Kingdom of Thailand
Bangkok Metropolitan Administration

Technical Cooperation Project on the Bangkok Master Plan on Climate Change 2013-2023 in the Kingdom of Thailand Final Report (1)

September 2015

Japan International Cooperation Agency (JICA)

Overseas Environmental Cooperation Center, Japan (OECC)
Pacific Consultants Co., Ltd.

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1. Background of the Technical Cooperation Project

(1) Climate Change Policy of the Kingdom of Thailand and Bangkok Metropolitan Administration (BMA)

The Kingdom of Thailand (population: 67.72 million, size: 514,000 km2, GDP5,560 (USD) per capita (2014)) has been setting Five-Year National Economic and Social Development Plans (NESDP) as a national mid-term development plan since 1961. Since the Seventh National Development Plan, the government of Thailand is focusing on "sustainable development" in the way in which economic and social development and resources and environmental conservation are harmonized. The government highlights the importance of developing low-carbon-society that is resilient to climate change in the Eleventh NESDP (2012-2016) issued in October 2011 under one of the sixth focal areas "Strategy for Managing Natural Resources and Environmental toward Sustainability".

The Royal Government of Thailand has been working on climate change issues based on the NESDP. In 1994, the country ratified the United Nations Framework Convention for Climate Change (UNFCCC) and established Sub-Committee on Climate Change for international negotiations and policy planning (was subsequently changed to National Climate Change Committee in 2006 putting the Prime Minister as a chairman). In January 2008, the cabinet approved the "National Strategy on Climate Change Management (2008-2012)", setting six pillars of international cooperation for climate change mitigation as follows: (a) Building capacity to adapt and reduce vulnerabilities to climate change impacts, (b) Promote greenhouse gas (GHG) mitigation activities based on sustainable development, (c) Support research and development to better understand climate change, its impacts and adaptation and mitigation options, (d) Raise awareness and promote public participation, (e) Build capacity of relevant personnel and institutions and establish a framework of coordination and integration, and (f) Support international cooperation to achieve the common goal of climate change mitigation and sustainable development. Following the National Strategy, the Government is currently in process of formalizing "Thailand Climate Change Master Plan (2012-2050), which foresees the achievement of long-term goals in a phased approach. Through this draft national master plan as well as other policy document the Government is in promote low carbon growth, and a low carbon and climate change resilient society, through strengthening mitigation and adaptation measures.

Against this background, in November 2014, the NCCC endorsed key policy directions, which were authorized by the Cabinet, including endorsement of the Thailand Climate Change Master

Plan (2012-2050), and the Thailand Nationally Appropriate Mitigation Actions (NAMAs), as well as preparation for an agreement for the Joint Crediting Mechanism (JCM) with Japan.

As for a local government, Bangkok Metropolitan Administration (BMA) has been setting ambitious strategies on climate change. In 2007, BMA with cooperation of 35 institutional stakeholders adopted "Bangkok Declaration on Mitigation of Climate Change" and started activities related to climate change policies. BMA prepared the BMA Action Plan on Global Warming Mitigation 2007-2012 which aims to reduce its emission at least 15% by 2012 compared to the projected baseline of business as usual. Under the declaration, BMA has been undertaking five initiatives as follows: (i) Expand mass transit and improve traffic system, (ii) Promote the use of renewable energy, (iii) Improve building electricity consumption efficiency, (iv) Improve solid waste management and wastewater treatment efficiency, and (v) Expand park area.

(2) The Position of Japan and JICA's cooperation policies, achievements, and the project

In the Japan's Official Development Assistance (ODA) for Thailand (2012), "responding to sustainable economic development and maturing society" is considered as one of the most important areas and development challenges related to environment, climate change, and flood control are highlighted. Under the policy, Japan International Cooperation Agency (JICA) provides wide range of assistance through implementing projects including the following: technical cooperation project "Capacity Development and Institutional Strengthening for GHG Mitigation" (2009-2012), ODA loan projects "Mass Transit System Project in Bangkok (Purple Line)" (Loan Agreement signed in 2008 and 2010) and "Mass Transit System Project in Bangkok (Red Line)" (Loan Agreement in 2009), technical cooperation for development planning "Project for Comprehensive Flood Management Plan for the Chao Phraya River Basin" (2011-2013), technical cooperation project "Integrated Study Project on Hydro-Meteorological Prediction and Adaptation to Climate Change in Thailand (IMPAC-T)" (2009-2014). Furthermore, JICA contributed to enhancing institutional capacity of the BMA by having them as their counterpart and implementing the technical cooperation project "Capacity Building on Climate Change Adaptation and Mitigation for Implementation in Bangkok" (2009-2012). Also the "Preparatory Survey for Bangkok Wastewater Treatment Project" (2010-2011) was conducted, which may provide technical insight for improving mitigation efforts in the wastewater sector.

BMA evaluated the implementation of the BMA Action Plan 2007-2012, and planned to formulate more holistic climate change long-term plan "Bangkok Master Plan on Climate

Change 2013-2023" (BMA Master Plan 2013-2023). The project succeeded the technical cooperation project "Capacity Building on Climate Change Adaptation and Mitigation for Implementation in Bangkok" (2009-2012) to formulate the BMA Master Plan 2013-2023 by strong partnerships of the institutional and individual stakeholders within Thailand, as well as enhancing capacities of institution and employees of BMA for implementing the master plan.

2. Overview of the Project

(1) Overall goal

- Bangkok Master Plan on Climate Change is well implemented by BMA in a sustainable manner.
- The responsible departments of BMA are able to manage, monitor and evaluate the progress of the Bangkok Master Plan.

(2) Project purpose

- The Bangkok Master Plan on Climate Change, including its action plan(s) is fully prepared for the implementation.

(3) Output

Output 1: Based on the assessment of the implementation of the Bangkok Action Plan on Global Warming Mitigation 2007-2012, the Bangkok Master Plan on Climate Change 2013-2023 is drafted as the framework to deal with the impacts of climate change.

Output 2: The capacity of BMA officials is increased for the efficient and effective implementation of the Bangkok Master Plan on Climate Change 2013-2023

(4) Project activities

(a) Project site and Stakeholders

The project site is within the Bangkok Metropolitan area in Thailand. The stakeholders are as below:

Counterpart (C/P) agency: Bangkok Metropolitan Administration (BMA)

Governmental Stakeholders: Thailand Greenhouse Gas Management Organization (TGO), Office of Natural Resources and Environment Policy and Planning (ONEP), Pollution Control Department (PCD), Office of Transport and Traffic Policy and Planning (OTP), Energy Policy and Planning Office (EPPO), Department of Alternative Energy Development and Efficiency (DEDE), Office of the National Economic and Social Development Board (NESDB), and Department of Disaster Prevention and Mitigation (DDPM) etc.

(b) Sector

- Energy Efficiency and Alternative Energy
- Environmental Sustainable Transport
- Efficient Solid Waste Management and Wastewater Treatment
- Green Urban Planning

- Adaptation planning

(c) Implementation period

- February 2013 - September 2015

Implementation schedule originally planned from February 2013 to March 2015 was extended by 6 months to September 2015 because of the project delay due to the political turbulence in Thailand started around November until April 2014.

(d) Inputs of Japanese Expert Team

Inputs of Japanese Expert Team

Specialty	Expert Number	M/M	
		Thailand	Japan
Project Leader/Master Planning	1	4.10	1.23
Environmentally Sustainable Transport	2	4.90	1.27
Energy Efficiency and Alternative Energy	2	4.83	1.07
Efficient Solid Waste Management and Waste Water Treatment	2	5.66	1.34
Green Urban Planning	2	4.90	1.14
Adaptation Planning	2	3.90	1.00
Project Coordination	2	12.46	5.33
Total	13	40.75	12.38

Table2-1 List of Japanese Expert Team

Name of Expert		Specialty
Mr. Makoto Kato	Mar. 2013 – Sep. 2015	Team Leader/Master Planning
Mr. Kazuhito Yamada, Dr. Eng.	Mar. 2013 – Sep. 2015	Energy efficiency and Alternative Energy 1
Ms. Mariko Fujimori, Dr. Eng.	Mar. 2013 – Sep. 2015	Energy efficiency and Alternative Energy 2/Adaptation Planning 2
Mr. Yasuki Shirakawa, Ph.D	Mar. 2013 – Sep. 2015	Environmentally Sustainable Transport 1
Mr. Yoshihiro Mizuno	Mar. 2013 – Sep. 2015	Environmentally Sustainable Transport 2
Mr. Yushi Tsurumi	Mar. 2013 – Sep. 2015	Efficient Solid Waste Management and Wastewater Treatment 1

Mr. Tetsuya Yoshida	Mar. 2013 – Sep. 2015	Efficient Solid Waste Management and Wastewater Treatment 2
Mr. Masahiko Fujimoto	Mar. 2013 – Sep. 2015	Green Urban Planning 1
Mr. Hisaaki Kato	Mar. 2013 – Sep. 2015	Green Urban Planning 2
Ms. Kumiko Kajii	Mar. 2013 – Aug. 2014	Adaptation Planning 1
Mr. Allan Tabucanon	Sep. 2014 – Sep. 2015	
Ms. Kikuko Muroya	Mar. 2013 - Oct. 2013	Training Planning 1/Program Coordinator 1
Ms. Saeko Kajima	Nov. 2013 – Mar. 2014	
Ms. Kotoko Yoneda	Apr. 2014 – Jul. 2015	
Mr. Toshihiro Kiso	Aug. 2015 – Sep 2015	
Mr. Yushin Nakao	Mar. 2013 – Mar. 2015	Training Planning 2/Program Coordinator 2
Mr. Jun Watanabe	Apr. 2015 – Sep. 2015	

Table2-2 Inputs of Japanese Expert Team

Specialty	Number of experts	Man/Month (M/M)	
		Thailand	Japan
Team Leader/Master Planning	1	4.20	1.30
Environmentally Sustainable Transport	2	4.76	1.40
Energy efficiency and Alternative Energy	2	4.86	1.03
Efficient Solid Waste Management and Wastewater Treatment	2	5.43	1.36
Green Urban Planning	2	4.73	1.39
Adaptation Planning	2	3.56	0.93
Training Planning/Program Coordinator	2	12.09	4.72
Total	13	39.63	12.13

*Result at the end of August 2015

Table2-3 Plan and result of Inputs of Japanese Expert Team in Thailand (1)

Name (Specialty)		FY 2013 *Upper row : Plan, Lower row : Result											
	3	4	5	6	7	8	9	10	11	12	1	2	3
Mr. Makoto Kato (Project leader/Master Planning)	7		8		7			7		7		7	
	7 (17-23)		13 (4/30-12)		6 (28-8/2)	4 (21-24)	9 (17-25)			6 (16-21)			
Mr. Kazuhito Yamada, Dr. Eng. (Energy efficiency and Alternative Energy 1)	7		8		7			7		7		7	7
	7 (17-23)		6 (7-12)		11 (23-8/2		8 (18-25)		8 (15-18,	20-23)			
Ms. Mariko Fujimori, Dr. Eng. (Energy efficiency and Alternative Energy 2/Adaptation Planning 2)	7		8		7			7		7		7	7
	7 (17-23)		6 (7-12)		11 (23-8/2)	4 (20-23)	6 (20-25)		7 (16-18,	20-23)			9 (26-31-1-3)
Mr. Yasuki Shirakawa, Ph.D. (Environmentally Sustainable Transport 1)	7		8		7			7		7		7	7
	7 (17-23)		6 (7-12)		10 (23-8/1)		8 (18-25)		5 (24-28)				
Mr. Yoshihiro Mizuno (Environmentally Sustainable Transport 2)			8					8				8	
			6 (7-12)		11 (23-8/2		8 (18-25)						

Name (Specialty)	FY 2014 *Upper row : Plan, Lower row : Result											
	4	5	6	7	8	9	10	11	12	1	2	3
Mr. Makoto Kato (Project leader/Master Planning)		7		7		7		7			7	
	4 (2-5)	14 (11-24)		4 (2-5)	5 (3-7)	5 (28-10/2)	7 (17-23)		5 (21-25)			7 (20-26)
Mr. Kazuhito Yamada, Dr. Eng. (Energy efficiency and Alternative Energy 1)		7		7		7		7			7	
		1 (15)		7 (14-17、19,20,22)		6 (8-13)	11 (12,13, 15-23)			6 (18-23)		
Ms. Mariko Fujimori, Dr. Eng. (Energy efficiency and Alternative Energy 2/Adaptation Planning 2)		7		7		7		7			7	
		2 (6,15)		12 (8,10-15 17-20,22)	5 (24-28)	6 (8-13)	11 (12,13, 15-23)			11 (11-23)		
Mr. Yasuki Shirakawa, Ph.D. (Environmentally Sustainable Transport 1)		7		7		7		7			7	
		12 (13-24)	6 (6/29-	7/4)	6 (3-8)		4 (20-23)			5 (18-22)		5 (24-28)
Mr. Yoshihiro Mizuno (Environmentally Sustainable Transport 2)		8		8				8				
		9 (13-21)	6 (6/29-	7/4)								

Name （Specialty）	FY 2015 *Upper row : Plan, Lower row : Result				
	4	5	6	7	8
Mr. Makoto Kato (Project leader/Master Planning)					
		10 ■ (8-10,17-23)		4 ■ (1 - 4) 1 1 ■ (8 - 1 1 、 1 9 - 2 5)	5 ■ (23-27)
Mr. Kazuhito Yamada, Dr. Eng. (Energy efficiency and Alternative Energy 1)					
		7 ■ (17-23)		10 ■ (16-25)	
Ms. Mariko Fujimori, Dr. Eng. (Energy efficiency and Alternative Energy 2/Adaptation Planning 2)					
		7 ■ (17-23)		12 ■ (14-25)	
Mr. Yasuki Shirakawa, Ph.D. (Environmentally Sustainable Transport 1)					
		10 ■ (14-23)		4 ■ (7-10) 5 ■ (21-25)	
Mr. Yoshihiro Mizuno (Environmentally Sustainable Transport 2)					
		10 ■ (14-23)			

*Result at the end of August 2015

Table2-4 Plan and result of Inputs of Japanese Expert Team in Thailand (2)

Name (Specialty)		FY 2013 *Upper row : Plan, Lower row : Result											
	3	4	5	6	7	8	9	10	11	12	1	2	3
Mr. Yushi Tsurumi (Efficient Solid Waste Management and Wastewater Treatment 1)			8		8			8		7		8	7
			6 (7-12)		11 (23-8/2)		9 (17-25)		9 (13-21)				
Mr. Tetsuya Yoshida (Efficient Solid Waste Management and Wastewater Treatment 2)			8		8			8		7		8	7
			6 (7-12)		11 (23-8/2)		9 (17-25)		8 (13-18,	20, 21)			
Mr. Masahiko Fujimoto (Green Urban Planning 1)			8		8			8		7		8	7
			5 (8-12)		11 (23-8/2)		9 (17-25)		9 (20-28)				
Mr. Hisaaki Kato (Green Urban Planning 2)			8					8				8	
			6 (7-12)		11 (23-8/2)				7 (18-24)				
Ms. Kumiko Kajii (Adaptation Planning 1)			8		8			7		7		7	7
			6 (7-12)						3 (20-22)				
Ms. Kotoko Yoneda (Training Planning 1/Program Coordinator 1)	7			30			30		30				
	7 (17-23)		(6-6/4)	30	30 (16-	8/14)	31 (11-	10/10)	16 (13-28)	9 (16-24)			
Mr. Yushin Nakao (Training Planning 2/Program Coordinator 2)	7		15			15		15			15		15
	7 (17-23)		(7-24)	18	11 (23-8/2)		9 (17-25)						

Name (Specialty)	FY 2014 *Upper row : Plan, Lower row : Result											
	4	5	6	7	8	9	10	11	12	1	2	3
Mr. Yushi Tsurumi (Efficient Solid Waste Management and Wastewater Treatment 1)		8		8		7		8			8	
		11 (14-24)		5 (6-10)		4 (30-	10/3)			6 (5-10) 3 (20-22)		5 (29-2)
Mr. Tetsuya Yoshida (Efficient Solid Waste Management and Wastewater Treatment 2)		8		8		7		8			8	
		(15,16,	19,20)	5 (5-9)			6 (1-5,22)			4 (8-11)		7 (29-4)
Mr. Masahiko Fujimoto (Green Urban Planning 1)		8		8		7		8			8	
		4 (15,16,	20,21)	4 (11,12,15	18)		7 (17-23)			6 (16-21)		
Mr. Hisaaki Kato (Green Urban Planning 2)		8		8				8				
		10 (13-22)		6 (13-18)			4 (12-15)			10 (13-22)		
Ms. Kumiko Kajii (Adaptation Planning 1)		7		7				7			7	
		15 (5-8,	14-24)	4 (9-12)								
Ms. Kotoko Yoneda (Training Planning 1/Program Coordinator 1)	30		30			30		30			15	
		24 (5-28)		5 (1-5)			15 (9-23)		4 (21-24)			
Mr. Yushin Nakao (Training Planning 2/Program Coordinator 2)				15			15		15	15		
		6 (18-23)										

Name （Specialty）	FY 2015 *Upper row : Plan, Lower row : Result				
	4	5	6	7	8
Mr. Yushi Tsurumi (Efficient Solid Waste Management and Wastewater Treatment 1)					
		11 ■ (13-23)	5 ■ (30-4)		
Mr. Tetsuya Yoshida (Efficient Solid Waste Management and Wastewater Treatment 2)					
		10 ■ (11-13,16-18,20-21,23-24)		9 ■■ (1-5,9,19-20,22)	
Mr. Masahiko Fujimoto (Green Urban Planning 1)					
		7 ■ (17-23)		3 ■ 3 ■ (2-4) (8-10) 5 ■ (18-22)	
Mr. Hisaaki Kato (Green Urban Planning 2)					
		5 ■ (17-21)		10 ■ (14-23)	
Mr. Allan Tabucanon (Adaptation Planning 1)					
		11 ■ (13-23)		10 ■ (14-23)	
Ms. Kotoko Yoneda (Training Planning 1/Program Coordinator 1)					
		10 ■ (14-23)			
Mr. Jun Watanabe (Training Planning 2/Program Coordinator 2)					
		7 ■ (17-23)		1 1 ■ (7-11, 19-24)	

*Result at the end of August 2015

Table2-5 Plan and result of Inputs of Japanese Expert Team in Japan (1)

Name (Specialty)		FY 2013 *Upper row : Plan, Lower row : Result											
	3	4	5	6	7	8	9	10	11	12	1	2	3
Mr. Makoto Kato (Project leader/Master Planning)	7		2		2			2		2	2		
	7 (3 - 9)	2 (25,26)				2 (19,20)		1 (9)		2 (12,26)	1 (17)	1 (6)	1 (28)
Mr. Kazuhito Yamada, Dr. Eng. (Energy efficiency and Alternative Energy 1)			2		2			2		2	2		
		2 (25,26)		2 (3,21)				2 (11,29)	1 (5)	1 (27)	1 (28)		1 (14)
Ms. Mariko Fujimori, Dr. Eng. (Energy efficiency and Alternative Energy 2/Adaptation Planning 2)			2		2			2		2	2		
		2 (25,26)		2 (3,21)				2 (22,25)	1 (7)				1 (20)
Mr. Yasuki Shirakawa, Ph.D. (Environmentally Sustainable Transport 1)			2		2			2		2	2		
		2 (25,30)				1 (24)	1 (9)	2 (22,29)		2 (2,26)	1 (17)	1 (6)	1 (6)
Mr. Yoshihiro Mizuno (Environmentally Sustainable Transport 2)			2					2			2		
		2 (25,26)		2 (3,21)				1 (22)					2 (27,28)
Mr. Yushi Tsurumi (Efficient Solid Waste Management and Wastewater Treatment 1)			2		2			2		2	2		
		1 (30)	1 (16)	2 (3,21)				1 (29)	2 (7 , 8)	1 (3)	2 (14,24)		

Name (Specialty)	FY 2014 *Upper row : Plan, Lower row : Result											
	4	5	6	7	8	9	10	11	12	1	2	3
Mr. Makoto Kato (Project leader/Master Planning)		2		2		2		2			2	
	2 (24,25)	2 (1, 2)	1 (27)	1 (29)	1 (29)		5 (8,27-31)	1 (5)	2 (25,26)			
Mr. Kazuhito Yamada, Dr. Eng. (Energy efficiency and Alternative Energy 1)		2		2		2		2			2	
	2 (17,22)	1 (19)	1 (30)	1 (7)	1 (12)			3 (4,5,11)	1 (26)			
Ms. Mariko Fujimori, Dr. Eng. (Energy efficiency and Alternative Energy 2/Adaptation Planning 2)		2		2		2		2			2	
	3 (17,24,28)	1 (19)	2 (4,27)	2 (3, 7)			1 (9)	2 (4, 5)	1 (24)			
Mr. Yasuki Shirakawa, Ph.D. (Environmentally Sustainable Transport 1)		2		2		2		2			2	
		1 (12)		2 (17,18)	1 (29)	1 (16)	1 (31)	2 (4, 5)	1 (26)		1 (6)	
Mr. Yoshihiro Mizuno (Environmentally Sustainable Transport 2)		2		2				2				
	1 (22)	1 (7)	1 (27)				1 (9)	1 (17)				
Mr. Yushi Tsurumi (Efficient Solid Waste Management and Wastewater Treatment 1)		2		2		2		2			2	
	2 (23,24)	1 (9)	1 (27)		1 (29)	1 (4)		2 (4, 5)	1 (26)			

Name （Specialty）	FY 2015 *Upper row : Plan, Lower row : Result				
	4	5	6	7	8
Mr. Makoto Kato (Project leader/Master Planning)					
	3 [redacted] (3,9,28)		3 [redacted] (18,19,25)	1 [redacted] (31)	1 [redacted] (10)
Mr. Kazuhito Yamada, Dr. Eng. (Energy efficiency and Alternative Energy 1)					
Ms. Mariko Fujimori, Dr. Eng. (Energy efficiency and Alternative Energy 2/Adaptation Planning 2)					
	1 [redacted] (9)	1 [redacted] (11)			
Mr. Yasuki Shirakawa, Ph.D. (Environmentally Sustainable Transport 1)					
	1 [redacted] (15)	1 [redacted] (11)	5 [redacted] (12,15,19,22,23)	2 [redacted] (1,31)	3 [redacted] (3,5,6)
Mr. Yoshihiro Mizuno (Environmentally Sustainable Transport 2)					
Mr. Yushi Tsurumi (Efficient Solid Waste Management and Wastewater Treatment 1)					
	1 [redacted] (24)				

*Result at the end of August 2015

Table2-6 Plan and result of Inputs of Japanese Expert Team in Japan (2)

Name (Specialty)		FY 2013 *Upper row : Plan, Lower row : Result											
	3	4	5	6	7	8	9	10	11	12	1	2	3
Mr. Tetsuya Yoshida (Efficient Solid Waste Management and Wastewater Treatment 2)			2		2			2		2	2		
		1 (25)	2 (15,16)					2 (1,9)		2 (25,26)			
Mr. Masahiko Fujimoto (Green Urban Planning 1)			2		2			2		2	2		
		3 (22,23,25)			2 (19,22)		1 (9)	2 (29,30)		1 (5)			
Mr. Hisaaki Kato (Green Urban Planning 2)			2					2			2		
				2 (3,21)				1 (29)	2 (14,15)		1 (14)		
Ms. Kumiko Kajii (Adaptation Planning 1)			2		2			2		2	2		
		2 (25,26)		2 (3,21)						1 (4)	1 (31)		3 (13,26,27)
Ms. Kotoko Yoneda (Training Planning 1/Program Coordinator 1)				20			20						
								6 (22,23,	25,28-30)	1 (12)	1 (17)	1 (6)	1 (28)
Mr. Yushin Nakao (Training Planning 2/Program Coordinator 2)					35		30						
							10 (9,21-25	28-31)	1 (26)	1 (12)	1 (17)	1 (6)	1 (28)

Name (Specialty)	FY 2014 *Upper row : Plan, Lower row : Result											
	4	5	6	7	8	9	10	11	12	1	2	3
Mr. Tetsuya Yoshida (Efficient Solid Waste Management and Wastewater Treatment 2)		2		2		2		2			2	
	2 (23,24)			2 (29,31)	1 (29)	2 (16,17)		3 (4,5,6)	1 (26)			2 (24-25)
Mr. Masahiko Fujimoto (Green Urban Planning 1)		2		2		2		2			2	
	3 (7,23,24)	2 (1,26)		2 (7,23)	3 (18,21, 29	2 (12,17)		2 (1, 4)			4	
Mr. Hisaaki Kato (Green Urban Planning 2)		2		2				2				
	1 (18)	1 (9)	1 (27)	1 (25)				2 (4, 5)	1 (26)			
Ms. Kumiko Kajii (Adaptation Planning 1)	2			2				2			2	
	3 (21,22, 24)	1 (12)	1 (27)					1 (4)	1 (26)			1 (5)
Ms. Kotoko Yoneda (Training Planning 1/Program Coordinator 1)			20									
	20 (2-30)		10 (2-6,23-27),	4 (23-24, 28-29)	1 (29)	5 (17-19, 29-30)	7 (9,24, 27-31)	2 (4, 5)	1 (26)	2 (6-7)	2 (10, 13)	3 (2-3 11)
Mr. Yushin Nakao (Training Planning 2/Program Coordinator 2)			35									
	20 (2-30)	3 (1,12-13)					2 (27,29)	2 (4, 5)	1 (26)			

Name (Specialty)	FY 2015 *Upper row : Plan, Lower row : Result				
	4	5	6	7	8
Mr. Tetsuya Yoshida (Efficient Solid Waste Management and Wastewater Treatment 2)					
	1 ■ (9)				3 ■ (14,17,18)
Mr. Masahiko Fujimoto (Green Urban Planning 1)					
	1 ■ (24)				4 ■ (10,13,24,25)
Mr. Hisaaki Kato (Green Urban Planning 2)					
	1 ■ (27)				
Mr. Allan Tabucanon (Adaptation Planning 1)					
Ms. Kotoko Yoneda (Training Planning 1/Program Coordinator 1)					
	7 ■ (7-10,13,28,30)	5 ■ (1,7-8,13,25)			
Mr. Jun Watanabe (Training Planning 2/Program Coordinator 2)					
		2 ■ (8,27)	4 ■ (1,3,19,25)		5 ■ (8,6,18,19,28))
Mr. Toshihiro Kiso (Training Planning 1/Program Coordinator 1)					
					2 ■ (26,31)

*Result at the end of August 2015

(e) Provision of equipment

Table2-7 List of equipment

No.	Name of Item	Date of Acquis ion	Place of Installment	Usage and Management Status
13-3-002083 13-3-002084	Laptop PC Dell Inspiron 5521	May 21, 2013	Department of Environment, BMA	The Equipment are handovered to Department of Environment, BMA after the project will finish.
13-3-002086	Photocopy Machine TSK3050CI	May 22, 2013		
13-3-002085	Projector EPSON EB-X12	May 30, 2013		

(f) Operating expense

Table2-8 Results of operating expense

(thousand Yen)	Temporary service	Rental/service	Supplies	Communication/transport	Documentation	Miscellaneous	Total
FY 2013	5,195	169	459	102	287	489	6,701
FY 2014	10,171	0	434	51	166	657	11,479
FY 2015	10,219	25	652	49	862	2,283	14,090
Total	25,585	194	1,545	202	1,315	3,429	32,270

(5) Results of project implementation

(a) Project implementation plan and results

The project was undertaken in the following seven steps according to the project implementation plan:

【0】Preparatory work

【1】First Term

【2】Second Term

【3】Third Term

【4】Fourth Term

【5】Fifth Term

【6】Regular work

Table2-9 Activities based on project implementation plan and implementation period

Activities based on project implementation plan	Implementation period
【0】Preparatory work	February 2013 - March 2013
【0-1】Collection of related information, and examination of basic policies, contents and schedule of the Project	
【0-2】Drafting an Inception Report (IC/R)	
【1】The First Term	March 2013 - April 2013
【1-1】Explanation and discussion on draft IC/R	
【1-2】Capacity assessment (interviews)	
【1-3】Purchase of Equipment for the Project	
【2】The Second Term	May 2013 - September 2013
【2-1】Output 1: Activities related to drafting the 1st the Bangkok Master Plan on Climate Change 2013-2023, based on the assessment of the implementation of the Bangkok Action Plan on Global Warming Mitigation 2007-2012	
【 2-1-1 】 Setting up the implementation structure (steering committee , working group, and task forces)	
【2-1-2】Carrying out a capacity assessment (analysis of current status)	
【2-1-3】Preparation for terms of reference for reviewing the Bangkok Action Plan 2007-2012	
【 2-1-4 】 Collection of information on the results of the implementation of the Bangkok Action Plan on Global Warming Mitigation 2007-2012	
【2-2】Output2 : The capacity of BMA officials is increased for the efficient and effective implementation of the Bangkok Master Plan on Climate Change 2013-2023	October 2013 - August 2014
【2-2-1】Organize training programmes and seminars to strengthen the capacity of BMA officials to facilitate the implementation of the Master Plan including TOT training programms for instruction and managers	
【2-3】Produce the Progress Report	May 2013 - September 2013
【3】The Third Term	October 2013 - August 2014
【3-1】Output1: Based on the assessment of the implementation of	

Bangkok Action Plan on Global Warming Mitigation 2007-2012, the Bangkok Master Plan on Climate Change 2013-2023 is drafted as the framework to deal with the impacts of climate change	
【3-1-1】Take stock of the current situation including existing BMA Action Plans, other relevant policies & measures, and activities	
【3-1-2】Review and improve data collection, methodologies for estimation and monitoring of GHG emission and reduction	September 2014 - March 2015
【3-1-3】Develop overall and sectoral strategies, using problem analysis, selecting practical approaches and identifying available resources and schemes for the implementation of the Master Plan	
【3-1-4】Draft the Bangkok Master Plan on Climate Change 2013-2023 in accordance with the developed sectoral strategies	
【3-1-5】Organize public consultation, workshops and seminars at various levels	April 2015 - October 2015
【3-2】Activities for Output 2: The capacity of BMA officials is increased for the efficient and effective implementation of the Bangkok Master Plan on Climate Change 2013-2023	April 2015 - October 2015
【3-2-1】Organize seminars and /or workshops for relevant stakeholders	
【3-3】Draw up the Progress Report (P/R2)	October 2013 - August 2014
【4】The fourth Term	September 2014 - March 2015
【4-1】Activities for Output 1: Based on the assessment of the implementation of the Bangkok Action Plan on Global Warming Mitigation 2007-2012, the Bangkok Master Plan on Climate Change 2013-2023 is drafted as the framework to deal with the impacts of climate change	
【4-1-1】Revise the Master Plan accordance with the feedbacks from the public consultations	
【4-1-2】Organize public consultation, workshops and seminars at various levels	April 2015 - October 2015
【4-2】Activities for Output 2: The capacity of BMA officials is increased for the efficient and effective implementation of the Bangkok Master Plan on Climate Change 2013-2023	September 2014 - March 2015
【4-2-1】Organize training programs and seminars to strengthen the capacity of BMA officials to facilitate the implementation of the	

Master Plan including a TOT training programs for instructors and managers	
【4-3】Draw up the Progress Report (P/R3)	
【5】The Fifth Term	April 2015 - October 2015
【5-1】Activities for Output 1: Based on the assessment of the implementation of the Bangkok Action Plan on Global Warming Mitigation 2007-2012, the Bangkok Master Plan on Climate Change 2013-2023 is drafted as the framework to deal with the impacts of climate change	
【5-1-1】Finalize the Master Plan	
【5-1-2】Facilitate the process for the approval of the Master Plan	
【5-1-3】Disseminate the Master Plan to such key organizations as the ministries and private organizations and neighbouring provinces	
【5-2】Activities for Output 2: The capacity of BMA officials is increased for the efficient and effective implementation of the Bangkok Master Plan on Climate Change 2013-2023	
【5-2-1】Organize seminars and/or workshops for relevant stakeholders	
【5-2-2】Develop and disseminate educational materials on the Master Plan for the public	
【5-3】Draw up the Final Report (F/R)	
【6】Regular Work	February 2013 - September 2015 (Entire period)
【6-1】Hold meetings of the Steering Committee and Working Group	
【6-2】Have consultation with external related organizations	
【6-3】Carry out a capacity assessment (Evaluation and Monitoring)	
【6-4】Disseminate Project Information via Websites, International Conferences etc.	

