OECD Green Growth Studies

Green Growth in Bangkok, Thailand

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BETTER POLICIES FOR BETTER LIVES

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Foreword

This publication is the result of a study on urban green growth in the Bangkok Metropolitan Region, Thailand. It is the first case study of the **Urban Green Growth in Dynamic Asia** project. The project explores how to promote green growth in fast-growing cities in Asia by examining policies and governance practices that encourage greening and competitiveness in a rapidly expanding economy. It contributes both to the *OECD Green Growth Strategy* and to the *OECD Strategy on Development*, as well as to ongoing discussions on the role of cities in tackling the urgent challenges of climate change. The project is part of the **OECD Green Cities Programme**, launched in 2010, which has conducted four metropolitan case studies (Paris, Chicago, Stockholm and Kitakyushu), two national case studies (China and Korea) and produced a synthesis report, *Green Growth in Cities* (2013).

The analysis is based on a "focused comparison" strategy of case study research. This entailed asking the same questions in the different city case studies in order to discern similarities and draw general lessons. Although the analysis focuses on Asian cities, the lessons for promoting green growth will also be relevant for other OECD member countries and cities.

The report was prepared by the Directorate for Public Governance and Territorial Development. The directorate's mission is to help governments at all levels design and implement strategic, evidence-based and innovative policies to strengthen public governance, respond effectively to diverse and disruptive economic, social and environmental challenges, and to deliver on governments' commitments to citizens.

The publication benefited from guidance by the OECD Regional Development Policy Committee and its Working Party on Urban Policy, as well as the support of the local team co-ordinated by the Bangkok Metropolitan Administration. It draws on data provided by the local team and the OECD Metropolitan Database. The analytical approach draws on *Urban Green Growth in Dynamic Asia: A Conceptual Framework* (2014). The expertise and experience of OECD member countries provided relevant international benchmarks and policy examples.

As part of the *OECD Green Growth Studies* series, further case studies will be carried out in a variety of cities, chosen on the basis of criteria such as population size, speed of growth, economic structure, and the centrality of the city in the national and regional economy. The results of the case studies will culminate in a synthesis report on *Urban Green Growth in Dynamic Asia*.

Acknowledgements

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The publication also benefited from valuable input from the Knowledge-Sharing Platform on Urban Green Growth in Dynamic Asia and the participants of the Bangkok Knowledge Sharing Workshop on Urban Green Growth in Dynamic Asia (6-7 August 2014). These include the Bangkok Metropolitan Administration, other local governments in the Bangkok Metropolitan Region, the central ministries and agencies, international organisations and experts, sub-national networks and other Asian and OECD cities. The workshop was supported by the OECD Knowledge-Sharing Alliance. Martina

Kampmann (former Senior Counsellor, OECD Knowledge Sharing Alliance) guided the knowledge-sharing methodology. Sébastien Mefflet and Ulrike Chaplar provided the organisational support.

The case study's two international peer reviewers from Japan and the United States, Tetsuya Nakajima (City of Yokohama) and Kelly O'Brien (Alliance for Regional Development), joined the OECD study mission to Bangkok (4-8 August 2014) and provided valuable reports. Tetsuo Kidokoro (University of Tokyo) also joined the OECD study team and provided valuable comments from the urban planning and governance perspectives. Richard Carlos Worden (international environmental consultant) provided valuable comments on urban resilience and disaster risk management. Francie Sadeski contributed to the policy assessment at the early stage of the study. Génia Oganian-Zagarinskaia contributed to the economic and environmental analysis. Amélie Bensimon, Yunjung Hwang, Jeremy Lereau and Margot Thierry (SciencesPo master's programme "Governing the Large Metropolis") assisted in the environmental analysis.

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Acronyms and abbreviations

3R	Reduce, reuse and recycle
AEC	ASEAN Economic Community
ASEAN	Association of Southeast Asian Nations
BAU	Business as usual
BMA	Bangkok Metropolitan Administration
BMR	Bangkok Metropolitan Region
BMTA	Bangkok Mass Transit Authority
BOD	Biochemical oxygen demand
BRT	Bus rapid transit
BTS	Bangkok mass transit system
BUR	Bangkok Urban Region
CF	Climate financing
CO_2	Carbon dioxide
CSO	Civil society organisation
CSP	Concentrated solar panel
DAC	Development Assistance Committee (OECD)
DDPM	Department of Disaster Prevention and Management
DO	Dissolved oxygen
EDA	Economic Development Administration
EE	Energy efficiency
EGAT	Electricity Generating Authority of Thailand
FAR	Floor area ratio
FCC	Flood Control Centre
FDI	Foreign direct investment
FEC	Final energy consumption
GDP	Gross domestic product
GHG	Greenhouse gas
GIS	Geographic Information System
GPP	Gross provincial product
GRP	Gross regional product
ICF	International Climate Fund

JICA	Japan International Co-operation Agency
KPI	Key performance indicator
KTOE	Thousand tonnes of oil equivalent
kW	Kilowatt
LED	Light-emitting diode
MEA	Metropolitan Electricity Authority
MRT	Mass rapid transit
MRTA	Metropolitan Rapid Transit Authority
MSW	Municipal solid waste
MWA	Metropolitan Waterworks Authority
NCIF	National Catastrophe Insurance Fund
NESDB	National Economic and Social Development Board
NESDP	National Economic and Social Development Plan
NGO	Non-governmental organisation
NRW	Non-revenue water
NUS	National University of Singapore
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
OIC	Office of Insurance Commission
ONEP	Office of National Resources and Environmental Policy Planning
OSR	Open space ratio
PM	Particulate matter
PPP	Public-private partnership
R&D	Research and development
RE	Renewable energy
RID	Royal Irrigation Department
THB	Thai baht (currency)
TIPMSE	Thailand Institute of Packaging and Recycling Management for Sustainable Environment
TMD	Thai Meteorological Department
TOD	Transit-oriented development
TREES	Thailand Rating Energy and Environment System
US EPA	United States Environmental Protection Agency
WHO	World Health Organization

Executive summary

This report analyses the economic and environmental performance of Thailand's Bangkok Metropolitan Region (BMR), assesses its policies and governance practices that promote green growth, and provides recommendations to enhance its green growth potential. Green growth aims to safeguard the natural assets, resources and environmental services on which our well-being relies. Cities play a critical role in national growth, but also generate negative externalities. They thus must be part of national solutions to stimulate growth and address climate change. Urban green growth policies encourage economic development while reducing either negative environmental externalities (for example, air pollution and carbon dioxide emissions that arise from urban activities) or the consumption of natural resources and environmental assets, including water, energy and undeveloped land.

In 2010, the BMR, consisting of the City of Bangkok and the Provinces of Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan and Samut Sakhon, was home to an estimated 14.5 million people, including unregistered migrant workers and commuters from surrounding provinces. While accounting for just over 20% of the national population, the region generated 44.2% of national gross domestic product (GDP) in 2012. Services constitute a significant share of the economy, but manufacturing still plays an important role. BMR's green growth challenges include increasing greenhouse gas emissions, air pollution, the depletion of natural assets, traffic congestion, management of wastewater and solid waste, and high exposure and vulnerability to seasonal floods.

As a dynamic and emerging market economy, Thailand has recorded strong growth over recent decades and is expected to continue to do so, but this growth has come at a high environmental cost. The challenge is therefore to improve environmental outcomes while supporting continued growth in output and living standards. Much untapped potential remains, particularly in the following areas: land use and transport, renewable energy and energy efficiency in buildings, and water resources and solid waste management. Resilience to floods is also an urgent cross-cutting issue that requires further attention.

Key findings and recommendations

Areas for action

More effective and cohesive land-use and transport policies in the BMR could significantly lower future greenhouse gas emissions and air pollution, while creating jobs and improving the quality of life for millions of ordinary citizens. Better co-ordinated land-use decisions by the BMA and surrounding provinces will help Bangkok avoid further urban sprawl. More effective policy instruments are needed to redevelop urban centres, particularly along mass transit lines. Accelerating investment in public transport is the backbone of all urban green growth strategies. However, given the demand for travel and the increasing dependency on automobiles, a multidimensional approach and policy alignment across governments are crucial.

The BMR should further develop renewable energy options, which accounted for 11% of final energy consumption in Thailand in 2013 and are rapidly expanding across the country. Rooftop solar panels, solar water heaters and waste-to-energy plants show particular promise. Green labelling could be used more effectively if it were combined with regulations, procurement frameworks and incentives such as Floor Area Ratio and Open Space Ratio bonuses, to encourage more efficient energy use in buildings. The Thai government should progressively remove fossil fuel subsidies and take steps to make renewable energy prices competitive by putting a real price on the carbon content of different fuels.

The BMR needs urgently to invest in wastewater and solid waste management. Only 46% of the water consumed in the City of Bangkok is treated. Nearly 90% of solid waste collected in the city is disposed of in sanitary landfill. Promoting waste-to-energy plants, recycling and composting a higher percentage of the solid waste stream all have great potential as part of a larger reduce, reuse, and recycle programme, as shown in the case of Stockholm. Community-based waste management practices should also be accelerated.

The BMR has already established a number of plans and strategies for green growth. Sub-national governments in the BMR could make the best use of such plans and strategies by ensuring that they reflect coherent green growth priorities. More emphasis could also be placed on the growth-generating potential of these plans.

Strategies for resilience to floods and other disasters

The 2011 floods resulted in significant economic damage in the BMR. Options for improving Bangkok's resilience to floods include enhancing its adaptive capacity through future "hard" investments in infrastructure (e.g. ecosystem-based adaptation) as well as "soft" investments involving organisational preparedness. Local and national governments could promote business continuity plans and optimise safety-net mechanisms to enhance the BMR's economic resilience, drawing on examples such as London or Florida. Local community and civil society organisations should be mobilised at the district level to raise public awareness and preparedness and increase social resilience.

Governance for urban green growth

Vertical co-operation should help direct spatial development and energy consumption in the BMR more efficiently. The Thai government could promote green growth at the provincial level, while recognising the BMR's unique position within the larger context of National Economic and Social Development Plans. Horizontal co-operation in the BMR could be improved by creating metropolitan-level commissions in each of the policy areas for green growth. Urgent action is needed in the area of land-use policies, to encourage a more consistent application of zoning regulations and investments in public infrastructure.

Financing urban green growth should be enhanced in a number of ways, such as creating national or city bonds and dedicated funds to support green growth policies and programmes, and making greater use of public-private partnerships, management or regulatory controls and fiscal tools. The incentives and the disincentives surrounding the investment, purchasing, consumption and disposal decisions of both businesses and citizens could be scrutinised and reformed, and the distributional effects of these changes carefully analysed to avoid unnecessary or inequitable economic or social consequences.

To build technical capacities, a BMR-wide Observatory could be set up to develop and monitor metropolitan key performance indicators. This would support BMR-wide governance structures and provide important information to local policy makers.

International development agencies have an important role to play in financing and capacity building in the BMR. Official development assistance and other development projects should encourage cross-sectoral and BMR-wide green growth actions, rather than focus on specific opportunity areas and single jurisdictions.

For BMR to be successful in implementing green growth, the pace of action must be accelerated. Successful interventions or pilot projects also need to be scaled up more aggressively. Finally, efforts should be made to develop mechanisms to enable international organisations to work more directly with sub-national government.

Chapter 1.

Economic and environmental performance in the Bangkok Metropolitan Region

Chapter 1 examines economic and environmental performance in the Bangkok Metropolitan Region (BMR).

The first section, the socio-economic profile of the metropolitan area, explains how the pace of urbanisation is correlated with the evolution of economic activity, poverty, social equity and living conditions. It includes an assessment of: 1) demographic changes over time; 2) economic performance and diversity; and 3) long-term growth challenges.

The second section addresses the greening challenges and the potential for green growth. It analyses the environmental performance of the city and indicates where opportunities for green growth lie. It includes an assessment of: 1) transport and land-use trends; 2) energy performance; 3) the risk of floods; and 4) water supply and wastewater treatment and solid waste management systems.

The last section on the institutional profile of the metropolitan area analyses the main governance challenges facing the BMR. It includes an assessment of: 1) the influence of the national government on local affairs; and 2) the need for horizontal co-operation between all local jurisdictions in the BMR.

Main points

- In 2010, the **Bangkok Metropolitan Region (BMR)** was home to an estimated 14.5 million people, including unregistered migrant workers and commuters from surrounding provinces, and accounted for just over 20% of the national population. However, it generated 44.2% of the national gross domestic product (GDP) in 2012, more than double its population share. The economy is increasingly driven by the services sector, but manufacturing activities continue expanding on its outskirts and beyond to the east.
- The BMR faces several challenges to its long-term growth, including the lack of a highly qualified labour force to drive urban green growth and a rising Gini coefficient, with growing social inequality between the rich and poor. **More than 2 million people live in urban slums**, many of them without adequate housing, potable water, wastewater treatment, solid waste collection, and with poor access to public transport services to commute to work, school or other services.
- The BMR faces several critical environmental challenges undermining its long-term economic growth and residents' quality of life. **The transport sector offers the most important opportunity for green growth**. The number of privately owned vehicles has doubled over the past ten years. This has contributed to debilitating traffic congestion resulting in lost productivity and reduced quality-of-life for residents and commuters, worsening air pollution with its attendant health costs, and half of all Bangkok's greenhouse gas emissions and high concentrations of particulate matter.
- The energy sector is the second most important area of opportunity that could facilitate a shift away from "brown" development toward a "green" growth model. This cross-cutting lever also affects other sectors, such as transportation and buildings. Electricity consumption has increased faster than population growth, especially in the residential and service sectors, but **improved energy efficiency in buildings and homes offers great promise**. Energy production in Thailand still depends heavily on fossil fuels, accounting for 76% of final energy consumption in 2013 while renewable energy alternatives only accounted for 11%. Renewable energy sources are developing quickly in the country, and the BMR has considerable potential in the solar and waste-to-energy sectors.
- **The BMR is at high risk of floods in the rainy season**, which have caused great economic, social and environmental damage in the past. The metropolis is highly exposed to floods given its topography, location and sprawling urban development. At the same time, it is highly vulnerable to future flooding or other threats. Building greater resilience to such risks is critical to achieve green growth in the BMR.
- Wastewater and solid waste management also present serious challenges and opportunities. **Only 46% of wastewater generated in the city of Bangkok is treated**; untreated water is discharged into soils, drainage systems, canals, rivers and even directly into the Gulf of Thailand. This contaminates the environment and poses serious public health risks, especially during disasters. Nearly 10 000 tonnes of municipal waste are collected every day in the city. **As much as 89% of collected municipal solid waste is disposed of in sanitary landfills**, while recycling activities, which are undertaken at the community level and by the private sector, are still very limited.
- The national government has historically exerted strong influence over local affairs. However, the recent trend toward decentralisation in Thailand, and the growing importance of cities in encouraging green growth, suggests that **national and sub-national government co-ordination** is now a matter of pressing concern. In addition, Bangkok's rapid expansion has left gaps between its functionally integrated economic area and administrative boundaries, highlighting the need for horizontal co-operation between local jurisdictions in the Bangkok Metropolitan Region and beyond.

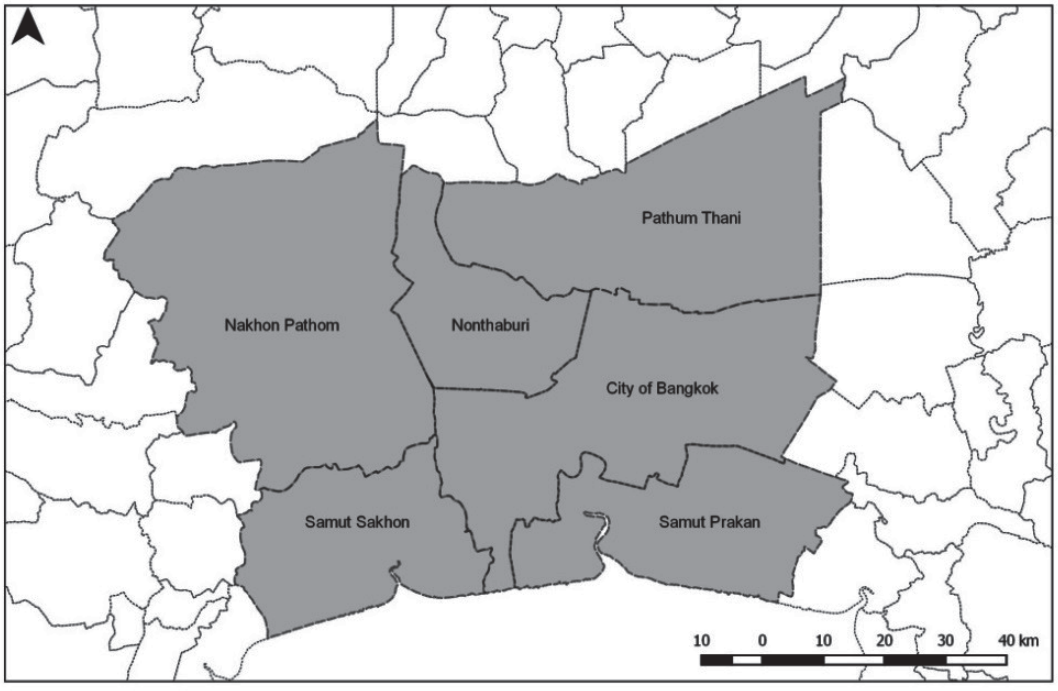
The Bangkok Metropolitan Region's economic potential is high, but it faces long-term challenges and obstacles

The Bangkok Metropolitan Region as a functional urban area

As a functional economy, defined by settlement patterns and human activity rather than by administrative frontiers, Bangkok extends far beyond the city of Bangkok, the capital city of Thailand, to the Bangkok Metropolitan Region (BMR) and beyond. The BMR consists of the city of Bangkok and five adjacent provinces (Nakhon Pathom, Nonthaburi, Pathum Thani, Samut Prakan and Samut Sakhon), encompassing 7 761.50 square kilometres (Figure 1.1). There is no metropolitan government to administer the BMR. The city is governed by the Bangkok Metropolitan Administration (BMA), and does not belong to any province; it has a status of special local authority. It is subdivided into 50 districts, which are further subdivided into 169 sub-districts.

It is not possible to define the functional urban area of Bangkok using the methodology developed by the OECD,[1] due to the lack of commuting data. Instead, the BMR is the unit of analysis in this study, although some analyses cover only the city of Bangkok due to limited data availability.

Figure 1.1. **Map of the Bangkok Metropolitan Region (BMR)**



Source: OECD, based on Global Administrative Areas (n.d.), *GADM database of global administrative areas*, available at: www.gadm.org (retrieved in May 2015).

A populous metropolitan region whose suburban areas are growing

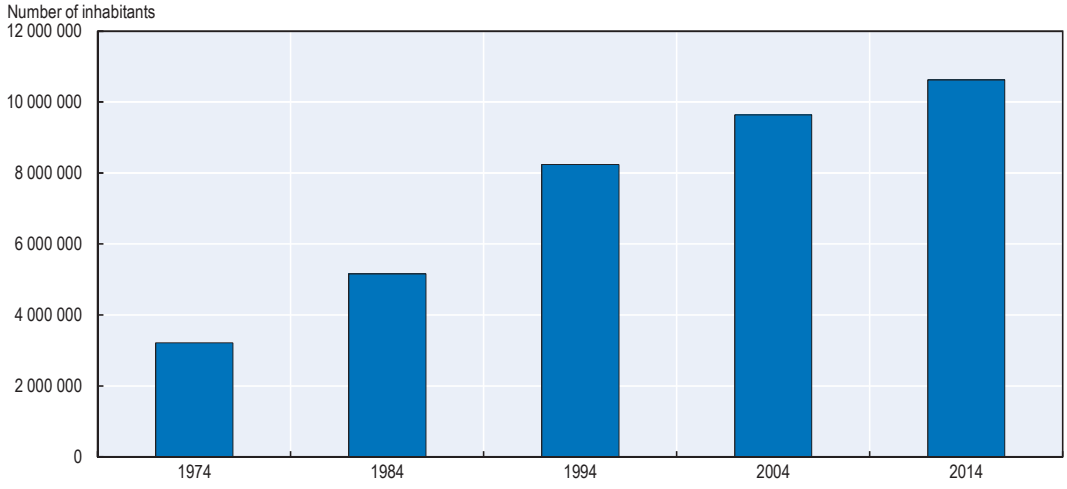
The BMR was home to 10.6 million registered inhabitants in 2014, representing 16.3% of the national population. The registered population of the city of Bangkok was 5.7 million, but it also includes a large number of non-registered inhabitants. In 2010, the real population of the BMR was estimated at 14.5 million, almost 22% of the Thai

population, with 8.3 million in the city of Bangkok (National Statistical Office, 2010). The BMR is much larger than Nakhon Ratchasima (Korat), the second-largest urban agglomeration in Thailand, whose registered population in 2011 was 2.6 million.

The population in the BMR expanded rapidly, and although it slowed down in the 1990s it is still growing (Figure 1.2). Accelerated growth from the 1960s to the 1980s was mainly driven by the growth of the population in the city of Bangkok. As in many developing and developed cities, the growth now mostly occurs outside the city in the five other provinces (known as vicinities) of the BMR. Indeed, the registered population in the city of Bangkok in 2013 was slightly below its 2002 level, while the suburban provinces grew around 24.9% between 2002 and 2013. One of the reasons for the higher population growth in the vicinities of the BMR is the growth of urban areas and expanded employment opportunities, which have attracted large numbers of internal migrants from rural areas since the 1980s. Meanwhile, since the 1990s, the city of Bangkok has attracted fewer rural migrants (United Nations Population Fund, 2011). Data on real population (i.e. including non-registered population), however, suggest that both the city of Bangkok and the vicinities experienced a sharp growth in population between 2000 and 2010. The relative contribution of the unregistered population to such growth is therefore particularly significant in the city of Bangkok (Figure 1.3). In addition, the projected population growth in urban areas in Thailand, like in many other Asian countries, clearly indicates that more people will migrate to the BMR in the years to come (Figure 1.4).

Figure 1.2. **Registered population in the Bangkok Metropolitan Region**

1974-2014



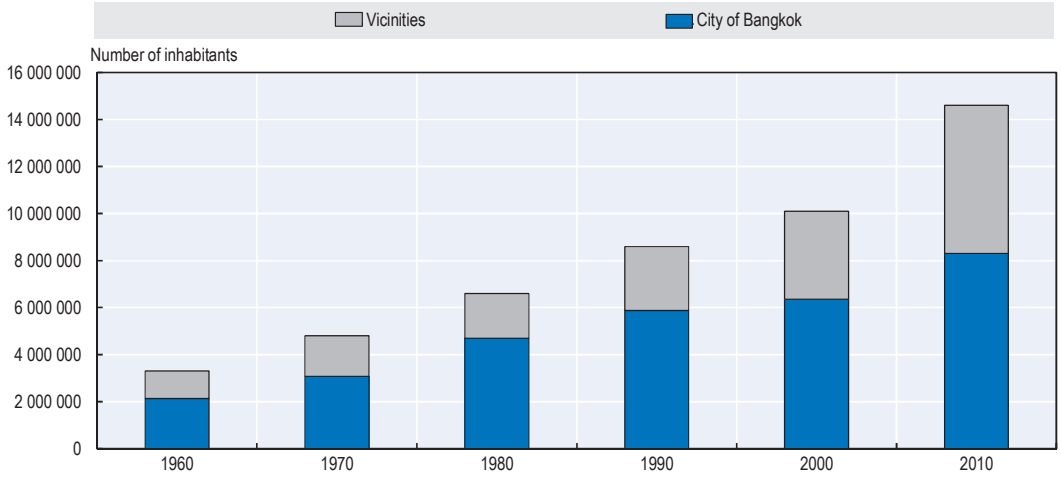
Sources: Lincoln Institute of Land Policy (n.d.), *Atlas of Urban Expansion*, www.lincolninst.edu/subcenters/atlas-urban-expansion/historical-sample-cities.aspx (last accessed 16 January 2015); National Statistical Office, Official Statistics Registration Systems, http://stat.bora.dopa.go.th/stat/sumyear.html.

The demographic structure of Thailand has changed remarkably in the past 50 years, from a largely young population to a progressively ageing population, and this trend is expected to continue. The share of Thai population aged 65 and more was 9.43% in 2000, but is expected to reach 21.22% in 2025. In Bangkok, similar trends are observable. The share of population aged 65 and more in the city of Bangkok was 7.38% in 2000 and is expected to reach 26.97% in 2025 (Keeratipongpaiboon, 2012). A decline in fertility rates

and increased longevity have been noted in Thailand (World Bank, n.d.). This means that the average age of the Thai population, particularly in the city of Bangkok, is likely to keep increasing in the near future (Marome and Rittironk, 2011).

Figure 1.3. **Real population in the city of Bangkok and its vicinities**

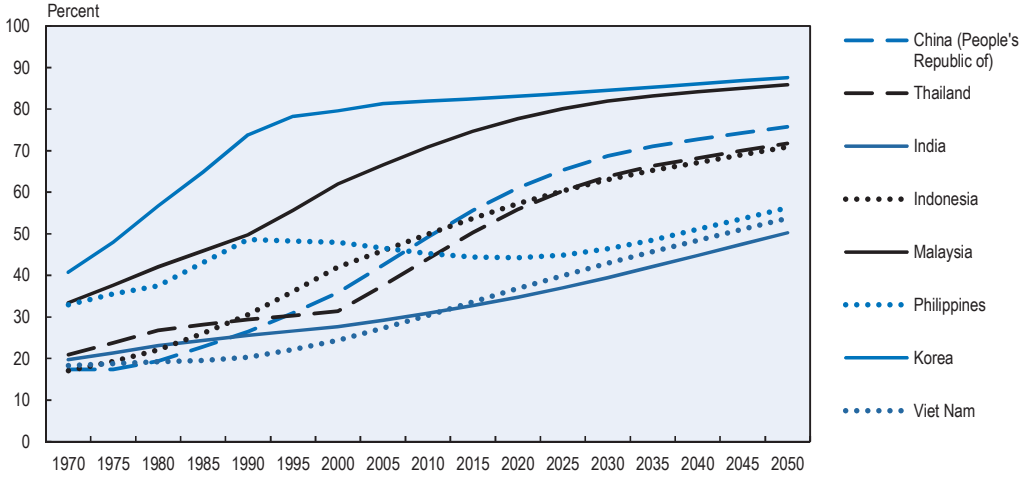
1960-2010



Sources: National Statistical Office (2013a), *Statistical Yearbook of Thailand 2013*, National Statistical Office, Ministry of Information and Communication Technology, Bangkok, http://web.nso.go.th/en/pub/e_book/YEARBOOK_2013/index.html#/72-73/zoomed (last accessed 16 January 2015); Choiejit, R. and R. Teungfung (2005), "Urban growth and commuting patterns of the poor in Bangkok", available at: http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1269364699096/6892630-1269364758309/choejit.pdf.

Figure 1.4. **Percentage of population at mid-decade residing in urban areas in selected Asian countries**

1970-2050



Source: United Nations (2014), *World Urbanisation Prospects, The 2014 Revision*, United Nations, Department of Economic and Social Affairs, Population Division, New York, New York, http://esa.un.org/unpd/wup (last accessed 22 January 2015).

An economically dominant metropolitan region supported by services and manufacturing

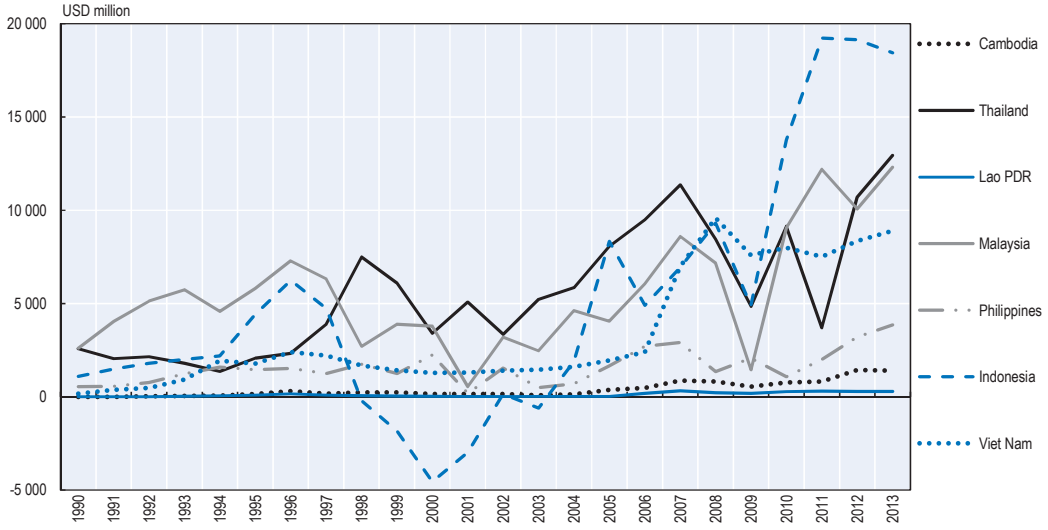
The BMR's economy is growing steadily. Between 2005 and 2012, the annual gross regional product (GRP) per capita of the BMR grew on average by 3.1%, to reach USD 29 540 (THB 359 798), while the annual gross provincial product (GPP) per capita of the city of Bangkok grew on average by 3.8% a year to reach USD 35 836 (THB 436 479).[2] The GRP per capital of the BMR and the GPP per capita of the city of Bangkok were almost twice and two and a half times, respectively, the national annual GDP per capita of USD 15 090 in 2012 (THB 183 803) (NESDB, 2014). The BMR is also highly dominant in economic activity. Its GRP in 2012 was USD 443.3 billion (THB 5.4 trillion), which represented 44.2% of the national GDP (THB 12.2 trillion). The city alone produced USD 303.8 billion (THB 3.7 trillion) in 2012, representing 30.2% of national GDP (NESDB, 2014). The primacy of the Bangkok region can be explained by the fact that it benefits from first-mover agglomeration economies (the difficulty other cities have in trying to compete, despite national programmes to deconcentrate the economy), the logistical advantages of being a coastal city and the preference of foreign investors, which significantly supported the development of industries in the Bangkok region at the expense of other regions (NESDB and World Bank, 2010).

The BMR's economic growth has been strongly supported by foreign direct investment (FDI). Thailand has maintained a favourable international investment environment, despite the global economic crisis and floods of 2011. With Indonesia and Malaysia, it has been one of the most attractive emerging countries of Southeast Asia in terms of FDI inflows (Figure 1.5). This has significantly benefited manufacturing. In 2011, of FDI inflows of USD 9 million, USD 5.86 million went to this sector (Puapan, 2014). The electronic industry was the sector that attracted the most FDI.

Economic activities in the Bangkok region – and especially manufacturing activities – have progressively sprawled in the vicinities of the BMR and outside the BMR towards the eastern and south-eastern provinces of Chon Buri, Chachoengsao and Rayong. Together with the province of Samut Prakarn they form Thailand's eastern seaboard, an emerging economic region. The northern province of Pra Nakhon Si Ayudhaya (Ayutthaya), located above the province of Pathum Thani, is also closely connected to the BMR's economy and functional urban area. These four provinces and the BMR form the Bangkok Urban Region (BUR).[3] The dispersion of industrial activities in the BUR has been supported by the extension of the road network (e.g. Chon Buri Motorway and the city of Bangkok's outer ring road) which allowed firms to retain the benefits from agglomeration economies while avoiding raising production costs associated with congestion and land rents (NESDB and World Bank, 2010). The emerging industrial estates and the locational advantages also explain the outward movement of industrial activities to Ayutthaya and Pathum Thani in the north, and Samut Prakan and Samut Sakhon in the south. In 2009, the BUR accounted for 58% of national GDP, against 42% for the BMR and 26% for the city of Bangkok (NESDB and World Bank, 2010).

Figure 1.5. **Foreign direct investment by country**

1990-2013



Source: UNCTAD (2013), *World Investment Report 2013,* Annex tables, United Nations Conference on Trade and Development, Geneva, http://unctad.org/en/pages/DIAE/World%20Investment%20Report/Annex-Tables.aspx (last accessed 15 January 2015).

Overall, the BMR and other parts of the BUR experienced robust growth in secondary and tertiary sector activities. The BMR's economy, however, is increasingly dominated by the tertiary sector, which accounted for 71% of its GRP in 2011, against 68% in 2005 (NESDB, 2011). The share of value added of the services sector of the BUR in national value added increased from 14.1% in 2000 to 53.5% in 2006 (NESDB and World Bank, 2010). In the services sector, the printing and publishing industry in particular, experienced the largest gains. It grew by 14.7% per year on average between 1997 and 2007 in the city of Bangkok and by 23.6% per year on average in other parts of the BUR (NESDB and World Bank, 2010). In 2007, the BUR accounted for around 92% of national gross output in the printing and publishing industry, including 71% for the city of Bangkok alone. Other services sectors that experienced the largest gains were: real estate activities, hardware consultancy, legal activities, and market research and public opinion polling (NESDB and World Bank, 2010).

The BMR's secondary sector, driven by manufacturing, representing 28% in 2011 as a share of GRP, is relatively significant in comparison with many OECD metropolitan regions. In 2010, the secondary sector of Japan's Osaka Prefecture accounted for 20.4% of its GRP, and Toronto's 19%. The BMR is more comparable to an industrial OECD city, such as Kitakyushu (Japan), where the share of the secondary sector is around 25% (OECD, 2013a). However, it is still more service-oriented than a city like Shanghai, (People's Republic of China, hereafter "China"), where the secondary sector accounts for 37% of the GPP (China Knowledge, n.d.). Despite the increasing dominance of the services sector, the secondary sector is still robust in the region. At the end of 2013, 29.4% of Thailand's industries were located in the BMR (40 691 factories out of a total of 138 177), 27.8% of annual industrial investment (THB 1.55 million out of THB 5.59 million) and 46.8% of Thailand's employees in the industrial sector (1.9 million out of 4.07 million employees). The economic output of manufacturing in the entire BUR has significantly increased in absolute value in the automotive, electronics,

food processing, metalworking and textile industries. The metalworking industry experienced the largest increase among the BUR's manufacturing sectors, followed by food processing and textiles. The city of Bangkok also experienced significant growth in all manufacturing sectors – especially textiles and metalworking – except the automotive sector (Table 1.1). The share of the secondary sector in the GRP, however, is slowly decreasing in favour of the service sector: it was 30% in 2005 (NESDB, 2011). The contribution of the manufacturing sector to national manufacturing output and employment in manufacturing also decreased between 1997 and 2007. This percentage decline has mostly affected manufacturing of radio, television and communication apparatus, and manufacturing of motor vehicles, trailers and semi-trailers (NESDB and World Bank, 2010).

Thailand's and the BMR's manufacturing industries are critical assets for exports. They contributed to the recovery from the 1997 Asian financial crisis, and now account for more than two-thirds of the national GDP (Centre for the Promotion of Imports from Developing Countries, n.d.). The composition of Thailand's exports, mainly sourced from the BUR, has dramatically shifted from exports based on primary and resource-based products to medium- and high-tech products (NESDB and World Bank, 2010). Since the 1970s, the share of primary products in exports (garments and textiles in particular) fell by 70%, while that of electronics, automotive and other manufacturing goods increased by 57%. Export growth has been driven primarily by demand from Thailand's regional trading partners.

In 2010, export values in US dollars surged by over 40%, mainly in motor vehicles and parts, electronics and electrical appliances. Japan and the United States continue to be major export destinations, but growth in trade with China (both imports and exports) grew substantially in nominal terms from 2000 to 2010, with China becoming the lead export destination by the end of the period (OECD, 2013b).

A spatial analysis reveals an increasing concentration of manufacturing activities in the vicinities of the BMR and the other provinces of the BUR, to the detriment of the city of Bangkok. The BUR accounted for 77% of Thailand's manufacturing output in 2009, against 48% for the BMR and 16% for the city of Bangkok (NESDB and World Bank, 2010). Between 1997 and 2007, the city of Bangkok experienced a decrease of 34.5% in the number of establishments in the auto parts industry, and a very slight growth in output from this sector, while the number of establishments grew by more than 90% in other areas of the BUR, and output grew by 41.1%. The food processing, metalworking and electronic industries also experienced more spectacular changes in the other areas of the BUR, but still grew in the city of Bangkok. The textile industry, however, grew more significantly in the city of Bangkok than in other parts of the region (Table 1.1).

Table 1.1. **Industrial change by manufacturing sector in the Bangkok Urban Region, city of Bangkok and Thailand**

1997-2007

	Auto parts		Electronics		Food processing		Metalworking		Textiles	
	2007	1997-2007 change	2007	1997-2007 change	2007	1997-2007 change	2007	1997-2007 change	2007	1997-2007 change
Bangkok Urban Region										
Number of establishments	782	11.9%	418	166.2%	4 887	375.4%	12 177	606.3%	23 014	753.3%
Number of employees	74 555	-3.3%	111 526	87.2%	268 222	52.1%	160 462	75.0%	392 379	27.5%
Value of gross output (THB)	493 763 765	30.1%	182 827 379	68.0%	55 848 640	105.0%	223 197 236	145.6%	359 753 702	86.0%
City of Bangkok										
Number of establishments	325	-29.2%	155	118.3%	1 936	386.4%	6 598	540.6%	15 883	729.4%
Number of employees	19 761	-34.5%	19 693	25.8%	81 985	44.6%	56 836	49.5%	188 371	32.9%
Value of gross output (THB)	104 465 836	0.8%	43 567 111	56.8%	136 855 652	35.1%	57 016 771	98.5%	147 933 665	99.5%
Thailand										
Number of establishments	1 336	22.0%	753	191.9%	115 696	3160.9%	34 308	1 417.4%	165 074	4 759.4%
Number of employees	158 581	47.9%	289 768	155.7%	617 614	54.7%	252 568	95.3%	657 389	64.3%
Value of gross output (THB)	815 326 993	74.9%	937 071 430	361.1%	1 128 891 097	87.7%	366 765 342	130.2%	482 613 390	83.3%

Source: NESDB and World Bank (2010), "Industrial change in the Bangkok Urban Region", Office of the National Economic and Social Development Board (Thailand) and the World Bank, available at: http://documents.worldbank.org/curated/en/2011/07/14551619/industrial-change-bangkok-urban-region.

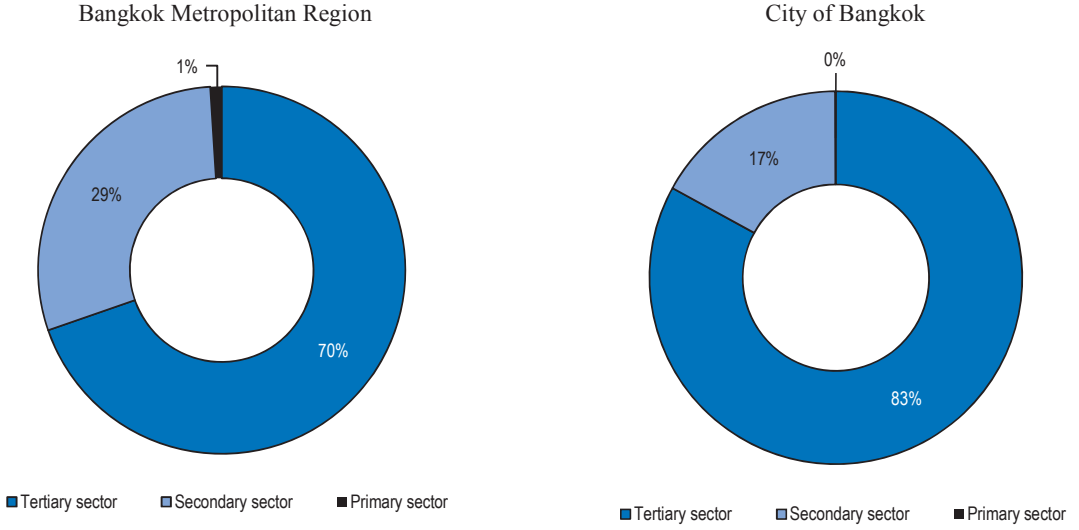
The city of Bangkok, in contrast, is more dominant in terms of services. The share of the tertiary sector in its GPP was as high as 83% in 2011, against only 17% for the secondary sector (Figure 1.6). Research and experimental development, market research, architectural services, accounting and labour recruitment services are highly concentrated in the city of Bangkok. The number of establishments in the real estate sector, for instance, rose 1 488% between 1997 and 2007, and in hardware consultancy by 1 287%. Labour recruitment services, however, are mostly found outside the city of Bangkok, as they tend to locate near industrial estates in other parts of the BUR. Overall, however, all services sectors are rapidly increasing throughout the BUR (NESDB and World Bank, 2010).

