United Nations FCCC/TP/2014/13/Add.2

Framework Convention on Climate Change

Distr.: General
26 November 2014

English only

Updated compilation of information on the mitigation benefits of actions, initiatives and options to enhance mitigation ambition

Technical paper

Addendum

Technical examination process to unlock mitigation potential for raising pre-2020 ambition in urban environments

Summary

This updated technical paper compiles information on the mitigation and sustainable development benefits of actions, initiatives and options to enhance mitigation ambition, with a focus on the thematic areas of land use, urban environments, carbon dioxide capture, use and storage, and non-carbon dioxide greenhouse gas emissions. Information for the update was provided in literature, submissions from Parties and observer organizations, and at the technical expert meetings held during the sessions of the Ad Hoc Working Group on the Durban Platform for Enhanced Action held in June and October 2014 in Bonn, Germany. The technical paper builds upon the previous version of the technical paper, contained in document FCCC/TP/2014/3 and its addendum FCCC/TP/2014/3/Add.1.

This technical paper consists of the main document and four addenda. The addenda are focused on mitigation action in the thematic areas of land use, urban environments, carbon dioxide capture, use and storage, and non-carbon dioxide greenhouse gas emissions. The addenda elaborate on mitigation potential, progress, benefits, costs and barriers, as well as on good practice policies, key opportunities and options for catalysing action in these four thematic areas.

Contents

I. Introduction

1. This update of the technical paper on mitigation benefits of actions, initiatives and options to enhance mitigation ambition was requested by the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) at the third part of its second session.[1] The first and second versions of this technical paper were published on 28 May and 30 October 2013, respectively, and are contained in documents FCCC/TP/2013/4 and FCCC/TP/2013/8 and Add.1 and 2.

2. It comprises five parts: the main text, contained in document FCCC/TP/2014/13, and four addenda, contained in documents FCCC/TP/2014/13/Add.1–4. The main text contains a summary of the main findings, substantiated by the more detailed information provided in the addenda, which capture the content of the discussions that took place at the technical expert meetings (TEMs) on land use, urban environments, carbon dioxide capture, use and storage (CCUS) and non-carbon dioxide (non-CO_2) greenhouse gas (GHG) emissions, held in June and October 2014 in Bonn, Germany, during the fifth and sixth parts of the second session of the ADP.[2]

3. This addendum covers the discussions on urban environments and consists of two parts, focusing on mitigation potential, progress, benefits, costs and barriers; and practices, policies and actions to unlock mitigation potential in relation to urban environments.

II. Technical summary on urban environments

A. Mitigation potential, progress, benefits, costs and barriers

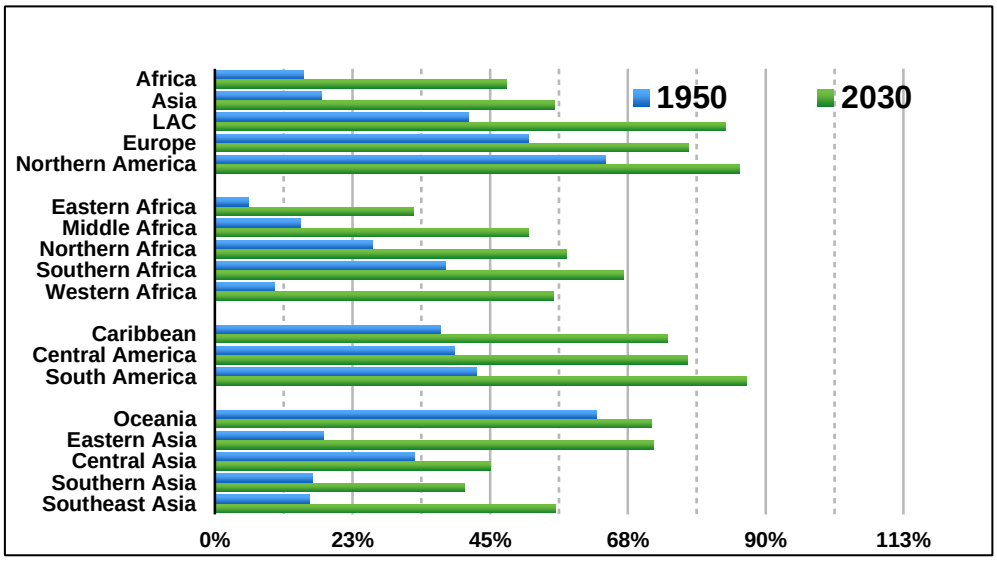
4. Rapid urbanization has been one of the defining socioeconomic developments of the past 50 years and will continue to play a defining role in the next 50 years. In 1975, only 38 per cent of the world's population lived in cities and towns. By 2007, a historic milestone was achieved when more than half of the global population lived in cities and towns (UN Habitat, 2012). The trend towards urbanization in the last 50 years was most pronounced in developing countries and today, 7 out of every 10 urban residents in the world reside in these countries (UN Habitat, 2012).

5. By 2030, the world urban population is projected to increase to nearly 5 billion persons, increasing to 5.7 billion by 2040, which equates to 2 billion more urban residents than at present (IPCC, 2014). Of the 187,066 new city dwellers that are being added to the world's urban population every day since 2012, 91.5 per cent are born in a developing country (UN Habitat, 2012). Figure 1 below illustrates the rise of the urban population by region.

[1] FCCC/ADP/2013/3, paragraph 30(c)(ii).

[2] Detailed information on the TEMs held in June and October 2014, including the initial summaries of the discussions at the meetings, is available at <http://unfccc.int/bodies/awg/items/8171.php>, <http://unfccc.int/bodies/awg/items/8170.php>, <http://unfccc.int/bodies/awg/items/8421.php> and <http://unfccc.int/bodies/awg/items/8420.php>.

Figure 1
Percentage of population residing in urban areas by region, in 1950 and 2030



Source: United Nations, Department of Economic and Social Affairs, Population Division. 2012. *World Urbanization Prospects: The 2011 Revision.*

Abbreviation: LAC = Latin America and the Caribbean.

