

Executive Summary

The Bangkok Master Plan on Climate Change 2013-2023



September 2015

Message from Governor of Bangkok

Bangkok, a rapidly expanding metropolis, is very much aware of the challenges of climate change, including increased risks of natural disasters, as indicated by the flood crisis of 2011, and wishes to make a contribution to the international community's efforts to reduce carbon emission and conserve our planet.

To this end, The Bangkok Metropolitan Administration has undertaken a study leading to the drafting of "Bangkok Master Plan on Climate Change 2013-2023", sponsored by Japan International Cooperation Agency (JICA) under a technical cooperation project. The Plan aims to propose five main measures to reduce greenhouse gas emission and with adaptations to deal with climate change, which includes environmentally sustainable transport, energy efficiency and alternative energy development, efficient solid waste management and wastewater treatment, green urban planning and adaptation planning. This Plan is subsequent to our implementation of the Action Plan on Global Warming Mitigation B.E. 2550-2555 (2007-2012).

I would like to take this opportunity to thank JICA and all stakeholders for their support in producing "Bangkok Master Plan on Climate Change 2013-2023" as the framework for our efforts in the reduction of greenhouse gas and strengthening the capacity to cope with and adapt to any effects caused by climate change, within a basis of sustainable development. It is my hope that cooperation from all sectors will drive the implementation of the above Action Plan and that it will be the path to developing Bangkok to be a metropolis of good environment, with a good quality of life for the public, and to be a livable city in the future.



M.R. Sukhumbhand Paribatra
Governor of Bangkok

Message from Chief Representative Japan International Cooperation Agency (JICA) Thailand Office

Climate change is an imminent global threat endangering human security through worsening natural disasters, diminishing water resources, etc. If we continue our current unsustainable economic and social life style, it is expected that greenhouse gas emissions will grow and that the 21st century will encounter serious challenges. The Government of Japan (GoJ) has adopted policies to support a wide range of developing countries in alignment with the progress of international negotiations, including countries vulnerable to the negative impact of climate change and those making contributions to reduce global greenhouse gas emissions. Based on the policies adopted by the GoJ and by utilizing the experience, achievements and technology of Japan, Japan International Cooperation Agency (JICA) has actively been supporting measures to tackle climate change in developing countries.

In 2009, JICA initiated cooperation with the Bangkok Metropolitan Administration (BMA) in efforts to implement the Bangkok Action Plan on Global Warming Mitigation 2007-2009, by organizing study tours to Japan and dispatching technical experts. Following this, JICA expanded its work with BMA, through the Technical Cooperation Project onfor Bangkok Master Plan on Climate Change 2013-2023, from March 2013 for a period of 2 years and 6 months to provide support for drafting the Master Plan as well as capacity development for its implementation.

To help advance the work by BMA and JICA, there are several key partners. Ministries and agencies of the national government have continuously provided important advice, especially in relation to the national climate change policies, Also, through stakeholder meetings and outreach events, citizens, the private sector, civil society, academia etc, have actively participated in making the Master Plan.

Also it is worth noting that the City of Yokohama has contributed its knowledge and experience of elaborating and implementing climate change policy at the local government level. By this city-to-city cooperation, the Technical Cooperation Project to develop the Master Plan has been conducted through a creative yet pragmatic approach. I truly believe all of these have been essential parts of the Bangkok Master Plan on Climate Change that will be implemented jointly by all of the Bangkok partners.

The Master Plan has already attracted a high level of attention. Especially as the capital city of Thailand as well as a leading megacity of the Southeast Asian region, the efforts by Bangkok will have a significant impact, not only for itself but also for other cities in ASEAN region and beyond. In this regard, I sincerely expect that these ongoing efforts by BMA through implementing the Master Plan on Climate Change will lead to other local governments creating low carbon and climate change-resilient cities.



Mr. Shuichi Ikeda
Chief Representative, JICA Thailand Office

Preface

Climate change is one of the largest challenges to the current and future development of human society. The Intergovernmental Panel on Climate Change (IPCC) issued its Fifth Assessment Report warns that warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia, and the atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases (GHGs) have increased.

Bangkok can severely be affected by negative impacts of climate change. While it is still not scientifically possible to determine whether or not a specific extreme event is due to climate change, in 2011, Bangkok and areas along the Chao Phraya River were hit by a large scale flooding, and historically economic and social damages were recorded. It reminded that the Metropolis would need to accelerate actions to respond to climate change, as similar negative impacts have been already warned in many scientific research papers. At the same time, it is also evident that Bangkok is contributing to emitting GHGs. As the largest city in Thailand, as well as a major global city in the Southeast Asia, and the world, economic and social activities in Bangkok have a trend of increasing emission, which should be mitigated through policies and measures.

The Bangkok Action Plan on Global Warming Mitigation 2007-2012 was established to reduce GHG emission by at least 15 % of the total GHG emission anticipated in the year 2012 under business as usual projection. It includes 5 initiatives, namely expand the mass transit rail system within Bangkok metropolitan area, promote the use renewable energy, improve building electricity consumption efficiency, improve solid waste management and wastewater treatment efficiency and expand park area. In order to achieve these goals, full support from the people of Bangkok as well as every sector is acquired for the successful implementation of the activities under the Bangkok Metropolitan Administration's action plan. The opinions and suggestions were put together and refined by number of interdisciplinary experts including 36 organizations such as Ministry of Natural Resources and Environment, Ministry of Energy, The Federation of Thai Industries, Thailand Environment Institute etc., and other organizations from both private and public sectors.

However, challenges still remain, the implementation of the Action Plan was successful in initiating work to address climate change issues at local government level in a systematic manner with a satisfactory result of 14 percent reduction of GHG emissions. The BMA also decided to design a Bangkok Master Plan on Climate Change during the period of 2013-2023, aiming to work on (1) environmental sustainable transport; (2) energy efficiency and alternative energy; (3) efficient solid waste management and wastewater treatment; (4) green urban planning; and (5) adaptation planning. To support this, BMA and Japan International Cooperation Agency (JICA) agreed on the Technical Cooperation Project for Bangkok Master Plan on Climate Change 2013-2023, and jointly worked during the initial period of the Master Plan, during 2013-2015, with strong support by the Thai government ministries and agencies of knowledge sharing by the City of Yokohama, Japan.

This Master Plan provides a framework for Bangkok to establish a low carbon and climate change resilient city, by introducing future visions, prospects and proposed policies and measures in mitigation and adaptation, roles of BMA and its partners, roadmaps and mechanisms to implement efforts in a short, mid, and long-term. It is strongly hoped that the Master Plan will provide a useful and living platform for all stakeholders of Bangkok to make and strengthen their joint efforts to address climate change. And as a member of the global community, Bangkok decided to take a leading role to drive its efforts, in partnership with all parties.

Table of contents

1. Bangkok and climate change	6
2. A future vision toward establishment of a low carbon and climate change resilient city	7
3. Scope of the Master Plan	7
4. GHGs emission prospects and mitigation targets under the Bangkok Master Plan on Climate Change 2013-2023	8
5. Adaptation concern	10
6. Mitigation and adaptation measures under the Master Plan	10
7. Institutional arrangement for implementing the Master Plan	43
8. Monitoring and evaluation (M&E) and measurement, reporting, and verification (MRV)	44
9. Roadmap for implementation	45
10. Capacity building and outreach	46



Executive Summary of the Bangkok Master Plan on Climate Change 2013-2023

1. Bangkok and climate change

Climate change is one of the largest challenges to the current and future development of human society. To respond to the climate change in the Kingdom of Thailand, tremendous effort have been made since its ratification to the United Nations Framework Convention on Climate Change (UNFCCC), and the establishment of the National Committee on Climate Change (NCCC) chaired by the Prime Minister. Since then the government adopted and implemented major policies related to climate change such as the Energy Efficiency Development Plan 2011-2030 and the Alternative Energy Development Plan etc. Most recently, the National Master Plan on Climate Change and Thailand Nationally Appropriate Mitigation Actions (NAMAs) were adopted. The implementation targets to reduce the national GHG emission from energy and transportation sectors by 7% by 2020 based on Business as Usual (BAU) emission level. The reduction target may reach 20% with the support from international society as stated by the Minister of Natural Resource and Environment at the 20th Conference of the Parties to the UNFCCC

For Bangkok, climate change is also a big challenge. In 2011, Bangkok and areas along the Chao Phraya River were hit by a large scale flooding, and historically economic and social damages were recorded, which reveals that Bangkok is vulnerable to such extreme events that might be induced by climate change. At the same time, as the largest city in Thailand, as well as a major global city in the Southeast Asia and in the world, economic and social activities in Bangkok have caused large emission of greenhouse gases (GHGs). In addition, climate related damages in Bangkok affect not only Bangkok itself but also many other cities and countries.

In this regard, Bangkok Metropolitan Administration (BMA) needs to accelerate actions to respond to climate change. Further to the efforts made through the Bangkok Action Plan on Global Warming 2007-2012, BMA decided to elaborate measures for mitigation and adaptation to climate change, in cooperation with its domestic and international partners.

2. A future vision toward establishment of a low carbon and climate change resilient city

Toward establishment of a low carbon and climate change resilient city, the Master Plan sets 5 keys to future vision of Bangkok as follows;

- » BMA in partnership with the national government ministries and agencies, takes a major responsibility to mitigate and adapt to climate change.
- » BMA endeavors to establish well balanced action to harness economic and social development and climate change concerns.
- » BMA takes comprehensive approach to the low carbon and climate change-resilient urban development and action- oriented approach to the implementation of the Master Plan, as a vehicle in an evolving nature
- » BMA promotes actions by citizens, the private sector, academia, as well as other key players to mitigate and adapt to climate change, which should involve a multi-channel communication platform, innovative ways of promotional schemes and low carbon technology leapfrogging.
- » BMA, as a leading city of Southeast Asia and the world, takes proactive measures to mitigate and adapt to climate change in short, mid and long terms.