The Bangkok Metropolitan Region's long-term growth challenges

Thailand's economic success, based on manufacturing for export, has begun to lag behind its competitors in Southeast Asia. It is most directly threatened by competition in labour-intensive manufactured goods from countries such as China, India Indonesia and Viet Nam (OECD, 2013b). Such competition is expected to become even fiercer as a result of regional economic integration when Thailand enters the ASEAN Economic Community on 31 December 2015. Thailand, including the BMR, seems to lack the qualified labour force to fulfil the demands of a growing economy. Thai educational institutions have not produced enough science and technology graduates with the skills and of the quality required by the private sector (World Bank, 2010), which has impeded attempts to develop more sophisticated production sectors. This particularly hampers productivity in the industrial clusters of the Bangkok Urban Region (NESDB and World Bank, 2010).

Figure 1.6. **Economic structure of Bangkok Metropolitan Region and the city of Bangkok**

2011



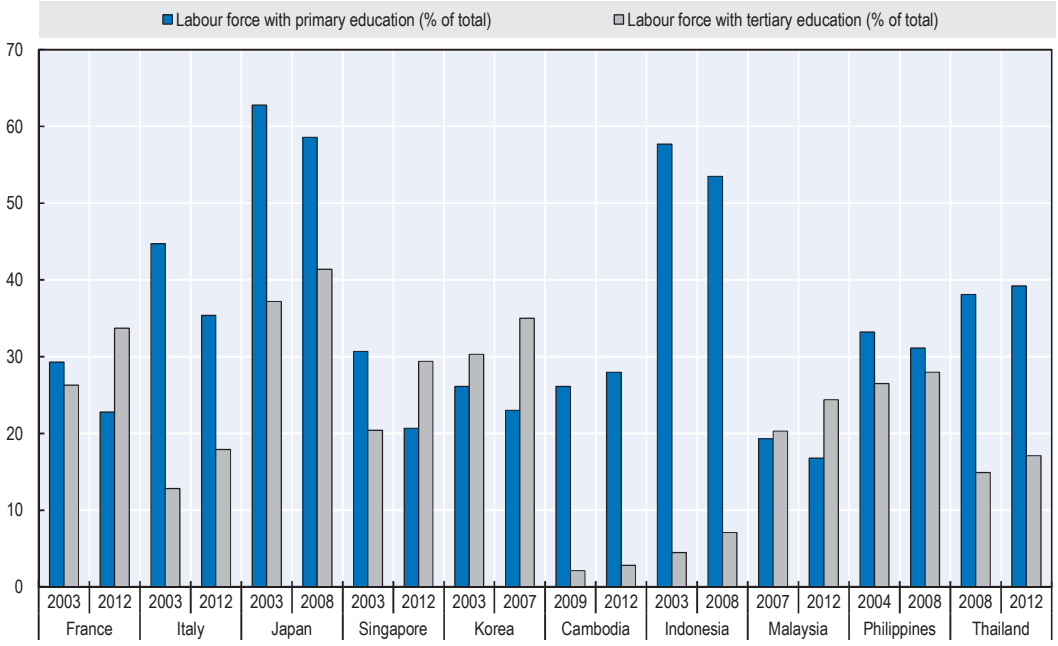
Source: NESDB (2013), *Gross Regional and Provincial Product, Chain Volume Measures 2012*, Office of the National Economic and Social Development Board, Bangkok.

In Thailand, the percentage of the labour force with tertiary education is low (17.1% in 2012), compared with such ASEAN peers as Malaysia (24.4% in 2012) and the

Philippines (28% in 2008), as well as major OECD countries (e.g. 41.4% in Japan in 2008; Figure 1.7). Only a quarter of faculty members in Thai universities hold doctorate degrees, and Thailand has one of the lowest levels of research and development (R&D) spending and R&D workers in the region, and continues to fall behind other middle-income countries (OECD, 2013b). The auto and electronics industries are still engaged in the production of labour-intensive, low-value, standardised products, rather than high added-value products. This is especially true of Thai industries, which have not developed domestic technologies. Weak collaboration with higher education institutes is also a factor in low productivity in the Bangkok region (NESDB and World Bank, 2010). Increasing the share of the labour force with tertiary education through stronger human capital investment may support the shift toward urban green growth. This will help Thailand compete in international markets, by moving to higher value-added activities and improving the capacity of domestic firms.

Figure 1.7. **Labour force with primary and tertiary education**

% of total



Source: World Bank (n.d.), *World Bank Development Index*, available at: http://data.worldbank.org/indicator/all (last accessed 15 January 2015).

The BMR also faces some formidable social problems. While personal income is increasing, not all citizens of the BMR benefit from growth. The Gini coefficient in the city of Bangkok has increased since 2000, reaching an estimated 0.46 in 2009. Poverty and social inclusion are urgent concerns, especially in the city of Bangkok, where most of the BMR's urban poor are concentrated. In 2013, 2 051 slums were identified in the city of Bangkok, housing a total population of almost 2.1 million (BMA, 2014a).[4] This accounts for almost one quarter of the city's total population, including non-registered inhabitants. Many are migrant workers from northeast Thailand or neighbouring countries and are not registered, owing to the local administration's lack of capacity to track the massive inflows of migrants. Slum dwellers live without adequate access to public

transport, housing, potable water, wastewater treatment and solid waste collection, especially along the canals and the rivers, where living conditions are particularly bad.

Bangkok also needs to address the issue of informal workers. In 2012, more than 1.2 million employees were working in the informal sector in the city of Bangkok, enjoying little legal protection and no social security. This represents 32.6% of the total number of workers in the BMR (around 3.9 million people in 2012). Most are service workers, shop sales workers and skilled agricultural and fishery workers (National Statistical Office, 2013b). Their working conditions are also poor, which presents an obstacle for labour productivity and the BMR's overall economic development.

The Bangkok Metropolitan Region's greening challenges and potential for green growth

Bangkok faces critical environmental challenges that undermine its long-term economic growth and its residents' quality of life. Most of these challenges can be traced to specific sectors, in particular land use and transport, energy, water resources and solid waste management.

Motorisation and urban sprawl have increased congestion and environmental externalities

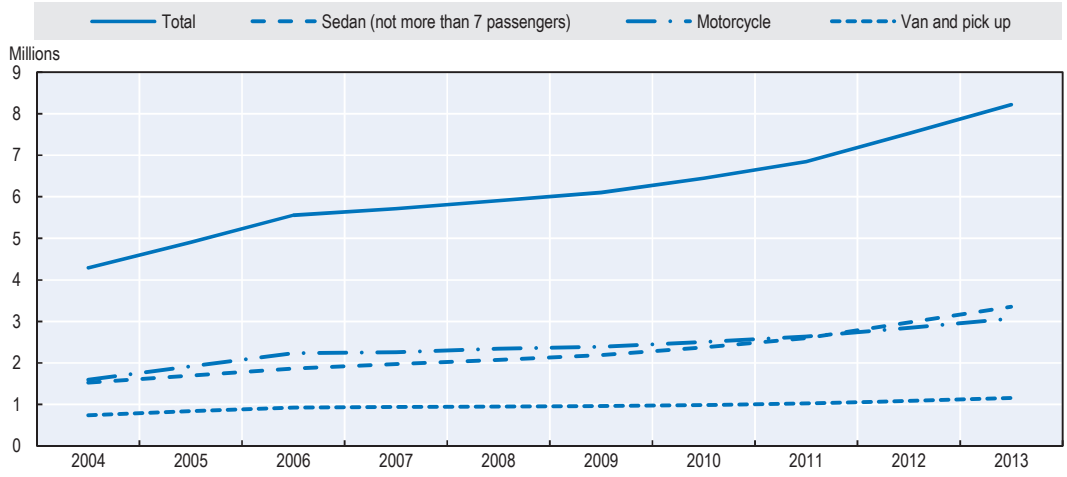
The transport sector offers the most important opportunities to green Bangkok's growth. First, the BMR has a highly developed public transport system. Public transport represented 43% of the modal split for commuting in 2011, against 57% for both cars and motorcycles (data on cycling and walking are not available, so the share of both transport modes in the total modal split should be lower). Although a direct comparison with other cities is difficult because of the lack of data on the modal share of walking and cycling, the share of public transport in the BMR is probably higher than that of many OECD cities: the share of public transport is as low as 5% in Denver, Colorado (United States) and Toyama (Japan), 12% in Chicago, Illinois (United States) and 16% in Vancouver (Canada) , while private cars account for more than 75% of the modal share in these cities (OECD, 2013a). However, some developing cities perform better: the share of public transport in the Mexico City Metropolitan Zone of Valle de Mexico (ZMVM) was 73% in 2010 (Federal Government of Mexico, 2012).

Among modes of public transport, buses accounted for 89% of passenger trips in the BMR in 2011, against 6% for electric trains, 3% for boats and 3% for public vans and trains (Ministry of Transport, 2013). In the city of Bangkok, the mass transit system includes a 25.3-kilometre elevated rail network (BTS Skytrain) and a 21-kilometre underground train network (MRT), and accounts for 42% of trips by public transport (compared to 44% for urban buses and 14% for boats). As the figures show, these mass transit networks primarily serve the city of Bangkok, rather than the entire metropolitan area. Thanks to the current extension of the network, however, it is expected that by 2037, the mass transit network will account for 43% of passenger trips among public transport in the whole BMR, compared to 51% for buses, 2% for boats and 4% for public vans and trains (Ministry of Transport of Thailand, 2013).

Public transport in the BMR, however, is threatened by increasing motorisation. The number of registered vehicles in the city of Bangkok has risen steeply, almost doubling between 2004 and 2013 to an estimated 8.22 million (Figure 1.8), almost equal to the city's real population. Per capita vehicle ownership increased from 0.9 in 2002 to 1.4 in 2013. This was mainly due to a sharp rise in private vehicles: the number of urban taxis

grew by 110% in the period, while the number of cars (carrying fewer than eight passengers) grew by 106%, the number of vans and pickup trucks by 47% and the number of motorcycles by 30.3%. Cars and motorcycles account for, by far, the most significant percentage of registered vehicles, with over 3 million vehicles in each category in 2013. However, the number of fixed-route buses only increased by around 20%. It is projected that the use of public transport in the BMR will decrease to 41% by 2037, against 59% for private vehicles, despite plans to extend the urban railway networks (Figure 1.10).

Figure 1.8. **Number of vehicles registered in the city of Bangkok**

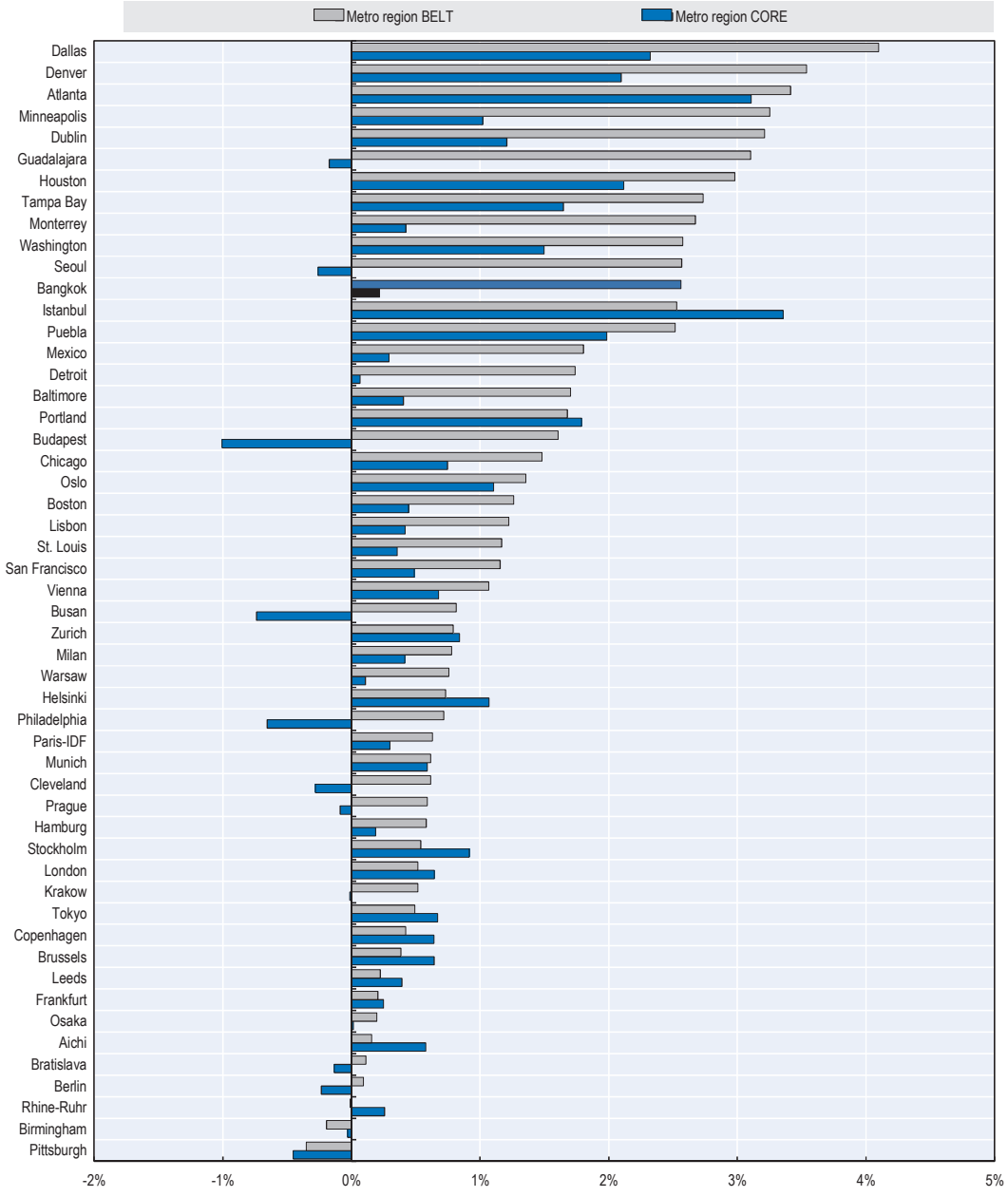


Source: BMA (2014c), "Answers to the OECD case study questionnaire", internal document, unpublished.

At the same time, Bangkok is expanding outward towards the more dynamic vicinities of the BMR. The speed of suburban expansion was fast, compared with OECD metropolitan areas; from 1995-2007, the registered population of the BMR's suburban belt grew at an annual average rate of 2.6%, while the population growth of the core (i.e. city of Bangkok) was 0.2% (Figure 1.9). Suburban expansion has contributed to the loss of agricultural land. From 2001-10, the share of agricultural land decreased significantly in the city of Bangkok, Nakhon Pathom, Nonthaburi and Pathum Thani (see Figure 3.2 in Chapter 3).

Figure 1.9. **Suburbanisation process in OECD metropolitan regions and in the Bangkok Metropolitan Region**

Annual average population growth 1995-2007

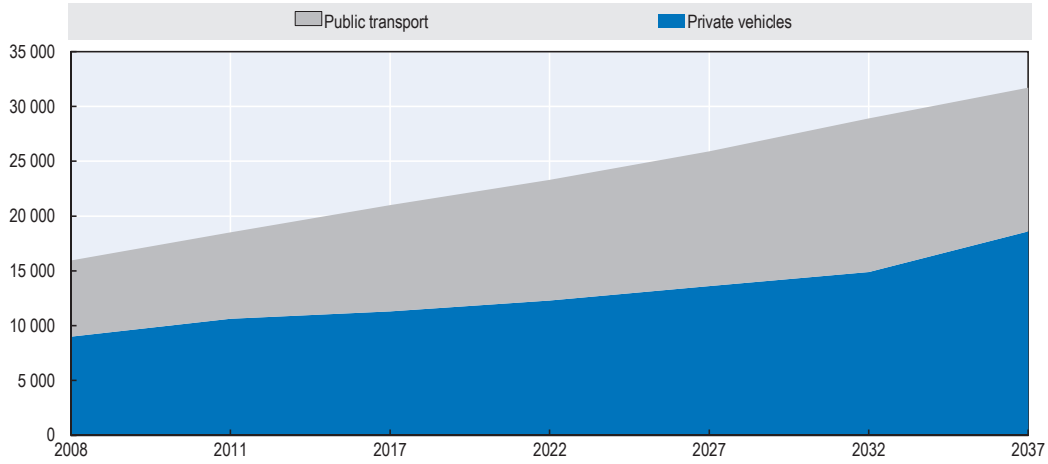


Note: Based on OECD definition of metropolitan areas. For Bangkok, the BMR is taken as the Bangkok Metropolitan Area and BMA is taken as the core, since the OECD definition is not available, due to the lack of data.

Sources: OECD (2013d), "Metropolitan areas", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/data-00531-en (last accessed 15 January 2015); OECD (2013e), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (last accessed 17 January 2015); Bureau of Registration Administration, Department of Provincial Administration.

Figure 1.10. **Number of commuting trips in the Bangkok Metropolitan Region (2008-37)**

1 000 trips per day



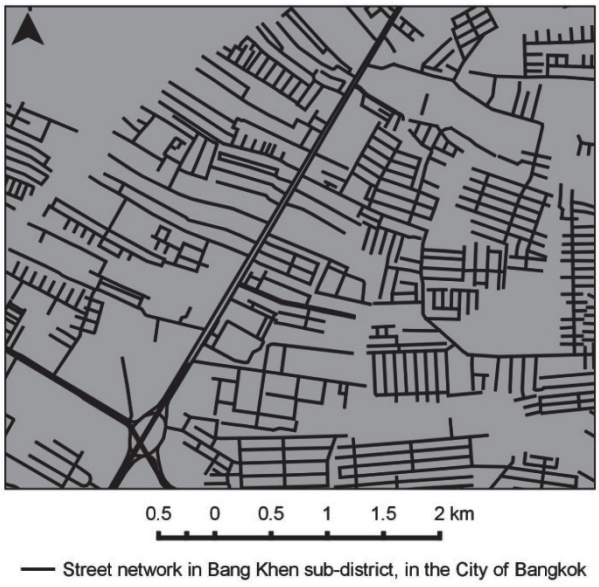
Source: Ministry of Transport of Thailand (2013), *Transport and Traffic Statistics of Thailand*, Office of Transport and Traffic Policy and Planning, Bangkok.

Motorisation and urban sprawl is a serious threat to the BMR's green growth. Congestion is holding back both Bangkok's economic development and its quality of life, and traffic is often cited as a major concern in city surveys. The growth in the number of vehicles has outpaced the development of road infrastructure (Oanh et al., 2012). The BMR has a good network of freeways, but the number of arterial roads is still insufficient (Shlomo, Sheppard and Civco, 2005). Many of the existing *soi* (side streets) in Bangkok are dead-end streets, unlike the street grids of such cities as Barcelona or New York (Figure 1.11). This forces drivers to use main roads, which are heavily congested (Dissanayake, 2012). The historic infrastructure is thus a critical factor in the inefficiency of the transport networks. The shortage of bridges over rivers and canals is also a problem in the city of Bangkok, whose density is relatively high, at 3 616 pop/km^2. The population density in suburban areas was much lower than in the city of Bangkok, at 759 pop/km^2 in 2012, while the overall BMR population density was 1 347 pop/km^2. This is lower than in other Asian metropolitan areas, such as Fukuoka, Japan (1 792.6 pop/km^2), Tokyo, Japan (3 365 pop/km^2), Seoul, Korea (4 201.7 pop/km^2) and Busan, Korea (4 550.8 pop/km^2).[5]

Thanks to fuel standards adopted by the Thai government, air quality in the city of Bangkok has improved remarkably during the last 20 years, and pollutants such as sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) now fall below both World Health Organization (WHO) standards and Thailand's National Ambient Air Quality Standards (Wangwongwatana, 2013). However, high concentrations of particulate matter (PM_{10} and $PM_{2.5}$) remain a challenge in the city, and the problem seems even more severe in the vicinities of the BMR. While annual average concentrations of PM_{10} have decreased from 89 µg/m^3 in 1997 to 54.3 µg/m^3 in 2013 in roadside areas, and decreased over the same period from 81 µg/m^3 to 41 µg/m^3 in residential areas, concentrations are still far above WHO standards (20 µg/m^3). $PM_{2.5}$ is the most harmful pollutant, because of its small size. The annual level of $PM_{2.5}$ in the city of Bangkok was 20 µg/m^3 in 2012, better than many other Asian cities but above WHO annual standards of 10 µg/m^3 (Figure 1.12). The road transport sector, in particular diesel vehicles, is the main contributor to particulate matter emissions in the BMR (BMA, 2012; Oanh et al., 2012). Diesel accounted for 50.3% of all

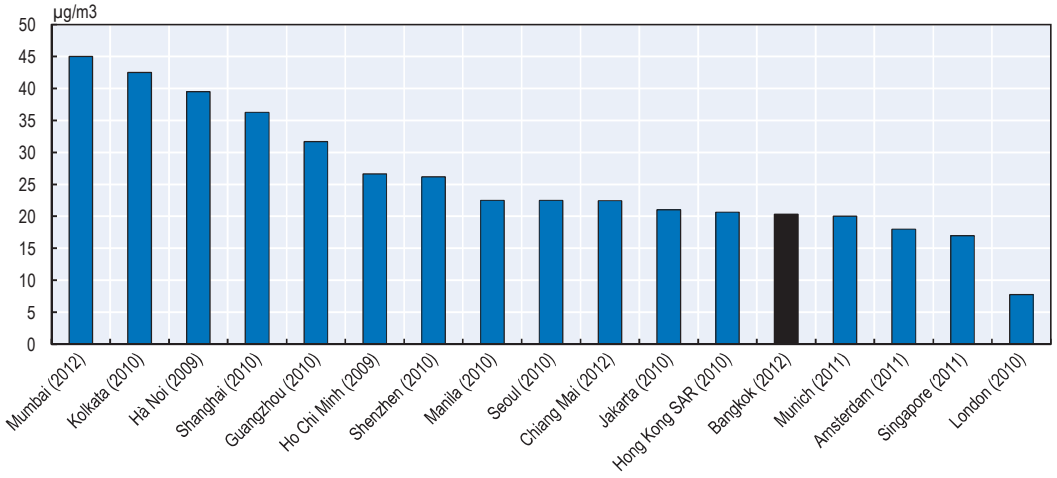
fuel consumption (all sectors included) in the city of Bangkok in 2010 (BMA, 2012). By contrast, liquefied petroleum gas, compressed natural gas, electric and hybrid vehicles only accounted for 0.6% of registered vehicles in 2014. This is similar to many OECD countries: amongst the European Union member countries, for instance, the percentage of cars powered by alternative fuels in the total passenger car fleet is less than 1% (Eurostat, n.d.).[6] Levels of ozone are also relatively high in the outskirts of the city: they progressively increased from 1997 to reach 36 µg/m^3 in roadside areas and 40 µg/m^3 in residential areas in 2013. In Thailand, the cost of PM_{10} and ozone emissions combined was estimated at around USD 27 billion in 2010, and resulted in 24 590 deaths (OECD, 2014).

Figure 1.11. **Street network in a district of Bangkok**



Source: Own elaboration based on OpenStreetMap (n.d.), www.openstreetmap.org/#map=5/51.500/-0.100. (last accessed 15 May 2015).

Figure 1.12. **Annual level of $PM_{2.5}$ in selected cities**



Source: World Health Organisation (2014), *Ambient (Outdoor) Air Pollution in Cities Database*, www.who.int/phe/health_topics/outdoorair/databases/cities/en (last accessed 15 January 2015).

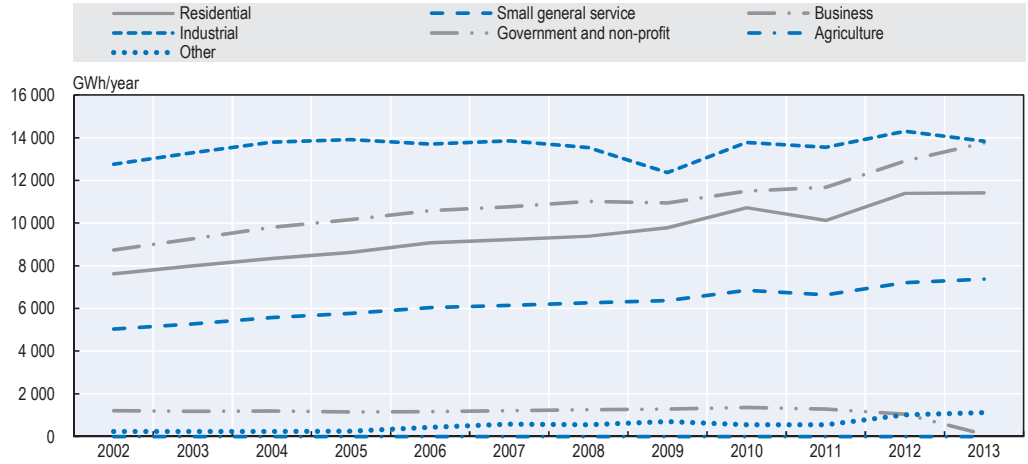
According to the latest data available for the city of Bangkok, the transport sector is the main source of CO_2 emissions, at around 50% (see Figure 2.2 in Chapter 2). This is higher than many OECD cities: the share of the transport sector in CO_2 emissions was at 46% in New York City, 38% in Los Angeles, 34% in Paris, 31% in London, 26% in Seoul, and 21% in Tokyo in 2010 (OECD Metro Explorer).[7] In 2012, 42 million tons of CO_2 were released in the city of Bangkok (BMA, 2012), or 7.4 tonnes per capita per year (5.1 tonnes per capita per year including the unregistered population). Many developed and emerging cities have higher average annual per capital CO_2 emissions, such as Toronto (14.8 tonnes) and New York City (17.7 tonnes), but the performance of other cities, like Tokyo (6.8 tonnes) and Seoul (5.7 tonnes), shows that Bangkok has room for improvement (OECD Metro Explorer).

Rising energy consumption and high dependency on fossil fuels

The energy sector is the second most important sector for shifting away from a "brown" development pathway to a green growth model, and a highly cross-cutting lever affecting other sectors, such as transport and buildings. Electricity, in particular, is the second most significant source of CO_2 emissions in the city of Bangkok. Electricity consumption where the Metropolitan Electricity Authority (MEA) operates, in the city of Bangkok, Samut Prakan and Nonthaburi (48 244 GWh), accounted for around 30% of total electricity consumption in Thailand in 2012 (Ministry of Energy of Thailand, 2013a), and has increased faster than population in recent decades. This is not only due to population increase in the metropolitan area; the electricity consumption per capita in the MEA areas has been growing steadily, from 4.6 MWh/person in 2002 to 6 MWh/person in 2012 (Ministry of Energy, 2013a). This is higher than Paris (5.01 MWh/person) and Hong Kong, China (5.9 MWh/person) but lower than Stockholm (7.12 MWh/person), Singapore (8.4 MWh/person), Chicago (10.35 MWh/person) or Kitakyushu, Japan (11 MWh/person)[8] (World Bank, n.d.). Industry is the largest user of electricity in the MEA areas, but electricity consumption in the residential and business sectors is rapidly increasing, suggesting untapped potential for energy efficiency in buildings and homes (Figure 1.13).

Figure 1.13. **Electricity consumption by sector in Bangkok**

2002-13



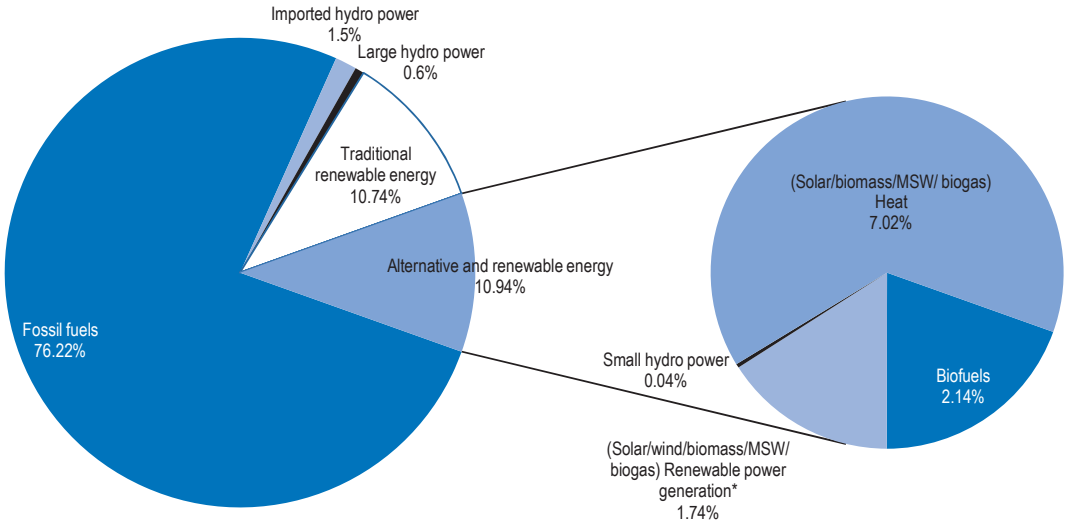
Note: Bangkok in this figure means the service areas of the Metropolitan Electricity Authority: the city of Bangkok, Nonthaburi and Samut Prakan provinces.

Source: Ministry of Energy of Thailand (2013a), "Chapter 5: Electricity", in: *Energy Statistics of Thailand 2013*, Energy Policy and Planning Office, Bangkok, available at: www.eppo.go.th/info/cd-2013/pdf/cha5.pdf.

Energy production in Thailand still depends on fossil fuels (coal, petroleum and natural gas), which accounted for 76.2% (57 328 ktoe) of final energy consumption (FEC) in 2013 (75 214 ktoe). Petroleum alone accounted for 45.6% (34 330 ktoe) of FEC, while coal and natural gas respectively accounted for 7.9% (5 947 ktoe) and 7.1% (5 339 ktoe) of FEC.[9] Alternative and renewable energy (RE) accounted for only 10.9% (8 232 ktoe) of total FEC (Figure 1.14). This is slightly lower than many OECD countries: the average share of renewable energy in FEC in the EU-28 member states was at 15% in 2013, and the target is to reach 20% by 2020 (Eurostat, n.d.).[10] However, energy consumption from alternative and renewable energy is growing fast: it was only 4 636 ktoe in 2009, almost half its value of 2013 (Ministry of Energy of Thailand, 2013b). While biomass is the most important RE source in terms of installed capacity, solar and wind are the two most rapidly growing sectors: they experienced a 2 126% and a 99% increase between 2009 and 2013, respectively, and benefited from the largest public and private investments in RE in 2013 (Ministry of Energy of Thailand, 2013b).

Figure 1.14. **Final energy consumption by sector in Thailand**

2013



Source: Ministry of Energy of Thailand (2014), *Energy in Thailand, Facts and Figures 2013*, Department of Alternative Energy Development and Efficiency, Bangkok.

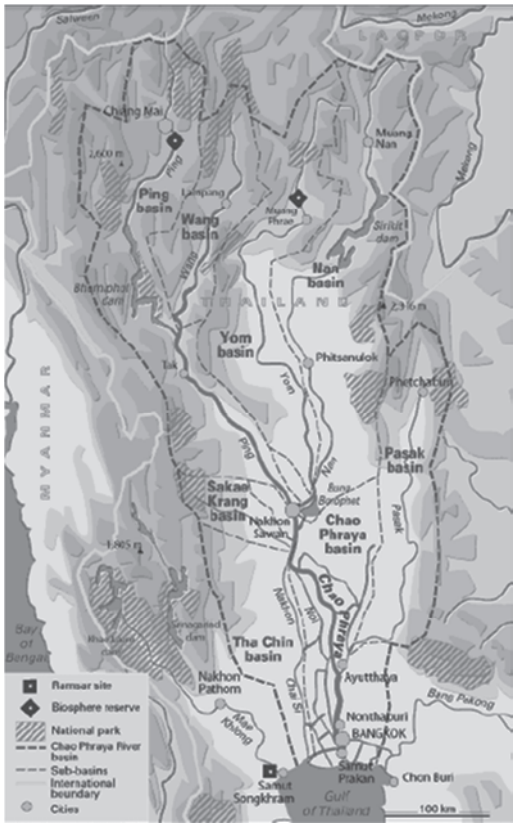
The BMR, more specifically, is the largest energy consumer in Thailand, but does not rely much on renewable energy. For instance, the city of Bangkok, Samut Sakhon, Nonthaburi and Pathum Thani are amongst the areas with the lowest share of heat consumption from renewable energy in Thailand (Ministry of Energy of Thailand, 2014). The BMR should have secure access to clean energy generated from other parts of Thailand, but it also shows some potential to benefit from local RE production. It is estimated that solar, solid biomass and waste-to-energy production potential in the BMR amounts to around 11 769 ktoe, 918 ktoe and 711 ktoe, respectively, whereas the installed capacities were respectively at 75 ktoe, 11 ktoe and 20 ktoe only in 2013. Wind power production shows less potential in the BMR, and there is no wind power plant in the BMR (Ministry of Energy of Thailand, 2013b). However, offshore wind-power production in the Gulf of Thailand seems more promising.

High flood risk during the rainy season

The BMR is at high or extreme risk of flooding from storms in the rainy season between July and October (Thampanishvong, 2013). It experienced major floods in 1942, 1978, 1980, 1983, 1995, 1996, 2002, 2006 and 2011 (Ahsan, 2013). Building greater resilience to floods is critical to achieve green growth in the BMR, given the economic, social and environmental impact of such disasters. The 2011 floods resulted in damages of USD 9.1 billion (THB 296 million) in the city of Bangkok, and severely hit the urban poor (see Chapter 3). The high flood risk in the region is due to three factors:

- Weather and climate events: the average annual rainfall in Bangkok over the period 1991-2013 was high, at 1 710.6 mm. In 2011, when a massive flood hit the BMR, annual rainfall was 2 257.5 mm (BMA, 2014b). In comparison, the average annual rainfall in France is 867 mm (World Bank, n.d.). Thanks to climate change, local precipitation and flood volumes may increase in the future.
- Exposure, which refers to the inhabitants and their livelihoods; environmental services and infrastructure; or economic, social and cultural assets in places that could be adversely affected (IPCC, 2012). In the case of the BMR, exposure is closely linked to:
  - Location: the BMR is located in the central region of Thailand on low-lying plains at the mouth of the Chao Phraya Basin, just above the Gulf of Thailand, and is exposed to water discharge from northern and eastern provinces (Figure 1.15).
  - Topography: the ground elevation of Bangkok is less than 2 metres above sea level, creating the conditions for floods when intense rainfalls occur during the monsoon season. The BMR's coastal zone, facing the Gulf of Thailand, is also vulnerable to tidal movements, saltwater intrusions into nearby agricultural areas and sea-level rise.
  - Sprawling urban development: changes in land use have affected the BMR's drainage capacity (Institute of Development Studies, 2007), extended the built environment under threat and increased land subsidence. Some urban areas are now closer to sea level and more exposed to floods.
- Vulnerability, which refers to the propensity or predisposition to be adversely affected (IPCC, 2012): in the BMR, many assets and residents (in particular the urban poor) have been affected by floods, due to a lack of safety-net mechanisms and poor access to urban services (see Chapter 3).

Figure 1.15. **Map of the Chao Phraya Basin**



Source: Marome, W. (2012), "Bangkok: Data on coastal cities, needs, opportunities and challenges", presentation made at Academia Sinica, Chinese Taipei.

Inefficient wastewater and solid waste treatment

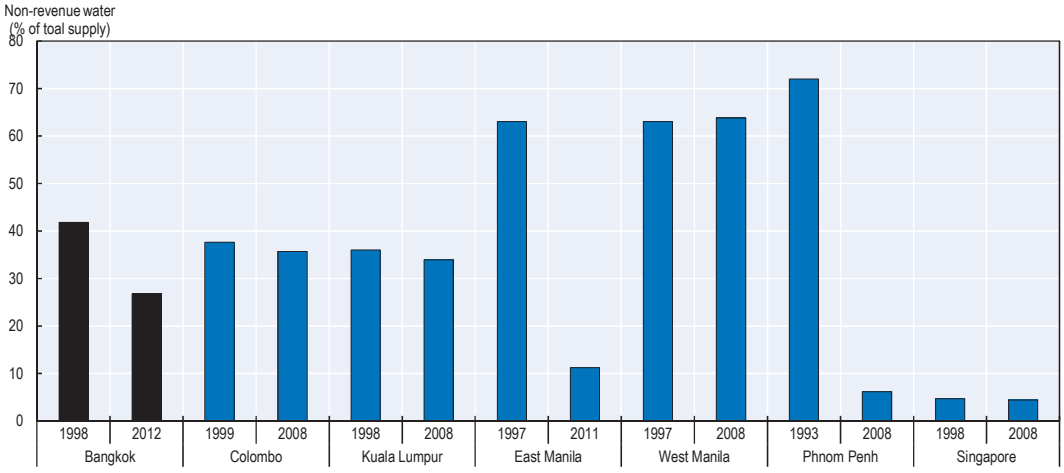
Water and solid waste management also present serious challenges and room for improvement. The sources of water supply for Bangkok are the Chao Phraya River and the Tha Chin River. In the city of Bangkok, the water distribution network covers most of the jurisdiction, and every citizen has access to drinking water that meets water-quality standards. In the vicinity provinces of the BMR, however, there are still some residents who do not have access to drinking water. Domestic water consumption per capita remained steady between 1998 and 2008, and reached approximately 211 litres per day in 2008. This is relatively high compared to most cities in the region. In Singapore, for instance, domestic water consumption per capita was 151 litres per day in 2013 (Singapore National Water Agency, n.d.). The steady trend contrasts with trends in OECD cities, where per capita water consumption has declined overall over the past ten years (OECD, 2015a). Total water consumption (domestic and industrial water consumption) per capita in the city of Bangkok increased from around 400 litres per day in 1998 to around 440 litres per day in 2013. This was mainly attributable to non-domestic water consumption, in particular by businesses and industries (ADB and NUS, 2012).

The city of Bangkok still has high levels of non-revenue water (NRW). The percentage stood at 26.76% in 2012 (BMA, 2014c) despite significant improvements in the past 15 years. Other Asian cities, for example Phnom Penh (Cambodia), have

experienced a significant reduction in levels of NRW, below 10% (Figure 1.16). Most non-revenue water is caused by water that is unaccounted for owing to obsolete pipe networks. This results in the unnecessary depletion of freshwater resources and economic losses for the Metropolitan Waterworks Authority.

A more significant problem, however, is wastewater management. In the city of Bangkok, 2.5 million m^3 of water were used every day, and only 1.1 million m^3 (45.8%) were treated in 2012 (BMA, 2012; 2014c). By comparison, around 80% of the OECD population was connected to wastewater treatment plants in 2009 (OECD, 2012b). This, however, represents a significant improvement, given that the share of treated wastewater was around 2.4% in 2000 (Figure 1.17). The city of Bangkok has 22 wastewater treatment facilities. Some are operated by the BMA while others are operated by the private sector under the BMA's supervision. Although recent construction has given 54.5% of the population access to an urban sanitation system in 2008, as compared with 2.3% of the population in 1998 (ADB and NUS, 2012), the overall capacity does not meet the increasing demand. Untreated wastewater is mainly generated by the industrial sector and households and directly discharged into grounds, drainage systems, rivers and canals or the sea. This damages the ecosystem and threatens freshwater availability. In particular, the quality of surface water (rivers and canals), measured by the amount of biochemical oxygen demand (BOD) is a serious environmental problem. Out of the 296 monitoring stations installed by the BMA along the Chao Phraya River and canals of the city of Bangkok, 201 (70%) indicate that water is moderately polluted (4-15 mg/L) and 48 (17%) indicate that water is severely polluted. The BOD value is as high as 30-50 mg/L in the densest areas in the centre of the city (BMA, 2012).

Figure 1.16. **Non-revenue water in selected Asian cities**

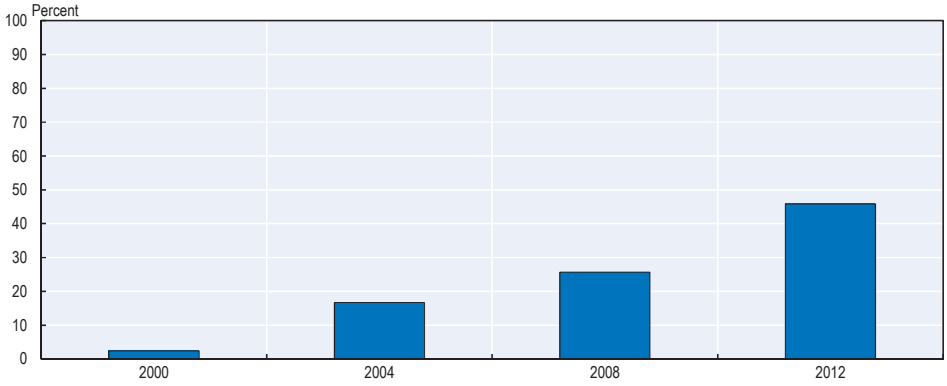


Notes: Data for Phnom Penh and Singapore correspond to unaccounted-for water (UFW), which comprises physical water losses due to leakages, and apparent water losses due to illegal connections and meter inaccuracies. The non-revenue water comprises unaccounted for water and legitimate water consumption that is unbilled, such as free supplies to tenement gardens and fire hydrants.