6. In both developed and developing countries, cities are playing an ever-increasing role in creating wealth and attracting investment, producing a disproportionately large portion of gross domestic product (GDP) (UN Habitat, 2010). Cities also generate an important amount of revenue for governments. One example is the city of Mumbai, whose residents pay nearly 40 per cent of India's total taxes (UN Habitat, 2012). Nearly half of the total global economic output in 2011 was produced by just 300 of the largest urban economies worldwide, containing only 19 per cent of the world's population (Brookings institution, 2012).

7. The process of urbanization has created a dramatic shift in how human societies are organized and in the way in which they interact with the natural environment. Cities now also profoundly shape and influence social and political relations at every level and are a major factor in economic development and sustainability processes. Urban areas currently account for up to 76 per cent of global energy use and are estimated to be responsible for 71–76 per cent of energy-related carbon dioxide (CO_2) emissions (IPCC, 2014), even though an estimated 30–40 per cent of urban dwellers in developing countries do not have access to modern forms of energy, such as electricity or clean cooking fuels (UN Habitat, 2013).

8. Demand for urban land is fast-growing as cities are expanding in many cases in a discontinuous, scattered and low-density form that is not sustainable. In fact, the expansion of urban areas is on average twice as fast as urban population growth (IPCC, 2014). To meet the demands of the growing urban population, declining population densities and continued economic growth, it is projected that urban land cover will expand by 56 to 310 per cent between 2000 and 2030 (IPCC, 2014). By 2030, the expected increase in urban land cover will be greater than the cumulative urban expansion in all of human history (IPCC, 2014). Further, contrary to the trend of the beginning and the middle of the twentieth century, the majority of urban growth will occur in developing countries, mainly in small- to medium-sized cities. From now until 2050, it is estimated that the world will add the equivalent of a city of 1 million people every five days (Seto et al, 2012).

9. It is well recognized that the investment required to meet the demand for infrastructure is significant. The World Economic Forum and the World Bank estimate that more than USD 1 trillion per year is needed to finance the infrastructure growth in low- and middle-income countries (United Nations Climate Summit, 2014). The Organisation for Economic Co-operation and Development (OECD) puts the figure much higher, at an estimated USD 53 trillion that will need to be invested in the development of new urban infrastructure by 2030 (OECD, 2012). In addition to these large-scale infrastructure development opportunities, myriad small low-cost measures can be implemented in the short term in order to reap significant benefits in the pre-2020 period.

10. The unprecedented demand for infrastructure stemming from rapid urbanization provides a major window of opportunity to enable transformation and build new urban systems that avoid the 'lock-in' of carbon-intensive infrastructure. It also provides an opportunity to promote socially inclusive cities that could bring about multiple co-benefits such as healthy living space. The choice of the design and performance of the new urban world will define the success or failure of the global path to low-emission, climate-resilient development.

11. While urban GHG emission reductions have a global impact that will benefit future generations, mitigation policies also provide a variety of important co-benefits that are perceptible by the current generation at the local and regional levels. These co-benefits can be crucially important decision -making criteria in analyses by policymakers (IPCC, 2007). Mitigation actions often depend on the ability to localize and reframe the strategy to highlight the co-benefits that could be realized (IPCC, 2014). For example, energy-efficiency and fuel-switching programmes can improve air quality and generate economic benefits in addition to GHG emission reductions. Bus rapid transit (BRT) systems, in addition to demonstrated GHG emission reductions, also reduce road traffic fatality rates, road congestion and travel times. Other examples of the co-benefits of urban GHG mitigation strategies include, inter alia, energy-supply security (through increased energy diversity), health and socioeconomic benefits, cost savings, equitable sustainable development, as well as productivity increases in urban centres. Co-benefits together provide additional motivation for undertaking more aggressive urban mitigation actions, and strategies to "bundle issues" have proven successful in generating local support and action in developing country cities (IPCC, 2014).

12. However, it must also be recognized that climate policy can have adverse risks and side effects on societal goals. Therefore, it is important to maintain close management of mitigation and adaptation strategies and cross-sectoral monitoring to ensure robust policy support (IPCC, 2014).

13. Successful climate actions have shown that the development of low-carbon, climate-resilient cities can be effectively driven at the local level. Lessons learned (drawn from the presentations and the discussions at the TEM on urban environments, Forum on experiences and best practices of cities and subnational authorities in relation to adaptation and mitigation and from the literature) include the following:

(a) Cities are key actors for achieving national mitigation targets and objectives related to climate adaptation and resilience, strengthening and reinforcing national policies to reach higher mitigation ambition and scaling up actions;

(b) Cities directly influence infrastructure investment. On average, approximately 75 per cent of all government capital expenditure on environmental protection is made by subnational governments (Merk et al., 2012). This provides considerable scope to influence mitigation and adaptation through investments in the transport, building, water and waste sectors. Public spending and procurement by cities can

be aligned with mitigation objectives by influencing criteria for investments, subsidies, loans, tax incentives, procurement and through public–private partnerships (OECD, 2013);

(c) Cities and subnational governments are often best placed to identify local needs and co-benefits, which can be addressed through targeted local action, and to exploit synergies between local and national action. Local representatives and leaders can be directly accountable for the timely and efficient delivery of actions, particularly those that have a direct positive impact on local living conditions and generate significant co-benefits;

(d) Political leadership at the local level can effectively shape attitudes and influence awareness, behaviour and collaboration, particularly if citizens are engaged and brought together in a participatory planning process that builds relationships and trust;

(e) By concentrating greater attention and resources to the city–regional level, national governments can provide opportunities to improve the fluidity of markets for land, labour and products, resulting in better-integrated urban–rural development, thereby enabling important possibilities for peripheral rural areas (UN Habitat, 2012).

1. Mitigation potential and practices

14. A recent review of 144 cities that have announced short-term GHG emission reduction targets estimates that the achievement of these targets will result in an emissions reduction of 2.8 Gt CO_2 eq below 'business as usual' levels by 2020. In the same review, an additional 27 cities made emission reduction commitments for 2030, which, when combined with the commitments across 171 cities, contributes to a potential total emissions reduction of 6.1 Gt CO_2 eq below 'business as usual' levels by 2030 (C40, 2014).

