a project based on regenerative braking in trains as a clean development mechanism (CDM) project with the UNFCCC in 2007. This is an example of a ‘partnership’ between a municipal government and the international regime, orchestrated by the CDM board that also includes private actors. It is expected to earn 400,000 CERs for a ten-year period beginning December 2007. The DMRC will earn Rs. 12 million (240,000 US dollars) per year from this which will be used to offset additional investment and operation costs (UNFCCC 2007). Another CDM project is being planned wherein the DMRC will claim CERs for the reduction of tail-pipe emissions as commuters switch to the Metro. These sorts of projects could potentially pave the way for significant sources of finance for public transport infrastructures in the global south.

though they do of course come with all the usual caveats about CDM projects and the benefits (environmental, social or economic) that they may be able to realize in practice.

4.3 Urban Infrastructures

Urban infrastructures, for example, energy (electricity and gas networks), water and sanitation systems, urban flood drainage and coastal defenses, are critical in mediating the relation between climate change and cities. One the one hand, inadequate provision of infrastructure or its poor maintenance can exacerbate the impacts of climate change and the vulnerability of urban populations. On the other hand, the nature of utility provision – for example, fossil fuel based or renewable energy - can influence the GHG intensity of daily decisions and the cumulative impact of the city on the global environment. Governing urban infrastructures is, however, a complex matter. Frequently, such systems lie outside the direct control of municipal governments or, even where they are supposedly the responsibility of local authorities, inadequate funding combined with a lack of recognition of the rights of those living in informal settlements (Satterthwaite 2008: 11) can lead to their neglect. The significant sums of money involved in developing urban infrastructure systems often require municipal governments to work in partnership with national governments, private sector actors and donor organizations, leading to potential conflicts amongst priorities and problems of inter-agency co-ordination. In addition, the planning and development of urban-scale infrastructure systems can take several decades to come to fruition, and is frequently unable to predict or track the sorts of social, economic and environmental changes that might be witnessed over such timescales.

Because of the long time horizons and large financial investments involved, issues of social and environmental justice are particularly pertinent in responding to climate change in the infrastructure sector. As Huq et al (2007: 14) have argued, the “kinds of changes needed in urban planning and governance to ‘climate proof’ cities are often supportive of development goals. But … they could also do the opposite – as plans and investments to cope with storms and sea-level rise forcibly clear the settlements that are currently on floodplains, or the informal settlements that are close to the coast”. Equally, mitigation strategies, such as smart-meters for demand reduction or the embedding of energy generation technologies in household infrastructures, could open up new divides between those who are able to pay and participate in mitigation measures and those for whom they will lead to new forms of social and economic exclusion. We return to these points below.
In the remainder of this section, we discuss the mixture of approaches adopted in the case-study cities (self-governing, regulation, provision, enabling, partnerships) for governing climate change mitigation and adaptation in the built environment. We provide examples from across the case-studies and examine the similarities and differences between cities (Figure 4). The drivers, barriers and implications of policy and action are discussed in Section 4.4.
Figure 4: Examples of climate change policy interventions for urban infrastructures in the case-study cities

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<th></th>
<th>Municipal government</th>
<th>Partnerships</th>
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<tr>
<td><strong>Reducing municipal emissions</strong></td>
<td>Regulation</td>
<td>Enabling</td>
</tr>
<tr>
<td>Beijing</td>
<td>Green Lighting project for street lighting</td>
<td>Pilot Guanting Windfarm supplied electricity to all of the 2008 Olympic Games venues. Additional renewable energy projects underway.</td>
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<td></td>
<td>Water system repair underway as part of the WCWDI.</td>
<td>Water Conservation and Water Demand Initiative (WCWDI)</td>
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<td>Energy ‘poverty tariff’</td>
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<td></td>
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<td>Power purchase agreement with the Darling Wind Farm to increase supply of renewable energy to meet target of 10% by 2020.</td>
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<tr>
<td>Cape Town</td>
<td>Planning guidelines proposal for a 5m buffer zone along the coast</td>
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<td>The Delhi Jai water mains replacement programme</td>
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<td>Rainwater harvesting promotion</td>
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<td>Delhi</td>
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<td>Hong Kong</td>
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HSBC project for renewable energy in schools
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<th>Municipal government</th>
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<td><strong>Reducing municipal emissions</strong></td>
<td><strong>Regulation</strong></td>
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<tr>
<td>Jogjakarta</td>
<td>Streetlight Management Scheme</td>
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<tr>
<td>Melbourne</td>
<td>Renewable energy demonstration projects</td>
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<td>Mexico City</td>
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<tr>
<td>Mumbai</td>
<td>Planning restrictions in costal zones set to be enhanced</td>
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<tr>
<td>Sao Paulo</td>
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<tr>
<td>Seoul</td>
<td>Land-use planning for river restoration and flood defence</td>
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4.3.1 Self-governing