(b) Implementation of Missions and Study Tours

Table2-10 Implementation of the 1st term

Mission	Period	Major activities
The1st Mission	March 2013	・ JICA Expert Team met and consulted with BMA departments, including the Department of

		Environment Air Pollution and Noise Control Division, Waste Division, Wastewater and Drainage Subdivision, the Department of Transport, the Department of Public Work, the Department of City Planning, and the Fire Department

Table2-11 Implementation of the 2nd term

Mission	Period	Major activities
The 2nd Mission	April - May 2013	・ The 1st JCC / Steering Committee ・ Consultation for establishing Taskforces (TF) for the 5 sectors ・ Coordination meetings with the BMA Secretariat
The 3rd Mission	July - August 2013	・ Coordination meetings with the BMA Secretariat for ➢ Study sessions on steps of climate change master planning, and BAU identification ・ TF meetings for ➢ Data and information collection ➢ Studying climate change master planning ➢ Consultation on local consultants selection ・ Workshops(Green Urban Planning, and Transport)
Extra Mission	August 2013	・ Support for BMA Information Explanatory Meeting ・ Preparation for the 1st Study Tour to Japan ・ Preparation for the 1st Working Group (WG)
The 4th Mission	September 2013	・ The 1st WG ・ Dispatch of Yokohama City Experts (3 experts only) ・ TF meetings for ➢ Data and information collection ➢ Selection of local consultants

Table2-12 Implementation of the 3rd term

Mission	Period	Major activities
The 5th Mission	November 2013	• Elaboration in TFs based on outputs from the 2nd Study Tour

		➢ Mitigation and adaptation project under the Master Plan ➢ Data collection and sorting out approaches to MRV
Extra Mission	December 2013	• Emergency consultation with BMA and JICA Thailand Office, given the wide spread security uncertainty. ➢ Rescheduling of dispatching Yokohama officials to Bangkok, shifting to plan from December, 2013 to January 2-14. • Follow-up of the 5th mission ➢ Data collection by the respective TFs • Management of project budget
The 6th Mission	May 2014	• 2nd WG(May 20) ➢ Recommendation was made to the 2nd JCC/SC to adopt the table of contents, based on the output of the 2nd Study Tour to Japan, with some more elaboration • 2nd JCC/SC(May 23) ➢ Approval was given to the table of contents, recommended by the 2nd WG ➢ Consideration was made on the extension of the Technical Cooperation Project, to cover the delay due to the political turbulence. • Support to Yokohama City officials displacement (due to the declaration of martial laws etc., the programme was partially completed) • TF meeting to prepare for the above WG and JCC/TF ➢ Ideas on mitigation and adaptation projects under the Master Plan were elaborated.
The 7th Mission	July 2014	• TF meetings ➢ Responding to the outcomes of the 2nd WG and 2nd JCC/SC, 1st master plan text was drafted • Secretariat meeting

		➢ Consultation was made for adjustment to the project period extension.
Extra Mission	August 2014	• BMA Secretariat meeting ➢ Consultation for the contents of the 1st Draft ➢ Consultation on organizing the 3rd WG to approve the 1st Draft ➢ Preparation for the 3rd Study Tour to Japan(Oct) ➢ Small Study Session on MRV

Table2-13 Implementation of the 4th term

Mission	Period	Major activities
The 8th Mission	October 2014	・ 3rd WG (October 22) Dispatch of Yokohama City Experts Approval of the 1st Draft of Master Plan
Extra Mission	December 2014	・ Information collection on developments in national climate policy ・ Coordination on drafting Bangkok Master Plan ・ Coordination on preparing 4th WG
The 9th Mission	January 2015	・ 4th WG (January 21) Report of the 2nd Draft of Master Plan Dispatch of Yokohama City Experts
Extra Mission	March 2015	・ Preparation for the 3rd JCC/SC in May 2015 ・ Coordination on target setting in line with Thailand NAMA

Table2-14 Implementation of the 5th term

Mission	Period	Major activities
The 10th Mission	May 2015	・ 5th WG (May 20) ・ 3rd JCC/SC (May 22) Approval of the 2nd Draft of Master Plan Dispatch of Yokohama City Experts
The 11th Mission	July 2015	・ Stakeholder Meeting (July 9) ・ Open Seminar (July 21) Implementing public hearing ・ 4th JCC/SC (July 22)

		Approval of the Master Plan Dispatch of Yokohama City Experts

(c) Implementation of Study tours

Table2-15 Overview of the study tours

	Period	Focus of the Study Tour	Major outputs
1st Study Tour	Oct 21 through 30, 2013	・ To learn climate change related work conducted by local government in Japan and the world, by participating in Smart City Week. ・ To learn inter-departmental coordination that is necessary to conduct climate change related work, with examples of Yokohama City ・ To learn cased of public-private partnership in the area of climate change	・ Understanding of low carbon and climate resilient society was enhanced and strong motivation was created. ・ Understanding of inter-departmental coordination for climate change in a local government was enhanced by referring to the case of Yokohama, and motivation was created to utilize the institutional arrangement established by the 1st JCC/SC. ・ Useful cases of public-private partnership were showcased in Yokohama, and consideration on how to introduce such activities in BMA was initiated.
2nd Study Tour	April 17 through 25, 2014	・ To be engaged in consultation with Yokohama officials and JICA Expert Team and elaborate a master plan. ・ To learn practical experience of adaptation to climate change in Mie Prefecture	・ A draft table of contents was made to be submitted to the 2nd WG and the 2nd JCC/SC ・ Understanding was enhanced on adaptation approaches to be taken by local governments, and elaboration on prioritizing activities in BMA.
3rd Study Tour	October 26 through November 6, 2014	・ To learn useful experiences of local governments in Japan, with the development and implementation of climate	・ Template of M&E/MRV was developed and the Task Forces learned how to fill out it, and also developed ideas for

		change policies, especially those of the City of Yokohama. ▪ To learn elaborating institutional arrangement for implementation, monitoring and evaluation (M&E)/measurement, reporting, and verification (MRV) and outreach activities for public-private partnership regarding Master Plan.	outreach activities to be conducted in Bangkok in the coming year.

Table2-16 List of participants of the 1st Study Tour

Name	Organizations	Groups/ Course level
Ms. Suwanna Jungrungrueng	Deputy Director General, Department of Environment, BMA	JCC&SC /Executive
Ms. Chutinthorn Praditphet	Policy and Plan Analysis, Professional Level, Office of Transport and Traffic Policy and Planning (OTP)	WG /Executive
Ms. Pisamai Sathienyanon	Renewable Energy Expert, Department of Alternative Energy Development and Efficiency	WG /Executive
Mrs. Suthimol Kessomboon	Director, Drainage Information System Division, Department of Drainage and Sewage	WG /Executive
Ms. Somsri Ravadeerakha	Chief, Environmental Strategy Sub-Division, Public Health and Environmental Strategy Division, Strategy and Evaluation Department, BMA	WG /Executive
Ms. Siriporn Tantivanich	Director, Air quality and Noise Management Division, Department of Environment, BMA	WG /Executive
Mr. Surasak Wongpoot	City Planner Senior Professional Level,	WG

	Urban Development Planning Division, City Planning Department, BMA	/Executive
Act. Sub Lt. Wiruch Tanchanapradit	Chief, Environmental Impact Study and Analysis Sub-Division, Air quality and Noise Management Division, Department of Environment, BMA	Secretariat /Technical
Ms. Supaporn Kittwarodom	Environmentalist, Environmental Study and Analysis Sub-Division, Air quality and Noise Management Division, Department of Environment, BMA	Secretariat /Technical
Mr. Thosapol Suparee	Civil Engineer, Traffic and Transportation Department, BMA	TF (Transport) /Technical
Mr. Tharathon Kanjanakorn	Civil Engineer, Traffic and Transportation Department, BMA	TF (Transport) /Technical
Mr. Choowet Senparn	Civil Engineer, Department of Public Works, BMA	TF (Energy) /Technical
Ms. Thipawan Saenchan	Urban Planner, Urban Development Planning Division, City Planning Department, BMA	TF (Green Urban Planning) /Technical
Namoiy Pradabphet, POL.SGT.MAJ.	Disaster Prevention and Mitigation Professional Level, Bangkok Fire and Rescue Department, BMA	TF (Adaptation Planning) /Technical
Mr. Panuwatt Ontes	Policy and Plan Analyst, Policy and Plan Division, Department of Environment (DOE), BMA	TF (Waste and Wastewater) /Technical

Table2-17 List of participants of the 2nd Study Tour

Name	Organizations	Groups/ Course level
Ms.Sarocha Roonsiri	Environmental Official Climate Change Office, Office of Natural Resources and Environmental Policy and Planning (ONEP)	WG (Secretariat)
Mr. Vichai Somboon	Chief of Project Management Section , Main System Development Division,	WG (Adaptation)

	Department of Drainage and Sewerage, BMA	
Ms. Chatraporn Kaewyont	Dissemination Technical Officer (Professional level) Department of Disaster Prevention and Mitigation (DDPM)	WG (Adaptation)
Ms. Thanaporn Kemdang	Environmentalist, Practitioner Level, Air quality and Noise Management Division, Department of Environment, BMA	WG (Secretariat)
Miss Hunsa Amattayakul	Civil Engineer, Department of Public Works, BMA	TF (Transport)
Ms. Kreufah Boondoung	Computer Technician, Traffic and Transportation Department, BMA	TF (Transport)
Ms. Supawan Intoon	Environmentalist, Air Quality and Noise Management Division, Department of Environment (DOE), BMA	TF (Energy)
Mr. Siriwat Thaisuriyo	Architect, Department of Public Works, BMA	TF (Energy)
Ms. Soysook Phongspul	Urban Planner, Urban Development Planning Division, City Planning Department, BMA	TF (Green Urban Planning)
Ms. Chanida Rodsawat	Agriculture Technical Officer, Public Parks Office, Department of Environment, BMA	TF (Green Urban Planning)
Ms. Wankaew Homnan	Sanitary Technical officer Solid Waste Hazardous Waste and Nightsoil Management Division Department of Environment, BMA	TF (Waste)
Ms. Suchada Bosup	Sanitary Technical officer Air Quality and Noise Management Division, Department of Environment, BMA	TF (Waste)
Ms. Pornapa Methaweewongs	Strategy and Evaluation Department, BMA	TF (Adaptation)

Mr. Keerati Sripramai, Dr. Eng.	Disaster Prevention and Mitigation Practitioner Level, Bangkok Fire and Rescue Department, BMA	TF (Adaptation)
Mr. Surart Jaroenchaisakul	Chief of Drainage System Development Sub-Division 3, Department of Drainage & Sewerage, BMA	TF (Adaptation)

Table2-18 List of participants of the 3rd Study Tour

Name	Organizations	Groups
Ms.Supaporn Wongwattanasiri	Plan and Policy Analyst Practitioner level, Agriculture, Natural Resource and Environment Planning Office	JCC
Mr. Thawatchai Somnam	Assistant Senior official, Strategy office, Thailand Greenhouse Gas Management Organization (Plucblic Organization)	JCC
Mr.Seksan Sangdow	Director of Planning Division, Air Quality and Noise Management Bureau, Pollution Control Department	JCC
Dr. Manaswee Arayasiri	Sanitary Engineer, Construction Design Office, Department of Public Works, BMA	Department of Public Works
Mrs. Waraporn K. Chantrapanon	Chief of Planning, Senior Professional Level, Bangkok fire and Rescue Department	WG
Mr. Ariyah Mekhakul	Chief of Building Engineer, Department of Public Works, BMA, (Team Leader)	TF (Energy)
Ms. NatnaresMacharoen (Nat)	Environmental Officer, Air quality and Noise Management Division, Department of Environment, BMA	TF (Energy)
Acting Sub Lt. Kangwan Chanprasert	Policy and Planning Analyst, Professional Level, Environment Strategy Sub-division, Public Health and Environment Strategy Division Strategy and Evaluation Department, BMA	TF (Energy)
Mr. Jakrapon Wannagul	Civil Engineer, Traffic and Transportation	TF (Transport)

	Department, BMA	
Ms. Sirilak Leerasiri	Chief of Database and Tariff Collection Sub-Office, Department of Drainage & Sewerage, BMA, (Team Leader)	TF (Waste and Waste water)
Mr.Pakpoom Suakham	Mechanical Engineer, Solid Waste Disposal Division, Department of Environment,BMA	TF (Waste and Waste water)
Ms. Panyalaln Thawonrat	Environmentalist, Air Quality and Noise Management Division, Department of Environment, BMA (Secretary)	TF (Adaptation)
Mr. Visnu Charoen	Civil Engineer Professional Level, Department of Drainage & Sewerage, BMA	TF (Adaptation)
Ms. Orapim Pimcharoen, Ph.D	Senior Urban Planner, City Planning Department, BMA	TF (Green Urban Planning)
Ms. Khwanchanok Sakkosit	City Planner, Urban Development Planning Division, City Planning Department, BMA	TF (Green Urban Planning)
Mrs. Warittha Chaimchirakun	Agriculture Technical Officer, Public Parks Office, Department of Environment, BMA	TF (Green Urban Planning)
Ms. Chuenjit Niyomjit	Policy and Planning Analyst Practitioner level, Policy and Planning Division, Department of Environment	Department of Environment

3. Approach to implementing the Project

(1) Approach to climate change issue for Bangkok as a local government

(a) GHG quantification and MRV for BMA

In the past, practices of GHG quantification were not common and limited to national GHG inventories submitted as part of national communications to the UNFCCC, and the clean development mechanism as a project based emission reduction mechanism, introduced under the Kyoto Protocol. As to GHG quantification at a city level, there are the GHG Protocol introduced by the World Resources Institute (WRI) in 2012, and local governments' mandatory planning on global warming prevention in Japan, introduced by the2014 amendment of the Act on Promotion of Global Warming Countermeasures, and gradually exemplar practices are increasing. However, these are mostly concentrated in developed countries, and it is still rare in local governments in developing countries.

In this regard, at the time of 2007, when BMA initiated the implementing the Bangkok Action Plan on Global Warming Mitigation 2007-2012 with quantified BAU emission and -15% emission reduction target against it, BMA's initiative can be said an extremely advanced and proactive endeavor. As to the GHG quantification in this Action Plan, there were some challenges such as ensuring the consistency in scopes of GHG emissions and quantification approaches, as well as access to information and data sources which are necessary for the measurement of GHG reduction *ex post.*

Based on these experiences and taking into account the lesson learned, in this Technical Cooperation Project, the following approaches were taken to the GHG quantification and MRV.

(i) Scope of matters of GHG emission

In the Technical Cooperation Project, the relationship of different GHG emission sources and BMA was first sorted out. The first category of GHG emission is those from BMA-owned buildings and facilities such as BMA offices, schools and hospitals, and public services operation by BMA, such as the Bangkok Transit System (BTS) or public buses. In other words, GHG emissions from them are directly attributed to BMA. The other category of the GHG emission is those from buildings and facilities in Bangkok area and owned by the private sector, national governments and others, such as private houses, shopping centers, office buildings, as well as the Mass Rapid Transit (MRT). While these emissions are not attributed directly to BMA, it is important to include in the scope of matters, since the share of such GHG emission shares a large part of the total emission, and it is important to address them, in order for Bangkok to become a low carbon city. Also, as a reference case, the Yokohama City Action Plan

for Global Warming Countermeasures also include GHG emissions attributed directly to the City as well as those attributed to those other than the city government, but located inside city geographically.

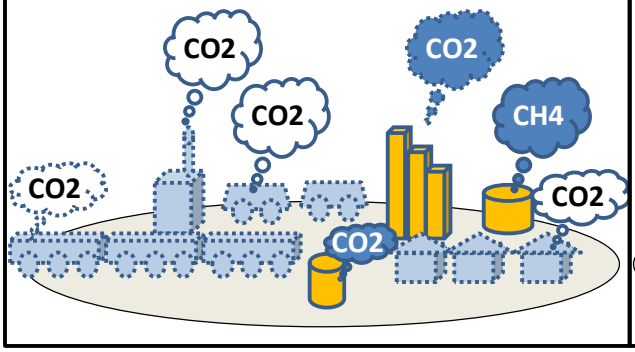
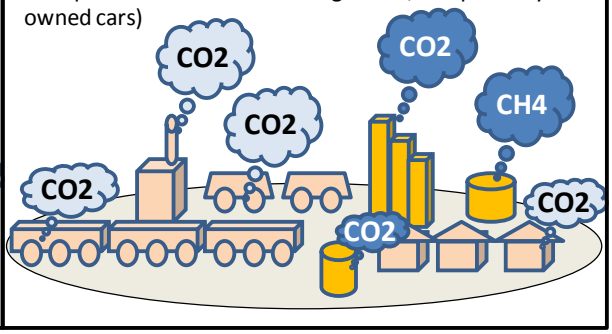
(1) BMA as a GHG emission entity	(2) BMA as a governmental entity that has GHG emission entities within its territory
Counts GHG emissions from public buildings, waste water plant, public schools, etc.. Does not count GHG emissions from buildings which are not owned by the BMA	In addition to the buildings owned by BMA, it counts entities built within the district controlled by BMA (including office buildings of private companies, public transportation facilities including metro, and privately-owned cars)
	

Table 3-1 Sorting out attribution of GHG emissions in/from BMA

(ii) Alignment with approaches and MRV methodologies taken by the national government

As provided in (i) above, emission sources in Bangkok area controlled by the national government , the private sector, and others are within the scope of coverage of the Master Plan, and therefore it is important that the Bangkok Master Plan should ensure the alignment with approaches and MRV methodologies taken by the national government. This is especially important and relevant since the Thailand Nationally Appropriate Mitigation Actions (NAMAs) were endorsed in the National Committee on Climate Change (NCCC) in November 2014, and later authorized by the Cabinet and communicated to the UNFCCC.

In Thailand NAMAs, there are a variety of mitigation actions and many of them are planned in Bangkok area. In terms of quantification, it refers to the Energy Efficiency Development Plan (EEDP, 2011-2030) and the Alternative Energy Development Plan (AEDP, 2011-2021) in elaborating a scenario in business-as-usual (BAU) and a scenario with implementation of mitigation measures. Since a large portion of mitigation actions in the transport and the energy sectors of the Bangkok Master Plan is shared by these NAMAs, when quantifying GHG in these sectors, the abovementioned national plans were used as the key references.

Also, in Thailand NAMAs, the national government set its mitigation target in 2020 according

to the UNFCCC Cancun Agreement (1/CP.16). In order to seek the consistency with the national target, as of the time of developing the Bangkok Master Plan, the mitigation target against its BAU emission is also set in 2020. Also, reference emission data (either actual results or estimation made in the past) were collected to estimate BAU emission in 2020, and the mitigation target was calculated by aggregating emission reduction to be realized by implementing respective mitigation measures under the Master Plan.

In case of the transport and the energy sectors, national statistical data are available, and the same data for the GHG quantification at the national level should be used also at Bangkok level. In this regard, in these sectors, estimated BAU emissions were calculated by proportionally dividing the national BAU into the scale of Bangkok, referring to its population and economic sizes (top-down approach). On the other hand, in the waste and wastewater and the green urban development sectors, activity data for GHG emission (such as amount of waste etc.) are available at project or entity level, so that the BAU in these sectors were calculating by aggregating the respective emissions and reflect estimated growth (bottom-up approach).

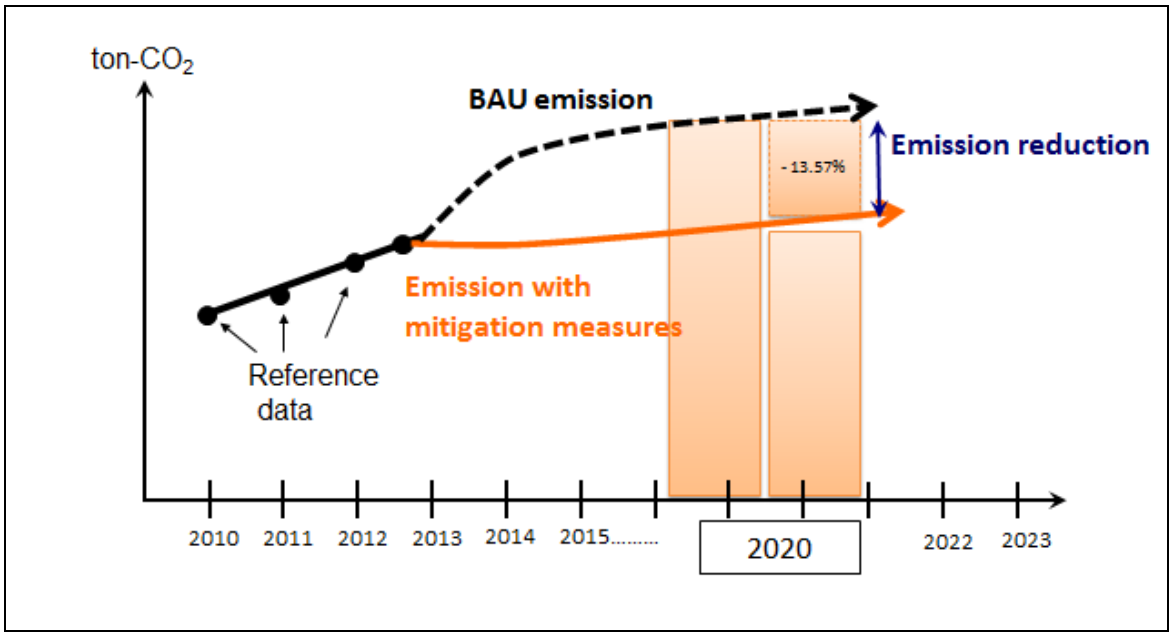


Figure 3-1 Conceptual diagram on GHG emission prospects in BAU and with mitigation measures

As to measurement, report, and verification (MRV), a simple methodology was taken (Emission reduction (absorption) = activity X emission factor). This is because the basic calculation for emission reduction should be based on simple multiplication. And in most cases they are not used for offsetting others emission, which are the case for the CDM and other market

mechanisms, requiring third party entity verification and complicated emission estimation methodologies. [1]

(b) Adaptation measures and M&E for BMA

Compared with mitigation, adaptation is a relatively new challenge, so has been for BMA. In many cases, in the area of adaptation, negative impacts of climate change occur to increase the intensity, the frequency, or the scale of existing natural disasters. For example, flooding has happened in the history of Bangkok time to time, however, the impact of climate change may cause a larger scale of flooding. In this regard, it is important for policy makers and administrators to start by stocktaking existing countermeasures to address such natural disasters, and assessing what are gaps made by climate change impact.

To this end, in adaptation planning, impact analysis was conducted, sorting out current problems and responses, and future problems and necessary responses, and based on that adaptation measures were planned. Also M&E was examined in order to check the progress of the implementation.[2]

(2) Alignment and coordination with the national government climate change policies

As abovementioned, the scope of the Bangkok Master Plan includes mitigation measures conducted by the national government, and statistical data from the relevant national plans were reflected to it. And in the sectors such as transport and energy, a major portion of the mitigation measures are shared by measures under Thailand NAMAs in terms of emission reduction quantity. While this may look an overlap, it is rather important to mention NAMAs conducted in Bangkok area, since BMA should also clarify how it may be able to contribute to smooth implementation of such mitigation actions, by providing supplementary support. BMA has a relatively better access to BMA citizens and consumers, and it should help government promote awareness of participating climate change actions. For example, in the national governments manage a part of road traffic control as well as public transportation in Bangkok area, BMA can promote the choice of a low emission type of transportation[3]

In order to enhance the alignment and coordination, BMA invited national government officials to the Steering Committee and the Working Group of the institutional arrangement. Also, in

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[1] For M&E and MRV of mitigation measures, tools (M&E sheet and MRV sheet) were developed in this Technical Cooperation Project, and provided a prototype.

[2] In case of adaptation, quantification approach is not necessary applicable, like mitigation. In this regard, M&E sheet was introduced only.

[3] Some of these are already in practice. While the Mass Rapid Transit (MRT) is operated by the government, in order to enhance the transfer from the Sky train (BTS)、connection corridors and escalators were built by BMA.

initiating sectoral consideration, the Task Forces started with stock-taking relevant existing plans and measures, including those by the national government, and sort out the relationship with measures to be included in the Master Plan. Further than that, the TFs coordinated individually with the relevant ministries and agencies to develop specific measures, with support by the JICA experts.

(3) Institutional arrangement for drafting and decision making for the Master Plan

For local governments in efforts to address climate change issues, one of the common challenge is how to deal with them through their existing administrative institution. In many cases, local government administration is highly segmented in departments and divisions, and in regular operation, most works are completed within their own realms of administrative areas. However, responses to climate change require coordinated and combined efforts across these different departments and divisions, and it requires strengthening institutional coordination setting and a work modality. For this purpose, in the Technical Cooperation Project, the below institutional arrangement was set up, in order to ensure a coordinated approach to drafting and decision making on the Master Plan.

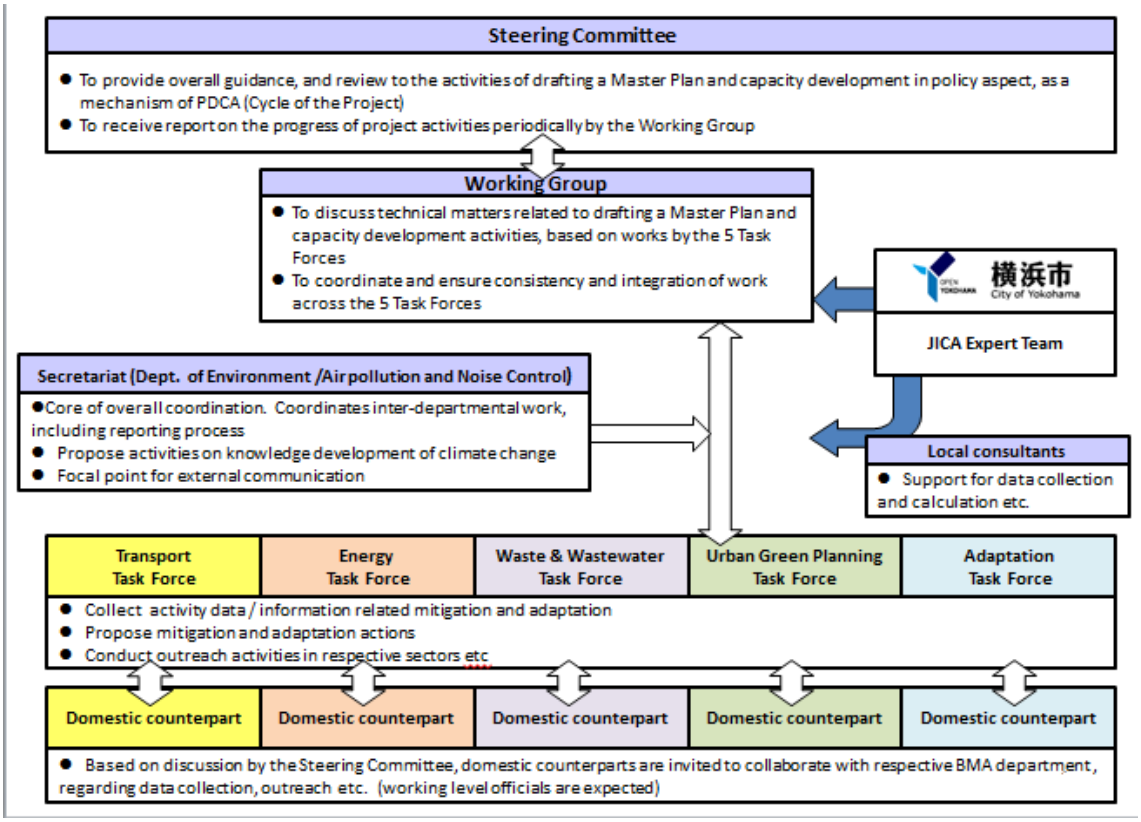


Figure 3-2 Institutional arrangement for drafting and decision making for the Master Plan

In this institutional arrangement, the following units were established with defined functions.

(a) Steering Committee

The Steering Committee (SC) is a higher forum to decide overall policy-level decision making, including authorization of the completion of the Master Plan for the Technical Cooperation Project. The SC was participated by BMA officials at the director-general, or deputy director-general level, and national government officials at the director level.

(b) Working Group

The Working Group (WG) ensures coordinated approach across the 5 different sectors, by providing opportunities for technical reviews and check progress of drafting work by the TFs. In the WG, working level officials from BMA and the relevant national government ministries and agencies, and they discussed technical aspects of mitigation and adaptation measures and MRV approaches.

(c) Task Forces

TFs were set up for transport, energy, waste and wastewater, green urban development, and adaptation planning as a unit to advance actual Master Plan drafting work, including BAU and target setting, elaborating mitigation and adaptation measures, developing M&E and MRV methodologies, and conducting outreach activities. In one TF, officials more than two BMA departments participated so that coordination at the working level was enhanced through TF activities as well. To support these activities, two JICA experts and one local consultant were dispatched per TF. Also experts from the City of Yokohama also had occasion of meetings to exchange of information

(d) Secretariat

To enable the SC and the WG to function as fora for discussion, it is necessary to set a unit to prepare and manage them. In this regard, a secretariat was established in the Department of Environment. In this Technical Cooperation Project, the Secretariat functioned also as the direct counterpart body, and in cooperation with the JICA experts, it took a lead to organize and implement overall activities for drafting the Master Plan.

While this institutional arrangement was set up for the purpose of implementing the Technical Cooperation Project, it was also intended to provide a foundation for the implementation of the Master Plan itself.

(e) Sharing experiences of Japanese local governments

Due to the policy guidance and requirements by the Act on Promotion of Global Warming Countermeasures, many Japanese local governments have experiences with climate change planning and its implementation. In such planning documents, there are common elements as well as their original characteristic demise. At the beginning of the Technical Cooperation Project, a review study was conducted taking the cases of climate change plans of London, New York, Stockholm, Los Angeles, Tokyo and Yokohama, together with other Japanese cities as exemplar cases. As common elements, most cities included impacts of climate change on those cities and their own GHG emission today and in future, visions for a low carbon and climate change-resilient society, quantitative emission reduction targets, measures to achieve such targets. In this sense, it was clear that the Bangkok Master Plan should include these elements as well.