Sources: ADB and NUS (2012), *Good Practices in Urban Water Management: Decoding Good Practices for a Successful Future*, Asian Development Bank and National University of Singapore, Mandaluyong City, Philippines, available at: www.adb.org/sites/default/files/publication/29888/good-practices-urban-water-management.pdf; IFC (2012), "Case study of Manila Water Company", in: *Inclusive Business Models – Guide to the Inclusive Business Models in IFC's Portfolio*, International Finance Corporation, Washington, DC, available at: www.ifc.org/wps/wcm/connect/3af114004cc75b599498b59ec86113d5/Pub_002_IFC_2011_Case%2BStudies.pdf?MOD=AJPERES.

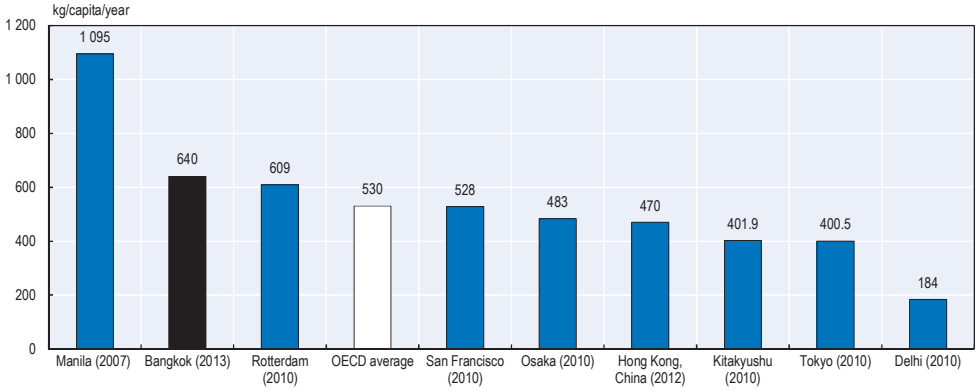
The lack of proper solid waste management is also an environmental and public health concern. Large amounts of solid waste are generated in the BMR. In 2013, 9 993 tonnes of municipal waste were collected every day in the city of Bangkok (BMA, 2014a). This amounts to 1.75 kg per capita per day, or 640 kg per capita per year (excluding the non-registered population). This is higher than the OECD average and more than many large developed cities, such as Hong Kong, China, which generated around 470 kg of solid waste per capita in 2012 (Hong Kong Council of Social Service, n.d.), or 1.28 kg per capita per day (Figure 1.18). The volume of municipal solid waste is steadily increasing, at an annual growth rate of 2.49% from 2005 (8 291 tons/day) to 2013. Some of the recent growth, however, is due to the 2011 flood, which resulted in large amounts of solid waste, created by the massive destruction of household furniture and materials (BMA, 2012).

Figure 1.17. **Share of wastewater treated in the city of Bangkok**



Sources: ADB and NUS (2012), *Good Practices in Urban Water Management: Decoding Good Practices for a Successful Future*, Asian Development Bank and National University of Singapore, Mandaluyong City, Philippines, available at: www.adb.org/sites/default/files/publication/29888/good-practices-urban-water-management.pdf; BMA (2012), *Bangkok State of Environment 2012*, Bangkok Metropolitan Administration, Department of Environment, Bangkok, available at: http://203.155.220.174/pdf/BangkokStateOfEnvironment2012RevisedEdition.pdf.

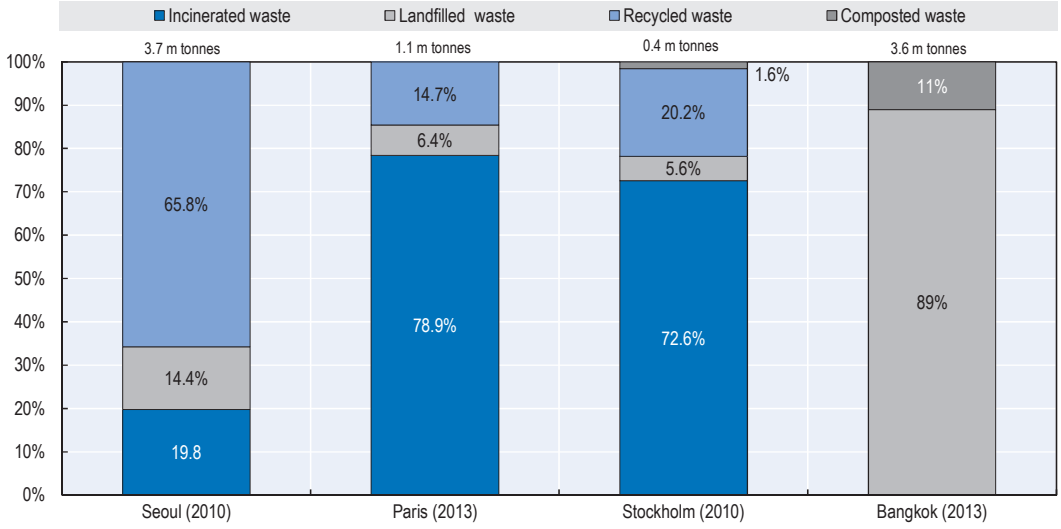
Figure 1.18. **Solid waste generation in selected cities**



Sources: UN-Habitat (2010b), *Solid Waste Management in the World's Cities, Water and Sanitation in the World's Cities 2010*, UN-Habitat, New York; BMA (2014a), *Statistical Profile of Bangkok Metropolitan Administration 2013*, Bangkok Metropolitan Administration, Strategy and Evaluation Department, Bangkok, available at: www.bangkok.go.th/main/backoffice/upload_editor/file/stat2013%28ENG%29.pdf; Hoornweg, D. and P. Bhada-Tata (2012), "What a waste: A global review of solid waste management", *Urban Development Series Knowledge Papers*, No. 15, World Bank, Washington, DC, available at: http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf; Waste Atlas, www.atlas.d-waste.com (last accessed 21 January 2015); Hong Kong Council of Social Service (n.d.), "Social indicators of Hong Kong", www.socialindicators.org.hk/en/indicators/environmental_quality/23.10 (last accessed 21 January 2015).

Municipal waste collected by the BMA is brought to transfer stations, where waste is separated and transferred for composting or landfilling. As much as 89% of such waste is disposed of into sanitary landfill, while 11% is composted. An international comparison shows that Bangkok has room to improve its recycling and incineration rates (Figure 1.19). To date, there is no incinerator in the city, although the first incinerator (with the capacity of 300 tonnes per day) is under construction at the Nongkhem waste disposal centre. However, some recycling activities are undertaken at the community level or directly by industries. In 2013, the amount of recycled waste was 1 610 tonnes per day, according to the BMA.

Figure 1.19. **Treatment of collected municipal solid waste in Bangkok, Seoul, Paris and Stockholm**



Notes: The absolute values above each bar indicate the total amount of municipal solid waste collected in each city. Recycled waste in Bangkok is not shown in this figure, as it is not part of the municipal collection process. According to the Bangkok Metropolitan Administration, the amount of recycled waste in 2013 was 1 610 tonnes per day.

Sources: Yoo, K.-Y. and S. Yi (2014), "Evaluation and development of solid waste management plan: A case of Seoul for past and future 10 years", *Journal of Material Cycles and Waste Management*, Vol. 5, No. 12, pp. 1 091-1 103, Springer Japan, http://dx.doi.org/10.1007/s10163-014-0294-2; City of Paris (2013), *Rapport Annuel sur le Prix et la Qualité du Service Public de Gestion des Déchets à Paris*, Paris; OECD (2013c), *Green Growth in Stockholm, Sweden*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264195158-en; BMA (2014c), "Answers to the OECD case study questionnaire", internal document, unpublished.

The volume of industrial waste generated, both hazardous and non-hazardous waste (51 818 and 202 890 tonnes, respectively, in 2014) is also increasing rapidly, and some is not treated properly (Department of Industrial Works, 2015). The collection of household hazardous waste is also a problem: while the BMA expected to collect 28 tonnes of such waste per day in 2012, it only collected 1.4 tonnes (510 tonnes in total) (BMA, 2012). In addition, the amount of toxic waste collected in the city of Bangkok increased from 4 593 tonnes in 2002 to 9 866 tonnes in 2012 (BMA, 2012).

Solid waste is a great concern, especially in the slums of the BMR. Waste collection service does not reach many slum residents, and non-collected waste creates health and environmental hazards. The 2011 floods spread this waste in the slums and polluted water. Various waste management methods have been adopted in some slums, but are not

widespread enough to eradicate these issues (see Chapter 2). Solid waste management is therefore a critical way of enhancing social inclusion.

The Bangkok Metropolitan Region's institutional landscape

Thailand's national government has historically exerted a strong influence over urban green growth policies. The recent decentralisation trend in the country, and the increasing role of cities in green growth, suggest how important national and sub-national government co-ordination can be in this respect. Bangkok's rapid expansion has created a gap between its functionally integrated economic area and its administrative boundaries, highlighting the need for horizontal co-operation between local jurisdictions in the BMR and beyond.

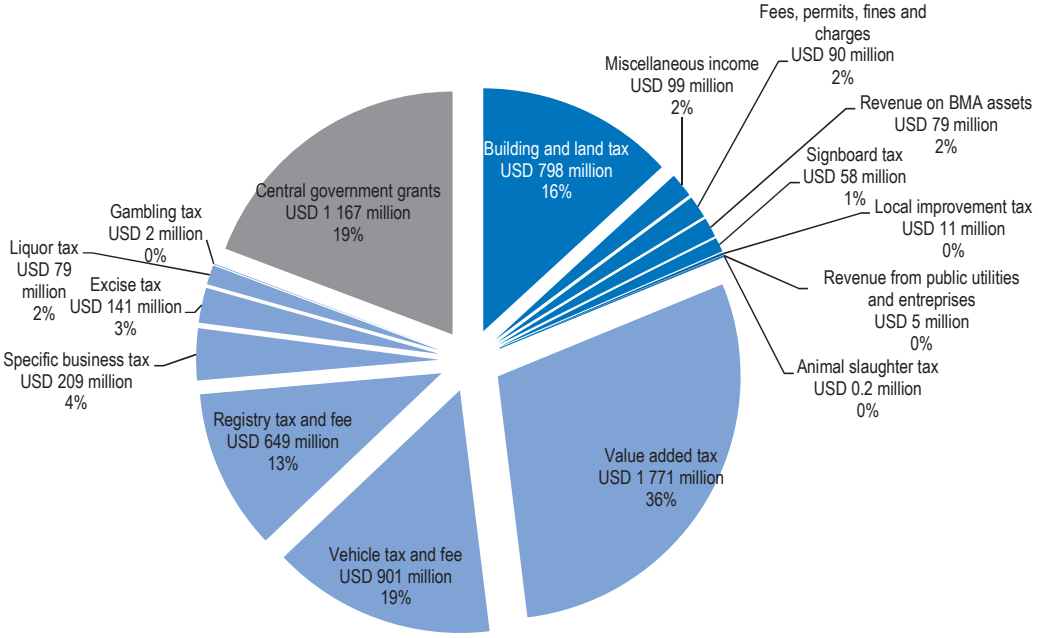
Thailand's centralised government structure favours national and sub-national co-ordination

The Thai central government is a central decision maker in many areas of urban green growth policies. Special-purpose authorities of the central government, such as the Mass Rapid Transit Authority (MRTA), the Bangkok Mass Transit Authority (BMTA), the Metropolitan Electricity Authority (MEA) and the Metropolitan Waterworks Authority (MWA), are powerful institutions with extensive responsibilities in key development sectors within the BMR (see Chapter 2).[11] This is also the case in many Asian national capitals, where most urban functions are carried out by central government ministries, special-purpose authorities or quasi-governmental corporations (Laquian, 2011).

The influence of the Thai government in these sectors is exercised through plans and strategies, and through policy instruments. Regulatory and monitoring tools and public procurement are largely defined at the national level and used accordingly by local governments. The national government also maintains control over local finances. The BMA's budget (i.e. the sum of revenues collected by the BMA plus revenues transferred from the central government) amounted to USD 4.9 billion (THB 59.5 billion) for the fiscal year 2013.[12] In addition to this budget, USD 1.2 billion (THB 14.2 billion) was allocated by the central government and used for special projects in 2012. Of that total, revenues collected directly by the BMA accounted only for 18.8%, whereas the major share (81.2%) came in revenues and grants from the central government (Figure 1.20). In Thailand in general, revenues locally raised by sub-national governments account only for 2% of total public revenues in the country, and sub-national governments account for 10% of total public expenditure (UCLG, 2010). On average, sub-central governments account for about 40% of total public expenditure and 42.6% of total public revenue in OECD countries – 18.6% considering only the share of sub-national tax revenue of total public revenue (OECD, 2015b). This suggests not only that the national government is a major spender and investor in Thai cities, but also that local governments depend on transfers from the central government, and potentially lack the capacity to undertake green growth.

Figure 1.20. **Revenue of the Bangkok Metropolitan Administration by sector**

Fiscal year 2012



Note: Dark-blue sources of revenue are directly collected by the BMA. Light-grey sources of revenue are transferred from the central government; dark grey refers to grants from the central government.

Source: BMA (2013a), *Annual Performance Report for the Fiscal Year 2012*, Department of Finance, Bangkok.

The influence of the national government has decreased recently, however. The 1997 Decentralisation Action Plan gave authority to local governments in six critical areas: 1) infrastructure (which includes urban planning and development); 2) quality of life; 3) order and security of communities and society; 4) planning, investment promotion, and commerce and tourism; 5) natural resources and environmental protection; and 6) arts and culture, traditions and local wisdom (Ratanawaraha, 2010). A notable change under the reform was granting local governments the right to draft their own Comprehensive Plan. In 1999, the BMA was the first local government to design its own plan (Ratanawaraha, 2010). One consequence of the allocation of responsibilities to local authorities is a stronger need for co-operation between different levels of government. In some cases, implementing such co-operation has been difficult, compromising the efficiency of public action in sectors with high potential for green growth in the BMR (see Chapter 4).

The need for institutional co-ordination at the metropolitan scale

Bangkok's functional area has expanded beyond the city of Bangkok into the BMR and beyond, but no institutional mechanism is in place in the BMR. The BMR is composed of the BMA, which administers the city of Bangkok, and the other five provinces, all of which are autonomous urban authorities with their own planning, legislative and executive branches. The BMA benefits from its special status as a single municipality equivalent to a province: it manages 50 districts and 169 sub-districts. The 5 provinces include 94 local municipalities, each of which has an elected mayor and council members (Table 1.2).

Horizontal co-operation between the BMA and the five provinces has been organised for some large-scale policies and projects (e.g. mass transit development), but beyond these few exceptions, metropolitan co-operation has been weak. The BMA has no authority to take unilateral action with the five surrounding provinces. Local governments cannot use their budget to fund projects that extend beyond their administrative borders, and no legal provision or ministerial guidelines indicate how local governments can establish intra-regional co-operation (Ratanawaraha, 2010). Significant co-operation initiatives between the city of Bangkok and the other five provinces must first be approved by the national government. This lack of metropolitan co-operation may significantly compromise the BMR's potential for green growth.

Table 1.2. **The local administrative system in the Bangkok Metropolitan Region**

	City of Bangkok	Nakhon Pathom Province	Nonthaburi Province	Pathum Thani Province	Samut Prakan Province	Samut Sakhon Province
Registered population (2013)	5 686 252	882 184	1 156 271	1 053 158	1 241 610	519 457
Number of districts *amphoe/khet*)	50	7	6	7	6	3
Number of sub-districts (*tambon/khwaeng*)	169	105	52	60	50	40
Number of municipalities	1	19	17	27	18	12
– Cities (*thetsaban nakhon)*	1	1 (Nakhon Pathom)	2 (Nonthaburi and Pak Kret)	1 (Rangsit)	1 (Samut Prakan)	2 (Samut Sakhon, Om Noi)
– Towns *(thetsaban mueang*)	–	4	4	9	4	1
– Sub-district municipality (*thetsaban tambon*)	–	18	11	17	13	9

Source: Department of Local Administration, www.dla.go.th/en/s2.jsp (last accessed 16 January 2015).

Notes

1. For details, please see OECD (2012a).
2. All numbers converted in USD in this paragraph are calculated using the 2012 purchasing power parity conversion factor for GDP between USD and THB, http://data.worldbank.org/indicator/PA.NUS.PPP (last accessed 30 January 2015).
3. All references and figures related to the Bangkok Urban Region in this section exclude the BMR's province of Nakhon Pathom.
4. These figures are based on the BMA's definition of a slum settlement: an overcrowded, dilapidated and densely built community, with a minimum of 15 housing units per 1 600 m² (Archer, 2012).
5. The population data for the OECD cities here are based on the population data from *LandScan Global Population Database* 2009.
6. This is, however, not true for all member countries of the EU. The percentage of cars using alternative fuels was 12% in Poland, 7% in Italy and 4% in the Netherlands, for instance. Data are available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Passenger_cars_in_the_EU (last accessed 17 January 2015).
7. All the data apply to the metropolitan areas.
8. The data (2009) for Chicago correspond to the Chicago CMAP region (7 counties); the data for Paris correspond to the Île-de-France region; the data for Kitakyushu (2007) and Stockholm (2009) correspond to the cities.
9. Data for petroleum, coal and natural gas exclude their respective contribution to electricity consumption. Data do indicate that fossil fuels contribute to 80% (11 701 ktoe) of electricity consumption (14 626 ktoe), but do not provide a breakdown by type of fossil fuel.
10. http://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics (last accessed 7 April 2015).
11. These authorities tend to cover an area larger than the city of Bangkok but smaller than the BMR. The MEA, for instance, covers the city of Bangkok and the provinces of Nonthaburi and Samut Prakan, but does not cover the provinces of Samut Sakhon and Nakhon Pathom.
12. All numbers in USD in this paragraph were converted using the PPP conversion factor for Thailand in 2013.

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Chapter 2.

The Bangkok Metropolitan Region's opportunities for urban green growth

Chapter 2 reviews current policies in the Bangkok Metropolitan Region (BMR) in the following six areas: energy, land use and transport, housing and buildings, water resource management, solid waste management, and green manufacturing and research and development (R&D). The analysis focuses on the following:

1) Current policies in each area. This will give more precise information on the actions taken by various authorities and the policy instruments and tools used to reach goals in each of these areas. It helps to identify gaps between existing opportunities and policy responses.

2) Policy outcomes. Where data were available, the impact of each policy is analysed to assess its effectiveness and to identify options for improvement.

3) Policy synergies and complementarities. To strengthen the impact of urban green growth policies, it is important to assess the extent to which the BMR has integrated areas of opportunity into coherent and effective policy packages.

The results call for several urgent policy actions.

Main points

- The single most important step that the Bangkok Metropolitan Region (BMR) could take is to realise its full green growth potential by introducing more effective land-use and transport policies. **The Bangkok Metropolitan Administration (BMA) and other five surrounding provinces of the BMR need to co-ordinate their land-use decisions to avoid "leapfrog" development and to create a more compact, energy-efficient, healthier and more liveable city**. In suburban areas, investment needs to be concentrated in mixed-use "hubs" along transit corridors and the Bangkok mass transit system (BTS) Skytrain and metropolitan rapid transit (MRT) stations. Downtown, the BMA needs to implement effective policy instruments to redevelop the urban cores and fill in brownfields. Accelerating investment in public transport is the backbone of all urban green growth strategies. However, given the demand for travel and the increasing dependency on automobiles, a multidimensional approach and policy alignment across governments are crucial.

- The proportion of renewable energy (RE) sources should be rapidly and aggressively developed in Thailand and the BMR as an integral part of its future energy mix. A number of specific RE technologies show particular potential for development. Meanwhile, **the Thai government should continue to roll back fossil fuel subsidies** and gradually increase the carbon tax on transport fuels and electricity, in proportion to their relative carbon intensity, to reflect their real cost to society. This step alone would make the price of renewable energy sources competitive with fossil fuels. The other main aspect of the energy sector dilemma is **energy efficiency (EE). In the industrial, transport, building and housing sectors**, numerous well-known and proven technologies can be used, with targeted policies, upgraded standards, price signals and regulations tied to sanctions could help create the necessary incentives and disincentives to make important improvements in EE.

- The BMR needs to continue to invest in its wastewater treatment system. Its capacity is in urgent need of expansion, and **service fee structures should be put on a solid financial foundation, so that the adequate revenue is raised**. Solid waste management is yet another untapped area of "green" potential for the BMR. Introducing **waste-to-energy plants** is a good option and should be accelerated and scaled up. Recycling and composting has great potential, but **improving waste source-separation is critical**. Community-based solid waste management should be accelerated at the district level in the city of Bangkok and within the other five provinces of the BMR.

- Policies to **promote the inclusion of residents living in urban slums** and to improve the quality of their housing and access to public services should be accelerated. Developers should be given more incentives to provide housing for low-income communities.

- As a major site of manufacturing, the BMR needs to make the manufacturing process greener and promote more green services and products. A green label programme introduced by the national government for consumer and industrial products has been awarded to over 500 products. **The green label programme should be linked with public green procurement programmes (at both the central and local level), which could impose compulsory environmental specifications for such goods and services**. Public procurement procedures could also be designed to grant extra points for green solutions, thus making it more likely that they are selected. Increasing public awareness of these services and products is also essential.

A metropolis oriented toward mass transit rather than automobiles

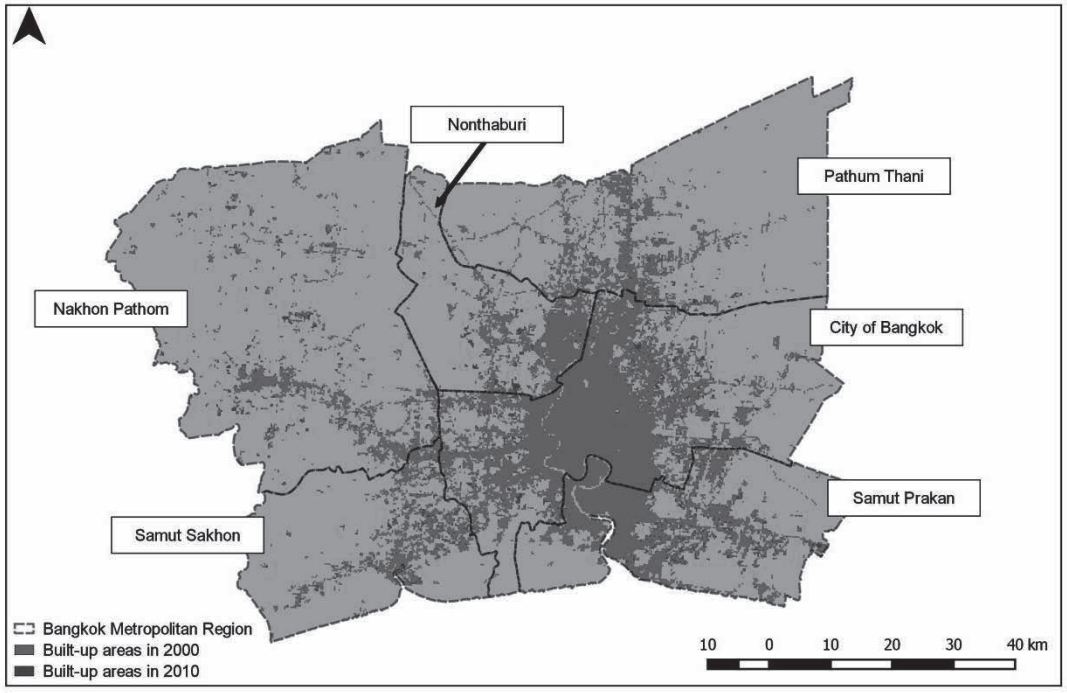
Avoiding urban sprawl and promoting a transit-centred spatial structure

Bangkok was once a small city located on the eastern bank of the Chao Phraya River. It has grown into a megacity of more than 14 million people, covering 7 700 square kilometres (km²). Growth was originally towards the north, and then shifted to the east. Since the early 1970s, there has been an extensive construction programme of bridges and roads that has accelerated urban development on the western side of the Chao Phraya River. The relocation of industrial facilities from the city of Bangkok to the surrounding areas in the 1980s contributed to even more suburbanisation. Appproximately 170 km², or nearly 3% of the total land in the BMR, turned into built-up areas between 2000 and 2010. The built-up areas in 2010 covered 1 876 km², accounting for a fourth of the total land in the BMR, and are still expanding in all directions (Figure 2.1).

While suburban development was important to accommodate the growing demand for housing and businesses, land use within the BMR is not optimal. The main challenges of Bangkok's spatial land use are continuing suburban expansion and the loss of agricultural land and forests (see Chapter 1), both of which may impede Bangkok's long-term economic competitiveness and environmental sustainability. The BMR is now falling into a pattern of dependency on private cars, which is environmentally harmful and not socially equitable. The use of private cars is skyrocketing (see Figure 1.8 in Chapter 1), and investments in mass transit have not increased the daily share of commuter trips in the BMR (see Figure 1.10 in Chapter 1). The result is a car-dependent society with higher CO_2 emissions and the ensuing consequences on healthcare (estimated at nearly 25 000 premature deaths and healthcare costs of USD 27 billion in 2010; see Chapter 1). Although the BMA Action Plan on Global Warming Mitigation (2007-2012), one of the first attempts in Thailand to tackle climate change at the city level, succeeded in reducing the city's carbon dioxide (CO_2) emissions by 14% below its business-as-usual (BAU) projections (around 42 million tonnes instead of 48.69 million tonnes of CO_2 equivalent in 2012), total CO_2 emissions actually increased in absolute terms. While the Action Plan contained five initiatives (expand mass transit and improve the traffic system; promote the use of renewable energy; improve building electricity consumption efficiency; improve solid waste management and wastewater treatment efficiency; and expand park areas), mass transit was the only one of the five listed in the 2007-2012 BMA Action Plan that fell short of its target, reaching only 20% of projected CO_2 reductions (see Table 2.1). This was due to a great extent to delays in public transit investments. Implementing more effective land-use and transport policies would be the single most important step the BMR could take to realise its full green growth potential.

Figure 2.1. **Urban expansion in the Bangkok Metropolitan Region**

2000-10



Sources: OECD, based on Mertes, C.M. et al. (2015), "Detecting change in urban areas at continental scales with MODIS data", *Remote Sensing of Environment*, Vol. 158, pp. 331-347, http://dx.doi.org/10.1016/j.rse.2014.09.023; and Schneider, A. et al. (2015), "A new urban landscape in east-Southeast Asia, 2000-2010", *Environmental Research Letters*, Vol. 10, No. 3, http://dx.doi.org/10.1088/1748-9326/10/3/034002.

Table 2.1. **Targeted and actual reduction of CO_2 emissions through the Bangkok Metropolitan Administration Action Plan on Global Warming Mitigation**

2007-12

Initiative	Action Plan	Target reduction of CO_2 in 2012 (million tonnes)	Total amount of CO_2 reduction (million tonnes)
1. Expand mass transit and improve the traffic system	1. Expand the mass transit rail system within the Bangkok Metropolitan Area 2. Improve the public bus system 3. Improve the traffic system	5.53	1.01
2. Promote the use of renewable energy	1. Promote the use of biofuels	0.61	0.88
3. Improve building electricity consumption efficiency	1. Improve building energy consumption efficiency 2. Electricity conservation campaign	2.25	2.70
4. Improve solid waste management and wastewater treatment efficiency	1. Increase efficiency in solid waste management 2. Increase efficiency in wastewater treatment	0.46	0.70
5. Expand park area	1. Plant trees in the Bangkok Metropolitan Area 2. Plant trees in the neighbouring provinces	0.90	1.69
Total		9.75 (20% below business as usual)	6.98 (14.3% below business as usual)

Source: BMA (2013a), "Low-carbon society development in Bangkok", Bangkok Metropolitan Administration, Bangkok.

Urban layout: Creating suburban mixed-use hubs served by arterial roads and public transport, and redeveloping existing urban centres

Transforming the BMR from a car-oriented to a transit-oriented metropolis is indispensable, but it will be a long-term, incremental and often costly process.

Much can be done to improve the supply of public transport, but the city's layout poses a challenge. The BMR has a good network of freeways, but is sorely lacking in arterial (secondary) roads that can link its major districts, providing corridors for public transport (see Figure 1.11 in Chapter 1). It is hard to design bus routes in Bangkok that leave passengers within a reasonably short walk of their destinations. Few through roads cut through the heart of the city, and most streets are very narrow (Angel, 2011). This is the result not of poor planning but of Bangkok's history of private land development. Landowners in previous centuries built private roads to access their properties; through roads would have attracted traffic, with all the nuisance this implied. These rational private choices produced a collectively irrational urban layout: Bangkok's congestion owes much to its labyrinthine road network. In addition, bridges over the canals (*klongs*) are too few in number to handle the demands of increasing traffic, and congestion is far worse than in many denser cities.

Bangkok's best option for reducing congestion and developing an urban space better suited to public transport would probably be to expand its underdeveloped arterial roadway system. However, in some central districts, high property values could make the cost of securing the necessary rights of way prohibitively expensive (Angel et al., 2005). One advantage of Bangkok's scattered development is that suburban areas offer many opportunities to develop arterial roads at reasonable cost. One solution would be to develop multiple mixed-use "hubs" around future public transport extensions in the five provinces surrounding downtown Bangkok and encourage commercial and employment growth and affordable housing opportunities there. In more central areas, a strategy that would circumvent the problem would be to build up, on elevated BTS lines, or down, by building a subway. These options would in most places be more expensive than surface-level alternatives, but might be relatively less costly and disruptive given that the alternative involves acquiring and redeveloping the most expensive real estate and congested roadways in the country. Underutilised land and brownfields need to be redeveloped and linked with BTS and MRT stations to increase efficiency.

The 2013 Bangkok and Vicinities Development Structure Plan, which was prepared by the Ministry of the Interior's Department of Town and Country Planning in 2007, defines land-use, open space and transport strategies at the metropolitan scale. Its aim was to harmonise policies between the six provinces of the BMR, including the city of Bangkok, through measures such as: 1) specific locations for industries; 2) environmental conservation areas that also serve as floodways in case of high water discharges from the north; 3) wetland conservation areas to protect coastal zones; and 4) extension of the mass transit network. This BMR-wide spatial plan could be revisited from the perspective of green growth, engaging all the provincial and municipal governments in the BMR.

Decisions on land use should be co-ordinated across the Bangkok Metropolitan Region and across sectors

A major problem is that land-use decisions are often poorly co-ordinated across jurisdictional boundaries, contributing to leapfrog development in places where no measures are in place to protect farmland. Land-use controls to protect forests and

agricultural lands from urban development and to guide development along transit corridors are generally weak. Bulk controls for urban development, such as floor area ratios (FAR) and minimum open space ratios (OSR) were not used until 2006, and are only now being introduced in the BMA. Even with bulk controls, the FAR in the city's agricultural zones is as high as 1.5, while actual densities there range from 0.005 to 0.8 (Ratanawahara, 2010), allowing developers to legally build large-scale residential and commercial buildings in agricultural areas. As a consequence, large-scale urban development (commercial, industrial and residential) projects have been located in places with no connections to mass transit systems and with inadequate provision for preserving agricultural and forested areas.

To minimise the negative externalities of urban sprawl and create a more compact, energy-efficient, healthier and liveable city, the BMA and other provincial governments in the BMR should work together to make a BMR-wide land-use plan and make their own land-use decisions consistent with the plan. This is especially true for land prone to floods and land serving as natural drainage habitats. The first step could be to set up a committee of relevant governmental bodies in the BMR to prepare a region-wide spatial land-use master plan consistent with the National Economic and Social Development Plan (2014-2018) (see Chapter 4).

Co-ordination between urban and rural development policies is also crucial. In rapidly urbanising suburbs, valuable agricultural and forestry areas are at risk of urban development. Urban agriculture and forestry at strategic locations in the BMR should be promoted, recognising that they will ensure the BMR's long-term urban attractiveness and create job opportunities. In addition to restricting the use of rural and agricultural land for urban development, strategies to promote economically attractive alternative uses for rural/agricultural land can help reduce urban sprawl. Portland, Oregon, in the United States, has protected farmland and the natural environment surrounding the urban cores for their intrinsic value, which helped meet urban sustainability objectives (OECD, 2012). The Paris metropolitan area (Île-de-France), France's most populated region, still has 51% agricultural and 24% forested land, virtually the same shares of land use as the national average, and its master plan (*Schéma Directeur de la Région Île-de-France*) aims to retain that character by pursuing a polycentric urban structure (OECD, 2012).

Guiding urban development along transit corridors and BTS Skytrain and MRT stations

Not enough policies and programmes are in place to guide urban development along transit corridors. In the current land-use control framework of the city of Bangkok, an FAR Bonus System is applied for several types of urban development. However, no effective initiatives are in place to promote redevelopment or transit-oriented development (Box 2.1). The BMA could consider more active use of these incentives. Similar incentives could also be offered to developers who contribute to urban resilience, for example, to those creating green open spaces and rainwater storage capacity on site.

Box 2.1. **Land-use controls in the Bangkok Comprehensive Plan 2013**

The 2013 Bangkok Comprehensive Plan is the latest spatial development plan for the city of Bangkok, composed of a Land-Use Plan, an Open Space Plan, an Infrastructure Plan and a Transportation Plan. The Land-Use Plan, in particular, is the main instrument to control land use, and includes the following measures:

- Permitted, prohibited and conditional uses, as defined in the plan. Prohibited uses prohibit activities considered to have common functional or nuisance characteristics, such as factories that create environmental problems. This was put in place in the past to relocate petrochemical industries out of the city of Bangkok.
- Density control through definition of the maximum floor area ratio (FAR) and minimum open space ratio (OSR). The OSR system aims to specify the extent of open space required according to the floor area of buildings. This regulation is also defined by the biotope area factor (BAF), which cannot be less than 50% of the OSR. This factor aims to mitigate storm drainage and climate change problems.
- FAR Bonus System. In addition to classic FAR tools, five types of FAR bonuses were introduced to conduct projects for public benefit in the city of Bangkok:
  1. Incentive to provide housing for low-income communities. Developers can get a FAR Bonus if they provide adequate and standardised housing to low-income communities. It can apply to existing low-income developments or for new residents. The extra FAR is no more than four times the floor area provided for low-income communities, and no more than 20% of the restricted FAR.
  2. Incentive to provide green open space. Developers can get the FAR Bonus if they provide public open space in front of their buildings. This measure is restricted to the high-density residential zones (R.8-R.10) and the commercial zones (C.2-C.5) as defined by the 2013 Comprehensive Plan. The extra FAR is no more than five times the area of the open space provided and no more than 20% of the restricted FAR.
  3. Incentive to provide natural green open space and rainwater storage. The FAR Bonus can be obtained if developers provide rainwater storage. If the capacity of the rainwater storage is not less than $1m^3$ per 50 m^2 of the project area, the extra FAR will be 5%. The extra FAR can be increased proportionally up to 20% of the restricted FAR, if the capacity is more than $1m^3$ per 50 m^2 of the area.
  4. Incentive to provide parking space in public buildings. This measure supports the plan's objective to develop and promote an efficient mass transit system and comprehensive transportation networks. It is restricted to public buildings located in the suburban areas and can be used at the park-and-ride stations. If public-building developers, in accordance with building control regulations, decide to provide public parking space, they obtain the FAR Bonus. The extra FAR is not more than 30 m^3 for each additional parking lot and not more than 20% of the restricted FAR.
  5. Incentive to provide green building construction. If project developers decide to follow the green building construction concept, which is approved by the Thai Green Building Institute (TGBI) and defined by the regulation to encourage energy conservation, then they will obtain the FAR Bonus according to the level: 1) certified; 2) silver; 3) gold; or 4) platinum. The extra FAR can be no more than 5%, 10%, 15% and 20% of restricted FAR, respectively.
- Control of building heights and sizes. This measure aims to preserve the urban visual landscape. In the coastal areas of Bangkok, the height of buildings is limited to 12 metres, and large commercial, residential, business and marketplace buildings are prohibited. This preserves the stability of land, which is already weak due to coastal erosion.
- Setback along the canals and main roads. This measure aims to avoid human settlements along the edges of canals, as they are risk-prone and sensitive areas. The setback leaves some space for flood protection and drainage infrastructure (e.g. water gates, drainage tunnels, etc.). Along main roads, this measure requires a 15-metre setback of open space on each side of the street, including 2 metres of vegetation.

Under this framework, the building permission system ensures that urban development conforms to the Comprehensive Plan. There is no detailed development plan framework to guide urban development at the district scale.

Source: BMA (2013b), *Bangkok Comprehensive Plan 2013*, City Planning Department, Bangkok Metropolitan Administration, Bangkok.

In addition, urban development guidelines for pedestrian and public spaces near stations must be developed. These would promote public and private investment for pedestrian-based mixed housing, shopping and employment land-use planning. Part of the BMR's congestion problem can be attributed to the chaos on sidewalks and streets involving pedestrians and vendors. Similar lessons have been learnt elsewhere. In Bogotá (Colombia), limited planning for the optimal location of station areas for the Transmilenio bus rapid transit (BRT) system, and a lack of incentives for private property owners to redevelop land around stations and along corridors have hindered its effects on urban development. For cost-reduction reasons, stations were located in the medians of busy roadways, often with poor pedestrian access and in economically depressed and marginalised urban areas with minimal development potential. In Ahmedabad (India), land-use planning around stations was not sufficiently taken into account as part of the planning process of the Janmarg BRT system. This has resulted in low pedestrian accessibility to BRT stops and has limited ridership and land-use changes around stations (Cervero and Dai, 2014).

The BMA should also speed up the preparation of station area plans for the BTS Skytrain and MRT stations, in which connectivity between the station and the streets and surrounding buildings, as well as investment in public space, are specified. "Sky walkways" connect the BTS Skytrain and MRT stations with shopping centres and major office buildings without the need to descend to street level, allowing people to walk farther, in a safe area away from cars and traffic. Property owners and the private sector should participate in the planning process of each station area. Mass transit operators would eventually benefit if dynamic incentives, such as higher FAR, were offered near transit corridors, with development guidelines for the private sector to ensure a pedestrian-based environment. Stockholm's inner-city transit-oriented development, along with "Horseshoe" light-rail transit, with detailed development plans around the stations, has attracted private investment in brownfields (OECD, 2013a). Public investment in mass transit contributes to higher redeveloped land prices. The co-ordination between the national and local governments plays a critical role in the BMR, as the BMA and surrounding provincial governments are responsible for land-use planning, whereas public transport planning is primarily the responsibility of the Ministry of Transport (MOT).[1]

Details of the land-use regulatory framework need to be revisited to improve implementation. The scale of the maps of the Bangkok Comprehensive Plan is too small, particularly in terms of defining zoning systems. As a result, the geographical boundaries between zones are not accurate enough to efficiently enforce the regulations. The zoning areas are also too large and do not accurately reflect the existing local diversity of communities and neighbourhoods (Ratanawahara, 2010). Local authorities may therefore need to develop more accurate zoning maps to allow for effective enforcement of land-use regulations. Furthermore, producing an accurate cadastre of land and properties should be accelerated.

Redeveloping downtown Bangkok

The city of Bangkok reached its peak population in 2003 and is now in decline, as congestion, pollution, high housing prices and other urban externalities drive people out of the city. The density of urban centres (the peak density) in the city is not as high as in many other Asian cities, implying that the most expensive urban land is not being efficiently used. The urban centre has many underutilised areas, for example under or alongside public transport corridors like the Airport Link. Such underutilised areas are

often occupied by squatters, who later block development or block access to the land, and reduce the overall efficiency and attractiveness of the urban core.

In the current land-use control framework, no effective initiatives are currently being taken to promote redevelopment (Box 2.1). The BMA could consider providing developers with more dynamic FAR and OSR incentives for redevelopment. Another option to promote redevelopment is to develop a land registry and buildable land inventory in the city of Bangkok and to set targets to promote redevelopment of developed or underused land in the urban cores. Portland provides good examples (Box 2.2).

Box 2.2. **Portland's Buildable Lands Inventory and "refill rate" as monitoring tools for brownfield development**

Portland Metro is required by state law to review the capacity of the Urban Growth Boundary (UGB) every five years to ensure a 20-year land supply. Metro, its metropolitan government, has developed the Buildable Lands Inventory, a detailed and sophisticated land-monitoring process to inventory vacant land and track the "refill rate". This is defined as the rate at which new development occurs through "infill" (when more units are constructed on an already developed lot) or "redevelopment" (when a structure is removed and another built in its place).

