Reference material
(The 4th workshop material)

Phnom Penh City Climate Change Strategic Action Plan
(Kitakyushu City - Phnom Penh City Collaboration Project)

Final Draft Plan

February 14, 2017

Kitakyushu City

NIKKEN SEKKEI CIVIL ENGINEERING LTD

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Needs and Positioning of the Action Plan

Needs of Phnom Penh City Climate Change Strategic Action Plan

- Cambodia has been identified as a country which will be strongly affected by climate change due to global warming.
- With cooperation of international agencies, etc. , the Cambodian government launched the Cambodia Climate Change Strategic Plan 2014-2023, as the first comprehensive national plan to respond to climate change issues in November 2013(Phase 1). This was followed by Phase 2 (mid-term), where individual central governmental agencies established action plans (2015-2018). However, specific measures were not implemented and a specific project for the reduction of GHG is needed.
- Kitakyushu City concluded sister city accord with Phnom Penh City on March 29, 2016, and plans to provide technical cooperation in fields which are strong points of Kitakyushu City, such as environmental conservation, water supply and sewerage systems. As one specific approach, support in the formulation of the Phnom Penh City version of the action plan (Phnom Penh City Climate Change Strategic Action Plan), based on plans with higher priority, is carried out..

Positioning of Phnom Penh City Climate Change Strategic Action Plan

Upper Level Plan (National Plan)

Rectangular Strategy for Growth, Employment, Equity, and Efficiency

A comprehensive national strategy with the development goals of sustainable economic growth and reduction of poverty. Growth strategies in four fields (agriculture, private sector, infrastructure development, and human resource development) will be shown.

National Strategic Development Plan (NSDP) 2014-2018

Strategic plan for implementing the quadrilateral strategy. In order to balance development and Environmental Conservation, an action plan for the purpose of strengthening natural resources management is shown.

Plans related to climate change

National Adaptation Programme of Action (NAPA)

Plans for countering immediate needs to adapt to climate change

Cambodia Climate Change Strategic Plan 2014 - 2023(CCCSP)

The first comprehensive national policy document for the purpose of responding to the challenges of climate change, it shows strategic objectives and directions for 2014 to 2023.

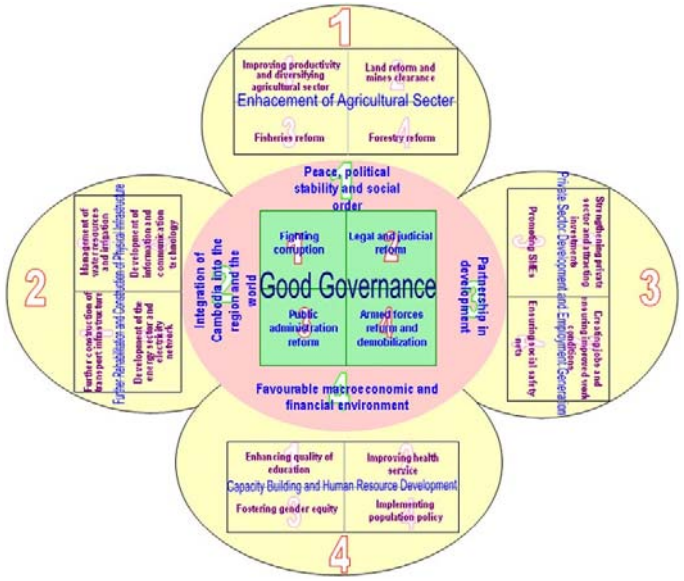
Climate Change Action Plan of Each Department(CCAP) 2015 - 2018

Plan of Phnom Penh City

- Implementation of Phnom Penh Land Use Plan
- Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)
- Drainage Improvement and Flood Control in the Municipality of Phnom Penh
- Master Plan of Greater Phnom Penh Water Supply

Climate Change Strategic Action Plan

Reference : Rectangular Strategy



The Royal Government of Cambodia Rectangular Strategy

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Reference : Cambodia Climate Change Strategic Plan 2014-2023 (1/2)