At the same time, in case of the Yokohama City Action Plan for Global Warming Countermeasures, a strong focus was given to proactive engagement and mobilization of the private sector and citizens, and perspectives to future urban development and management. Also in case of Mie Prefecture, Japan, adaptation aspects were highlighted, by setting priorities among from their many challenges. These experiences were very useful in taking consideration on BMA's approaches to climate change policy and more specifically in developing mitigation and adaptation measures. For this reasons, Yokohama City officials were dispatched to BMA several times to introduce their experiences at the SC, WG, and TFs. Also at the time of the Study Tour to Japan, BMA officials visited Yokohama and Mie.

(f) Capacity building

Throughout the process of developing the Master Plan, BMA officials had opportunities for capacity building to enhance their understanding on technical matters, such as basic process of developing a climate change plan ("Seven steps to develop the plan"), concept of BAU and emission reduction, and GHG quantification etc. By conducting exercise type activities for calculating GHG, and developing mitigation and adaptation measures, BMA officials acquired logics and rationales of key technical matters.

Also, increasing their capacity for outreach to the public is extremely important, given the fact that climate change actions require active mobilization of stakeholders. In this regard, the TFs planned and organized several outreach events by themselves, and experienced with how to approach to the private sectors and other key stakeholders.

(g) Study tour to Japan

During the Technical Cooperation period, BMA participated in the study tour to Japan 3 times to learn policy and technical themes relevant to the Master Plan on climate change.

In the 1st tour, BMA officials participated in the "Smart City Week" organized in Yokohama. In this event, they were exposed to active discussion by local governments in Japan and other parts of the world, on how to build a low carbon and climate change-resilient cities, and it was useful to initiate considering future visions included in the Master Plan. In the second tour, the major focus was on adaptation. For this BMA officials visited Mie Prefecture, and engaged themselves in discussion with the local government officials, exchanging their actual challenges and how they coped with such challenges. The third study tour was conducted in April 2014. Since the political turbulence of Thailand from November 2013, visit by the JICA expert team was temporarily suspended and the delay of the project was a challenge. In order to cover the gap and expedite process, the third study tour functioned as a master plan drafting workshop, participated by working level officials by BMA and the national government. In this occasion, critical aspects of the Master Plan, such as institutional arrange, M&E and MRV, outreach to the private sector and citizens were discussed and the result of the elaboration were brought back to Bangkok for the following session of the WG and SC.

Opportunities of study tour functioned to enhance motivation for BMA officials. Through the exposure to advanced information and knowledge on climate change policies in Japan, many BMA officials raised their awareness, and after returning home, their engagement in the master plan development became stronger in many cases. Also, by having officials in different departments of BMA, as wells as the government, the study tour enhanced the communication between them. It was especially useful after returning home, in following up actions.

4. Outputs from the Project

(1) Completion and approval of the Bangkok Master Plan on Climate Change 2013-2023

The major output of the Technical Cooperation Project is completion and approval of the Bangkok Master Plan on Climate Change 2013-2023. After the 2.5 years project period, the draft was given a basic approval of the contents by the 5th Joint Coordinating Committee/Steering Committee on July 22, 2015, pending the final internal formal process within BMA.

The major contents of the Bangkok Master Plan on Climate Change 2013-2023 are as follows;

1. Climate change as a largest threat for human society

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.

2. Bangkok and climate change

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.

3. 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.

4. 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.

5. GHGs emission prospects and mitigation targets under the Bangkok Master Plan

BMA set the following mitigation targets in 2020, which is consistent with Thailand NAMAs submitted by the central government to the UNFCCC.

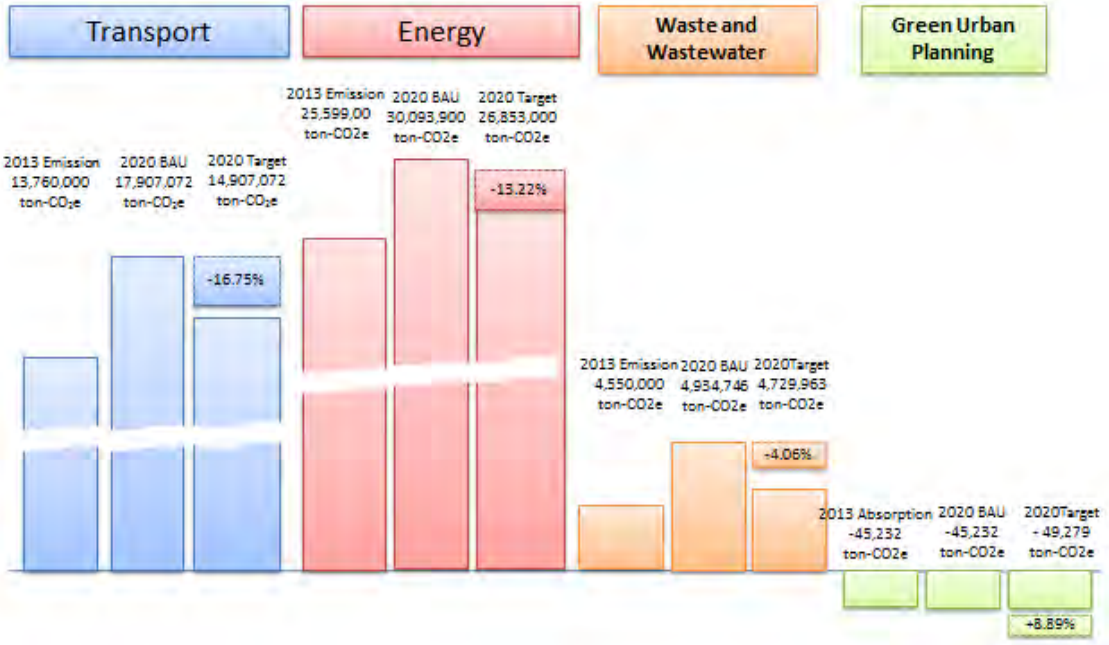


Figure 4-1 GHG emission in 2013 and BAU emission and mitigation targets in 2020 (by Sector)

Table 4-1 Comparison of GHG emission in future in different scenarios in 2020[4]

Unit million t-CO_2e

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%)

[4] 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 CO_2 absorption by expanding green areas.

6. 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.

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) and External Partners。

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

In order to keep the track of implementing mitigation and adaptation measures, the Master Plan sets a common approach to M&E. For mitigation measures, GHG reduction will be quantitatively assessed through MRV.

9. Roadmap for implementation

The implementation of the Master Plan will be managed not only short but mid- and long-term perspective according to the roadmap. Also, in order to review the implementation, in 2017, a mid-term comprehensive review will be conducted.

10. Capacity building and outreach

Since climate change mitigation and adaptation requires not only BMA's own actions but also a wide range of stakeholders' participation, it is important to advance capacity building and outreach to them. Also in future, it is expected that experiences of Bangkok will be also shared and transferred to other ASEAN cities, in cooperation with partner cities such as Yokohama.

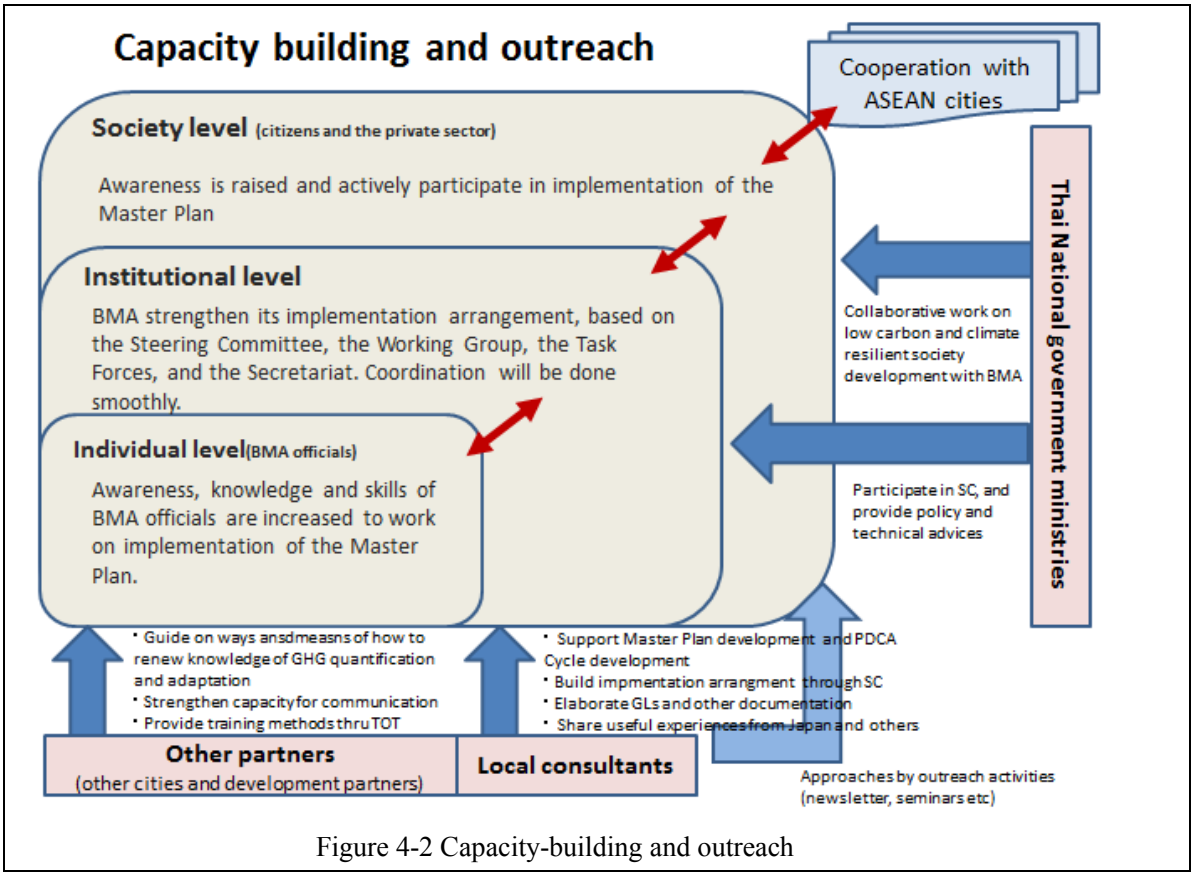


Figure 4-2 Capacity-building and outreach

(2) Increased BMA's capacity to implement the Bangkok Master Plan on Climate Change

As mentioned above, capacity building was also one of the focuses of the Technical Cooperation Project, and positive results have been found.

At the individual level of BMA officials, they came to understand the basic knowledge about climate change and understand how BMA as a local government should deal with climate change issue. This change of awareness has provided a vital foundation to accelerate their efforts to learn other technical part of climate change issues, such as GHG quantification and MRV, as well as vulnerability assessment and adaptation planning.

At the institutional level, the obvious result is that the institutional arrangement has been established and regularly operated. When officials try to work in a voluntary way, the SC, the WG, and the TFs, as well as the Secretariat have provided their vehicles and relevant actions have been made. In future, more work for M&E and MRV are waiting. In that case, additional capacity building should be necessary to operationalize such M&E and MRV. Especially the techniques of ex post MRV are yet to be learned by BMA officials. So that such technical support may be very appropriate in the next step.

Capacity-building at the society level is not an essential coverage of the Technical Cooperation Project in its project design. However, considering the importance of stakeholders' involvement, some activities were conducted. For example, in the final process of the Master Plan development, a stakeholder meeting was organized in order to collect their review comments. Also, after that, an open seminar was organized to mobilize and enhance involvements and voluntary commitments by the citizens, the private sectors, etc. While these are still at the embryonic stage, it is significant that BMA and stakeholders initiated working on the Master Plan.

(3) Other outputs

After the start of the Technical Cooperation Project, the attention to the Joint Crediting Mechanism (JCM) became higher. In case of Thailand, the Ministry of the Environment, Japan conducted feasibility studies on the JCM accelerating the implementation of the Bangkok Master Plan on Climate Change. The JICA's Technical Cooperation Project provided an important platform for stakeholders, including BMA, Yokohama, as well as Thai and Japanese private sector organizations in efforts to advance mitigation measures.

The activities in detail were described by 5 sectors in the following sections.

5. Sectoral activities

(1) Environmental sustainable transport

(a) Background on the transport sector in Bangkok

In Bangkok, a number of registered vehicle has been increasing and reached 8.65 million in 2014. Due to the shortage of public transport and inadequate road network, the traffic congestion is still in the serious situation.

In addition to that, with the presence of old-style vehicle, GHG emissions from transport sector in Bangkok is very large as about 13.7 million tCO_2 in 2013. Approach from the side of climate change has become an important issue.

Under such circumstances, OTP (Office of Transport and Traffic Policy and Planning) has developed the Environmental Sustainable Transport Master Plan, and has decided to promote some of measures as NAMA, and most of the measures are in Bangkok or Bangkok area.

On the other hand, BMA developed the "Action Plan on Global Warming Mitigation 2007 - 2012" and has been promoting the approach such as introducing public transportation and effort to reduce traffic congestion.

(b) Sectoral counterpart (support target) and related organization

Establish a Transport Task Force formed by Traffic and Transportation Department of BMA and Environment Department of BMA to develop the Master plan and carry out outreach activities. And conduct a periodical discussion with OTP as the relevant government organization, particularly on national policy and cooperation. Furthermore, regarding the activity of Transport Task Force, Dr. Jakapong Porigthanaisawan from National Science Technology and Innovation Policy Office and Dr. Kerati from PSK consultants conducted data collection and technical support as local consultants.

(c) Detailed activity and results

(i) Quantification of the GHG (BAU and reduction target)

(i-1) Current status of GHG from the Transport Sector

(i-1-1) Scope of Emission

CO_2 emissions associated with transportation activities (road, railway, waterway) within BMA administrative area, also emissions associated with BMA owned vehicles.

(i-1-2) Methodologies for Calculation

<u>Road</u>

CO_2 emission from road sub-sector (motor vehicles) is calculated multiplying "Fuel consumption from road sub-sector in Bangkok by fuel types" by "CO_2 emission factor by fuel

types (per liter etc.)". The methodology is based on "2006 IPCC Guidelines for National Greenhouse Gas Inventories". CO_2 emission from combustion of biofuel is accounted as zero. As for High Speed Diesel (HSD) fuel, the blending ratio of biodiesel (B100) is assumed as 6 %. "Fuel consumption from road sub-sector in Bangkok by fuel types" is provided by the Ministry of Energy, Thailand. "CO_2 emission factor by fuel types" is calculated by "CO_2 emission factor by fuel types (per energy unit)" provided by IPCC and "Net calorific value by fuel types" provided by the Ministry of Energy Thailand

Railway

Railways include MRT (Blue line), Skytrain and ARL (Airport Rail Link). CO_2 emission from railway sub-sector is calculated multiplying "Electricity consumption of MRT and Skytrain in Bangkok" by "CO_2 emission factor of the grid electricity". "Electricity consumption of MRT and Skytrain in Bangkok" can be obtained from the companies of MRT and Skytrain. "CO_2 emission factor of the grid electricity" is provided by the local expert of the project.

Waterway

Waterways include Chaophraya river ferries (operated by three companies) and canal boats (SaenSaep canal extension and Phasricharoen canal). CO_2 emission from waterway sub-sector is calculated multiplying "Fuel consumption of waterways" by "CO_2 emission factor of the grid electricity". "Fuel consumption of waterways" can be obtained from the companies of waterways. "CO_2 emission factor by fuel types" is calculated by "CO_2 emission factor by fuel types (per energy unit)" provided by IPCC and "Net calorific value by fuel types" provided by the Ministry of Energy Thailand.

BMA owned vehicles

CO_2 emission from vehicles owned by BMA is calculated multiplying "Fuel consumption from road BMA vehicles by fuel types" by "CO_2 emission factor by fuel types (per liter etc.)". CO_2 emission from combustion of biofuel is accounted as zero. As for HSD fuel, the blending ratio of biodiesel (B100) is assumed as 6 %. "Fuel consumption from road BMA vehicles by fuel types" is available monthly from the responsible department of BMA. "CO_2 emission factor by fuel types" is calculated by "CO_2 emission factor by fuel types (per energy unit)" provided by IPCC and "Net calorific value by fuel types" provided by the Ministry of Energy Thailand.

(i-1-3) Result of Calculation

CO_2 emission from the road sub-sector in 2013 within BMA administrative area is estimated as shown in Table 5-1-1. CO_2 emission from the transport sector in BMA administrative area in

2013 is 13,693,732 tCO_2/year. Diesel fuel has the highest share, 32.7%, and natural gas is the 2nd highest proportion, 30.6%. The proportion of gasoline fuel including gasoline, gasohol E10, gasohol E20 and gasohol E85 is 24.9%. LPG is 11.8%.

The result indicates that, in Bangkok, fuel shifts from high carbon intensity fuel such as petroleum based gasoline and diesel to low carbon intensity fuel such as natural gas and biofuel-blended gasoline are well progressed. If such low carbon fuel is not used, the total emission from the transport sector in BMA administrative area would have been much higher.

Table 5-1-1 CO_2 emission from the road sub-sector in 2013 within BMA administrative area in 2013

Fuel types	CO_2 emission (tCO_2/year)
Natural Gas	4,193,268
LPG	1,622,395
Gasoline	216,030
Gasohol E10	2,815,147
Gasohol E20	358,616
Gasohol E85	17,177
Diesel (HSD)	4,471,099
Total	13,693,732

CO_2 emission from the railways in 2013 in Bangkok is estimated as shown in Table 5-1-2.

Table 5-1-2 CO_2 emission from the railways in Bangkok in 2013

Lines	CO_2 emission (tCO_2/year)
BTS	39,369
MRT (Blueline)	12,991
ARL (Airport Rail Link)	N.A.
Total	52,360

CO_2 emission from the waterways in 2013 in Bangkok is estimated as shown in Table 5-1-3.

Table 5-1-3 CO_2 emission from the waterways in Bangkok in 2013

Lines	CO_2 emission (tCO_2/year)
Chaophraya river ferries*1	8,200
Canal boat*2	3,301
Total	11,501

*1: Operated by three companies, Chaophraya Express Boat Company, Sap Thananakorn Ltd. and Supatra Ltd.

*2: Include Saen Saep canal extension (11 km, 9 station) and Phasricharoen canal (11.5 km, 15 station)

CO_2 emission from the BMA owned vehicles is estimated as shown in Table 5-1-4.

Table 5-1-4 CO_2 emission from the BMA owned vehicles in 2013

Fuel types	CO_2 emission (tCO_2/year)
Gasoline (ULG91)	7,688
Diesel (HSD)	87,534
GASOHOL E10	1,421
Total	96,643

* Emissions from garbage trucks are included.

* The emission is also counted in the emission within BMA administrative area

(i-2) Business-as-Usual (BAU) Emission of the Transport Sector

(i-2-1) Scope of Emission

Future (BAU) CO_2 emissions associated with transportation activities (road) within BMA administrative area.

* Railways and waterways are excluded in estimating the increase rate of the BAU emission, because of simplification since these emissions are very low (less than 1% compared to road transportation).

(i-2-2) Methodologies for Estimation

The BAU emission is estimated by multiplying “Current emission (year 2013)” by “Increase rate of BAU emission”.

“Current emission (year 2013)” is described in (a). “Increase rate of BAU emission” should be set using appropriate parameter. Basically, CO_2 emission has high correlation with energy consumption, therefore, in this estimation, “Increase rate of BAU energy consumption in transport sector” is applied for “Increase rate of BAU emission”. One of the well-known data is

provided in “Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy”. The plan estimated future energy consumptions by 2030 by sectors in Thailand as shown below (Figure 5-1-1).

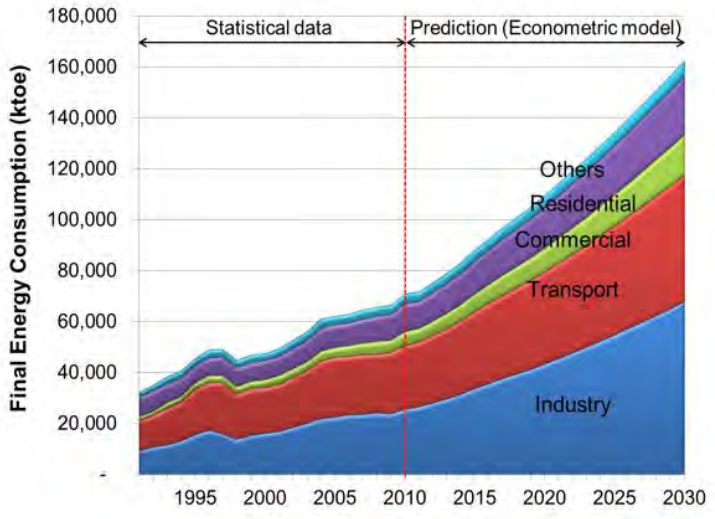


Figure 5-1-1 Future (BAU) energy consumptions by 2030 by sectors in Thailand (Source: ”Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy”)

(i-2-3) Result of Calculation

Future (BAU) CO_2 emissions associated with transportation activities (road) within BMA administrative area is shown in Figure 5-1-2. Total GHG emission in BMA is projected to increase from 13.7 million tons of CO_2 in 2013 to 19.8 million tons of CO_2 in 2023.

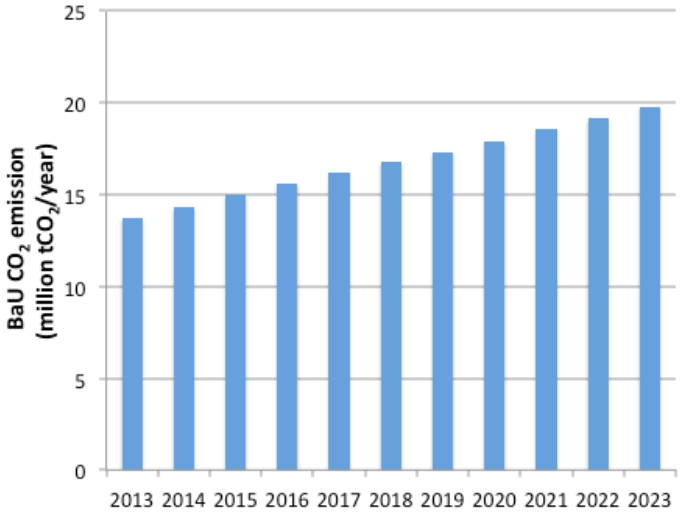


Figure 5-1-2 Future (BAU) CO_2 emissions associated with transportation activities (road) within BMA administrative area

(i-3) Reduction target

(i-3-1) Concept of target setting

Considering transparency of target setting methodology and in view of the explanation to the many stakeholders, it was decided to comply with the reduction target of the transport sector of country (OTP) (top-down approach). Dividing OTP target value (Thailand national reduction target 12 million tCO_2/ year) by the appropriate indicators to the BMA administrative area.

(i-3-2) Method of target setting

The ratio of fuel consumption (energy base) of transport sector in Bangkok and Thailand is used as the indicator to divide the OTP target value as relevant indicator to CO_2 emissions.

(BMA emissions reduction target) = (emission reduction target of Thailand) × (dividing ratio)

- National emission reduction target : 12 million tCO_2 / year (2020) (16% reduction compared with BAU)
- Dividing ratio : 25% (ratio of fuel consumption (energy base) of the transport sector (Bangkok) / national (three year-average of 2011-2013)) (using the data from Ministry of Energy)

(i-3-3) Target value

The target value is calculated as 3 million tCO_2 by the above calculation formula and parameters (Figure 5-1-3). This is a 16.8 % reduction rate compared with BAU emissions 17.91millon tCO_2 of 2020.

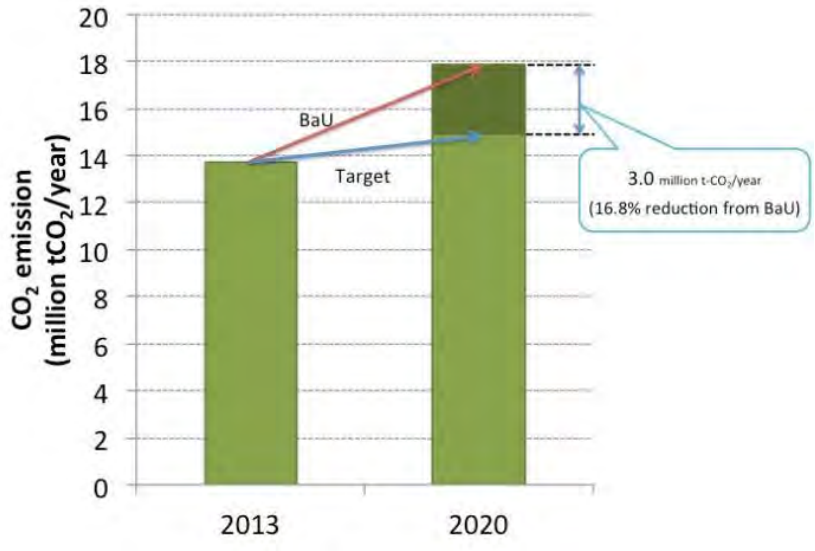


Figure 5-1-3 BAU emissions in 2020 and emission reduction

(i-3-2) Reference: GHG emissions reduction target of Thailand at the national level

EST Master Plan

In the Thailand Environmental Sustainable Transport Master Plan (EST master plan) of Ministry of Transport of Thailand, it has been setting the following GHG emissions reduction target for transportation sector of Thailand.

* Calculating emission reductions of each countermeasure by the traffic model and adding up these data.

Table 5-1-5 GHG emissions reduction target for transportation sector of Thailand

Year B.E. (A.D).	GHG Emissions(CO_2) in Transport Sector BAU (million tons CO_2e)	Potential for GHG Emissions Reduction in Transport Sector		Target in GHG Emissions Reduction in Transport Sector (based on 80% of potential)	
		(million tons CO_2e)	(%)	(million tons CO_2e)	(%)
2548 (2005)	57.52	-	-	-	-
2560 (2017)	67.35	11 – 13	16 – 19	10	15
2563 (2020)	**74.02**	**15 – 16**	**20 – 22**	**12**	**16**
2573 (2030)	102.82	27 - 30	26 - 29	23	22

Source: Thailand Environmental Sustainable Transport Master Plan, OTP.

* As for the **Target** of the Master Plan of GHG emissions reduction in the transport sector, it is considered that the reduction should be in line with energy saving target of the next 20 years i.e. approximately 80% of the potential value of each year as listed in A above.

* Annual average expected CO_2 emission reduction in the 20-year period (2011-2030) of EEDP is 20 million tons (p.4-14 of EEDP (Thailand 20-Year Energy Efficiency Development Plan (2011 - 2030))).

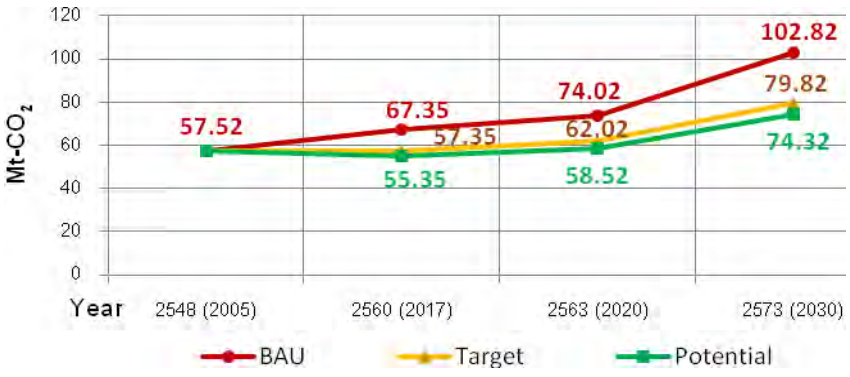


Figure 5-1-4 BAU and reduction target in OTP EST master plan

NAMA

Draft of emissions reduction target of the transport sector in Thailand's NAMA is a 12 million tCO_2 / year in 2020. It is based on the 2020 target on the EST master plan.

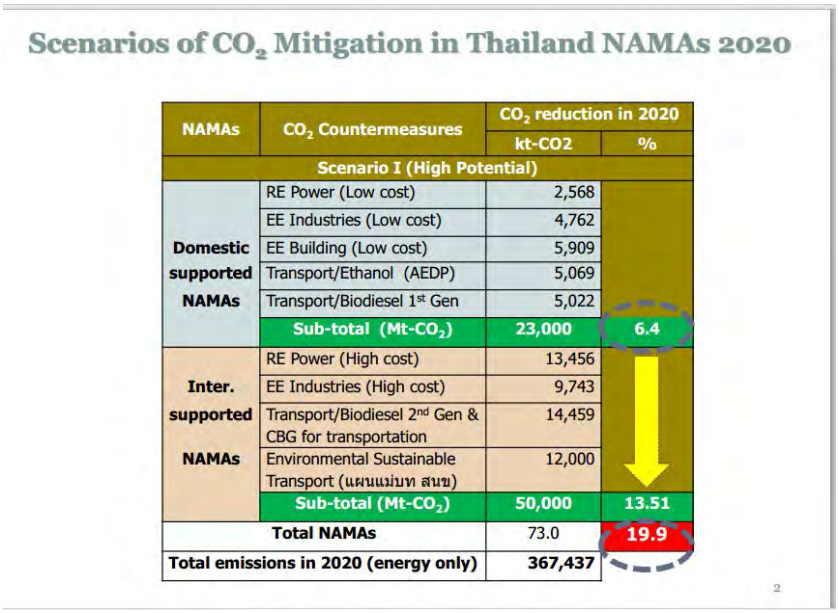


Figure 5-1-5 Thailand's NAMA reduction targets

(i-4) Explanation and awareness in the process of quantification work

Regarding the quantification of emissions, especially for emissions from whole Bangkok administrative area, BAU emissions and calculation of emission reduction target, considered the method which BMA staff can calculate by themselves as much as possible, and it can be secured reproducibility and objectivity and continuity.

Since statistical data is not enough in Thailand and Bangkok, all emission sources are not covered, however results that includes a major emission sources were obtained.

Regarding the Bangkok Port and the Don Muang Airport, these facilities are managed by the government and relatively closed boundary, and also individual measures have been promoted by themselves. Therefore these facilities are not included in the scope.

Calculation of whole emissions including these facilities are future challenges.

Also, towards the development of emissions inventory of Bangkok and other local governments, guidelines or guidance which are in line with the actual conditions based on the available information and data are needed.

(ii) Development of mitigation measures in the transport sector

In Bangkok, means of transportation of people are extremely dependent on the motor vehicles, modal share of public transport (railway) is a very low.

Therefore, it is important to aim high modal share of railway by creating an environment that is easy to use public transportation including railway, bus and waterway by promoting the development of public transport infrastructure (rail, etc.).

Also it is effective to perform in consistence with the climate change measures along with the air pollution control by promoting the vehicle-individual measures such as introduction of low-emission vehicles.

In addition, in order to solve traffic congestions which is a big challenge of Bangkok, promote the construction of roads and bridges and the improvement of traffic flow by improvement of signal etc., achieve a reduction of greenhouse gas emissions furthermore.