In 2009, Metro found that the refill rate for new industrial development was 20%. For non-industrial use, 52% of new capacity was built on developed land (Metro, 2009). The residential refill rate has climbed steadily, from 30.4% in the period 1997-2001 to 33% in 2001-06 (Metro, 2009). Metro predicts the rate will rise to 38% from 2010 to 2030 (Metro, 2010). If it does, the urban growth boundary will be able to accommodate 11 300 additional dwellings without expanding. Refill rates are highest in the central city and lowest in suburban residential neighbourhoods. Most residential refill is multifamily housing, often as part of transit-oriented development (TOD). Portland prioritises transport projects that support refill and investment in TODs to achieve higher density and a greater mix of uses than prevailing market conditions would support in terms of developers' construction costs and income from rent or sale (Metro, 2011).

Source: OECD (2012), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en.

Renowned as the "Venice of the East", Bangkok should not underestimate the potential of canals as a commuting option and asset for tourism. Strategic use of canals for intra-city transport, including linking them to the mass transit system, could attract local commuters, as well as tourists. Several canals are used for passenger traffic, including the ones along the Chao Phraya River. Unfortunately, with rapid urbanisation, many canals were filled in in recent decades to create roads, and those that remain suffer from severe water pollution. Improving the water quality of canals and increasing the convenience of canal transport would increase transport options for workers as well as tourists.

Bangkok should also continue expanding the current bicycle-sharing experimental programme (Pun-Pun). This can help reduce traffic congestion in the central business district and provide an alternative to driving or taking taxicabs for short trips. The BMA recently announced plans to extend the system from 500 to 10 000 bicycles and to connect it to the BTS, MRT and Airport Rail Link stations. Bicycles may also be useful in the old towns that neither BTS nor MRT serve, although this would require improving the roads for cyclists and pedestrians.

Accelerating investment in public transport

Accelerating investment in public transport is the backbone of all the urban green growth strategies in the BMR, considering the increased travel demand and automobile dependency. In 2011, more than 18.5 million trips were made per day in the BMR, including 42.6% by public transport (Office of Transport and Traffic Policy and Planning, 2013). There are extensive bus networks in the BMR, carrying more than 10.4 million passengers a day in 2011, operated by the Bangkok Metropolitan Transit Authority (BMTA), and accounting for 89% of passengers on public transport in 2011. The city of Bangkok also has a mass transit network that now includes a 25.3-kilometre elevated rail network (BTS SkyTrain), a 21-kilometre underground train network (MRT) and a 18.5-kilometre Airport Rail Link (ARL) between the downtown area and Suvarnabhumi Airport. Multiple extensions are planned and under construction on all three systems. The number of rail passengers has steadily increased since its opening. According to the BMA, among commuters using public transport in the city of Bangkok in 2013, 40% now use the rail system, while 46% take buses and 14% ride on boats on canals (*klongs*) or rivers.

Despite the creation of these systems, investments in mass transit have not increased the share of commuter trips per day. The Bangkok BTS and MRT systems are primarily used by those who used to commute by bus and not by those using private cars and motorcycles: the number of bus riders dropped significantly, from around 4 million a day in the 1990s to around 1 million per day after the opening of the BTS Skytrain (Supatn, 2011). It is thus crucial to implement the government's current plan to build several new lines and extensions of existing lines, adding 350 kilometres to the network over the next two decades. National and local governments have been very astute in using public-private parnterships (PPPs) and other leveraged financing mechanisms to mobilise private resources for these investments. Inter-modal linkages to local bus lines and taxi services are needed to get people to and from their homes quickly and efficiently once they leave the BTS or MRT systems.

The BMR's bus system needs careful scrutiny so that it can become a more viable element of the public transit system. Its services suffer from traffic congestion, and the vehicles are typically old and not very comfortable. Modernising the vehicle fleet may also be a good way to attract more passengers. Increasing the connectivity to the MRT and BTS by improving the feeder bus services would also help. A bus rapid transit (BRT) project giving priority to public buses serving one route between Ratchapruk and Sathon is being piloted, somewhat unsuccessfully. Drivers of private vehicles complain that providing a priority lane for buses deprives private cars of a lane. Public resistance is understandable, given the lack of awareness about the necessity and benefits of shifting away from private vehicles toward public transit during commuting hours. Winning acceptance of such measures by private motorists will not be easy, but BMA officials need to demonstrate to motorists and residents the advantages of the BRT system.

Multidimensional, well-aligned policies towards sustainable transport

If sustainable transport policies are to be effective, a multidimensional approach is called for. For example, major investment in public transport is under way, but the BMR has used few policy instruments to discourage the use of private cars. As a world-class tourist destination, Bangkok could drastically limit the use of private cars in downtown areas. Jakarta is taking progressive steps to limit motorbike traffic in the main streets downtown. In 2012, Indonesia's Office of Transport and Traffic Policy and Planning,

Ministry of Transport, conducted a study to develop a master plan for an environmentally sustainable transport system, and to mitigate the impact of transport activity on climate change. It suggested that the ministry develop six strategies, including a standard for travel demand management, designated zones with restrictions on the use of private vehicles that emit pollution, market-based measures to reduce greenhouse gas (GHG) emissions in the transport sector, R&D and adoption of environmentally friendly innovations and technologies, and a public awareness campaign on eco-friendly driving. A multidimensional approach of this kind could be promoted by the BMR.

Aligning policies at different levels of government is also crucial. For example, the Thai government should consider abandoning fiscal incentives for car ownership and use the saved budget to promote public transport. Minimum parking space requirements in new developments, which are common in Bangkok, are another example of policy incoherence that should be readjusted. Many employers allow employees to commute by car and park their cars at work for a minimal fee, confounding the attempt to promote public transport. All such policy measures working at cross-purposes with public transport need to be examined at different levels of governments so that they conform with urban green growth objectives.

Overall, all land-use and transport policies need to be coherent and complementary to avoid locking in development into infrastructure that promotes the use of private cars, which is environmentally harmful and less socially equitable.

Exploring untapped renewable energy potential while managing energy demand

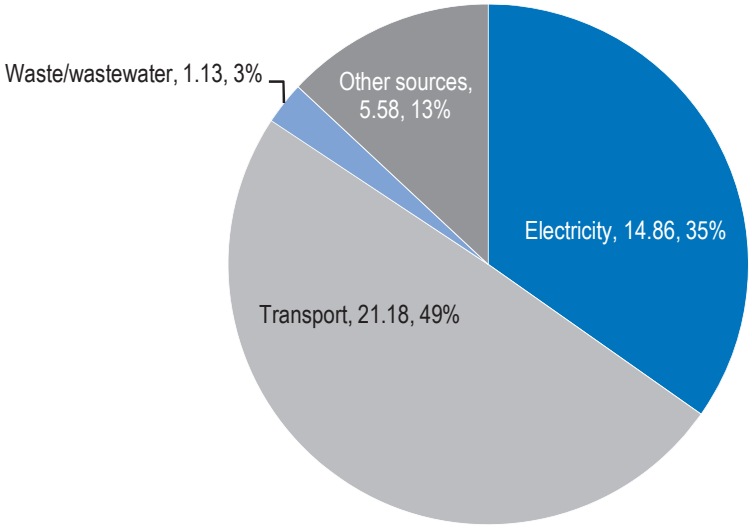
More renewable energy options should be pursued

Renewable energy (RE) options have great potential in Thailand. Their exponential growth worldwide over the past decade has been nothing short of stunning. In 2000, it was predicted that wind power would only generate 30 gigawatts (GW) by 2010; in fact, it accounted for over 200 GW in that year, and has now reached nearly 400 GW, continuing to accelerate rapidly. Rooftop solar panels were expected to reach 1 GW by 2010; they exceeded that seventeen-fold, and now stand at nearly 50 times that amount of electricity generated (New York Times, 2015). Concentrated solar power (CSP) plants, which have the advantage of being able to store energy for several hours when there is no sunlight, have also seen explosive growth in the past ten years. Global installed CSP capacity has increased nearly tenfold since 2004 and grew at an average rate of 50% per year over the last five years. In 2013 alone, worldwide installed capacity increased by 36%, or nearly 1 GW, to more than 3.4 GW. The number of countries with installed CSP is growing, notably in developing countries in tropical or desert regions with high solar radiation, something that Thailand enjoys (REN21, 2014). Renewable energy development also creates jobs, primarily in sales, finance, operations and engineering.

The city of Bangkok has full access to electricity for residential, commercial and industrial use at a relatively low cost. Indeed, the cost may be too low in environmental terms, as the energy sector is a major source of GHG emissions. In the city of Bangkok, the power sector was responsible for 34% of GHG emissions (Figure 2.2), mainly because the Thai electricity mix is dominated by fossil fuels, and in particular natural gas. RE options only accounted for 11% of the country's total energy consumption in 2013.

Figure 2.2. **Greenhouse gas emissions by sector, city of Bangkok (2007)**

CO_2 equivalent, million tonnes/year



Source: BMA (2008), "The BMA Action Plan on Global Warming Mitigation 2007-2012", Bangkok Metropolitan Administration, Bangkok.

The Thai government has introduced a number of incentives to encourage investment in renewable energy through capital grants for renewable energy equipment, such as solar thermal systems, biogas installations and municipal solid waste (MSW) energy projects. Since 2004, it has offered tax exemptions for the import of renewable energy equipment. It also introduced a feed-in tariff in 2007 (IISD, 2013). In its 15-year Alternative Energy Development Plan (2008-2022), the Thai government aims to increase the share of renewable energy in final consumption to 25% by 2021, estimating that achieving these targets would: 1) obviate the need for more than USD 19 billion in energy imports annually; 2) encourage around USD 15 billion in private investment; 3) avoid 76 million tonnes of GHG emissions per year; 4) create at least 40 000 new jobs; and 5) generate extra income and employment in rural areas. In Thailand, most renewable energy projects, such as biomass power plants, are located in rural areas,[2] and must be tied into the electric transmission system via feed-in tariff agreements. The challenge for the BMR is therefore to identify effective renewable energy options to reduce GHG emissions, and at the same time to stimulate the local economy through the energy sector, with an overall goal of achieving urban low-carbon development. Energy production and distribution is the responsibility of the Thai government, and co-ordination among national and local governments is needed to provide renewable energy to urban areas.[3] The Electricity Generating Authority of Thailand (EGAT) can play the role of intermediary.

A number of specific RE technologies show particular promise for development in the BMR. Much potential is still untapped in the solar sector. Rooftop solar panels or water heaters for residences, commercial buildings and factories have not been actively promoted yet, given the low rates charged for electricity, but solar power plants are increasingly being developed in suburban areas of the BMR by private firms. The BMA could take the lead by creating a forum, such as an *ad hoc* committee, to discuss options and develop an action plan among key stakeholders. Private sector participation will be

important in its success. The BMR can draw upon practices from Barcelona and other Spanish cities that have demonstrated the potential of solar thermal technologies in urban areas. By making it compulsory as of 2000 to use solar energy to supply 60% of running hot water in new and renovated buildings, Barcelona saved 11 222 megawatt hours (MWh) of energy and 1 973 tonnes of CO_2 per year in 2011. The energy saving is reaching 1% of the estimated hot water energy needs of 1 329 815 MWh, or 28% of the residential energy needs. It is also estimated that approximately 1 500 to 1 600 jobs were created in Barcelona through the installation of solar thermal collectors (ICLEI, 2014).

Biomass and biofuels also show potential in the BMR. While large-scale biomass power plants tend to locate in rural regions in Thailand, promoting smaller power plants to provide electricity to factories and large-scale residential or commercial complexes in the BMR may complement electricity provision based on fossil fuels. Such power plants could also generate heat that can be used for hot water in the BMR's urban centres. Promoting biofuels and biodiesels may also benefit the BMR. In addition to the reduction of CO_2 emissions, the use of biofuels and biodiesel can reduce air pollution. Under the BMA Action Plan on Global Warming Mitigation (2007-2012), the BMA achieved a reduction of 0.88 million tonnes of CO_2 in the period 2007-12 (Table 2.1). While biofuel policy is under the jurisdiction of the Thai government, the BMA and other provinces in the BMR could collaborate with relevant ministries to further facilitate the production and use of biofuels. For example, the BMA could use its authority to introduce a tax on gasoline to increase the price competitiveness of biofuels.

Offshore wind turbines are another viable alternative for providing power for Bangkok. There are good wind areas along the eastern coastline of the Gulf of Thailand (from Nakhon Srithammarat through Songhkla and Pattani provinces, and also Phetchaburi, Prachuabkirikhan, Chumphon and Suratthani provinces; Department of Energy Development and Promotion, 2001). Proximity of production to end-use and exploitation of new wind energy materials and turbine technology are important factors in keeping costs per unit of energy consumed (kwh) reasonable. One example of using the strategic location of a city is offered by the Chicago Tri-State metropolitan area, which has favourable conditions for wind power exploitation. Investment incentives encouraging greener wind-turbine manufacturing and component suppliers helped the region to shift from car manufacturing to the green wind-energy industry. In addition to investment incentives, the governance environment helped to attract the headquarters of a large number of global wind-energy companies (OECD, 2012).

Managing increasing energy demand by promoting more energy-efficient equipment/appliances

Demand-side energy policies are equally important for reducing carbon emissions. They can be highly cost-effective by comparison with the cost of building new capacity or supply to meet the ever-increasing demand for energy. As air conditioning and refrigeration (since both are needed on a 24-hour basis) account for a substantial part of energy consumption in a hot climate, promoting or subsidising the purchase of more energy-efficient appliances and raising performance standards gradually could both be effective demand-side management strategies. This could be combined with public education programmes or materials describing why it is important to conserve energy, explaining the long-term financial benefits of lower energy bills. Since 2007, Thailand has instituted mandatory and voluntary minimum energy performance standards (MEPS) as well as voluntary high energy performance standards (HEPS) (IEA, 2013). These

standards should be regularly revised. The Label Number Five, a nation-wide energy efficiency labelling system for electric appliances certified by the Electricity Generating Authority of Thailand (EGAT), should be linked to green building standards and public procurement policies specifying its use, at the national and local levels of government in the BMR.

Aligning central and local government policies is also crucial. Street lights in the city of Bangkok, for example, offer an opportunity to reduce electricity consumption. At present, the Metropolitan Electricity Authority (MEA) does not charge the BMA for electricity used in public spaces such as streets and parks. The maintenance of street lights and the lighting system in public parks is the responsibility of the BMA, which has no incentive to replace light bulbs with, for example, LED lights of higher energy efficiency. The MEA and BMA should work together to initiate a programme to replace old light bulbs. The Energy Conservation (ENCON) Fund, established in 1992, and the Energy Service Company (ESCO) Fund, established in 2008, could be used to finance such a programme. These funds could also be used to promote urban-related renewable energy projects, including energy-related research and development, human resources development and training, as well as public awareness campaigns about energy efficiency.

Industrial factories in Thailand with energy capacity over 1 000 kilowatts (kW), or with annual consumption exceeding 20 terajoules (TJ), are required to implement energy management programmes and to make progress reports available for external auditing (IEA, 2013). The policy targets could be expanded to smaller scale factories. It would be worth exploring whether regulatory schemes of this kind could be combined with financial support. The central government of Thailand offers a direct subsidy of 20% of EE measures for designated buildings and factories; 30% of EE measures for non-designated buildings and factories up to a maximum of THB 3 million, with a payback period equal to or less than seven years.

Pricing the real cost of energy more accurately

The Thai government has introduced a number of incentives to encourage investment in renewable energy through capital grants for renewable energy equipment, such as solar thermal systems, biogas installations and municipal solid waste (MSW) energy projects. In addition, it introduced a feed-in tariff in 2007, and since 2004 has offered tax exemptions for the import of renewable energy equipment (IISD, 2013). Nonetheless, fossil fuel subsidies are still in place. In 2013, they amounted to USD 3.6 billion, or 0.9% of Thai gross domestic product (GDP) (IEA, n.d.), even though the government recently reduced the amounts.[4] While developing RE sources, the Thai government should continue to remove such subsidies and take steps to put a real price on the carbon content of different fuels and energy sources, so that renewable energy can be put on an equal footing with fossil fuels. Prices for renewable energy sources, such as wind and solar energy, have fallen significantly and more quickly than expected. They are thus already becoming competitive with fossil fuels, even without taking the negative externalities and costs of fossil fuels into consideration.

Advances in materials technologies have driven down the cost and improved the performance of wind and solar energy, leading to a surge in global investment in renewables. The dramatic reduction in the cost of solar energy, from over USD 1 200 per megawatt hour (MWh) in 1990 to less than USD 150/MWh in 2012 makes it price competitive with the conventional fossil fuel price range of around USD 100/MWh

(Global Commission on the Economy and Climate, 2015). This has led to equally dramatic increases in investment in renewables and added production capacity. From 2004 to 2013 (the last year for which annual figures are available), investments rose from USD 40 billion globally to USD 279 billion (total investment in solar energy was just under USD 75 billion, with USD 36 billion for wind power generation). Meanwhile, the installed capacity increased from just under 4 GW in 2004 to over 139 GW ten years later in 2013 for solar power, and from 48 GW to 318 GW for wind power over the same period (REN21, 2014).

Such reforms, however, must be consistent with strategies to reduce poverty and social policies, such as cash transfer programmes, of the kind that are now being implemented in Indonesia and Malaysia (OECD, 2014). Fuel subsidies are regressive and inefficient instruments for poverty reduction, since they benefit those who consume more fuel and receive the subsidy.

Designing green buildings: Labelling new buildings and renovating existing buildings

Green building design and construction is an important area for the BMR to promote and encourage through incentives/disincentives, building and appliance standards, and regulations. According to the MEA, electricity consumption in the residential and commercial sectors in 2013 accounted for 23.8% and 28.7% of the total consumption of nearly 150 terawatt hours (TWh), respectively (see Chapter 1). New buildings have the greatest potential to achieve high energy efficiency, but promoting the renovation and retrofitting of existing buildings to improve energy efficiency is also a productive policy to pursue, as many older office and large residential buildings with lower energy efficiency performance will be renovated in the future.

Local governments in the BMR need to co-operate with the national government, since building standards are under the mandate of the national government. For instance, Thailand has a Building Energy Code regulating the design of new or retrofitted buildings with total area greater than or equal to 2 000 square metres. The Thai Green Building Institute (TGBI), the main agency delivering green building standards, also promotes the Thailand Rating Energy and Environment System (TREES), a certification programme covering standards in energy consumption, material and resources, and indoor environmental quality, which provides advice and standards to building managers. Local governments in the BMR could reward building owners who use TREES for new and existing large buildings with similar FAR and OSR incentives and benefits, as the city of Bangkok does.

In addition to promoting the use of energy-saving appliances and energy-efficient materials, passive cooling design in new buildings also has high potential and should be promoted. In hot climates, low-cost solutions such as reflective roofs and walls, exterior shades, and low-emissivity window coatings and films can significantly reduce energy consumption for cooling (IEA, 2013). National and local government institutions with the technical assistance of university and research institutions could support research on passive cooling designs, and provide vocational training for a new generation of installation technicians and technical assistance for contractors and construction companies.

Improving water and solid waste management

Increase the capacity and effectiveness of wastewater treatment in the Bangkok Metropolitan Region

The BMR needs to increase the capacity of its wastewater treatment systems. Since the 1990s, the BMA has invested in the construction of a central system of wastewater collection and treatment. The system diverts sewage flows from the network of canals within the priority areas to wastewater collection and treatment facilities, thus subsequently reducing pollution of the waterways. However, the latest figure indicates that 2.48 million m^3 of wastewater is generated but only 1.136 million m^3 (45.8%) is treated (Chapter 1). In most other places in the BMR, wastewater is directly discharged into rivers, canals and the sea – especially in slums.

To increase treatment capacity, two critical problems should be addressed. First, users do not pay for the cost of treating wastewater, as the BMA does not charge them. The BMA needs to accelerate the ongoing discussion of introducing wastewater tariffs. The tariff should factor in distributional effects on the poor, and be based on per unit costs on water usage amounts (so that the marginal rate per unit goes up as consumption increases), to discourage over-consumption through marginal pricing structures. It should also seek co-operation with the Metropolitan Waterworks Authority (MWA) so that it can collect fees jointly with drinking water. Pricing wastewater would allow the BMA to finance the operation of the existing wastewater treatment plants and construction of new plants. Second, PPP in wastewater treatment projects is a key strategy for the BMA to pursue, and coupling water and wastewater tariffs could be an incentive for private developers/investors to get involved in these projects. Construction and operations by the private sector should reduce both the up-front capital costs and operation and maintenance costs by optimising the design. In addition, since wastewater treatment operations need a lot of energy (50% of the total operation costs of the plants come from energy), new wastewater treatment projects could use renewable energy (solar, biomass, etc.) for their operations.

Second, to improve the effectiveness of the overall treatment system, it is crucial for the BMA to require large-scale factories and commercial buildings within its serviced areas to connect to the city's wastewater system. In the city of Bangkok, it is not obligatory for residents or businesses to be connected to it, and many large-scale factories and commercial buildings are not connected to the BMA's wastewater facilities. They are supposed to meet the standard set by the Ministry of Industry for treated wastewater before it is discharged into bodies of public water, but these standards are not stringently enforced. For low-income households which cannot afford the connecting fees, other types of in-kind contributions (in labour and community organisation) have been successfully experimented with in many other developing country cities/neighbourhoods, and differential fees have been charged for single-latrine households.

An effort to reduce non-revenue water

The BMR is doing well in providing fresh drinking water. All registered inhabitants in the city of Bangkok have access to clean water (Chapter 1). Nonetheless, the high levels of non-revenue water (NRW) in the city of Bangkok, Nonthaburi and Samut Prakarn constitute a challenge (26.76% in 2012, according to the MWA). These are caused by water leaks due to obsolete water pipes and the poor performance of metres.

The levels of non-revenue water in other parts of the BMR, operated by the Provincial Waterworks Authority (PWA), also need to be examined.

A combination of water infrastructure upgrading and governance reform would dramatically reduce the levels of non-revenue water. The success of Phnom Penh (Cambodia) is explained by the rehabilitation of old pipes, the removal of illegal connections, the training of meter readers and of payment collectors and the provision of subsidies to connection fees for poor households. Hai Phong (Viet Nam) also decreased its level of non-revenue water from around 70% in 1993 to 10% in 2007, thanks in part to decentralising responsibility to the ward level and a ward-based model for NRW management (Water and Sanitation Program South Asia, 2009). East Manila, in the Philippines, was targeted by a similar programme and reduced its leakage from 63% in 1997 to 11% in 2011. An intensive remetering programme eradicated deficient meters in households and better informed investment needs to reduce the NRW. In addition, the expansion of formal water access to low-income communities was achieved thanks to the extension of the pipeline network and social programmes that included subsidised rates for the poor (ADB and NUS, 2012). Bangkok itself also successfully reduced the NRW from around 40% to 30%, by using performance-based service contracts for leakage reduction: the MWA outsourced physical loss reduction to private contractors in 3 of the 14 service branches of the MWA from 2000 to 2004 (World Bank, 2006). This effort should be revisited to look for cost-effective measures to further reduce the NRW in Bangkok.

Introducing a tariff structure that discourages excessive water consumption

In addition to introducing wastewater tariffs in the BMR, measures are needed to reduce demand for water. Pricing mechanisms should be used more actively to change consumption patterns, taking into account disproportionate hardships to the poor. These can be remedied by marginal use price signals, income-based fee rebates and or other distributional mechanisms. The tariff structure employed by the MWA is flatter than that of East Manila and East Jakarta (Figure 2.3). Introducing a much higher rate for households that consume more water could be considered. At the same time, the use of smart metering for drinking water and wastewater in households should be promoted, so that households can be informed on a real-time basis how much water they consume. Smart metering in households provides a key growth opportunity.

Online, real-time monitoring of water quality

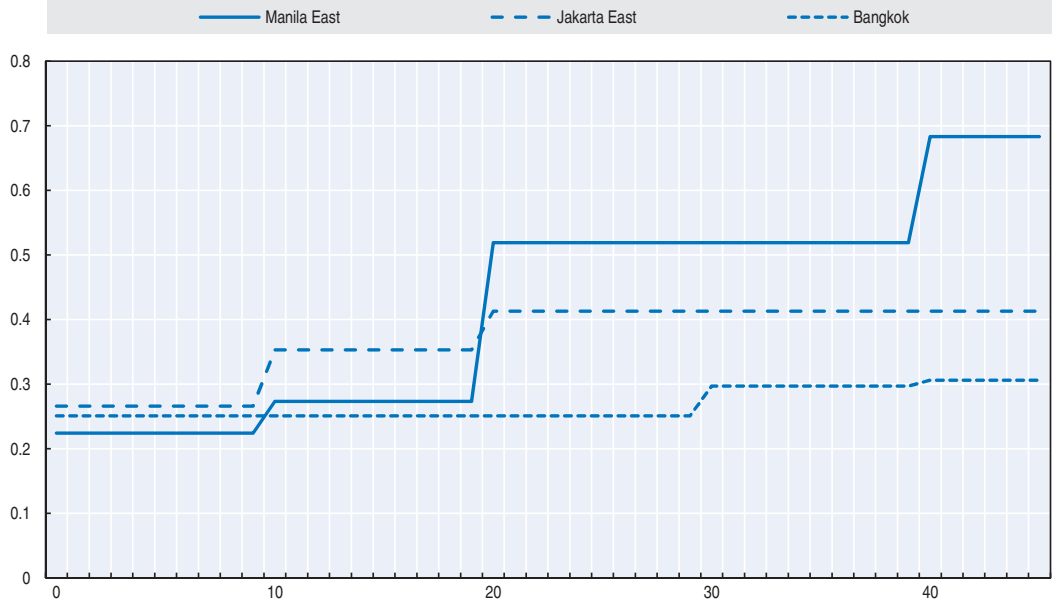
Online, real-time water quality monitoring tools (for both drinking water and wastewater) are critical to enhance resource efficiency based on advanced data collection methods. A major advantage of such tools is that they make it possible not only to monitor and measure the current levels of pollution and provide support for policy decisions, but also to disclose such information to citizens and avoid exposing them to health risks. Bangkok's campaign for real-time tap water quality monitoring, in the "Metropole Watch" programme, is a good example, and should be extended other parts of the BMR[5] (Box 2.3).

A comprehensive strategy for solid waste management

Solid waste management is yet another source of untapped potential for greening the BMR. Solid waste generation in the BMR continues to rise steadily, although there is no effective local or national plan to prevent this, such as by promoting a 3R (reduce, reuse

and recycle) programme. This could encourage innovation, create work for local firms that can hire local, low-skilled and poor residents, and reduce local governments' expenditures on waste collection and disposal (OECD, 2013a). Most solid waste in the BMR is disposed of in sanitary landfill sites – almost 90% in the case of city of Bangkok (Chapter 1). The city is currently transferring most domestic solid waste to three disposal centres in the city (Saimai, Nongkhem and On-nut) and to two landfill sites outside its jurisdiction – in Nakhon Pathom and Chachoengsao provinces. Both sites are operated by the private sector for a fixed period, and once they become full, the BMA must find new sites within or near the city, which will not be easy. Some of the solid waste in the BMR is dumped at poorly managed "open" landfills without adequate site access, worker safety, cellular design, wind or rain protection/daily cover, leachate or methane collection systems, or proper closure and rehabilitation requirements. Solid waste contributes to climate change through the release of greenhouse gases (GHG) from landfills and from older, less efficient waste incinerators. Methane from landfills, which contributes the largest share of GHG emissions produced by the waste sector, is of the greatest concern, because it has a significantly greater impact on climate change than CO_2 emissions and continues to be released for decades after waste disposal (IPCC, 2007).

Figure 2.3. **Tariff structure of selected Southeast Asian cities**



Source: Manila Water (n.d.), http://www.manilawater.com/Downloadables/2015%20Tariff%20Table%20June%201,%202015.jpg (last accessed 3 July 2015); PT Aetra Air Jakarta (Aetra) (2012), "Info Tariff Aetra", available at: http://www.aetra.co.id/uploads/info_tarif_aetra/tarif_air_AETRA_2007.pdf; Metropolitan Waterworks Authority (n.d.), http://www.mwa.co.th/ewtadmin/ewt/mwa_internet_eng/ewt_news.php?nid=309 (last accessed 3 July 2015).

Box 2.3. **Metropole Watch programme: Toward open source water-quality monitoring in Bangkok**

Infrastructure improvement (construction of sewage treatment facilities) is one of the strategies developed by the BMA to tackle the issue of water quality in the Chao Phraya River and its canals. An advanced water quality surveillance system is also being implemented. From 2002-05, the Fugro OCEANOR-OTC Consortium developed the Metropole Watch monitoring system, which consists of 12 automatic real-time monitoring stations based along the Chao Phraya River and selected channels in the city of Bangkok. Water is pumped into the stations and analysed, and the results are subsequently transmitted via phone to the main servers and database system (an Environmental Surveillance and Information System, or ENSIS, as supplied by COWI and the Norwegian Institute for Water Research/Norwegian Institute for Air Research). All stations measure the same basic parameters: water temperature, water level, conductivity (salinity), dissolved oxygen, pH and turbidity, while other parameters such as chemical oxygen demand, nitrates, RedOx potential, chlorophyll-A and trace metals (zinc, cadmium, lead, thallium, copper and nickel) are measured in the selected location.

Information gathered between different monitor points allows technicians and managers to map water quality patterns over time in Bangkok and identify strategic areas where additional wastewater treatment facilities can be constructed. This reduces uncertainty about pollutant loading and helps identify polluters. In Bangkok, particular focus has been placed on flushing pollutants through the network of channels and minimising saltwater intrusion. For an advanced monitoring system to be efficient in the long term, attention must be paid to maintaining investments in infrastructure and trained personnel.

The Metropole Watch programme, developed as the "real-time tap water quality monitoring system", is accessible at: http://wqconline.mwa.co.th/wqc/OverviewMap.aspx?uiculture=en-US.

Source: Dutch Water Sector (n.d.), http://www.dutchwatersector.com/solutions/projects/187-metropole-watch.html (last accessed 22 January 2015).

Introducing waste-to-energy plants is a good option for the BMR. Such plants can divert waste from landfill and recover heat and electricity from waste incineration, and should be accelerated. The first waste-to-energy plant in the city of Bangkok is now being built in the Nongkhem district, which can incinerate 300 tonnes per day and generate 8 megawatts of electricity. However, the treatment capacity only accounts for about 3% of the total solid waste generated in the city. Scaling this up is crucial. The BMA and other local governments should work together to find funding and optimal locations to build a few more waste-to-energy plants in the BMR, since the budget and resistance from residents may present obstacles.

An even more important option for the BMR is promoting recycling and composting. More than 60% of the waste in the city of Bangkok's landfills is compostable or recyclable, highlighting the great potential of the policy (Table 2.2). It also complements waste-to-energy plants, as composting can reduce demand for incineration and allow them to incinerate only non-recyclable wastes. While waste provides fuel for waste-to-energy plants, more value could be extracted from waste by recycling it. Recycling and composting constitute a complementary element of a comprehensive solid waste management strategy/system.

Table 2.2. **Composition of waste at transfer stations in the city of Bangkok (2013)**

Percent

Compostable		49.78
	Food waste	43.34
	Wood and leaves	6.44
Recyclable		11.29
	Recycled paper	1.88
	Recycled plastic	3.56
	Foam	1.57
	Glass	3.08
	Metal	1.2
Others		38.93
	Non-recycled paper	9.67
	Non-recycled plastic	21.54
	Leather and rubber	1.45
	Textiles and textile waste	3.92
	Rock and ceramic	0.73
	Bone and shells	1.62
Total		100.0

Source: BMA (2014), "Answers to the OECD case study questionnaire", internal document, unpublished.

One problem is that most of different types of waste are not effectively separated at the source, or at the time of collection, so each type of waste cannot be properly recycled, composted or incinerated. A further problem is that, even if wastes are separated at the household level, they are mixed again at transfer or landfill sites. Improving waste separation at the source is crucial. Campaigns by the BMA to raise citizen awareness of the need for domestic solid waste separation should be accelerated and expanded to all districts within the city and to the other BMR provinces. Stockholm (Sweden) provides a complete set of policy instruments including waste-to-energy, privately financed recycling, composting of food waste and the recent efforts to produce biochar (for a description, see Box 2.4). As the BMR produces much wood and green waste, biochar could contribute to Bangkok's urban agriculture and the quality of air and storm water runoff, and could play a role in closing the cycle of comprehensive waste management in the BMR.

The BMR should also consider requiring businesses, restaurants and bars, and large apartment complexes to recycle, charging marginal rate collection fees based on volume, in order to promote recycling. A mandatory recycling system has been introduced in many cities in the state of California (United States). The city of San Carlos, for example, adopted a mandatory commercial recycling ordinance in 2010, which became operational within a year. The ordinance was phased in over two years and includes all types of recyclable materials: special wastes, food waste and green waste. It was adopted after extensive consultation with the business community (which supported the ordinance) and includes an extensive outreach programme to educate businesses.

Box 2.4. **Stockholm's comprehensive solid waste management strategy**

Stockholm has made great strides in diverting waste from landfill. The only items landfilled are stabilised fly-ash and bulky household waste (Lundkvist, 2012). Very little household waste in the city of Stockholm goes to landfill, with 21% of the total recycled and 70% incinerated (City of Stockholm, 2012a). The recycling system is entirely paid for by an association of producers, or companies who sell packaging (either manufactured or imported), and who are legally responsible for separation, collection and recycling. This system does not involve household collection but rather relies on collection points throughout the city. The city has also initiated voluntary food waste disposal, which so far involves approximately 800 businesses. Before 2011, most of the separately collected food waste was processed by composting, but since the beginning of 2011, 100% of the food waste has been converted to biogas for vehicles (City of Stockholm, 2012b). The 75 trucks that collect household waste in the city run on biogas, which is also produced by the Sjöstaden and Henriksdal wastewater treatment plants (Lundkvist, 2012).

Stockholm is also a leader in cleanly incinerating non-recyclable waste and generating power and electricity. Its first incineration plant was established in 1909 (City of Stockholm, 2012a). The city's waste incineration currently takes place at the Högdalen combined heat and power plant, a cornerstone of the city of Stockholm's district heating system (Lundkvist, 2012). A small share (8%) of the organic waste (food waste and other biowaste) is sorted separately and digested or combusted to become biofuel, which is used by Högdalen and by the Hammarby thermal power station. What is not sorted out is incinerated for energy recovery.

National regulations have played an important role in the city's success in reducing the waste going to landfill. A national ban has existed since 2002 on sending unsorted combustible waste to landfill, and this was extended in 2005 to cover nearly all organic waste (City of Stockholm, 2012a). These bans, along with a national landfill tax, are largely responsible for the very low share of waste going to landfill (Lundkvist, 2012). Another national policy that has played a large role in Stockholm's waste disposal patterns is the "Producer Fees" requirement, under which companies that market packaging fund the collection, sorting and processing of recyclable materials. This is unusual in that it shifts all responsibility for materials recycling to the private sector.

In September 2014, Stockholm's project proposal "Biochar – for a better city ecosystem" was selected as one of the five winners in the Bloomberg Philanthropies' Mayors Challenge – a competition for European cities focusing on urban challenges. The proposal was to produce biochar from garden waste and use it for multiple purposes for making the city more sustainable. Biochar is an organic carbon produced from leaves and other green wastes. It creates high-quality soil to increase tree growth, sequesters carbon and purifies water from pollutants. Biochar plants also generate heat and electricity by incinerating green wastes.

Sources: OECD (2013a), Green Growth in Stockholm, Sweden, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264195158-en; City of Stockholm (2014), "The Stockholm Biochar Project", presentation made at the City Innovation Summit, 17-18 November, Barcelona, available at: www.cityinnovationsummit.com/Presentaciones/Dia%2018/Stockholm%20Biochar%20Presentation.pdf (last accessed 24 March 2015); City of Stockholm (2012a), "OECD green cities Stockholm background report", 13 January, City of Stockholm; City of Stockholm (2012b), personal communication by email with Lovisa Wassbäck, environmental co-ordinator, City of Stockholm Traffic Administration, 4 May; Lundkvist, N. (2012), "Sustainable waste management" presentation, 18 April, City of Stockholm Waste Administration.

Promoting a community-based approach

Solid waste management is of particular concern in slums, where waterways are more polluted because of uncollected and untreated solid waste. In these areas, proper solid waste management and higher water quality will not only enhance public health, but will make these waterways more suitable for the development of urban amenities, and

therefore enhance the appeal of the city. Community-based initiatives are a promising way to improve solid waste management in Bangkok's slums.

Community-based action plays an important role in reducing waste, separating waste, enhancing recycling and creating local jobs. In the city of Bangkok, solid waste separation at the community level started in 2010, and composting at the community level is conducted in 42 communities. The BMA and other local governments in the BMR should accelerate such actions, for example, by setting quantifiable targets for different kinds of waste, using comparisons with other districts, and through innovative pilot projects, trying out new strategies, approaches and methods at the district level to improve performance.

The BMA and other local governments in the BMR should examine how to formalise informal sectors involved in the recycling business. Residents already separate some items from their waste to sell to street buyers. Waste collectors and pickers separate recyclable material from rubbish in dustbins, garbage trucks and at landfills. Street vendors, restaurants and bars recycle nearly all of their used bottles, but none of their Styrofoam packaging or plastic wrapping wastes. Larger businesses can sell some materials directly to recycling factories. Materials that are regularly collected for recycling include plastic and glass bottles, food tins and cartons, paper and cardboard. Some of these items are sold to recycling factories to make new products. It is important to legally recognise such businesses and incorporate them into the formal sector.[6] The Thailand Institute of Packaging and Recycling Management for Sustainable Environment (TIPMSE), a privately funded organisation established in 2006, with the support of the Federation of Thai Industries (FTI), promotes community-based recycling through technical training, establishing recycling databases and supporting community projects such as the "Zero-Baht shop" (Box 2.5). This is an instructive example of formalising the informal business sector, and the public sector should try to replicate its success.

Box 2.5. **Zero-Baht shop: Community-based recycling in Thailand**

A "Zero-Baht shop" is a cash-free barter system that allows the trade of recycled materials in communities for necessities, goods and services.

The system works as follows: 1) community members collect recyclables; 2) they separate the collected recyclables by type and bring them to a "Zero-Baht shop"; 3) the recyclables are weighed; 4) the community members receive an invoice from a member of the shop's staff; 5) they bring the invoice to the shop and exchange it for goods and services of the same value, or

deposit it into a "bank" as savings; 6) the collected recyclables are sold to junk collectors; 7) the income is used to create a welfare fund and provide services to community members.

Through the system, low-income community members are officially registered as formal garbage collectors and separated from informal waste pickers. They are also able to receive some social support (such as medical care, support for funeral services, etc.) as community members. Overall, the system helps to formalise the informal sector, to promote recycling and alleviate poverty.

In 2006, the Thailand Institute of Packaging and Recycling Management for Sustainable Environment (TIPMSE), established, with the Federation of Thai Industries (FTI), the concept and continued expansion of the network of Zero-Baht shops. They can send a consultant to communities and organisations interested in the establishment of Zero-Baht shops. As of 2013, 12 Zero-Baht shops were in operation. The TIPMSE also organised the "Zero-Baht Shop Mobile," as a showcase of the project to communities, educational institutes and governmental agencies.

Source: TIPMSE (2014), presentation at the Bangkok Knowledge Sharing Workshop on Urban Green Growth in Dynamic Asia, 6-7 August, Bangkok.

Promoting social inclusion of the slum population

Measures to promote social inclusion of the slum population in the BMR can advance green growth and social justice goals simultaneously. It is estimated that more than 2 million people live in slums in the city of Bangkok, many of whom are unregistered inhabitants with inadequate housing and poor access to public services like water supply, waste collection/disposal services and public transport. Many live along the canals and rivers in the city, exposed to floods and storm damage. The presence of these settlements in ecologically fragile and vulnerable locations, without proper wastewater treatment and garbage collection, creates environmental hazards that affect others living in the BMR. Programmes to improve housing quality and public services as part of upgrading slums, using local labour to the extent possible, should be accelerated in the interests of job creation, social inclusion, public health and greener growth.

Community-driven approaches should be central to this effort. The city of Bangkok has already implemented several community-driven housing development initiatives, such as the Ban Mankong project, launched in 2003 by the Community Organisations Development Institute. It successfully provided clean and secure housing to approximately 1 000 households, with social support systems to empower citizens. Such initiatives should be replicated elsewhere in the BMR. In particular, housing improvements and slum upgrading should aim to achieve cross-sectoral benefits that include low-carbon objectives. Installing energy-efficient appliances and a community-based recycling system in communities and neighbourhoods could be accomplished at the same time as housing upgrades and provision of public services. As slums were physically improved, unregistered residents in these areas could be formally registered. This would mean that they could participate more fully in political decisions that affect them directly, such as receiving public services and social welfare benefits. Residents in such local communities should meanwhile be viewed as partners and assets, not just as recipients of public assistance. Not only can they help identify pressing concerns, but they could be enlisted to select, design and implement solutions to those concerns. As contributing partners in the shared responsibility of finding solutions to pressing economic, social and environmental challenges, they could simultaneously shift some of the burden from local governments.