In general, the urban infrastructures that municipalities have direct control over tend to be those through which the mitigation of climate change can be addressed, and even here remain rather small in scale. Some municipalities have sought to shift their reliance on fossil fuel based electricity providing through national grids through the development of small-scale, decentralised (off-grid) low carbon or renewable energy systems. One example we find in our case-studies is Melbourne, where, in addition to the CH2 project discussed above which involves the production of renewable energy, demonstration photovoltaic cells have been built on the city centre Queen Victoria Market – providing some electricity for the municipality but also acting as a demonstration project as to what it might be possible to achieve. Similarly in New Delhi, solar hot water systems have been made mandatory for government buildings, displacing conventional fuels used for this purpose.

One set of infrastructures which is the direct responsibility of municipal authorities in many parts of the world is street lighting. One of the most ambitious projects to address mitigation found in our case-studies lies in this domain. Over the period 2001-2006, under the auspices of the CCP programme, Yogyakarta developed a Streetlight Management Scheme, which involved the retrofit of 775 light bulbs and the installation of 400 energy meters at a cost of $1.7 Million, resulting in an annual saving of 2,051-3,170 tonnes of carbon dioxide (annual energy saving 4,278,408 Kwh) and an estimated $211,765 (ICLEI 2004). In Beijing, a “Green Lighting” project has been implemented to promote a more efficient, energy saving lighting system for the entire city. Similar schemes have also been advanced by local authorities across Greater Melbourne, who have in the main found their efforts frustrated by the private companies involved in providing energy and maintaining the street lighting system, together with the long time horizons (20 years) over which bulbs are replaced. Missing the ‘window of opportunity’ to achieve change can therefore have significant knock-on effects for GHG emissions over the next two decades, suggesting that advanced planning and gathering sufficient political momentum is particularly important in this are of urban governance.

4.3.2 Regulation

Our case-studies demonstrate that where regulation is being used to shape the development of urban infrastructures, this is mainly through the use of planning requirements rather than the direct regulation of, say, water provision or energy services. Several of our case-studies have
integrated environmental and urban planning in place, particularly with regard to water, urban
green spaces, and environmental health (e.g. Sao Paulo, New Delhi, Melbourne and Mexico
city). One example of where the planning system has been used to improve the resilience of a
city to climate change is in Seoul and the restoration of Cheong-gye-cheon River for flood-risk
management (Kim 1999). The project dismantled a highway and allowed the channel to revert
back to its original natural course. It ran from July 2003 to September 2005 covering 5.84 km
with an estimated cost of 390 billion won (USD 300 million approximately) (MLIT 2008). While
the aim of the project was flood aversion, benefits included biodiversity restoration, decrease
in ambient temperature, reduction of health risks on floodplains and increased number of
visitors (Pitts and Kim 2005). More explicitly directed at concerns for climate change have been
efforts to shape the development of coastal areas. Cape Town commissioned a Framework for
Adaptation to Climate Change study in 2006 and conducted a comprehensive risk assessment of
sea-level rise as a port city in 2008 (CCT 2006b and 2008b). The 2005 Vulnerability Assessment
of Western Cape proposed creation of a 5m buffer zone along the coast (Midgley et al. 2005). In
Mumbai, climate change is also beginning to have an effect on coastal zone planning. In 1991
the Union Government had issued regulations which demarcated coastal areas as Coastal
Regulation Zones (CRZs) and restrictions were placed on the nature and extent of development
that could take places in such Zones. In May 2008, the Government issued a notification
proposing amendments to the 1991 regulations which would in effect make the restrictions
 stricter (MoEF 2008). As Mumbai lies in one of the CRZs, the Notification of 2008, if approved, is
likely to improve the management of the coastal resources and protect the city from extreme
weather events.