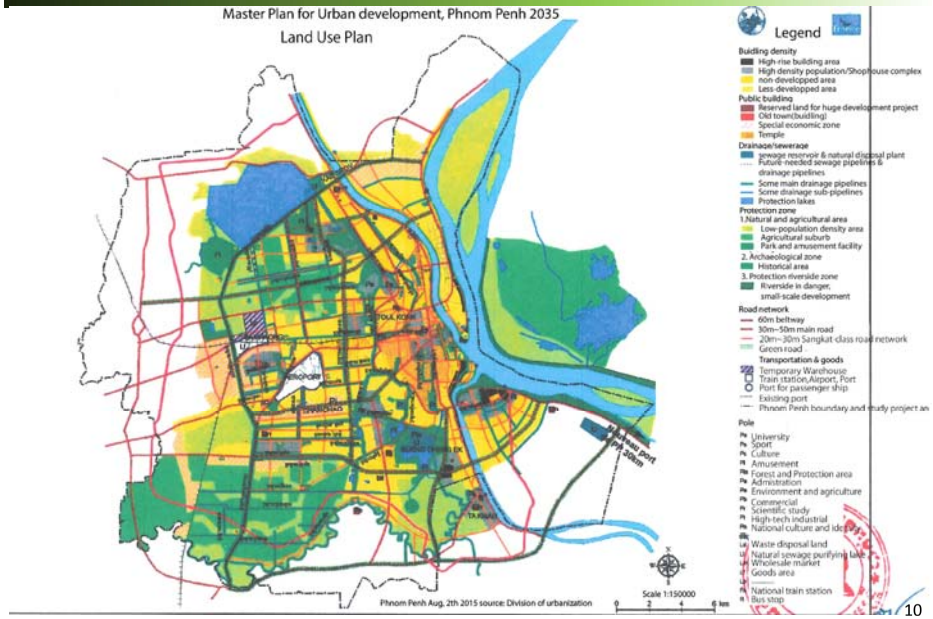
Reference : Cambodia Climate Change Strategic Plan 2014-2023 (2/2)

Immediate term (2013 – 2014)	▪ Institutional and financial arrangements; ▪ Develop action plans (2014-2018) by concerned line ministries and agencies; ▪ Develop a Climate Change Financing Framework; ▪ Establish a national M&E framework; ▪ Develop a Climate Change Legal Framework.
Medium term (2014 – 2018)	▪ Establish a nationally accredited mechanism for the Adaptation Fund and Green Climate Fund; ▪ Research and knowledge management activities; ▪ Develop capacity; ▪ Mainstream climate change at various sectoral levels; ▪ Operationalize M&E and data management system; ▪ Increase the climate change finance for national and sub-national planning, budgeting and implementation modalities; ▪ Establish appropriate institution with sufficient capacity and full credibility for direct access to the Adaptation Fund and Green Climate Fund.
Long term (2019 – 2023)	▪ Scale-up successful pilots and carry on with the mainstreaming of climate change at national and sub-national levels; ▪ Increase the use of budget support for national programmes, including implementation of climate change response measures through sub-national administrations.

Reference：
The Implementation of Phnom Phnom Penh Land Use Basic Plan(1/2)

The Plan Name	The Implementation of Phnom Phnom Penh Land Use Basic Plan (Appendix of sub decree No.181 S.P)
Approval Authority and Date	Council Ministers Plenary Meeting on December23,2015
Target Year	2035
Planned Population	300 million (There are 6 million people in zones covering areas approximately 100km from Phnom Penh)
Development Strategy	Phnom Penh City will become a central city of social economic development in Southeast Asia by preserving her identity, environment and international standard. 1. Central development base in Southeast Asia(Urban development corresponding to the rapid population increase) 2. City of the international quality standard 3. Improvement of important infrastructure (national highway, harbor, railroad, the airport and dry port) 4. Development preparations of the great city level (building of a network in a public space, a road and a green tract of land) 5. Patrimony of Special zone and city view (Development policy of each zone, Construction of sewage purification plants, new landfills, and incineration facilities, etc.)
Action Plan	1.Dissemination of the development strategy 2.Crucial projects required urgent approval ・Regulation and planning regarding public facilities, main roads, railway and drainage in suburb area. ・Setting location for railway station and dry port ・International Railway project(Ho Chi Minh- Phnom Penh) ・Expanding of Phnom Penh International airport ・Concreting of Shore of Bassac River as development base ・Setting the area where skyscrapers are led or restricted. ・Construction of new landfills and improvement of the existing landfills. ・Setting ecological area ・Preservation and Development in the historical center area. 3.Urbanization regulation of each area4.Continued development activities and public investment

Reference：
The Implementation of Phnom Phnom Penh Land Use Basic Plan(2/2)