Making the manufacturing process greener and promoting green research and development

Making the most use of labelling schemes

Industry is the largest user of electricity in the areas where the MEA operates, accounting for about 29% of demand. It is thus important to pursue ways to reduce energy consumption and CO_2 emissions from the industrial sector. The aim must be to make the manufacturing process as "green" as possible by promoting more green services and products in the marketplace, rather than displacing carbon-intensive activities. In OECD countries, many cities with low carbon emissions have effectively de-industrialised by "outsourcing" their emissions and importing carbon-intensive goods. This is not a useful model for combating climate change, nor is it an economically attractive path for Bangkok. Efforts to make existing industries greener, rather than simply outsourcing them, require innovation, which can create new business and employment opportunities.

In Thailand, labelling schemes can not only help consumers to choose more energy-efficient and environmentally friendly services and products, but also encourage the manufacturing industry to produce greener products and services. The Thai Green Label Scheme is a major eco-label designed in Thailand, and launched in 1994 by the Thailand Environmental Institute (TEI) and the Thailand Industrial Standards Institute (TISI). It aims to provide reliable information and guide customers in their environmentally conscious choice of products, thus creating market incentives for manufacturers to develop and supply environmentally sound products. It awards environment certification to products shown to have less impact on the environment than other products serving the same function. The initiative has been developed to promote the concept of resource conservation, pollution reduction and waste management (Thailand Environment Institute, n.d.). The Green Label programme has also been introduced by the national government. Green labels have been awarded to over 150 consumer and industrial products. In the energy sector, the Label Number Five, a nation-wide energy efficiency labelling system for electric appliances, certified by the Electricity Generating Authority of Thailand (EGAT), is widely known and used for most of major electric appliances, such as air conditioners and refrigerators.

In addition, the Thailand Greenhouse Gas Management Organisation (TGO) promotes the following labelling, focusing on promoting low-carbon manufacturing processes (TGO, 2011):

- Carbon Reduction Label: manufacturers can apply for the "Carbon Reduction Label" for a product whose industrial processes emit 10% less GHGs emissions than they did in 2001. The initiative started in 2009, and as of 2011, there were 145 products registered for such carbon labels.
- Carbon Footprint Label: The carbon footprint indicates the quantity of GHG emissions from each production unit for the whole life cycle of a particular product. As of 2011, 197 products had been trained by TGO and allowed to use such labels.

Combined with such labelling schemes, public procurement can be a critical lever to encourage green services and products, since it accounts for around 20% of the total acquisitions in the Thai economy. In 1992, the central government initiated the Green Procurement Strategies, which have been followed by several key procurement plans and programmes, such as the Green Public Procurement Promotion Plan (2008-2012) and the Green Public Promotion Plan (2013-2016), as discussed in Chapter 4 (APEC, 2013). The BMA as a local government has also introduced the procurement of green products and green services since FY2010 in 17 categories (Box 2.6). Local governments in the BMR and the Thai government can consult the Recommendation of the Council and the "compendium" developed by the OECD on green public procurement to further enhance their own procurement programmes (Box 2.7).

While the Label Number Five has been very successful in guiding consumers to purchase more energy-efficient appliances, other labelling schemes have had only limited success in Thailand, partly due to the fact that green products are more expensive in most cases. Combining more tools with labelling schemes could maximise the benefit. To date, the Thai government and the BMA have only used public procurement to promote production and consumption of green products and services. Public procurement systems, joint subsidy programmes with interested companies, upgraded standards and public information campaigns could help to promote greater public acceptance and interest in green services and products. Such efforts could be expanded to other provinces in the BMR.

Box 2.6. **Green procurement in the Bangkok Metropolitan Administration**

The government organisations are obliged by the 10th National Economic and Social Development Plan (NESDP; 2007-2011) and the Environmental Quality Management Plan (2007-2011) to procure environmentally friendly products and services to support environmentally friendly markets. The 11th NESDP (2012-2016) promotes the use of green products, focusing on sustainable production and consumption for helping conservation of natural resources and the environment.

The BMA as a local government also promotes green products and services, in line with the policy of Ministry of National Resources and Environment. It has introduced the procurement of green products and green services since fiscal year 2010 in 17 categories, aiming for at least 60% of the total procurement in the BMA. The BMA's Department of Environment has provided a guidebook on selecting green products and services for the BMA's offices and the public.

According to the BMA's Department of Environment, in FY2013 11 categories (photocopiers, folders, correction pens, printing paper/colored covering paper, paint, printers, hotel services, fluorescent lamps, whiteboard markers, metallic furniture and cleaning services) met the 60% target and 6 categories (ink cartridges, document boxes, photocopier rentals, primary batteries, tissue paper and envelopes/packages) failed to meet the target.

Source: BMA (2014), "Answers to the OECD case study questionnaire", internal document, unpublished.

Expanding the types of products and services to be labelled could also be considered. In September 2012, the Thai government and the German International Co-operation Agency (GIZ) launched the "Sustainable Consumption and Production for Low Carbon Economy – Low Emissions Public Procurement and Eco-Labelling" (SCP4LCE) project. This promotes the extension of existing eco-labels in Thailand. The current environmental criteria for products and services are mainly established for office products, such as printers and light bulbs, but do not cover the transport sector, for example (APEC, 2013).

Promoting more green R&D and green skill development

Encouraging green research and development (R&D) is a crucial strategy to stimulate innovation for greening the manufacturing industry. In urban areas such as the BMR, the local economy may benefit from policies encouraging green research and development, since many universities, research institutions and innovative technology firms are concentrated in the BMR. The Thai government's Science Technology and Innovation for Renewable Energy Development Implementation Plan (2012-2016) promotes such research and development. Moreover, developing knowledge and skills on renewable energy technologies at academic and vocational institutions may attract further investments in the installation, production and maintenance of wind, solar and biomass technologies in the BMR. The BMA and other local provinces in the BMR should therefore explore better co-ordination with the Thai government to encourage research and development skills in such institutions.

Box 2.7. **Going Green: Best practices for green procurement**

Public procurement is being increasingly used worldwide to achieve environmental protection policy objectives, including transition to a low-carbon economy. Green public procurement is defined in the OECD *Recommendation of the Council on Improving the Environmental Performance of Public Procurement* as the procurement of products and services that are less environmentally damaging, taking their whole life cycle into account. In 2015, the OECD adopted the *Recommendation of the Council on Public Procurement* to encourage the use of procurement as a smart governance tool, including recommendations on how to integrate secondary policy objectives, like sustainable green growth, into public procurement.

To contribute to the OECD Green Growth Strategy and provide concrete examples for countries wishing to invest in green public procurement, the OECD's Public Governance Committee developed a compendium of green public procurement good practices. The compendium presents case studies across six dimensions of green public procurement implementation, which correspond to green public procurement challenges reported by countries to the OECD. The case studies together present a comprehensive view of what may constitute good approaches to successful green procurement and are published by the OECD at: www.oecd.org/gov/ethics/best-practices-for-green-procurement.htm.

Sources: OECD (2015a), "Smart procurement. Going green: Best practices for green procurement", OECD, Paris; OECD (2015b), *Recommendation of the Council on Public Procurement*, C(2015)2, OECD, Paris, http://acts.oecd.org/Instruments/ShowInstrumentView.aspx?InstrumentID=320&InstrumentPID=348&Lang=en&Book=False (last accessed 15 January 2015); OECD (2002), *OECD Recommendation of the Council on Improving the Environmental Performance of Public Procurement*, C(2002)3, OECD, Paris, http://acts.oecd.org/Instruments/ShowInstrumentView.aspx?InstrumentID=46&InstrumentPID=43&Lang=en&Book=False (last accessed 15 January 2015).

The BMR could also develop comprehensive and standardised workforce-development strategy and training programmes to create new skills and jobs for the new "green" economy. For example, the Thai government and the BMA could collaborate with each other and expand the BMA's vocational training programmes to other provinces in the BMR.

Gathering opportunities for complementarity and synergies

Bangkok needs the economic arguments making the case for removing fossil fuel subsidies and gradually instituting a carbon tax to reflect its true cost to society. At the same time, the incentives in cost, ease of use and convenience, should be shifted away from private car ownership. Viable, multimodal public transit options should be introduced. New growth "hubs" in the BMR should be planned around public transit, housing, shopping and centres of employment, and investment increased in RE and EE technologies in the energy sectors. Meanwhile, political, social and economic leaders and the general public should be widely informed about the urgent need to reduce the costs, losses and damages associated with the increasingly severe effects of climate change. Delaying action and locking in investment in fossil fuel-based infrastructure rather than adapting to climate change as part of a new "green growth" economy will entail huge costs. As Thailand's sole megacity and centre of political and economic power, Bangkok must take the lead in making this shift toward a more prosperous, harmonious, resilient and sustainable economy and society.

The areas of opportunity presented in this chapter have strong potential to advance urban green growth. Each can contribute in a number of ways: green jobs and innovation; inclusiveness; climate change adaptation and mitigation; and a healthier local

environment and urban attractiveness (Table 2.3). Achieving urban green growth will require a concerted and simultaneous effort to take action holistically on these different fronts. For such policies to succeed, Thailand's institutions will have to take cross-sectorial action to generate synergies (see Chapter 4). Coherent policy packages can help mitigate the trade-offs among environmental, growth and equity priorities: a properly designed policy package would address the costs of reducing environmental impact in a co-ordinated way and have less impact on the most vulnerable people (OECD, 2013b). Presented below are some key issues the BMR could consider.

Mainstreaming green growth and streamlining existing plans and strategies

The BMR has already instituted a number of plans and strategies for green growth, notably on climate change, transport, solid waste management, air quality and noise management. Most of these target the city of Bangkok (Table 4.3), but more emphasis could be placed on the growth potential they can generate. Bangkok's development plans (Bangkok 2020, launched in 2009, and Bangkok 2032, which replaced it in 2012) do not explicitly discuss the extent to which the proposed environmental actions will create new job opportunities, a persuasive way to build public and political support (Box 2.8). Green growth is associated not only with economic advantages but benefits such as improved air quality and lower public health costs. This would improve the city's competitiveness and its ability to attract international companies and a highly trained labour force. The advantages of a healthy environment and quality of life should help to win political and public support for such a strategy. The same could be applied to other sectoral plans and strategies. An analysis of the BMA Action Plan on Global Warming Mitigation (2007-2012) could be conducted to demonstrate how the initiatives benefited the city's economic performance and its citizens' health. The Bangkok Master Plan on Climate Change (2013-2023), which is being prepared by the BMA after the Action Plan,[7] could also include a forecast of the proposed measures' potential impact on economic growth.

Table 2.3. **Potential contribution of areas of opportunity to green growth in the Bangkok Metropolitan Region**

	Land use and transport	Renewable energy/ energy efficiency	Water and solid waste management (SWM)	Social inclusion of the slum population	Greener manufacturing and green R&D
Green jobs and innovation	– Expansion of mass transit can create green jobs	– Green jobs in renewable energy and energy efficiency development industries – Green jobs in construction and services sectors (consulting)	– Green SWM jobs can be created to support separation and collection of waste for recycling, waste-to-energy schemes		– Green public procurement can create new jobs in green product value chains
Inclusiveness	– Expansion of mass transit provides better access to jobs and services to all citizens			– Slums can perform green jobs and access social services in return – Schemes for the involvement of slums in the collection of waste for waste-to-energy plants	– Green sector educational programmes and workforce training programmes can support all citizens
Climate change adaptation and mitigation	– Improved public transport results in lower greenhouse gas emissions – Compact and transit-oriented development helps tackle urban sprawl and vulnerability to floods	– A decrease in the use of fossil fuels, increased energy efficiency in all sectors and an increased use of renewable energy result in lower greenhouse gas emissions than business as usual	– Greenhouse gas emissions from landfill sites are decreased thanks to better source separation and recycling		– Lower greenhouse gas emissions from industrial production
Healthier local environment and urban attractiveness	– Lower concentrations of particulate matter as a result of an increased use of public transport – Redevelopment of urban cores around transit corridors increases attractiveness and investment – Health benefits from walking and cycling	– Successful renewable energy development schemes can increase the attractiveness of Bangkok and attract investors	– Health hazards from waste and polluted water dispersion during floods are decreased – Better quality of canals and rivers has health benefits and creates opportunities to develop amenities along waterways – Decrease in waste amounts in landfill sites	– Community-driven housing development initiatives can improve living conditions in slums	– Lower levels of air and water pollution from manufacturing industries

Source: Own elaboration.

Box 2.8. **Bangkok 2020 and Bangkok 2032**

Launched in 2009, Bangkok 2020, or the Bangkok Development Plan, was the BMA's 12-year vision to guide the development of the city. It proposed five key strategies:

1. Strengthening Bangkok's infrastructure for a regional megacity. It included comprehensive urban planning (community centres with a balance of mixed jobs and housing land use), the development of four areas around an all-accessible and multimodal transport system. One target was to double the percentage of public transport users, currently at 45%. Another was to increase the land surface used for transport purposes by 10% compared with 2008, by investing in transport infrastructure.
2. Developing a strong economy and a knowledge-based society. The target included 5% growth of gross provincial product (GPP) and eight specialised tertiary and postgraduate curriculums.
3. Striving for a green Bangkok. Environmental targets included: 60% of domestic water should be treated; the biochemical oxygen demand (BOD) in the city's urban canals should be improved to below the US EPA standard for BOD5 for surface water quality (50 mg/L); the percentage of toxic waste management should be increased by 25% each year, etc. Strong emphasis was placed on flood control and drainage: reducing the duration of flood alleviation on 12 major roads to less than 2 hours, for example.
4. Providing quality of life in a cultural megacity. The fourth target was for Bangkok to become one of the top ten cities in Asia in terms of civic participation in urban development.
5. Mastering services and megacity management.

In 2012, the Bangkok 2032 project was launched as a collaborative effort between the BMA and Chulalongkorn University. As a result, the BMA launched Bangkok Vision 2032, which incorporated six themes (a safe city; a green and comfortable city; a city for all; a compact city; a democratic city; and a city of a growing economy and lifelong learning), 31 strategies and 115 measures. Bangkok Vision 2032 was then transformed into the Development Plan Bangkok 20 years (2013-2032), or Bangkok 2032. The Phase One (2013-2017) plan was validated in October 2014 and is to take effect in 2015. The overall vision is to create a vibrant city, guided by seven principles:

- Bangkok as a safe city. A city free from pollution (wastewater, garbage, air pollution, etc.), and from crime, accidents, disasters, unsafe buildings and illness.
- Bangkok as a green and comfortable city (relocation of cables underground, public and green areas throughout the city, a complete and affordable mass transit system with flowing traffic and commuting options).
- Bangkok as a city for all.
- Bangkok as a compact city (efficient use of land and resources).
- Bangkok as a democratic city (in which residents guide Bangkok's vision).
- Bangkok as an economic and learning city (including the development of green services).
- Management strategy.

Source: BMA (2014), "Answers to the OECD case study questionnaire", internal document, unpublished.

Given the multiple plans and strategies in place promoting different priorities or measures, the BMA could review them closely to make sure they cover all the major policy areas and are aligned with green growth objectives. The BMA Action Plan on Global Warming Mitigation, for example, cites energy efficiency in buildings as one of the main measures for climate change mitigation. However, Bangkok 2032 does not explicitly recognise this in its strategy "Bangkok as a green and comfortable city". Such inconsistencies may reduce the policy's overall effectiveness. The BMA also could consider developing a strategy on green industry and/or energy at the city level, since these policy areas are not included in the BMA's plans and strategies.

Mainstreaming green growth objectives is already under way at the national level. Thailand has a number of plans and strategies related to green growth, notably on climate change, energy, land use and green procurement (see Table 4.3 in Chapter 4). First, the 11th NESDP, Thailand's five-year framework for sustainable development, provides a framework for sustainable development, recognising the effects of climate change and acknowledging that the environment has deteriorated in Thailand, particularly with respect to depleted and degraded natural resources. Shifting toward a low-carbon economy is part of the strategy of the 11th NESDP (see Box 4.1 in Chapter 4). Second, Thailand's Climate Change Master Plan (2012-2050) is a national framework of integrated policies and action plans related to climate change. It supports climate change preparedness initiatives and aligns with the country's economic and socio-cultural context. In the energy sector, the government has been actively introducing national plans to promote renewable sources of energy and reduce energy consumption.

Thailand has many good strategies for green growth and has made significant progress. However, it is critical that these plans be implemented with some urgency. The Thai government is now developing the green growth development plan, which will become a part of the current 11th NESDP. This will greatly help mainstream green growth objectives and align green growth policies, plans and programmes within the government's usual planning and budgeting processes. For example, this presents an opportunity to require relevant ministries to review their sectoral plans and strategies in the next planning and budgeting cycle to make sure they incorporate green growth objectives.

Policy instruments for green growth in the Bangkok Metropolitan Region

A number of policy instruments have been used to encourage urban green growth in the BMR, but the central and local authorities need policy instruments that are more innovative and more specific to local contexts. Five instruments can be used in any of the thematic areas mentioned in this chapter for green growth in fast-growing Asian cities: financial tools; regulatory instruments; public procurement; information dissemination; and mandatory measuring, monitoring and reporting requirements (OECD, 2014). Financial tools and mandatory and publicly accessible measuring, monitoring and reporting requirements, in particular, can significantly help promote green growth in the BMR.

Subsidies are powerful tools/incentives to stimulate private sector investment, and similar options should be pursued in other sectors and areas. Meanwhile, different policy and/or regulatory tools should be used in a coherent manner. The national government should pursue such efforts, but local authorities should also explore options to set up similar mechanisms where appropriate. In the building sector, for instance, the BMA could consider requiring builders to subsidise public transit coupons instead of in-building parking privileges, and provide greater floor area ratio and open space ratio

benefits for installing rooftop solar collectors, storm water storage systems and more permeable landscaped surfaces on their grounds or properties.

In addition to subsidies, the use of pricing mechanisms could be used more strategically in the BMR to promote green initiatives and actions. Congestion charges and parking fees that are higher in congested areas and during peak hours and congestion could disincentivise the use of private cars and motorcycles and encourage the use of public transport, while the mass transit network is being expanded. This would also help raise local revenue to finance green programmes. Co-operation with the national government may be required, however, to implement such reforms. Taxes are also critical financial instruments to support local authorities in undertaking urban green growth policies. The building and land tax and the land improvement tax are two such taxes that have so far not been used to their full extent. These potential revenue sources are among those that could be exploited more extensively.

Regulatory instruments used to support green growth initiatives could be used more assertively in Bangkok. As a first step, more stringent energy efficiency standards could be introduced for new commercial and residential buildings and equipment/appliances. Second, regulations already promulgated by the BMA and surrounding provinces should be improved to manage land use more efficiently and ensure that credible enforcement programmes and applied sanctions ensure that urban development complies with land use and building codes. Bulk control regulations have not been adopted by the surrounding provinces in the BMR, which has significantly affected the attractiveness of land-use purchases and undermined green growth efforts. In cases where the central government has regulatory authority, governments at different levels need to share information to examine their efficiency, and then monitor, evaluate and revise them on a regular basis.

The BMA and other provincial governments in the BMR could consider the use of pilot projects at the district level. For example, the BMA could identify "green champions" in the 50 districts, and the relevant stakeholders to include in working advisory groups in each district, possibly starting with a small subset of districts in order to work out problems and inefficiencies in the process. These district-level green growth plans, strategies or actions could then feed into the broader citywide or regional BMR green strategies.

Each year, the BMA publicly releases the *Statistical Profile of Bangkok Metropolitan Administration*, which includes extensive data on population, energy, industries and financing. Some data are provided for each district, which makes it possible to compare indicators across different areas of the city of Bangkok. The BMA performs well in terms of provision of information to the public on the city's environmental performance. For instance, the BMA and some ministries, such as the Ministry of Natural Resources and Environment, publicly promote ways to improve energy efficiency in buildings, provide information on the dangers of air pollution and publish information on the progress of environmental performance (Asian Green City Index, 2010). Such information would be beneficial for both the public and private sectors undertaking policies, programmes, projects and businesses in the BMR. It could also help other cities learn how to design and implement successful green growth policies. This could raise awareness among residents on the efforts made by the local government to achieve green growth, and inform policy makers on the issues the BMR faces.

Main policy recommendations

- Prepare a region-wide spatial land-use master plan; promote the use of existing building incentives (e.g. floor area ratio and open space ratio) more actively; decrease the scale of zoning maps in Bangkok's Land-use Plan; produce an accurate cadastre of land and properties; and set targets for the redevelopment of undeveloped land/underutilised land in the urban cores.
- Implement area-development plans around MRT and BTS stations; improve multimodal mass transit options (MRT or BTS integrated with BRT or normal bus/taxi service); and remove government subsidies that promote private car ownership.
- Develop the proportion of concentrated solar power (CSP), rooftop solar panels and waste-to-energy plants; remove fossil fuel subsidies and take steps to gradually increase the carbon tax on transport fuels and electricity.
- Improve energy efficiency performance standards for office buildings, residential houses and household appliances (especially for water heaters, air conditioning units and refrigeration).
- Augment wastewater treatment plants' capacity, adopt stricter wastewater regulations and set up an efficient water monitoring system; raise adequate revenues from these services by introducing marginal cost fees and reducing non-revenue water.
- Consider a mandatory recycling ordinance for large businesses and apartment complexes and expand community recycling programmes aimed at employing the poor and young.
- Set a target to reduce the unregistered population in slums; prepare a comprehensive development plan at the district level in the BMA; and promote neighbourhood initiatives in 3R or local public works, to create jobs for local, low-skilled and poor residents that contribute to urban resilience at the same time.
- Link existing green label programmes with public green procurement programmes; design public procurement procedures to grant extra points for green solutions; and create green sector educational programmes and workforce training programmes in the BMR, with the help of universities.

Notes

1. Following a consolidation of responsibilities for transport in 2002, the Ministry of Transport (MOT) is responsible for planning, setting standards, regulating services and for the operation of BMTA bus services in the BMR.

2. The total production of renewable energy in 2012 was 8 525 ktoe, up from 15.3% 2011. Of this total, 61.6% was shared by bagasse, followed by agricultural waste, hydro, biogas, paddy husk, municipal solid waste (MSW) and other (fuel wood, solar, wind and geothermal) shared 15.1%, 8.7%, 6.4%, 5.3%, 1.1% and 1.8% respectively. The total production of traditional renewable energy in 2012 was 11 751 ktoe, a decrease of 16.3% from 2011. Of this total, 79.4% was accounted for by wood fuel, followed by agricultural waste and paddy husks, at 6.0% and 14.6%, respectively (DEDE, 2012).

3. In Thailand, the Electricity Generating Authority of Thailand (EGAT) is a principal power generator and distributor. The Metropolitan Electricity Authority (MEA) is responsible for distribution in the BMR. The EGAT sells power to the MEA and also to some large industrial electricity users who are directly connected to the transmission network (IISD, 2013). Outside the BMR, the Provincial Electricity Authority buys power from the EGAT and supplies the rest of Thailand.

4. On 3 December 2014, Thailand's Energy Policy Administration Committee ended the seven-year subsidy for liquefied petroleum gas and also increased prices for compressed natural gas by 1 baht.

5. See: http://wqconline.mwa.co.th/wqc/OverviewMap.aspx?uiculture=en-US (last accessed 10 January 2015).

6. Solutions to the issue of informal workers (Trade Union Law, the Co-operative Law and other programmes that the state guarantees), give informal workers the possibility of access to basic municipal services such as health, education and housing (ILO, 2011). Viet Nam has offered an appropriate legal framework and conditions for securing basic rights for informal labourers. Through the Trade Union Law and the Co-operative Law of the state, a guarantee is offered to labourers from the informal sector to participate in socio-economic organisations to represent their interests.

7. An improvement in the new Master Plan is the greater integration of adaptation planning, which was not emphasised in the previous Action Plan.

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Chapter 3.

Building resilience to floods and other disasters in the Bangkok Metropolitan Region

Chapter 3 examines the resilience of the Bangkok Metropolitan Region (BMR) to floods, which occur during the rainy season. It is critical to address this risk to ensure sustained and cost-effective urban green growth while adapting to the impacts of climate change, because precipitation and flooding affecting the region will likely increase in the future. This chapter analyses four critical elements for enhancing urban resilience to floods:

1) flood-resilient urban infrastructure in the BMR

2) flood-resilient land use in the BMR

3) the BMR's economic resilience to floods

4) the BMR's social resilience to floods.

This chapter benefited from discussions at the Knowledge-Sharing Workshop on Urban Green Growth in Dynamic Asia, held in Bangkok on 6-7 August 2014, which was supported by the OECD Knowledge Sharing Alliance.

Main points

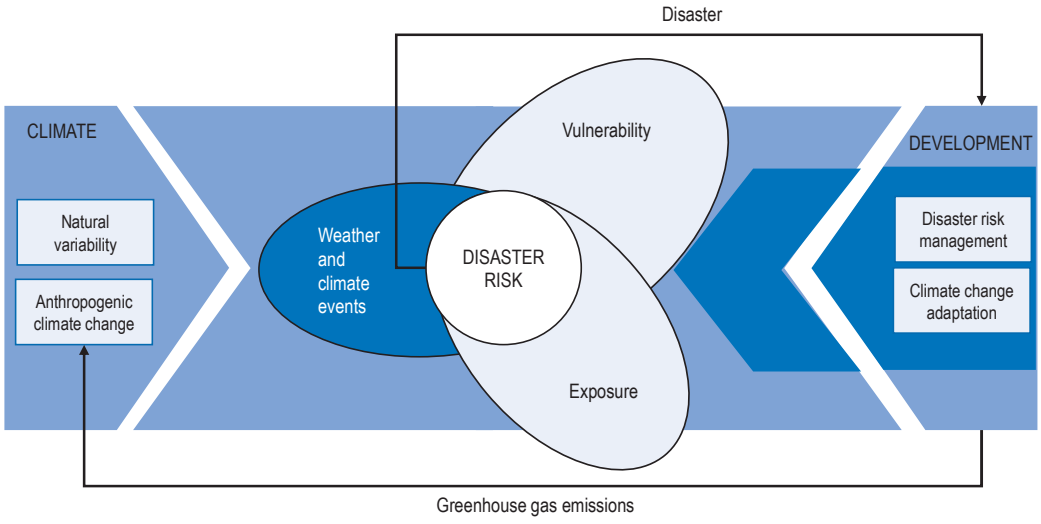
- **The Bangkok Metropolitan Region (BMR) is highly exposed and vulnerable to floods** caused by seasonal storms between the months of July and October. It experienced major floods in 1942, 1978, 1980, 1983, 1995, 1996, 2002, 2006 and 2011. Floods have profound short-term impacts on the economy, environment and public health. They also have long-term economic and social consequences, such as negatively affecting the attractiveness of expanding existing manufacturing plants or building new ones, and redressing urban poverty and social inequity issues. The BMR needs to find ways to become more resilient to floods – in other words, to better absorb and bounce back from such events to ensure green growth in the long term and adapt to the impacts of climate change.
- To protect the city of Bangkok from floods, the BMA and the national government have made massive investments since the 1980s to develop large-scale polder and drainage systems. To avoid over-burdening the city's finances and escalating the need for such infrastructure in the future, public authorities need to consider complementing them with a variety of more adaptive infrastructure measures, such as **ecosystem-based adaptation or semi-permeable surfaces**. State-of-the-art information and communication technology (ICT) also offers many opportunities to optimise city functioning, better inform infrastructure decisions and improve emergency response services, to complement existing flood-control systems.
- The city of Bangkok and five surrounding provinces in the BMR have seen major changes in land use over the past 20 years, with significant loss of agricultural lands and conversion to residential, commercial and industrial uses. Such development has had negative effects on the city's resilience to floods. In particular, it has lost natural water-retention areas (swamps, wetlands, mangroves, etc.) and natural drainage systems that played a key role in managing excess water and limiting the damage done by floods. **An efficient region-wide strategy will require co-ordinating land-use strategies and assessing the climate-induced threads, exposure, adaptive capacity and the resulting vulnerability of urban areas.**
- The devastating flood of 2011 that affected the BMR and other parts of Thailand is reported to have ranked among the costliest natural disasters in the world since the 1980s. It caused damages in excess of USD 9.1 billion in the city of Bangkok alone. Among the economic activities affected, the manufacturing and business sectors were particularly hard hit, absorbing 58% and 18% of the total damages in the city of Bangkok, respectively. **As a consumer and supplier of climate adaptation measures and public infrastructure, the private sector must be targeted and engaged in strategies to increase the city's economic and physical resilience to floods.**
- The 2011 flood also had severe social costs. No fewer than 42 of the 50 districts of the city of Bangkok were left underwater for weeks, and the flood highlighted the vulnerability of the BMR's poorest residents to extreme weather events. It affected 73% of people living in low-income communities, often located in the most exposed areas near canals and rivers. **Local and national governments should find ways to involve local communities in raising public awareness** about the need to increase their resilience to floods and other threats. A more consistently integrated and comprehensive approach to this issue from governments at all levels would build their social capital, cohesion and on-the-ground preparedness during a crisis.

Reducing the Bangkok Metropolitan Region's exposure and vulnerability to floods: The need for a policy response

The BMR faces high flood risk, in particular during the rainy season, between the months of July and October. It experienced major floods in 1942, 1978, 1980, 1983, 1995, 1996, 2002, 2006 and 2011 (Ahsan, 2013). These natural disasters caused severe economic disruption, as well as social and environmental damage. Weather and climate events, exposure (location, topography, sprawling urban development) and vulnerability (the propensity of people, infrastructure and assets to be affected) are common factors of flood risk, including in the BMR (see Chapter 1; see also Figure 3.1). Exposure and vulnerability are dynamic and depend on economic, social, geographic, demographic, cultural, institutional, governance and environmental factors. They are often the result of skewed development processes associated with, for example, environmental degradation, rapid and unplanned urbanisation in hazardous areas, and limited options of livelihoods for the poor (IPCC, 2012). The BMR faces similar development challenges. Because it is projected to undergo rapid demographic, economic and urban changes, a concerted policy response to the high flood risk it faces can significantly increase its resilience.

Floods are only one of several possible risks that the BMR will face in the near future, both anticipated and unexpected. The flooding shed light on a number of basic principles applicable to other risks to lives, livelihoods, property and other assets. These include shared problem-solving, risk mapping, community and private sector engagement, and inclusive decision making. This chapter offers recommendations to enhance the BMR's resilience to floods, and can also be relevant for other types of risk.

Figure 3.1. **Disaster risk framework**



Notes: In the source document mentioned below, exposure is defined as "the presence of people; livelihoods, environmental services and resources; infrastructure; or economic, social, cultural assets in places that could be adversely affected". Vulnerability is defined as "the propensity or predisposition to be adversely affected". In the case of the BMR, it is difficult to assess the future impact of climate change on local precipitation and the likelihood of floods. Some studies suggest that precipitation and flood volumes will increase in the region in future (Panya Consultants Co. Ltd., 2009).

Source: IPCC (2012), "Summary for policymakers" in: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, and New York, pp. 1-19.

This chapter consists of four sections, based on two sets of policy challenges observed in the BMR. First, it discusses "hard" investments in flood-resilient urban infrastructure integrated with land-use planning and zoning policies. Urban infrastructure and land-use policies are at the core of flood resilience strategies. Physical capital and the urban form shape the built environment and are major factors exposing land and urban residents to floods. If properly managed, they can, however, be critical in containing such risks, and in contributing to urban green growth. Second, this chapter discusses adoption of "soft" (i.e. non-structural) resilience measures to shift economic and social patterns and behaviour toward a greener, more sustainable development. Engineering solutions to flood risks have been the dominant paradigm for enhancing urban resilience, but in the BMR and elsewhere, economic and social policies can help mobilise resources and synergies from other groups in civil society, communities, the media and the private sector. This will also help avoid economic and/or social resistance to green policies and programmes and reduce the social impact of future disasters. An analysis of the BMR's performance with respect to these parameters can inform policy assessment and shape recommendations to improve its resilience in the eventuality of floods and other threats.

Promoting flood-resilient urban infrastructure in the Bangkok Metropolitan Region

Complementing polder and drainage infrastructure with adaptive infrastructure

Flood protection infrastructure is a crucial element in the flood risk the BMR faces. The local climate, high exposure to water runoff from the north and the east, and the numerous possible flood ways make monitoring and maintaining infrastructure extremely demanding. Flood protection infrastructure in the BMR is developed and maintained by different authorities since 1983, including the BMA (Department of Drainage and Sewerage) and the central government (Royal Irrigation Department, and also, the Water Resources Department and Electricity Generating Authority of Thailand in the vicinities of the BMR).

The first type of infrastructure in place is a polder system, consisting of numerous dykes to prevent water discharge from the north, the east and from high tides, and to prevent overflow from urban waterways. This is particularly important, considering that some areas of the city, mainly in the eastern districts, are found below these waterways. The second type of infrastructure is a drainage system that supplements the polder system and whose aim is to protect urban areas that are already inundated. It consists of: 1 682 canals (*klongs*) totalling approximately 2 600 kilometres, whose objective is to drive water to the Chao Phraya River and the sea through pumping stations and water gates; 6 400 kilometres of drainage pipes along major and secondary roads, and 7 drainage tunnels to evacuate excess water from the surface to the Chao Phraya River and the sea; and 25 storm water retention ponds scattered across the city to capture early rainfall and decrease peak runoff in low-lying areas and in areas where the drainage capacity is too low to bring storm water to the river and canals. The city of Bangkok's flood protection and drainage infrastructure was primarily developed to cope with localised flooding, more precisely water overflow from the river and canals from exceptional heavy rainfall. A substantial amount of water runoff originated upstream, north of the Chao Phraya Basin, and was carried by the Chao Phraya River down the Gulf of Thailand through the BMR during the 2011 floods. Since the overflow could not be contained by the current infrastructure, the BMA is trying to expand its capacity to avoid a similar disaster in the future. The current project consists of the construction of six new diversion tunnels,

including three large drainage tunnels, five additional retention ponds and water expressways to drive overflow to the sea or to diversion tunnels.

The BMR is making good progress in developing polder and drainage infrastructure. However, these tools (new diversion tunnels, waterways, etc.) are a burden on the city's finances, and the 2011 floods illustrated that they alone may not be able to protect the city from exceptional and unanticipated water runoff caused by extreme weather. One alternative is to develop more "adaptive" infrastructure, such as ecosystem-based measures. Such an example can be found in the city of Portland, Oregon (United States). One of its key policies, in the city's 2005 Watershed Management Plan (PWMP), is the use of plants and soil to slow, filter and infiltrate runoff close to its source, in a way that strengthens and mimics natural functions/processes (OECD, 2012). In Malmö (Sweden), a system has been put in place to drain rainwater from rooftops and other impervious surfaces and channel it through canals, ditches, ponds and wetlands before it arrives in a sub-surface conventional sewer system. The objective was to avoid further overflow in the traditional drainage network (Naumann et al., 2011). Such adaptive measures are important complementary resilience strategies and present three main benefits:

- These strategies are often more cost-effective than polder and drainage infrastructure. It is estimated, for example, that Atlanta's tree cover has saved more than USD 883 million by precluding the need for storm-water retention "grey" facilities (US EPA, 2007). Chicago's experience with its Green Alleys programmes has shown that investing in permeable pavements, downspout disconnections, rain barrels and tree planting are an estimated three to six times more effective in managing storm water per USD 1 000 invested than conventional methods (American Rivers et al., 2012).
- Such alternatives can be put in place more quickly and are more flexible than polders and drainage systems. This is especially important given that projections of future changes in precipitation (due to climate change) and socio-economic trends are subject to considerable uncertainty. Ecosystem-based adaptation measures to counter flood risk can therefore contribute to an "adaptive" management of the BMR.
- Such measures, in particular ecosystem-based adaptation measures, can simultaneously address other green growth policy goals. Green curbs, for example, can increase natural vegetation in cities, create pedestrian space and disincentivise private car use. In addition to offering increased absorptive capacity in heavy rainfall, they are likely to win public support.

The Bangkok and Vicinities Development Structure Plan 2013 and the Bangkok Comprehensive Master Plan (2014-2018) already incorporate some principles of adaptive management to floods, through land-use strategies such as the creation of environmental conservation areas and flood diversion channels (see Chapter 4). Agricultural land is also used, to some extent, to drain water runoff. The following "adaptive" infrastructure strategies could be developed to enhance the BMR's flood resilience:

- Local governments in the BMR should assess how more flexible infrastructures can complement the existing polder and drainage systems, not only in the plains of the BMR but also in denser areas of the city of Bangkok. Cost-benefit and cost-effectiveness analyses could be carried out to compare their performance with conventional flood-protection infrastructure.

- Peri-urban ecosystem-based infrastructures could be developed: in the vicinities of the BMR, the creation or restoration of lost natural habitat (coastal and upstream wetlands, mangroves, forests) and retention ponds can play a critical role in draining and retaining water runoff. This is particularly relevant in the northern suburban upstream areas, where this strategy is more economically acceptable.
- Canals need to be preserved and well maintained. Many have been buried and replaced by roads as a result of sprawling urban development. Those that remain are also losing their function as waterways, partly because they are not well maintained. Dredging canals and removing the waste as well as contaminated soils would recover their functions and improve water quality.
- Smaller scale infrastructure could also be developed in urban centres. There is considerable unused land in the downtown areas of the city of Bangkok that might serve as retention ponds, such as old parking lots or railroads used as dumps for old trains. Instead of buying the land outright, which is prohibitively expensive in these areas, the BMA could simply purchase the right of usufruct for these areas in times of flooding and build dykes around them, while connecting them to the city's water supply and sewerage system. Installing semi-permeable surfaces on secondary roads (*soi*) and small sidewalk rain-absorbing planter boxes could also yield high retention rates. Amendment of building codes, branding of office buildings, compensation mechanisms for water storage capacity and green roof subsidies are some instruments local authorities could use to implement these strategies. New York City provides a variety of practices (Box 3.1).

Box 3.1. **Managing storm water with green roofs and "blue belts" in New York City**

In New York City, street, basement and sewer flooding is expected to become more frequent, due to greater storm intensity and sea level rise attendant on the effects of climate change. Increasing storm water and wastewater flows will be a challenge for the city's existing sewerage system. Built over the course of hundreds of years, the current system is mostly gravity-based. The sunk-cost of the city's sewer systems is huge, and it has almost no flexibility to modify existing piping, either in size or scope, without costly and disruptive retrofitting. Ecosystem-based and green infrastructure approaches have been identified as feasible and cost-effective alternatives (New York Department of Environmental Protection, 2008).

Several initiatives have been taken to promote the use of green infrastructure to manage storm water, including expanding the use of natural landscape for drainage and run-off control, the modification of codes to increase the capture of storm water and the provision of incentives for green infrastructure. Since 2007, USD 1.5 billion has been committed for green infrastructure to clean New York City waterways, by making the city greener and more permeable. The initiative was part of Mayor Michael Bloomberg's goal of making 90% of New York City's waterways suitable for recreation. Hitherto, they had been degraded by excess sewer and rain runoff. The city bargained that this investment, combined with targeted cost-effective grey infrastructure, will reduce combined sewer overflows (CSOs) by 40%. Compared with an "all-grey" approach, this plan is expected to save ratepayers more than USD 2 billion. In addition to improving the quality of the city's waterways, green infrastructure has a number of other benefits, including improvements in air quality, lower energy demand, reduced carbon emissions, increased species habitat and property values, and reduction in the city's vulnerability to the impacts of climate change (City of New York, 2011).

Box 3.1. **Managing storm water with green roofs and "blue belts" in New York City** *(cont.)*

New York City is also using tax incentives to expand the use of green roofs by helping to offset their cost. Expansion of the "Blue Belt" programme, which provides runoff control using natural landscape, is promoting cost-effective storm water management. The programme preserves natural drainage corridors, called "blue belts", including streams, ponds and other wetland areas. This allows them to perform their functions of conveying, storing and filtering storm water, while providing community open spaces and diverse wildlife habitats. It is estimated that the Blue Belt programme saves tens of millions of dollars in infrastructure costs, when compared to providing conventional storm sewers for the same land area (New York City Department of Environmental Protection, 2008).

Source: OECD (2013a), *Water and Climate Change Adaptation: Policies to Navigate Unchartered Waters*, OECD Studies on Water, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264200449-en.

It is important to note that many of these actions could also contribute to climate change mitigation. Green roofs, trees and green corridors could reduce the "heat island" effect and lower energy needs, and provide social benefits by preserving livelihoods in local communities and providing recreational green spaces. Local authorities could start out with some pilot projects in the city to assess how to adapt existing best practices (from the Netherlands, Sweden and the United States, for example) in the context of the BMR, while raising public awareness among local communities about their benefits.

Improving systems through simulation and integrated monitoring technology

The BMA and other relevant agencies operating infrastructure in the BMR should develop technology to help policy makers rethink systems. The objective is to obtain a comprehensive understanding of how water flow and infrastructure interact, and how different types of infrastructure are connected. This will help to inform policies to increase the BMR's capacity to withstand floods. Simulation and monitoring tools are critical instruments that can also encourage green growth.