And it is necessary to continue educational activities to raise awareness of citizens concerning transportation and climate change.

Figure shows the overall aspects of the transport sector of the mitigation measures.

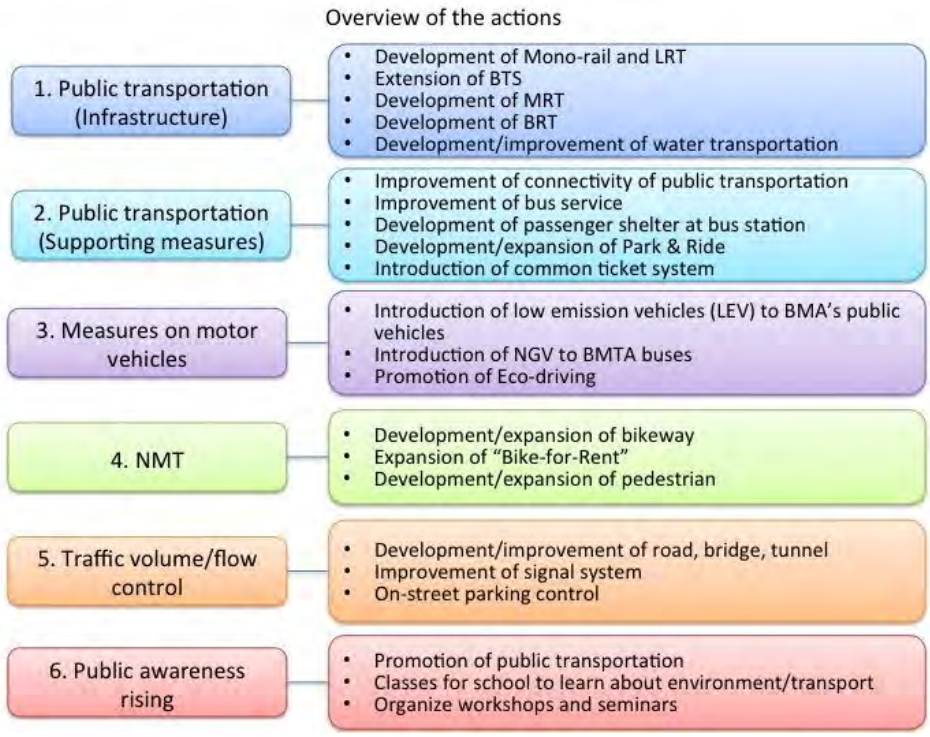


Figure 5-1-6 overall aspects of the transport sector of the mitigation measures

Among the measures shown in Figure , the "Development of Mono-rail and LRT (development of the Monorail and LRT)" is shown in detail in the table below.

This measure is monorail and LRT planned to implement mainly by BMA. Especially gray line with total length of 26 km is most important measure from a point of view of public transport development and it is set as a high-priority measure in the BMA Transport Department.

Title	Development of 3 monorails and 1 LRT lines
Details	- Monorail: Gray line (Watcharaphon - RAMA IX): 26 km, 21 stations, Along the Pradit Manutham Road, and connecting between Watcharaphon Road and RAMA IX Road.  - Monorail: Ramkhamhaeng University - Soithonglo line: 11.1km, 6 stations - Monorail: BMA hall 2 - Victory monument - Yothi road: 6.5km, 7 stations, Prachasongkhor Road, Dindaeng Road, Ratchaprarop Road, Yothi Road. - Light rail: Bangna - Suvarnabhumi: 15.3km (extend 3km), 12 station (extend 2), Along the Bangna trad Road 
BMA's Responsibility	Direct
Stakeholders	BMA (KT)
Implementation schedule	Mid to long term
Estimated GHG	*Emission reduction of the Grey line is included in 1-3.

emission reduction	N/A for other lines.
Comments	- 5 development plans of Monorail are in the planning stage now. - Feasibility study for Gray line has already done. The project of Gray line is high priority one. - The feasibility studies for another 4 lines have already done also. - Grey line is approved under M-MAP. - Other 3 lines are already approved by the cabinet.

(iii) Capacity building for the BMA staff

(iii-1) Study session for the emissions calculation

Study sessions regarding the emissions from the transport sector (whole BMA administrative area and BMA owned vehicles), BAU emissions and calculation methods of mitigation target were conducted at the TF meeting.

BMA staff learned about the necessary data and information for the calculation and calculation formula including basic ideas referring the case of Yokohama City. Moreover, for the emission reduction of typical measures (MRT, eco-driving, etc.), It was carried out to calculate the specific case using Excel. As a result of those study sessions, Bangkok staff understood the basic matters about concepts of emission, emission reductions and calculation.

(iii-2) Visit to facilities related to transportation in Yokohama City on the study tour for Japan

During the training course in Japan, the person in charge of BMA's traffic sector observed various facilities related to improvement/facilitation of public transportation in Yokohama Station etc, (ticket gate system, ticket vending machines, transfer guide, etc.), Yokohama Seaside line, small electric car sharing and so on. In particular, visits in relation to the convenience of public transportation were very significant for study of measures in the master plan because improvement of the user-friendliness of railways in Bangkok is one of the problems.

(iv) Outreach activities and public awareness

As outreach activities, the following events were implemented in high school and junior high school in Bangkok.

Name : Road Show on Climate Change
Venue : Matthayom Banbangkapi School (http://www.mbp.ac.th/),High school
Date : 16 July 2015
Time : 9.00-10.30 AM
Target : High school Students with teacher and other school staff (300 person)
Organizer : Traffic and transport Department,BMA

Objective :

1.To provide participants a knowledge and understanding about climate change, climate change effect, transport and environmentally transportation

2. To raise awareness and help prevent environmental problems with an emphasis on practice of reducing emission in the transport sectors.

Activites:

1. Describe about climate change, climate change effect, transport and environmentally transportation
2. Q & A
3. Games such as let participant sort transport from past to present in Bangkok,or let participant think about measure to prevent the climate changes

Created the following panel on transportation and climate change for the dissemination activities, it was also used in the above-mentioned outreach activities.

(d) Lessons learned and future tasks

(i) Lessons learned

<u>Ownership of BMA Transport Bureau staff</u>

Task Force members of the BMA side (5 people) were ambitious and actively participated in the development activities of the master plan. On the other hand, each person tends to be busy in

routine work of their department. Persons who were continuously participated in the development activities of the master plan were limited but avid to learn about knowledge of climate change. As a characteristic of the business of local government, it seems to be difficult to place a plurality of people as climate change in charge in order to tackle the issues, because the role of the individual operations are clearly given.

Cooperation with BMA relevant departments

In order to implement the master plan effectively and efficiently, it is essential to cooperate with the department of environment which is a main responsible department for the master plan. However, the involvement of the department in development process of the master plan (traffic part) is not always enough. It should have been in closer cooperation.

A similar problem is also seen at the time of the development of a master plan of the Japanese local governments. It is desirable to provide for implementation of the master plan taking advantage of lessons learned in Japan

Cooperation with other organizations

In the implementation of the traffic measures in Bangkok, the government are involved in many cases such as maintenance of MRT. A substantial number of measures such as NAMA of the transport sector will be implemented in Bangkok. For this reason, building good cooperation with the government (especially OTP) and ensuring the integrity of various measures are very important. In this study, obtaining a consensus and establishing the foundation of cooperation for the implementation of master plan in the future by conducting close consultation with OTP.

Consideration of measures

In the transport sector of the BMA, a number of traffic measures has already been implemented. A lot of measures have already planned for the future. These are not focus on climate change. However, many of them will result in the reduction of greenhouse gas emission. It has been extremely important that how efficiently extract the measures that have already planned and evaluate them from the viewpoint of the climate change aspect under the cooperation with the BMA. In addition to them, established a more extensive measures by proposing new measures.

Emissions calculations

In Japan, local government implements the calculation of emissions in accordance with "Manual of developing execution plan of global warming measures for local government " presented by the Ministry of Environment of Japan. Since such guideline and manual have not been developed in Thailand, the calculation method in accordance with the actual situation of the

statistical data of the BMA had been used. In the future, when other local governments in Thailand performing the emission calculations, developing standardized calculation guidelines are necessary in order to facilitate the calculation by each municipality.

A series of results

In this study, we developed the master plan in logically and in stages taking advantage of the knowledge and experience of Yokohama City along with implementing the capacity building of the BMA staff. In developing countries, a very few local governments has developed systematic and detailed plan as this climate change master plan. Therefore at all points of development process, this master plan could be a reference for a city of another countries in the future.

(ii) Future tasks

The necessity of a cross-sectoral department/function on climate change

The climate change measure is not a core business of the local government until now. For this reason, local governments in Japan had faced a big problem over 10years on which department will be in charge and whether to promote towards the efficient and effective implementation. Therefore, it is necessary to address a cross-sectoral department/function on climate change that specializes in climate change measure to be able to promote the M & E and MRV properly with the initiative by each department (Department of Transportation, Department of Urban city etc.). At this point, further support taking advantage of Japan's experience will be needed.

Cooperation with other organizations

As previously mentioned, in order to implement the traffic policies effectively in Bangkok, it is essential for a close collaboration with the government (especially OTP). Particularly for measures such as railway (MRT etc.) and NMT (bicycle use promotion), continuous discussions between the government and BMA about more effective capable way because these measures are implemented in Bangkok area by the government and BMA each. And it is also required consultation and coordination with the agencies such as MRTA and SRT which are an implementation body of these measures

Implementation method of each measures

Most of traffic measures that incorporates including in the climate change master plan are able to implement with the human and financial resources of BMA. However, appropriate support will be needed in order to implement as planned because a lot of measures are included in the master plan. For example, for a software side, it requires the establishment and revision of the

institutions and the regulations in BMA in order to introduce low-emission vehicles as BMA owned vehicles, Japanese experience such as Yokohama City can be introduced.
On the hardware side, especially for infrastructure development such as MRT and vehicle improvement, it will be able to facilitate the implementation by considering the possibility of various financial support from public and private sectors. In addition, support for MRV of each countermeasure from Japanese side is necessary because there is no accumulation of know-how in the BMA transport department at this moment.

(e) Reference materials

Table 5-1-6 WG Related Documents

Material	Items
1st WG presentation materials (September 2013)	- Progress report - Workshops report - Method of calculation of emissions, etc.
2nd WG presentation materials (May 2014)	- Measures list - Details of the measures, etc.
3rd WG presentation materials (October 2014)	- Emissions calculation method / result (current situation, BAU) - Measures structure - Details of the measures, etc.
4th WG presentation materials (January 2015)	- Emissions calculation method / result (current situation, BAU) - structure of measures and details - M & E, MRV - draft of Outreach activities, etc.
5th WG presentation materials (May 2015)	- Emissions calculation method / result (current situation, BAU) - Emission reduction targets - Structure of measures, etc.

(2) Energy Efficiency and Alternative Energy

(a) Background of the energy sector

Construction of large commercial facilities and office buildings are increasing continuously in Bangkok because of its rapid economic growth in recent years. It brings energy demand increase, especially in electricity demand.

The energy related policies in Thailand indicate directions to introduce renewable energy, promote energy saving, "Waste to Energy" and various actions have been implemented. On the other hand, Bangkok has limited area for the installation of renewable energy equipment and it means energy saving is the most feasible activities in Bangkok.

Department of Energy of Thailand has established the 20-Year Energy Efficiency Development Plan (EEDP). It has been put into operation to implement energy usage reporting obligation by large-scale buildings and subsidy for energy conservation. Bangkok Metropolitan Administration (BMA) has implemented a survey of energy usage in more than 700 of its own public facilities and a cost effectiveness simulation about energy saving renovation of the sampled facilities. In addition, BMA is planning energy saving renovation for its government office buildings.

(b) Sectoral counterpart and relevant organizations

The Energy Task Force (TF) was established for drafting the Master Plan and conducting outreach activities in the sector. The TF members were invited from the Department of Public Works, the Department of Strategy and Evaluation and the Department of Environment. To support data collection and elaborating mitigaion measures, Dr. Wongkot, Associate Professor, the University of Chiang Mai was assigned as a local consultant to support the Energy TF members as well as to collect and analyze the data. He has been involved in the development of greenhouse gas (GHGs) inventory and various master plans for the government of Thailand and familiar with information and actions in the energy sector.

(c) Activities and outputs

(i) GHG quantification (BAU and mitigation target)

◆ Scope of Emission

The Energy TF surveyed GHG emissions by energy consumption in the administrative boundary of Bangkok. The covered facilities were divided into two categories, namely, "BMA direct" meaning emissions from BMA owned facilities (BMA government buildings, schools, hospitals, etc.) and "Entire area of Bangkok" means emissions from Non-BMA facilities such as residential/household, commercial/business and industrial/manufacturing buildings located in Bangkok.

Energy consumption data was collected about electricity and fossil fuel (oil, natural gas and coal) consumption. Scope of the Energy sector of the Master Plan excludes the energy consumption in Transport sector and Efficient solid waste management and wastewater treatment sector.

◆ Collection of data and information

Energy consumption data (mainly secondary data) from 2009 to 2012 was collected from related organizations as followings:

- 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)

◆ Calculation of GHG emission

The GHG emission was calculated by the collected data and the Emission Factors (EF) from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2, Energy.

◆ Result of quantification

The electricity consumption has been increasing 3.77 % /year on average, and the fuel consumption has been decreasing 3.73 /year on average. Results of GHG emissions calculation based on the collected data is shown in Table 5-2-1.

Table 5-2-1 The amount of GHG emission from electricity and fuel

Type	2009	2010	2011	2012
Electricity	13,503	14,312	14,368	15,278
Fuel	6,644	5,854	6,141	6,217
Total	20,147	20,166	20,509	21,495

(Unit: 1,000 tCO_2-eq)

◆ Business as Usual (BAU)

Annual BAU emissions are estimated in accordance with the expected amount of energy consumption data (both BMA direct and entire area of Bangkok).

The calculation method of the BAU is shown in Figure 5-2-1 and the graph of calculated GHG emissions is shown in Figure 5-2-2.

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 CO_2 emission factors with the trends.

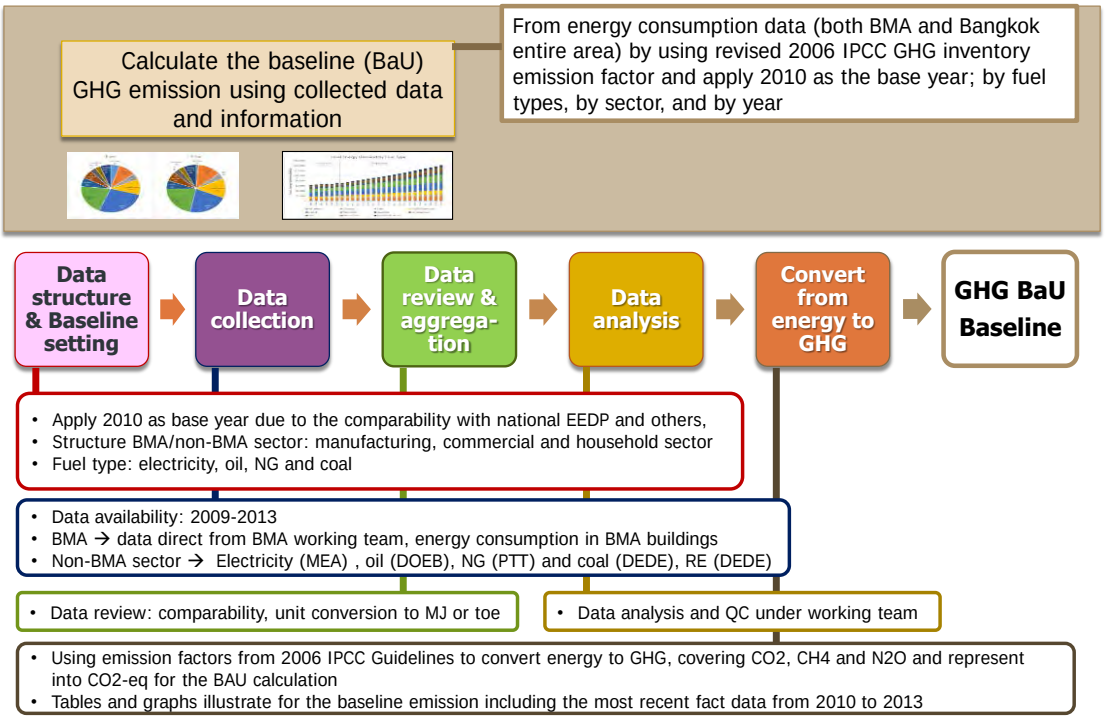


Figure 5-2-2 Flow of BAU GHG emissions calculation

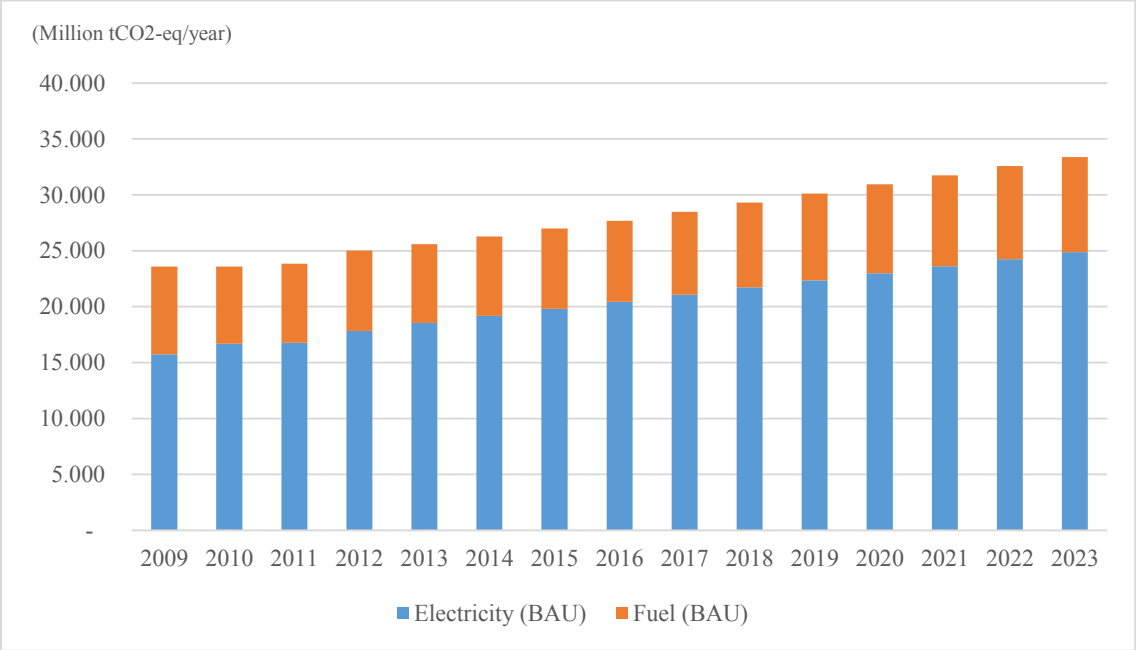


Figure 5-2-2 BAU GHG emissions from Energy Efficiency and Alternative Energy sector

◆ Mitigation target

The mitigation target is set by referring to the estimated value of CO_2 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.

The calculation results are shown in Table 5-2-2.

Table 5-2-2 BAU Emission and Emission with Mitigation Actions

	Base Year	2020
BAU Emission	23,580,000 ton-CO2e (2010) 25,022,000 ton-CO2e (2012)	30,939,000 ton-CO2e
Emission with Mitigation Actions		26,853,000 ton-CO2e 13.2 % (Reduction against BAU emission in 2020)

(ii) Mitigation measures in the energy sector

◆ List of Mitigation measures

A list of mitigation measures in the energy sector is shown in Table 5-2-3. As mentioned above, the measures are classified to BMA direct and entire area of Bangkok.

Although GHG emissions from the BMA public facilities is less than 1% of the emission from

entire area of Bangkok, the measures for BMA direct are important because they can be achieved by BMA's own decision making only. It is also significant to indicate the BMA's initiatives for the energy conservation and reduction of GHG emissions. Therefore, the Energy TF has selected and developed energy saving measures for the public facilities and awareness raising to officials and citizens.

Table 5-2-3 List of Mitigation measures

Category			Possible mitigation actions (countermeasures)	
1. BMA government buildings & facilities	1-1. Energy saving renovation/ repair work for existing facilities	1-1-1. General tasks	a	Form the systematic schedule of retrofitting BMA's existing building for appropriate management of energy
			b	Systematic implementation of energy saving retrofitting works of BMA's existing building
			c	Selection of model project for energy saving renovation work Intensive adoption of top-runner appliances
			d	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.)
			e	Consideration of renovation work, extension work, conversion at the time of facilities update (maximum utilization of existing stocks)
			f	Efficient retrofitting/renovation work for energy saving by introducing private capital know-how (ESCO business etc.)
		1-1-2. Improve insulation performance (renovation technique)	a	Introduce thermal barrier roof coatings
			b	Improve external insulation and waterproofing
			c	Introduce roof greening
			d	Improve heat insulating window (high heat insulating glass such as low-e pair glass)
			e	Improve heat insulating window (thermal barrier film)
			f	Controlling solar radiation heat by installing louver or eaves
		1-1-3. Cut down air conditioning/ ventilation load (retrofitting technique)	a	Replace existing air-conditioning equipment by high-efficiency one
			b	Introduce variable flow controller
			c	Introduce task ambient air conditioning system - controlled by motion/temperature sensor, timer etc.
			d	Introduce high-efficiency fan (total heat exchanger)
			e	Introduce cogeneration system
		1-1-4. Cut down lighting load (retrofitting technique)	a	Introduce LED lighting or hf fluorescent lamp
			b	Introduce task ambient lighting
			c	Install motion sensor lighting to bathroom, corridor or staircase
			d	Daytime energy reduction by daylight sensor
		1-1-5. Energy reduction by	a	Upgrade to water saving sanitary appliances
			b	Introduce rainwater recycling system
			c	Introduce waste water recycling system (reuse as toilet bowl flushing water)

Category			Possible mitigation actions (countermeasures)	
		water-saving		
		1-1-6. Others	a	Solar power generation systems
			b	Introduce BEMS, building energy management systems
			c	Replacing street lighting to LED
	1-2. Energy saving consideration for new construction	1-2-1.General tasks	a	Construct high energy efficiency building
			b	Requirements of certificate acquisition for new construction of BMA facilities (CASBEE or LEED etc.)
	1-3. Information campaign	1-3-1. Conduct campaign to citizens	a	Promote environmental education at school
			b	Support opening exhibition of energy saving merchandise for BMA facility
			c	Visualization of energy saving of BMA facility Notify saving energy activities by panel or monitor
			d	Promote "Green Curtain" installation at school to reduce air conditioning load
			e	Hold workshop on energy saving repair work for public participation (schoolchild, public facilities)
		1-3-2. Conduct campaign to the officials	a	Raise preset cooling temperature
			b	Commendation for saving energy activity
			c	Turn off lightings during lunch break
			d	Thorough power saving setting on PC or OA equipment
	1-4. Promotion of low carbon city	1-4-1. Model areas	a	Setup 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	a	Promotion of low-carbon/energy saving detached house (Publicity of cost benefit from the viewpoint of LCC, backup exhibition, provide advertising spaces at BMA facilities
			b	Facility equipment introduction promotion of energy saving in houses (LED lights, energy-saving air conditioning system or hot‐water apparatus etc.)
		2-1-2. Promotion of energy saving repair work	a	Publicity of cost benefit by repair work for energy saving
			b	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	a	Purchase promotion of energy saving home electric appliances (air conditioning, fridge, TV etc.)
		2-1-4. Promotion of energy saving action	a	Promote better understanding of air conditioner maintenance (conduct free cleaning)
		2-1-5.	a	Promote solar panel installation

Category			Possible mitigation actions (countermeasures)	
		Others		（subsidy system or mediating installable roof）
	2-2. Commercial/Business part	2-2-1. Promotion of energy saving building	a	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	a	Conduct energy saving inspection of public buildings
			b	Promotion of ESCO business for existing buildings (Educate ESCO business, advertisement promotion support, subsidy system for energy saving diagnosis)
			c	Promotion of repair work for energy saving: insulation upgrade by double glazing, heat barrier film, renew air conditioning device (subsidy system etc.)
			d	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 action	a	Promote saving energy activity (publicity of cost benefit etc)
			b	Raise preset cooling temperature at public buildings Turn off lightings during lunch break
			c	Thorough power saving setting on PC or OA equipment
			d	Commendation for saving energy activity
		2-2-4. Others	a	Promote solar panel installation （subsidy system or mediating installable roof）
	2-3. Industrial part	2-3-1. Promotion of energy saving factory	a	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	a	Conduct energy saving inspection of public factories
			b	Promotion of repair work for energy saving (subsidy system etc.)
			c	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 action	a	Promotion activity for factory's energy saving technique (for SMEs)
			b	Commendation for saving energy activity
		2-3-4. Others	a	Promote Solar Energy （subsidy system or mediating installable roof）
			b	Promote beneficial use of factory exhaust heat

◆ Practical measures

The details of the typical measure are shown in Table 5-2-4.

Table 5-2-4 Details of the typical measure

Title	"Promotion of ESCO business for existing buildings (Education of ESCO business, advertisement promotion support, subsidy system for energy saving diagnosis)"
Description	a. Promotion of ESCO business for existing buildings b. Educate ESCO business c. Advertisement promotion support d. Subsidy system for energy saving diagnostic e. Publicity of cost benefit f. Backup exhibition and provide advertising spaces at BMA facilities
BMA Responsibility	BMA: Support Other Organization: DEDE
Stakeholder	TCC
Plan	short term)2015-2013)
GHG Mitigation	Accumulate 10 years = 121.264 thousand CO_2-eq/
Comment	ESCO fund program in Thailand started for more than five years

More than 99% of GHG emissions in the entire area of Bangkok is emitted by private sectors and more than 30% of it is emitted by commercial facilities, large-scale buildings and factories. As the countermeasures to the emission, the Energy TF has listed the promotion of ESCO projects to the existing buildings.

Large amount of energy is used for air conditioning in the existing buildings. By the energy saving renovations such as installation building energy management system (BEMS) to the buildings can reduce the energy consumption drastically. Economic benefit is also high for building owners due to utility cost reduction. Therefore, some advanced private companies in Bangkok have already implemented ESCO projects utilizing Japanese high efficient technology by their own budget (without subsidies)

BMA will promote energy saving activities to private entities by disseminating information about subsidies of DEDE and sponsoring events such exhibitions to achieve significant GHG emission reduction in entire area of Bangkok.

(iii) Capacity development of BMA staff

◆ Ensure identification and traceability of relevant data sources

As data collection and analysis is required to contact not only to internal BMA but also to various agencies and departments of the government, the local consultants who is familiar with those contact points and information sources has performed the central role to develop the Master Plan. However, to avoid the situation that the BMA staff cannot deal with the implementation and monitoring of mitigation measures and revising the Master Plan by

themselves in future, JICA Expert Team has supported BMA staff to record the details of data/information sources and to understand the importance of these information sources.

◆ The recognition of difference between "BMA direct " and "entire area of Bangkok"

BMA staff can introduce energy saving measures to BMA facilities by their own decisions and they are very active to realize such projects. On the other hand, they have limited experience to encourage national organizations and private companies located in Bangkok and encouragement of energy saving activities to these entities has not been carried out enough.

Therefore, as the first step of the Master Plan development, Energy TF members were assisted to understand the importance of their roles and position by comparing the amount of GHG emissions from BMA direct to that from entire area of Bangkok. Second, they were supported to clarify the importance of model projects for BMA facilities (e.g. ESCO, CASBEE) to promote the measures in entire area of Bangkok even if the total amount of GHG emission from BMA Direct is less than 1%.

Finally, BMA staff were encouraged to recognize that they can make effective contribution to promote private sector's activities by supporting the national level actions and cooperating with national governmental organizations.

(iv) Outreach activities and awareness raising

Outreach activities in energy sector was held on 28 and 29, July 2015, mainly for the BMA staff, at the entrance hall of ground floor of BMA Second Government Building. The photograph of the days are shown in Figure 3 and 4. Posters about the Master Plan were displayed, energy saving calculation game was prepared, and talk shows were carried out. Exhibition booths were also set for TGO (Thailand Greenhouse Gas Management Organization) and 8 manufacturers (Panasonic, Daikin, Azbil, etc.) to display their mitigation activities and energy saving products.

The total participants were more than 200. They could understood benefit and importance of energy saving and their knowledge and awareness were improved about energy saving products. In addition, the energy saving products were sold by discount-price and participants hoped BMA to hold similar events in future.

Figure 5-2-3 State of the energy sector outreach activities (booth)

Figure 5-2-4 State of the energy sector outreach activities (talk show)

(d) Lessons learned and future issues

(i) Lessons learned

◆ Related data information sources

As mentioned in the above section, BMA staff could recognize the importance of data collection method and information sources in order to continue the monitoring by themselves during the implementation period of the Master Plan.

Through these efforts, it was found that some data is difficult to collect in regular work of BMA. For example, the amount of fuel consumed by boilers for waste treatment and by waste collection vehicles is recorded together and it is not possible to count separately.

In particular, concerning the MRV, the organizations responsible for the energy data include various national departments and private organizations. Therefore it is desirable to determine a department in charge of collecting data as well as to develop a manual for BMA staff to support their continuous operation of data collection.

In addition, the technical knowledge and human network of the local consultant was very effective to collect data for the development of the Master Plan. To ensure the implementation of monitoring by BMA staff without the local consultant in future, continuous support to them is desirable.

◆ Understanding the efforts in entire area of Bangkok

It was confirmed that the departments and staff in charge of energy have potential of active involvement if they can understand their own role in the Master Plan, as they have relatively abundant budget and human resources.

Through the discussion by the Energy TF, BMA staff could improve their recognition about the importance to understand the situation of energy consumption not only in BMA direct but also in entire area of Bangkok. They could also recognize the importance to encourage actions by the national government and private companies in entire area of Bangkok.

In addition, through the training trip to Japan discussion with Japanese local governments such as Yokohama city, they could share their experiences to cooperate with national government and citizens. It also helped BMA staff to recognize that their range of activities is not only within BMA but also entire area of Bangkok.

On the other hand, still BMA staff are not very familiar to seek actions to the national governmental organizations and private companies that account 99% of emission sources in Bangkok. They have not considered about “what they should do”, “what they can do” and “with which organizations and entities should they cooperate” for the emission reduction in entire area of Bangkok. However, they have understood that BMA can contribute indirectly to the measures which are controlled by national lows and regulations as well as the possibility of intensive

collaboration with private companies. For the implementation of such countermeasures in the Master Plan, it is necessary to keep continuous support by assistance organizations such as JICA.

◆ Development of ownership

At the very beginning stage of the Master Plan development, some of the Energy TF members looked to have relatively less motivation to cooperate with foreign assistance organizations because of their busy daily work and past difficult experiences. However, they could improve their understanding and develop the ownership gradually through the repeated explanation and discussion via Thai interpreters that the Master Plan aims realization of practical mitigation projects and should be developed as easy-to-understand and easy-to-use plan for the working level staff.