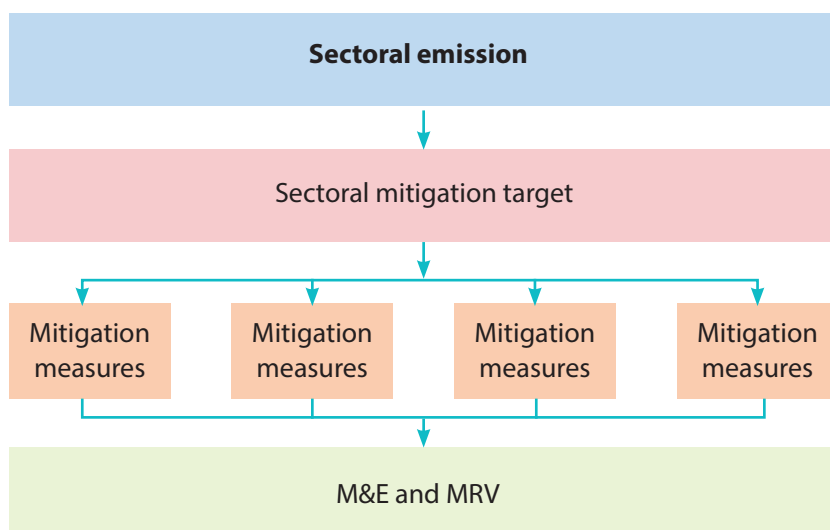
3. Scope of the Master Plan

The Bangkok Master Plan on Climate Change 2013-2023 covers the whole geographical area of BMA, in the following sectors;

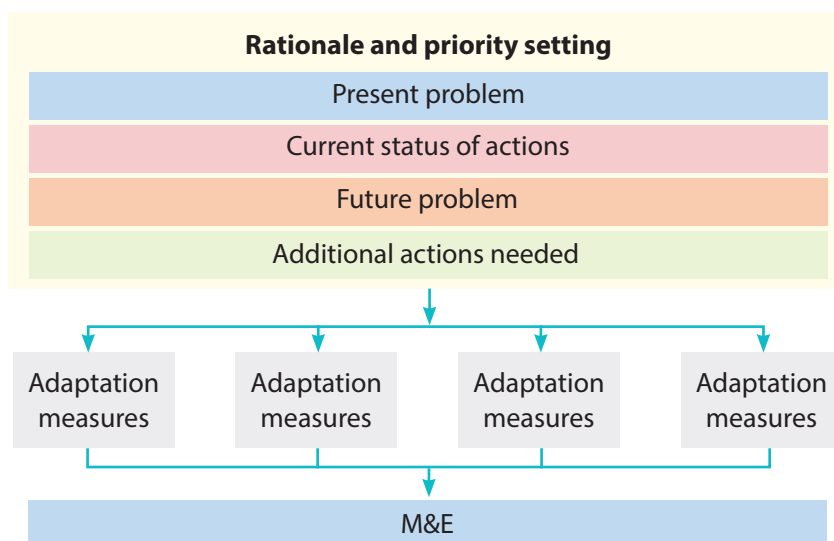
- (1) Environmentally sustainable transport;
- (2) Energy efficiency and alternative energy;
- (3) Efficient solid waste management and wastewater treatment;
- (4) Green urban planning;
- (5) Adaptation planning

The main role of the Master Plan is to select mitigation and adaptation measures as practical projects based on the assessment of their priority, urgency and feasibility. In order to develop a comprehensive and action-oriented approach, the Master Plan includes assessment of the current and future situations, prioritizing possible interventions, proposing concrete implementation plans of feasible measures. Therefore, it contains a package of Business as Usual (BAU) setting, target setting, and actual mitigation and adaptation measures. In addition, Monitoring & Evaluation (M&E) as well as the Measurement, Reporting, and Verification (MRV) mechanisms were developed to ensure the successful implementation of the Master Plan. The following figures show a structure of steps from the understanding of current situation to the selection of necessary measures and its M and E and MRV.

Mitigation package for sectors



Adaptation package

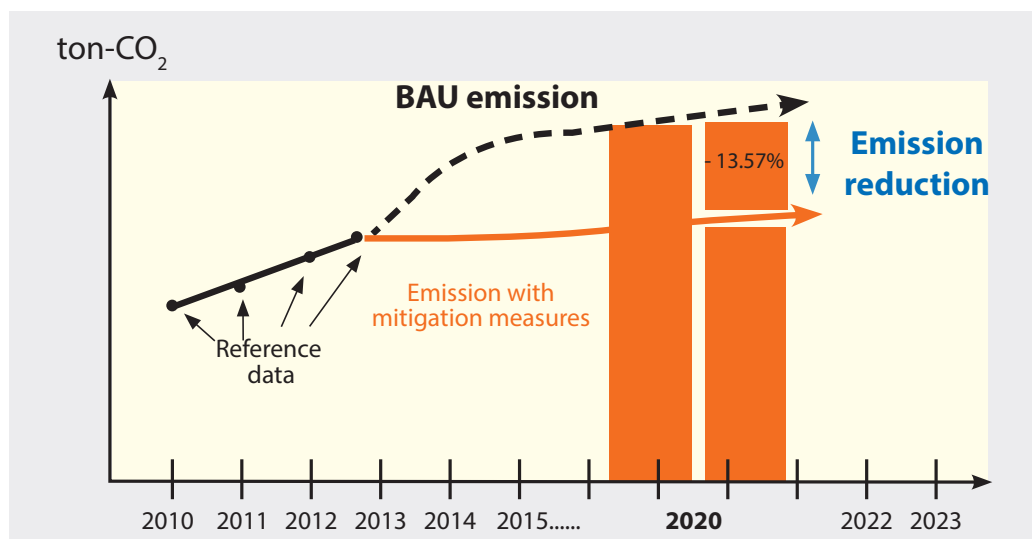


4. GHGs emission prospects and mitigation targets under the Bangkok Master Plan on Climate Change 2013-2023

Based on the survey, due to the steady population and economic growth of the country as a whole, and in particular rapid urbanization of Bangkok, there is a general trend of increasing GHGs emission in all sectors. To address this situation, the Master Plan foresees GHGs emission in business as usual (BAU) from 2013 through 2020¹, and with implementation of measures hereby set forth, promotes to reduce GHGs emission and mitigate climate change. In this regard, while absolute GHG emission amount will still increase even with mitigation measures, the emission will be greatly reduced against the BAU scenario.

¹ The contents of the mitigation measures of this Master Plans vastly overlaps with the Thailand Nationally Appropriate Mitigation Actions (NAMAs), submitted to the United Nations Framework Convention on Climate Change (UNFCCC). Namely, NAMAs planned and implemented in Bangkok area are also regarded mitigation measures under this Master Plan, and those emission reduction results will be a part of quantitative efforts of this Master Plan. Since NAMAs timeframe of the mitigation targets are set in 2020, the Master Plan also aligned itself. In this regard, it is expected that Master Plan's mitigation target in the rest of years until 2023 will be considered in future, along with the development of the national climate change policy.

Conceptual diagram on GHG emission prospects in BAU and with mitigation measures



The GHGs emission prospects in BAU and mitigation targets in the respective sectors are shown in the following diagram and table. The assumption of these targets is full implementation of mitigation activities in alignment with the relevant national policies and aggregated efforts at the local level.

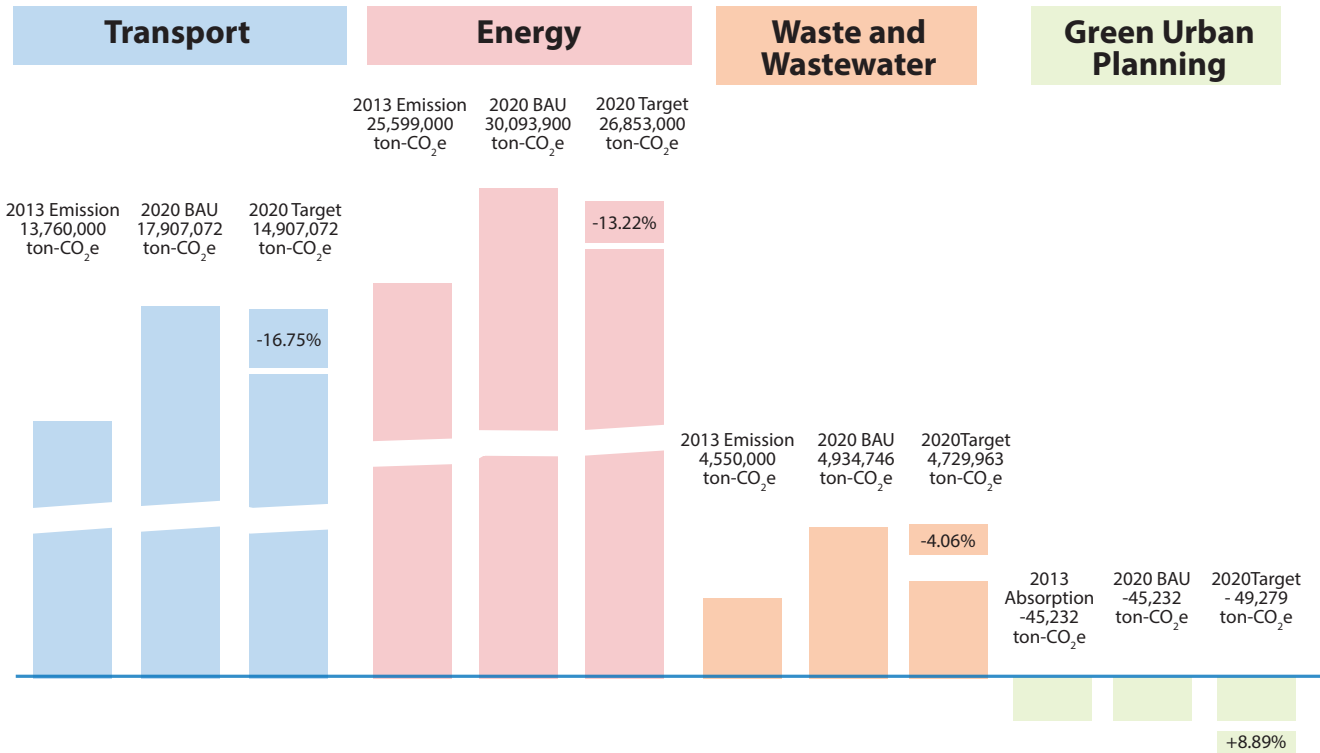
Table: Comparison of GHG emission in future in different scenarios in 2020²

Unit million t-CO₂e

Sector	Year 2013	Year 2020		
	GHG emission	Future GHG emission in BAU Scenario	Future GHG emission with Bangkok Master Plan Implementation	Expected reduction/absorption amount (reduction rate against BAU)
Transport	13.76	17.91	14.91	3.00 (-16.75%)
Energy	25.60	30.94	26.85	4.09 (-13.22%)
Waste and wastewater	4.55	4.93	4.73	0.20 (-4.06%)
Green urban planning	-0.045	-0.045	-0.049	-0.004 (+8.89%)
Total	43.87	53.74	46.44	7.29 (13.57%)

² The figures were estimated on the basis of multiple data sources and assumptions. When quoting these figures, please refer to the logics of the GHG quantification explained in the respective sectors, contained in "6.Mitigation and adaptation measures under the Master Plan". For the green urban planning sector, the figures are shown in "plus", since its mitigation activities are increasing CO₂ absorption by expanding green areas.

GHG emission in 2013 and BAU emission and mitigation targets in 2020 (by Sector)



As shown in the above table, GHGs emissions in Bangkok will increase significantly if the current socio-economic conditions are maintained per BAU assumptions. It is expected that future net GHGs emission in Bangkok could grow from 43.87 million tons CO₂ equivalent by the year 2013, to as high as 53.74 million tons CO₂ equivalent by the year 2020. These Master Plan, if implement properly, would yield total net GHG emissions in the year 2020 of 46.44 million tons CO₂ equivalent, approximately 13.57%

5. Adaptation concern

Given the fact that Bangkok is situated in a mega delta, one of the most vulnerable areas, and economic and social lives of the countries as well as the world heavily rely on the Metropolis. It is a pressing concern to address this adaptation needs. Measures to address issues like flooding, coastal erosion and draught and saline intrusion related to climate change turned out to be matters of priority. Thus in this Master Plan, countermeasures through short, mid, and long-term timeframe have been identified, together with responsibilities of divisions and other stakeholders, to work in coordination and collaboration.

Also, it is evident that adaptation is a concern that comes across different sectors, which usually recognized with mitigation focus, such as transport, energy, waste and wastewater, and green urban development. These sectors should also integrate adaptation concerns into their mitigation measures.

6. Mitigation and adaptation measures under the Master Plan

In order to realize the mitigation target and strengthening adaptation capacity, this Master Plan contains various measures implemented by BMA and its partners.

Mitigation measures in the transport sector



(1) Mitigation measures in the transport sector

GHG emission in the transport sector shares a large portion of the total emission and essentially related to the urbanization of Bangkok. Mitigation measures include development of environmentally sustainable transportation infrastructures and promotion of modal shifts, as well as public awareness-raising. To advance such measures, BMA will cooperate with the relevant national authorities, as well as the private sectors and citizens. By conducting such mitigation measures, it is also expected that the transportation modes will be upgraded and mobility and convenience are improved.