15. A recent study demonstrates that aggressive mitigation actions by cities in the core areas of buildings, transportation and waste could result in GHG emission reductions of 3.7 Gt CO_2 eq below the amount that national actions are currently on track to deliver in 2030, rising to 8.0 Gt CO_2 eq in 2050. This would equate to approximately 6 per cent of global 'business as usual' GHG emissions in 2030, and 11 per cent in 2050 (Erickson et al., 2014). Mitigation technologies and practices and their estimated mitigation impacts by 2030 and 2050 are presented in table 1 below.

Table 1
Mitigation technologies and practices and relevant mitigation potential by sector at the city level, by 2030 and 2050

Sector	*Technology or practice*	*Annual mitigation potential, Gt CO_2 eq*		*Share of total mitigation potential (%)*	
		2030	*2050*	*2030*	*2050*
Buildings, residential	New building heating efficiency	0.6	1.2	16	15
	Heating retrofits	0.4	0.5	12	7
	Appliances and lighting	0.4	0.9	12	11
	Fuel-switching /solar photovoltaics (PV)	0.1	0.2	3	3
Buildings, commercial	New building heating efficiency	0.3	0.5	7	7

Sector	*Technology or practice*	*Annual mitigation potential, Gt CO_2 eq*		*Share of total mitigation potential (%)*	
	Heating retrofits	0.2	0.2	6	3
	Appliances and lighting	0.3	0.7	8	8
	Fuel-switching /solar PV	0.1	0.2	3	3
	Subtotal, buildings	2.4	4.5		
Transport, passengers	Urban planning, reduced travel demand	0.2	0.5	5	6
	Mode shift and transit efficiency	0.4	1.0	11	12
	Car efficiency and electrification	0.2	0.9	7	11
Transport, freight	Logistics improvements	0.1	0.2	2	3
	Vehicle efficiency	0.1	0.3	3	4
	Subtotal, transport	1.0	2.9		
Waste	Recycling	0.2	0.3	4	4
	Landfill methane	0.0	0.3	0	4
	Subtotal, waste	0.2	0.6		
Total		**3.7**	**8.0**		

Source: Erickson P and Tempest K. 2014. Working paper no. 2014-06. *Advancing Climate Ambition: How City-scale Actions Can Contribute to Global Climate Goals*. Stockholm Environment Institute US Center.

16. While thousands of cities are defining climate action plans, their actual total impact on urban GHG emissions is not clear. To date, there has been little systematic assessment of the impact of city climate action plans on overall city-wide emissions and climate change (IPCC, 2014). The majority of urban climate actions are based primarily on strategies to improve energy efficiency, rather than on land-use policies or cross-sectoral measures to reduce urban area expansion. Comprehensive and consistent data sets of urban GHG emissions do not currently exist. The potential GHG emission reductions available to cities are therefore difficult to quantify and are the subject of debate. While thousands of cities are defining climate action plans, the actual extent of urban mitigation is highly uncertain (IPCC, 2014).

17. While faster-growing regions in developing countries have a greater opportunity to influence how demand for growth is met in terms of energy and land requirements, these regions could influence associated GHG emissions. Cities in developed countries with much slower growth rates also have key opportunities to lower the GHG emissions intensity of their residents (United Nations Climate Summit, 2014).

18. Climate mitigation action plans in cities may not always be reflected in global-scale emission reductions. For example, energy-intensive industries can relocate outside the city to avoid the limits set by city policies. Therefore, it is important for cities to also address emissions associated with consumption of goods and services. For example, in developed countries as much as 40 per cent of per capita GHG emissions are related to food choice and product purchases (Lee et al., 2014).

2. Barriers to mitigation action at the local level

19. Many challenges related to climate action at the local level stem from the fact that they can be viewed by residents and decision makers to have little or no tangible short- or even mid-term impact. Overall, in some cases, rising concentrations of GHGs are not the most direct short-term drivers of warming in cities impacting human health, energy use and air quality. Many cities suffer significant direct impacts from short-lived climate pollutants (SLCPs) and urban heat island effects due to physical land-based drivers of climate change. In fact, between 1961 and 2010, most large cities in the United States of America were shown to be warming at twice the rate of the planet as a whole (Stone et al., 2012). Evidence from both rural and urbanized regions where activities have resulted in significant changes to land cover suggests that land use is a primary and measurable driver of climate change – one that operates through a physical mechanism independent of atmospheric GHGs.

20. There are many technical and economically feasible climate actions that are immediately available to cities and subnational authorities to enable them to reduce GHG emissions and improve climate resilience. However, social, institutional and political challenges can be significant barriers to implementation, as demonstrated in table 2 below.

Table 2
Barriers to mitigation action by cities and subnational governments

Barriers	*Details drawn from the technical expert meeting and relevant submissions*
Political and institutional barriers	• Lack of coordinating mechanisms for actions between national and subnational governments and the private sector, and between central government departments and ministries • Overlapping mandates/unspecified limitations on authority between national governments and cities • Gaps in institutional memory between government transitions • Lack of political incentives for city governments, and political and cultural differences between national governments and local communities • Lack of defined frameworks that coordinate and create synergy and linkages between all levels of climate action, including the UNFCCC process, national climate policies and subnational government priorities
Financial barriers	• Unequal access to financial markets and mechanisms by authorities at different levels • Limitations in the scale or authority of public budgeting and competing budgetary priorities • Lack of access to affordable finance and difficulty mobilizing private funding without the backing and sovereign guarantee of the national government. Only 4 per cent of the 500 largest cities in developing countries are considered to be creditworthy by international standards

Barriers	*Details drawn from the technical expert meeting and relevant submissions*
	• Local fiscal policies restricting mitigation efforts (e.g. property taxes or other taxes imposed on new development) may lead to expansion into rural areas or sprawl instead of resulting in more compact cities
Capacity- and skills-related barriers	
	• Inadequate dissemination of new techniques and technologies • Need for transparent baselines and capacity to calculate them or to compile and update greenhouse gas (GHG) inventories • Lack of skilled staff with sufficient awareness of technical options and/or the skills to support implementation of GHG mitigation strategies at the subnational level, particularly in developing countries
Information- and knowledge-related barriers	
	• Differences in awareness and access to information between national and local governments • Barriers to collaboration and communication originating from misplaced competition and eroded trust due to vested interests, differences in culture or in political ideology • Inadequate emissions data at the local level and a lack of consistency in emissions accounting methods

Sources: Harrison N and Muller S. 2014. What National Governments Can Do To Accelerate Subnational Action on Climate: Synthesis of Current Research and Good Practice. Low Emissions Development Strategies (LEDS) Global Partnership (GP), Working Group on Subnational Integration; Presentations at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments, held in June 2014.