4.3.3 Provision

Up until the mid-1990s, many municipal authorities around the world owned their energy
generation, water provision and waste services. In effect, they provided utilities for their
communities. In this manner, “local governments were able to control the nature of
infrastructure development and to influence practices of public consumption and waste in such
a way as to limit emissions of greenhouse gases” (Bulkeley and Kern 2006: 2245) and
potentially to enhance their resilience to the impacts of climate change. With the rising tide of
neoliberalism in the utilities sector, many such municipally owned companies in Europe and
Australia were sold during the 1980s and 1990s, though in parts of the UK and US this took
place much earlier, so that the direct provision of services has declined (Bulkeley and Kern
2006; Schroeder and Bulkeley 2009). Nonetheless, our case-studies indicate that municipalities
still play a critical role in the provision of urban infrastructures and services. These roles include the maintenance of existing systems and the development of new forms of infrastructure.

Water supply is one area of infrastructure maintenance that is critical for both climate change adaptation (in terms of reducing vulnerability to water shortages) and mitigation (given the energy intensive nature of cleaning and distributing water for drinking and sanitation systems). For example, The Delhi Jal Board, the government agency responsible for water supply in Delhi, has estimated that distribution losses are to the tune of 40% of the total water supplied which are due to leakages and unauthorized use. The Board is in the process of replacing parts of the water mains as significant portions of the pipelines are 40-50 years old. In Cape Town, a similar scheme of water system repair is also underway.

In terms of the development of new infrastructures, policies and projects are few and far between and attention in our case-studies has focused primarily on low carbon and renewable energy. In Beijing, renewable energy currently only provides 1% of electricity supply. A pilot Guanting Windfarm (1st phase) was established to generate electricity and in order to supply electricity to all of the 2008 Olympic Games venues, and 15 more renewable energy pilot villages and 10-15 biomass pilot projects are planned. In 2008, Seoul Metropolitan Government devised a New Town Development Plan which aims to build 277,000 new apartments with district heating (DH), estimated to cost US$2.6 billion. While the energy and carbon dioxide savings, and propriety of the process, have been called into question (Park and Kim 2008), it demonstrates that making large-scale infrastructure changes to the provision of energy are on the agenda in Seoul in a way that is not yet apparent in most of the other case-studies included in this report.

4.3.4 Enabling

In the main, strategies for enabling action by communities and stakeholders with respect to urban infrastructures are focused at the level of individual buildings, and hence discussed above (Section 4.1.4). However, our case-studies do reveal some examples of more comprehensive approaches aimed at reducing the use of resources in order to tackle issues of poverty as well as energy and water shortages (with consequent implications for climate change mitigation and adaptation). In Delhi, rainwater harvesting is being promoted in the city and monetary assistance is being given to individuals, resident organizations and institutions to put in place the required system (GoD 2008a). In Cape Town, two innovative schemes have been developed to address the combined effects of poverty and resources shortages. The city
was the first to launch a “poverty tariff”, where 50kWh of free electricity per month is provided to households using below 400kWh per month on average over the 12 months up to May / June 2008 (CCT 2005; CCT 2008a). To address future water shortages and stressed wastewater treatment rather than climate change, CCT devised a Water Conservation and Water Demand initiative which won an award from the national Department of Water Affairs and Forestry in May 2008 (CCT 2007b and 2008c). The initiative involved installing advanced meters that are programmed to dispense a pre-agreed amount of water each day, as little or as much as the householder can afford (CCT 2007b). Any unused amount will be carried over to the next day but once the agreed-upon daily allocation has been reached, the flow stops until the next morning (CCT 2007b). By April 2008, 7500 water management devices were installed. The target is to reach 20,000 installations by mid-2009, targeting high leakage properties often occupied by poor families. The City will repair all internal leaks before the meter is set, with the intention of protecting both the consumer and water resources. This example does, however, raise concerns about issues of justice and access to resources, and whether these should be determined by price alone. Furthermore, with respect to energy, in May 2008 the ANC agreed that power prices will double to about R 46c/kWh in 5 years by 2012 (Economist 2008). Hence, CCT faces considerable challenges as it attempts to jostle with energy and water poverty, the rising energy prices demanded by industry, power shortages and environmental objectives in the future.