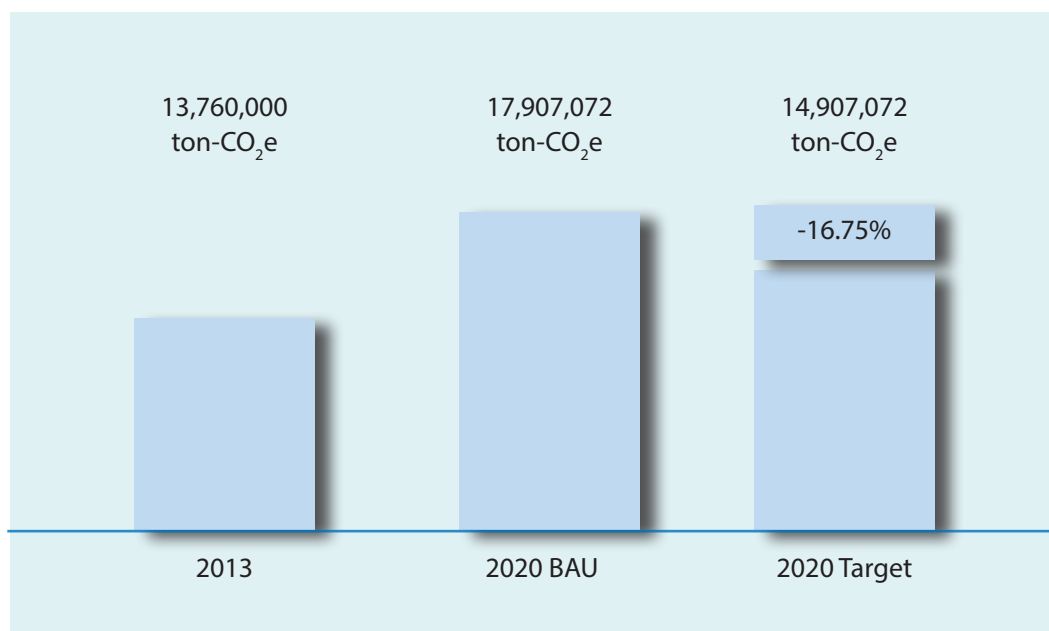


Table: Comparison of GHG emission in future in different scenarios in 2020 in the transport sector

Unit million t-CO₂ e

Sector	Year 2013	Year 2020		
	GHG emission	Future GHG emission in BAU Scenario	Future GHG emission with Bangkok Master Plan Implementation	Expected reduction/absorption amount (reduction rate against BAU)
Transport	13.76	17.91	14.91	3.00 (-16.75%)

GHG emission in 2013 and BAU emission and mitigation targets in 2020 in the transport sector



GHG emission in 2013

The emission is the sum of emissions from road, railways and waterways in BMA administrative area. Each sub-sector emission is calculated multiplying activity data and emission factors of fuel or electricity. As for the activity data, “Fuel consumption from road sub-sector in Bangkok by fuel types”, “Electricity consumption of MRT and Skytrain in Bangkok” and “Fuel consumption of waterways” in 2013 are used for respective sub-sector.

BAU emission in 2020

Future (BAU) CO₂ emissions associated with transportation activities (road) within BMA administrative area are estimated by multiplying “Current emission (year 2013)” by “Increase rate of BAU emission”. As for increase rate of BAU emission, “increase rate of BAU energy consumption in transport sector” provided in “Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy” is applied.

GHG emission in 2020 with mitigation actions implemented

The figure is estimated by subtracting the emission reduction target in 2020 from BAU emission in 2020. The reduction target is estimated multiplying the national target value (12 million tCO₂ / year set by OTP) by the ratio of fuel consumption (energy base) of transport sector in Bangkok and Thailand (25% three year-average of 2011-2013).



In the transportation sector, most measures will focus on reducing GHG emission from private vehicles. In order to promote this, measures to construct infrastructures, such as developing Mono-rail and LRT etc, are proposed. Also, to facilitate smooth modal shift, it is very important to implement support measures, such as improvement of connectivity of public transportation and increase the convenience of services.



It is also important to promote non-motorized transport, such as riding bicycles and for these measures, BMA will develop and expand bikeways, so that citizens can ride bicycles in a safe and convenient way, which also contribute to reduction of GHG by replacing private vehicle use.

The below measures are proposed under the Master Plan for implementation. Some of them are also implemented as part of Thailand NAMAs by the Government.

Category	Measure
1. Public transportation (Infrastructure)	1.1 Development of Monorail and Light rail Transit System
	1.2 Extension of BTS
	1.3 Development of MRT
	1.4 Development of BRT
	1.5 Development/improvement of water transportation
2. Public transportation (Supporting measures)	2.1 Improvement of connectivity of public transportation
	2.2 Improvement of bus service
	2.3 Development of passenger shelter at bus station
	2.4 Development/expansion of Park & Ride
	2.5 Introduction of common ticket system
3. Measures on motor vehicles	3.1 Introduction of low emission vehicles (LEV) to BMA vehicles
	3.2 Introduction of natural gas vehicle NGV to BMTA buses
	3.3 Promotion of Eco-driving
4. Non-motorized transport (NMT)	4.1 Development/expansion of bikeway
	4.2 Expansion of "Bike-for-Rent"
	4.3 Development/expansion of pedestrian
5. Traffic volume/flow control	5.1 Development/improvement of road, bridge, tunnel
	5.2 Improvement of signal system
	5.3 On-street parking control
6. Public awareness rising	6.1 Promotion of public transportation
	6.2 Classes for school to learn about environment/transport
	6.3 Organizing workshops and seminars

Mitigation measures in the energy sector



(2) Mitigation measures in the energy sector

GHG emission in the energy sector shares the largest part of the total emission. As the most GHG emissions in the energy sectors in Bangkok are related to those from buildings, mitigation measures focuses on introducing energy efficiency and renewable energy.

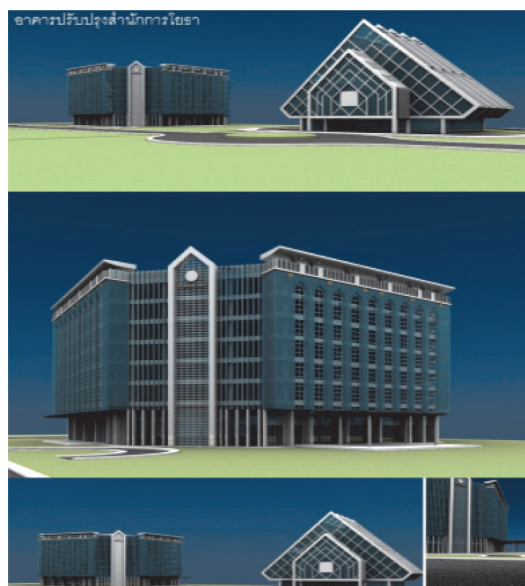
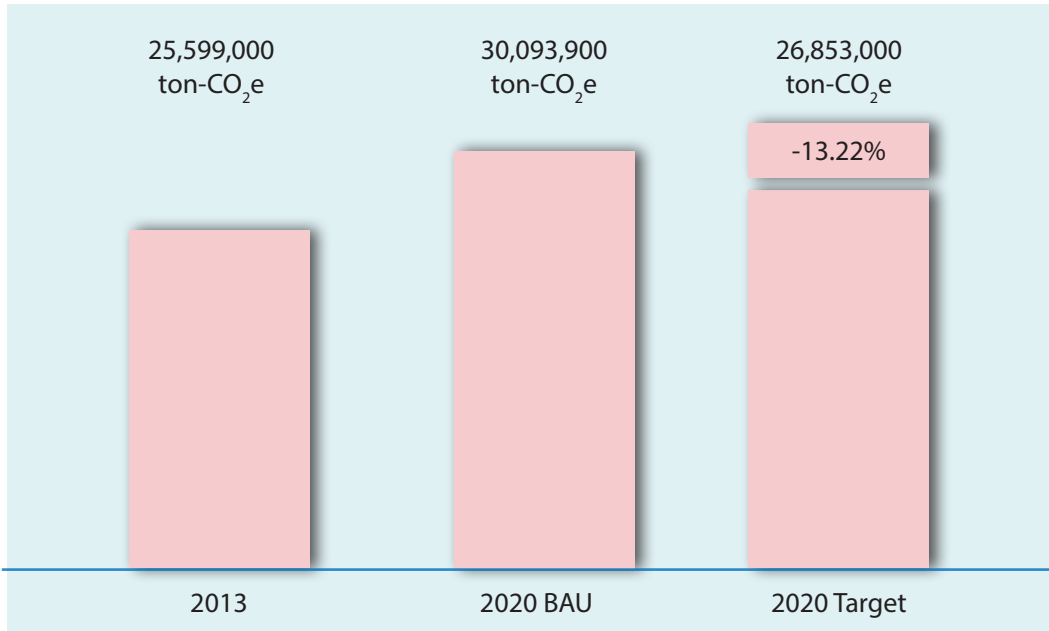


Table: Comparison of GHG emission in future in different scenarios in 2020 in the energy sector

Unit million t-CO₂e

Sector	Year 2013	Year 2020		
	GHG emission	Future GHG emission in BAU Scenario	Future GHG emission with Bangkok Master Plan Implementation	Expected reduction/absorption amount (reduction rate against BAU)
Energy	25.60	30.94	26.85	4.09 (-13.22%)

GHG emission in 2013 and BAU emission and mitigation targets in 2020 in the energy sector



GHG emission in 2013

Energy consumption data (mainly secondary data) from 2009 to 2012 was collected from the relevant authorities and organizations as follows:

- » Electricity: Metropolitan Electricity Authority (MEA)
- » Oil: Department of Energy Business (DOEB), Ministry of Energy
- » Natural Gas: PTT PLC
- » Coal: Department of Alternative Energy Development and Efficiency (DEDE)

The EEDP and other energy related plans at the national level are the main reference for estimating the current GHG emission of 2013. In particular, the Energy TF has collected future trends of electricity and fuel consumption in EEDP etc. and estimated GHG emissions by multiplying the appropriate CO₂ emission factors with the trends. In other words, the GHG emission in 2013 is estimation from the trends, given the fact that the National GHG Inventory for 2013 is yet to be available as the time of calculating this.

BAU emission in 2020

As energy consumption in Bangkok is particularly large in Thailand, it is important to ensure consistency with this Master Plan and the national plans and measures in the calculation of future prediction and reduction of the GHG emission in energy sector. Therefore, the EEDP and other plans of national level are referred for the BAU setting. In particular, Energy TF has collect future trends of electricity and fuel consumption in EEDP etc. and set the BAU GHG emissions by multiplying the appropriate CO₂ emission factors with the trends.

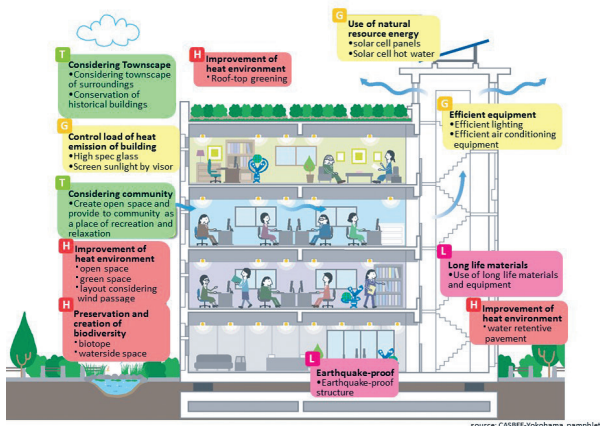
GHG emission in 2020 with mitigation actions implemented

The mitigation target is set by referring to the estimated value of CO₂ emission reduction when the energy conservation measures listed in EEDP is realized at the national level, and the assumption that these measures are realized also in Bangkok.