B. Practices, policies and actions to unlock mitigation potential in relation to urban environments

21. Many cities have been implementing comprehensive, integrated and innovative approaches to climate mitigation and actions that have significant mitigation and adaptation co-benefits. Around the world, cities and subnational governments are increasingly taking a leadership role, realizing significant work to ensure that local climate action is compatible with the action taken to mitigate and adapt to climate change at the global and national levels.

22. **Strengthening institutional arrangements and legal and regulatory instruments**: city and subnational climate action plans for low-carbon, climate-resilient development have a direct influence on development and are critical for attracting financing. These plans provide a longer-term vision and specific metrics for development plans and public investment that also build investor confidence and mobilize the private-sector financing needed to ensure action on the ground. The example of the city of Malmo demonstrates good practice in promoting economic revival at the local level (see spotlight box 1 below).

Spotlight box 1

Economic revival and transition to an 'eco-city' in Malmo

In the 1960s, Malmo was an industrial city close to bankruptcy. Its sole economic activity was a shipyard, and the industry was in decline. The city took a bold step to transition from an industrial city to a community of information and knowledge, turning the shipyard into a sustainable housing development. Today, more jobs have been created than during the whole period during which it was a shipyard. The success of the transition proves that challenging transformations can take place in a short amount of time and with minimal resources.

Under the leadership of the Swedish national government, Malmo has continued to develop as a sustainable city. A number of key policies are providing the frameworks for continued transformational activity in Malmo, including: the local Agenda 21 programme; the Environmental Programme; and the Urban Development Master Plan (2014–2032). Some of the objectives of the city include carbon neutrality by 2022, and 100 per cent renewable energy consumption by 2030. As a result of this transformation, energy consumption will decrease by at least 20 per cent by 2020 and by another 20 per cent by 2030, and GHG emissions will decrease by at least 40 per cent below the 1990 level by 2020.

Malmo's success can be attributed to a number of circumstances. Firstly, the city receives significant guidance and financial support from the Swedish national government. Many policy objectives originate at the national level and are transmitted to the city to be implemented through local policies, plans and regulations. This demonstrates the critical importance of collaboration among different levels of government to innovate policy for sustainable development. At the city level, development plans are shared between all political parties, providing public civil servants with a stable working environment. Further, Malmo has been able to secure financial support through the European Union's Horizon 2020 research and innovation programme. From 2014 to 2020, EUR 80 billion has been made available to support 'lighthouse' projects that drive economic growth and create jobs. Another key aspect is that Malmo is creating an attractive and dynamic business environment in the city. As a result, EUR 1 million of public seed money has been able to attract EUR 200 million in investment from the private sector.

Source: Presentation by Malmo at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments in June 2014.

23. One of the examples of city-level collaborative arrangement and advocacy process is the Local Government Climate Roadmap,[3] that started in 2007, as a broad coalition of government networks that advocates for recognition, engagement and empowerment of city and subnational governments. A concrete product of this effort is the "carbon*n* Climate Registry"[4] that facilitates global transparency and the accountability of local and subnational climate action through the creation of an online reporting platform, which contains information on climate and energy commitments, GHG emission inventories and the mitigation and adaptation actions of more than 465 local and subnational governments that serve around 12 per cent of world's urban population.

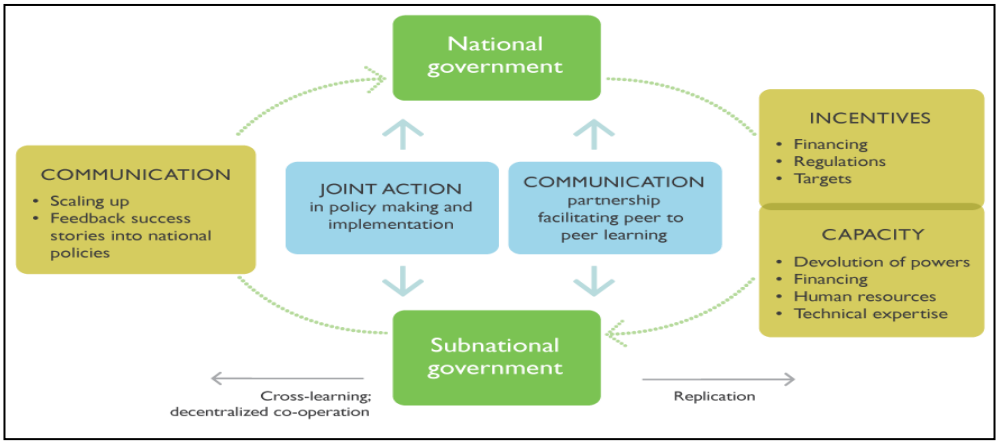
24. National government support is critical to ensure the successful implementation of innovative policy measures to address implementation barriers at the subnational level. There are many examples of successful vertical integration between national governments,

[3] <www.iclei.org/climate-roadmap>.

[4] <www.carbonn.org>.

regions and cities, including subnational actions as part of efforts to develop and implement nationally appropriate mitigation actions (NAMAs). Subnational integration and multilevel governance entails effective collaboration and coordination between different levels of government, as demonstrated in figure 2 below.

Figure 2
Model of national and subnational integration



Source: Green Growth Best Practice Report. 2014. *Green Growth in Practice: Lessons from Country Experiences.*

25. National governments can promote enhanced action through the establishment of nationally appropriate coordination mechanisms which provide a basis for developing effective implementation plans based on local circumstances (see spotlight box 2 below).

Spotlight box 2
Decentralizing green growth in Viet Nam

The Green Growth Strategy of Viet Nam represents the determination of the national government to drive the transformation of the economy. Specific targets include reducing greenhouse gas emissions, lowering the intensity of gross domestic product (GDP) by 8–10 per cent by 2020 compared to the 2010 level, and reducing BTUs/GDP by 1.0–1.5 per cent per year. In order to achieve these goals, all 63 provinces have been given the mandate to formulate their respective Provincial Green Growth Action Plans that best support the priorities in their cities and rural areas. These will then be integrated into each province's local five-year and annual Socioeconomic Development Plan.