4.3.5 Partnership

Across our case-studies, two forms of partnership are involved in the urban governance of infrastructures in response to climate change. The first involve CDM projects, facilitated through the international climate change agreements and overseen by the CDM board composed of state and non-state actors. In Delhi, a CDM project was registered in 2007 which processes municipal solid waste to produce fuel that would then be used to generate electricity. The project is expected to earn 2.6 million tons of CERs over the next ten years (UNFCCC, 2007a). In Delhi, at least four other similar projects have applied for registration under the CDM, and in Mumbai a further project has been registered. This type of CDM project is also taking place in Sao Paulo, with energy being sourced from two of the largest landfills in the world, Bandeirantes and São Joao, receive CDM credits (TCG 2008). Although Attero São Joao reached its full capacity in 2007, Aterro Bandeirantes continues to receive half of the waste (7000 tons) from Sao Paulo every day. At the end of 2008, 7% of CSP households were supplied by energy generated at both landfills. However, Bandeirantes is scheduled to close and
hence the city is planning to expel waste to neighbouring municipalities by December 2010, meaning that the energy supplied will also no longer be available (Keith 2007).

The second set of partnership projects take place at a smaller scale, and usually involve the private sector working with the municipality to develop new forms of infrastructure rather than in maintaining existing systems or working to improve their resilience for climate change adaptation. Several of these types of project are taking place in Hong Kong, including the HSBC project to install renewable energy in schools, and the development of offshore wind farms by two power utilities which are currently under review. Similar strategies to develop the energy base of the city are being developed elsewhere, but have reached a more advanced stage. In April 2007, Mr. Oh Se-hoon, Seoul’s Mayor signed a Memorandum of Understanding (MoU) with Korean Midland Power to expand city’s green energy. In Cape Town, in order to meet its target of producing 10% of electricity from renewable energy by 2020, the municipality has entered into a power purchase agreement with the Darling Wind Farm. The agreement provided financial and risk assurance for the generator whereby the city guarantees purchase for the next 20 years, and plans to sell the green electricity at a premium price (R 22c/kWh above current electricity rates) (CCT 2008a). However, Cape Town has yet to secure willing buyers. Meanwhile, Darling Wind Farm had not proved to attract investors in view of potential technical and legal complexities in contractual arrangements with the National Energy Regulator and Eskom (Reddy, 2008). This example shows that as such partnerships scale up from individual buildings to the broad scale, the technical, legal and financial challenges involved can be substantial.

4.4 Case-Study Findings and Implications

4.4.1 Modes of governing climate change in the case-studies

Overall, we find across our case-studies an increasing engagement with the issue of climate change, though in the main action remains focused on issues of mitigation rather than of adaptation. Given the dominance of cities from the global south in this selection, and the long running argument that mitigation should be an issue addressed in the north before countries in the south should take on such responsibilities, this may be a somewhat surprising finding. It suggests that climate change mitigation is becoming part of a discourse about the responsibilities of global and mega-cities, despite the continuing international conflicts over what ‘common but differentiated responsibilities’ might entail.
In terms of the sectors covered, we can see that action for climate change mitigation is taking place across the built environment, transport and urban infrastructure domains, but that action for climate adaptation is primarily related to infrastructures and usually as a side-benefit of policies to address issues of water pollution, green space and urban development more broadly. In contrast to previous studies based on cities in the north that have suggested that self-governing and enabling modes dominate urban responses to climate change, our case-studies suggest that regulation and provision, together with partnership initiatives led by other actors, are also important. The use of the regulation and provision modes in the transport sector is particularly prominent, while even in regard to the built environment – where self-governing and enabling modes might be easier to implement – regulation still has an important role.

In terms of the specific focus of policies and measures, as has been found in other research, efforts with respect to energy efficiency dominate (Bulkeley and Kern 2006). As Rutland and Aylett (2008: 636) have argued in the analysis of the development of climate change policy in Portland, USA, energy efficiency is a particularly powerful mobilizing device as it can ‘advance diverse (and often divergent) goals in tandem’, serving to translate various interests into those concerning climate change and effectively forging new alliances. In our case-studies, concerns over energy security and the economic benefits of energy saving are serving to push energy efficiency actions up the climate change agenda. At present, this effort appears primarily directed towards corporate and government buildings rather than the domestic housing stock, suggesting that our case-studies reflect a difference in approach from that which dominates municipalities in North America, Europe and Australia where interventions in the domestic sphere have been much more common. This focus could bring a distinct politics to energy efficiency in the built environment in cities in the global south, resting more on the involvement of corporate partners and their corporate social responsibility agendas than the involvement of individual householders, reflecting a different ‘geography’ of responsibility for emissions reductions in these places. With respect to urban infrastructures, notable mainly for its absence in the efforts to date to mitigate climate change across these case-studies are initiatives to promote or develop sizable renewable energy installations. This may reflect the finding by Lasco et al. (2005: 17) that a “discourse of unrealism” with respect to renewables that is more extreme than is warranted appears to have taken hold and be widely accepted. Also in contrast to research on cities in other parts of the world, attempts to address GHG emissions from the transport sector are more common than might be expected, though here the predominant motivations are addressing air quality and health concerns and reducing congestion. Nonetheless, there is potential for considerable side benefits in terms of reductions of GHG
emissions to be realised as municipalities in the global south seek to tackle this most prominent of local environmental concerns.