Energy Management System



The primary area of actions is mitigation efforts in BMA owned buildings. As shown in the below table, there are several measures to increase the performance of energy used in the BMA owned buildings such as offices, schools, hospitals etc. such measures contribute to reduction of GHG directly emitted by BMA. In advancing these measures, it is important to make a systematic schedule for introducing new facilities and retrofitting existing facilities from the perspectives of energy efficiency.



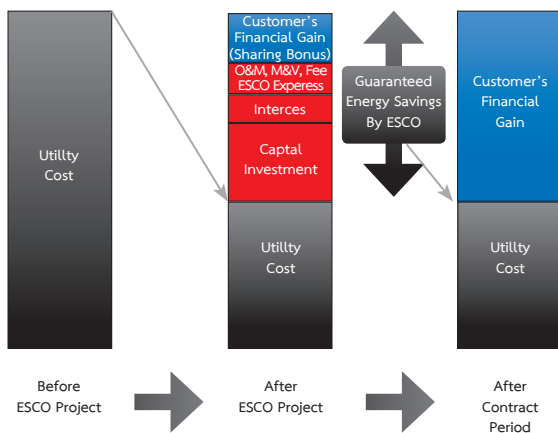
It is also essential to promote participation by its partners, such as the private sector to advance their efforts to increase energy efficiency in their commercial and office buildings, as well as citizens in their residential buildings. By making such efforts, cost savings are possible in many cases.

Introduction of ESCO scheme

Performance Based Contract (Shared Savings Type)

Evaluation by Total Contract Period

5-6YEARS



To provide holistic system for energy management, it is also useful to introduce energy standard such as CASBEE or LEED. By applying such energy standard, building owners and energy users can continuously review and improve their energy use.

In many cases, high initial investment cost is a barrier for introducing energy efficient facilities. In this regard, promoting ESCO may pave the way forward. The Master Plan promotes the use of ESCO, as a alternative ways to advance energy efficiency.

The below measures are proposed under the Master Plan for implementation.

Category		Possible mitigation measures (countermeasures)	
1. BMA government buildings & facilities	1.1 Energy saving renovation/ repair work for existing facilities	1.1.1 General tasks	1) Developing systematic schedules of retrofitting BMA's existing building for appropriate management of energy
			2) Systematic implementation of energy saving retrofitting works of BMA's existing building
			3) Selection of model project for energy saving renovation work Intensive adoption of top-runner appliances
			4) Energy saving requirements for retrofitting works of BMA facilities and setting of high-level of energy efficiency Acquisition of certification for energy saving renovation work (CASBEE or LEED etc.)
			5) Consideration of renovation work, extension work, conversion at the time of facilities update (maximum utilization of existing stocks)
			6) Efficient retrofitting/renovation work for energy saving by introducing private capital know-how
		1.1.2 Improving insulation performance (renovation technique)	1) Introduction of thermal barrier roof coatings
			2) Improving external insulation and waterproofing
			3) Introduction of roof greening
			4) Improving heat insulating window (high heat insulating glass such as low-e pair glass)
			5) Improving heat insulating window (thermal barrier film)
			6) Controlling solar radiation heat by installing louver or eaves
		1.1.3 Cutting down air conditioning/ventilation load (retrofitting technique)	1) Replacing existing air-conditioning equipment by high-efficiency one
			2) Introduction of variable flow controller
			3) Introduction of task ambient air conditioning system - controlled by motion/temperature sensor, timer etc.
			4) Introduction of high-efficiency fan (total heat exchanger)
			5) Introduction of cogeneration system
		1.1.4 Cutting down lighting load (retrofitting technique)	1) Introduction LED lighting or hf fluorescent lamp
			2) Introduction of task ambient lighting
			3) Installing motion sensor lighting to bathroom, corridor or staircase
			4) Daytime energy reduction by daylight sensor
		1.1.5 Energy reduction by water-saving	1) Upgrading water saving sanitary appliances
			2) Introduction of rainwater recycling system
			3) Introduction of waste water recycling system (reuse as toilet bowl flushing water)
1.1.6 Others	1) Introduction of Solar power generation systems		
	2) Introduction of BEMS, building energy management systems		
	3) Replacing street lighting to LED		

Category			Possible mitigation measures (countermeasures)	
1. BMA government buildings & facilities	1.2 Energy saving for new construction	1.2.1 General tasks	1)	Constructing high energy efficiency building
			2)	Introducing requirements of certificate for new construction of BMA facilities (Energy standard such as CASBEE or LEED etc.)
	1.3 Information campaign	1.3.1 Conducting campaign to citizens	1)	Promoting environmental education at school
			2)	Support to exhibition of energy saving merchandise for BMA facility
			3)	Visualization of energy saving of BMA facility Notify saving energy activities by panel or monitor
			4)	Promoting "Green Curtain" installation at school to reduce air conditioning load
			5)	Holding workshop on energy saving repair work for public participation (schools, public facilities)
1.3.2 Conducting campaign to the officials	1)	Raising preset cooling temperature		
	2)	Award for saving energy activity		
	3)	Turning off lightings during lunch break		
	4)	Thorough power saving setting on PC or OA equipment		
1.4 Promotion of low carbon city	1.4.1 Model areas	1)	Setting up low-carbon model area, each fields top runner measure, intensive equipment investment	
2. Civil Categories (Residential/ Commercial/ Industries)	2.1 Residential part	2.1.1 Promotion of energy saving house	1)	Promotion of low-carbon/energy saving detached house (Publicity of cost benefit from the viewpoint of low carbon community , backup exhibition, provide advertising spaces at BMA facilities
			2)	Facility equipment introduction promotion of energy saving house (LED lights, energy-saving air conditioning system or hot-water apparatus etc.)
		2.1.2 Promotion of energy saving repair work	1)	Publicity of cost benefit by repair work for energy saving
			2)	Promotion of repair work for energy saving: insulation upgrade by double glazing, heat barrier film, renew air conditioning device (subsidy system etc.)
		2.1.3 Promotion of energy saving home appliances		Purchase promotion of energy saving home electric appliances (air conditioning, fridge, TV etc.)
		2.1.4 Promotion of energy saving measure		Promote better understanding of air conditioner maintenance (conduct free cleaning)
		2.1.5 Others		Promotion of solar panel installation subsidy system or mediating installable roof

Category		Possible mitigation measures (countermeasures)	
2. Civil Categories (Residential/ Commercial/ Industries)	2.2 Commercial/ Business part	2.2.1 Promotion of energy saving building	Incentive for constructing/repairing saving energy factory (tax reduction, subsidy, zero-interest finance etc.)
		2.2.2 Promotion of energy saving repair work for existing building	1) Conducting energy saving inspection of public buildings
			2) Promotion of ESCO business for existing buildings (Explaining ESCO business, advertisement promotion support, subsidy system for energy saving diagnostic)
			3) Promotion of repair work for energy saving: insulation upgrade by double glazing, heat barrier film, renew air conditioning device (subsidy system etc.)
			4) Publicity of cost benefit by Electricity Peak-Cut Introduction support for automatic control facility of Electricity Peak-Cut
		2.2.3 Promotion of energy saving measure	1) Promotion of saving energy activity (publicity of cost benefit etc)
			2) Raising preset cooling temperature at public buildings Turn off lightings during lunch break
			3) Thorough power saving setting on PC or OA equipment
	4) Award for saving energy activity		
	2.2.4 Others	Promotion of solar panel installation subsidy system or mediating installable roof	
	2.3 Industrial part	2.3.1 Promotion of energy saving factory	Incentive for constructing/retrofitting saving energy factory (tax reduction, subsidy, zero-interest finance etc.)
		2.3.2 Promotion of energy saving repair work for existing factory	1) Conducting energy saving inspection of factories
			2) Promotion of repair work for energy saving (subsidy system etc.)
			3) Publicity of cost benefit by Electricity Peak-Cut Introduction support for automatic control facility of Electricity Peak-Cut
2.3.3 Promotion of energy saving measure		1) Promotion activity for factory's energy saving technique (for SMEs)	
		2) Commendation for saving energy activity	
2.3.4 Others	1) Promotion of Solar Energy subsidy system or mediating installable roof		
	2) Promotion of beneficial use of factory exhaust heat		

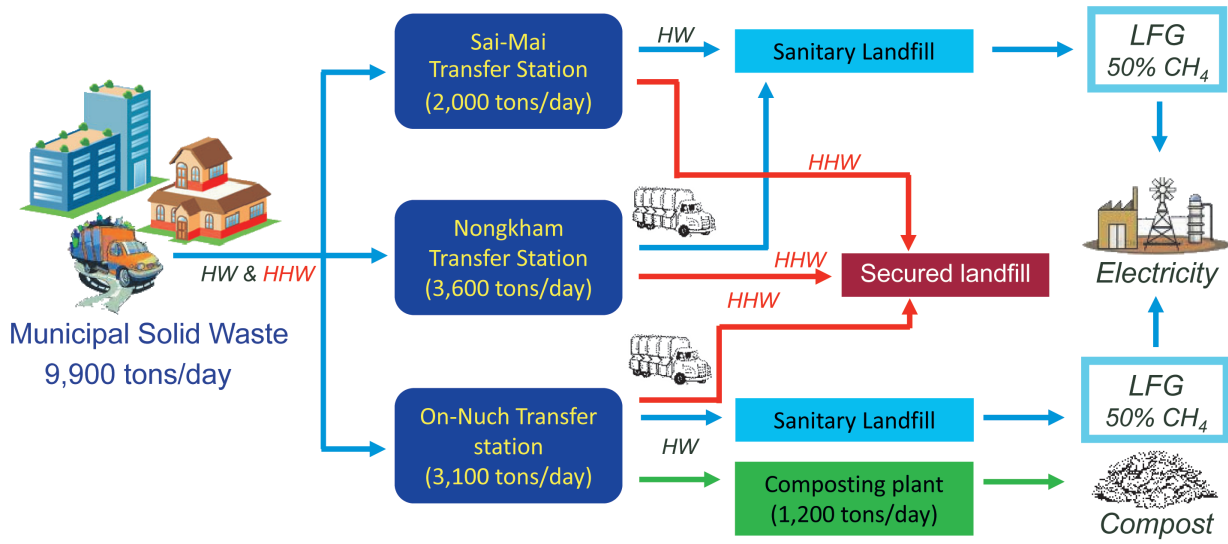
Mitigation measures in the waste and wastewater



(3) Mitigation measures in the waste and wastewater

Waste and wastewater are sources of methane and CO₂ emissions as in landfills and waste transportation, and reduction of GHGs require the reduction of waste and wastewater amount generated. In order to do so, BMA endeavors to introduce upgraded technologies and facilities for waste management and wastewater treatment, and at the same time, promote the reduction of generated amount by separation of waste etc.