Especially, the staff have mentioned that they have got deep impression by the interview and site visit to a private entity which operates ESCO projects in Bangkok. It helped them to understand the method of utilizing software in proper combination with individual energy saving technologies. Although it is necessary to amend the existing laws and regulations in order to introduce ESCO to BMA's official facilities, there were obvious improvement in ownership and positiveness of BMA staff to challenge the issues.

As a result, their capacity was developed dramatically. In the early stage, the TF members were tend to rely on the local consultant and JICA experts to prepare presentation materials. However, in the last stage, they could manage wide range of activities by themselves including planning, documentation and actions such as reporting at the Working Group meeting, planning framework and details of outreach activities, and handling the contact to the private companies.

(ii) Future issues

◆ Cooperation with private companies

For the development of the Master Plan, BMA staff could have good opportunities to learn practical method about energy saving through the site visits and lectures regarding BEMS and ESCO project by Azbil Corporation. In addition, Japanese companies such as Azbil, Panasonic and Daikin participated the outreach activity and they could provide awareness raising about energy saving technologies.

Participation and contribution by private companies in various sectors are essential to reduce GHG emissions from Energy sector in Bangkok, and it is necessary to establish a cooperative scheme between the BMA and the private sector in the future. Therefore, it is required to maintain and continue the active human network developed as the outcome of the Energy TF activities to derive benefit for necessary actions.

◆ Promotion of energy saving renovation of public facilities

For the encouragement of energy saving renovation of buildings by private entities, energy saving renovation of existing BMA facilities should be promoted as the model projects and good practices. In addition to already planned budget for the renovation, it is necessary to establish new financial scheme such as ESCO to ensure enough budget and quick realization of further projects.

As mentioned in the previous section, it seems that BMA staff awareness and motivation has been increased extremely. However, there is also a risk that the motivation might be depressed by taking time for the realization of the planned projects and interruption of continuous efforts by replacing the persons in charge. In order to realize the mitigation measures listed in the Master Plan steadily, it is essential to secure budget promptly and to carry out efficient internal coordination for the establishment of new schemes and institutions.

◆ The importance of a key actor organization for the integration of activities

It is important to have a key actor (an organization or a department) which enable to play the role of a focal point to integrate necessary activities such as cooperation with related national organizations to collect energy data, coordination with other sectors of the Master Plan which relate to energy sector, as well as internal coordination within BMA organization.

The assigned members of the Energy TF have made a great effort to develop the Master Plan regardless of their heavy routine work load but it was difficult for them to spare enough time to discuss the Master Plan. However, it is required to set a key actor organizations for the continuous implementation and progress management to realize the future mitigation projects and monitoring.

This is not only the issue in the energy sector but also one of the comprehensive issues related to the Master Plan itself. However, especially the energy sector requires human resources and an organization who could manage close and continuous cooperation with the national organizations and research institutes to collect, stock and maintain the huge amount of data and information.

(e) Reference materials

<u>WG Related Documents</u>

- WG presentation materials (September 2013)
- WG presentation materials (May 2014)
- WG presentation materials (October 2014)
- WG presentation materials (January 2015)
- WG presentation materials (May 2015)

(3) Efficient Solid Waste Management and Wastewater Treatment

(a) Background of the waste and wastewater sector

Recent growth in population and economic activities in Bangkok has accompanied the growth in the volume of municipal solid waste and domestic wastewater and also associated environmental and social problems.

Currently BMA collects about 9,700 tons of municipal solid waste every day, some of which are either recycled, treated at a composting plant, or transported to solid waste transfer centers inside Bangkok. Remaining wastes are transferred to final disposal sites located outside of Bangkok. In order to effectively treat such growing amount of waste, BMA has been taking various kinds of measures, which include 3R promotion at communities, biogas generation from organic waste at markets, various types of campaign and outreach activities. BMA is planning to further promote 3R throughout the city and also introduce some new activities and technologies such as construction of waste-to-energy facility.

Domestic wastewater, whose daily discharge volume reaches 2.5 million m^3, is collected by a combined wastewater collection system then treated at 8 central wastewater treatment plants (WWTPs) and several small-scale community treatment plants located in Bangkok. Properly treated wastewater is then discharged into water streams such as canals. BMA has a plan to construct new central wastewater treatment plants to treat the increasing amount of wastewater and expanding sewage areas.

(b) Sectoral counterpart and relevant organizations

All activities related to the development of Master Plan for waste and wastewater sector were principally carried out by Task Force for Efficient Solid Waste Management and Wastewater Treatment, whose members consist of representatives of several offices from Department of Drainage & Sewerage, and Department of Environment. Technical support was provided to Task Force from Thai expert, Dr. Wilasinee Yoochatchaval from King Mongkut's University of Technology Thonburi.

(c) Activities and outputs

(i) GHG quantification (BAU and mitigation target)

◆ Scope of Emission

- GHG emissions related to municipal solid waste generated in the administrative boundary of BMA and various activities related to handling of such waste
- GHG emissions related to domestic and commercial wastewater generated in the

administrative boundary of BMA and various activities related to treatment of such wastewater

- GHG emitted from the waste and wastewater that is originally generated in the administrative boundary of BMA but is transported to outside of its boundary, i.e. emissions from landfill sites located outside of Bangkok that accept municipal solid waste generated in Bangkok, and emissions from sludge sediment in canals located outside of Bangkok that is contained by wastewater from residential and commercial units and wastewater treatment plants in Bangkok

◆ Methodologies for Calculation

[Waste]

- CH_4 emission from disposed wastes is calculated by applying First Order Decay (FOD) model specified in 2006 IPCC Guidelines.
- Data of municipal solid waste generated in Bangkok such as waste amount and composition is taken from the report "Bangkok State of Environment 2013."
- Default values from 2006 IPCC Guidelines are applied for some parameters except those values where Thailand's country-specific value or BMA's actual data is available.

[Wastewater]

- CH_4 emission from wastewater sludge accumulated at the bottom of canal is estimated by multiplying "volume of wastewater discharged into canal" by CH_4 emission factor per BOD.
- CH_4 emission from septic tanks is calculated by multiplying BOD concentration of wastewater discharged from septic tanks installed in selected residential and commercial units by IPCC default emission factors.

[Electricity consumption]

- All GHG emissions due to electricity consumption (at waste transfer centers, composting plant, wastewater treatment plants) are calculated by recorded or estimated electricity consumption data multiplied by CO_2 emission factor of the national electricity grid.

[Transportation of waste/ sludge]

- GHG emissions due to fuel consumption by waste collection/ transportation trucks are estimated by using fuel emission factor calculated by Ministry of Energy and IPCC default data.
- Truck fuel consumption data is estimated from actual data provided by BMA districts.

◆ Methodology of Business-as-Usual (BAU) Emission Estimation

- Annual BAU emissions are estimated in accordance with the expected amount or volume of waste and wastewater and relevant activities related to treatment or management of such waste and wastewater.
- A future growth rate is applied to some parameters referring to the BMA's future development plan (such as expected population growth rate) or sectoral plan.
- Activity data related to plants and facilities that will be constructed during the Master Plan period such as waste management plants and wastewater treatment plants, as well as their technical details such as plant size and operation hours is in line with the BMA's official plans. Where such plans are not available, activity data is estimated in accordance with information of same or similar technology that is currently used by BMA.

◆ Result of BAU Estimation

BaU GHG emissions from Efficient Solid Waste Management and Wastewater Treatment sector are shown in the table and figure below.

Table 5-3-1

BAU emissions of Efficient Solid Waste Management and Wastewater Treatment sector

Sub-sector	BAU emissions (tCO_{2-e}/year)					
	2013	2014	2015	2016	2017	2018
Waste	3,837,438	3,891,484	3,941,658	3,989,132	4,034,761	4,079,163
Wastewater	714,388	724,225	731,468	738,782	746,170	753,632
Total	4,551,826	4,615,710	4,673,125	4,727,914	4,780,931	4,832,795

Sub-sector	BAU emissions (tCO_{2-e}/year)				
	2019	2020	2021	2022	2023
Waste	4,122,789	4,165,966	4,208,933	4,251,865	4,294,889
Wastewater	761,168	768,780	776,468	784,232	792,075
Total	4,883,957	4,934,746	4,985,401	5,036,098	5,086,964

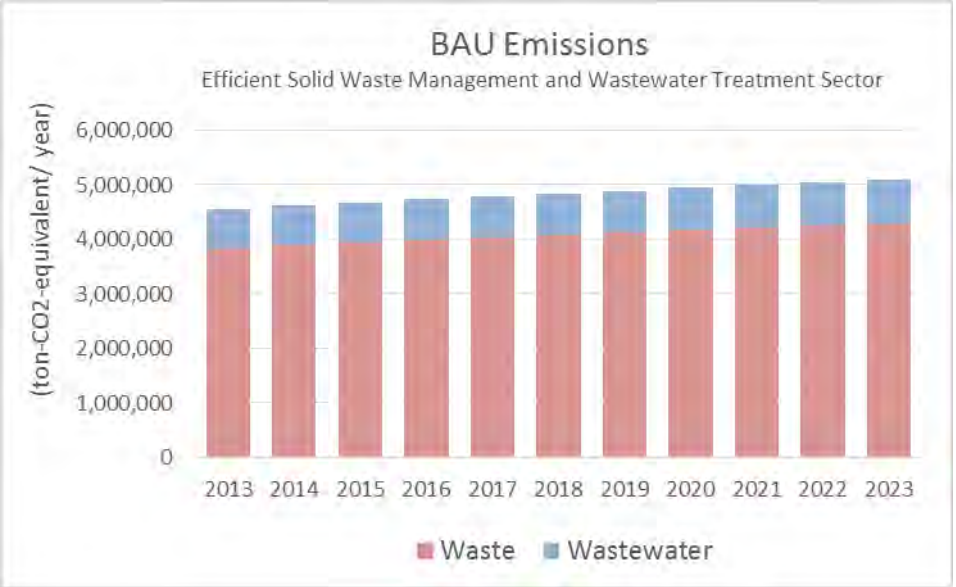


Figure 5-3-1
BAU emissions of Efficient Solid Waste Management and Wastewater Treatment sector

◆ Mitigation target

By implementing the mitigation activities under the Master Plan, expected GHG emission reduction against BAU in 2020 is estimated to be 4.1%.

This clause illustrates the overview of mitigation actions of Efficient Solid Waste Management and Wastewater Treatment sector.

(ii) Mitigation measures in the transport sector

List of mitigation actions of waste sub-sector and wastewater sub-sector is shown in Table 5-3-2 and Table 5-3-4 respectively.

It is important to note that most of the activities related to waste and wastewater treatment fall into the authority and jurisdiction of BMA. Various policies and plans related to this sector have already been established and in place by BMA. Mitigation actions in the Master Plan have been identified in line with such existing plans and are expected to contribute simultaneously to better waste/wastewater treatment and climate change mitigation.

Table 5-3-2 Mitigation actions for Solid Waste Management sub-sector

Category	Action
W1. Waste generation	W1.1 Promote participation on waste reduction and separation at source
	W1.2 Reduce the amount of plastic waste
	W1.3 Consider establishing and reinforcing of laws and regulations including incentive measures to accelerate waste reduction and separation at source
W2. Waste collection and transportation	W2.1 Improve fuel efficiency of waste collection and transportation system
	W2.2 Promote the standard development of Green Junk Shops
W3. Intermediate treatment	W3.1 Promote utilization of organic waste
	W3.2 Construct waste-to-energy incineration facility
	W3.3 Construct Waste segregation Plant
W4. Final disposal	W4.1 Install environment- friendly landfill system

An overview of an example mitigation action, "Promote participation on waste reduction and separation at source" (W1.1), is shown below.

This mitigation action is in line with one of the top priority activities of BMA related to the waste handling issue, which is waste reduction and separation at source and boost waste recycle. This action is significant because GHG emissions related to waste handling, ranging from waste collection and transportation to methane emissions at landfill site, all depend on the volume of waste generated at source. By reducing the waste volume at source, as a fundamental element of GHG emissions and various environmental issues, this mitigation action is expected to contribute to achieving low-carbon and sustainable Bangkok.

Table 5-3-3 Overview of mitigation action
"Promote participation on waste reduction and separation at source"

Title	W1.1 Promote participation on waste reduction and separation at source
Details	a) Enhance public awareness and partnership on waste management through public relation and campaigns b) Develop waste management model in district office, BMA's school, BMA hall1&2, BMA's health center service and BMA offices c) Promote partnership with the private sector in the management of

	solid waste at source
BMA's Responsibility	BMA (Directly implemented)
Stakeholders	Dept. of Environment, district offices, community, schools, university, private sector
Implementation schedule	Short to long term (2013-2023)
Estimated GHG emission reduction	304 ton-CO_{2e} /year (2013) – 9,330 ton-CO_{2e} /year (2023) (for mitigation action b)

Table 5-3-4 Mitigation actions for Wastewater Treatment sub-sector

Category	Action
WW1. Wastewater generation	WW1.1 Promote reduction of water usage at house
	WW 1.2 Promote collection of wastewater tariff
WW2. Wastewater collection	WW 2.1 Expand sewage area
	WW 2.2 Implement separate collection system
WW3. Wastewater treatment	WW 3.1 Improve operation and equipment of existing WWTPs
	WW 3.2 Construct new energy efficient WWTPs
WW4. Sludge treatment	WW 4.1 Promote utilization of sludge
WW5. Water reuse	WW 5.1 Promote water reuse

An overview of an example mitigation action of wastewater sub-sector, "Construct new energy efficient wastewater treatment plants (WWTPs)" (WW3.2), is shown below.

Currently 8 large-scale central WWTPs are in operation in Bangkok and BMA has a plan to construct new additional plants in coming years. Construction of energy-efficient plants is important since the large amount of electricity consumption by WWTPs not only contributes to GHG emissions but also takes a significant portion of BMA budget. The mitigation action intends to construct such energy-efficient WWTPs that are equipped with energy-efficient water pumps and air blowers, etc. in order to expand proper wastewater treatment areas as well as to reduce GHG emissions.

Table 5-3-5 Overview of mitigation action

"Construct new energy efficient wastewater treatment plants (WWTPs)"

Title	WW 3.2 Construct new energy efficient wastewater treatment plants (WWTPs)
Details	a) Construct New Central wastewater treatment plants (WWTPs) 1. Minburi (10,000 m3/d) 2. Thonburi (160,000 m3/d) 3. Klongtoey (360,000 m3/d) 4. Nongbon (135,000 m3/d) b) Energy efficiency improvement at new WWTPs c) Construct a new treatment system which can reduce sludge aeration from new WWTPs
BMA's Responsibility	BMA (Directly implemented)
Stakeholders	DDS, Ministry of Interior, Ministry of Finance, National Economic and Social Development Board
Implementation schedule	Long term (2019-2023)
Estimated GHG emission reduction (average)	434 ton-CO_{2e} /year (2018) – 28,849 ton-CO_{2e} /year (2023) (a) 15 ton-CO_{2e} /year (2013) – 994 ton-CO_{2e} /year (2023) (b) 4 ton-CO_{2e} /year (2013) – 11 ton-CO_{2e} /year (2023) (c)

(iii) Capacity development of BMA officials

Various occasions to enhance technical knowledge and understanding by BMA officials related to waste and wastewater management as well as climate change mitigation were provided under the Technical Cooperation project. Some of the approaches and activities taken for capacity development are shown below.

(iii-1) Practices and experiences from Japan

To further enhance knowledge of BMA officials related to waste and wastewater management activities, BMA officials and JICA Expert Team discussed over Japanese cases and compared with Bangkok cases. Topics contain basic policy and principle of waste management, legal and institutional structure, waste management flow, 3R experiences, effectiveness of various technologies such as waste-to-energy and semi-aerobic treatment, etc. For wastewater, both sides exchanged opinions about the overview of Japan's treatment systems, combined and separate wastewater collection system, possible energy-efficiency measures at wastewater treatment plants, etc.

(iii-2) Opinion exchange with Yokohama City

BMA officials had a chance to listen to first-hand experiences of Yokohama City related to waste and wastewater management, including involvement of citizens and outreach activities, climate change mitigation activities such as installation of energy efficient equipment and monitoring devices into city facilities, effective operation of plants, all of which were highly effective in developing mitigation actions for the Master Plan.

(iii-3) Training in Japan

Some of Task Force members had a chance to visit Japan to attend the training program which includes opinion exchange with city officials in Japan and also site visit at waste and wastewater-related facilities and plants. The training in Japan contributed further enhancing BMA officials' knowledge on the latest technologies and practices.

(iii-4) Study sessions of GHG calculation

In order to further enhance technical understanding and strengthen MRV preparedness by BMA officials, internal study sessions were held in addition to Task Force meetings. Study sessions focused on technical details of GHG calculation, both for BAU emissions and emission reduction by mitigation actions in the Master Plan.

(iv) Activities for outreach and public awareness

Outreach activities conducted under the Technical Cooperation focused on overall awareness raising and knowledge transfer related to waste and wastewater management and wide dissemination of Master Plan.

The outreach workshop was held in Klong Latmayon Floating Market, which is one of the most advanced communities in Bangkok in terms of effective waste management and various awareness raising activities by community. Participants had a chance to listen to the community's activities and their effectiveness, followed by presentations by BMA officials about the importance of waste and wastewater treatment at a community level and the positive relationship with climate change mitigation. JICA Expert Team provided some good cases of waste management in Japan.

＜Overview of outreach workshop＞

・Date: July 2, 2015

・Location: Klong Latmayon Floating Market, Bangkok

・Contents: outreach on community-level waste and wastewater treatment

・Participants: Officers from 50 BMA districts, local communities

Picture 1 Outreach workshop of waste and wastewater sector

Picture 2 Participants of outreach workshop of waste and wastewater sector

(d) Lesson learned and challenges for future

Lesson learned

◆ Importance of expanding good practices

In promoting the realization of mitigation actions, it is highly effective to identify the ongoing activities that yielded successful results and then encourage the same or similar activities in other target areas or to target groups. It was found that BMA has some successful cases of 3R activities at a community level, which was taken into consideration in developing potential mitigation actions for the Master Plan.

◆ Mitigation as co-benefit

Rather than developing a new project as a climate change mitigation action, it is efficient and effective to identify the existing practices of waste management or wastewater treatment and consider their climate change mitigation effect as co-benefit.

◆ Ownership of C/P personnel

BMA officials from waste and wastewater sector showed a significantly high motivation and ownership toward the Master Plan and Technical Cooperation project, partly because C/P officials have had a proper understanding of the above-mentioned co-benefit of climate change mitigation, and also because BMA has jurisdiction to most activities related to waste and wastewater management that enables BMA to have flexibility of mitigation action development and also have better access to relevant data and information.

Challenges for future

◆ Access to GHG data

BMA does not have access to some of the data necessary for accurate estimation of GHG emissions and emission reductions, such as data owned by operators of waste transfer centers and wastewater treatment plants. Arrangement to obtain or improve access to such data will be important at the time of BAU update and MRV activities.

◆ Further capacity development of BMA officials

Although capacity of some of the BMA officials has improved through the Project activities, further capacity development needs to be provided to wider target of BMA officials because larger number of people from various BMA offices and departments will be involved at the stage of implementation of mitigation actions identified in the Master Plan.

◆ Cooperation with external players

Although BMA has the authority over most of the waste and wastewater management issues as previously described, the field involves various and wide range of actors such as academic and private sectors, citizens and others. Effective approach to enhance cooperation and collaboration with such wide range of players needs to be identified and taken.

(e) Reference materials

Table 5-3-6 WG Related Documents

WG	Contents
1st WG (September 2013)	Progress of consideration of Task force (Related information, discussion in TF, calculation policy, challenges for future)
2nd WG (May 2014)	Tentative list of mitigation actions Extraction of mitigation actions
3rd WG (October 2014)	List and detail of mitigation actions Calculation of GHG emission Challenges for future
4th WG (January 2015)	Revised list and detail of mitigation actions M&E, Outreach activities
5th WG (May 2015)	Current GHG emission Emission target in 2020
Stakeholder Meeting	Reporting the overview of Master Plan

(4) Green urban planning sector

(a) Background of the green urban planning sector

In Bangkok, there are 31 public parks with the area of 4,457 thousand m2, and 3,493 small parks including special purpose parks, mini parks, neighborhood parks, community parks, others with the areas of 15,899 thousand m2 in 2013. In road side area of Bangkok, there are 2,822 street parks including linear parks, island parks, junction parks, others with the area of 7,383 thousand m2 in 2013. There are 976,183 trees planted by BMA in 2013, and 187,743 tress have increased since 2008.

In the mitigation of climate change, greening has functions to absorb and fix CO2 through growth of tree and to lower the temperature by evaporation. Bangkok Action plan on Global Warming 2007-2012 shows the mitigation actions of green urban planning including 1) tree plantation in public parks, road sides and riversides and 2) supporting and encouraging private sector to plant trees through public campaign.

(b) Sectoral counterpart and relevant organizations

A task force (TF) on green urban planning was established for the project activities, such as drafting the Master Plan, and conducting outreach activities. The green urban planning TF was comprised of city planning department, public park office of the environmental department and the department of environment in BMA. As the national governmental agency, The TF team discussed with the Geo-Informatics and Space Technology Development Agency (GISTDA) to utilize satellite image for the development of green urban planning and the monitoring of green area. To support data collection, Mr.Jumpon Moryadee, the environmental expert of Thai Environmental Technic Co., Ltd. participated in the TF as a local consultant. Dr. Ladawan Puangchit, the University of Kasetsert had the useful technical advice for the estimation of GHG absorption factor of trees in public parks and road sides.

(c) Activities and outputs

(i) GHG quantification (BAU and mitigation target)

◆ Current status of GHG absorption

Scope of GHG absorption is CO2 adsorption of planted trees, which can be managed and monitored by BMA in its controlled area, including public parks, roadsides, riversides, mangrove area, public facilities, excluding shrub, flower and turf.

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.

GHG absorption factor per tree is calculated as follows:

- Major species of 70% occupancy in distribution by type of whole species are selected using field survey in urban parks[*1] and main roadsides[*2] of Bangkok conducted by Kasetsart University and public park office of the environmental department in BMA.
- GHG absorption factor per tree(tC/tree) by species is estimated using allometric equation of species in FAO database and DBH(Diameter of Brest Height) of species.
- Averaged GHG absorption factor per tree (tC/tree) is estimated using distribution by type of species and GHG absorption factor per tree(tC/tree) by type of species.

Note: *1 : Santiphap Park(720 trees), Saranrom Park(356 trees) ,Rommaneenart Park(700 trees)
and Chutchuk Park(845 trees)
*2 : Roadside : 189,409 trees

Equation:

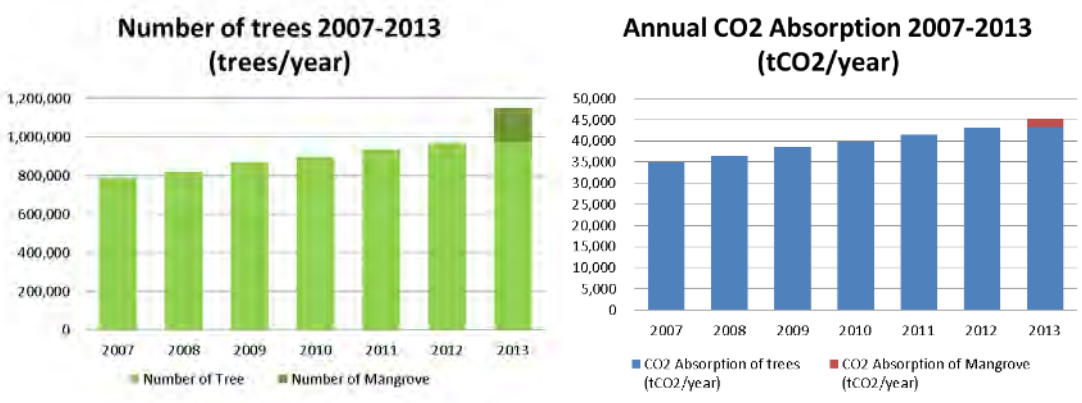
$$GHG\ \ Absorption = Activity\ Data \times Absorption\ Factor$$

Activity data: Number of planted trees (trees)

Absorption factor (whole area): 0.012tonC/ tree/year *1
(roadside): 0.012 ton C/tree/year *1
(urban park): 0.009 ton C/tree/year *1
(mangrove): 0.75 ton C/rai/year *2

Source: *1 Estimated by JICA expert team & Kasetsart University
*2 Kasetsart University

Annual CO2 absorption estimated using number of planted trees from year 2007 to 2013 is shown below.

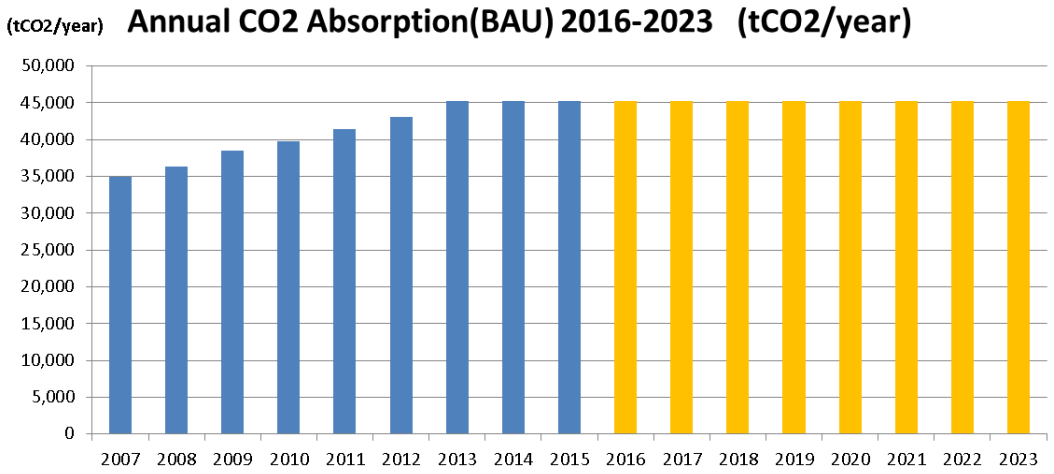


Source; Measured by district office,
Database on http://dailyplans.bangkok.go.th/parks/
Mangrove area : 699 rai measured by satellite image
250 mangroves/rai

◆ Business-as-Usual (BAU) GHG Absorption

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 calculated by multiplying number of trees planted by year 2013 by absorption factor per tree shown above.

BAU value of CO2 absorption in year 2020 is estimated to be 45,232 ton-CO2e/year. It is similar to CO2 absorption of year 2013 due to the proper maintenance of trees planted by year 2013.



◆ Mitigation targets

Mitigation target of GHG absorption in year 2020 is estimated in 5 measures (No1, 2, 3, 4 and 5) described in "(ii) Mitigation measures in Green urban planning sector" based on the implementing plan for green urban planning using the bottom up approach. In this approach, the green area and the number of planted tree are set by measures. GHG absorptions are estimated by measures and accumulated, and finally compiled to the target. GHG absorption is calculated by multiplying number of planted trees, which is estimated using proposed green area, by absorption factor per tree shown above.

Table 5-4-1 Green area and number of planted trees by mitigation measures in the green urban planning (cumulative total values)

year	Increasing new public parks in Bangkok (rai)	Increasing new green areas in public areas (rai)	Planting new trees along roadside areas (trees)	Increasing the Biotope Area Factor (BAF) in private lands (rai)	Mangrove reforestation (rai)
2016	67	667	100	115	0
2017	133	1,333	200	232	0
2018	200	2,000	300	352	50

2019	290	2,700	400	474	100
2020	380	3,400	500	599	150
2021	470	4,100	600	726	200
2022	560	4,800	700	855	250
2023	650	5,500	800	987	300

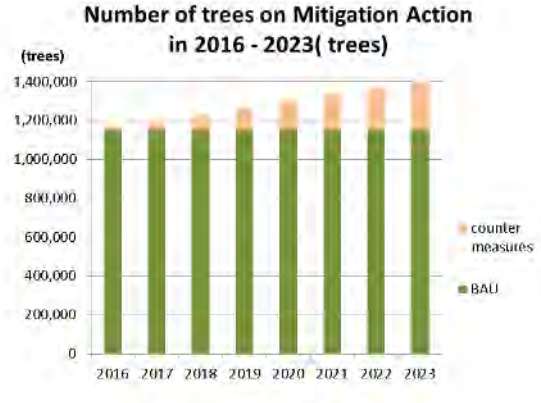
Source; prepared by the green urban planning task force

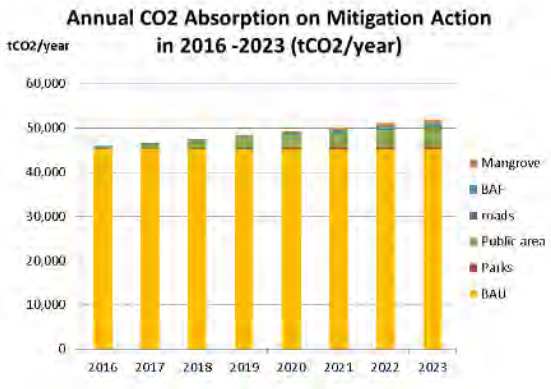
Target of GHG absorption by mitigation measures in year 2020 is estimated to be 4,047 ton-CO2e/year. In the combination with BAU, GHG absorption in year 2020 is estimated to be 49,279 ton-CO2e/year, with the additional absorption of 8.9% of BAU value.

Table 5-4-2 Targets in the green urban planning (year 2020)

No.	Measure	Activities to be conducted by 2020 (cumulative total values)	CO2 Absorption (ton-CO2e/year in 2020)
1	Increasing new public parks in Bangkok	380 rai	314
2	Increasing new green areas in public areas	3,400 rai	2,805
3	Planting new trees along roadside areas	500 trees	22
4	Increasing the Biotope Area Factor (BAF) in private lands	599 rai	494
5	Mangrove reforestation	150 rai	413
Total			4,047

Source; prepared by the green urban planning task force
Public parks, public area, private land : 25 trees/rai
Mangrove area : 250 mangroves/rai





(ii) Mitigation measures in green urban planning sector

Mitigation measures cover not only the conventional greening activities including the development of public parks and public area, tree plantation along roads, well managing and

maintenance of planted trees, but also the urban planning approach like the induction and regulation to increase the green area.

It aims to promote private sector and citizens to increase greening in private land, which has still rooms for expansion, using the induction and regulation of urban planning because the conventional greening activities which is the responsibility of BMA has rather the limitation to increase green area.

BMA targets to develop the green city in cooperation with private sector and citizens.

Table 5-4-3 Mitigation actions in the green urban planning

No.	Measure	category
1	Increasing new public parks in Bangkok	Quantitative measures
2	Increasing new green areas in public areas	
3	Planting new trees along roadside areas	
4	Increasing the Biotope Area Factor (BAF) in private lands	
5	Mangrove reforestation	
6	Well-managing and maintaining of planted trees	Qualitative measures
7	Encouraging rooftop greening and wall greening	
8	Raising public awareness in increasing green areas	

For example, 2 measures including the development of public parks which is the direct activity of BMA and the induction and regulation of greening in private land through the urban planning approach are shown below.