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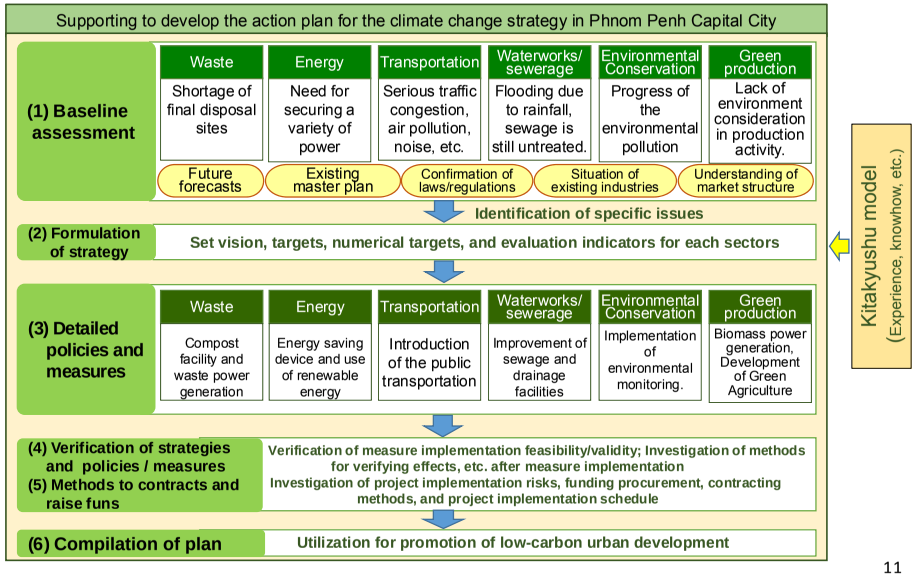
The Flow of Supporting to develop the Strategic Action Plan



The Flow of Supporting to develop the Strategic Action Plan

Items of Consideration	Details
1) Baseline Assessment	・Collect data and resources for each field related to GHG emissions, understand the actual conditions, and clarify any issues involved. ・Understanding items which should be considered, such as the plan with higher priority and legal regulations.
2) Formulation of Strategy	・Based on the climate change strategy plan of the country, establish the vision of sustainable development in Phnom Penh City, specific numerical goals included GHG reduction, and indications to evaluate goal achievement, etc.
3) Detailed Policies and measures	・To achieve the vision and goals described above, specific measures which should be worked on are determined, and their short, mid, and long term priorities should be considered. ・For the projects which should be carried out in a short term, a pilot project is considered, as well as applicable operations such as JCM, the implementation system, GHG emission reduction effect, environment improvement effect, approximate costs, an operations schedule, etc.
4) Verification of the strategy and measures Consideration of methods	・Consider the feasibility, risk, appropriateness of verification and approaches for continuous improvement of the plan.
5) Ordering / fund procurement Consideration of methods	・To promote specific measures, consider the ordering / fund procurement method focusing on short and mid term projects, as well as the overall schedule for the measures.
6) Organization of the plan	Organize documents of the plan in a visually, easy to understand way. (Japanese/English ver)

Baseline Assessment

Natural Condition/Temperature

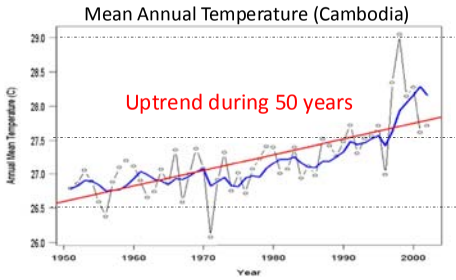


Fig Mean Annual Temperature during 1951-2001 in Cambodia

Source: Heng Chan Thoeun, Observed and projected changes in temperature and rainfall in Cambodia, Weather and Climate Extremes 7 (2015) 61–71

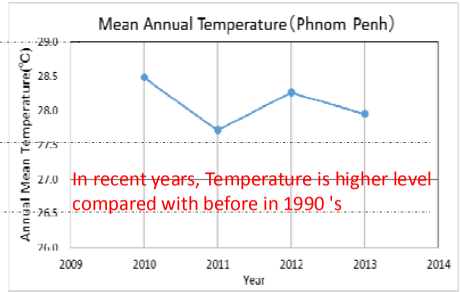


Fig Mean Annual Temperature during 2010-2013 in Phnom Penh

Source: Japan Meteorological Agency, http://www.data.jma.go.jp/gmd/cpd/monitor/climatview/frame.php

Climate Projection(CCCSP)

- Mean monthly temperature will increase between 0.013 and 0.036°C per year by 2099.
- Rice grain yield will decline by 10% for each 1°C increase in growing-season.