The BMA has a Flood Control Centre (FCC) that was established in 1990. It uses computer technology to systematically manage flood protection. The FCC monitors and collects hydrological data (rainfall and water level), data on the condition of operation facilities, on flood damage and water quality, using an online system. Improvement of this flood technology system could also help inform decisions on infrastructure that can boost the BMA's resilience to floods. The Public Utilities Board of Singapore, for instance, is using a cutting-edge simulation software called 3Di.[1] This not only measures real-time water levels in different places in the city, but analyses, models and forecasts potential water flows in the city in case of flash floods. Such a system can help to identify catchment-wide solutions to reduce the speed of surface runoff in urban areas, to identify which areas to monitor and to decide proactively on appropriate infrastructure and land-use strategies (Public Utilities Board of Singapore, 2013). Such technology would be a good complement to the existing FCC for the BMA. Most importantly, the FCC and other types of technology-based assessment as 3Di should be distributed to other local authorities in the BMR and integrated into the metropolitan-wide monitoring framework, to harmonise the analytical capacities over the entire metropolitan region, thereby

encouraging a comprehensive regional approach. This is critical, because most of the infrastructure is in the city of Bangkok, and the software may help to identify needs in other provinces of the BMR that are also risk factors for the city.

A city's flood resilience does not only depend on flood-protection infrastructure. Improvements to the wastewater treatment system, in particular, will be critical in avoiding public health issues. Biochemical oxygen demand (BOD) and dissolved oxygen (DO) are at critical levels in many canals (see Chapter 1), and pollution created by untreated water can create public health issues when a flood occurs. Similarly, uncollected solid waste in slums and informal settlements along the river and canals can be a source of concern, as floods can spread them throughout the city, causing severe environmental degradation and public health hazards. After the 2011 floods, in the month of December, the amount of solid waste generated dramatically increased to around 12 000 tonnes per day, from around 7 000 tonnes per day in November. This was mainly due to the damages to household furniture and materials (BMA, 2012). In addition, waste sometimes obstructs drainage pipes, compromising the efficiency of flood protection infrastructure. Improving the performance of wastewater and solid waste treatment performance will be a crucial part of increasing the BMR's resilience to floods while fostering green growth.

Transport also presents major infrastructure challenges that can affect the BMR's resilience to floods. Mass transit and non-motorised transport modes can help offset the road-centric development of the BMR. This has increased its vulnerability to floods, by destroying natural habitats and encouraging urban sprawl. Few wide roads are connected to the main arteries of the city in low-income communities, which exposes the urban poor to risk during floods and obstructs relief operations (Marome, 2014).

Such factors illustrate the need for infrastructure systems thinking. Assessing how different types of infrastructures interact with each other in case of disaster is a critical part of identifying needs and adapting infrastructure, economic and social policies accordingly. To achieve this difficult task, local authorities in the BMR and the central government could consider developing other types of IT management tools, relying on high-technology sensor networks that monitor all critical infrastructure in the region (energy, water, solid waste, flood defences, transport, etc.). Collecting data will help to study their overall performance on a day-to-day basis and in case of disaster. The Operations Centre of the city of Rio de Janeiro is a good example of a citywide data system integrating information on different types of urban infrastructure. It was developed by IBM and collates all data, input online, to identify trends and complex impacts of potential disasters, such as floods, fires and landslides. This can help decision makers select the most appropriate action and identify which urban areas need support.[2] The BMA and the Thai government could consider developing such technology progressively in the BMR.

Promoting flood-resilient land use in the Bangkok Metropolitan Region

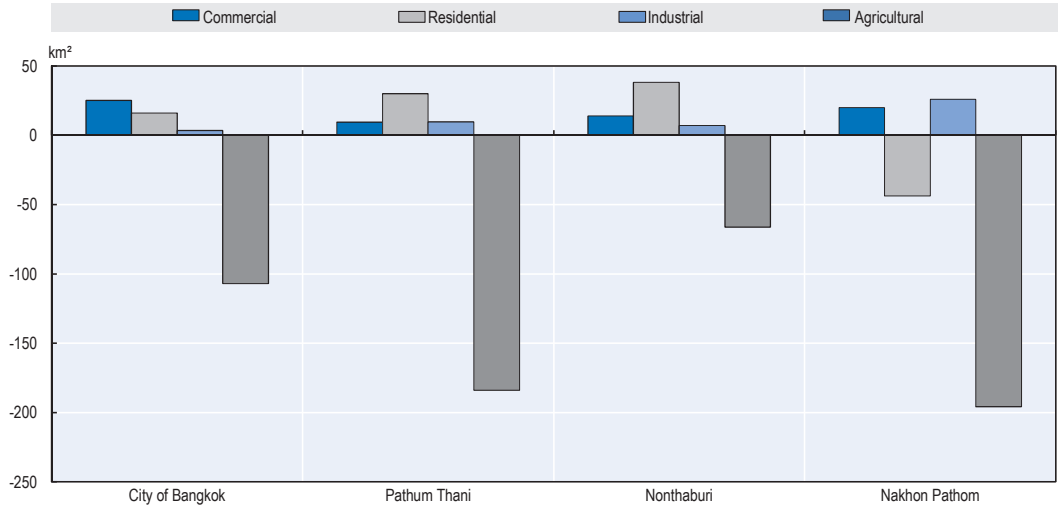
Co-ordination mechanisms can help promote flood-resilient land use in the Bangkok Metropolitan Region

Urban development can expose the BMR to further risks by allowing people to settle in flood-sensitive areas. Urban planning should control land use to avoid exposing businesses and people to floods. It is also important to climate-proof critical infrastructure.

The city of Bangkok and the surrounding provinces of the BMR in particular have undergone major changes in land use over the past 20 years, with significant loss of agricultural lands and an increase in residential, commercial and industrial land use. More than 30 km^2 of residential areas were created in the province of Pathum Thani between 2001 and 2010, while around 184 km^2 of agricultural land was lost (Figure 3.2). According to international research,[3] private construction and real estate driven by speculation and short-term economic gain has been a critical component of the BMR's rapid urban growth (Marome, 2013). Such development has had a detrimental effect on the city's flood resilience. Urbanisation in the vicinities of the BMR has been responsible for the disappearance of natural areas of water retention (swamps, wetlands, etc.) and natural flood ways (Snidvongs, 2012) that play a key role in managing excess water and limiting the damage from flooding. Mangroves, a critical natural feature in the metropolitan region that buffer the effect of storm surges, are also being cut down at a rapid rate, and are affected by coastal erosion (WWF, 2009). Land subsidence has also affected the city's exposure to floods, but it is no longer proceeding as rapidly in the city of Bangkok, unlike in industrial areas in the east of the city.

Figure 3.2. **Land-use change in Bangkok and three surrounding provinces of the Bangkok Metropolitan Region**

2001-10



Source: Marome, W. (2013), "Urban risk and vulnerabilities of coastal megacity of Bangkok, Thailand", proceedings of the 4th Global Forum on Urban Resilience and Adaptation, 31 May-2 June, Bonn, Germany.

One of the obstacles to efficient land use in the BMR is the lack of co-ordination mechanisms to promote flood resilience, such as the preservation of natural drainage habitats or zoning regulations for industries. This could negate the policies of one local government or the Thai government. The following efforts could be taken in the five provinces of the BMR:

- Implement regional land-use plans in all local plans: the 2014-2018 Bangkok and Vicinities Development Structure Plan defines some land-use and transport strategies at the scale of the BMR (see Chapter 4), and some of them may help to improve the BMR's flood resilience. They include: 1) specific locations for industries; 2) low-density areas that can serve as flood channels or emergency water storage areas; 3) wetland conservation areas to protect coastal zones; and 4) extending the

mass transit network. However, this is not legally binding. Public authorities should first make sure that other surrounding provinces in the BMR develop local spatial plans that are consistent with the 2014-2018 Bangkok and Vicinities Development Structure Plan. Metropolitan commissions on land use (see Chapter 4) could assess to what extent the regional plan is translated into all local plans in the BMR and consider what action might be taken if not.

- Regulations for flood-resilient buildings in the BMR should be co-ordinated. Bangkok's Comprehensive Plan 2014-2018 provides tools that can be used to enhance flood resilience, such as the FAR Bonus System, minimum open space ratio (OSR), setback along rivers, canals and main roads, and control of building heights and sizes. The FAR Bonus System, for instance, encourages developers to provide green space and rainwater storage areas (Box 2.1). However, these tools have only been adopted by the BMA, and all local governments in the BMR should be using them.
- Finally, zoning mechanisms should be used to restrict the location of firms in Pathum Thani and Samut Prakarn, where industries are highly exposed to floods because of their proximity to the Chao Phraya River. Local land-use controls should target the location of new industries, large commercial buildings and housing, in a consistent and coherent regional approach. Such land-use strategies would help mitigate losses and damages from flooding in the future.

The government, possibly with the assistance of metropolitan committees and advisory boards, could help municipalities achieve these goals, if they lack the requisite financial and technical capacity. They could also provide the political leadership necessary for this demanding enterprise (see Chapter 4).

Enhancing and enforcing land-use control through regulatory and financial instruments

Local governments should enhance land-use control tools. The effectiveness of the FAR Bonus System to date, which is not mandatory for developers, is questionable, and incentives to increase its impact (e.g. financial incentives for implementing the bonus) or imposing more binding rules could be considered. The potential for the local land improvement tax to reshape land use for flood resilience is underutilised in the BMR. The BMA and other BMR local governments could target specific locations where the rate of the land improvement tax could be raised, or alternatively, introduce development fees as disincentives to build and settle in areas of the city exposed to floods. Such instruments should avoid targeting existing low-income communities along canals and rivers, to avoid imposing an additional burden on them. Part of the revenues collected by local authorities from such taxes could be earmarked for flood resilience projects, to ensure that financial resources for this purpose are scaled up. They might, for example, finance projects to upgrade housing in low-income communities or relocate them to safer areas. Authority for implementing these taxes and development fees lies in the central government, which would need to closely co-ordinate these proposed measures with local governments.

Local governments should also improve the enforcement of land-use controls. Financial instruments could promote flood-resilient land use and strengthen the enforcement of land-use regulations. Penalties should be imposed on developers that do not comply, for example building in flood-sensitive areas in violation of zoning codes. In the BMA, the Financial Department and the City Planning Department are key stakeholders for achieving this objective, but financial and technical capacities need to be built up with the support of the central government.

Mapping flood risks in the Bangkok Metropolitan Region

Local governments in the BMR should also develop instruments to assess which urban zones and residents are particularly vulnerable to floods and design land-use regulations accordingly. Flood-risk assessment and mapping is not used widely, especially to protect low-income communities at risk. This may be the result of a lack of local capacity to develop and use the necessary technology, or a lack of awareness among local governments about the benefits of such tools. Flood-risk assessment can help communities and local governments better understand which people, places and assets are most exposed and inform them of possible flood adaptation policies. This can be done by mapping zones at risk of floods, in terms of exposure (e.g. topography and geography), but also in terms of vulnerability (e.g. social and economic factors such as proximity to social infrastructure, poverty, land tenure, insurance, enterprises, etc.). Such tools complement high-technology flood modelling systems, which predict and track the flow of water runoff in support of appropriate water management infrastructure and policies. For example, USAID provides useful guidance and key policy recommendations that local, provincial and national authorities could follow to develop capacities to assess their vulnerability (USAID, 2014). Key considerations would be to choose methods suited to the goals of the target groups of concern; to document data, methods, uncertainty and assumptions wherever possible; to invest in public outreach and communication; and to work directly with end users to improve their understanding of the results.

Flood-risk assessment tools should be used to assess both current and future threats. From this perspective, risk screening should be applied to areas where new development is likely to occur, and land-use regulations (e.g. zoning, building permits) could be used to create disincentives to develop such lands to avoid creating new zones at risk. In France, local prevention plans delineate areas at various levels of risk based on previous floods, but also according to predictions for the future. These measures should reinforce or complement economic interests (e.g. tourism) by taking flood risks into account.

Promoting the Bangkok Metropolitan Region's economic resilience to floods

The 2011 megaflood that hit the BMR and other parts of Thailand is reported to have been among the costliest natural disasters since the 1980s, along with the Great East Japanese tsunami and earthquake (2011), the Sichuan earthquake (2008), the Kobe earthquake (1995) and Hurricanes Katrina (2005) and Sandy (2012), in particular. It resulted in losses in the global supply chain of USD 44.2 billion and significantly slowed Thailand's economic growth in the months that followed the floods (OECD, 2013b). The flood revealed that most manufacturing industries were prepared for floods, which increased the magnitude of the damages. The manufacturing sector suffered a loss of USD 32 billion (i.e. 70% of total losses) at the country level. Forty-five percent of the world's manufacturing capacity of computer hard disk drives are produced in the affected area, and due to the flood disaster, it is estimated that global supply of hard drives fell 30% that year (OECD, 2013b). The tourism, financing and banking sectors were also significantly affected (Ahsan, 2013). In the city of Bangkok, total damages reached THB 296 billion (USD 9.3 billion at 2014 prices), and 58% of the damage went to the industrial sector (Table 3.1). More than 1 000 factories were affected in the Bangkok region and Bangkok's secondary airport, Don Mueang, was closed for six months (OECD, 2013b).

Table 3.1. **Damages sustained by different economic sectors in the city of Bangkok from the 2011 flood disaster**

Sector	Damage (THB billion)	Damage (% of total damage)
Industries	171.9	58
Business and infrastructure	54	18.3
Agriculture	37.1	12.5
Services and others	33	11.2

Source: BMA (2014), "Bangkok flood control", Department of Drainage and Sewerage, presentation made at the Bangkok Knowledge Sharing Workshop on Urban Green Growth in Dynamic Asia, 6-7 August, Bangkok.

Supporting business by enhancing insurance mechanisms and linking them to green growth

Economic resilience does not only imply being prepared for and withstanding shocks, but also being able to bounce back and emerge stronger than before (Matsumoto and Daudey, 2014). Insuring disaster-related losses is a critical instrument of flood resilience, complementing infrastructure protection. In Thailand, the insurance sector provides property insurance for losses due to the interruption of commerce by natural disasters. It also offers natural disaster coverage under life insurance policies, for automobile and personal accident insurance and for crop-failure insurance (OECD, 2013b). The affordability of flood insurance policies, however, can be a significant barrier, especially considering the frequency of such disasters, which increase premiums on the instruments. After the 2011 floods, many businesses and individuals struggled to find affordable insurance policies to cover flood damages and losses. Of the total losses in 2011, only about USD 10 billion were insured. In response, the national government set up the National Catastrophe Insurance Fund (NCIF) in 2012, which is used as a reinsurance reserve, and regularly raises awareness about it and other insurance products at seminars and events (OECD, 2013b). Local insurance companies that issue policies carry part of the risk and transfer the rest to the NCIF, which passes on a portion of that risk to international carriers operating on the global reinsurance markets (OECD, 2013b).

Ensuring economic resilience to floods also means building capacity to evaluate post-disaster needs and prepare for post-recovery and reconstruction plans. The Ministry of Interior, with the help of the World Bank and other development partners, undertook an assessment of the impact of the 2011 floods in 26 of the 66 provinces affected by the disaster. This offered recommendations for recovery in several economic sectors (OECD, 2013b). Thailand's Office of Insurance Commission (OIC) collects data from insurance companies, which keep track of insured losses. These data are then transmitted to the NCIF. The OIC also reviews the capital adequacy of companies' exposure to disaster risks, so that they can be adequately covered in risk-based capital reserve calculations (OECD, 2013b).

Insurance systems could be further discussed to provide further protection against floods for the BMR's economy. Crucially, the private sector should be encouraged to participate in the system though tax incentives, especially for small and medium-sized enterprises. Certain industries could be required to participate. Such risk-financing mechanisms could be combined with risk reduction: more incentives could be given to developers and builders to "build back better" (e.g. by increasing access to public transport, nearby shopping centres, restaurants and recreational opportunities, and providing green public spaces), to avoid simply rebuilding and exposing housing to the same risks. The national government could subsidise insurance compensations or provide

matching funds based on such efforts (OECD, 2014). The national and local governments could also consider investing in *ex ante* parametric risk-financing instruments or disaster reserve funds. The objective is to avoid having to mobilise and shift budgets from other competing demands in the aftermath of a flood disaster. In Austria, for instance, the Catastrophe Fund (*Katastrophenfonds*) is used to finance damages from disruptive shocks sustained by public bodies, households and businesses, which also require *ex ante* prevention investments and actions taken before the fact. It is financed by a mix of income, capital and corporate taxes (OECD, 2014). International development partners and donors could also participate in such schemes, given that Thailand may have lower financing capacities than a developed country. Finally, more research needs to be conducted on how to optimise such safety-net mechanisms. A clearer evaluation of potential damages across sectors and jurisdictions would be useful to raise awareness on the need for safety nets and insurance policies. Better informed, pro-active decisions on green growth can protect residents and their livelihoods, places of special importance, private and public property, and other BMR assets, with multidimensional benefits.

Encouraging businesses and industries to develop their own resilience strategies

To ensure long-term economic resilience to floods, national and local authorities can also encourage the private sector to design their own business continuity and post-disaster recovery plans, to reduce disruption to their economic activities. The Greater London Authority has developed a Business Preparedness Checklist available online, and a five-step strategy to assist the private sector in business continuity planning. This includes: 1) analyse the business; 2) assess the risks; 3) plan and prepare; 4) communicate the plan; and 5) test the plan. Each of the five strategies are adapted according to the size of the business at risk (small, medium or large). The Greater London Authority also features key actions to be taken in case of a shock, and pools knowledge on best practices for urban resilience worldwide (Greater London Authority, n.d.). In Florida, the Business Continuity Information Network helps to connect businesses and their employees with local governments before and during a disaster. It allows the company to stay connected after a disaster, to share critical reports about facilities and monitor the condition of the community where the business operates. (Business Continuity Information Network, n.d.). Local authorities in the BMR can learn from such examples.

National and local governments should also encourage the private sector to take voluntary infrastructure measures to protect their businesses. After the 2011 floods, the Industrial Estate Authority, a public company run by the national government, provided financial assistance for the construction of flood protection infrastructure around industrial facilities. In the city of Bangkok, and the provinces of Pathum Thani, Samut Sakhon and Samut Prakarn, a total of around THB 6.8 billion (USD 211 million at 2015 market prices) were invested in the construction of concrete walls, dykes and sheet piles (Thampanishvong, 2013). One option would be to develop such initiatives, especially for small and medium-sized (manufacturing) enterprises with relatively weak financial reserves and limited management capabilities. It is critical, however, that such investment does not result in mal-adaptation measures. An "individualised" approach to protect one business (e.g. building a single dyke) could put neighbourhood or downstream properties and assets at greater risk, and it is in the financial interests of businesses to invest in flood resilience measures consistent with regional plans and strategies, to guard against this. National and local authorities should assist the private sector in making comprehensive investments to prepare for large-scale floods in the BMR. Standing committees or councils involving major stakeholders from the public and private sector could be created

at the BMR level to organise defences against floods. They should be chaired by the Thai government, which plays a prominent role in building resilience to floods in the BMR, and should also be supported by specific funds allocated by the Thai government to support these strategies (see Chapter 4). Decisions should be based on the information of the database on businesses and industries and their vulnerabilities, as mentioned previously.

It is also crucial to understand that such infrastructure effort by the private sector can contribute to the resilience of the communities in which they are located, their workforce and its ability to get to work, and the ability of supply chains to continue functioning or return to normal functioning as quickly as possible. Moreover, resilience measures also generate significant co-benefits, such as improved green spaces, healthier environments in which workers live, a more attractive and safer community to attract a better labour pool, and a better quality of life. For example, the financial support provided by the Industrial Estate Authority could expand such a comprehensive approach in its efforts to create pocket parks in neighbourhoods.

Developing the knowledge base of economic vulnerability

One important element the BMR needs to increase its economic resilience to floods is to develop a knowledge base of economic vulnerabilities. Experts and policy makers in the BMR could make use of the Aqueduct Global Flood Analyser,[4] a recent tool developed by the World Resources Institute, that estimates the future economic and human consequences of floods under a variety of scenarios. For instance, in a scenario of severe climate change and continued current socio-economic development trends, it estimates that even with a 100-year flood protection system, the annualised gross domestic product (GDP) affected by inland floods in the BMR could currently reach USD 450 million (USD 272 million for the city of Bangkok alone) and USD 2.7 billion in 2030 (USD 1.7 billion for the city of Bangkok alone). Most of the increase in the losses by 2030 would be caused by socio-economic change. However, this tool is only a basis for reflection, as infrastructure is the main variable taken into account to calculate economic and human damages. Experts and policy makers must also integrate cost-benefit analyses of resilience policies and develop "soft" policies to properly tackle economic vulnerability to floods.

To enhance the city's economic resilience, local governments in the BMR should further develop information and mapping of the people, places and assets at risk. This will provide the basis for flood risk assessments so that corrective action can be taken. A database of businesses and industries could be built, with information on the type of enterprises by sector and area, employment size, access to roads and other basic services, etc. This would inform the risk assessment exercise and help create maps showing information on economically valuable areas and assets, as well as centres of employment for lower skilled people who live and work in the BMR.

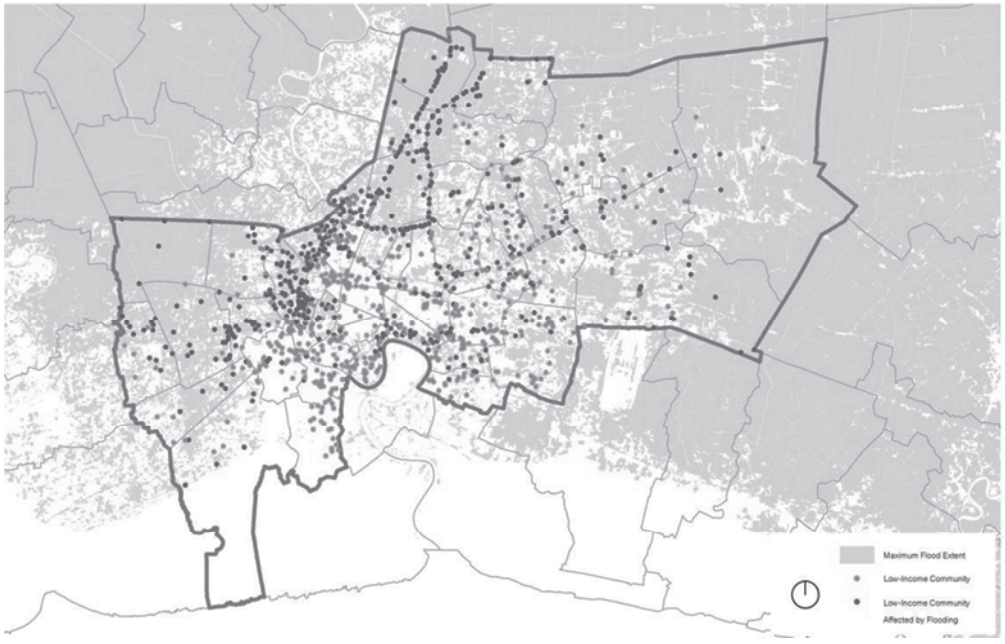
Encouraging participation and input from businesses and industries could also be helpful in building this database on economic vulnerability. Local authorities in the BMR could involve private stakeholders by providing a platform where the public and private sectors can exchange information on their vulnerabilities and needs. In the United States, the US Economic Development Administration (EDA) of the Department of Commerce, thanks to its six regional offices working closely with local partners, has organised conferences where community actors, including business owners, were invited to share their experience regarding disaster resilience. The US EDA then funded the Vermont Economic Resilience Initiative, consisting of community forums gathering local

representatives. Participants were invited to provide input on a series of questions about current threats, needs and successes of economic stakeholders in building greater resilience to shocks and stresses. This event has been a useful way of communicating between the public and private sectors. As a result, local action plans were sent out as templates to all communities in Vermont (Vermont Agency of Commerce and Community Development, n.d.). The US EDA has also set up a website where economic stakeholders can exchange information on how to overcome challenges. This online space also disseminates best practices for economic resilience. (Restore Your Economy, n.d.). In the case of the BMR, such joint discussions could be organised with the help of major private organisations, such as the Thai Federation of Industries, or TIPMSE, or within the framework of metropolitan taskforces/committees specifically dedicated to resilience to floods, as noted previously. Not only could it help obtain information from the private sector, but it could raise the awareness of the private sector about flood resilience issues in the city.

Promoting the Bangkok Metropolitan Region's preparedness and response capacity to floods

Floods in the BMR may entail not only significant economic but social costs. In the 2011 floods, no fewer than 42 of the 50 districts of the city of Bangkok were under water, affecting around 1.8 million residents. Human damages are also likely to be high in case of future floods: in one scenario of severe climate change and continued current socio-economic development trends, and even with a 100-year flood protection system, the Aqueduct Global Flood Analyser estimates that around 54 600 people would be affected by inland floods in the BMR (around 35 500 in the city of Bangkok alone) and that around 144 500 people would be affected in 2030 (around 88 400 in the city of Bangkok alone). The 2011 flood also highlighted the vulnerability of the poor to extreme weather events: 73% of people within its communities of urban poor (i.e. 457 805 people) were affected by the disaster – a far higher share than for more affluent segments of the population (UN ESCAP, 2012). Floods disproportionately affect the urban poor in the BMR and deepen poverty and inequalities, resulting in weaker long-term economic growth. As explained earlier, they tend to settle in vulnerable areas such as canals and riverbanks (Figure 3.3). While this can be explained by their poor access to urban services, such as electricity, transport, and water supply and treatment, it also stems from a lack of efficient policies to directly protect them from floods. To increase the BMR's resilience to floods, it will be critical to enhance the preparedness and response capacity of local communities, especially the urban poor.

Figure 3.3. **Low-income communities affected by the 2011 floods in the city of Bangkok**



Source: National Housing Authority (2012), "GIS-assisted approach in housing development for low-income earners", GIS Section, Department of Housing Development Studies, presentation made to the delegation from SUDU, UN ESCAP, Bangkok.

Encouraging direct participation of residents in building resilience to floods

One of the most important policy responses of the BMA to contain the social impact of floods on local communities is the Bangkok Disaster Prevention and Mitigation Plan 2010-2014 (BADPREMOP-2010-2014). This defines the actions of the Bangkok Fire and Rescue Department (BRRD), the lead BMA agency in charge of disaster relief in the city of Bangkok, and follows the guidelines of the National Disaster Prevention and Mitigation Plan 2010-2014. These plans particularly target pre-disaster preparation (e.g. improve public awareness, education and safety), incident management (e.g. evacuation to shelters) and post-disaster management (e.g. infrastructure reconstruction).

These three types of actions are mostly top-down, while one of the most effective strategies to fight floods, which is not explicitly specified in the Disaster Prevention and Mitigation Operational Plan, is the direct involvement of these communities before, during and after a disaster. During the 2011 megafloods, many residents volunteered to fight floods (Global Disaster Preparedness Centre, 2013). This encouraged the BMA to change its strategy and to co-operate more with the local residents, by going out into the field to the volunteers' camps, and discussing the flooding issues with local leaders in these camps. This co-operation provided remarkable help and human resources to fire fighters, for carrying supplies and helping the most vulnerable populations in the city (e.g. the elderly, the young and disabled).

The assistance provided by volunteers during the 2011 flood is a good example of the benefits offered by joint actions between local authorities and communities and individual citizens. Such contributions could have been used even more efficiently had their response been organised *ex ante* and their co-operation and collaboration been worked

out in advance. Mechanisms to allow civil society organisations (CSOs) to participate in the design of disaster action plans should be reinforced, so that they can make contributions based on their knowledge and experience of practical and viable community-based responses to disasters. The important role that is played by communities and individuals acting as "first responders" was dramatically demonstrated in the Great Hanshin Earthquake of 1991 in Kobe, Japan, where more than 27 100 people were rescued by their neighbours, as compared with only 7 900 by the Kobe Fire Department (IFRC). The Netherlands and the United States also provide some innovative practices of stakeholder engagement that Bangkok could replicate (Boxes 3.2 and 3.3).

Box 3.2. **A three-dimensional tool to engage stakeholders in flood defence**

In 2008, the Dutch water authority of the Rijnland in the Netherlands launched a project on integrated coastal works to strengthen primary water fences near the municipalities of Noordwijk and Katwijk.

The project included the development of an innovative three-dimensional vision game. Game sessions were organised by the regional water authority, which invited small groups of stakeholders to participate. Overall, 75 people attended, including local officials, restaurant and hotel owners, inhabitants, non-governmental organisations (NGOs) and local business. Participants were given certain budgets and tasked to develop innovative water-fencing solutions. These exercises helped raise awareness among the stakeholders involved of their respective interests. The regional water authority, as a result, shifted from sharing messages to facilitating the communication process, with the aim of creating ownership of the outcome. Creative solutions emerged from these sessions that were later considered by the regional water authority in the project. Stakeholders involved in the game suggested finding additional space for an underground parking garage that was subsequently built in the inner zone of the dune, with capacity for 650 cars. The simulation game also helped regional water authorities build lasting relationships with stakeholders and encouraged better communication between those working and living in the coastal area.

Source: OECD (2015), *Stakeholder Engagement for Inclusive Water Governance*, OECD Studies on Water, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264231122-en.

Another example is offered by the city of Kitakyushu (Japan), which has also experienced periodic flood disasters. The city developed co-ordinated response mechanisms between civil society and local government. The local government set up frequent meetings with citizens living in vulnerable urban areas to exchange information and experience on both sides ("shared learning dialogues"). It allowed the city to come up with improved safety measures for residents, and raise awareness about the need to settle in safer areas of the city. Similarly, local and national authorities can take inspiration from the Vietnam Urban Forum (VUF) initiative, which gave diverse representatives from CSOs a vehicle or means to share their views on urban issues of concern. One of the focal discussion points of the forum was how to integrate climate change adaptation into urban development planning and management. Similar types of multi-stakeholder forums could be set up on any number of issues of concern, such as flood resilience, a shift to greener transport modes, land-use planning and building codes, water supply and wastewater treatment needs, and enhancing urban green spaces in the BMR, at the regional scale as well as at the individual provincial and district levels. Such interactions could be facilitated by officials and local leaders, especially in slum areas, which are typically less accessible and under-represented in public policy discussions and decisions.

Box 3.3. **Community engagement for post-disaster recovery in the United States**

Founded in response to the devastation of Hurricane Sandy in 2013, Rebuild by Design has been dedicated to creating innovative community- and policy-based solutions to protect American cities vulnerable to increasingly intense weather events. Initiated by the Presidential Hurricane Sandy Rebuilding Task Force and a partnership between US Housing and Urban Development and the Rockefeller Foundation, Rebuild by Design's aim was to connect the talented researchers and designers with the active businesses, policy makers and local groups in the area affected by Sandy. The goal was to understand how to redevelop their communities in environmentally and economically healthier ways, and to prepare better for the next storm.

The Rebuild by Design competition was held from June 2013 to June 2014 and addressed the structural and environmental vulnerabilities Hurricane Sandy had exposed in communities throughout the region. It also developed solutions to protect residents from the dangers posed by future climate events. Given the enormity of this challenge, the Rebuild by Design process was developed to find better ways of implementing designs and informing policy. The competition included a year of thoughtful engagement by the design teams, who formed strong local coalitions, tailored to specific geographies, to develop fundable, implementable solutions to inform new policies on every level. These coalitions, comprised of local and state government officials, government agencies, businesses, community members, advocates, etc., worked intensively with each team to develop their final design proposals. They also continued to convene and connect beyond the design competition timeline, developing local resiliency networks that continue today.

Beyond developing strategic partnerships in their communities, design teams were required to host public workshops to ensure they were designing solutions embraced by their constituents. Considering the differences in projects, communities and designers, Rebuild by Design partners did not set a specific format for how these workshops should be implemented. Instead, design teams were asked to work with local community partners to develop workshops or public programmes that would attract the broadest audience and allow for the greatest participation.

During the competition, the Urban Institute completed a rigorous evaluation of the entirety of the competition, including the engagement process. The evaluation process consisted of interviewing over 100 individuals involved in the competition year, from the teams to community stakeholders and funders. The evaluation showed that stakeholder coalitions and groups on the ground have taken ownership of the project. The model created a network of hundreds of leaders who are invested in the outcome of these projects and are now working to ensure the government implements the projects with the same level of innovation and community-based design. The 535 organisations throughout the Sandy-affected region, 64 communities, 141 neighbourhoods and cities, and 181 government agencies were involved. Now educated, they have become owners and advocates of the implementation. Rebuild by Design and its partners have demonstrated that by working together in this regional design process, ambitious, realistic, more resilient standards of development and infrastructure can be set and respond to communities' needs in a changing world.

Source: OECD (2015), *Stakeholder Engagement for Inclusive Water Governance*, OECD Studies on Water, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264231122-en.

Increasing social resilience and public awareness through districts, schools, churches and media

Mobilising urban residents to fight floods and making them agents of resilience to floods in the BMR can be more easily implemented through district administrations, schools, churches and media. Local governments in the BMR can encourage the involvement of these civil society institutions/entities in more decentralised preventive strategies. Local communities can be helped to build greater resilience to floods by increasing their "social capacities" to self-organise, prepare for and respond to stresses

and shocks (crisis), which is reported to be lacking in some communities (Marome, 2014). It will be critical to raise public awareness among urban residents on a community-by-community basis.

The city of Bangkok is composed of 50 districts, each with an elected mayor. These are further divided into 169 sub-districts. The BMA could leverage its human and financial resources by encouraging the establishment of community-based resilience committees at the district level and providing them with capacity-building training. With other technical and logistical support, they could carry out simple vulnerability assessments and develop threat or risk maps, and establish some priorities among actions to enhance their resilience. These could then be proposed to the BMA and other provincial governments or BMR-wide resilience commission for approval and funding.

Schools and churches (Buddhist *wat* and Muslim temples in Bangkok's case) are natural centres for community action and organisation. They possess several critically important physical assets and attributes in times of crisis, such as having large open areas that can act as emergency shelters, with food preparation operations and eating facilities, medical attention units and staff. Their organisational lines of authority and responsibility are already operational, and they are also an integral part of a community's social capacity or capital. Residents are used to frequenting them and talking to their neighbours about all sorts of issues of common interest. When it comes to building greater resilience and adaptive capacity to prepare for, respond to and recover from shocks and crisis, physical and social assets and attributes go hand in hand. A major threat to flood resilience is a lack of social capital on the ground, which can lead to inaction when a disaster occurs. In the BMR, lack of information and interest among residents – partly owing to lagging levels of education – has been identified as a key social obstacle (Institute of Development Studies, 2007). School education and capacity-building programmes on the management of floods, and making information on flood risks publicly available could also complement these community-based workgroups or committees. The following measures could be implemented in schools and churches:

- School programmes and religious centres can raise awareness of flood risks, and include practical workshops to build knowledge on how to manage floods at the household and community levels. They can also serve as efficient communication channels assisting district administrations, and provincial and national governments. If they deploy early warning systems in the neighbourhoods where they are located, they can inform the population about the imminence of a flood. Likewise, they can be critical "first responders" and "safe havens" to complement local authorities' action to protect local communities and assets in case of disaster.
- Flood risk maps should be made publicly available and widely disseminated in schools and churches to communicate the risks and preventive or corrective actions that can be taken by local communities. Simple posters, local newspapers and online, in particular through social networking programmes, are all options. Three-dimensional (3D) flood mapping tools could also be used for this purpose. Schools and churches could even play a greater role by reviewing and refining base maps showing physical infrastructure assets, elevation or proximity to other "risk factors" such as rivers, canals and the coast. The BMA and the 50 district administrations could train schools and churches in how to do simple flood-risk assessment. If it is successful, the idea could be picked up and replicated in other provinces of the BMR.

Finally, the media is another important civil society stakeholder to involve in raising public awareness. Topical urban issues in the BMR can be publicly debated, in multiple

media resources, such as radio shows, news articles, social networks and other digital and physical platforms. Local authorities could consider ways to encourage and support the media in raising awareness among the local population about the need to be prepared for the unexpected. Unpredictable events are becoming more and more frequent (the "new normal"), and urban residents must be ready to take action under different disaster scenarios. Local authorities could work more systematically with the media as new strategies to build resilience to floods are announced, and also in workshops, training sessions and forums. This will also enhance a sense of community, a key element in building social capital and resilience to floods.

Main policy recommendations

- Complement existing infrastructure with mangrove forests and wetlands; **semi-permeable surfaces on secondary roads and sidewalks with rain-absorbing planter boxes**, and urban parks and **ecological corridors** ("greenways").
- Complement the Flood Control Centre with **state-of-the-art flood simulation tools, early warning systems and integrated data collection systems** to analyse and disseminate information in real-time on changing conditions during times of crisis or urgent need.
- **Co-ordinate flood-resilient building regulations** in the entire BMR, and more consistently enforce zoning mechanisms and land-use controls to build resilience to floods, such as by more assertively using land value capture tools and financial incentives.
- **Develop maps of urban flood risk zones that more accurately reflect changing flooding threats** (in terms of exposure and vulnerability) to inform policy makers, residents and businesses of the potential future impacts.
- **Promote insurance** mechanisms to build greater financial resilience while supporting green growth policies and programmes, **business continuity plans** and a **database of economic vulnerabilities**.
- **Use existing community entities, such as schools, religious centres and public facilities**, to increase local communities' resilience to floods and other threats more comprehensively. **Engage the media** in the coverage of such events and to broadcast public interest messages, community events and information about flood risks and other impending threats.

Notes

1. The 3Di Water Management software was developed by Deltares, the Delft University of Technology and Nelen&Schuurmans, in the Netherlands.
2. www.epa.gov/jius/projects/rio_de_janeiro/rio_operations_center.html.
3. Coastal Cities at Risk (CCaR): Building Adaptive Capacity for Managing Climate Change of Coastal Megacities (Vancouver, Manila, Lagos and Bangkok) is funded by the International Development Research Centre (IDRC) and three Canadian research councils.
4. See: http://floods.wri.org/#/state/4000/Bangkok%20Metropolis,%20Thailand (last accessed 16 January 2015).

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Chapter 4.

Governance for urban green growth in the Bangkok Metropolitan Region

Chapter 4 examines strategies that can boost green growth in the Bangkok Metropolitan Region (BMR). Previous chapters analysed areas of opportunity for urban green growth in the BMR, while this chapter considers the existing tools and remaining challenges to make sure green growth policies have a concrete impact. The following issues require particular attention:

1) vertical and horizontal co-operation among various government jurisdictions in the BMR

2) the involvement of communities, civil society, the private sector, the media and research institutions

3) financing options

4) capacity-building activities

5) role and contributions of international co-operation agencies.

Main points

- Thailand's central government ministries and agencies with specific mandates for managing key infrastructure exert a strong influence over land-use development patterns and key urban services in the Bangkok Metropolitan Region (BMR). **Vertical co-operation is needed** to pro-actively direct the spatial development process as well as the production and consumption of energy of the metropolis efficiently. **Lack of horizontal co-operation is also an obstacle** to the implementation of policies, plans and programmes in the BMR. Opportunities therefore lie in better institutional co-ordination and collaboration.
- Achieving urban green growth in the BMR will also require mobilising as many non-public sector stakeholders as possible. This is all the more important considering the extent of problems faced by the city, and local governments' limited capacity to undertake the necessary policies in each area of opportunity. Therefore, local governments should seek to involve local communities, the private sector and higher education institutions in **creating networks of opinion makers ("resilience champions") and supportive stakeholders to promote urban green growth policies and programmes**.
- The means to finance urban green growth in the BMR needs immediate attention and should be pursued aggressively. **Local revenue generated by the BMA alone cannot meet the pressing needs of key urban infrastructure systems**, and will require sufficient levels of private investment and a diversified field of revenue sources.
- Building the technical capacity of local governments is a critical step. The Thai government and international partners have provided assistance to train and share knowledge with local governments, but their capacity could be further developed, including results-based monitoring and evaluation systems. The BMA has developed key performance indicators (KPIs), but no such mechanism exists at the level of the BMR. Similarly, **data is not consistently produced at the scale of the BMR**. This undermines local administrators' capacity to monitor progress towards green growth, to understand the underlying dynamics affecting the entire BMR and to estimate the region's investment needs in a more integrated, efficient manner.
- **International development agencies** have an important role to play, both in financing the BMR's priority green growth actions through national and local plans, and in building capacity. In the past decade, local and national authorities have begun to support a shift towards green growth and resilience, with the help of development agencies such as the World Bank, the United States Agency for International Development (USAID), the Japan International Co-operation Agency (JICA) and several other important initiatives, such as the 100 Resilient Cities Initiative. However, the pace of action needs to be accelerated, and successful programmes and pilot projects scaled up quickly if the BMR is to meet the challenges of climate change, rapid urbanisation, growing social inequality and unsustainable economic growth.