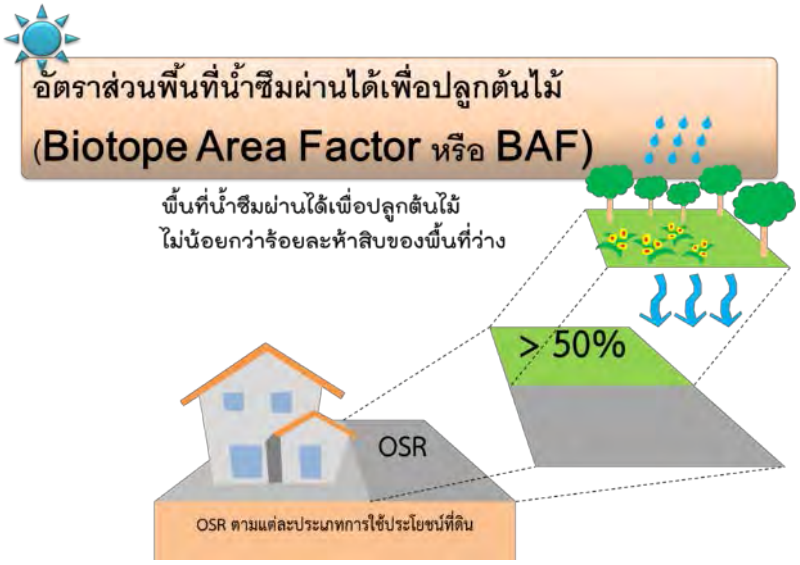
Example 1) Increasing new public parks in Bangkok

Title	Increasing new green areas (Public Parks)
Details	Construction of 15 new public parks: - 5 middle/large scale parks(200rais) in short/mid terms - 10 middle/large scale parks(450rais,4-174 rais/park) in long term. 
BMA's	Directly implemented

Responsibility	
Stakeholders	Implementation: Public Park Office of Environmental Department Maintenance: Public Park Office, 50 district offices Evaluation: Public Park Office, 50 district offices, Strategy and Evaluation Department
Implementation schedule	- 5 middle/large scale parks (200rais) in short/mid terms(year 2016-2018) - 10 middle/large scale parks (450rais) in long term(year 2019-2023).
Estimated GHG emission reduction	165 ton CO2/year（5,000 trees planted) in short/mid terms(year 2016-2018) 371 ton CO2/year（11,250 trees planted) in long term(year 2019-2023) Data for estimation: -Number of trees per rai in park: 25 trees/rai. (source: averaged number of trees in 3 small scale parks such as Santiphap Park, Saranrom Park, Rommaneenart Park) -GHG absorption per rai : 0.825 tonCO2/rai/year = 25 trees/rai * 0.009 ton C/tree/year *44/12

Example 2) Increasing the Biotope Area Factor(BAF) in private lands

Title	Increasing the Biotope Area Factor(BAF) in private lands
Details	1) Increasing green area by BAF law enforcement - totally 352 rais in short/mid terms (year 2016-2018) - totally 635 rais in long term (year 2019-2023) 2) Developing BAF database in GIS database and improving reporting system of BAF database in short/mid term 3) All of permitted building construction will have BAF in their area in long term - Promoting new planting on private land along the Bangkok Comprehensive Plan. - Advertising the concept of Biotope Area Factor(BAF) to related stakeholders and citizens - Encouraging the provision of Biotope Area Factor(BAF) in governmental buildings

	
BMA's Responsibility	Directly implemented
Stakeholders	Implementation: Environmental Department, City Planning Department, 50 district offices, Public Works Department Maintenance: 50 district offices, Public Works Department, City Planning Department Evaluation: 50 district office, Public Works Department, City Planning Department
Implementation schedule	in short/mid terms(year 2016-2018) and long term(year 2019-2023)
Estimated GHG emission reduction	291 ton CO2/year(Short to mid-term) 523 tonCO2/year (Long term) Data for estimation: - Number of trees per rai: 25 trees/rai. (similar to park case) - GHG absorption per rai : 0.825 tonCO2/rai/year - Green area is estimated in the following process. 1. Statistical data of housing and building area during year 2005 to 2013 is collected. 2. Data is categorized into 5 groups using the number of stories; a) 1-4 stories, b) 5-7 stories, c) 8-10 stories, d) 11-20 stories, e) over 20stories 3. Floor area in year 2014 to 2023 is estimated using the average growth rate of each group. 4. OSR (Open space ratio) of each group is set; a) 1-4 stories= 10.0%, b) 5-7 stories= 6.5%, c) 8-10 stories= 4.5%, d) 11-20 stories= 4.0%,e) over 20stories= 3.0% 5. Area of OS(Open Space) is calculated by multiplying floor area by OSR 6. Finally, green area is estimated by multiplying area of OS by 50%(BAF).

(iii) Capacity development of BMA officials

◆ Task force meeting related to reviewing Bangkok Action plan on Global Warming 2007-2012

In the beginning of this project, the task force meeting was held in order to grasp the current situation of urban greening in Bangkok in reviewing Bangkok Action plan on Global Warming 2007-2012. Local consultants conducted the interview with city planning department and public park office of environmental department in BMA, and also conducted data collection survey in the related district office. Then the following problem related to Bangkok Action Plan implementation was clarified through the analysis of interview results and collected data and

1) Expected CO_2 adsorption has not been accomplished because there was not enough land in BMA.
2) Goal in the action plan has been set without the sufficient consultation with the implementing team.
3) Responsibility of related agencies in BMA was not clarified in monitoring the activities.

These problems were shared in task force team. It clarified the points to be considered in new master plan implementation. It led to minimize the potential risk to cause the same problems in the selection of mitigation measures and establishment of monitoring institution.

◆ Task force meeting related to the methodology for estimating GHG absorption factor of trees in urban parks and roadsides

The task force meeting was held to estimate the value of BAU and the effect of mitigation measures quantitatively. Then, it was clarified that GHG absorption factor of tree species in the IPCC guideline was not applicable to species of tree in green area of Bangkok. It was concluded that GHG absorption factor suitable for tree species in green area of Bangkok needed to be newly developed.

Based on the lesson learned of TF team members that they could not understand how to estimate GHG absorption sufficiently in the development of Bangkok Action plan on Global Warming, the methodology for developing GHG absorption factor of trees and how to estimate GHG absorption of mitigation measures using the absorption factor was transferred to TF team members.

It promoted BMA officers' understandings of the methodology for estimating GHG absorption factor of trees and GHG absorption amount of mitigation measures. It led that BMA officers could develop the MRV methodology and monitoring institution of mitigation measures with confidence.

(iv) Activities for outreach and public awareness

The green rally for urban greening promotion was held in Lumpini Park for Bangkok citizen from 16:30 to 18:00 on 18th July in 2015. Almost 300 participants attended in this event, who were mainly citizens including families cooling off in the evening in Lumpini park on Saturday.

In the green rally, participants visited around 3 points set in park and answered the questions about the effect of urban greening in each point. At last, the seedlings of flower trees shown in urban parks and road sides were distributed.

Participants wrote their opinions on short strips of paper about their desirable image for Bangkok green city. It raised their awareness for proactive involvement to develop the green city.

Participants who answer the question at the rally point

Short strips of paper on which citizens describes their opinion

(d) Lesson learned and challenges for future

(i) Lessons learned

Members of task force team of green urban planning has the structured knowledge related to the development and maintenance of urban parks, public area, and the promotion of greening in private land using the induction and regulation of urban planning approach. But they did not have the sufficient knowledge related to the methodology of GHG absorption estimation and MRV planning in the project beginning stage. So, in TF meeting, members of TF team were not be involved in the TF activity proactively, whereas JICA expert team shared information related to mitigation measures of Japanese urban greening.

Through the preserving discussion on the periodical task force meetings and Japanese Training Course, 6 month later, members of task force team became to deepen their understanding of overall image on this project activity. Then, they had a proactive involvement to provide the list of proposed mitigation measures and its concrete amount of activity in each mitigation measure.

It indicates that BMA officer can develop mitigation measures by themselves with their high

level knowledge and skill related to their responsible sector, if they can have a chance to learn knowledge and skill related to so-called new filed of climate change mitigation.

(ii) Challenges for future

The list and action plan of mitigation measures in green urban planning sector was established. Next it is important to implement the mitigation measures and monitor and evaluate its progress actually, by a certain routine work.

The monitoring system has been already developed. This system has some functions to record the daily greening activities by district offices (number of planted trees, green area) and to gather these records to public park office of environment department from each district office and finally to compiles records to database.

It is expected that tree data including not only number of tree and green area but also species of tree, height and DBH(diameter of breast height) of tree will be monitored and recorded in updating the system.

Currently, it is considered to be impossible to monitor the situation of implemented roof top greening periodically because of the difficulty of on-site inspection on roof top.

It is expected to promote roof top greening and to update the monitoring system using satellite image in order to grasp the progress of roof top greening implementation in cooperation with GISTDA.

(e) Reference materials

<u>WG Related Documents</u>

- WG presentation materials (September 2013)
- WG presentation materials (May 2014)
- WG presentation materials (October 2014)
- WG presentation materials (January 2015)
- WG presentation materials (May 2015)

(5) Adaptation planning

(a) Background of the adaptation planning

In July 2015, Thai Government has adopted "Thailand National Climate Change Master Plan 2015-2050" in which adaptation is one of three elements. Moreover, the Master Plan encourages local authorities to plan climate change adaptation. This direction is consistent with the national plan, "the 12-year Bangkok Development Plan (2009-2020)", and addresses to climate change impacts are important as a driving factor to achieve a strategy toward Green Bangkok[5].

The "Bangkok Master Plan on Climate Change 2013-2023" raises elaboration of adaptation measures as one of its major objectives, in cooperation with its domestic and international partners.

(b) Sectoral counterpart and relevant organizations

Implementation of adaptation measures requires cooperation among BMA and other external organizations. The Adaptation Task Force (TF) and Department of Environment of BMA which works as the secretariat is the main driver in BMA. Dr. Alice Sharp, an Associate Professor at the Sirindhorn International Institute of Technology (SIIT), was assigned as a local consultant. While an external organization includes ONEP and Department of Disaster Prevention and Mitigation (DDPM), NGO, research institutions and citizens in whole Bangkok area. Furthermore, national organizations were invited to join the Working Group and the JCC. Outreach activity conducted by Task Force was used for information dissemination to citizens.

(c) Activities and results

(i) Issue identification, developing methodologies and framework on prioritizing adaptation measures

(i-1) Issue identification:

Through a series of discussion by the Adaptation Task Force members, three issues are identified as priority with their expectation to be more serious by future climate change, namely,

- Flooding,
- Coastal Erosion, and
- Drought and Saline Intrusion.

(i-2) Identification of current and future impacts and their addressing actions:

Local consultants and JICA experts carried out extensive literature reviews from reports and studies by BMA, Thai Universities as well as reliable international organizations to collect the below information.

[5] http://dailyplans.bangkok.go.th/dailyplans/dailyplans/book/bma12_5659.pdf (in Thai)

- Present problem,
- Current action to cope with the existing problem,
- Future problem based on anticipation and prediction, and
- Action needed in order to cope with future problem.

The "problem" means those which might be caused by climate change, or related to climate or extreme weather events. The Adaptation Task Force members discussed to integrate BMA's practical knowledge and experience related to above information.

(i-3) Identification of adaptation measures and their classifications:

The above information derived was reviewed and analyzed through discussion of the Adaptation Task Force members to identify possible adaptation measures. Furthermore, in order to clarify the priorities; namely urgency and importance of the measures, classification of each measure was conducted by the Task Force based on timescale, acceptability level of impact and direction. Such types of classification are referred to a guideline developed in Japan to support adaptation at local government level[6].

- Timescale:

The criteria referred to correspondence to time of occurrence, certainty of impact, current situation of measure and possibility of implementation. In this Master Plan, three timescales are considered namely, short (1-3 years), mid (3-5 years) and long (5-10 years) terms.

- Acceptability level of impact:

Based on expected outcome of implementation, it can be divided into three levels namely,

- Protection (Level 1): prevention of climate change impacts such as construction of permanent coastal erosion defense (stone dike),
- Minimization of impact (Level 2): accept certain level of impacts with mitigating them such as establishment of hazard maps, and
- Change/Reconstruction (Level 3): vulnerability improvement in regional/social side against unavoidable climate change impacts such as establishment of funds and subsidiaries for post disaster restoration.

[6] Hosei University, the S-8 Project, "Comprehensive Study on Impact Assessment and Adaptation for Climate Change," implemented by the Environment Research and Technology Development Fund of the Ministry of the Environment, Japan, Guideline for Climate Change Adaptation, 2015, http://www.adapt-forum.jp/tool/pdf/tekiousaku-guideline_last.pdf

➢ Adaptation direction:

When time scale and acceptability level of impact are considered together, adaptation measure can be further categorized into three types based on implementation direction namely,

- Strengthen existing adaptation measures,
- Acclimatize/Accommodate to medium/long term impacts, and
- Fundamental improvement of vulnerability (see (e) Reference materials for further information).

The categorization is introduced through discussion of the Adaptation Task Force. Due to various benefits expected from the implementation, it is possible that one measure contains more than one direction.

(i-4) Prioritization of adaptation measures:

Measures expected to have relationship with other sectors (refer to Section 6 "Lesson learnt and challenges for future") are categorized into three types of priority as follows:

- High: first priority, or it should be given as highly urgent and should be primarily implemented,
- Middle: moderate priority, and
- Low: lower priority or less urgency than others.

The results applied above classifications can be found in a full report of the Master Plan.

(ii) Identification and development of adaptation measures

As the results from the previous analysis, adaptation measures for the three priority issues were selected and developed in the tables as follows.

Table 5-5-1: Flooding

Time scale of impact	Adaptation level	Adaptation measure
Short term 1-3 years	Level 1 Prevention	Strengthen measures for retention areas e.g., construct and improve temporary retention basins (BMA et al., 2009)
		Dredge of drainage channels
		Install drainage pumps
		Improve small scale irrigation facilities e.g., gates, weirs and etc. (NESDB et al., 2013)
		Construct 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 Minimize impacts	Provide catchment area to store water and reduce volume of flood water flow rate

Time scale of impact	Adaptation level	Adaptation measure
		Ensure feed for livestock (NESDB et al., 2013)
		Designate evacuation areas (MOEJ, 2010) with appropriate facilities/equipment
		Develop disaster evacuation plan and revise the plan as necessary
		Develop emergency preparedness plan
		Strengthen emergency communications (BMA et al., 2009)
		Promote people's participation to maintain community canal
		Educate/inform citizens on flood related issues e.g., risk of residing in flood prone area, health care during flood, situation of flood
		Establish "Flood Aid Units" which are ready to help promptly and thoroughly
		Compensate for damaged farmland and properties
	Level 3 Change and Reconstruction	Coordinate with government/related organizations/neighboring provinces to develop agreement on flood water management
		Formulate business continuity plans (MOEJ, 2010)
		Provide financial support during inundation period (NESDB et al., 2013)
Midterm 3-5 years	Level 1 Prevention	Continue the implementation according to the plan
		Promote household level flood protection measures such as flood walls
		Construct community-based small scale retention pond
		Maintain canals/rivers and increase drainage capacity (NESDB et al., 2013) e.g. maintenance of levees and river bank dredging
		Develop Ayutthaya bypass channel regulation
		Operate existing dams effectively and revise dam water management plan as appropriate
		Construct and elevate outer ring road as alternative for transportation during flood
		Provide alternative power source and power transmission lines
		Construct flood proof buildings (BMA et al., 2009)
		Effectively utilize existing flood protection facilities and extending their lifetime via regular maintenance (MOEJ, 2008)
	Level 2 Minimize impacts	Establish flood hazard maps
		Implement education program to create understanding on flood risk map and to introduce self-flood prevention measure to citizen
		Improve accuracy of weather forecast and upgrade monitoring and warning systems (MOEJ, 2008)
		Develop flood management information system with link to other sectors e.g., planting schedule
		Establish guidelines for flood control facilities operation
		Enforce law on land use and adopt integrated land use planning e.g., prohibit construction in flood prone area
		Implement intervention measure in agricultural sector when appropriate (NESDB et al., 2013)
		Develop emergency preparedness plans (BMA et al., 2009)
		Provide more catchment areas
		Relocate housing in flood prone areas
	Level 3	Utilize urban planning measures

Time scale of impact	Adaptation level	Adaptation measure
	Change and Reconstruction	Conduct research and develop countermeasures technologies (MOEJ, 2010)
Long term 5-10 years	Level 1 Prevention	Continue the implementation of plans
	Level 2 Minimize impacts	Continue the implementation of plans
		Ensure operational guidelines for flood control facilities
		Enforce law on land use and integrated land use planning (BMA et al., 2009)
		Improve flood management information system (NESDB et al., 2013)
		Upgrade monitoring and warning systems (MOEJ, 2008)
	Level 3 Change and Reconstruction	Continue the implementation of plans
		Provide government sponsored flood insurance (for areas outside of flood protection facilities) (BMA et al., 2009)
		Establish funds and subsidies for post disaster restoration (MOEJ, 2008)
		Conduct research and develop countermeasures technologies (MOEJ, 2010)

Table 5-5-2: Coastal erosion

Time scale of impact	Adaptation level	Adaptation measure
Short term 1-3 years	Level 1 Prevention	Construct temporary coastal area protection fence (Bamboo)
		Integrated disaster prevention system for coastal community - including evacuation road, hazard map and early warning system to sea side and inland areas
		Improvement of dike system (BMA et al., 2009)
	Level 2 Minimize impacts	Promote people's knowledge on benefits of mangrove forest and its conservation
		Promote mangrove forest plantation
		Develop emergency preparedness plans (BMA, et al., 2009)
		Public information campaigns and training exercises (World Bank, 2010)
	Level 3 Change and Reconstruction	Set clear goal for coastal area protection measures and develop action plan accordingly
		Set up joint committee of stakeholders to develop the coastal area management master plan by adopting integrated coastal zone management approach (MOEJ, 2008)
Midterm 3-5 years	Level 1 Prevention	Construct permanent coastal erosion defense wall (Stone dike)
		Integrated disaster prevention system for coastal community - including evacuation road, hazard map and early warning system to sea side and inland areas
		Maintain and improve coastal area protection facilities (MOEJ, 2008 and MOEJ, 2010)
		Comprehensive sediment control along rivers and coastal areas (MOEJ, 2008)

Time scale of impact	Adaptation level	Adaptation measure
		Design proper wastewater discharge
	Level 2 Minimize impacts	Prohibit and restrict construction in high risk zones (MOEJ, 2008)
		Enforce law on land and fisheries and enhance the role of communities in coastal protection tasks
		Improve coastal ecosystem services to maintain existing capacity in supporting food security
		Rehabilitate mangrove forest along the shoreline of Bang KhunThian (The World Bank, 2010)
		Relocate community from high risk zones
		Develop integrated land use plan
		Initiate and develop hazard maps
		Develop emergency preparedness plans (BMA et al., 2009) including early warning system (ONEP, 2011), and monitoring system (MOEJ, 2008)
		Coastal Monitoring Center
		Public information campaigns and training exercises (The World Bank, 2010)
		Operate harbor/port
	Level 3 Change and Reconstruction	Implement integrated coastal zone management according to the plan (MOEJ, 2008)
		Conduct research and develop countermeasure technologies (MOEJ, 2010)
Long term 5-10 years	Level 1 Prevention	Implement integrated coastal zone management according to the plan
	Level 2 Minimize impacts	Implement integrated coastal zone management according to the plan
		Monitor ecosystem changes for protection purpose (BMA et al., 2009)
		Implement integrated land use plan
		Upgrade monitoring system (MOEJ, 2008)
	Level 3 Change and Reconstruction	Implement integrated coastal zone management according to the plan
		Conduct research and develop countermeasure technologies (MOEJ, 2010)

Table 5-5-3: Drought and saltwater 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 Minimize impacts	Expand water supply service area
		Construct small water reservoirs
		Supply water from other sources/areas
		Promote water conservation measures, use water efficiently
		Develop drought management and emergency preparedness

Time scale of impact	Adaptation level	Adaptation measure
		plans and monitoring system
		Strengthen emergency communications (BMA et al., 2009)
		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 Minimize impacts	Implement drought management plan
		Drought hazard map
		Implement water and energy conservation measures
		Plant trees (BMA et al., 2000)
		Public information campaigns and training exercises (The World Bank, 2010)
		Develop warning and monitoring systems (MOEJ, 2008)
	Level 3 Change and Reconstruction	Implement drought management plan
		Conducting research and developing technologies for countermeasures (MOEJ, 2010)
Long term 5-10 years	Level 1 Prevention	-
	Level 2 Minimize impacts	Implement drought management plans with proper monitoring and warning systems (MOEJ, 2008)
		Implement integrated land use planning
		Implement water and energy conservation measures
		Plant trees
	Level 3 Change and Reconstruction	Establish funds and subsidies for post-disaster recovery (MOEJ, 2008)
		Implement actions as planned
		Conduct research and develop countermeasures technologies (MOEJ, 2010)

(iii) Capacity development of BMA staff

Two main activities aiming for capacity development of BMA staffs were implemented as below.

(iii-1) Support through Adaptation Task Force Meetings

◆ Link experience of BMA staffs on disaster management to climate change adaptation

As described above, a process of literature reviews was important to create list of possible adaptation measures. BMA staffs learned from the reviews and consequently created understanding through TF discussion on what is adaptation they have done and what will be needed more to cope with future climate change. BMA staffs were also encouraged to share their experience and opinion on the above issues as practical information integrated to the

Master Plan.

◆ Consider cross-cutting adaptation measures with other sectors

Some adaptation measures relate to other TF sector's mitigation measures. For example, mangrove reforestation which both decreases coastal erosion and at the same time increases green area of Bangkok supporting Green Urban Planning sector. Benefit of cross-cutting implementation includes cost saving by avoiding duplication of measures and synergy of the measures. BMA staff reviewed the relationship and highlighted effectiveness of such measures. Therefore, these measures were given as criterion for prioritization. Cross-sectoral discussion meetings among related Task Forces should be encouraged for cooperative implementation.

(iii-2) Training trips to Yokohama

◆ Development of Monitoring and Evaluation (M/E) table

The M/E table development was initiated in one of the training trips to Yokohama, Japan between 26 October and 6 November 2014. The table is used for supporting the effective progress management of the adaptation measures. Through the discussion on the table, the priority adaptation measures, such as construction of stone dikes, of Bang Khun Thian district and developing flood and drought hazard maps were raised.

Through sharing and explaining experience from staff of Yokohama City, BMA staff could understand the success and difficulties of hazard map development in Yokohama, and such knowledge was reflected to the first draft of the M/E table. After the trip, a series of discussion on development of the M/E table among Adaptation Task Force members, local consultant and JICA Experts were conducted and the result was integrated in the Master Plan. When new prioritized adaptation measure is considered, it is expected that Adaptation Task Force will be able to develop and/or update the M/E table for the effective implementation of the adaptation measures by themselves.

(iv) Activities for outreach and public awareness

Adaptation Task Force recognizes that in order to achieve implementation of the adaptation measures identified, public participation especially from the community in impacted area is a key driver to success. To encourage public participation, Adaptation Task Force conducted two outreach activities under the theme "Adaptation World" in two of such local communities:

- To disseminate the Bangkok Master Plan on Climate Change 2013-2023, and
- To share experience on adaptation to climate change.

Outreach Activity 1: Community affected by coastal erosion (Figure 1)

Location: Klongpittayalongkorn School, Bang Khun Thian District

Date and time: 16 July 2015, 10:00 - 12:00

Participant: 63 persons including local governments such as policemen, community leaders, citizens and NGOs

◆ Background:

Bang Khun Thian is located along the coast of Bangkok. At present, more than 760 m of the shoreline has been severely eroded. BMA has implemented various measures to mitigate the problem, for example, by constructing bamboo dike and rock-pile embankment. In order to strengthen the measures and to reclaim previously eroded area, BMA has planned to construct strong stone dike. In addition, BMA is planning to establish the Coastal Monitoring Center to monitor the coastal erosion as well as to encourage public awareness about the problem. Currently, the process of getting permit for the stone dike construction is under EIA process.

◆ Information and opinions from the impacted community:

Community leaders addressed urgent need of robust stone dike to prevent the further coastal erosion and to recover the eroded area. There are some comments which criticize about taking time for EIA procedure, however, with BMA's explanation on long process of acquiring EIA permit for the construction, they understood the process. Meanwhile, in order to address the problem in short term, several urgent measures are raised from citizens, namely:

- Construction of evacuation road for local people,
- Early warning system for strong wind and storm surge to both sea side and inland areas such as through radio network so that people fishing in the sea as well as staying inland can catch the warning, and
- Hazard map

Adaptation Task Force has understood the above urgent practical needs and integrated them as one of the priority adaptation measures.

Figure 5-5-1: Outreach activity with communities in the coastal area

Outreach Activity 2: Community affected by flooding (Figure 2)

Location: City Law Enforcement Department, BMA, Thonburi District

Date and time: 17 July 2015, 10:00 - 12:00

Participant: 51 persons including local governments, community leaders, religious leader, citizens and NGOs

Background:

Thonburi District is located beside Chao Phraya River where floods have been occurred many times especially the great one in 2011. Citizens were hardly affected by the floods in economic and social aspects. Several flood prevention measures were already implemented such as dikes and pumping station. Based on the Master Plan, as one of the adaptation measures, BMA is intending to establish a flood hazard map which has been attracted by the success of Yokohama City.

Information learnt from the impacted community:

Figure 5-5-2: Outreach activity with communities in the area affected by flooding

(d) Lesson learnt and challenges for future

Lesson learnt

◆ Development of ownership to the Master Plan by Task Force members

In the first stage, the concept “adaptation” itself seemed to be relatively new and difficult to understand for BMA staffs. It seemed to have been one of the causes of difficulties that extent of impacts and effects of adaptation measures tend to depend on qualitative information, while GHG emission and reduction can be assessed quantitatively in mitigation measures. Therefore, Task Force members have been felt rushed for a period such as “Our Task Force has been got behind the other sectors”.

However, through the repeated explanation and discussion helped them to understand that various actions which they are already implementing in their regular work as a local government has been already a first step of adaptation measures. In addition, they also understood that many governmental officers in other countries and regions are also facing a similar difficult situation in the process of development and implementation of adaptation measures. By doing so, they could understand adaptation step by step.

Especially, we emphasized that the Master Plan is a plan for “actual practice” and in order to realize that, the plan should be easy-understanding and user-friendly for working level staff. It resulted in their proactive participation, especially by some major members. For example, in the initiation of activities, they were tend to ask a local consultant and JICA experts in preparation of presentation materials for Taskforce meetings, but in the last stage, they developed reporting materials and made presentations only by themselves for the training trip in Japan and the Working Group, and their ownership has been enhanced obviously.

In the Outreach activities, BMA staff could implement almost all required things by themselves, such as selection of target districts, consideration of presentation contents, responding to logistical issues, contact and coordination for participants, etc. It was attributed to utilize a human network and an interface function effectively that have been established through the experiences of presentation meetings on some projects in their regular work.

◆ Internal supporters for developing the Master Plan

Securing local consultants who can meet following conditions is very important key issue in order to manage effective Task Force meetings and develop the Master Plan based on the discussion. The conditions are; to ensure sufficient communication in Thai language with BMA staffs who belongs to different divisions, to ensure a reading ability of English literatures efficiently, and to ensure a technical communication with JICA experts. As there are only limited number of researchers on adaptation, it was difficult and took time to select an appropriate person. However, the TF could get support from preferable expert finally. Dr. Alice,

assistant professor, had a strong advantage in the aspect of cooperation with JICA experts because she completed her doctorate on natural resource management in Japan.
In addition, the existence of an interpreter at every Task Force meeting was also necessary. Most of BMA staffs have limited chance to speak in English on a daily work, therefore, it is not easy to discuss and read/understand in English. However, by the intervention of an interpreter, the discussion was activated very much. Also, understanding of the interpreter herself had been deepen by using same interpreter continuously, therefore the TF could expect correct interpretation.

◆ Cooperation with local governments in Japan

In the training in Japan for developing the Master Plan, it was a large impact that BMA staffs could share actual experiences such as specific cases on adaptation actions by local governments in Japan, and their problems and solutions, etc. The experience regarding development of hazard map in Yokohama-city was one example. Mie-prefecture's actions for adaptation were also an important reference. Visiting Mie prefecture by all participants of training including other sectors' staffs, hearing directly from officers of Mie prefecture about specific cases of adaptation measures and experience of establishing internal cross-sectoral organization/structure for developing/implementing adaptation plan helped them to have a specific image on adaptation measures.

Challenges for future

◆ Discussion on priority issues

The discussion should be continued whether further understanding of current impacts and developing adaptation measures are necessary regarding other issues except for already identified priority issues such as flooding, coastal erosion and drought and saltwater intrusion. For example, food security, infection diseases, heat stroke are considered to be remaining priority issues.

◆ Continuity of capacity development

There was a certain progress regarding capacity enhancement of BMA staff. However, the situation has not been changed largely that adaptation measures are still new issues for many staff. In Task Force members, some staff have got higher ownership but some were relatively still passive.
For understanding climate change impacts and development/implementation adaptation measures, it is necessary to cooperate with government institutions, other local governments, research institutes and international organizations etc. For the adaptation measures against flood,

it is necessary to cooperate with local governments located upper river basin of Chao Phraya River. For the adaptation measures against coastal erosion, cooperation with local governments located both sides of BMA's coast is effective. Some measures such as securement of retarding basins at the time of flood, improvement of evacuation roads, and prevention of grand subsidence by excessive groundwater intake in the coastal area have conflict of interest among various stakeholder. Therefore, the coordination of them will face difficulty.

Such process of coordination will be difficult for BMA staffs only. However, they have to develop their own capacity to collect and analyze information regarding such issues and measures, carry out the adaptation measures, continue monitoring and progress management after implementation of the measures, and develop a necessary approach for such issues and provide a direction to practical actors. In order to make them keep working as their own challenges, with reducing proportion of dependence on local consultant, continuous support for further capacity development is inevitable.

◆ Addressing cross-cutting issues

In the Master Plan, there are some adaptation measures which have deep relationship with mitigation measures. They are expected to be implemented more effectively in combination with the mitigation measures at same time or in parallel. There are still a few cases such consideration has been introduced in a local government level and it is a new challenge.

It is preferable to share specific information on measures and experiences gained through daily works with related actors appropriately, and start from measures which will be easy to initiate. Also, this action could be a very good example for other cities in Thailand as well as cities in ASEAN which address mitigation and adaptation. The progress of actions and output should be disseminated widely.

In the future, toward a realization of adaptation measures identified as cross-cutting issues, methods and organization structure for cooperation with other sectors have not been developed yet. As mentioned in Chapter 6 of whole challenges, it is necessary to coordinate among relevant divisions by an organization which integrates climate change measures of whole BMA.