4.4.2 Drivers for action

In common with previous research, our case-studies suggest that the four factors of leadership, the remit of local governments, resources and issue framing have been critical drivers for climate policy and action.

In terms of leadership, we find that individual political champions, such as the Mayor of Yogyakarta, have been important in terms of driving initiatives forward. More important, though, have been opportunities for the municipality to display ‘global’ leadership on issues of climate change and environment. In three of our case-studies (Beijing, Delhi and Cape Town), the window of opportunity created by global sporting events has been used as a vehicle for promoting action on climate change within the city. In Seoul, membership of the C40 network and the forthcoming meeting in May 2009 were also seen to be important in galvanising action. Such ‘trigger events’ provide the motivation, and physical opportunity, for intervening in the urban landscape (e.g. transportation systems, housing) in order to address climate change.

While find little evidence of such forms of leadership with respect to adaptation – as might be expected from our review of the literature (see Section 3.5) - we do find that trigger events are also important in terms of adaptation responses. We have found that adaptation measures often get adopted only in response to specific local or regional natural disasters, which may or may not be climate related. For example, in Mumbai, after the 2005 deluge flooding the Greater Mumbai Disaster Management Plan was revised in 2007, strengthening the Municipal Corporation of Greater Mumbai’s Disaster Management Committee and raising disaster preparedness of the city (Gupta 2007). In Yogyakarta, the 2006 earthquake highlighted the lack of government management capacity and understanding of disaster response (Hadi 2007a). Consequently, a Disaster Management Bill and a National Action Plan for 2007-09 were enacted (Hadi 2007b). At the local level, Yogyakarta’s provincial and local agencies conducted a damage loss assessment and formulated a local action plan including regulatory, institutional and funding frameworks and recognizing the need to enhance institutional capacity and networks among government, the private sector and civil society (Hadi 2007a).

With regard to the remit of municipal governments, we find that the impetus of national government action (in China and South Korea in particular), has been an important factor in
creating the political space for local government action on climate change. We also find that municipalities that have a broader range of competencies (e.g. for street lighting, for the provision of public transport) have been able to intervene across the different modes of governing for climate change, while those with a restricted remit have had less scope to become directly involved.

*Resources* have been another critical factor. Seoul is one case-study in which a number of significant initiatives have taken place. This has been made feasible partly due to the availability of funding. In August 2007, Seoul expanded the scope of the City Gas Business Fund to a broader climate change fund with a goal to raise more than USD100 million by 2010 in order to finance research, technological development and mitigation schemes, support renewable energy, as well as improve energy accessibility to the poor and promote energy efficient appliances (SMG News, 2008 August 24). The country’s private sector also raised six funds totalling about USD100 million in 2007 for climate change purposes (Oh 2008). Such resources are scarce amongst our case-study cities. One means through which additional resources have been garnered is the CDM, with projects in the transport and infrastructure sectors in Sao Paulo, Mumbai and Delhi. This suggests that the CDM could be an important mechanism for addressing climate change in cities in the future.

*Issue framing* has also been important. Above, we outlined the importance of both ‘localising’ climate change and of ‘issue bundling’, both of which strategies serve to make climate change an important issue on local agendas and one that cross-cuts other (priority) sectors. Our case-studies suggest that this has been very important in moving climate action forward. First, with respect to energy security, energy efficiency and fuel poverty, which have proved to be driving factors in almost all of the case-studies. Second, with respect to air quality and health, which has provided the impetus for action in the transport sector in all of the case-studies. The exception in both cases is Melbourne, which is based in a region with abundant coal resources and where issues of local air pollution, while important, have not served to drive climate change action.