CCCSP : Cambodia Climate Change Strategic Plan 2014-2023

Natural Condition/Rainfall

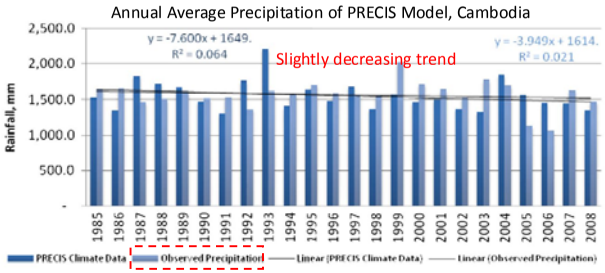


Fig Annual Rainfall during 1985-2008 in Cambodia

Source: Heng Chan Thoeun, Observed and projected changes in temperature and rainfall in Cambodia, Weather and Climate Extremes 7 (2015) 61–71

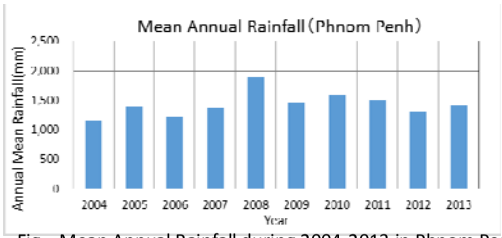


Fig Mean Annual Rainfall during 2004-2013 in Phnom Penh

Source: Japan Meteorological Agency, http://www.data.jma.go.jp/gmd/cpd/monitor/climatview/frame.php

Climate Projection(CCCSP)

- Mean annual rainfall indicates an increase
- Rainfall will get higher in the provinces at higher elevation during wet season, but it will get drier during the dry season.
- The coastline is vulnerable to sea-level rises and the sever impacts of more frequent typhoon.
- Coastal zones would be affected by tropical cyclones while the central plains would experience seasonal flooding.

CCCSP : Cambodia Climate Change Strategic Plan 2014-2023

Natural Condition/Sea Level

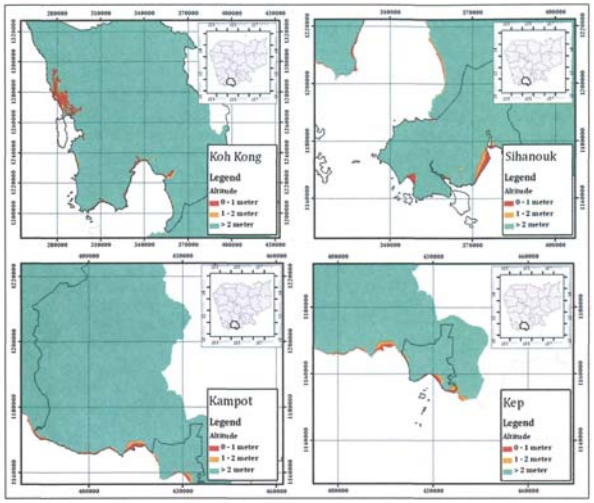


Fig. Area of Coastal Zone being inundated due to Sea Level rise

Source: Cambodia's Second National Communication

Climate Projection(CCCSP)

Sea levels in the region are projected to rise under various scenarios by 2090 relative to 1980-1999.

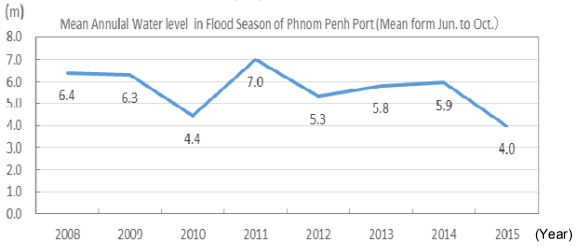
a. 0.18-0.43m under low emission scenario
b. 0.21-0.52m under medium emission scenario
c. 0.23-0.56m under high emission scenario
(This rate would cause permanent inundation of about 25,000 ha of coastal Cambodia within 90 years.)

- The coastline is vulnerable to sea-level rises and the sever impacts of more frequent typhoon.
- Coastal zones would be affected by tropical cyclones while the central plains would experience seasonal flooding.

CCCSP : Cambodia Climate Change Strategic Plan 2014-2023

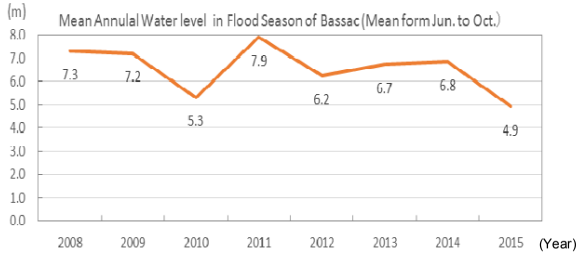
Natural Condition/Water Level

Phnom Penh Port Zero gauge Phnom Penh Port = 0.07 m above MSL



Because of the short time period in which the data was collected, the trend of the water level is not seen.