(e) Reference materials

Table 5-5-4 Three directions of adaptation measures to be implemented

		Level for adaptation measures		
		Level 1 Protection	**Level 2 Minimization of impact**	**Level 3 Change/ Reconstruction**
		Improvement of adaptive capacity ⟷		Improvement of vulnerability
Timescale of climate change impacts	**Present /short term impacts**	**I Strengthen existing adaptation measures** 1. Impact assessment and development of approaches on adaptation measures 2. Improvement of monitoring network and management 3. Development and demonstration of adaptation measures 4. Diffusion of adaptation measures (information, economy and restriction measures) 5. Promotion of cooperation and establishment of organization		**III Fundamental improvement of vulnerability** 1. Restructuring of land use and regional structure 2. Transformation of economic system with diversity and flexibility 3. Community restructuring with a care for the disadvantaged
	Medium /long term impacts	**II Acclimatize/Accommodate to medium/long term impacts** 1. Setting alternatives based on impact assessment 2. Selection, implementation and revision of alternatives through monitoring 3. Record, explanation, participation and learning of stakeholder		

Source：Guideline for Climate Change Adaptation (2015)
http://www.adapt-forum.jp/tool/pdf/tekiousaku-guideline_last.pdf (in Japanese)

WG Related Documents

- WG presentation materials (September 2013)
- WG presentation materials (May 2014)
- WG presentation materials (October 2014)
- WG presentation materials (January 2015)
- WG presentation materials (May 2015)

6. Lesson learned and challenges for future

There are many lessons learned from the implementation of the Technical Cooperation Project. Amongst them, the following aspects in the box are highlighted.

(1) Sorted out elements of a climate change master plan
(2) Provided generic steps for developing a climate change mater plan
(3) Elaborated approaches to consistency with mitigation targets and adaptation planning between national and local levels.
(4) Developed methodologies on GHG quantification and MRV for mitigation measures
(5) Developed a mechanism for prioritization and coordination of adaptation needs
(6) Established institutional arrangement to enhance cross-cutting coordination within a local government and with relevant national authorities for building consensus
(7) Developed tools for M&E and MRV
(8) Enhanced outreach to the private sector for public-private partnership
(9) Conducted planning and capacity building in cooperation with Japanese local government

As a major characteristic of the Technical Cooperation Project, city-to-city cooperation was extremely useful, since it has provided not only conceptual information on climate change actions, but also a more realistic and pragmatic perspectives were provided through discussion between Bangkok and Japanese local government officials. As to a challenge, in the case of local governments, there are periodical staff change occurs. In that case, it is important to strengthen the storage of institutional memory, which ensures the smooth and steady continuation of work, even staff change happened.

Also, as to M&E and MRV, the Technical Cooperation Project provided a basic framework in ex ante manner (prior to implementation). When it comes to the stage of full implementation of the Master Plan, it is further necessary to adjust the current framework, with inputs and advices of technical experts.

7. For the effective implementation of the Master Plan and establishing a low carbon and climate change-resilient city

The Technical Cooperation Project completed its activities by having the major outputs as the above mentioned. Throughout the project period, diligent efforts were made by BMA, Thai national authorities, Japanese local governments, such as the City of Yokohama, and other key experts both from Thailand and Japan. This process itself created a useful platform, where many different stakeholders can work jointly in a coordinated manner.

Also, highly motivated BMA officials have been a real driving force of the Master Plan and further to the establishment of a low carbon and climate change-resilient city. The involvement of top-level official such as the BMA Governor to working level officials throughout BMA, it is important that the climate change policy based on the Master Plan should be mainstreamed into their respective local government administrative actions. While the challenge of climate change itself is extremely big, yet, the Master Plan is expected to pave the way forward.

At the same time, the Bangkok Master Plan on Climate Change 2013-2023 will pave the way forward also for other cities in the ASEAN region and the world. Its efforts have attracted high attention by other cities, and may provide a good model case for spillover effects. To this end, the steady implementation of the Master Plan is important and meaningful for BMA and its partners.

8. Reference materials (1)

WG related materials of 5 task forces

- 1st WG presentation materials (September 2013)
- 2nd WG presentation materials (May 2014)
- 3rd WG presentation materials (October 2014)
- 4th WG presentation materials (January 2015)
- 5th WG presentation materials (May 2015)

Materials for activities of capacity development

- General Approach toward drafting a master plan on climate change
- Seven steps to develop the Master Plan

Materials for outreach activities

- Panel (roll up) for outreach activities of 5 task forces

Bangkok Master Plan on Climate Change 2013-2023

- Executive summary (English version)
- Executive summary (Thai version)

*Following materials are included in Final Report (2)

- Bangkok Master Plan on Climate Change 2013-2023 (English version)
- Bangkok Master Plan on Climate Change 2013-2023 (Thai version)

Environmentally Sustainable Transport Task Force

Joint Team made by
Environmentally Sustainable Transport Task Force and JICA Experts in Transport Sector

Time line

Date	Meetings	Topics
9th May, 2013	1st Task Force Meeting	• The outline of the JICA project • The framework and basic principles of the master plan formulation in the transport sector • Selection of local consultant/expert • Preparation for upcoming tasks (Review of the previous Action Plan)
24th July	2nd Task Force Meeting	• Review of the 1st JCC/SC and 1st TF meeting • Progress on the review of the Action Plan • Interview on transport projects in BMA • Details of the workshop • Schedule
July	Interviews to related organizations	• OTP, MRTA, DLT, BMCL, SRT, DOH, KT Co. Ltd, EXAT (With the local consultant)
30th July	Internal Meeting	• Activities of BMA on transport and environment (Mr. Thosapol, Mr. Wiruch, JICA experts)
30th July	1st Workshop	• To understand and summarize policies/measures related to environmentally sustainable transport in Bangkok • To promote further understandings about transport projects in the context of climate change issues

Policy Information & Data collection

Organization	Information & Data
BMA	• Statistical year book on transport • Major project related to transport and environment
OTP	• Environmental Sustainable Transport Master Plan
MRTA	• MRT development map/construction plan/investment plan • MRTA rolling stock requirement • Park & ride, current situation and future plan • Statistics, such as MRT passenger, revenue, energy consumption
SRT	• Update status of MRT constructions
BMCL	• Annual Report 2012
BTS	• Annual Report 2012
KT	• On-going projects on public transport and non-motorized mode transport
DLT	• Number of vehicle registered in Thailand by Fuel as of 30 June 2013 • Number of vehicle registered in Bangkok by Fuel as of 30 June 2013 • Report on inspection
DOH	• Highway Development Plan in Bangkok and vicinity as of 2013 • On going project of highway • Annual Report 2012
DRR	• Action Plan on Traffic Problem Alleviation in BMR, and Annual Report 2012

Discussion at the Task Force Meetings

- TF members understood:
  - The objectives and tasks of the JICA project
  - The framework and basic principles of the master plan formulation in the transport sector
  - Basic concept of emission reduction calculation
- Discussed about MRV on:
  - Target area: focus on BMA's each policy/measure or GHG emission from whole area of Bangkok
  - Target policies/measures: DIRECTLY controlled by BMA or includes policies/measures INDIRECTLY controlled by BMA
  - Important aspects: "Practical" and "Transparent" MRVs, and some measures can be monitored qualitatively, not stick to quantification

Discussion at the Workshop

- TF members and participants learned:
  - Policies/measures related to environmentally sustainable transport in Bangkok
  - Importance of MRV and basic concept of emission reduction calculation
- Participants made supportive comments such as:
  - The master plan is very important, since the local government can directly communicate with people in the area.
  - Cooperation between BMA and other organizations are necessary not only at the stage of formulating the master plan, but also at the stage of implementation.
  - BMA and OTP should work closely on this matter, and OTP could fully support BMA on this project.

Emission estimations in the transport sector

Category	Remarks
Project base (Emissions from projects directly owned/controlled by BMA)	• Estimate emissions of each project directly controlled by BMA, such as BMA's motor vehicles, BTS, BRT etc. • Relatively easy to collect and monitor necessary data in BMA's routine work
Area base (Emissions from Bangkok area as a whole, including emissions indirectly controlled by BMA, owned/ controlled by other authorities, etc)	• Estimate emissions of whole Bangkok area, including all the transportation mode. • Relatively difficult to collect and monitor necessary data in BMA's routine work

Emission estimations in the transport sector

Basic approach to quantify transport emissions are...

$$Emission = Activity \times Emission\,Factor$$

Option 1	Energy (fuel, electricity) consumption (liter, kWh)	EF (kg/liter, kg/kWh)
Option 2	Driving distances (km)	EF (kg/km) = EF(kg/liter)/FE(km/liter)
Option 3	Transport amount (passenger-km)	EF (kg/passenger-km)
Option 4	Transport amount (ton-km)	EF (kg/ton-km)
Option xx		

Achievements, Lessons learned & challenges, and expectation

- Mostly collected relevant and updated policy and data in regard to transport and environment of BMA area.
- Next step is to list up candidate measures to be included in the master plan and to estimate emission reduction.
- It is important to learn more in terms of activities of Japanese local government on climate change and transport.

Environmentally Sustainable Transport Task Force

Working Group for Discussing the 1st Draft Master Plan on Climate Change and its Actions

October 22, 2014

Current status of GHG emission and future trend

Current status of GHG from the Transport Sector

- Scope of Emission
  - o CO_2 emissions associated with transportation activities (road, railway, waterway) within BMA administrative area
  - o CO_2 emissions associated with BMA owned vehicles.
- Methodologies for Calculation

Road

"Fuel consumption from road sector in Bangkok by fuel types" x "CO_2 emission factor by fuel types (per liter etc.)" x "Fraction of carbon oxidized by fuel types"

*"Fuel consumption from road sub-sector in Bangkok by fuel types" is estimated using "Total fuel consumption of road sub-sector in Thailand by fuel types " and "Number of motor vehicles registered in Thailand and Bangkok "

Railway

"Electricity consumption of MRT and Skytrain in Bangkok" x "CO_2 emission factor of the grid electricity"

Waterway

"Fuel consumption of waterways in Bangkok" x "CO_2 emission factor by fuel types" x "Fraction of carbon oxidized by fuel types"

Current status of GHG from the Transport Sector

Results (emissions in 2013)

Emissions from Road

Fuel types	emission (tCO_2/year)
Natural Gas	4,515,215
LPG	2,971,405
ULG91	15,013
ULG95	239,008
GASOHOL E10 91	1,406,942
GASOHOL E10 95	1,264,221
GASOHOL E20	353,565
GASOHOL E85	9,853
HSD	7,264,730
Total	18,089,952

Emissions from Railways

Fuel types	emission (tCO_2/year)
BTS	34,118
MRT (Blueline)	11,258
ARL (Airport Rail Link)	
Total	

Emissions from ARL will be estimated.

Emissions from Waterways

Fuel types	emission (tCO_2/year)
Chaophraya river crossing ferries*1	1,706
Canal boat*2	1,562
Total	3,268

*1: Operated by two companies, Sap Thananakorn Ltd. and Supatra Ltd.
*2: Include Saen Saep canal extension (11 km, 9 station) and Phasricharoen canal (11.5 km, 15 station)

Emissions from BMA owned vehicles

Fuel types	emission (tCO_2/year)
ULG91	7,611
HSD	86,658
GASOHOL E10 95	1,407
Total	95,676

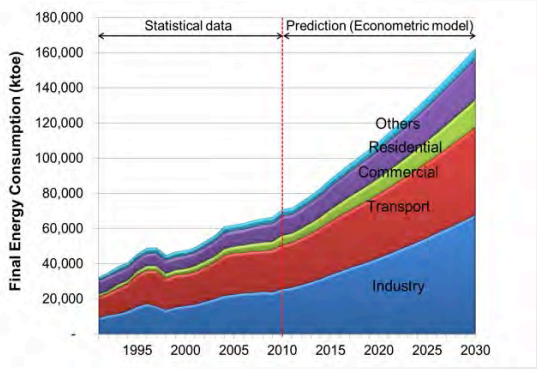
Business-as-Usual (BAU) Emission of the Transport Sector

- Scope of Emission
  - Future (BaU) CO_2 emissions associated with transportation activities (road) within BMA administrative area.
  - BaU Emissions from railways and motorways are excluded, because of simplification since these emissions are very low (less than 1% compared to road transportation).
- Methodologies for Calculation

"Current emission (year 2013)" x "Increase rate of BaU emission"

Increase rate of BaU emission: "Increase rate of BaU energy consumption in transport sector of Thailand" is applied based on "Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy"

The increase rate is under discussion. More appropriate method will be set.

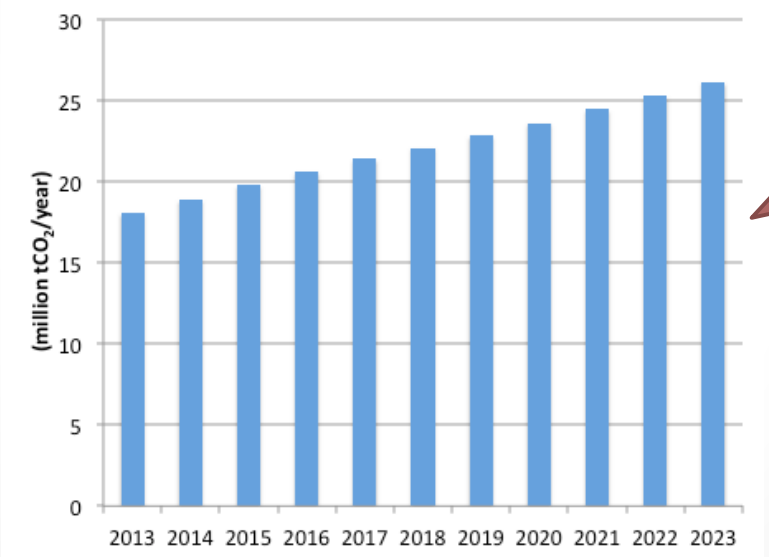


Future (BaU) energy consumptions by 2030 by sectors in Thailand (Source: "Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy")

Business-as-Usual (BAU) Emission of the Transport Sector

Results

Future (BaU) CO_2 emissions associated with transportation activities (road) within BMA administrative area



This is tentative result, and the increase rate is under discussion.

Mitigation actions for the Transport Sector

Overview of the actions

1. Public transportation (Infrastructure)	• Development of Mono-rail and LRT • Extension of BTS • Development of MRT • Development of BRT • Development/improvement of water transportation
2. Public transportation (Supporting measures)	• Improvement of connectivity of public transportation • Improvement of bus service • Development of passenger shelter at bus station • Development/expansion of Park & Ride • Introduction of common ticket system
3. Measures on motor vehicles	• Introduction of low emission vehicles (LEV) to BMA's public vehicles • Introduction of NGV to BMTA buses • Promotion of Eco-driving
4. NMT	• Development/expansion of bikeway • Expansion of "Bike-for-Rent" • Development/expansion of pedestrian
5. Traffic volume/flow control	• Development/improvement of road, bridge, tunnel • Improvement of signal system • On-street parking control
6. Public awareness rising	• Promotion of public transportation • Classes for school to learn about environment/transport • Organize workshops and seminars

Details of the actions (examples)

Example: Monorail Gray line (Watcharaphon - RAMA IX)

Category : Public Transportation (Infrastructure)

Measure : Development of LRT, Mono-rail

Details of the measure : Monorail: Gray line (Watcharaphon - RAMA IX)

Responsibility: BMA (Directly implement)

Implementation Schedule : Short term (2013-2018)

Service area: 26 Kilometers , 21 stations , Along the Pradit Manutham Road, And connecting between Watcharaphon Road and RAMA IX Road.

Map : Monorail Gray Line (Watcharaphon - RAMA IX)

Example : SaenSaep canal extension, Phasricharoen canal

Category : Public Transportation (Infrastructure)

Measure : Development/improvement of water transportation

Details of the measure : SaenSaep canal extension, Phasricharoen canal

Responsibility: BMA (Directly implement)

Other organization: KrungthepThanakhom, Marine department, MOT

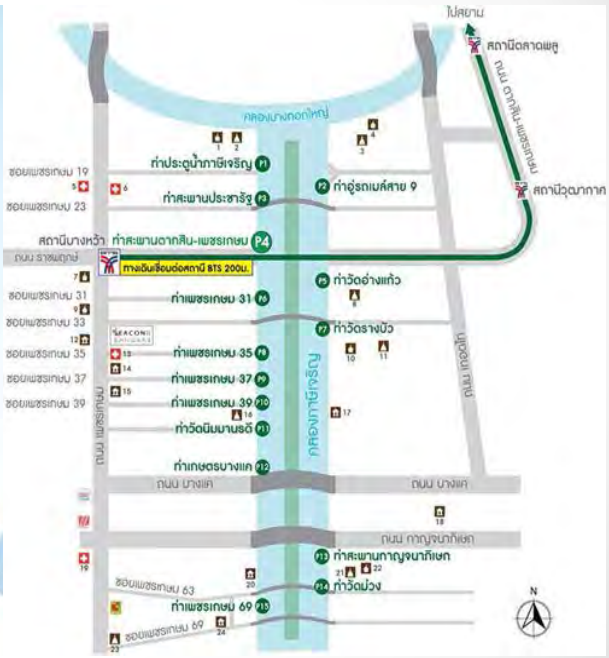
Implementation Schedule : Short term (2013-2015)

Service area: 1. SaenSaep canal extension ; 11 Kilometer, 9 station .
2. Phasricharoen canal ; 11.5 kilometer , 15 station.

Map : Water Transportation

SaenSaep canal extension

Phasricharoen canal



Example : Increase 250 stations and 10,000 bikes

Category : NMT (Non Motorize Transportation)

Measure : Expansion of "Bike-for-Rent"

Details of the measure : Increase 250 stations and 10,000 bikes

Responsibility: Private companies (not identified), BMA: Support

Implementation Schedule : Short term (2013-2016)

Service area: CBD zone and along the BTS and MRT line

Map : PUN PUN Bike-for-Rent Scheme

Example : Car free day program

Category : Public awareness rising

Measure : Car free day

Details of the measure : Car free day program

Responsibility: BMA (Directly implement)

Implementation Schedule : Short term (Annually)

Service area: Bangkok City

Technical and policy challenges

Discussion points with other sectors

- Emissions from garbage trucks. Waste sector or transport sector?
- Each sector should use same emission factors for emission calculation, for example, grid electricity emission factor.
- How each sector will coordinate together for the Master Plan Project.
  - For example, When the city plan sector has a project on improvement of city landscape, a project of bicycle lane improvement initiated by Transport sector could be integrated in the project.

Environmentally Sustainable Transport Task Force

The 4th Working Group for Discussing the 2nd Draft Master Plan on Climate Change and its Actions

January 21, 2014

Current status of GHG emission and future trend

Current status of GHG from the Transport Sector

- Scope of Emission
  - o CO_2 emissions associated with transportation activities (road, railway, waterway) within BMA administrative area
  - o CO_2 emissions associated with BMA owned vehicles.
- Methodologies for Calculation

Road

"Fuel consumption from road sector in Bangkok by fuel types" x "CO_2 emission factor by fuel types (per liter etc.)"

*"Fuel consumption from road sub-sector in Bangkok by fuel types" is estimated using "Total fuel consumption of road sub-sector in Thailand by fuel types " and "Number of motor vehicles registered in Thailand and Bangkok "

*The methodology is based on "2006 IPCC Guidelines for National Greenhouse Gas Inventories"

Railway

"Electricity consumption of MRT and Skytrain in Bangkok" x "CO_2 emission factor of the grid electricity"

Waterway

"Fuel consumption of waterways in Bangkok" x "CO_2 emission factor by fuel types"

Current status of GHG from the Transport Sector

Results (Draft) (emissions in 2013)

Emissions from Road

Fuel types	emission (tCO_2/year)
Natural Gas	4,537,904
LPG	2,986,337
ULG91	15,165
ULG95	291,927
GASOHOL E10 91	1,421,154
GASOHOL E10 95	1,276,991
GASOHOL E20	357,137
GASOHOL E85	9,952
HSD	7,338,111
Total	18,234,678

Emissions from Railways

Fuel types	emission (tCO_2/year)
BTS	34,118
MRT (Blueline)	11,258
ARL (Airport Rail Link)	
Total	

Emissions from ARL will be estimated.

Emissions from Waterways

Fuel types	emission (tCO_2/year)
Chaophraya river ferries*1	8,200
Canal boat*2	3,301
Total	11,501

*1: Operated by three companies, Chaophraya Express Boat Comapany, Sap Thananakorn Ltd. and Supatra Ltd.
*2: Include Saen Saep canal extension and Phasricharoen canal

Emissions from BMA owned vehicles

Fuel types	emission (tCO_2/year)
ULG91	7,688
HSD	87,534
GASOHOL E10 95	1,421
Total	96,643

Business-as-Usual (BAU) Emission of the Transport Sector

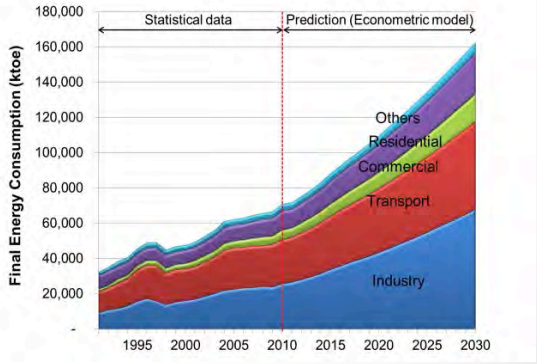
- Scope of Emission
  - Future (BaU) CO_2 emissions associated with transportation activities (road) within BMA administrative area.

    *BaU Emissions from railways and motorways are excluded, because of simplification since these emissions are very low (less than 1% compared to road transportation).

- Methodologies for Calculation (Option 1)

  "Current emission (year 2013)" x "Increase rate of BaU emission"

  Increase rate of BaU emission: "Increase rate of BaU energy consumption in transport sector of Thailand" is applied based on "Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy"



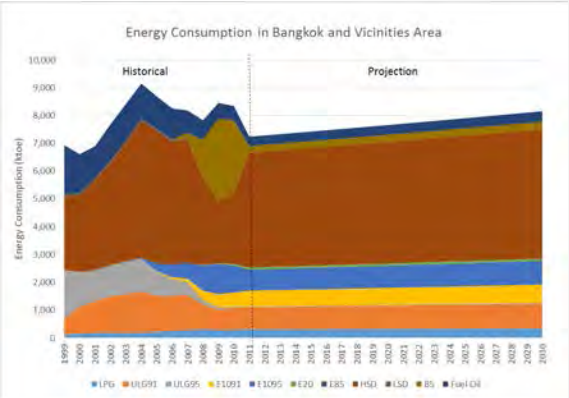
Future (BaU) energy consumptions by 2030 by sectors in Thailand (Source: "Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy")

Business-as-Usual (BAU) Emission of the Transport Sector

- Methodologies for Calculation (Option 2)

  "Current emission (year 2013)" x "Increase rate of BaU emission"

  Increase rate of BaU emission: "Increase rate of BaU energy consumption in transport sector of Thailand" is applied based on historical data of transport energy consumption based on "Oil and Thailand annual report from 1999 to 2011, which is provided by Department of Alternative Energy Development and Efficiency, Ministry of Energy." which is 0.63% per year.

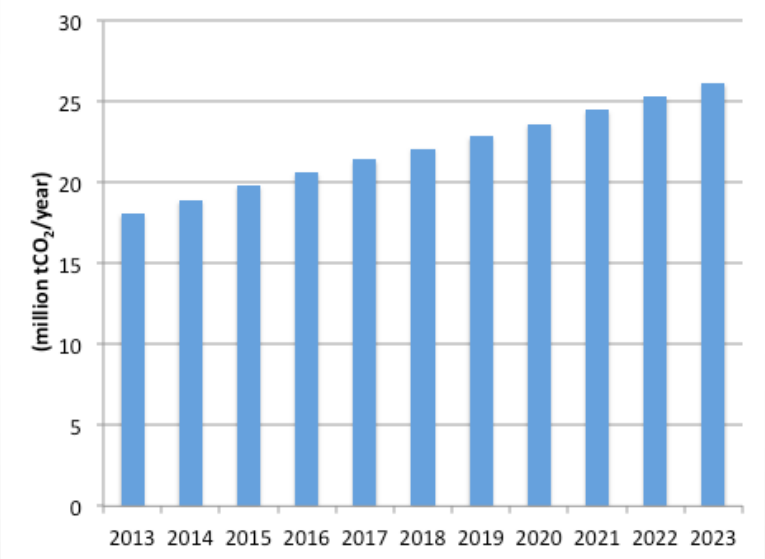


Future (BaU) energy consumptions by 2030 by sectors in Thailand (Source: based on "Oil and Thailand annual report from 1999 to 2011, which is provided by Department of Alternative Energy Development and Efficiency, Ministry of Energy.")

Business-as-Usual (BAU) Emission of the Transport Sector

Results (Option 1)

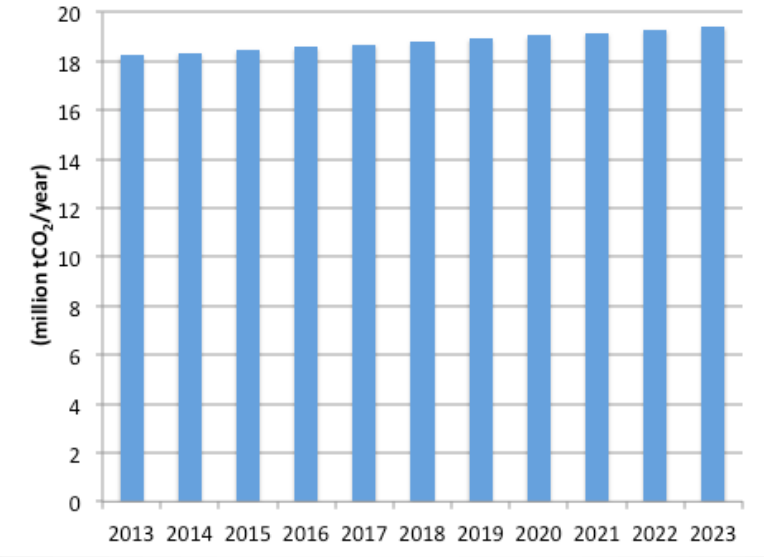
Future (BaU) CO_2 emissions associated with transportation activities (road) within BMA administrative area



Business-as-Usual (BAU) Emission of the Transport Sector

Results (Option 2)

Future (BaU) CO_2 emissions associated with transportation activities (road) within BMA administrative area



Mitigation actions for the Transport Sector

Overview of the actions

1. Public transportation (Infrastructure)	• Development of Mono-rail and LRT • Extension of BTS • Development of MRT • Development of BRT • Development/improvement of water transportation
2. Public transportation (Supporting measures)	• Improvement of connectivity of public transportation • Improvement of bus service • Development of passenger shelter at bus station • Development/expansion of Park & Ride • Introduction of common ticket system
3. Measures on motor vehicles	• Introduction of low emission vehicles (LEV) to BMA's public vehicles • Introduction of NGV to BMTA buses • Promotion of Eco-driving
4. NMT	• Development/expansion of bikeway • Expansion of "Bike-for-Rent" • Development/expansion of pedestrian
5. Traffic volume/flow control	• Development/improvement of road, bridge, tunnel • Improvement of signal system • On-street parking control
6. Public awareness rising	• Promotion of public transportation • Classes for school to learn about environment/transport • Organize workshops and seminars

Details of the actions (examples)

Example: Monorail Gray line (Watcharaphon - RAMA IX-Tha Phra)

Category : Public Transportation (Infrastructure)

Measure : Development of LRT, Mono-rail

Details of the measure : Monorail: Gray line (Watcharaphon - RAMA IX – Tha Phra)

Responsibility: BMA (Directly implement)

Implementation Schedule : Short term (2013-2018)

Service area: 39.91 Kilometers , 38 Stations and divided into 3 phase
Phase 1 Watcharaphon – Thong Lor , 16.25 Kilometers , 15 Stations
Phase 2 Phrakhanong – RAMA III , 12.17 Kilometers , 14 Stations
Phase 3 RAMA III – Tha Phra, 11.49 Kilometers , 9 Stations

Map : Monorail Gray Line (Watcharaphon - RAMA IX - Tha Phra)

- Phase 1 Watcharaphon – Thong Lor , 16.25 Kilometers , 15 Stations Along Pradit-Manutham Road
- Phase 2 Phrakhanong – RAMA III , 12.17 Kilometers , 14 Stations Along Rama IV ,Sathorn ,Narathiwas and Rama III Road
- Phase 3 RAMA III – Tha Phra , 11.49 Kilometers , 9 Stations Along Rama III ,Ratchada Pisek Road

Example : SaenSaep canal extension, Phasricharoen canal

Category : Public Transportation (Infrastructure)

Measure : Development/improvement of water transportation

Details of the measure : SaenSaep canal extension, Phasricharoen canal

Responsibility: BMA (Directly implement)

Other organization: KrungthepThanakhom, Marine department, MOT

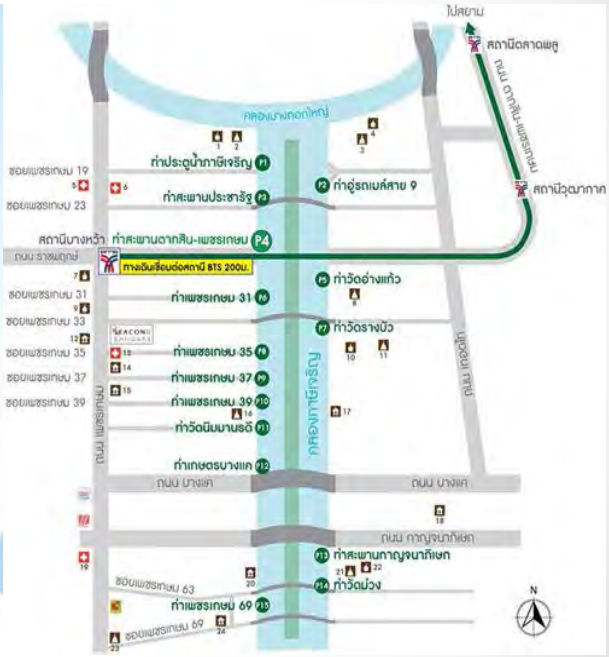
Implementation Schedule : Short term (2013-2015)

Service area: 1. SaenSaep canal extension ; 11 Kilometer, 9 station .
2. Phasricharoen canal ; 11.5 kilometer , 15 station.