### 4.4.3 Barriers

The factors that have driven climate change action in some of our case-studies – opportunities for leadership, a remit to tackle the issue, access to resources, and a framing that has attracted political support – can also serve to hamper efforts for governing climate change in the city. This may account for why climate change adaptation is relatively low on the agenda, with few
opportunities to demonstrate leadership (repairing water systems is hardly headline grabbing), a lack of an explicit remit to address climate adaptation, limited access to resources to repair infrastructure systems or enhance the resilience of the urban environment, and an absence of issue framing that has linked adaptation to pressing urban social, economic and environmental issues. It also explains why some cities – such as Mumbai in our case – have to date taken little action to mitigate climate change. In the midst of other pressing environmental, health and economic concerns, the issue does not have the traction or the support required to ensure that it is on the urban agenda.

In addition, however, we find one other set of issues that have acted as a barrier to further action at the municipal level: the relation between continued fossil fuel use and economic growth. In most of our case-study cities, demand for travel and for energy consumption are increasing exponentially, and in the main these needs will be met through the continued provision of fossil-fuel based energy.
Part V: Conclusions

In conclusion, we turn to consider the overall findings from the review of the evidence base and our case-studies, before considering the specific lessons that may be drawn from the cases, and the recommendations for municipalities, national and regional governments, and donor and transnational organisations.

5.1 Governing for mitigation and adaptation in the city

Our review of the evidence on urban climate change mitigation and adaptation strategies found a strong bias towards the former, a history of engagement primarily by cities in the north, and a focus on issues of energy conservation. While there is evidence of a new ‘wave’ of urban climate change response, encompassing a broader geographical range of cities and placing adaptation on the agenda, the emphasis remains on mitigation in both research and policy. Our case-studies confirmed this finding, with evidence of action to mitigate climate change across the built environment, transport and urban infrastructure sector, while action on climate adaptation remained marginal and was usually a secondary impact of policies designed to tackle other urban problems. We found evidence that municipalities are deploying multiple modes of governing climate change, with more emphasis on regulation and provision than is the case in many cities in the north, and that there is evidence, especially with respect to the built environment, that urban responses to climate change are being undertaken by other stakeholders. Across all three sectors, concerns for energy efficiency – rather than the provision of alternative sources of energy or demand management – dominate.

In terms of the key drivers and challenges for climate change at the urban level (Figure 5), our review and case-study research concur that the key factors shaping responses to mitigation are:

- Effective policy entrepreneurs
- Municipal competencies in critical areas such as transportation, infrastructure, energy and planning policy
- Access to additional financial resources and flexibility in their deployment
- An enabling policy framework at national and regional levels
- The fit between jurisdictional areas and problem boundaries
- The ability to engage partners in order to achieve action beyond the municipality
• The knowledge and resource capacity, as well as political support, generated by networks and partnerships
• The reframing of climate change as an issue of local importance and the absence of conflict between addressing climate change and other local priorities

In terms of adaptation, we find that the key factors are:
• Availability of data and information about local impacts from climate change
• Good governance
• Access to financial and human resources, provided by the national government or international donors
• Coordination of policies and measure across both local agencies and levels of government
• Empowerment and training of civil society to help strengthen service provision, environmental management and the livelihoods of the most vulnerable people
• Nurturing a sense of readiness for disaster emergency