Enhancing vertical and horizontal co-operation

Institutional co-operation can help increase the coherence of policies at different levels of government, and improve the efficiency of public action at the local level. Two aspects, in particular, merit attention: 1) vertical coherence of strategies and actions between local governments in the BMR and the Thai central government; and 2) horizontal co-operation between local governments in the BMR.

Aligning national and local plans, strategies and action for urban green growth

The Thai central government is a central decision maker in all opportunity areas for green growth in the BMR, especially through planning, infrastructure development, financing and policy instruments. Special-purpose authorities of the central government, such as the Mass Rapid Transit Authority (MRTA), the Bangkok Mass Transit Authority (BMTA), the Metropolitan Electricity Authority (MEA) and the Metropolitan Waterworks Authority (MWA), are powerful institutions with extensive responsibilities in key development sectors. The 1997 Decentralisation Action Plan, however, delegated authority to local governments in critical areas, as explained in Chapter 1. While the Thai government still tightly controls development, the BMA has discretion over some important policy levers, especially in the areas of land use, wastewater treatment and solid waste management (Table 4.1).

A consequence of the decentralisation reform in Thailand is a stronger need for co-ordinated actions between different levels of government. For some specific activities, co-operative frameworks between the central and local governments are well established. For instance, the extension of the mass rapid transit system is being jointly undertaken through public-private partnerships supervised by the central government. The central government is extending underground MRT lines, and the BMA is extending the elevated BTS lines (SkyTrain). Extensions of both lines are planned jointly and are connected with each other, so that they form part of a single mass transit network. In 2015, they were due to transition to a single, interchangeable ticketing system to make transferring from one system to the other more convenient for users. The overall development of the mass transit network in the BMR is supported by a Mass Rapid Transit Master Plan drafted by the Office of Transport and Traffic Policy and Planning in the Ministry of Transport. As for flood resilience, the Thai central government has established major disaster prevention and relief guidelines for action at lower levels of government through the National Disaster Prevention and Mitigation Plan (2010-2014). This provides major recommendations for the BMA's Disaster Prevention and Mitigation Plan. The degree of direct central government involvement during floods depends on the severity of the disaster, but the national government remains active at different stages of disaster prevention and relief operations in co-ordination with BMA agencies (Table 4.2).

Table 4.1. **Allocation of responsibility among the different levels of government**

Major policy instruments in sectors with high potential for urban green growth

	Energy	Land use and transport	Housing and buildings	Water resources management (including flood protection)	Solid waste management	Manufacturing and R&D
National government	– Energy production and distribution (Ministry of Energy, Electricity Generating Authority of Thailand, Metropolitan Electricity Authority) – Energy performance standards (Ministry of Energy) – Fossil fuel subsidies – Fuel standards – Grants/subsidies for renewable energy/energy efficiency equipment	– Air pollution standards – Vehicle inspection and penalties for emissions and noise – Permitted use of public vehicles – Transport service fees – Construction and operation of public transport (Office of Transport and Traffic Policy and Planning, Mass Rapid Transit Authority and Bangkok Mass Transit Authority)	– (Green) Building Standards (Ministry of Natural Resources and Environment)	– Wastewater tariffs – Watergate regulation (Royal Irrigation Department)	– National environmental framework – Industrial and hazardous waste (Pollution Control Department, Department of Industrial Works) – Landfill regulations (Department of Industrial Works) – Incineration regulations (Department of Industrial Works) – Electrical and electronic waste management (Department of Industrial Works, Pollution Control Department)	– Taxes for industrial investments – Subsidies for energy-efficient industrial equipment (Ministry of Energy) – Green labels
Provincial governments (including BMA)	– Management of street lights	– Zoning regulations – Permitted, prohibited and conditional uses – Density and size control (floor area ratio, open space ratio) – Parking space requirements	– Building Energy Management Systems (BEMS)	– Water quality in canals and rivers – Watergate regulations (DDS)	– Household waste management	

Sources: BMA (2013a), *Bangkok Comprehensive Plan 2013*, Department of City Planning, Bangkok; UNEP International Environment Technology Centre (IETC) (2009), "Converting waste plastics into fuel", Report on Situation Analysis of Existing Solid Waste Management System in the Bangkok Metropolitan Area; MLIT, Japan (2013), "An overview of spatial policy in ASEAN and European countries", General Affairs Division, Ministry of Land, Infrastructure, Transport and Tourism, www.mlit.go.jp/kokudokeikaku/international/spw/general/thailand/index_e.html.

Table 4.2. **Areas of co-ordination for disaster prevention and relief between national and BMA agencies**

	National	Local
Risk assessment	– National Disaster Prevention and Management (DPM) Committee/National Plan – Flood risk assessment by Royal Irrigation Department, Department of Disaster Prevention and Management (DPPM)	– Department of Drainage and Sewerage – Fire and Rescue Department – District offices
Warning/ monitoring	– National DPM Committee – National Disaster Warning Centre – Thai Meteorological Department (TMD), DDPM	– Department of Drainage and Sewerage – Fire and Rescue Department – District offices
Prevention and mitigation	– National DPM Committee – DPPM	– Department of Drainage and Sewerage – Fire and Rescue Department
Preparedness	– National DPM Committee – DDPM	– Department of Drainage and Sewerage – Fire and Rescue Department – District offices
Response	– National DPM Committee – DDPM – Military Response Team – Medical Team	– Bangkok Protection and Mitigation Command Centre – District Disaster Protection and Mitigation Command Centre (50 districts)
Disaster relief	– National DPM Committee – DDPM – Department of Social Welfare – Armed forces	– Bangkok Protection and Mitigation Command Centre – District Disaster Protection and Mitigation Command Centre (50 districts)
Reconstruction and recovery	– National DPM Committee – Line agencies/ministries – DDPM – Special projects	– Department of Drainage and Sewerage – Fire and Rescue Department – District offices
Co-ordination	– National DPM Committee – DDPM – Armed forces – Metropolitan Waterworks Authority (MWA)/MEA – Metropolitan Police Bureau – TOT Public Company Limited – Expressway Authority – Bangkok Mass Transit Authority	

Source: BMA (2014a), "Institutional mechanisms for urban climate change resilience", Department of Environment, presentation made at the Bangkok Knowledge Sharing Workshop on Urban Green Growth in Dynamic Asia, 6-7 August, Bangkok.

Some issues may complicate the alignment of national and local plans, strategies and actions for urban green growth. Local governments are under no administrative or legal requirement to faithfully follow the spatial development plan for the BMR (Ratanawaraha, 2010). As a consequence, local spatial plans (comprehensive plans) in the BMR may not be consistent with the BMR-wide 2013 Bangkok and Vicinities Development Structure Plan issued by the Department of Town and Country Planning (DTCP). Most city-regional plans in Asian agglomerations are not formally adopted as legally binding documents and are mainly regarded as "indicative guidelines" for the future development of mega-urban regions (Laquian, 2011). A more concrete example is a BMA project to build a pumping station as part of the new mega-tunnel construction project. It has been blocked because it was not well co-ordinated with the central government's Department of Rural Roads and the Marine Department, which controls these areas. Such authorisation takes time, because the procedures for checking that construction conforms with building and environmental codes can be protracted. Many permits from both local and national governments are required for flood management operations, such as opening water gates (BMA, 2014a, b). This may compromise the efficiency and speed in managing water runoff and avoiding heavy floods.

Thailand should as a matter of top priority align all the national and local plans and strategies related to the BMR's green growth, notably on climate change, energy, land use and green manufacturing (Table 4.3). This could be achieved by legally requiring such local plans and strategies to be consistent with the equivalent national plans and strategies, or by introducing a consultation procedure in which national and local governments can co-ordinate with each other over the preparatory stage of their plans and strategies. The 11th National Economic and Social Development Plan 2012-2016 (11th NESDP; Box 4.1) should be the central national framework of integrated policies and action plans that can support green growth objectives. In addition, such national plans and strategies could recognise and spell out in more detail how sub-national governments and cities can play a role in encouraging green growth. National and sub-national governments can share responsibilities and tasks, and work more effectively together. Sub-national governments, communities, civil society and the private sector should be engaged closely in the development and implementation of new national, regional and local green growth and resilience strategies. This will increase the policy coherence of the programmes and take into account important information about sub-national needs (GGBP, 2014).

Table 4.3. **Plans and strategies related to urban green growth**

By level of government

	National	Provincial/local
Economic development	– 11th National Economic and Social Development Plan (2012-2016)	– Bangkok Development Plan (Bangkok 2020) – Bangkok 2032
Climate change	– National Strategy on Climate Change (2008-2012) – National Strategy on Climate Change (2013-2017) – Thailand Climate Change Master Plan (2012-2050)	– BMA Action Plan on Global Warming Mitigation (2007-2012) – Bangkok Master Plan on Climate Change (2013-2023)
Environmental quality	– Environmental Quality Management Plan (2007-2011)	– Bangkok Air Quality and Noise Management Action Plan (2012-2016)
Land use/ transport	– National Spatial Development Policy Plan (2007-2057), with strategic plans for 5-year (-2012), 10-year (-2017) and 15-year periods (-2022) – 2013 Bangkok and Vicinities Development Structure Plan (a BMR-wide plan run by the central government)	– Bangkok Land Use Comprehensive Plan – Bangkok's Mass Transit Development Plan
Energy	– Energy conservation plan – 20-year Energy Efficiency Development Plan (2011-2030) – 10-year Alternative Energy Development Plan (2012-2021)	– Bangkok Master Plan on Climate Change (2013-2023)
Water and solid waste management	– National Roadmap of Solid Waste Management Plan (2015-2019)	– 20-year Bangkok Solid Waste Management Plan (2007-2026) – Master Plan on Sewage Sludge Treatment/Disposal and Reclaimed Wastewater Reuse in Bangkok (1999-2020) – Preparatory Survey for Bangkok Wastewater Treatment Project in Thailand: Conception Master Plan (2011-2040)
Green manufacturing	– Green Public Procurement Promotion Plan (2008-2012) – Green Public Promotion Plan (2013-2016)	
Resilience	– National Disaster Prevention and Mitigation Plan (NDPMP; 2010-2014)	– 100 Resilient Cities Initiative Resilience Plan – Bangkok Disaster and Prevention Management Plan (2010-2014)

Source: BMA (2014b), "Answers to the OECD case study questionnaire", internal document, unpublished.

Box 4.1. Green growth and the National Economic and Social Development Plan in Thailand

Since 1961, Thailand's five-year national economic and social development plans (NESDPs) have provided a framework for sustainable development. Early NESDPs focused mainly on economic development, which resulted in prosperity for the nation but also had a number of negative environmental impacts. The concept of green growth was first raised in the 8th NESDP (1997-2001), although no action was taken in that plan.

The 10th NESDP (2008-2012) was the first integrated plan covering the three dimensions of the sustainable development concept. Its vision was to create a "Green and Happy Society", and development strategies it proposed included "economic restructuring toward balance and sustainability" and "development on biodiversity and strengthening of the environment and natural resources base". The plan also functioned as a national sustainable development strategy for Thailand (Office of NESDP, 2008). Based on that plan, a *Guidance Manual for a National Sustainable Development Strategy for Thailand* was also published by the government.

The current 11th NESDP (2012-2016) continues to focus on sustainable development. It recognises the effects of climate change, and that the environment has deteriorated in Thailand. Under the vision of "a happy society with equity, fairness and resilience", the plan sets out four "missions" (NESDB, 2014):

1. promote a fair and peaceful society
2. increase the potential of all Thais, based on a holistic approach that enables physical, mental, intellectual, emotional, ethical and moral development through social institutions
3. develop an efficient and sustainable economy by upgrading production and services based on technology, innovation and creativity, using effective regional links, by improving food and energy security, and by upgrading eco-friendly production and consumption toward a low-carbon society
4. build secure natural resource and environmental bases through supporting community participation and improving resilience that will cushion the impact of climate change and disasters.

A low-carbon economy is also part of the strategy of the 11th NESDP, under which relevant ministries and municipalities are to mitigate the effect of greenhouse gases (GHG). Four pillars for green low-carbon growth in Thailand were developed, including:

1. maintaining rapid economic growth while orienting the country's economic structure toward a less energy- and carbon-intensive economy
2. achieving greater urbanisation, while shifting toward green, liveable, low-carbon cities
3. meeting the huge demand for energy while transforming the energy sector toward one of high energy efficiency and widespread diffusion of low-carbon technologies
4. improving the quality of life while shifting toward a resource-efficient and sustainable lifestyle.

Source: NESDB (2014), "The 11th National Economic and Social Development Plan", www.nesdb.go.th/Default.aspx?tabid=62 (last accessed 20 January 2015)

Horizontal co-ordination among the Bangkok Metropolitan Administration and the surrounding five provinces

The lack of horizontal co-operation is an obstacle to the implementation of policies, plans and programmes, due to the diverse structure of local administrations in the BMR (see Chapter 1). The local plans and strategies related to green growth, (notably on climate change, transport, solid waste management, air quality and noise management) mainly apply to the city of Bangkok, not to the BMR. This is true of the BMA Action Plan on Global Warming Mitigation (2007-2012), the Bangkok Master Plan on Climate Change (2013-2023) that the BMA is currently preparing, and also of other sectoral plans and strategies such as the Bangkok Land Use Comprehensive Plan, Bangkok's Mass Transit Development Plan, the Master Plan on Solid Waste Management in Bangkok (2007-2026), Solid Waste Disposal Centre Project Development Plan, and the Bangkok Air Quality and Noise Management Action Plan (2012-2016). The few exceptions of BMR-wide plans and strategies, including the 2013 Bangkok and Vicinities Development Structure Plan, were produced by the Thai central government. This is mainly because no metropolitan government or governing body covers the BMR.

Ineffective horizontal co-operation has also become the source of problems in other aspects of the development and management of this vast region, in particular in terms of land-use instruments. The BMA has adopted bulk control mechanisms for buildings (e.g. floor area ratio [FAR] and open space ratio [OSR]) since the Bangkok Comprehensive Plan of 2006, but none of the surrounding provinces in the BMR have adopted them (Ratanawaraha, 2010). This lack of uniformity may create sudden changes in land use, such as uncontrolled urban development just outside the administrative borders of the BMA, and uncontrolled land prices. This could affect the efficiency of land use, and impede green growth in the city. Lack of co-ordination also affects the resilience of the BMR to floods, and one area's vulnerability to floods may affect the entire region. For example, in 2011, the flood disaster severely impacted manufacturing industries in outlying provinces of the BMR, mainly in Pathum Thani and Samut Prakarn, due to their proximity to the Chao Phraya River. The economic consequences were not only felt in these provinces, but across the entire BMR and even the nation. By protecting one location, policies may simply shift the risk to adjacent locations (an example of "mal-adaptation"), instead of addressing the issue in a lasting, comprehensive manner.

Horizontal local co-ordination beyond the BMR is also needed. Although the urban agglomeration has been concentrated in Bangkok and the five adjacent provinces that comprise the BMR, in recent years, industrialisation has extended to a few provinces further to the southeast (Chon Buri, Chachoengsao, Rayong) which are now a part of the Bangkok Urban Region (see Chapter 1). Effective co-ordination could be explored by defining Bangkok's boundary, which corresponds to functional rather than administrative entities, and designing and implementing plans and strategies. The OECD's functional urban areas (FUA) could be applied to Thailand to define metropolitan areas in the country, taking into account population density and commuting between urban areas (OECD, 2012). This would help to identify the most appropriate scales for policy making and implementation.

Creating mechanisms to co-ordinate metropolitan-scale plans and policies

To tackle the institutional challenges already noted, the local governments of the BMR and the Thai central government should work together more systematically, by

setting up a Metropolitan Commission. This would work on critical urban systems/functions that lead to green growth and greater resilience, including energy, land use and transport, housing and buildings, water supply and sanitation, solid waste management and green manufacturing. After agreeing on the priorities, they could formulate co-ordinated strategies, policies and programmes. Attempts have been made to improve vertical and horizontal institutional co-ordination in the BMR. In 1991, the Thailand Development Research Institute (TDRI) recommended that the Bangkok Metropolitan Region Development Committee be granted more significant development responsibilities. In 2007, a committee jointly initiated by a deputy prime minister and the Governor of Bangkok recommended that another committee be created, called the Committee for the Integrated Development of the Bangkok Metropolitan Region (Ratanawaraha, 2010). These recommendations, however, have not yet been translated into concrete action and are urgently needed. Now that most of the population and economic growth is occurring in the vicinities of the BMR, an increasing number of municipalities must take into account the growing impact ("negative externalities") of their urban development, such as air and water quality, waste disposal and traffic congestion, on neighbouring provinces. Integrating decisions across the BMR could reduce some of these negative externalities.

The Metropolitan Commission could be composed of policy makers from the Thai central government and all the provinces in the BMR. An advisory board and a metropolitan fund (see below) can also be set up to support these policy makers professionally and financially. The commission could pursue the following objectives:

- Encourage the adoption or "mainstreaming" of BMR-wide sectoral and comprehensive policies for urban green growth into Bangkok's annual planning and budgeting cycle. This could help incorporate regional green growth strategy elements or initiatives in the city's planning and budgeting. If possible, green growth policies and actions (e.g. enforcing land-use zoning and building codes) could be co-ordinated across administrative boundaries to reduce negative externalities. Increased coherence of region-wide policies and standards would have several benefits, particularly for flood resilience. Flood protection infrastructure can only function well if the city of Bangkok and surrounding provinces work together. A joint Flood Control Centre, based on the one already developed by the BMA and extended to the entire BMR area, could also play a critical role collecting and monitoring flood data at a regional scale. This would be better placed to identify where additional flood prevention infrastructure and disaster response mechanisms were needed.
- Implement comprehensive projects for urban green growth in the BMR, using the metropolitan fund (see below).
- Follow up and assess progress towards green growth targets through indicators applied regionally, (see below) and set up monitoring protocols and reporting mechanisms to encourage all of the BMR provinces and the BMA to implement the decisions taken by the Metropolitan Commission.
- Share information on green growth issues and initiatives with the public and media, to update the BMR's residents and local and national policy makers on the progress of specific green growth policies and actions.

A crucial element of this effort will be to engage all the provincial and municipal governments in the BMR in a shared problem-solving and decision-making process. Successful multi-level co-operative frameworks in other countries can offer some

inspiration. In Barcelona, three sectoral inter-municipal authorities were created in 1987, each covering a different geographical area: a planning authority, a transport authority and an environmental authority. Co-operation between municipalities in the metropolitan area through these metropolitan-wide entities has resulted in metropolitan strategic plans covering many municipalities (Box 4.2). Bangkok could try to replicate such an initiative (particularly in planning and environmental issues), bearing in mind that it would be unrealistic for the metropolitan commissions to become an authority, at least in the short term. The metropolitan commissions could progressively demonstrate the benefits of BMR-wide governance, and might even evolve into further forms of co-operation in the long term. In Barcelona, high political tensions surrounded the creation of a Metropolitan Corporation in the 1970s and 1980s, but the manifest benefits of inter-municipal co-operation after more than 20 years led to the creation of a metropolitan authority in 2011 that brought together the three inter-municipal authorities. In the case of Bangkok, as already noted, the national government's participation will also be critical. Chicago's experience shows some ways in which the national government can support metropolitan-wide agencies with no formal authority over planning (Box 4.3).

Box 4.2. **Inter-municipal co-operation in Barcelona**

In 1975, Spain's central government created a Metropolitan Corporation of Barcelona (Corporación Metropolitana de Barcelona, CMB), covering 27 municipalities. However, it was dissolved in 1987, when political tensions escalated between the city of Barcelona and the autonomous community of Catalonia, after Barcelona was chosen in 1986 to host the 1992 Olympics. Three sectoral inter-municipal authorities were instead created in 1987, each covering a different geography:

- a planning authority (Mancomunitat de Municipis de l'Àrea Metropolitana de Barcelona, MMAMB), covering 31 municipalities (3.1 million people)
- a transport authority (Entitat Metropolitana del Transport, EMT), covering 18 municipalities (2.9 million people)
- an environmental authority (Entitat del Medi Ambient, EMA), covering 33 municipalities (3.2 million people) in charge of the water network and waste treatment.

Before and after the Olympics, a process of strategic planning took place, starting with a focus on the core city and gradually evolving towards the metropolitan scale. The city of Barcelona published its first strategic plan in 1990, a second in 1994 and the third in 1999 with the three sectoral inter-municipal authorities. These strategic plans involved the regional government, all the municipalities, universities, the private sector, the port and civic organisations. The Association for the Strategic Plan of Barcelona (Pla Estratègico Metropolità de Barcelona, PEMB), a non-profit organisation created in 2000 with 300 members of the political, business and social communities, launched the first Metropolitan Strategic Plan in 2003, which covered 36 municipalities. A new plan, *Barcelona Visió 2020*, was published in 2010 as a continuation of the 2003 plan. Finally, a metropolitan authority was set up in 2011 by Law 31/2010 of the Parliament of Catalonia. The Àrea Metropolitana de Barcelona (AMB) brings together the three sectoral inter-municipal authorities (the MAAMB, EMT and EMA). Its Metropolitan Council is composed of the mayors of all 36 municipalities covered under the strategic plan, including the city of Barcelona. The AMB is in charge of planning, transport, water, waste treatment, social cohesion and economic development. In 2013, its budget was around EUR 600 million, composed mainly of subsidies and transfers (56%), fees and user charges (24%), and own taxes (17%). A specific authority in charge of public transport (Autoritat del Transport Metropolità, ATM), runs an integrated public transport network with a single unified fare system.

Source: OECD (2015a), *Governing the City*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264226500-en.

Box 4.3. The national government's role in facilitating inter-municipal strategies in Chicago

The Chicago Metropolitan Agency for Planning (CMAP) does not have formal authority over land use and zoning, which remain under municipal jurisdiction. The metropolitan master plan GO TO 2040 is funded at the local level under a technical assistance programme, the US Department of Housing and Urban Development's Sustainable Communities Regional Planning Grant Program. The CMAP initiated the Local Technical Assistance (LTA) Program in 2010. The programme provides assistance to communities across the Chicago metropolitan region to undertake planning projects that advance the principles of GO TO 2040. The CMAP has initiated 160 local projects with local governments and non-profit and intergovernmental organisations to address local issues at the intersection of transport, land use and housing, including the natural environment, economic growth and community development. The CMAP announced 25 new LTA projects in October 2014. This fourth wave of projects emphasises implementation of past plans, such as updates of zoning and regulations, the creation of capital improvement plans and analysis of municipal review procedures.

Source: OECD (2015a), *Governing the City*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264226500-en.

Engaging local communities, the private sector and universities to support green growth

Achieving urban green growth in the BMR will also require mobilising as many non-public stakeholders as possible. This is particularly important given the extent of problems the city faces, and local governments' limited capacity to undertake the necessary policies in each area of opportunity. In particular, local communities, the private sector and higher education should be enlisted in the effort.

Local communities are critical stakeholders in the effort to promote green growth

Community-based approaches to reduce risks and build resilience are major trends in Asia. They can complement the efforts of local governments. They can both identify the greatest problems they face, and help decide which actions are likely to be most pragmatic and effective. Meanwhile, local governments can also consult research or technical institutions, and expert consultants hired by external donors.

"Listening to communities" has been one of the key lessons learnt from a broad cross-section of experience in the field over the past decade. Donors and national governments have been too eager and focused on implementing their own solutions and have unwittingly imposed their own vision and agenda. Without obtaining a sufficient degree of local ownership and commitment, the investments in many cases cannot be sustained. Solutions cannot be imposed by others. They need to be developed and agreed to by the local government, the affected communities and the other stakeholders involved, in civil society, the media and the private sector.

In Thailand, community participation is encouraged from the highest spheres of the government. Part of the mission of the 11th National Economic and Social Development Plan (11th NESDP 2012-2016), is "to build a secure natural resources and environmental base by supporting community participation and improving resilience to cushion impacts from climate change and disasters" (NESDB, 2011). As shown in the previous chapter,

community involvement sustains actions more effectively and durably. In the city of Bangkok, the community initially participated in the planning process. The policy-making process in Thailand has traditionally flowed from the top down, with little use of participatory mechanisms (Institute of Development Studies, 2007). But in 2009, the BMA opened participation to local residents and collected input in preparing the 2013 Comprehensive Plan, with help from public administrations in the 50 districts. This could be expanded to other planning and implementation processes. The proposed third phase of the technical assistance from the Japan International Co-operation Agency (JICA) to the BMA on its Strategic Plan for Climate Change will be oriented toward helping implement the five main initiatives and associated activities of the plan.

Engaging communities in urban green growth should not be extended only to designing but also implementing policies. The BMA has a special status that allows it to manage six development zones in the city's boundaries. From a legislative standpoint, each of the 50 districts has one or more elected representatives on the Bangkok Metropolitan Council, involved in citywide affairs. The executive and legislative branches are thus well connected to the Governor of Bangkok and can transmit information to the chiefs of the six development zones and district officers. One of the functions of the district administrators is to monitor the progress towards targets set up by the BMA to measure key performance indicators. These district-level officers are also connected to 169 sub-districts through identified leaders, existing associations and local non-governmental organisations (NGOs) in their communities. Information and suggestions can thus be channelled up to higher levels of local government. These are key resources, and could be trained in green growth and resilience issues and used by the BMA to reach out to local communities. The rapidly growing slums of the city of Bangkok, which now have a population of more than 2 million, according to the BMA's latest *Statistical Profile*, can be difficult for local authorities to manage because of the unregistered population and lack of land-use controls.

A promising area for community-based risk reduction in the BMR would be solid waste collection and recycling efforts, as described in Chapter 2. An initiative of the Thailand Institute of Packaging and Recycling Management for Sustainable Environment (TIPMSE) to create recycling centres in communities has begun to improve solid waste collection and recycling. A few community centres of this type have been created in Thailand or Bangkok (see Chapter 2). This programme has demonstrated the many benefits of collaborating with the urban poor. This represents an alternative to the lack of capacity in local governments' human and financial resources that can provide economic, social and environmental benefits to local communities. It also shows that even in an informal environment, local communities can be organised and work hand in hand with the private and public sectors to achieve socially and environmentally desirable goals. This initiative, however, is still very small in scale, and cannot adequately solve the solid waste management issues of the BMR. Over-consumption of packaging materials, inadequate source separation and separation of solid wastes from hazardous or special waste streams are all an issue. The subsequent mixing of waste, inefficient transport of solid waste, and unhealthy and environmentally damaging final disposal must be addressed. The national and local governments could help TIPMSE and other similar organisations replicate such actions in other districts, and develop other innovative ideas. Flood prevention and preparedness is another area where community engagement could potentially yield social benefits. These could include reducing losses and damages to people and their livelihoods, their property and other assets, as well as to other important infrastructure (see Chapter 3).

A co-ordination unit for civil society organisations (CSOs) to encourage citizens' participation, assist in community actions and manage mechanisms of dialogue could be set up in all local governments in the BMR. Input from residents can help transmit to higher levels of government information on residents' needs and preferences. A CSO co-ordinating mechanism could be helpful given the size and complexity of the city, the local authorities' lack of resources, and the need to obtain input and feedback at the community level. It could help set up tools to receive feedback from citizens, such as letterboxes and newsletters, regular neighbourhood meetings, information kiosks and management software, and simple updates and analytical reports. To encourage consultation with citizens on an informal and permanent basis, this unit could offer open office hours, giving citizens regular opportunities to meet and talk to decision makers. In Iceland, all ministers hold open hours once a week at a given time and place. The United Kingdom holds citizens' panels composed of citizens selected on the basis of a representative sample of the population. Advisory committees like those in Denmark and Poland, composed of representatives of community interests, could ensure broad representation and provide a forum for on-going consultation (OECD, 2015b). Slum representatives should be part of all these participatory processes.

Raising public awareness among urban residents is a key social policy for enhancing community participation. Local experts and policy makers in the BMR have noted the lack of such awareness in the BMR. The BMA has already designed the Environmental Education Activity Project in 435 schools in the city of Bangkok. These programmes mainly target energy consumption reduction, through training, seminars and youth camps. One hundred BMA schools were also selected to be honoured for their outstanding efforts to raise awareness of efficient energy consumption among students (BMA, 2012). Similar programmes have been undertaken at the community level with the help of the district offices. Such a mechanism could improve the level of civic participation in planning, implementation and monitoring, giving the urban poor a voice and improving the sense of community among its residents in the city. This can build social capital and disaster preparedness (see Chapter 3).

Engaging property owners and developers and tapping into private initiatives

Opportunities to further involve property owners and developers in urban green growth actions should be explored. Around 80% of the land in the city of Bangkok is privately owned, and landowners and developers could play a significant role in greening the city. Raising awareness of the need for green growth (e.g. to make the city more resilient, more liveable and more attractive) could be a policy initiative. Continued improvements in building energy efficiency (EE) could be secured by acquiring more EE chillers and air conditioning units or other green products, or constructing new buildings and retrofitting existing ones to higher EE standards with green materials.

Local governments in the BMR should also work more closely with the private sector. This could mobilise more voluntary green growth actions, especially at the community level. The waste collection and recycling initiative of TIPMSE, for instance, was entirely a private sector initiative. Greater assistance and encouragement from public authorities might help to scale up more such initiatives.

In addition to raising public awareness, the BMA could consider establishing more stringent standards of property and building owners (and other private stakeholders) in greening the city. The FAR Bonus System encourages private developers to connect their malls to the SkyTrain network, but this is not a binding requirement. Stronger

development regulations and building/zoning codes could be used to discourage urban sprawl unconnected to public transport and employment centres.

Mobilising the resources of academic and research institutions

Academic institutions and research centres can offer great opportunities to undertake urban green growth. This is especially true of the disciplines for which green technology is central (e.g. energy, water resources management, green manufacturing goods and services). In Milwaukee, Wisconsin (United States), the Water Council is a group of over 150 water technology companies working to improve water resources management in the region and beyond. Academic collaboration is a critical element of the cluster in producing new knowledge and new products. In the BMR, academic institutions could be invited to participate in green growth clusters and produce skilled labour and new products. The BMA University, for instance, works in close co-operation with the Institute of Metropolitan Development. It has designed programmes and courses whose objective is to carry out research and increase the understanding of urban development and management from a science and engineering perspective. It is worth noting that these programmes, which are brand new, involve the private sector in their curriculum in a substantive way. The BMA and other municipalities in the BMR should continue developing similar training programmes and increase their visibility by consulting with industrial/commercial firms.

The BMA has also co-operated with the Thai Environment Institute to conduct research on community-based solid waste management and environmental protection to study the different ways to cope with these issues. The findings will recommend specific actions, depending on the type of community targeted and will be summarised in a manual (BMA, 2012). The BMA also contracted Kasetsart University as a consultant for waste disposal, as well as to develop a master plan for the handling of waste. It will be used to increase the impact of the 3R (reduce, reuse and recycle) strategy introduced by the BMA (BMA, 2012).

Framing stakeholder engagement

Engagement of local communities, the private sector, and academic and research institutions should be framed by local governments in the BMR and not left to *ad hoc* initiatives. This would also help to engage these stakeholders together, given that they often all have a role to play in the critical areas for green growth, and create synergies. All stakeholders should participate in developing a citywide or regional "green vision" and green growth action plan. Examples of the benefits of multi-stakeholder engagement can be found in the Netherlands, the United States and Spain (Boxes 3.2, 3.3 and 4.4). The report *Stakeholder Engagement for Inclusive Water Governance* (OECD, 2015c) provides some insights on how to do this effectively in the water sector (including flood management) and could also be applied to other sectors with strong potential for green growth. The report recognises the following principles for effective and outcome-oriented stakeholder engagement:

- Map all stakeholders who have a stake in the outcome or are likely to be affected, as well as their responsibility, core motivations and interactions.
- Define the ultimate decision-making authority, the objectives of stakeholder engagement and the expected use of input.

- Allocate proper financial and human resources and share needed information for result-oriented stakeholder engagement.
- Regularly assess the process and outcomes of stakeholder engagement to learn, adjust and improve accordingly.
- Embed engagement processes in clear legal and policy frameworks, organisational structures/principles and responsible authorities.
- Customise the type and level of engagement to the need and keep the process flexible in changing circumstances.

Box 4.4. **Stakeholder engagement for restoration and sustainability: Experiences in the United States and Spain**

The South Bay Salt Pond Restoration project, located in the southern region of San Francisco, California (**United States**), was initiated in March 2003 by the California Department of Fish and Game, the US Fish and Wildlife Service and the California State Coastal Conservancy. It is one of the largest wetland restoration projects in the United States, and is working toward restoring former industrial salt ponds to nature, while providing flood control and public access. The project provided an opportunity for a variety of actors (below) to engage in decision making:

- local businesses with a commercial interest in the development of the project
- environmental organisations working for the protection and defence of the local environment and habitat
- flood management and public health/public works districts that have a stake in flood protection and water quality.

Through formal bodies such as local government groups, regional working groups and annual Stakeholder Forum meetings, a wide range of actors provided feedback on the progress of the restoration project and helped build a sense of openness, honesty and accountability over the project's benefits and implications.

In **Spain**, the city of Sabadell committed to improve its environmental sustainability in partnership with SAMCLA. This company, which is specialised in the field of remote irrigation networks, helped to optimise the use of water resources and improve water and energy efficiency in public parks. Together, they developed a remote irrigation management system. This uses online control software and communications equipment (GPS) to monitor water consumption at any given point in the irrigation network, detecting and managing possible leaks in real time. Since its implementation in 2008, Sabadell's remote irrigation system has been the subject of a technical article and presentations at national and international conferences (e.g. Smart City Congress). This highlighted the positive impact this approach has had on the city's water consumption for public parks. Up to 56% of water was saved, and return on investment was estimated at three to four years. The remote system has also contributed to saving time that was previously allotted to public park maintenance.

Source: OECD (2015c), *Stakeholder Engagement for Inclusive Water Governance*, OECD Studies on Water, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264231122-en.

Financing urban green growth in the Bangkok Metropolitan Region

The means to finance urban green growth in the BMR needs to be considered early on and pursued aggressively. This section examines the tax and budget system of the BMA and opportunities to diversify external sources of revenue for the BMR's provinces, as well as to leverage local sources of private sector financing for urban green growth.

Creating a public investment framework for urban green growth

Urban green growth in the BMR requires a significant amount of public investment across levels of government. Creating a more effective public investment framework is crucial (OECD, 2014). For example, central government's investment in the MRT system and the BMA's investment in the public spaces around MRT stations need to be well co-ordinated to maximise the resource. Creating a co-ordination mechanism at the BMR scale can also effectively set priorities for public investment in the BMR for urban green growth. The Thai central government could help set up a BMR-wide fund in priority sectors to finance proposed actions to benefit the BMR as a whole. Energy efficiency and renewable energy initiatives in large office buildings, as proposed in Bangkok's two Climate Change Strategies for 2007-12 and 2013-23, could be expanded to the whole BMR and be supported by these financial channels.

Involving private investors in urban green growth projects

Involving private actors and financing institutions in the investment should be a way to strengthen the capacity of government at different levels. Expertise can be brought to projects through better advance assessment, improved analysis of the market and credit risks, and achieving economies of scale and cost-effectiveness (OECD, 2014). Local governments can seek ways to further involve the private sector through careful analysis of the pros and cons of different private participation arrangements and what they entail in terms of risk and government financial and administrative capacity (OECD, 2014).

Public authorities in Thailand, in particular the central government, have encouraged the creation of public-private partnerships (PPPs) in several key strategic urban sectors. These sectors, such as public transport, wastewater treatment, flood protection and drainage infrastructure, have required massive capital investment, using a variety of different financial frameworks (Table 4.4):

- The MRT system was financed with a USD 3.1 billion concessional loan from the Japanese Bank for International Co-operation (JBIC), covering 80% of the cost. It is operated by the Bangkok Metro Public Company Limited (BMCL) under a 25-year concession granted by the MRT Authority of Thailand.
- The Airport Train Link (ARL) is also owned by a central government entity, the State Railway of Thailand (SRT), and is operated by an SRT subsidiary.
- Conversely, the Bangkok Mass Transit System (BTS) SkyTrain was financed and is operated by the BTS Corporation under a 30-year concession granted by the BMA, and currently operates entirely within the administrative boundaries of the city. However, a new extension is being funded by the MRTA, since it is located outside the city limits of Bangkok. This will create a "closed loop" route, completely encircling a large portion of the BMR. The BMA also owns Bangkok's bus rapid transit (BRT) system, which is operated by the same entity as the BTS SkyTrain. The original plans for the BRT in 2004 called for 14 BRT routes, but only 5 were finally approved for construction, and only 1 (Sathorn-Ratchaphruek) is currently operating. Its continued operation remains in doubt.

Box 4.5. **OECD Recommendation on Effective Public Investment Across Levels of Government**

In 2014, the OECD adopted a *Recommendation of the Council on Effective Public Investment Across Levels of Government*. This is an OECD instrument adopted by the Council. Recommendations are not legally binding, but practice accords them great moral force as representing the political will of member countries.

Sub-national governments, defined as federated states, regions and other municipalities, undertook 72% of total public investment in 2012 throughout the OECD area in terms of volume. Variations across countries are important, as sub-national public investment ranges from 31% in Greece to 91% in Canada. More effective public investment has a critical role to play to address inequalities, rebuild trust, restore growth and enhance well-being. The impact of public investment depends to a significant extent on how governments manage this shared competence across levels of government. Effective public investment requires substantial co-ordination across levels of government to bridge information, policy or fiscal gaps that may occur, as well as critical governance capacities at different levels to design and implement public investment projects.

The purpose of these principles is to help governments assess the strengths and weaknesses of their public investment capacity in a multi-level governance perspective and set priorities for improvement. An Implementation Toolkit provides guidance with details for all countries (available at: www.oecd.org/effective-public-investment-toolkit).

Source: OECD (2014), *Recommendation of the Council on Effective Public Investment Across Levels of Government*, OECD, Paris, available at: www.oecd.org/gov/regional-policy/Principles-Public-Investment.pdf.

Table 4.4. **Current public-private partnerships in green growth opportunity areas in Bangkok**

Green growth opportunity area	Focus of the PPP	Period of implementation	Details of the activities
Transport	MRT Blue Line	1992-17 (MRT)	The MRT Chaloem Ratchamongkhon Line (Blue Line) is managed jointly by the Mass Rapid Transit Authority of Thailand (MRTA) and the Bangkok Metro Public Company Ltd. (BMCL), representing the private sector. The MRTA is responsible for project management and is the investor in civil infrastructure and land acquisition. The BMCL was granted the 25-year concession for the system and is the operator, and invested in the train operations system and equipment. The Japan Bank for International Co-operation (JBIC) funded 80% of the cost of the project (USD 3.1 billion in total) and the BMCL the remaining 20%. The MRT system was inaugurated on 3 July 2004. Currently, the MRTA is assigned to implement a part of the MRT extension network approved by the Cabinet on 18 March 2008.
Transport	BTS Skytrain	1992-22 (BTS)	The Mass Rapid Transit System (also known as BTS or SkyTrain) was initiated in 1992 under a PPP scheme. The BTS System is operated by the Bangkok Transit System Corporation (BTSC), under a 30-year concession granted by the BMA. The BTSC is responsible for the design, financing, construction and operation of the system. The BMA is the overall public partner of the BTS system, and played a key role in allowing construction to take place over the main arterial roads. The PPP faced major financial problems in the first years after the BTS was opened in 1999. Ridership was lower than forecast, due to its poor accessibility and lack of integration with other transport modes. Its finances were restructured in the mid-2000s, however, and the BTS is now the centrepiece of the government's mass transit strategies for the BMR. The BMA is currently financing the extension of BTS lines.
Wastewater treatment	WWTP plants	1990s-	Contracts are awarded by the BMA for the operation and maintenance of wastewater treatment plants on a five-year contractual basis. In 2009, four treatment plants were run by private companies. This is currently not a revenue-generating activity. However, an increase on each resident's/user's water bill could generate profits from this service.
Flood protection and drainage facilities	Construction of mega-drainage shafts	2013-16	The design and construction of three mega-drainage tunnels, one pump station and floodgates, is being undertaken in partnership between Thai Engineering Consultant Co., Ltd and Nawarat Patanakarn Public Co., Ltd. and the BMA, which are sharing in financing these upgrades to the existing system. This is not a revenue-generating activity.

Sources: ADB and NUS (2012), *Good Practices in Urban Water Management: Decoding Good Practices for a Successful Future*, Asian Development Bank and National University of Singapore, Mandaluyong City, Philippines, available at: www.adb.org/sites/default/files/publication/29888/good-practices-urban-water-management.pdf; BMA (2014c), "Drainage tunnel beneath Bang Sue Canal", Department of Drainage and Sewerage, presentation made at the Bangkok Knowledge Sharing Workshop on Urban Green Growth in Dynamic Asia, 6-7 August, Bangkok; UN ESCAP (2014), "Traffic demand risk: The case of Bangkok SkyTrain (BTS)"; UN ESCAP (n.d.), www.unescap.org/ttdw/ppp/ppp_primer/92_the_underground_mrt_system_bangkok_thailand.html.