Phnom Penh (Bassac) Zero gauge Phnom Penh (Bassac) = -1.02 m above MSL



Positioning Map

Source: Mekong River Commission, Graph of Water Levels and Reports, http://www.mrcmekong.org/

Natural Condition/Flood・Drought

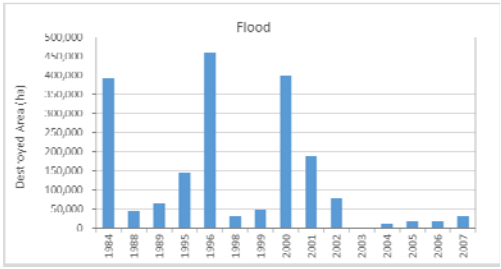


Fig. Total Rice Cultivation are destroyed by flood in Cambodia

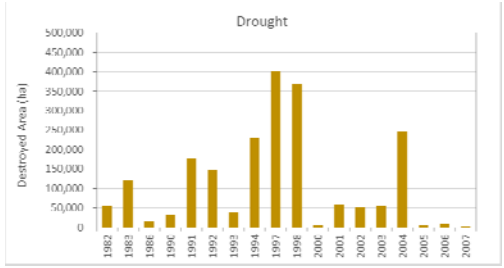


Fig. Total Rice Cultivation are destroyed by drought in Cambodia

Source: Cambodia's Second National Communication

Impact of flood and drought on agriculture

- Based on data from the past 20 years, losses in production were mainly due to flooding (about 62%) and drought (about 36%).
- Floods have not always coincided with high rainfall in Cambodia. Most flooding occurs due to increased water levels in the Mekong River and Tonle Sap Lake between early July and early October.
- In the last 30 years, the most devastating floods were in 1984, 1996 and 2000. The 1984 and 2000 floods were due to increased water levels in the Mekong River, rather than heavy rainfall in Cambodia.
- Floods destroy infrastructure, including irrigation facilities, and can result in loss of life.

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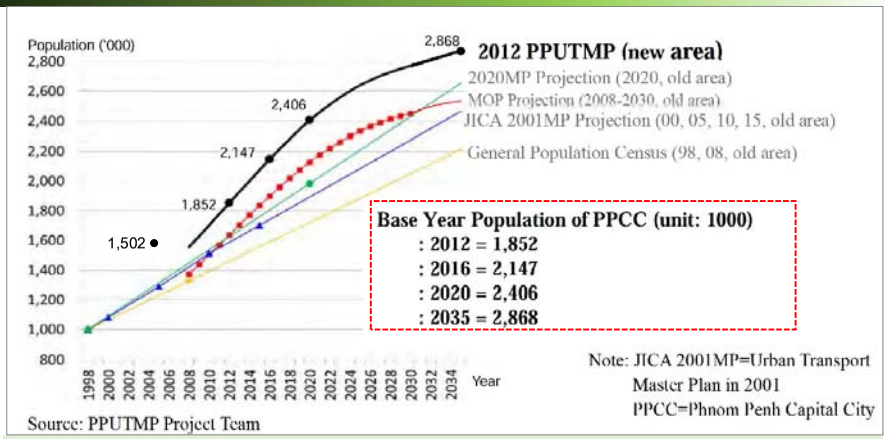
Socioeconomic Situation /Population