In part, the differences in the drivers and the challenges faced reflect the different type of city upon which the research base has been built. In relation to climate change mitigation, our case-studies, and most of the evidence available to date, relates to cities which have at least a minimal level of governance capacity and often quite significant resources for regulating, providing services and enabling stakeholder engagement. In low income countries and cities with minimal if any urban governance capacity, the challenges of addressing climate change are of a different order. This is reflected in our review of urban responses to adaptation, in which the literature stresses the importance of basic governance functions and the provision of infrastructure to meet basic needs. Nonetheless, our case-study findings suggest that even where governance capacity exists, climate change adaptation remains marginal. We suggest that this could derive from the relative lack of action by transnational networks on climate adaptation to date, a lack of opportunities for leadership, limited knowledge on which to base decisions, a lack of resources for the provision and maintenance of infrastructure systems, and an absence of issue framing that has linked adaptation to pressing urban social, economic and environmental issues, with the result that adaptation has limited traction or support locally.
<table>
<thead>
<tr>
<th>Factors shaping urban climate change governance</th>
<th>Mitigation (key factors emphasised)</th>
<th>Adaptation (key factors emphasised)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Climate knowledge</strong></td>
<td>Drivers: downscaling global targets and national emissions data</td>
<td>Drivers: need for technical capacity at local/regional level to design and implement adaptation measures at urban level</td>
</tr>
<tr>
<td></td>
<td>Challenges: lack of accurate local data to assess GHG emissions profile and trajectory</td>
<td>Challenges: lack of data; lack of science/knowledge capacity at local level as it is more likely located at the national level, if it exists</td>
</tr>
<tr>
<td><strong>Governance capacity</strong></td>
<td>Drivers: policy entrepreneurs; opportunities for municipality to take a leadership role; municipal competencies in critical policy areas of energy, transport, waste; dedicated human resources; access to additional financial resources; reframing climate change as an issue of local importance; ability to engage partners</td>
<td>Drivers: good governance, i.e. political agendas that seek to extend municipal services and safety provisions to all; (external) resources for the provision and maintenance of urban infrastructure</td>
</tr>
<tr>
<td></td>
<td>Challenges: institutionalising climate policy agenda beyond individual entrepreneur; relationship with central government; ability to engage partners in climate change agenda; limited resources; low prioritisation either because of other urgent issues or due to overt conflict with other local agendas</td>
<td>Challenges: a policy and implementation deficit, i.e. lack of capacity, will or interest in designing and implementing policies that serve city as a whole; lack of national government mandate; lack of resources</td>
</tr>
<tr>
<td><strong>Planning capacity</strong></td>
<td>Drivers: opportunities to provide low carbon infrastructure; carbon offsetting and finance schemes; national and local planning infrastructures</td>
<td>Drivers: as above - good governance, resources for urban infrastructure</td>
</tr>
<tr>
<td></td>
<td>Challenges: urban sprawl and increasing energy consumption; provision of adequate infrastructure and services; inappropriate planning models; mismatch between jurisdictional area and planning problem (fit)</td>
<td>Challenges: as above - policy deficit, lack of resources</td>
</tr>
<tr>
<td>Factors shaping urban climate change governance</td>
<td>Mitigation</td>
<td>Adaptation</td>
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<tr>
<td><strong>Multilevel governance</strong></td>
<td>Drivers: horizontal co-ordination within municipality; climate change mainstreamed; <strong>enabling national policy</strong> environment; <strong>devolved competencies for municipal authorities</strong></td>
<td>Drivers: formation of cross-municipal agencies or discussion forums; top-down adaptation measures facilitate urban adaptation services</td>
</tr>
<tr>
<td>Challenges: climate change confined to environment department and marginalised within municipality; contracting out of municipal services; limited municipal competencies; conflict with national policy</td>
<td>Challenges: poor coordination among agencies within the municipality; concentration of power at national level; lack of clarity in division of responsibility across levels; financial constraints</td>
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<tr>
<td><strong>Networks and partnerships</strong></td>
<td>Drivers: facilitate information exchange; provide <strong>access to funding</strong>; offer opportunities for leadership; lend <strong>political support</strong>; partnerships can bring on board knowledge and additional resources</td>
<td>Drivers: civil society organisations can strengthen service provision, environmental management and the livelihoods of the most vulnerable people</td>
</tr>
<tr>
<td>Challenges: require level of resource to participate in networks; may be exclusive</td>
<td>Challenges: ingrained culture of bureaucracy, a <strong>lack of access to information</strong>, low levels of education, low income and disinterest</td>
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<tr>
<td><strong>Engaging communities</strong></td>
<td>Drivers: partnerships with non-governmental actors; opportunities for providing low carbon domestic infrastructure (e.g. solar panels)</td>
<td>Drivers: donor support for grassroots initiatives</td>
</tr>
<tr>
<td>Challenges: public information campaigns often fail to produce behavioural change</td>
<td>Challenges: lack of a sense of disaster emergency</td>
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</tbody>
</table>
5.2 Lessons

By disaggregating urban climate change governance across different sectors and in relation to the different ‘modes’ of governing employed, we can identify specific lessons that may be applicable beyond the case-studies considered here. As has been noted earlier in this report, the cases from which these lessons are derived represent a particular subset of cities in rapidly industrialising countries and in which there is both a capacity to govern at the urban level and a growing impetus to address climate change. The relevance for cities in low income countries or where urban governance capacity is virtually non-existent will therefore be limited.