Source: Nguyen M H and Muller S. 2014. The Subnational Integration of the Viet Nam Green Growth Strategy. Low Emissions Development Strategies Global Partnership, Working Group on Subnational Integration.

Abbreviation: BTU = British thermal unit.

26. Many Parties are examining their climate-related targets and identifying how city carbon budgets can help to achieve those targets (GGBPR, 2014). When designing and implementing effective climate policies, it is important to have the required legal, institutional and governance structures in place to provide the necessary security and certainty to the investment community. Cities need to be organized in order to be effective institutions. For example, something as simple as having a single focal point in the city administration to liaise with potential investors would encourage greater engagement from the private sector. Further, effective institutions also attract good leaders. Good

management and leadership may be the two most critical, cost-effective, technical innovations that can spur cities onto a low-carbon, climate-resilient development path.

27. Support for good governance and leadership that in turn support interdisciplinary integrated planning allows for a holistic approach and can avoid unintended consequences that may occur when approaching urban development in an isolated, ad hoc manner or when it is limited to election cycles only. However, recent analyses have found that:

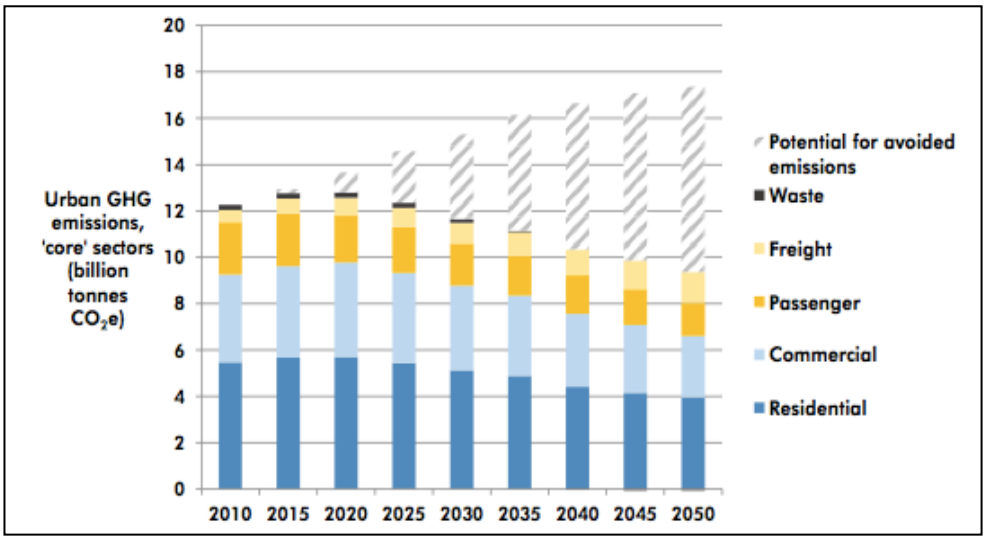
(a) Only about 20 per cent of the world's 150 largest cities have even the basic analytics needed for low-carbon planning;[5]

(b) Two thirds of cities lack the institutional capacity to implement any environmental programmes (UN Habitat, 2013).

28. **Strengthening spatial planning efforts**: many of the key drivers of energy and GHG emissions are related to urban form, namely density, land-use mix, connectivity and accessibility. Spatial policy instruments cover a range of issues, including promotion of compact cities, provision of green spaces, retrofitting of existing buildings, green infrastructure, distributed generation of renewable energy sources, increasing non-motorized and public transportation coverage, and payment for urban ecosystem services that link demand for key services in cities that are sourced from outside the city boundaries, such as water provision or flood control. As urban spatial planning has long-term effects, these actions are key to tackling climate change. It is through urban policies, including enabling, mandating and incentivizing policies, that city governments can influence low-carbon, climate-resilient development.

29. **Design and implementation of effective policies, instruments and measures** could lead to low-carbon, climate-resilient development at the local level. Actions with strong mitigation potential implemented across such sectors as buildings, transport and waster in aggregate could reduce GHG emissions in these sectors by an estimated 24 per cent by 2030 and by 47 per cent by 2050, as demonstrated in figure 3 below (Erickson et al., 2014).

Figure 3
Greenhouse gas emissions and potential emissions avoided in the urban action scenario



Source: Bloomberg et al. 2014. *Advancing Climate Ambition: Cities as Partners in Global Climate Action.* C40 Cities Climate Leadership Group.

[5] ADP TEM on urban environments; presentation by the World Bank, June 2014.

30. Actions with strong mitigation potential by sector are as follows:

(a) **Residential and commercial buildings**: establishment of building energy codes, energy standards and efficiency retrofit programmes, increasing lighting, heating/cooling and appliance efficiencies, district energy, and incentives for solar photovoltaics and solar thermal power;

(b) **Passenger transport**: expansion of public transit networks, investment in non-motorized transportation options, measures to improve vehicle efficiency (including electrification), or transport demand and flow management (such as variable speed zones, optimized signal timing or congestion charging), and also land-use planning for compact urban development form;

(c) **Road freight transport**: improved urban freight logistics management and measures to increase urban road freight vehicle efficiency;

(d) **Solid waste and wastewater**: integrated solid waste management plans that include collection, recycling and landfill management for methane recovery are cost-effective measures. Other effective actions include organic composting and wastewater recycling for purposes such as irrigation or vehicle washing.

31. **Strengthening financial instruments**: enabling rapid low-carbon development transformation in urban environments is highly dependent on a city's financial and governance capability across all sectors. The options for strengthening financial instruments include policies such as: improvements in municipal financial management and creditworthiness, introduction of direct subsidies and financial incentives, economic instruments to leverage private-sector financing and promotion of public–private partnerships to attract climate-friendly investments.

32. The drivers of urban emissions are interrelated and can be addressed by a number of different types of policies. In fact, while the mitigation options in urban areas are contextual, policy instruments are expected to be most effective when bundled (IPCC, 2014). A range of policies are being utilized to mobilize financial resources that address the key barriers discussed above, including capacity-building activities, innovative financial instruments and close collaboration with the private sector.