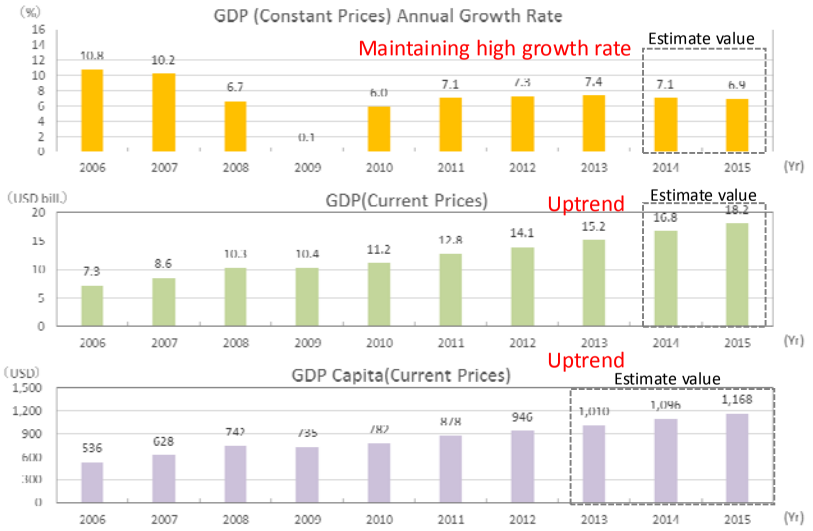


Source: PPUTMP Project Team

【The future population of Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)】

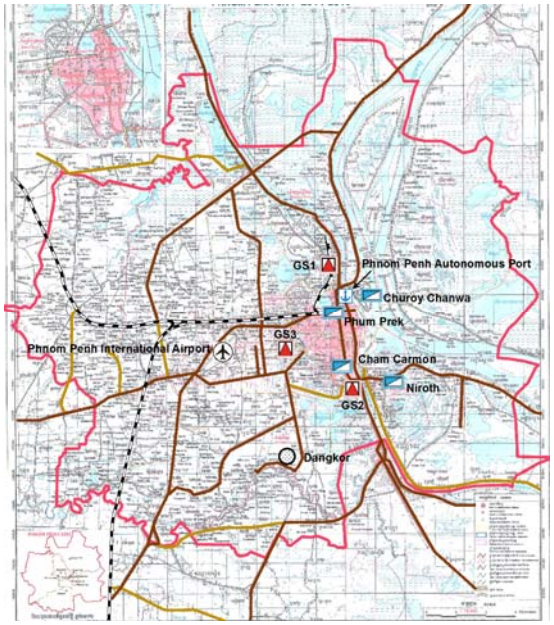
- The future population of Phnom Penh for 2016, 2020 and 2035 are forecasted in this study based on the population forecasts by the Ministry of Planning (MOP) in January 2011. However, the population forecasted by the Ministry of Planning was only confined to the old city area.
- In this study, the 2008 population census is also used to correct this shortcoming for estimating the future population of the city inclusive of the new city areas. The population of Phnom Penh City at 2012 which is the base year in this study, is set at 1.85 million. The population for the medium-term target year of 2020 is forecasted at 2.41 million and for the final target year of 2035, 2.87 million.

Socioeconomic Situation／GDP・Economic Growth



Source: International Monetary Fund, World Economic Outlook Database, April 2016

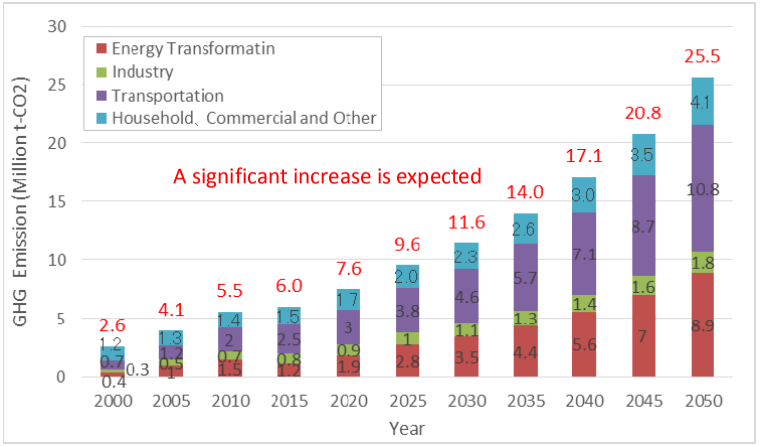
Social infrastructure



- Road maintenance is insufficient, such as a discontinuous national highway, low road density and non-paved roads in the suburbs, etc. In addition, public transportation consists of only 3 bus routes and railway service has been suspended for the entire line. Because of this, traffic congestion in the capital is severe.
- There are four water purification plants and the population with water supply in the capital is about 85%.
- Daily life wastewater is released virtually untreated into waterways and ponds, so environmental pollution is progressing.
- Power is supplied mainly from Vietnam or diesel generators in the capital, and supplied to the capital via three substations, and power supply is unstable with power outages, etc. In addition, electricity prices are high compared to neighboring countries.
- In the capital, there is only one landfill. Due to rapid population growth and economic development, the landfill is filling up at a speed that far exceeds the plan.

Greenhouse Gas (GHG)

Estimated GHG emission from Energy sources (excluding biomass)(2000-2050)



Source: the Ministry of the Environment, Japan,2016. New Mechanisms Information Platform
http://www.mmechanisms.org/initiatives/cambodia_info.html

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Current status and tasks

(1) General remarks

- The water supply adoption rate is about 85%, and development is progressing with it being possible to drink the water directly from the tap except for some areas. On the other hand, development of infrastructure such as roads, sewerage, waste management, etc. is delayed, and environmental pollution and public health are progressively getting worse. In order to improve the life of citizens, infrastructure development is urgently needed.
- Supplying power faces the challenges of power outages, voltage instability, etc. In addition, because electricity prices are high, the impact extends to the entrance of countries from abroad and economic activities of companies. The development of diverse power sources including renewable energy such as solar power, biomass power generation, etc. is necessary.
- In addition, since Phnom Penh is in a low-lying coastal area and is thus susceptible to the effects of rising water levels, it is desirable to actively introduce renewable energy and suppress emissions of greenhouse gases.
- It is necessary to suppress the energy demands, water demands, and greenhouse gas emissions that are expected to accompany future rapid economic development and population increases.
- As can be seen from the example of Kita Kyushu which has experienced green growth, it is possible to carry out environmental improvements while undergoing economic expansion, and in order to overcome severe pollution, sustainable development with harmony between the economy and the environment is necessary.