Built environment

1. Energy conservation is a critical local ‘hook’ for municipal action on climate change, and the built environment is a key sector in which such approaches can be put into action. There are significant opportunities to pursue this agenda, especially in the commercial sector.

2. Municipal governments have the capacity to go beyond national building standards and adopt additional means of regulating energy use in the built environment. Forms of ‘soft’ regulation can be effective in this regard.

3. Municipal governments have various means of enabling action by stakeholders and communities in reducing energy use in the built environment through the provision of information, recognition and reward for achievement.

4. Stakeholders outside of local government are important drivers of action in this sector. This is particularly the case in the commercial built environment. There is potential for further partnership work and for action on climate change mitigation and adaptation in the absence of significant municipal capacity for climate governance.

Transportation

1. In the transportation sector, action on climate change benefits from a strong link to issues high on the agenda of rapidly expanding cities – air pollution, congestion, sprawl – but is reliant on the planning and governance capacity of municipalities as well as the availability of funding from national governments or external agencies.

2. Municipalities have been able to use various forms of regulation, predominantly concerning efficiency and emissions standards through also relating to behavioural change, to address transport issues in ways that could have benefits for GHG emissions.

3. Municipal provision of low carbon transport infrastructures is another key means through which local governments can combine local priorities and climate change agendas.
4. Our cases also suggest that there a number of incentives that municipalities can deploy to achieve behavioural change, though these are under-developed compared to regulatory and service provision modes of governing.

Urban infrastructures

1. In the main, addressing climate change is a marginal issue in the development and maintenance of urban infrastructures and any benefits that arise in terms of mitigation and/or adaptation are incidental.

2. Street lighting is one important arena in which municipal governments have been taking action to reduce energy use and save money, but this requires significant investment and the timing of intervention is crucial.

3. One case, that of Cape Town, shows that addressing climate change in terms of reducing energy use and securing water supplies, can go hand in hand with development goals of meeting basic needs, but that this faces considerable challenges in a context of rising energy costs and inadequate infrastructure provision.

4. The availability of carbon finance – in the form of CDM projects and other voluntary offsetting schemes – may provide a resource which municipalities can use to deliver low carbon infrastructures and meet sustainability goals, but the potential impacts of such schemes on different sectors of society will need to be carefully considered.

5.3 Recommendations

In addition to the lessons that can be learnt with respect to addressing climate change in particular sectors, recommendations for policy-makers are various levels can also be derived from the findings of this report.

For municipal authorities this report offers three recommendations:

- Mainstream climate change: evidence suggests that the integration of climate change across different policy domains is critical to developing effective policy and action. Various different institutional structures can facilitate this (e.g. climate reporting for all departments, centralising climate change in a Chief Executive’s department).

- Use local hooks: localising climate change is a critical strategy for gaining the finances and political support necessary for action. Looking for opportunities to consider the local impacts of climate change may prove to be especially important in addressing adaptation.
• Work together: municipal responses to climate change need to move beyond the confines of local authorities to engage with stakeholders and communities in order to address climate change at the city-wide scale.

For national and regional governments this report suggests that priorities include:

• Recognise municipal role: national and regional governments need to explicitly recognise the contribution that municipal authorities can make in order to enable action, and could offer guidance on how municipalities could use existing competencies to address climate change.

• Climate financing: the provision of dedicated funding for municipal climate initiatives has been a successful strategy in some countries, while in others flexibility over the use of municipal funds has been important in facilitating local action.

• Work together: co-ordination between different levels of government in relation to climate policy is regarded as critical to success, and as crucial in overcoming conflicts between climate change and other social, economic and environmental priorities.

For international agencies and transnational networks recommendations include:

• Recognise capacity constraints: too much emphasis on measuring, monitoring and verifying performance in future programmes may exclude a large number of cities in which action on climate change is important. Striking the right balance between assessing performance and achieving action on the ground will be critical.

• Provide political support as well as finance: this report identifies the political challenges of addressing climate change locally as a key issue. The role of international agencies and transnational networks in providing opportunities for leadership and political support are perhaps as important as providing access to additional sources of funding in terms of building local capacity to act on climate change.

• Engage municipalities, stakeholders and communities: the capacity for municipal governments to enable action is critically dependent on a range of stakeholders and communities. Equally, urban responses to climate change are being driven by agents outside of municipalities. Seeking to develop partnership working between these constituents at a local level will be an important function of future programmes for urban climate change responses.
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