33. **Improving the financial management and creditworthiness of cities**: as clearly demonstrated by the example of Kampala, highlighted in spotlight box 3 below, improving the creditworthiness of cities improves and strengthens their revenue base and provides cities with access to low-cost finance. USD 1 invested in creditworthiness is proven to mobilize USD 100 in private-sector financing for low-carbon and climate-resilient infrastructure. This is important because at present only 4 per cent of the 500 largest cities in developing countries are considered creditworthy by international standards.[6] This is a significant challenge but also an equally large opportunity for cities to improve their creditworthiness and start accessing low-cost financing for their low-carbon, climate-resilient development. And, as cities are demonstrating, this can be achieved in a relatively short period of time.

[6] ADP TEM on urban environments; presentation by the World Bank, June 2014.

Spotlight box 3
Moving towards creditworthiness in Kampala

The World Bank, through its Public–Private Infrastructure Advisory Facility's City Creditworthiness Initiative, is supporting a large number of cities and is committed to making 350 cities around the world creditworthy. It is also assisting them to implement plans that would facilitate the flow of low-cost finance. The city of Kampala has embarked on this programme to improve its financial sustainability. The city was able to restructure and improve its Treasury management systems and put in place a new accounting manual. As a result, revenue collections increased by 110 per cent in a period of three years. The city also completed a review of its asset register, which established that fixed assets had been undervalued by 800 per cent.

The increased revenue, coupled with prudent financial management, helped the city to finance projects such as the introduction of eco-stoves, solar street lighting, flood-proofing, recycling of drainage water, waste to energy projects, overhauling the transport system through the introduction of a bus rapid transit (BRT) system, and increasing green space. Public–private partnership is central to the operation of the BRT system, the waste to energy and street-lighting projects. Resilience to climate change impacts has been incorporated into all infrastructure design projects.

To address congestion in the city, in addition to putting in place the BRT system, the city also plans to develop satellite towns around Kampala to avoid the need for commuters to travel into the city. Currently, the city's daytime population is 4 million, while the night-time population is 2 million, which means that 2 million people commute into the city to work.

Source: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments; presentation by Kampala, June 2014.

34. **Introduction of special direct subsidies or financial incentives**: many cities with the requisite capacity and authority are starting to successfully issue green bonds to finance low-carbon urban infrastructure directly. Johannesburg's green city bond is worth USD 143 million and will support several projects to reduce the city's GHG emissions. The bond auction was so successful that it was oversubscribed by 150 per cent.[7] Other cities are working closely with their national governments to initiate new streams of financial support. For example, since 2008, Germany's National Climate Initiative Fund has subsidized 50–65 per cent of technical project costs in more than 300 projects in over 1,700 cities. This has led to over 1.4 Mt CO_2 eq of emission reductions and has resulted in important co-benefits, including reduced municipal spending from lower heating costs. The finance is raised via the sale of emission trading certificates (GIZ, 2013). India's national programme for urban development and renewal provides co-financing for cities to improve efficiency in urban infrastructure and service delivery (GGBPR, 2014).

35. **Innovative economic instruments to leverage private-sector financing**: city authorities can utilize various innovative instruments to manage the challenges caused by rapid urbanization and climate change. An example of an innovative economic instrument is the International Lighting Efficiency Finance Facility being developed by the World Bank. This will support light-emitting diode (LED) street lighting by pooling demand in cities so that credit risk can be considered in aggregate. The cumulative investment target is over USD 1 billion and the savings from increased energy efficiency will cover both the principal investment and the interest.

[7] Growth and development strategy by 2040 of the city of Johannesburg.

36. Many countries use various economic instruments to promote robust urban development. For example, Singapore is taking a leading role in the transport sector by using holistic strategies to address issues related to congestion and climate change. In order to reduce reliance on car use, Singapore introduced an electronic road toll system as a congestion pricing tool. It has also imposed an extremely high tax on new cars to discourage vehicle ownership, as well as correlating taxes and rebates with car emissions. Other examples of economic instruments in the main urban sectors with high mitigation potential are presented in table 3 below.

Table 3
Economic instruments in the main urban sectors with high mitigation potential

	Transportation	*Buildings*	*Water/waste*	*Energy*
Taxes		• Property tax		
Fees and charges	• Congestion charges • Parking fees • 'High occupancy' toll lanes	• Building permits	• Tariffs and fees	• Electricity user fees
Grants	• General grants with environmental indicators, specific grants for environmental goods and services, matching grants			
Public–private partnerships	• Concessions and private finance initiatives, energy performance contracts			
Land-based income		• Development charges/impact fees • Value capture tax • Higher-density building rights • Tax increment financing		
Loans and bonds	• Loans and 'green' bonds			
Carbon finance	• Clean development mechanism/joint implementation projects, voluntary carbon offsets			

Sources: Organisation for Economic Co-operation and Development. 2012. *Financing Green Urban Infrastructure*; Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments; presentation by the World Business Council for Sustainable Development, June 2014.

37. Another example where city authorities put a price on carbon and use innovative instruments is an urban cap-and-trade programme, to prioritize the flow of financing to low-carbon initiatives, as demonstrated by the city of Tokyo, highlighted in spotlight box 4 below.

Spotlight box 4
Pioneering the urban carbon cap-and-trade programme in Tokyo

Launched in April 2010, the Tokyo cap-and-trade programme requires carbon dioxide emission reductions from large commercial, government and industrial buildings through one of the following two ways:

- On-site energy efficiency measures;
- Participation in the emissions trading scheme.

The city authorities established a carbon price and prioritized the flow of financing to low-carbon initiatives. This is the world's first urban cap-and trade programme.

The programme accounts for 20 per cent of Tokyo's total greenhouse gas emissions and aims to reduce emissions by 25 per cent by 2020 compared with the 2000 level. To date, the system has been remarkably effective in reducing emissions, with some of the participating facilities not only exceeding their target for the first compliance period (2010–2014), but 70 per cent of them already meeting the target for the second compliance period (2015–2019). The astounding success of Tokyo's cap-and-trade programme provides compelling evidence that this emerging innovative instrument can be used by cities to achieve major emission reductions.

Recently, the Tokyo metropolitan government proposed a nationwide cap-and-trade programme to the Japanese Government, thereby demonstrating that cities can be climate-action leaders and increase the ambitions of national governments to take aggressive mitigation actions.