Solid Waste Management



Wastewater Management

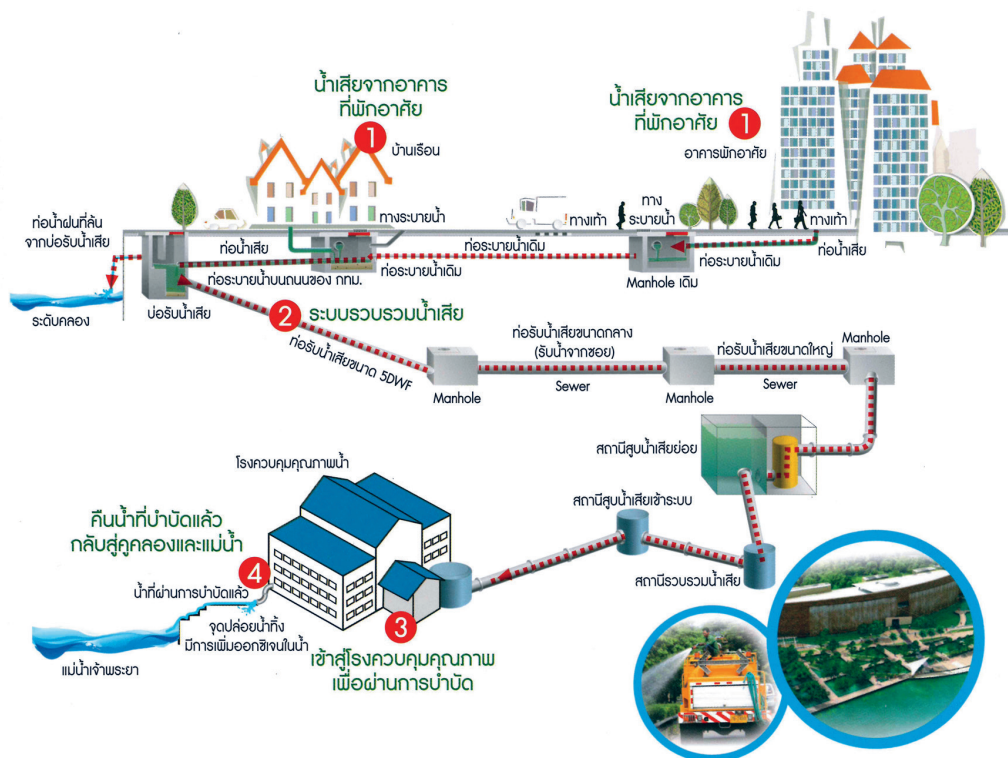
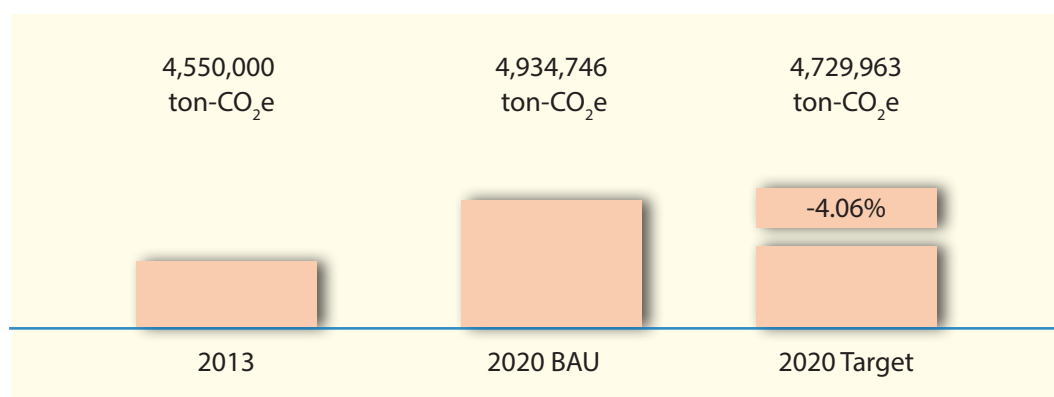


Table: Comparison of GHG emission in future in different scenarios in 2020 in the waste and wastewater sector

Unit million t-CO₂e

Sector	Year 2013	Year 2020		
	GHG emission	Future GHG emission in BAU Scenario	Future GHG emission with Bangkok Master Plan Implementation	Expected reduction/absorption amount (reduction rate against BAU)
Waste and wastewater	4.55	4.93	4.73	0.20 (-4.06%)

GHG emission in 2013 and BAU emission and mitigation targets in 2020 in the waste and wastewater sector



GHG emission in 2013

GHG emissions in 2013 are calculated based mostly on the actual activity data of 2013 related to waste management and wastewater treatment activities by BMA. Such data includes daily amount of municipal solid waste generated and volume of wastewater discharged in Bangkok, waste and wastewater composition, amount of electricity consumption by related plants and facilities, amount of fuel used for transportation, etc., many of which are taken from official statistical data or recorded data of 2013.

BAU emission in 2020

BAU emissions of 2020 are estimated based on the abovementioned 2013 GHG emissions data taking into consideration the BMA's future plans and policies related to waste management and wastewater treatment as well as expected population growth in Bangkok.

GHG emission in 2020 with mitigation actions implemented

Emissions in 2020 are calculated by deducting aggregated amount GHG emission reduction by all mitigation actions listed in the Master Plan from the above BAU emissions of 2020. Expected amount of GHG emission reduction from each mitigation measure is individually calculated using a suitable methodology.


All of the above calculation methodologies were selected with reference to the Volume 5 Waste, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

By enhancing public awareness and partnership through public relations and campaigns, BMA will develop a mode of solid waste management in its office. Also, in order to promote waste separation at source, the private sector, citizens, and NGOs/community organizations are encouraged to join such activities. At the same time, enforcement of laws and regulations and providing incentives should be considered for further advancing waste reduction.



For the wastewater treatment, it is important to avoid methane generation from wastewater itself as well as reducing energy use at treatment plants. In order to implement these measures, consideration on upgrading infrastructure as well as introducing management measures should be introduced together, thus increase the effectiveness and efficiency of these measures.

Bangsue EECC




1. Year of operation : August 2013
2. Service Area: 20.7km²
3. Population 223,990
4. Capacity 120,000m³/d

Rattanakosin



1. Commencement year of operation: 2000
2. Area: 4.1 km²
3. Served population : 70,000
4. Two-stage Activated Sludge Process
5. Capacity 40,000 m³/day

Chatuchak




1. 2005
2. 33.4 km²
3. 432,000
4. Sequencing Batch Reactor Process
5. 150,000 m³/day

Nangkhaoem




1. 2002
2. 44.0 km²
3. 520,000
4. Vertical Loop Reactor Process
5. 157,000 m³/day

Din Daeng




1. 2004
2. 37.0 km²
3. 1,080,000
4. Activated Sludge Process
5. 350,000 m³/day

Tungkru




1. 2002
2. 37 44.0 km²
3. 177,000
4. Vertical Loop Reactor Process
5. 65,000 m³/day

Sipraya




1. 1994
2. 2.7 km²
3. 120,000
4. Contact Stabilization Activated Sludge Process
5. 30,000 m³/day

Chongnonsi



1. 2000
2. 28.5 km²
3. 580,000
4. Sequencing Batch Reactor Process
5. 200,000 m³/day

Source: JICA 2011

Legend
 Existing interceptor

The below measures are proposed for implementing under the Master Plan. In case of the waste and wastewater sector, measures have sorted out along with their treatment process. (see the colored figures on the tables).



Figure Categorization of mitigation measures according to basic flow of solid waste management

Table Mitigation measures for solid waste management sub-sector

Category	Measure
1. Waste generation	1.1 Promoting participation on waste reduction and separation at source
	1.2 Reducing the amount of plastic waste
2. Waste collection and transportation	2.1 Improving fuel efficiency of waste collection and transportation system
3. Intermediate treatment	3.1 Promoting utilization of organic waste
	3.2 Constructing waste-to-energy incineration facility
	3.3 Constructing Waste segregation plant
4. Final disposal	4.1 Installing environment- friendly landfill system



Figure Categorization of mitigation measures according to basic flow of wastewater treatment

Table Mitigation measures for the wastewater treatment sub-sector

Category	Measure
1. Wastewater generation	1.1 Promoting reduction of water usage at house
	1.2 Promoting collection of wastewater tariff
2. Wastewater collection	2.1 Feasibility study for construction of separated sewerage collection system
	2.2 Implementing separated sewerage collection system
	2.3 Constructing separated sewerage collection system
3. Wastewater treatment	3.1 Improving operation and equipment of existing WWTPs
	3.2 Constructing new energy efficient WWTPs
4. Sludge treatment	4.1 Promoting utilization of sludge
5. Water reuse	5.1 Promoting water reuse

Mitigation measures in the green urban development sector



(4) Mitigation measures in the green urban development sector

Green urban development provides many co-benefits of mitigation actions. By expanding green areas, it increases the amenity and attractiveness of the city. Also, measures such as green roof tops have additional benefits of helping the reduction of energy use. For this sector, BMA will make efforts in its parks, but it is also important that private land owners should participate in such actions.

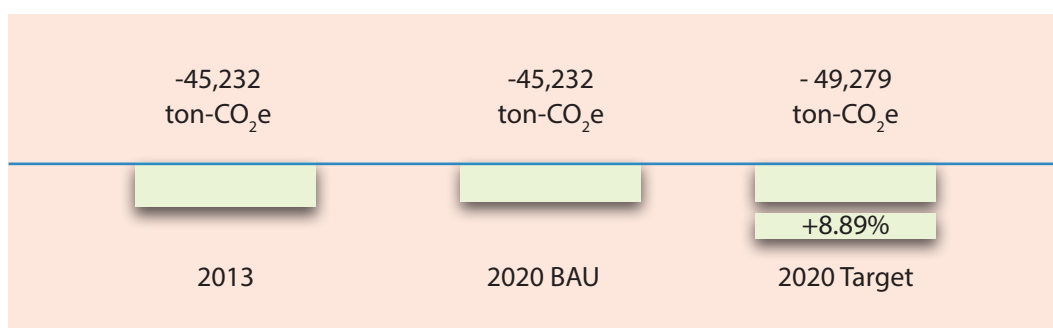


Table: Comparison of GHG emission in future in different scenarios in 2020 in the green urban planning sector

Unit million t-CO₂ e

Sector	Year 2013	Year 2020		
	GHG emission	Future GHG emission in BAU Scenario	Future GHG emission with Bangkok Master Plan Implementation	Expected reduction/absorption amount (reduction rate against BAU)
Green urban planning	-0.045	-0.045	-0.049	0.004 (+8.89%)

**GHG emission in 2013 and BAU emission and mitigation targets
in 2020 in the green urban planning sector**



GHG emission in 2013

Current GHG absorption is calculated by multiplying activity data such as number of planted trees by absorption factor per tree. Activity data such as number of planted trees is measured by district office and is compiled as statistical data by public park office in department of environment in BMA.

BAU emission in 2020

In BAU setting, number of trees planted in BMA controlled area is assumed to be kept due to the proper maintenance by BMA. BAU value of CO₂ absorption is similar to CO₂ absorption of year 2013.