PPPs bring critical financial resources to such public infrastructure investments, but they also require sophisticated technical expertise, which Bangkok has shown it can muster. This may prove difficult for smaller, less experienced local governments to replicate successfully. The new PPP Act, Private Investments in State Undertakings B.E.2556 (2013), and the Thai PPP Secretariat Office (State Enterprise Policy Office) of the Ministry of Finance can help to strengthen sub-national capacities for PPPs, in the city of Bangkok and in other local governments in the BMR. Better understanding of the barriers to PPPs and private investment in public infrastructure projects is needed. The less attractive risk-return profile of sustainable transport infrastructure projects, compared to fossil fuel-based alternatives, often limits private investment (Ang and Marchal, 2013). To further address barriers to low-carbon and climate-resilient infrastructure investment, climate policies and investment policies need to be integrated within a green investment policy framework (Corfee-Morlot et al., 2012). Enabling conditions for private investment in low-carbon and climate-resilient infrastructure should be improved, to ensure that investors, producers and consumers receive consistent signals across the full breadth of the regulatory landscape (OECD, 2015f). Multilateral co-operation to address outstanding barriers to international trade and investment in low-carbon infrastructure should also be strengthened. In a context of global value chains, as in the solar and wind energy sectors, incentives that favour domestic manufacturers, such as local-content requirements, may hinder international trade and investment across the value chains (OECD, 2015g).

Institutional investors, such as insurance companies and pension funds, have not yet been fully involved in such projects for a variety of reasons. They could, however, play a key role in financing the transition to a low-carbon and climate-resilient economy given the enormous resources they control, estimated in the tens of trillions of dollars (OECD, 2015d; Kaminker et al., 2013). A series of recent reports (OECD, 2015b; Kaminker et al., 2013) lists a range of obstacles that can affect the risk-return profile of green infrastructure and determine whether a particular green infrastructure is attractive or accessible to private investors including institutional investors. They include:

- environmental, energy and climate policies and regulations that favour investment in "brown" infrastructure over green infrastructure
- regulatory policies with unintended consequences which discourage private investors from investing in infrastructure
- a lack of suitable financial instruments and funds or de-risking approaches
- a shortage of objective information, data and skills to assess transactions and underlying risks.

Several alternative means are available for the public sector to encourage greater private investment in urban infrastructure projects. Widely known, commonly used policy incentives include tax relief or rebates, price subsidies and feed-in tariffs for electrical energy producers selling electricity to distribution companies. The Bangkok Metropolitan Electricity Authority (MEA) buys energy from the Electricity Generating Authority of Thailand (EGAT). Alternatives include financial instruments and risk mitigants like loan or bond guarantees, *ex ante* "parametric" insurance policies and lines of credit to immediately access emergency response funds. Longer term financing needs are being negotiated between governments and external sources of financial assistance, and by transforming capital contributions into shareholder ownership (equity) of the asset/project. Such tools are most effectively used when they are used jointly with

national governments and/or international development agencies and banks. These can also play influential roles in overcoming investors' concerns and hesitation to engage in such projects.

Municipal "green bonds" can also be used to attract institutional investors. The BMA does not at present issue municipal bonds, but could easily do so with the support of the national government and/or international financial institutions, such as the World Bank Group, which has now issued close to USD 12 billion since its inception in 2008 and whose growth is accelerating rapidly. Alternatively, the Asian Development Bank (ADB) and several other dedicated funds have been set up, such as the Green Climate Fund (GCF), the Adaptation Fund (AF), the Climate Investment Funds (CIF), the Global Environment Facility (GEF), the Clean Technology Fund (CTF) or the Special Climate Change Fund (SCCF). The USAID-ADB-DFID-Rockefeller Foundation Trust Fund is now part of the foundation's Urban Climate Change Resilience Partnership, which is designed to leverage financing, including an additional USD 1 billion in public and private investment, to scale up climate change resilience for 25 cities in Asia. This type of financing mechanism presents another opportunity for Bangkok to raise additional finance for green growth projects. Green bonds, in particular, could be set up jointly by the local governments in the BMR and the national government. Such an instrument could help attract private investors and alleviate the (actual or perceived) financial risks associated with investments in some key green growth projects. The city of Gothenburg (Sweden), with the support of the World Bank, has issued green bonds since 2013 to leverage finance for climate change mitigation and adaptation projects and other environment-related activities (Climate Bonds Initiative, n.d.). In Bangkok, this strategy could be further explored in the area of energy use, for instance, where private investors are not yet effectively involved. Co-operation and co-ordinated action with the national government would be highly advantageous. The Thai central government could assist provincial governments in the BMR by participating in the use of such tools and promoting them through any one of the policy or financial instruments mentioned above or noted at the end of this chapter.

Diversifying local revenues for urban green growth

Local finances at present are heavily dependent on transfers and grants from the national government (see Chapter 1). While such transfers provide substantial financial resources to local governments, meeting the green growth challenges presented in the previous chapters will require enhanced financial resources and capacities at the local level. Several strategies can be pursued by the BMA and all municipalities in the BMR to leverage local finance for urban green growth. Although the BMA is in charge of the building and land tax and the land development tax within its own jurisdiction, collection of property cadastre data remains a challenge, partly because capacity is lacking to map and collect data on land use and the value of properties in the city of Bangkok. This is a labour-intensive exercise, and expenditure on personnel is restrained by national legislation (Berman, 2011). Local authorities should therefore consider increasing internal capacity to collect property identification data, with the support of the Ministry of Finance and international organisations. OECD (2013a) advised that a first step for municipalities to strengthen their property tax collections would be to set up cadastres and carry out a comprehensive review of cadastral values to restore the tax base. In Mexico, a new programme to update cadastres (*Programa de Modernización Catastral*) has been set up by the National Institute of Statistics and Geography (*Instituto Nacional de Estadística Geografía e Informática*, INEGI) with the financial support of the development bank

BANOBRAS. This has successfully contributed to updating the cadastre of 11 municipalities and increased their property tax collection by an average of 40% (OECD, 2015b). The same could be achieved in the BMR, through training of the staff working in the local finance departments, in particular to master modern tools such as GIS (if relevant), and modernise IT tools to identify and appraise properties in the city.

Revenues could also be enhanced by raising tax rates and reducing exemptions. The many exemptions limit the revenues collected from the building and land tax, notably for owner-occupied properties (Berman, 2011). All local governments in the BMR could reduce tax exemptions and instead introduce tax incentives/disincentives so as to encourage green growth. Local authorities could also explore opportunities to increase the land improvement tax, which accounted for only 0.24% of the total revenue in 2012, and use it as a land-value capture tool. The tax rate in parcels whose attractiveness increased as a result, such as those near current and future public transport stations or green areas, should be increased to leverage local finance. The potential is great, as the private sector owns around 80% of land in the city. This would be a good complement to ensure private financial participation in the construction of infrastructures such as drainage infrastructure, mass transit and solid waste management. Part of the revenues directly collected by local authorities or transferred from other levels of government could be earmarked by local authorities to finance green growth projects. The benefits of this strategy should be tracked, reflected in the quality of public services and shared with the public, which may not otherwise support tax increases.

Local governments in the BMR could also explore opportunities to increase the use of fees and charges, which accounted for only 2% of the BMA's total revenue in 2012 (see Figure 1.20 in Chapter 1). In most OECD countries, tariffs and user fees represent on average 15.2% of sub-national government revenue (OECD, 2015e). Development charges could be used to finance the costs of services for green growth (e.g. climate-proofing water, transport and energy systems). Wastewater fees, for example, are not efficiently collected. The capacity to increase fee collection should thus be improved. Also, while fees exist for providing potable water to residents, they do not cover the full investment and operational costs of operating the water supply and wastewater treatment system. The fee could therefore be modified to cover the full cost of building new and maintaining existing infrastructure, and to encourage water conservation through increasingly steep marginal costs based on usage (i.e. water use becomes increasingly expensive incrementally per unit of water). The use of fees and charges also offers complementary co-benefits that can help achieve urban green growth.

Such policies may need to be jointly decided with the Thai government, which has considerable influence over local governments' ability to attract and raise finance. To date, tax rates are controlled by the Ministry of Finance, while local taxing authorities' discretionary power is limited to minor fees and charges. The building and land tax rate for commercial buildings can only be modified by national legislation, and has been held at 12.5% for years, despite requests from the local government to update it. The Ministry of Finance should consider updating the tax rates on a more frequent and regular basis and diversifying tax rates with a view to mustering the resources to finance urban green growth. Meanwhile, revenue collected by other government units and transferred to the BMA does not reflect the size of the population living in the city of Bangkok (BMA, 2013b). The money transferred does not include the unregistered population – more than 2 million people in the city of Bangkok alone – who benefit from publicly provided services, such as schools, roads, solid waste collection and wastewater treatment, and potable water. Local and national governments should reduce the number of unregistered

residents, so that the tax amount transferred to the BMA reflects the actual number of people living in the city. This would also help optimise revenues collected through the building and land tax. Alternatively, they could consider using the estimate of unregistered residents in the calculation of the BMA's share of the value-added, liquor and excise taxes.

In addition to these measures to maximise local revenues, financial support from the central government should remain an important tool for financing urban green growth in the short term. In Sweden, a national programme (KLIMP) provides local governments financial support to manage greenhouse gas (GHG) emissions and adapt to climate change. Local governments can apply for national subsidies that can be used to promote local investment to reduce emissions and improve energy efficiency and independence. Examples of funded municipal activities include removing disincentives for individuals to reduce emissions, such as eliminating free parking, and subsidising the cost of retrofitting filling stations to add a pump to supply renewable biofuels (Corfee-Morlot et al., 2009). This could also be achieved in the BMR to support the Metropolitan Commission. Specific financial channels in key thematic areas for green growth could be added to ensure that recommended policies are translated into practice.

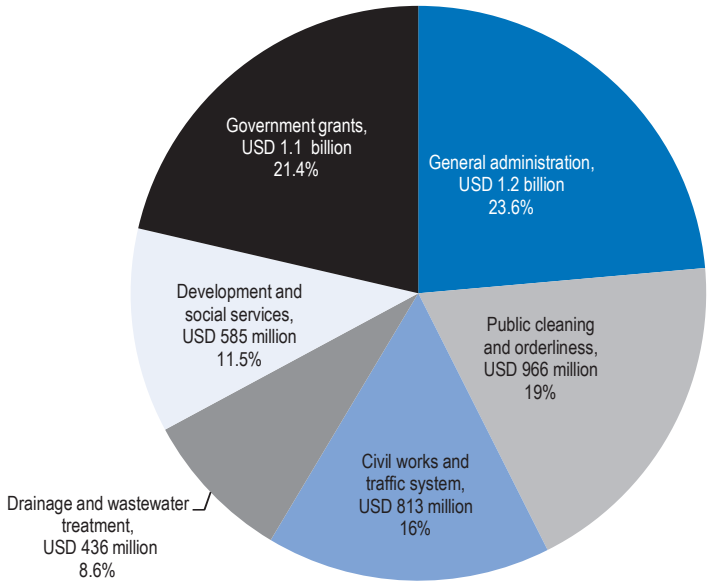
Tracking urban green growth expenditure

The BMA's expenditures for fiscal year 2012 were USD 4 billion (THB 48.7 billion).[1] General administration (23.6% of total expenditures) and public cleaning and orderliness (19%) were the two top sectors in terms of expenditure. Of these expenses, 84.9% were operating expenditures and 15.1% capital expenditures. Expenditures from government grants were USD 1.1 billion (THB 13.2 billion), which was mainly spent on special projects for educational support and senior citizens' monthly allowances (Figure 4.1).

It is difficult to estimate how much in total is spent for green growth policies. Although water quality management, land use and traffic control systems can be identified in the BMA's records, expenditures on energy, transport, housing and buildings, solid waste management and promoting green manufacturing goods and services should be made less difficult to identify, by the use of special "dedicated" budget codes and tags. This would help show how much public funds are spent on green growth initiatives and on what activities or programmes, and offer opportunities to restructure expenditures for green growth objectives. The Finance Department should work with other relevant departments in the BMA to track urban green growth expenditures. In each of these sectors, the BMA could also compare its expenditures (as a share of the total) with the expenditures in the same sectors in other developed and developing cities. The other local governments in the BMR could also pursue this strategy.

Figure 4.1. **Expenditure of the Bangkok Metropolitan Administration**

By sector, fiscal year 2012



Source: BMA (2014b), "Answers to the OECD case study questionnaire", internal document, unpublished.

Capacity building at all levels of government

Building technical capacity at different levels

While it is critical to increase financial capacities of local governments, technical capacities should also be strengthened with green growth in mind. One of the three strategies of Thailand's National Climate Change Master Plan (2012-2050) is to strengthen the technical capacity of public institutions to manage the risks and impacts of climate change and other cross-cutting issues. The Thai government has been promoting the "Clean City, Clean Mind" and "Low-Carbon City" initiatives, providing technical assistance to local governments. The Thailand Greenhouse Gas Management Organisation (TGO), with support from the Joint Graduate School of Energy and Environment at King Mongkut's University of Technology Thonburi, has developed a nine-step process to help localities work towards becoming a low-carbon city (ASIA LEDS Partnership, 2013). This initiative has proven successful in Muang Klaeng, in the province of Rayong, the pilot for the initiative. The collaboration emphasises the importance of stressing the co-benefits of climate change mitigation in each targeted policy sector. This can win buy-in from various stakeholders who can help achieve low-carbon targets (ASIA LEDS Partnership, 2013). This initiative is a good starting point but must be further explored in a metropolis like Bangkok, where human, financial and technical capacities must be more significant to produce results. Given the success of the pilot initiative, the Thai government should invest more resources in building capacities for a low-carbon Bangkok in each of the municipalities of the BMR. The metropolitan commissions could also be focal points to co-ordinate this initiative and better use resources to develop the BMR.

Several other initiatives could be pursued at three levels: the enabling environment, the organisation level and the individual. The BMA, sometimes with the help of

international agencies, has already set up initiatives to build administrators' and students' capacities and awareness on a number of issues critical for green growth (e.g. energy efficiency, solid waste management and climate change master planning). These have chiefly focused on individual skills and knowledge. Additional initiatives could be taken, especially in terms of the enabling framework (i.e. metropolitan commissions) and at the organisational level. Local academic institutions – especially those developing urban development programmes, such as BMA University and the Institute for Metropolitan Development – should tailor their courses to local governments' needs and collaborate with them closely to design and implement training programmes in urban planning, procurement, cadastre, financial management, etc. (Table 4.5).

Strengthening monitoring and evaluation systems at the scale of the Bangkok Metropolitan Region

Monitoring and evaluation (M&E) of the progress towards green growth is a critical element for informing and building capacity for policy makers to address the green growth challenges faced by the BMR. They make it possible to track the performance of infrastructure and policies in critical sectors and provide crucial information on investment needs. This is increasingly important at the regional and local levels, owing to decentralisation, deregulation and the progressive takeover of public sector functions by non-governmental service providers, including the private sector, NGOs and civil society groups. Results-based M&E focusing on outcomes is a key public management tool, as it helps track progress and demonstrates the impact of plans and policies (Kusek and Rist, 2004).

Table 4.5. **Proposed capacity building in the Bangkok Metropolitan Region**

	Enabling environment	Organisational level	Individual level
Overall capacity objective	– Develop regulatory frameworks for environmental governance and investment – Improve inter-institutional co-ordination between provinces in the BMR and national governments	– Develop organisational performance and environmental management capabilities	– Improve understanding of environment-development linkages – Develop technical skills (e.g. tax collection, flood vulnerability assessment) – Support long-term commitments to professional development
Past/existing initiatives	– Some co-operation frameworks have been established between the BMA and the national government (e.g. mass transit development and flood disaster management and relief) – International donors/partners have provided assistance on a number of projects (see Table 4.7)	– Groups of volunteers have been created and trained since 2011 to identify pollution hotspots and polluting vehicles. Awards were created by public authorities as incentives – The Japan International Co-operation Agency (JICA) and the BMA jointly worked on the Bangkok Wastewater Treatment Master Plan in 2011 – JICA and the city of Yokohama built the BMA officials' capacities in 2013 to design and implement the Bangkok Master Plan on Climate Change Mitigation and Adaptation	– Workshops involving BMA officials and street vendors were organised in 2011, 2013 and 2014 to reduce pollution from grilled food and raise awareness on its health and environmental impacts – Officials from the BMA Department of Environment and community representatives underwent training in 2010 and 2011 to reduce air pollution from open burning of waste – BMA and private stakeholders organised seminars in 2012 to teach students from 16 schools in the city of Bangkok how to reduce energy consumption – The BMA and Ministry of Energy organised training, seminars and youth camps in 2008-09 to build 435 schools' capacities to reduce energy consumption and promote the use of renewable energy (RE) – As part of the Green Living Project, the BMA initiated a programme in 2012 to increase its officials' and district administrators' capacities to increase energy efficiency in the BMA's buildings – The BMA and the Tokyo metropolitan government held the Workshop on 3R and Waste Management in Bangkok in 2012. The workshop helped improve knowledge on how to enhance waste disposal and separation at source, and how to manage waste in case of disaster

Table 4.5. **Proposed capacity building in the Bangkok Metropolitan Region** (*cont.*)

	Enabling environment	Organisational level	Individual level
Some proposed measures	– Create metropolitan commissions in green growth sectors and develop guidelines on environmental management at the regional scale – Set up a metropolitan fund for green growth projects – Set up a national development bank to fund urban projects in the BMR – Encourage region-wide international financial assistance in the BMR	– Integrate key performance indicators in project design/implementation to assess organisational performance and environmental management capabilities of local administrations in the BMR – BMA University and the Institute for Metropolitan Development develop programmes to train specialists in urban planning, cadastre, financial management, etc. – Create professional development mechanisms offering certificates for competences, such as the World Bank Institute's extensive offering of long-distance e-courses free or at low cost	– Create awareness and provide basic skills development – Request national and international technical support in building capacities for measuring and monitoring green growth and other implementation obstacles (e.g. air pollution $PM_{2.5}$, flood vulnerability, tax collection) – Develop a systematic approach to detect training needs, through the collection of organisational, occupational and curricular information; align individual training and workforce needs
Cross-cutting intervention	– Raise awareness of the benefits of green growth – Create platforms for policy dialogue among key stakeholders (i.e. professional networks or conferences to review and discuss states of practice) – Improve co-ordination mechanisms and procedures regarding the inclusion of social and environmental sustainability considerations ("safeguards") in government policies – Support pilot projects to test proposed capacity-building initiatives – Identify best practices in key thematic areas to promote and implement green growth strategies and action		

Source: Adapted from OECD (2012), *Greening Development, Enhancing Capacity for Environmental Management and Governance*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167896-en.

An M&E system of this kind has recently been set up in Thailand. The key performance indicators (KPIs), in particular, have been developed by provincial and local governments, including the BMA, in line with the targets of development plans, and are approved by the central government (UNDP, 2010). These critical results-based M&E tools can help the BMA assess progress in the critical sectors for green growth. Each of the seven strategies of the Bangkok Vision 2032 is supported by KPIs that help measure progress towards the objectives of the plan (Table 4.6). Each of the 50 districts of the city of Bangkok report every week on their progress. This is a good strategy to help decision makers determine the necessary improvements in projects and policies, and to generate information. To increase the utility of these indicators, the local government may need to consider applying disincentives or sanctions to districts that do not meet targets. This would encourage revising indicators to make them more realistic. In addition, the BMA should incorporate in the KPIs' systematic reporting not only quantitative but qualitative data. This will help assess why some goals are not attained, if necessary, and to take the necessary action.

Table 4.6. **Examples of key performance indicators defined by the Bangkok Metropolitan Administration**

Indicator	Objective			
	5-year period 2013-17	10-year period 2018-22	15-year period 2023-27	20-year period 2023-32
Additional length of flood prevention walls along the Chao Phraya River (km)	1 000	1 500	1 500	–
Percentage of green areas in the city of Bangkok	No less than 13	No less than 19	No less than 23	No less than 28
Percentage of Bangkok residents able to access mass transit systems and reach their destination within ten minutes	30	40	50	60
Average travel time between place of residence and place of work (in minutes)	60	50	40	30
Percentage of Bangkok residents travelling by bicycle	2	4	6	8
Percentage of economically disadvantaged and informal workers in Bangkok with secure jobs	30	50	70	100

Source: BMA (2012), *Bangkok State of the Environment 2012*, Department of Environment, Bangkok.

The functional urban area of Bangkok which extends to the vicinities of the BMR and even beyond, and options for extending M&E throughout the BMR should be explored. The KPIs are developed within provinces or municipalities and do not cover all jurisdictions in the region. Other agencies (e.g. MEA, MWA) produce different types of indicators, but rarely for the whole BMR. Indicators for green spaces and water consumption are available for the BMR, but indicators for waste and transport are only available for the city of Bangkok (Asian Green City Index, 2010; see Table 4.7). Air quality data is also only produced for the city of Bangkok, and M&E capacities are sparse in the region: only 21 air quality monitoring stations cover the city of Bangkok, and only 8 are in place in Samut Prakan, 2 in Nonthaburi, 1 in Pathum Thani, and none in the provinces of Samut Sakhon and Nakhon Pathom (Pollution Control Department, n.d.).

The 11th National Economic and Social Development Plan (11th NESDP 2012-2016) specifies that databases at provincial and local levels will be developed and linked with centralised databases and other relevant databases. The goal is to monitor implementation of the plan to promote climate change adaptation measures, among other concerns (NESDB, 2011). The development of BMR-wide KPIs would fit well within such a national framework, and could be supervised by a BMR Observatory (BMRO) established by the Thai government. This would essentially function as a green growth M&E entity. A BMR-wide performance-based M&E system focused on the development of KPIs would significantly help assess problems and outcomes to monitor and evaluate in sectoral areas (especially those such as land use, for which regional governance is needed), and therefore to encourage green growth in the BMR and not only the city of Bangkok. The BMRO could take the existing KPIs of the BMA as a basis for designing BMR-wide KPIs. The BMRO would be particularly useful to support the proposed metropolitan commissions and to encourage implementation of green growth policies and actions in the region. Central and local governments in the BMR could consider the example of the Gauteng City-Region Observatory in South Africa. This was established in 2008 as a partnership between the University of Johannesburg, the University of the Witwatersrand, Johannesburg and the Gauteng provincial government. Local government in Gauteng is also represented on the Gauteng City-Region Observatory Board. Its objective is to build strategic intelligence to plan, manage and govern the city-region through improved data, analysis and reflective evaluation on its opportunities and challenges.[2]

Table 4.7. **Examples of green growth indicators in the Bangkok Metropolitan Region**

Sector	Indicator	Scale
Water	Domestic and total water consumption per capita	MWA operating area (city of Bangkok, Nonthaburi and Samut Prakan)
	Non-revenue water (or unaccounted-for water)	MWA operating area (city of Bangkok, Nonthaburi and Samut Prakan)
	Volume of water produced	MWA operating area (city of Bangkok, Nonthaburi and Samut Prakan)
	Percentage of treated water produced	City of Bangkok
	Percentage of the population with access to an urban sanitation system	City of Bangkok
	River and canal pollution	City of Bangkok
	Economic damages created by floods	City of Bangkok
	Consequences of floods on low-income communities	City of Bangkok
Solid waste	Tonnes of garbage collected and hazardous waste generated	City of Bangkok
	Treatment of municipal solid waste (i.e percentage of waste landfilled, recycled, incinerated)	City of Bangkok
Land use	Land-use changes	BMR and each province of the BMR
	Density	BMR and city of Bangkok
	Land subsidence	City of Bangkok
	Status of natural resources (e.g. evolution of mangrove areas)	Thailand
	Location of slums	City of Bangkok
	Ground-level map	BMR
	Green areas	City of Bangkok

Table 4.7. **Examples of green growth indicators in the Bangkok Metropolitan Region (*cont.*)**

Sector	Indicator	Scale
Transport	Transport modal split	City of Bangkok
	Inventory of registered vehicles	City of Bangkok
	Concentration of air pollutants (e.g. particulate matter)	City of Bangkok
	Greenhouse gas emissions	City of Bangkok
	Commuting data	Some BMR provinces and city of Bangkok
	Vehicular kilometres travelled	City of Bangkok
	Congestion	City of Bangkok
Energy	Energy consumption per capita and by sector	MEA operating area (city of Bangkok, Nonthaburi and Samut Prakan)
	Final energy consumption by sector	Thailand
	Energy intensity by sector	Thailand
	Energy production capacity	City of Bangkok
	Proportion of real population without access to electricity	City of Bangkok
Housing and buildings	Housing stock data	BMR and each province of the BMR

Source: Authors' creation.

The role and contributions of international co-operation agencies

International co-operation can support the urban green growth agenda, even though dynamic Asia's dependence on international co-operation will begin to decrease progressively in the coming years as domestic demand and revenue sources increase (Matsumoto and Daudey, 2014). International co-operation devotes significant financial resources to green development in the BMR, through official development assistance (ODA) and technical expertise to local governments on urban climate change and resilience plans. It is thus critical in increasing the financial and technical capacities of local governments.

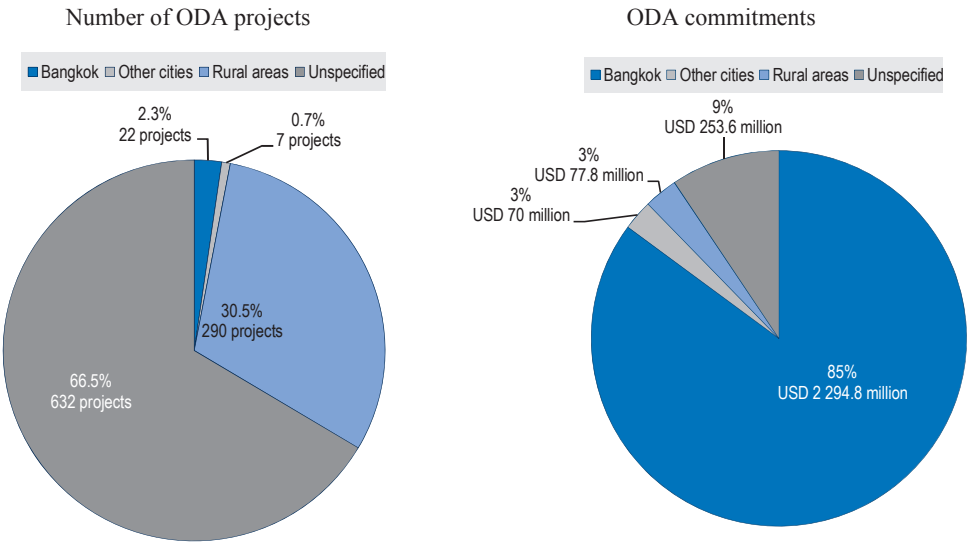
Official development assistance needs to be more comprehensive and target the Bangkok Metropolitan Region as a whole

Total ODA to Thailand peaked in the 1980s and 1990s, and then significantly decreased in the 2000s and the 2010s due to repayment of principal ODA loans (World Bank, n.d.). However, bilateral development finance committed by members of the OECD Development Assistance Committee (DAC) continues to support certain targeted development objectives. From 2002 to 2012, 951 projects were implemented bilaterally by DAC members in Thailand to contribute to environmental objectives (including the Rio Conventions).[3] At least 22 were specifically targeted to benefit the BMR (chiefly for the city of Bangkok). These 951 projects accounted for USD 2.7 billion, but the 22 projects in the BMR accounted for USD 2.3 billion, or 85% of total environmental-related ODA grants and loans for Thailand (Figure 4.2). Among the environmental-related ODA committed to the BMR over this period, the transport sector (mainly to finance the construction of some BTS and MRT lines) accounted for only 27% of projects, but 95% of the amount financed (USD 2.2 billion; Figure 4.3). Only USD 70 million (3% of environment-related ODA committed to the BMR) was allocated to flood resilience, mainly for the reconstruction of the Outer Ring Road and to improve flood management planning after the 2011 floods.

The BMR has monopolised international financial assistance for environment-related projects, but more investment is needed. The water and solid waste sectors only received USD 56.3 million and zero respectively from bilateral activities over this period.[4] Most importantly, bilateral ODA and other development projects listed below may need to encourage more cross-sectoral and metropolitan action on green growth, as many focus on a specific sector or issue, in one jurisdiction, at a time. Metropolitan commissions and advisory boards involving all local authorities in the BMR and the Thai government could analyse the benefits of cross-sectoral or region-wide actions to promote more comprehensive assistance from potential donors and local stakeholders.

Figure 4.2. **Number of bilateral ODA activities and bilateral ODA funding for urban and rural areas in Thailand for environmental purposes (including Rio Conventions) (2002-12)**

Bilateral commitments, USD billion, constant 2012 prices

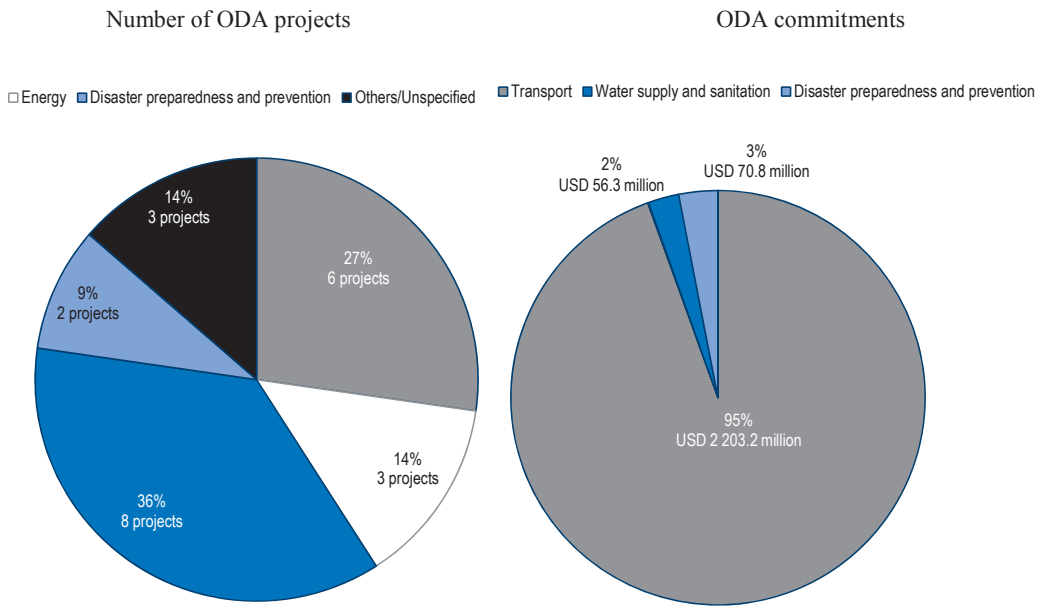


Source: OECD (2013b), Aid activities targeting Global Environmental Objectives", *DAC Creditor Reporting System* (database), https://stats.oecd.org/Index.aspx?DataSetCode=RIOMARKERS (last accessed 25 November 2014).

International organisations can help the national government and local governments in the BMR access and mobilise other types of international and private finance. For instance, they could further communicate with the BMA, other local governments in the BMR and the Thai government to raise awareness and share lessons on how to apply for finance from the range of funds available, e.g. the Climate Investment Funds (CIF), Global Environment Facility (GEF), the Adaptation Fund and the Green Climate Fund. The BMA and other local governments need to receive recommendations from the Office of Natural Resources and Environmental Policy and Planning (Ministry of Natural Resources and Environment) or the Thai government before applying for grants. It is important that local authorities and the national government work hand in hand to propose concrete, well-designed projects and programmes to international funds and donor organisations, to optimise their chances of financial and technical support. As an upper/middle-income country, Thailand is not eligible for certain types of international development funds, but may still apply for competitive demand-driven based thematic funding like those mentioned above.

Figure 4.3. **Number of bilateral ODA activities and bilateral ODA funding for Bangkok for environmental purposes (including Rio Conventions) (2002-2012)**

Bilateral commitments, USD billion, constant 2012 prices



Source: OECD (2013b), Aid activities targeting Global Environmental Objectives", *DAC Creditor Reporting System* (database), https://stats.oecd.org/Index.aspx?DataSetCode=RIOMARKERS (last accessed 25 November 2014).

International projects can be more directly undertaken with local governments in the Bangkok Metropolitan Region

In addition to financial assistance provided by bilateral providers of development co-operation, multilateral institutions, non-governmental organisations and cities in other countries provide other technical services and assistance to the city of Bangkok or/and with the Thai government. This includes areas with high potential to encourage green growth, such as energy efficiency, climate change planning and solid waste management. The BMA has been actively engaging other sub-national networks with specific policy expertise on flood resilience. The Asia-Pacific Adaptation Network has organised several workshops and conferences in Bangkok to bring together local and international experts to share knowledge and experience on this topic. The Global Disaster Preparedness Centre and the Red Cross have also been closely involved in raising citizen awareness and organising workshops to build flood resilience in the city of Bangkok. Capacity-building and urban resilience are frequently cross-cutting themes in many international co-operation projects (Table 4.8).

Table 4.8. **Selected international co-operation projects in the Bangkok Metropolitan Region**

Partner	Area of co-operation	Timeframe	Co-operation framework
ADB	Transport	2008-09	The Thai government requested the Asian Development Bank (ADB) to provide project preparatory technical assistance for developing a strategic approach, financing plan, implementation programme and project management arrangements to procure an integrated ticketing system for new rail lines to be added to the existing Bangkok MRT network (ADB, 2009).
JICA/city of Yokohama	Master Plan on Climate Change	2013-23	The objectives of the Japan International Co-operation Agency (JICA) Technical Co-operation Project for the BMA Master Plan on Climate Change (2013-2023) are twofold: to draft the Bangkok Master Plan on Climate Change and to help the BMA develop the capacities to implement it. The city of Yokohama is a designated collaborator to build capacities of the BMA and the Thai government to develop and implement the Master Plan.[1]
JICA	Bangkok Global Warming Mitigation Action Plan	2009-12	JICA assisted the BMA in developing the Action Plan (2007-2012) for the "Project on Capacity Building on Climate Change Adaptation and Mitigation for Implementation in Bangkok", from June 2009 to May 2012. The Action Plan comprised five major initiatives to: 1) expand mass transit and improve the traffic system; 2) promote the use of renewable energy; 3) improve electricity consumption efficiency in buildings; 4) improve solid waste management and wastewater treatment efficiency; and 5) expand park areas.[2]
JBIC/JICA	Mass transit development	2004-10	The Japanese Bank for International Co-operation (JBIC) and JICA have provided financial assistance to develop the mass transit system in Bangkok and the Suvarnabhumi airport.
JICA	Wastewater treatment	1981-present	JICA has provided assistance on the design of several wastewater treatment master plans (1981, 1999, 2011). Areas covered by the plans expanded progressively from 10 initially, then to 20 in 1999 and finally to 27 zones in the 2011 Master Plan.
DANIDA	Water	2002-04	DANIDA, Denmark's development corporation, has supported the development of water technology and capacity-building programmes for the BMA.
DANIDA	Renewable energy	2002-04	DANIDA has supported the development of solar water heating and photovoltaics in Bangkok.
Rockefeller Foundation	100 Resilient Cities	2010-	*100 Resilient Cities – Pioneered by the Rockefeller Foundation (100RC)* is dedicated to helping cities around the world become more resilient to the physical, social and economic challenges that are a growing part of the 21st century. Bangkok is one of the first 33 cities of 100 Resilient Cities selected for the Centennial Challenge Project. Cities in the 100RC network are given resources to develop a roadmap for resilience.[3]
Tokyo metropolitan government	Disaster risk management/ waste management	–	The Bangkok Fire and Rescue Department has been collaborating with the Tokyo Fire Department to exchange experiences and information on earthquake preparedness and management. The BMA's Department of Environment visited waste management facilities in Tokyo.
Citynet	Disaster risk management	–	Bangkok is one of the cities selected to join the Disaster Cluster of CITYNET, which trains city managers in disaster risk reduction and management approaches, facilitates urban risk profiling activities and disseminates best practices in disaster preparedness. The BMA is also a member of its 2014-17 Executive Committee
START	Disaster risk management	2009-	The BMA has co-operated with the Global Change System for Analysis, Research and Training network (START) to implement the Coastal City at Risk (CCaR) project (financed by the International Research Initiative on Adaptation to Climate Change, or IRACC).

Notes: 1. www.jica.go.jp/project/english/thailand/016/outline/index.html,
2. www.jica.go.jp/thailand/english/office/topics/events120426.html. 3. www.100resilientcities.org.

The Thai central government is a pivotal actor in obtaining international support for the BMR. It has placed a high value and priority on international co-operation, as indicated in the 11th National Economic and Social Development Plan (2012-2016). Enhancing Thailand's role in international areas related to environmental framework agreements and international commitments is one of the strategies developed in the NESDP 2012-2016. However, it does not adequately address the need for increased support for technical and financial assistance from international partners for green growth. In its participation in the ASEAN community, the Thai government could also emphasise the need to develop further regional environmental standards and labels, and help to diffuse environmentally friendly technology in Southeast Asia. Local governments encounter many difficulties in dealing directly with international donor organisations. In fact, the BMA must obtain the approval of the national government to initiate projects, even though the BMA is legally entitled to co-operate with international organisations directly – as long as this is approved by the BMA Council. Likewise, much ODA is channelled directly to the central government, even though it is intended for an urban project in the BMR. The international community should explore possibilities to co-operate more directly with local governments, as their assistance could compensate for the lack of technical capacity, experience implementing a green growth pathway and financial resources observed in the BMR.

The pace of action must be stepped up. Successful interventions or pilot projects need to be scaled up more aggressively if the BMR is to meet the challenges of climate change. Rapid urbanisation, growing social inequality, and unsustainable, short-sighted economic growth must make way for long-term, sustainable economic and social development. Efforts should be made to develop mechanisms to enable international organisations to work more directly with the sub-national government. Creating a national development bank or so-called "green investment banks" could be considered. These are domestically focused public institutions that use limited public capital to leverage or "crowd-in" private capital, including from institutional investors, for low-carbon and climate-resilient infrastructure investment. This would open a new channel for international organisations to finance urban projects in the BMR implemented by sub-national governments, not directly but through the bank.

Main policy recommendations

- Create **metropolitan commissions** responsible for critical urban systems or functions, such as land use and transport, the energy grid, communication, water supply and sanitation, solid waste and emergency medical response systems, that can promote green growth and greater resilience to unexpected stresses and shocks, through vertically and horizontally co-ordinated policies, plans, strategies, programmes and actions.
- Create **a co-ordination unit for civil society organisations** to encourage citizens' participation, assist in community actions and manage platforms for dialogue; encourage the private sector to prepare plans and take actions supporting green growth, such as TIPMSE's waste collection and recycling initiative in Bangkok's slums; consult with industrial and commercial firms to further develop green growth training and education programmes.
- Create **metropolitan funds** supporting the decisions and work plans of metropolitan commissions; reduce the number of unregistered people in the city; and **finance green investments** through public-private partnerships, green bonds and the use of price signals and regulatory tools.

Main policy recommendations *(cont.)*

- Align BMA University's and the Institute of Metropolitan Development's educational and training programmes with the needs of the public administration's future workforce, and **harmonise and monitor key performance indicators at the scale of the BMR with the support of a BMR Observatory (BMRO)**.
- **Encourage official development assistance and development projects to support more cross-sectoral and BMR-wide climate-resilient green growth**, and create a **national development bank** for local and foreign investors to support green investment.

Notes

1. All numbers are expressed in US dollars in this paragraph. In Figure 4.2, they were converted using the PPP conversion factor for Thailand in 2012.
2. www.gcro.ac.za/about-gcro/gcro (last accessed 13 January 2015).
3. Bilateral ODA activities targeting environmental objectives can be identified in a dataset accessible through the OECD statistical website and from the CRS database. This dataset contains commitment data on aid in support of environment sustainability and aid targeting the objectives of the Rio Conventions (biodiversity, climate change mitigation, climate change adaptation and desertification). The main approach to identifying projects committed to urban areas was based on a word search of their purpose name (e.g. "urban development and management"). For all other projects whose purpose name did not make it possible to determine whether the project was urban, the "urban" character was identified by examining at each project description. Similarly, the main element used to identify projects committed to rural areas was their purpose name ("rural development"). A second step, if the purpose name was not conclusive, was to look at the titles and a short description of the projects. Agricultural, fishery and forestry projects were classified as rural. The remaining rural projects were identified based on their long description. Unspecified projects refer to all other projects, with no detailed description, no details on the geographical scope or inconclusive geographical scope.
4. All the data on international finance assistance provided to the BMR only include bilateral activities and not multilateral activities, due to a lack of data availability. All the figures given in the text may therefore underestimate the total financial assistance provided for environmental projects in the BMR.

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