Map : Water Transportation

SaenSaep canal extension

Phasricharoen canal



Example : Increase 250 stations and 10,000 bikes

Category : NMT (Non Motorize Transportation)

Measure : Expansion of “Bike-for-Rent”

Details of the measure : Increase 250 stations and 10,000 bikes

Responsibility: Private companies (not identified), BMA: Support

Implementation Schedule : Short term (2013-2017)

Service area: CBD zone and along the BTS and MRT line

Map : PUN PUN Bike-for-Rent Scheme

Example : Car free day program

Category : Public awareness rising

Measure : Car free day

Details of the measure : Car free day program

Responsibility: BMA (Directly implement)

Implementation Schedule : Short term (Annually)

Service area: Bangkok City

BANGKOK CAR FREE DAY 2014
เดินทางร่วมกัน วันพาหนะส่วนรวม

Monitoring and Evaluation (M&E)

Measurement, Report, and Verification (MRV)

Overview of M&E/MRV (*tentative idea*)

Category	Action	M&E/MRV	
		Check the progress of measures	Estimation of GHG emission reduction
1. Public transportation (Infrastructure)	Development of monorail and LRT	✔	✔
	Extension of BTS	✔	✔
	Development of MRT	✔	✔
	Development of BRT	✔	✔
	Development/improvement of water transportation	✔	✔
2. Public transportation (Supporting measures)	Improvement of connectivity of public transportation	✔	
	Improvement of bus service	✔	
	Development of passenger shelter at bus station	✔	✔ (LED)
	Development/expansion of Park & Ride	✔	✔
	Introduction of common ticket system	✔	
3. Measures on motor vehicles	Introduction of low emission vehicles (LEV) to BMA’s public vehicles	✔	✔
	Introduction of LEVs to BMTA buses	✔	✔
	Promotion of Eco-driving	✔	✔
4. NMT	Development/expansion of bikeway	✔	
	Expansion of “Bike-for-Rent”	✔	
	Development/expansion of pedestrian	✔	
5. Traffic volume/ flow control	Development/improvement of road, bridge, tunnel	✔	
	Improvement of signal system	✔	
	On-street parking control	✔	
6. Public awareness rising	Promotion of public transportation	✔	
	Classes for school to learn about environment/transport	✔	
	Organize workshops and seminars	✔	

1-1 Development of mono-rail and LRT

M&E/MRV		Baseline indicator	End of Project/Action indicator	Data/Information	Data/Information Provider	Reporting cycle	Other remark
M&E	M&E of activities	· A feasibility study was almost completed (90%) · Budgetary arrangement is not yet decided. · Tender is not yet done · Construction is not yet done. · There is no Monorail yet.	· With the feasibility proposal to the Governor, and BMA Council for budget · Budgetary arrangement is decide. · Tender · Construction 3 monorail lines are build and operate	· FS Report · BMA council decision (Budget xxx Bath)	· DOT · BMA council, DOT, DOB		
	MRV of GHG emissions	· GHG reduction from modal shift is not yet in place	· GHG reduction from modal shift is in place	· Number of passenger of the MRT in year y (passenger/y) · Average trip distance of the passenger of the MRT in year y (km) · Electricity consumption of MRT (MWh/year) · Share of passengers that would have taken transport mode i (%) · CO2 emission factor of transport mode i (gCO2/km) · Average occupancy rate of transport mode i (passenger/vehicle)	· MRT company · MRT company · MRT company · BMA (Interview survey) · PCD or other agencies · BMA (Ex-ante measurement)	· Annually · Annually · Annually · every 2-3 years · not monitor · once before project start	

1-1 Development of mono-rail and LRT

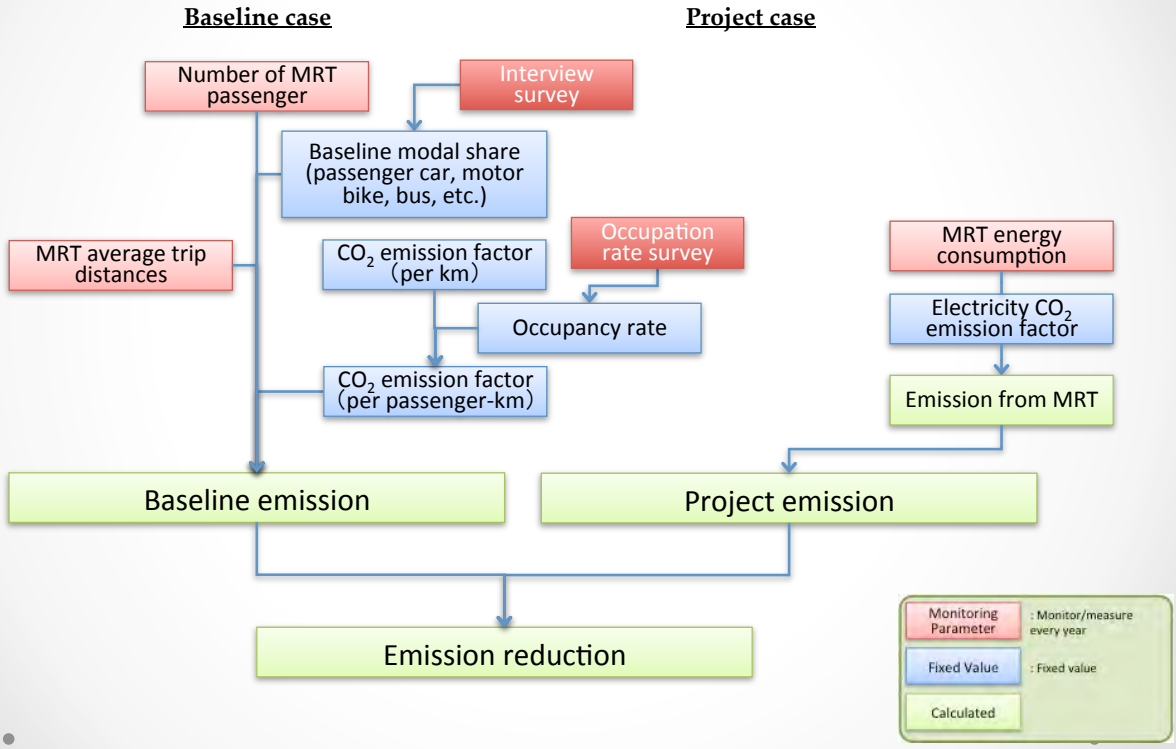
Logic of emission reduction: how emission is reduced?

Mode shift from passenger cars, motorbikes to buses

- ❖ High occupancy
- ❖ Less congestion
- ❖ High speed

1-1 Development of mono-rail and LRT

Outline of emission reduction calculation

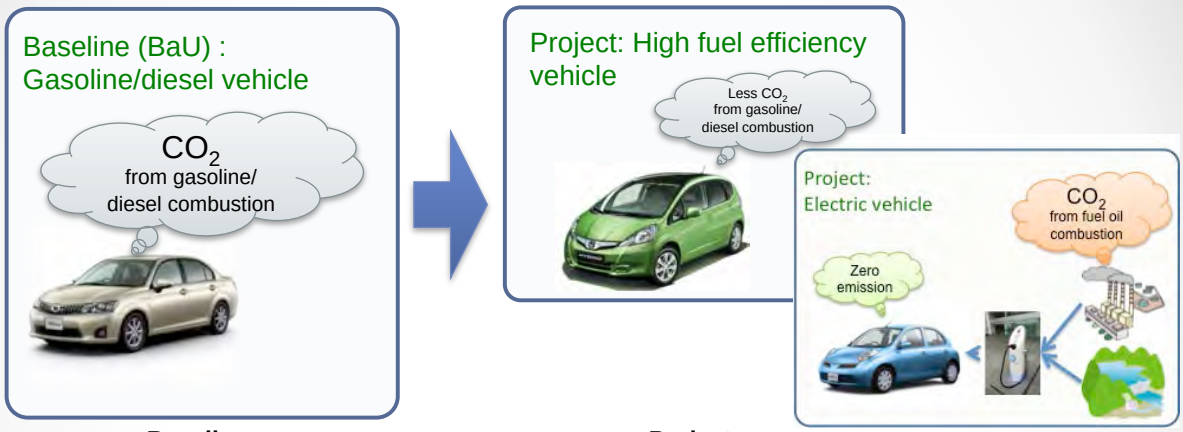


3-1 Introduction of low emission vehicles (LEV) to BMA's public vehicles

M&E/MRV		Baseline indicator	End of Project/Action indicator	Data/Information	Data/Information Provider	Reporting cycle	Other remark
M&E	M&E of activities	· A revise of the purchase BMA vehicle rule is under discussing · Governer is not yet approved a revise rule · There is no LEV BMA's public vehicle yet · Construction is not yet done.	· Propose a revise rule to the Governor for approve · Governer is approved · Construction 3 monorail lines are build and operate	· A revise of the purchase BMA vehicle rule · Govener Decision	· Strategy and Evaluation Department (SED) · BMA Governer		
	MRV of GHG emissions	· GHG reduction from change of BMA's vehicle is not yet in place	· GHG reduction from change of BMA's vehicle is in place	· Number of LEV · Driving distance (km) · Fuel Economy (of baseline vehicle) (km/l) For high efficiency vehicle · Fuel Economy (of project vehicle) (km/l) · CO2 emission factor(tCO2/l) For electric vehicle · Electricity Economy (km/kWh) · CO2 emission factor of grid electricity (tCO2/kWh)	· SED · SED · SED · SED · IPCC or Thai gov · SED · TGO or Thai gov	· Annually · Annually · Annually · Annually · Not monitor · Annually · Not monitor	

3-1 Introduction of low emission vehicles (LEV) to BMA's public vehicles

Logic of emission reduction & Outline of emission reduction calculation



Baseline case

CO_2 emission factor of gasoline/diesel (tCO_2/l)

Fuel Economy (km/l)

Project case

Fuel Economy (km/l) or Electricity Economy(km/kWh)

CO_2 emission factor of gasoline/diesel (tCO_2/l) or CO_2 emission factor of grid electricity (tCO_2/kWh)

Driving distances (km)

Baseline emission

Project emission

Emission reduction

Idea on Outreach (Draft)

Idea 1: Workshop on transport and environment

- Inform the Master Plan, importance of public transportation promotion, NMT, low emission vehicle, behavioral change, etc.

Idea 2: The promotion and demonstration of Eco-driving

- Lecture and demonstration of Eco-driving for BMA drivers/officers, etc..

Idea 3: Preparation/distribution of brochure for public transport promotion

- Design/prepare/distribute a brochure to promote public transportation for public.

The 3rd Working Group on the Bangkok Master Plan on Climate Change 2013-2023
May 20, 2015

Presentation on the BAU and Mitigation Target in the Environmentally Sustainable Transport Sector

Jointly by
The Environmentally Sustainable Transport Task Force, JICA Experts
and Dr. Jakapong Pongthanaisawan, Local Consultant

Outline

I. Current status of GHG emission

II. Business-as-usual (BAU) of GHG emission

III. Mitigation target and actions in the Transport Sector in 2020

Current status of GHG emission

Current status of GHG from the Transport Sector

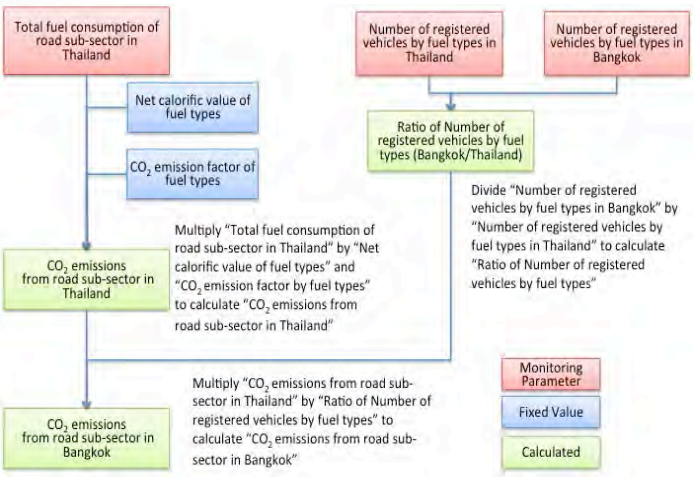
- Scope of Emission
  - o CO_2 emissions associated with transportation activities (road, railway, waterway) within BMA administrative area
  - o CO_2 emissions associated with BMA owned vehicles.

Current status of GHG from the Transport Sector

- Methodologies for Calculation

  Road

  "Fuel consumption from road sector in Bangkok by fuel types" x "CO_2 emission factor by fuel types (per liter etc.)"



*"Fuel consumption from road sub-sector in Bangkok by fuel types" is estimated using "Total fuel consumption of road sub-sector in Thailand by fuel types " and "Number of motor vehicles registered in Thailand and Bangkok "

*The methodology is based on "2006 IPCC Guidelines for National Greenhouse Gas Inventories"

Current status of GHG from the Transport Sector

- Methodologies for Calculation

  Railway

  "Electricity consumption of MRT and Skytrain in Bangkok" x "CO_2 emission factor of the grid electricity"

  Waterway

  "Fuel consumption of waterways in Bangkok" x "CO_2 emission factor by fuel types"

Current status of GHG from the Transport Sector

Results (Draft) (emissions in 2013)

Emissions from Road

Fuel types	emission (tCO_2/year)
Natural Gas	4,537,904
LPG	2,986,337
ULG91	15,165
ULG95	291,927
GASOHOL E10 91	1,421,154
GASOHOL E10 95	1,276,991
GASOHOL E20	357,137
GASOHOL E85	9,952
HSD	7,338,111
Total	18,234,678

Emissions from Railways

Fuel types	emission (tCO_2/year)
BTS	34,118
MRT (Blueline)	11,258
ARL (Airport Rail Link)	
Total	

Emissions from ARL will be estimated.

Emissions from Waterways

Fuel types	emission (tCO_2/year)
Chaophraya river ferries*1	8,200
Canal boat*2	3,301
Total	11,501

*1: Operated by three companies, Chaophraya Express Boat Comapany, Sap Thananakorn Ltd. and Supatra Ltd.
*2: Include Saen Saep canal extension and Phasricharoen canal

Emissions from BMA owned vehicles

Fuel types	emission (tCO_2/year)
ULG91	7,688
HSD	87,534
GASOHOL E10 95	1,421
Total	96,643

Business-as-usual (BAU) of GHG emission

Business-as-Usual (BAU) Emission of the Transport Sector

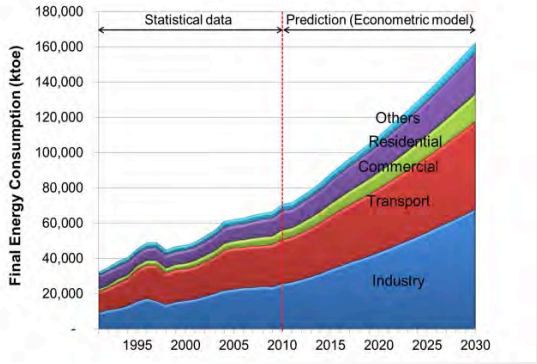
- Scope of Emission
  - Future (BaU) CO_2 emissions associated with transportation activities (road) within BMA administrative area.

    *BaU Emissions from railways and motorways are excluded, because of simplification since these emissions are very low (less than 1% compared to road transportation).

- Methodologies for Calculation

  "Current emission (year 2013)" x "Increase rate of BaU emission"

  Increase rate of BaU emission: "Increase rate of BaU energy consumption in transport sector of Thailand" is applied based on "Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy"

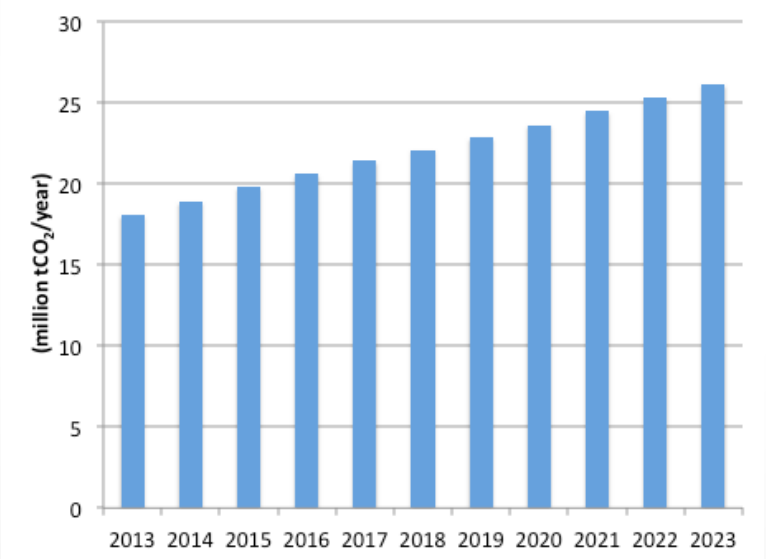


Future (BaU) energy consumptions by 2030 by sectors in Thailand (Source: "Thailand 20-Year Energy Efficiency Development Plan (2011-2030), Ministry of Energy")

Business-as-Usual (BAU) Emission of the Transport Sector

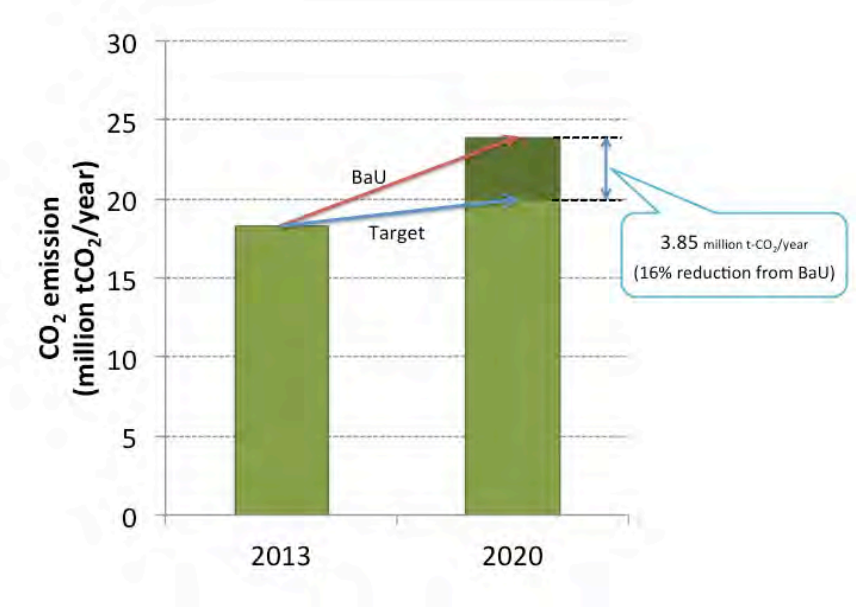
Results

Future (BaU) CO_2 emissions associated with transportation activities (road) within BMA administrative area



Mitigation target and actions for the Transport Sector

BMA emission reduction target of the transport sector (tentative)

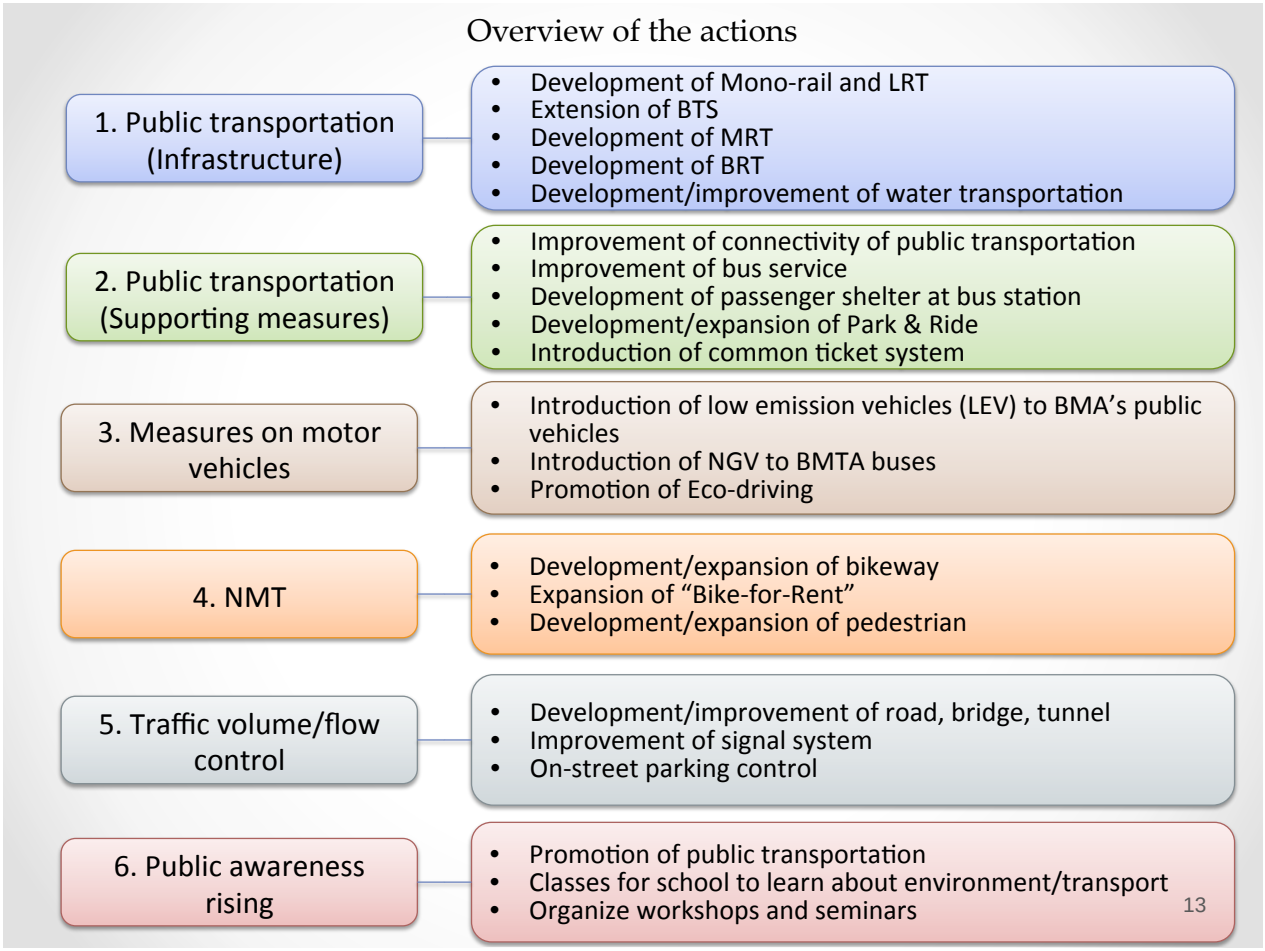


BMA ER target = (The national target)* x (Indicator: fuel consumption ratio of BMA/Total Thailand)**

= 12 million t-CO2/year x 0.321 (32.1%)

Source: * OTP and ** DOEB

Overview of the actions

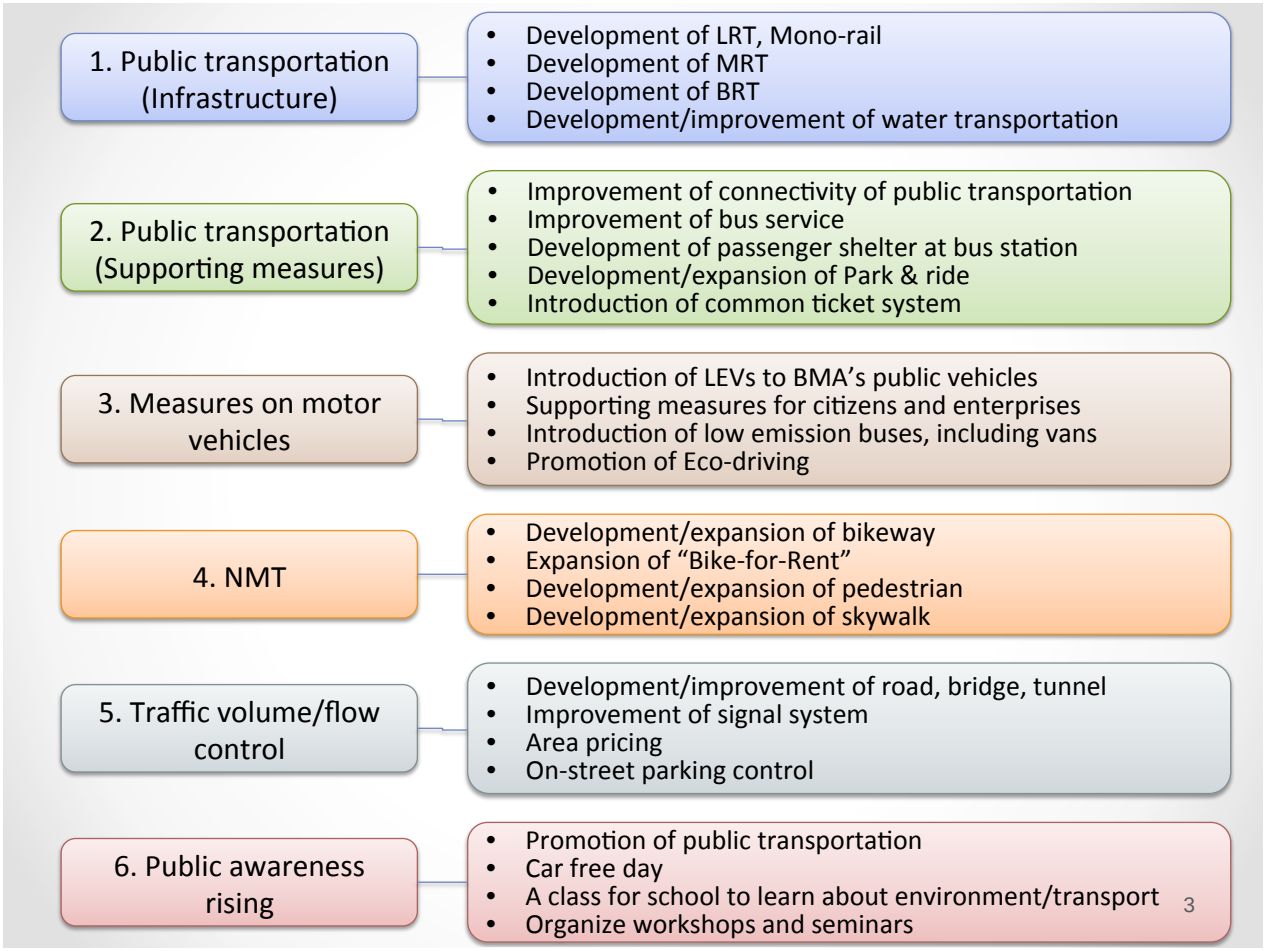


Environmentally Sustainable Transport Task Force

Workshop for Discussing the 1st Draft Master Plan on Climate Change and its Actions

May 20, 2014

List of measures



Category	Measures/Projects		Responsibility		Implementation Schedule
	Measure	Details of the measure (examples)	BMA	Other organization	
Public transportation (Infrastructure)	Development of LRT, Mono-rail	- Monorail: Gray line (Watcharaphon - RAMA IX)	D [1]		Short term
	Development of MRT	- Blue line, Purple line, Green line, Orange line - Red line		MRTA SRT	Short term Short term
	Development of BRT	- BRT extension (Ratchapruk – TlaadPlun)	D	KrungthepThanakhom	Long term
	Development/improvement of water transportation	- SaenSaep canal extension, Phasricharoen canal - SaenSaep canal, Chaopraya river	D S	KrungthepThanakhom Marine department, MOT	Short term Short term
Public transportation (Supporting measures)	Improvement of connectivity of public transportation	- Improve connectivity of BTS and canal boat at Bang Wa station (SaphanTaksin): Upgrade pedestrian to skywalk:	D		Short term
	Improvement of bus service	- Conversion from diesel to NGV - Bus re-routing	S S	BMTA BMTA	Short term Long term
	Development of passenger shelter at bus station	- Development of rules to introduce the roof and LED lighting etc. (now testing at 10 stations. There are 1,000 to 1,300 stations in Bangkok)	D		Short term
	Development/expansion of Park & ride	- Bang Yai (Nontaburi Province), Taling Chan, Bang Kae, Bering	S	MRTA	Long term
	Introduction of common ticket system	- Introduce common ticket system with BRT, BTS, MRT, ARL (SRT)	S	OTP	Short term
Measures on motor vehicles	Introduction of LEVs to BMA's public vehicles	- Need consideration	D		
	Supporting measures for citizens and enterprises	- Need consideration	S		
	Introduction of low emission buses, including vans	- Organize seminar and training course about environment, low emission vehicles, etc.	S	BMTA	Short term
	Promotion of Eco-driving	- Organize seminar and training course about eco-driving (add to current transport safety training course)	D		Short term
NMT	Development/expansion of bikeway	- Improve 12 bike routes (See List1) - Extend 1 bike routes (See List2) - Construct new 9 bike routes (See List3) - Improve connectivity of bike lanes between main and sub roads	D	BMA	Short term
	Expansion of "Bike-for-Rent"	- 250 stations and 10,000 bikes	D	BMA	Short term
	Development/expansion of pedestrian	- Improve 10 pedestrian	D	BMA	Short term
	Development/expansion of skywalk	- Development new 2 skywalks (See List4)	D	BMA	Short term

*1: D: Directly implement by BMA, S: Supported by BMA

Category	Measures/Projects		Responsibility		Implementation Schedule
	Measure	Details of the measure (examples)	BMA	Other organization	
Traffic volume/flow control	Development/improvement of road, bridge, tunnel	- Construct new 1 road (See List 5) - Construct new 2 tunels (See List 6) - Construct new 1 bridge (See List 7) - Improve 7 roads (See List 8) - Extend 1 bridge (See List 9)	D	BMA	Long term
	Improvement of signal system	- Install addition signal control 5 intersections	D	BMA	Short term
	Area pricing	- Install area pricing system (inner congested area)	D	OTP,BMA	Long term
	On-street parking control	- Extend no parking on street project	S	RTP,BMA	Short term
Public awareness rising	Promotion of public transportation	- Launch campaign on public transport use - Promote public transport use (free of charge) on special day i.e. Child day, Car free day	D	OTP, MRTA, SRT,BMA	Short term (Annually)
	Car free day	- Car free day program	D	BMA,OTP,DOH,MRTA , BTSC	Short term (Annually)
	A class for school to learn about environment/transport	- Launch program on public transport/ traffic discipline (environment effected from traffic and transport will be included) -	D	BMA,OTP, DOH	Short term (Annually)
	Organize workshops and seminars	- Seminars on road audit (public awareness on environment will be included)	D	BMA,OTP,DOH	Short term

*1: D: Directly implement by BMA, S: Supported by BMA

Details of measures (examples)

Example: Monorail Gray line (Watcharaphon - RAMA IX)

Category : Public Transportation (Infrastructure)

Measure : Development of LRT, Mono-rail

Details of the measure : Monorail: Gray line (Watcharaphon - RAMA IX)

Responsibility: BMA (Directly implement)

Implementation Schedule : Short term (2013-2018)

Service area: 26 Kilometers , 21 stations , Along the Pradit Manutham Road,

And connecting between Watcharaphon Road and RAMA IX Road.

Map : Monorail Gray Line (Watcharaphon - RAMA IX)

Example : SaenSaep canal extension, Phasricharoen canal

Category : Public Transportation (Infrastructure)

Measure : Development/improvement of water transportation

Details of the measure : SaenSaep canal extension, Phasricharoen canal

Responsibility: BMA (Directly implement)

Other organization: KrungthepThanakhom, Marine department, MOT

Implementation Schedule : Short term (2013-2015)

Service area: 1. SaenSaep canal extension ; 11 Kilometer, 9 station .

2. Phasricharoen canal ; 11.5 kilometer , 15 station.

Map : Water Transportation

SaenSaep canal extension

Phasricharoen canal

Example : Increase 250 stations and 10,000 bikes

Category : NMT (Non Motorize Transportation)

Measure : Expansion of "Bike-for-Rent"

Details of the measure : Increase 250 stations and 10,000 bikes

Responsibility: BMA (Directly implement)

Other organization: KrungthepThanakhom,

Implementation Schedule : Short term (2013-2016)

Service area: CBD zone and along the BTS and MRT line

Map : PUN PUN Bike-for-Rent Scheme

Example : Car free day program

Category : Public awareness rising

Measure : Car free day

Details of the measure : Car free day program

Responsibility: BMA (Directly implement)

Other organization: OTP, DOH, MRTA, BTSC

Implementation Schedule : Short term (Annually)

Service area: Bangkok City