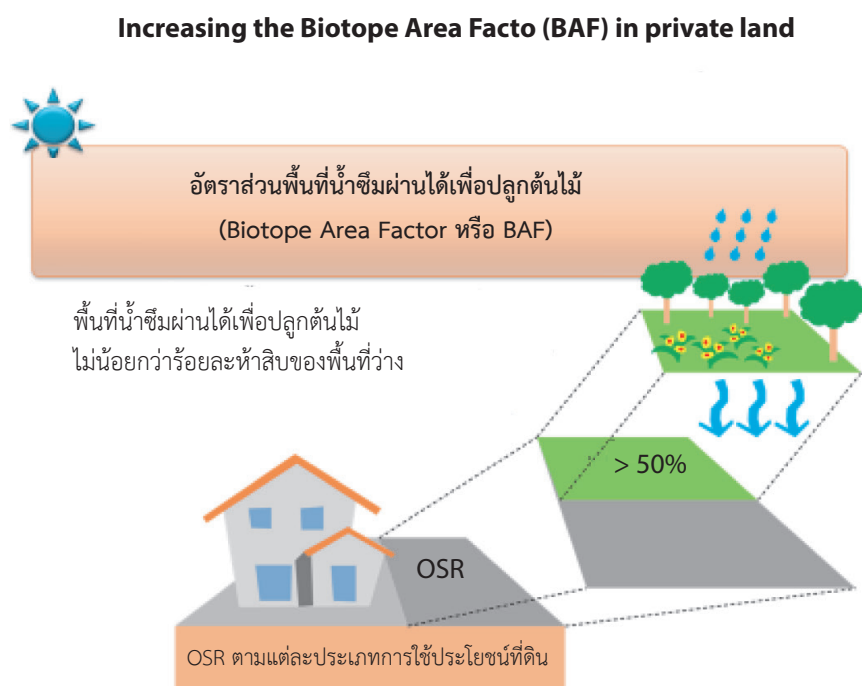
GHG emission in 2020 with mitigation actions implemented

Mitigation target of GHG absorption in year 2020 is estimated in 5 measures (Increasing new public parks, Increasing new green areas in public areas, Planting new trees along roadside areas, Increasing the Biotope Area Factor (BAF) in private lands, Mangrove reforestation) based on the implementing plan for green urban planning using the bottom up approach

In BMA areas, there are several part areas, which provide not only amenity of Bangkok citizens but also functions as CO₂ sink as well as mitigating urban heating areas. It is extremely important for BMA to maintain these areas and continue to provide such environmental functions. Also, it is expected that planting trees in the park area, so that absorption of carbon will increase.



However, actions only at BMA part areas may have quite limited effects, it is also important that participation by citizens and the private sector in expanding green area is crucial. For promoting this, it may be useful to organize campaign activities, as well as introducing incentives to increase Biotope Area Factor (BAF) in private land.



Source: BMA

The below measures are proposed under the Master Plan for implementation.

category	No.	Measure
Quantitative measures	1	Increasing new green areas (Public parks)
	2	Increasing new green areas (Public area)
	3	Planting new trees along roadside areas
	4	Increasing the Biotope Area Factor(BAF) in private land
	5	Reforestation mangroves
Qualitative measures	6	Well-managing & maintaining of planted trees
	7	Rooftop greening and wall greening
	8	Public awareness campaign

No.	Measure	Details	
		short/mid term (2016-2018)	long term (2019-2023)
1	Increasing new green areas (Public Parks)	Construction of 5 middle/large scale new public parks (79.08 acres) ³	Construction of 10 middle/large scale new public parks (177.93 acres, 1.58-68.80 acres /park)
2	Increasing new green areas (Public Area)	1.Planting new young trees at public area (government office, public schools, public hospitals, temples) 790.80 acres 2. It is based on "One community one park" project and "One school one park" project. 3.Encouraging the involved district offices to build the pocket parks	1. Planting new young trees at public area (government office, public schools, public hospitals, temples) 1,383.90 acres
3	Planting new trees along roadside areas	1.Planting 100 new trees per year along 40 roadsides that set back 2m including increasing new young trees between existing trees following the Open Space Plan on the Bangkok Comprehensive Plan 2013 2.Establishing the competition on the concept of "Green Road" among district office	
4	Increasing the Biotope Area Factor(BAF) in private land	1. Increasing Green Area by BAF law enforcement (totally 139.18 acres) in 2016-2018 2.Developing BAF database in GIS base and improving record of BAF database in short/mid term 3.100% of permitted building construction will have BAF in their area in long term -Promoting new planting on private area expected to be implemented in the development project along the Bangkok Comprehensive Plan. -Advertising the concept of Biotope Area Factor to related stakeholders and citizens -Encouraging the provision of Biotope Area in governmental buildings	1. Increasing Green Area by BAF law enforcement (totally 251.08 acres) in 2019 – 2023
5	Reforestation mangroves	1. Planning mangrove trees: 19.77 acres in 2018 2.Promoting increase of new mangrove areas with cooperation with major companies 3.Promoting the campaign for tree distribution(1 time/year, 10,000 trees/ time) 4.Seeding, nursing or producing mangrove trees	1. Planning mangrove trees: 19.77 acres /year, totally 98.85 acres in 2019-2023
6	Well-managing & maintaining of planted trees	1.Maintaining 100% of existing public parks and public area(governmental offices, public schools, public hospitals, temples, mangroves) 2.Looking after and maintaining planted trees in routine job done by Public Park Office 3.Training the involved staff on "how to correctly look after and maintain planted trees"	

³ 1 rai equals to 1,600 square metres (40 m × 40 m) or 0.3954 acres.

No.	Measure	Details	
		short/mid term (2016-2018)	long term (2019-2023)
7	Rooftop greening and wall greening	Promotion rooftop greening and wall greening on government and private area, with pilot project on "Rooftop and wall greening " by Public Park Office -Studying the appropriate model for good practice and the appropriate standard related to design guideline, standard drawing -Rooftop greening and wall greening will be set as incentive measure in the Bangkok Comprehensive Plan in long term	
8	Public awareness campaign	Promoting the public awareness campaign to children, student, and citizens with tree distribution(300,000 trees/year) to citizens in event -Recruiting the volunteers (50 persons/year) for looking after, preserving and maintaining the green area, and training them. -Encouraging the citizens, communities and land owners to preserve any Huge Trees in their areas	

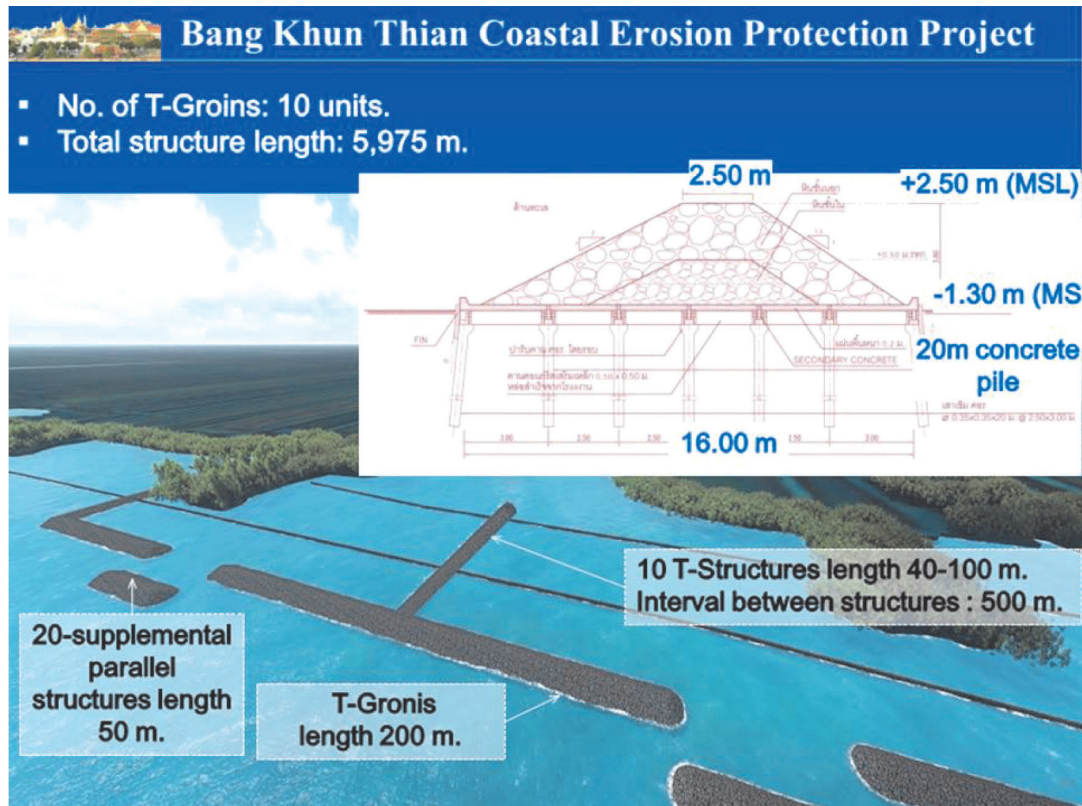
Adaptation measures



(5) Adaptation measures

Bangkok is situated on the floodplains of the Chao Phraya River and subjected to the tides of the sea which results in trapped water from rainfall (flooding) and subjected to the tides of the sea. Together with land subsidence problem arise from withdrawal of groundwater, the area trapped water from rainfall which then causes the overflow from the river. In addition, withdrawal of groundwater is also a cause of land subsidence in the area. It is expected that with climate change the vulnerability of Bangkok will increase in future, which may cause large scale of economic and social losses. As one of the priority areas of adaptation measures, BMA will take short term (1-3 years), midterm (3-5 years) and long term (5-10years) of actions, to prevent, minimizing impacts, and change and construct infrastructures. Such includes expanding retention areas, developing flood management information system with link to other sectors such as road constructions.





Around areas faced with the Gulf of Thailand, coastal erosion is an existing and future threats especially those residents living around. To stop erosion and prevent disasters, BMA plans to construction of stone dykes and evacuation roads and at the same time, and develop hazard maps .

Draught and saline intrusions are also occurring and BMA needs respond these extreme and slow onset events. Measures like conducting public awareness to citizens to save water use, as well as implementing drought management plan are included as part of the comprehensive measures.



The below measures are proposed under the Master Plan for implementation. In the adaptation area, flooding, coastal erosion, and drought and saline intrusion are main areas of response.

1	Flooding	
Time scale of impact	Adaptation level	Adaptation measure
Short term 1-3 years	Level 1 Prevention	1. Strengthening measures for retention areas e.g., construct and improve temporary retention basins (BMA et al., 2009)
		2. Dredging of drainage channels
		3. Installing drainage pumps
		4. Improving small scale irrigation facilities e.g., gates, weirs and etc. (NESDB et al., 2013)
		5. Constructing flood protection system (e.g., pumping station, water gate, flood dyke, tunnel) with proper supporting system such as alternative power sources and transmission lines
	Level 2 Minimizing impacts	1. Providing catchment area to store water and reduce volume of flood water flow rate
		2. Ensuring feed for livestock (NESDB et al., 2013)
		3. Designating evacuation areas (MOEJ, 2010) with appropriate facilities/equipment
		4. Developing disaster evacuation plan and revise the plan as necessary
		5. Developing emergency preparedness plan
		6. Strengthening emergency communications (BMA et al., 2009)
		7. Promoting people's participation to maintain community canal
		8. Educating/informing citizens on flood related issues e.g., risk of residing in flood prone area, health care during flood, situation of flood
		9. Establishing "Flood Aid Units" which are ready to help promptly and thoroughly
		10. Compensating for damaged farmland and properties
Level 3 Change and Reconstruction	1. Coordinating with government/related organizations/neighboring provinces to develop agreement on flood water management	
	2. Formulating business continuity plans (MOEJ, 2010)	
	3. Providing financial support during inundation period (NESDB et al., 2013)	