Current status and tasks

(2) Administration

- Part of the organization of the central government is incorporated into the Phnom Penh administration structure, so the chain of command has become more complex and in one aspect speedy administration operations have become difficult.
- For solving problems in the capital area, in addition to a top-down approach, a bottom-up approach based on proposals from the level of the person in charge is also important, and nurturing of personnel who can offer specific solutions is necessary.

(3)Company

- Although it is currently in the development stage focusing on light industry, in the future, nurturing of local industries to increase the industrial level and attracting overseas companies for the introduction of technology and knowhow is required.
- In particular, when evolving from light industry to heavy industry, pollution prevention measures and clean production efforts are necessary so that air, water, soil, etc. do not become contaminated.

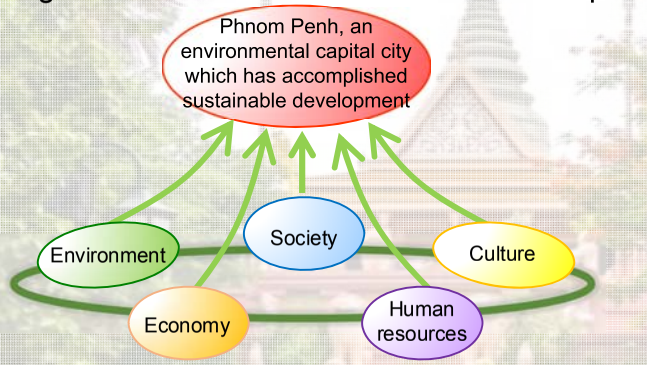
(4) Citizens

- With the problem of waste becoming serious, raising the environmental consciousness level of citizens, promotion of garbage sorting and recycling, and prevention of illegal dumping is necessary.
- Air pollution and increases in CO2 are progressing because of to traffic congestion due to automobiles and gasoline motorcycles, and a shift to public transportation use is required.

Formulation of Strategy

Vision of the Plan

The capital city of Phnom Penh will realize sustainable development by handling climate change wisely and becoming a model for an Asian environmental capital city.



The respective growths of environment, economy, society, and culture are important elements for achieving environment capital Phnom Penh, and while creating harmony and balance between the elements, it is also important that they have sustainability. In addition, development of human resources to support this group will be planned.

Basic policy (1/3)

■ Waste field: Reliable waste collection/proper treatment and construction of a resource cycle society and economy

- Waste will be reliably collected and properly treated. In addition, a cyclic societal and economic system in which waste is reused as resources will be constructed, and development of recycling business is planned.
- The occurrence of environmental problems due to waste will be thoroughly prevented and suppressed. Lifestyles and industrial structures/production activities which generate small amounts of waste will be achieved, and GHG from waste will be reduced.

■Energy field: Efficient use of energy and active utilization of renewable energy

- The currently unstable power supply will be corrected, efficient energy utilization and energy conservation will be actively promoted, and GHG which are forecast to increase in the future will be reduced.
- Renewable energy such as solar energy using the sunlight with which Phnom Penh is blessed, biomass, etc. will be actively promoted and at the same time a framework that can achieve both environmental and economic goals such as solar power generation business will be constructed.

Basic policy (2/3)

■Transportation field: High-convenience, low-carbon public transportation system

- In order to improve traffic congestion and air pollution which has become a major problem from societal, economic, and environmental aspects, a highly convenient public transportation system using low-pollution vehicles will be developed.
- Together with the development of hardware such as roadways, signal systems, etc., the software side such as a vehicle inspection system, exhaust gas restrictions, etc. will be enhanced, and these will be reliably implemented to relieve traffic congestion.

■ Waterworks/sewerage and rainwater drainage: Expansion of drinkable waterworks area and thorough treatment of sewage and rainwater

- Together with expanding the area where waterworks water can be drunk directly, sewage from households and offices will be properly treated to regenerate and create a good waterside environment free from water pollution.
- Flooding of areas which are still subject to frequent flooding will be eliminated so that citizens can live safely. In addition, in order to maintain functions as the capital, infrastructure development such as rainwater drainage facilities, etc. will be promoted so that the flood damage risks due to the increasing frequency of heavy rains because of climate change can be reduced.