Source: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments; presentation by Tokyo, June 2014.

38. **Promotion of public–private partnerships to attract climate-friendly investments**: to create sustainable cities, city officials will have to use municipal budgets to leverage financing from a wide range of sources. Private-sector funds already account for substantial investment in infrastructure development. Such investments are frequently made in the form of public–private partnerships, whereby companies not only supply products and services, but also conduct project management and provide long-term financing for a part of the cost. Engaging the private sector with new approaches to public–private partnerships has proven to be effective. Cities also have a role as a convener, as opposed to always playing the role of investor in infrastructure projects. They can use their convening power to bring together civil society, the private sector and other stakeholders to finance infrastructure development, sometimes in innovative ways. Significant opportunities exist for cities to catalyse and facilitate new business models which can reduce capital costs for public authorities through innovation.

39. A clear, well-defined vision backed by a comprehensive action plan with public participation creates opportunities for private-sector buy-in. Many major opportunities exist to involve private business leaders in driving transformational actions in cities (New Climate Economy Report, 2014). One of the relevant examples is the "Block by Block" approach to urban planning by the Government of the Netherlands, which encourages market actors to work together in consortia to enhance the energy efficiency of large housing blocks. This helps to overcome the barrier of split incentives between investors and beneficiaries of investments. Resources can also be mobilized by utilizing existing indigenous social organizations. For example, by mandating and strengthening the purok system (a purok consists of 50 to 100 households) in San Francisco, Philippines, the

municipality has been able to capitalize on a bottom-up governance approach to improve, inter alia, climate actions, disaster risk reduction and engagement with the private sector.[8]

40. **Capacity-building and knowledge management at the local level**: national governments often depend on cities to deliver mitigation actions. Initial training at scale supported by the national government can generate sector-wide impacts. For example, in Bangladesh a national training centre was developed to support city staff to develop the necessary capacity to implement waste management programmes that create new revenue streams and savings for city governments (GIZ, 2013).

41. Another example is Estructuradora Brasileira de Projetos (EBP), which was created in 2009 as a special-purpose company by a joint venture between the Brazilian Development Bank and eight financial groups. EBP assists municipal and state governments to meet infrastructure and public policy goals by acting as a sell-side advisor for concessions and public–private partnerships. EBP works with public institutions in all stages of the bidding and procurement processes, conducts studies and assessments to ensure compliance with government regulations and helps with innovative project economic and financial structuring. In four years, EBP has helped to structure over USD 1.4 billion in municipal infrastructure projects (Casey et al., 2013).

42. International institutions such as the Cities Climate Leadership Group and Local Governments for Sustainability provide important networks and forums for collaboration that enable shared learning and exchange of experiences between cities. One example is the Compact of Mayors, which was recently launched at the United Nations Climate Summit held in New York, United States of America, in September 2014 (see document FCCC/TP/2014/13, spotlight box 1).

43. While the initiatives and key support provided by international organizations to developing countries is of critical importance, the GHG emission reductions from cities, subnational governments and specific sectors are part of national GHG inventories and NAMAs. The integration of national and subnational climate strategies is a high priority. Examples of effective policies implemented at the local level are presented in table 4 below.

Table 4
Policy options menu of climate actions for cities and subnational governments

Select policy options	*Select country and city examples*
Strengthening of institutional arrangements and legal and regulatory frameworks	
City-level strategies, action plans and regulations to promote low-carbon, climate-resilient development aimed at the mitigation of greenhouse gas (GHG) emissions and adaptation to climate change	• Brazil, Fortaleza – community GHG inventory[a] • China, Hong Kong – guidelines to account for GHG emissions and removals for buildings[b] • Japan – Low Carbon City Act 2012[c] • New Zealand, Wellington – Climate Change Action Plan 2013[d] • South Africa, Cape Town – Action Plan for Energy and Climate Change[e] • Sweden, Malmo – Local Agenda 21 programme and Urban Development Master Plan (2014–2032)[f] • United States of America, New York – "PlaNYC" is New York

[8] ADP TEM on urban environments; presentation by the Philippines, June 2014.

Select policy options	*Select country and city examples*
	City's blueprint for sustainability and resiliency aimed at 30 per cent GHG emission reductions by 2030[g]
Multilevel collaboration and cross-learning among different levels of government as well as between city/national governments through national and regional programmes	• Association of South-East Asian Nations (ASEAN) – Environmentally Sustainable Cities Programme[h] • Serbia – expansion of existing heating network in the city of Valjevo, as a nationally appropriate mitigation action (NAMA), with support from the Japan International Cooperation Agency[i] • United Kingdom of Great Britain and Northern Ireland – devolution and low-carbon growth in British cities. Support for localism and the devolution of government[j] • United States of America, California – the Civic Spark partnership, an initiative by the Governor of California to provide climate change related technical assistance and capacity-building support to local governments in nine regions of California[k] • Viet Nam – subnational integration of the national Green Growth Strategy[l]
Support for good governance and leadership by encouraging and recognizing good practice action	• Philippines – national government support of local governments, Galing Pook Awards[m]
Spatial planning instruments	
Promotion of compact cities and high-density urbanization with concentrated zoning of areas for services and facilities, and housing areas close to transportation hubs	• Japan – Low Carbon City Development Guidance 2010. Kyoto Protocol Target Achievement Plan[n] • Republic of Korea – National Comprehensive Development Plan 2011[o] • Mexico – Integrated Sustainable Urban Development Guidelines on Infrastructure, Equipment and Services (Housing Aid)[p]
Provision of green spaces in the urban environment by integrating green infrastructure with the built environment to respond to mitigation and adaptation needs	• Australia, Melbourne – Green Infrastructure Regulations[q] • Colombia, Medellín – "Green Belt" of open space around the city to restrict future sprawl and create recreational space[r] • Malaysia – National Physical Plan, Green Township Policy, National Urbanization Policy, Iskandar Greenery Plan • Singapore – Green Plan 2012, Sustainable Singapore Blueprint 2030[s] • Thailand, Chiang Rai – land use and flooding buffer zones[t]
Distributed generation of renewable energy to reduce reliance on large centralized power	• Barbados, Chile, Denmark, Jamaica, Germany, Mexico, Spain and United States of America – these countries have all adopted measures to permit and promote distributed generation at the