1	Flooding	
Time scale of impact	Adaptation level	Adaptation measure
Midterm 3-5 years	Level 1 Prevention	1.Continuing the implementation according to the plan
		2.Constructing community-based small scale retention pond
		3.Maintaining canals/ivers and increase drainage capacity (NESDB et al., 2013) e.g. maintenance of levees and river bank dredging
		4.Developing Ayutthaya bypass channel regulation
		5.Operating existing dams effectively and revise dam water management plan as appropriate
		6.Constructing and elevate outer ring road as alternative for transportation during flood
		7.Providing alternative power source and power transmission lines of drainage system
		8.Constructing flood proof buildings (BMA et al., 2009)
		9.Effectively utilizing existing flood protection facilities and extending their lifetime via regular maintenance (MOEJ, 2008)
	Level 2 Minimizing impacts	1.Establishing flood hazard maps
		2.Improving accuracy of weather forecast and upgrade monitoring and warning systems (MOEJ, 2008)
		3.Developing flood management information system with link to other sectors e.g., planting schedule
		4.Establishing guidelines for flood control facilities operation
		5.Enforcing law on land use and adopt integrated land use planning e.g., prohibit construction in flood prone area
		6.Implementing intervention measure in agricultural sector when appropriate (NESDB et al., 2013)
		7.Developing emergency preparedness plans (BMA et al., 2009)
		8.Providing more catchment areas
		9.Relocating housing in flood prone areas
	Level 3 Change and Reconstruction	1.Utilizing urban planning measures
		2.Conducting research and develop countermeasures technologies (MOEJ, 2010)

1		Flooding	
Time scale of impact	Adaptation level	Adaptation measure	
Long term 5-10 years	Level 1 Prevention	Continuing the implementation of Flood Prevention Plans	
	Level 2 Minimizing impacts	1. Continuing the implementation of Flood Prevention Plans	
2. Ensuring operational guidelines for flood control facilities			
3. Enforcing law on land use and integrated land use planning (BMA et al., 2009)			
4. Improving flood management information system (NESDB et al., 2013)			
5. Upgrading monitoring and warning systems (MOEJ, 2008)			
Long term 5-10 years	Level 3 Change and Reconstruction	1. Continuing the implementation of plans	
		2. Providing government sponsored flood insurance (for areas outside of flood protection facilities) (BMA et al., 2009)	
		3. Establishing funds and subsidies for post disaster restoration (MOEJ, 2008)	
		4. Conducting research and develop countermeasures technologies (MOEJ, 2010)	

2		Coastal erosion	
Time scale of impact	Adaptation level	Adaptation measure	
Short term 1-3 years	Level 1 Prevention	1. Constructing temporary coastal area protection fence (Bamboo)	
		2. Improvement of dike system (BMA et al., 2009)	
	Level 2 Minimizing impacts	1. Promoting people's knowledge on benefits of mangrove forest and its conservation	
		2. Promoting mangrove forest plantation	
		3. Developing emergency preparedness plans (BMA, et al., 2009)	
		4. Public information campaigns and training exercises (World Bank, 2010)	
	Level 3 Change and Reconstruction	1. Setting clear goal for coastal area protection measures and develop action plan accordingly	
		2. Setting up joint committee of stakeholders to develop the coastal area management master plan by adopting integrated coastal zone management approach (MOEJ, 2008)	

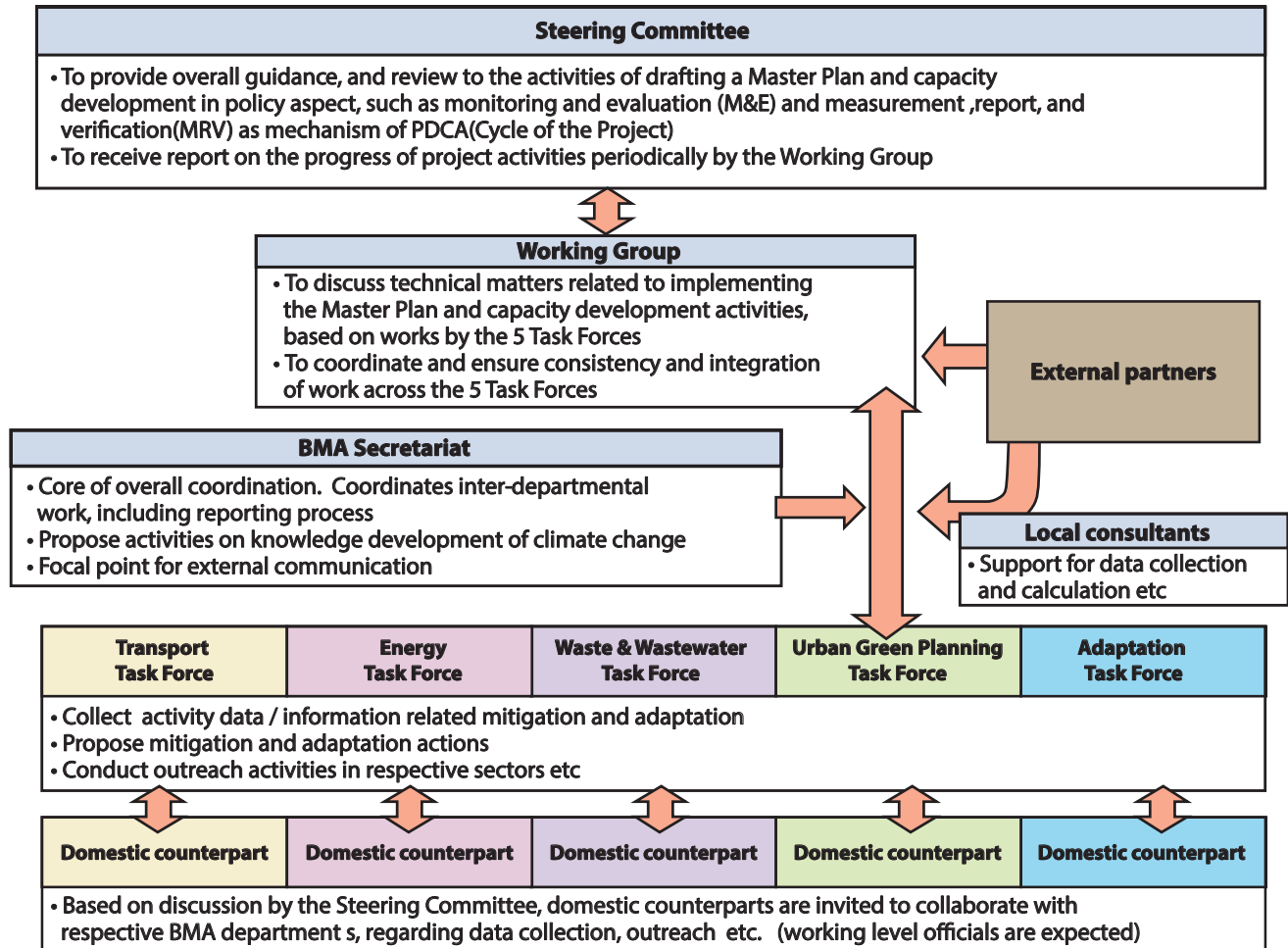
2	Coastal erosion	
Time scale of impact	Adaptation level	Adaptation measure
Midterm 3-5 years	Level 1 Prevention	1.Constructing permanent coastal erosion defense wall (Stone dike)
		2.Maintaining and improve coastal area protection facilities (MOEJ, 2008 and MOEJ, 2010)
		3.Comprehensive sediment control along rivers and coastal areas (MOEJ, 2008)
		4.Designing proper wastewater discharge
	Level 2 Minimizing impacts	1.Prohibiting and restrict construction in high risk zones (MOEJ, 2008)
		2.Enforcing law on land and fisheries and enhance the role of communities in coastal protection tasks
		3.Improving coastal ecosystem to ensure coastal stability and to maintain existing capacity in supporting food security.
		4.Rehabilitating mangrove forest along the shoreline of Bang KhunThian (The World Bank, 2010)
		5.Relocating community from high risk zones
		6.Developing integrated land use plan
		7.Initiating and develop hazard maps
		8.Developing emergency preparedness plans (BMA et al., 2009) including early warning system (ONEP, 2011), and monitoring system (MOEJ, 2008)
		9.Coastal Monitoring Center
10.Public information campaigns and training exercises (The World Bank, 2010)		
11.Operating harbor/port		
Level 3 Change and Reconstruction	1.Implementing integrated coastal zone management according to the plan (MOEJ, 2008)	
	2.Conducting research and develop countermeasure technologies (MOEJ, 2010)	
Long term 5-10 years	Level 1 Prevention	Implementing integrated coastal zone management according to the plan
	Level 2 Minimizing impacts	1.Implementing integrated coastal zone management according to the plan
		2.Monitoring ecosystem changes for protection purpose (BMA et al., 2009)
		3.Implementing integrated land use plan
		4.Upgrading monitoring system (MOEJ, 2008)
	Level 3 Change and Reconstruction	1.Implementing integrated coastal zone management according to the plan
		2.Conducting research and develop countermeasure technologies (MOEJ, 2010)

3	Draught and Saline Intrusion	
Time scale of impact	Adaptation level	Adaptation measure
Short term 1-3 years	Level 1 Prevention	The drought cannot be prevented as Bangkok situated at the end of the river area; and Bangkok is dependent on water from the north and weather
	Level 2 Minimizing impacts	1.Expanding water supply service area
		2.Constructing small water reservoirs
		3.Supplying water from other sources/areas
4.Promoting water conservation measures, use water efficiently		
5.Develop drought management and emergency preparedness plans and monitoring system		
	6.Strengthening emergency communications (BMA et al., 2009)	
	7.Public information campaigns and training exercises (The World Bank, 2010)	
	Level 3 Change and Reconstruction	Cooperate with government units and concerned agencies to plan for water allocation
Midterm 3-5 years	Level 1 Prevention	-
	Level 2 Minimizing impacts	1.Implementing drought management plan
		2.Drought hazard map
		3.Implementing water and energy conservation measures
		4.Planting trees (BMA et al., 2000)
		5.Public information campaigns and training exercises (The World Bank, 2010)
	6.Developing warning and monitoring systems (MOEJ, 2008)	
Level 3 Change and Reconstruction	1.Implementing drought management plan	
	2.Conducting research and developing technologies for countermeasures (MOEJ, 2010)	
Long term 5-10 years	Level 1 Prevention	-
	Level 2 Minimizing impacts	1.Implementing drought management plans with proper monitoring and warning systems (MOEJ, 2008)
		2.Implementing integrated land use planning
		3.Implement water and energy conservation measures
		4.Planting trees
	Level 3 Change and Reconstruction	1.Establishing funds and subsidies for post-disaster recovery (MOEJ, 2008)
2.Implementing measures as planned		
3.Conducting research and develop countermeasures technologies (MOEJ, 2010)		

7. Institutional arrangement for implementing the Master Plan

In order to implement, monitor and evaluate the progress of the Bangkok Master Plan on Climate Change, the Institutional Arrangement will be set up consisting of (1) Steering Committee, (2) Working Group, (3) Task Forces, (4) BMA Secretariat and (5) External Partners, as described in the below chart.