Select policy options	*Select country and city examples*
plants	subnational and individual building levels
Increased non-motorized and public transportation routes and access by shifting away from motorized modes of transport and individual vehicles within the framework of sustainable urban transport	• Argentina, Buenos Aires – Metrobus bus rapid transit (BRT) system, walking and cycling infrastructure, Sustainable Mobility Plan • China, Lanzhou – BRT and integration of transit-orientated development • India, Indore – iBus BRT • Indonesia, Jakarta – TransJakarta BRT • Peru, Lima – Metroplitano BRT, Metro de Lima (electric train), "Ciclodía", whereby a major avenue is closed to motor vehicles every Sunday • Republic of Korea, Suwon – cycling and walking infrastructure[u]
Enhancements in the provision of urban ecosystem services to increase the adaptive capacity of cities by providing an incentive mechanism for adaptation to climate change	• Bolivia, Costa Rica, Ecuador, India, Mexico, South Africa and United States of America – payments for watershed services • Brazil, Paraná – Public Redistribution Mechanism to protect forested watersheds and rehabilitate degraded areas[v]
Effective policies, instruments and measures by sector	
Promotion of energy efficiency in buildings through building sector development strategies and regulations	• Canada, Edmonton – green building policy and plan[w] • Germany – Conservation Act, EnEV-Energy Conservation Ordinance[x] • Philippines – Green Building Initiative, Mandaluyong City (mandatory) and Quezon City (voluntary)[y] • Paris, France – programme for the energy retrofitting of historical buildings covering 25,000 apartments, leading to an energy reduction of 30 per cent and the creation of 2,000 jobs[z]
Promotion and improvement of the efficiency of mass passenger and freight transportation systems	• European Union – European Rail Traffic Management System[aa] • Brazil, Czech Republic, Estonia, France, Germany, United States of America – 'zero fares' and free public transport • Netherlands – improving freight operation efficiencies[bb] • Norway – electric vehicle car-sharing programme. Electric vehicle benefits such as tax exemption, no parking fees, no road tolls • South Africa – Cape Town's green taxi fleet[cc]

Select policy options	*Select country and city examples*
Integrated solid waste management plans/wastewater treatment, including:	• Brazil – integrated solid waste management and carbon finance project implemented in cooperation with the Caixa Bank and the World Bank[dd] • China, Beijing – conversion of landfill gas to electricity and direct use of methane in the Gaoantun landfill[ee] • El Salvador, San Salvador – Nejapa landfill gas to energy (electricity)[ff] • Poland, Krakow – Barycz landfill gas to energy (electricity)[gg] • Ukraine, Mariupol – landfill flare with transition to electricity generation[hh] • United Republic of Tanzania, Dar Es Salaam – flaring methane in closed landfills[ii]
Organic waste composting	• Ghana, Accra – small-scale composting of domestic waste[ij] • Indonesia, Surabaya – accelerated decomposition with fermentation[kk] • Malaysia, North Kuching – "Bokashi" home food waste composting system[ll] • Thailand, Muangklang – conveyor belt system[mm]
Wastewater recycling	• Japan, Tokyo – urban reuse applications[nn] • Mexico, Tijuana – "Purple Pipe" project that recycles wastewater through separate pipes for appropriate purposes such as street washing or irrigation[oo] • Singapore – NEWater advanced wastewater recycling project[pp] • South Africa, Johannesburg – water recycling programme[qq]
Financial instruments	
Improving municipal financial management and creditworthiness of cities	• Brazil, Rio de Janeiro – low-carbon city development programme[rr] • Malawi, Lilongwe – programme to improve the city's financial sustainability with the assistance of the Public–Private Infrastructure Advisory Facility's City Creditworthiness Initiative of the World Bank[ss] • Uganda, Kampala – programme to improve the city's financial sustainability with the assistance of the Public–Private Infrastructure Advisory Facility's City Creditworthiness Initiative of the World Bank • World Bank – Low-Carbon Liveable Cities Programme, City Creditworthiness Training Programme[tt]
Introduction of special direct subsidies or financing mechanisms to finance low-carbon	• India – National Programme for Urban Development and Renewal[uu] • Germany – National Climate Initiative Fund[vv]

Select policy options	*Select country and city examples*
urban infrastructure	
Introduction of innovative economic instruments to attract climate-friendly investments	• Brazil – Estruturadora Brasileira de Projetos, a special-purpose company that helps federal, state and municipal governments to prepare and tender infrastructure projects • Canada, British Colombia – carbon tax and tax shift, Climate Action Dividend, Climate Action Tax Credit • Japan, Tokyo – urban carbon cap-and-trade programme • Thailand – Energy Efficiency Revolving Fund[ww] • United Kingdom, London – vehicle congestion charge • United States of America – Regional Greenhouse Gas Initiative
Promotion of new approaches to public–private partnerships to leverage financing from the private sector	• Abu Dhabi, Masdar City and Myanmar – special economic zones and initiatives such as the Infrastructure Development Project in the Thilawa special economic zone • Africa – Low Carbon Financing Coalition[xx] • India, Gujarat – 5 MW rooftop solar project with 25-year concessions[yy] • South Africa, Northern Cape Province – 150 MW concentrated solar power plants[zz]
Capacity-building	
Targeted programmes of national governments providing support for skills and knowledge development	• Bangladesh – national training centre for local waste management programmes[aaa] • Nepal, Ministry of Education – integrating disaster risk reduction and climate change education into the school curricula[bbb] • Sweden – economic revival and redevelopment of Malmo
Mobilization of support from local and international institutions and partnerships for local actions and learning	• ASEAN – Environmentally Sustainable Cities, Model Cities Programme • Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants – studying the impact of short-lived climate pollutants on health in urban areas • European Union – Covenant of Mayors

Note: Many of the policy options and examples provided in this table are taken from the presentations made during the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) technical expert meeting (TEM) on urban environments, held in June 2014, in submissions from Parties and in relevant technical literature. Detailed information on this meeting is available at <http://unfccc.int/bodies/awg/items/8170.php>. Many examples reference ongoing activities at the local and regional levels. The list is not exhaustive and the examples are for informational purposes only.

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