Institutional arrangement for implementing the Master Plan

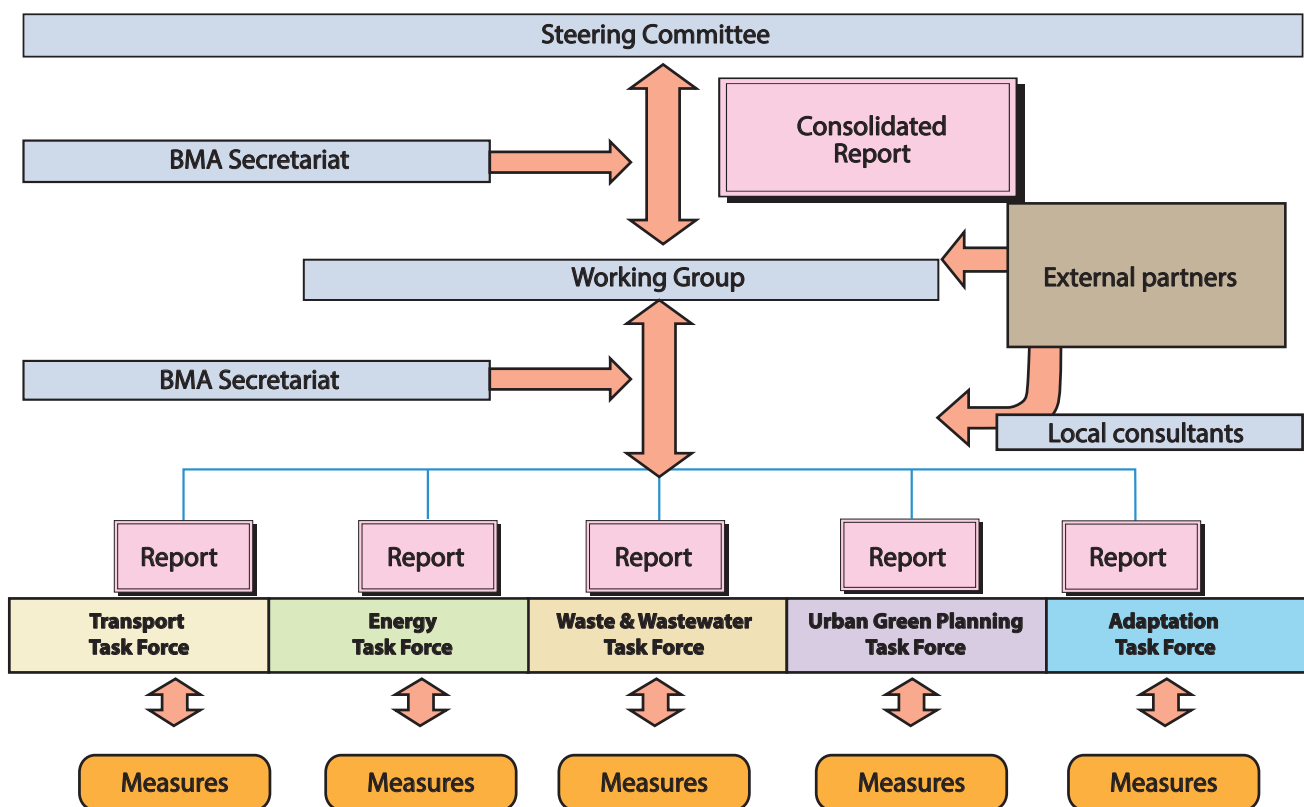


In order to enhance the institutional capacity to mainstream climate change concern and implement the Master Plan, BMA will consider strengthening of their administrative structure, such as establishing division officially in charge of climate change and global environmental affairs.

8. Monitoring and evaluation (M&E) and measurement, reporting, and verification (MRV)

The progress on the implementation of the Master Plan will be monitored and evaluated according to the institutional arrangement in the above chart, by collecting reports indicating baseline indicators and end of project/measure indicators for measures contained in the sectors. As to measures in the mitigation sectors, the reports should also contain baseline indicator of project and end of project/measure indicator for MRV. For these procedures, the tools (formats) of assessing M&E and MRV will be used. For respective measures, specific action plans or project documents will be prepared, and M&E and MRV will also be further elaborated, based on the framework consideration provided as below, and the main document. For the structure of the M&E and MRV, as well as the tools (formats), see the full text of the Master Plan.

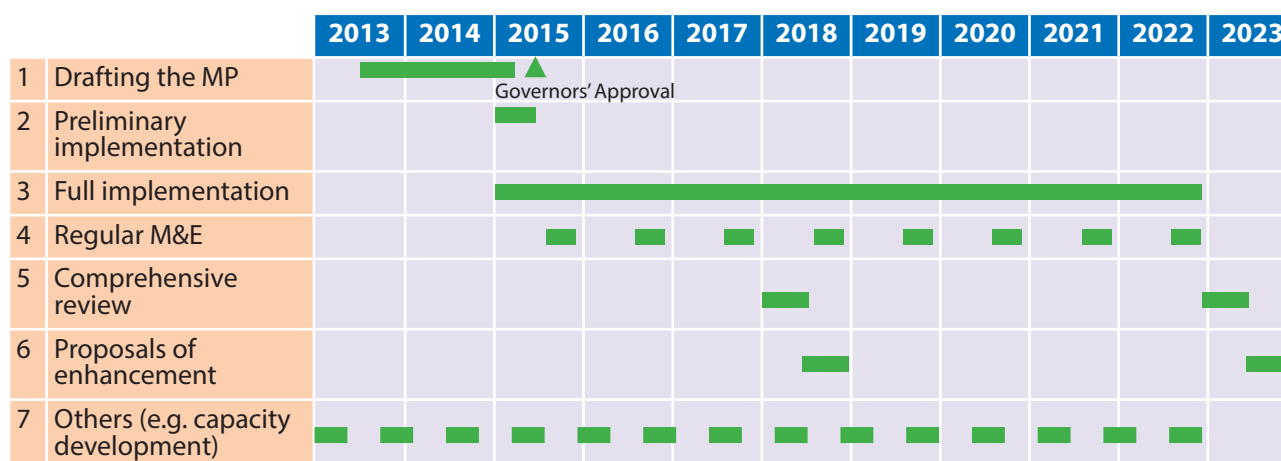
Monitoring and Evaluation through the institutional arrangement



9. Roadmap for implementation

The Bangkok Master Plan on Climate Change 2013-2023 expects key milestones during the implementation. The drafting of the Master Plan was conducted from March 2013 through July 2015, supported by the JICA Technical Cooperation Project on Bangkok Master Plan on Climate Change 2013-2023. During the same period, especially in early and middle of 2015, preliminary implementation of activities was started. Upon the completion and approval of the Master Plan by the BMA Governor, the full implementation is expected to be completed by the end of the fiscal year 2023.

In order to keep the right track of the implementation, and provide useful feedback of lesson learned, the regular monitoring and evaluation (M&E) is conducted. Also for more substantial improvement of the situation, such as addition of sectors, strengthening of the institutional arrangement, the 5-year comprehensive review will be conducted. The first comprehensive review will be conducted in the year 2018, for the period of 2013 through 2017, and the final comprehensive review will be conducted in 2024, that will cover not only the period of 2018 through 2023, but also the whole implementation period. Also regular and comprehensive M&E will be information resources of proposal for enhancement of work. Other than these continuous efforts to conduct capacity development of BMA officials and its stakeholders should be done. For the implementation of the Master Plan, a further detailed implementation plan will be developed.



10. Capacity building and outreach

(1) Capacity building and outreach for BMA Officials (Individual level)

Capacity building and outreach for BMA Officials play a critical role to maintain and strengthen the basis of implementing the Master Plan. For this reason, BMA should positively utilize internal and external opportunities for capacity building. Through the implementation of the Master Plan, BMA will consider how to mainstream climate change into their policy and administrative work and take appropriate measures for them.



(2) Capacity building of the institution of BMA (Institutional level)

Institutional capacity building is vital to steady and sound implementation of the Master Plan. Based on the institutional arrangement created in the earlier stage, it is expected that capacity to mainstream climate change issues within the BMA operation, smooth internal communications and coordination, and systems for M&E and MRV should be strengthened.



(3) Capacity building and outreach for relevant stakeholders (Society level)



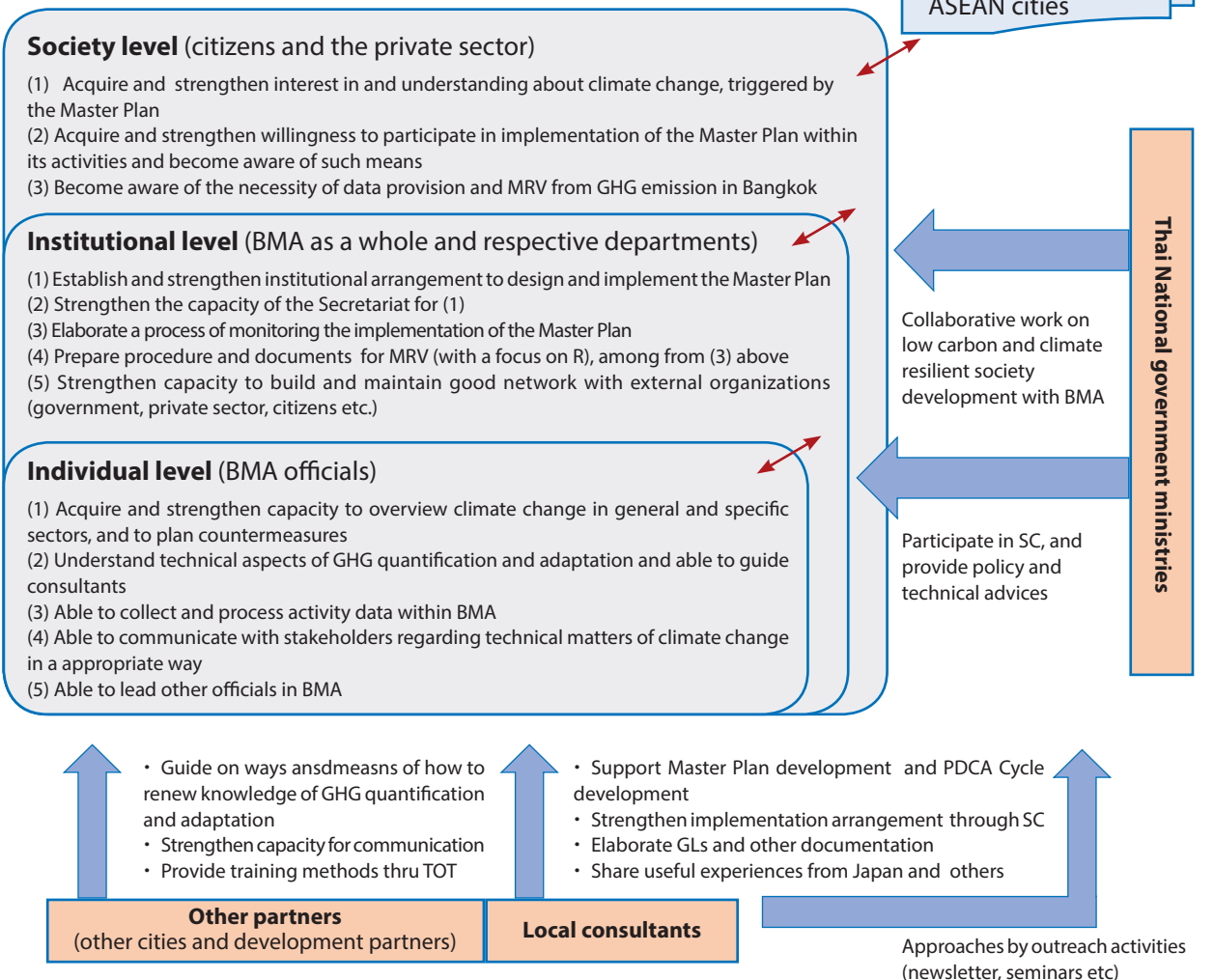
It is also important that BMA should conduct and promote capacity building and outreach for relevant stakeholders, as a part of the implementation of the Master Plan. In conducting such activities, it is important to explore collaborators in the government, civil society, and the private sector, including academia, NGOs, international organizations and other stakeholders, drawing experiences from other local governments, such as the City of Yokohama.

(4) Inter-city cooperation among ASEAN cities



As a leading mega city in Southeast Asia, BMA will cooperate with other ASEAN cities by sharing and transferring its knowledge and experiences of preparing and implementing the Master Plan. Such cooperation should also be participated by partners such as the City of Yokohama or other cities and urban development partners.

Capacity building and outreach



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- | | | |
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