Basic Policy (3/3)

■ Environmental conservation: Maintenance of an environment level suitable for an environmental capital city and coexistence with the natural environment

- Planning and comprehensive implementation of measures to reduce the negative impact of environmental problems (waste, sewerage, exhaust gas, noise, etc.) due to socioeconomic activities and maintain and improve the environmental level suitable for the environmental capital that Phnom Penh is aiming for.
- Expansion of measures to preserve the natural environments of the capital, such as forests, green spaces, and wetlands, ensure biodiversity for inherent coexistence with the natural environment, and foster a sense of values for the Cambodian culture which has been carefully handed down.

■Green production: Construction of low-carbon, environmentally friendly industrial structures

- Actively promote environmentally friendly production activities such as introducing cleaner production (production processes that efficiently use raw materials and energy and reduce environmental loads) with the aim of becoming low-carbon.
- Planning the transition to environmentally friendly structures in agriculture and also in other industries.
- Development human resources who will actively promote environmentally friendly societal and economic activities.

Numerical Goals (Draft)

Numerical goals in the table below was set referring to the numerical goals of Cambodia's Second National Communications (MoE、Nov.2015) and various master plans and indicates of other cities.

	Items \ Target Year		2017-2023	2035
Entire Country	GHG	Amount of emissions	7,149GgCO$_2$ (2025) (=BaU 9,601−2,452)	1,0313GgCO$_2$ (=BaU 14,043−3,730)
		Reduction Amount	2,452GgCO$_2$(2025) (26% reduction Compared to BaU)	3,730GgCO$_2$ (27% reduction Compared to BaU)
Phnom Penh City	GHG	Amount of emissions	3,053GgCO$_2$	4,403GgCO$_2$
		Reduction Amount	1,047GgCO$_2$	1,593GgCO$_2$
	Index value of the evaluation (indication)	Waste Collection Rate	City Solid Waste : 90% or more Industrial Waste : 85% or more	City Solid Waste : 100% Industrial Waste : 100%
		Waste Recycle Rate	City Solid Waste : 50% or more Industrial Waste : 85% or more	City Solid Waste : 95% or more Industrial Waste : 95% or more
		Reduction Amount of GHG by Utilizing Renewable Energy	100.8GgCO$_2$ (2025)	99.9GgCO$_2$
		Public Transportation Utilization Ratio	20% or more	25% or more
		Automobile Inspection Rate	50% or more	100%
		Achievement Rate of the Exhaust Standard (Cars, bikes, etc.)	50% or more	100%

Numerical Goals (Draft)

	Items \ Target Year		2017-2023	2035
Phnom Penh City	Index value of the evaluation (indication)	Achievement rate of the environmental quality standard for air	50% or more	100%
		Achievement rate of environmental quality standard for surface water	50% or more	100%
		Piped Water Supply Coverage Ratio	90% (Possibility rate of drinking a tap water directly : 80% or more)	100% (Possibility rate of drinking a tap water directly : 100%)
		Sewage Treatment Rate	Domestic Sewage: 5% or more Industrial Sewage: 10% or more	Domestic Sewage: 50% or more Industrial Sewage: 100%
		Green Area	10m^2/Person (Whole country: 60% of the National land)	20m^2/Person (Whole country: 60% of the National land)
		Implementation Rate of Green Agriculture	10%or more	70%

Basis for setting numerical goals (proposal) (1/4)

1. GHG emissions amount and reduction amount for the entire country

For the numerical goals for the emissions amount and reduction amount for the entire country, it was decided to use the Total Baseline Emissions and Total Savings stated in Cambodia's Second National Communications (MoE, Nov. 2015)

GHG emissions amount (numerical goal) = Total Baseline Emissions - Total Savings
GHG reduction amount (numerical goal) = Total Savings

2. Phnom Penh GHG emissions and reductions

Phnom Penh GHG emissions amount and reduction amount
= Entire country GHG emissions amount and reduction amount × Income ratio (42.7%)*1

Here, the income ratio (2013 to 2014) is determined by the following formula:
Income ratio (42.7%) = Total income for all Phnom Penh businesses (1,614 million USD) / Total income for businesses in entire country (3,776 million USD)

＜Reference＞
- Ratio of population of Phnom Penh/Entire country (2025 forecast) = 11.5%*2
- Ratio of number of businesses in Phnom Penh/Entire country (2014) = 14.9%*1
- Ratio of number of employees in Phnom Penh/Entire country (2014) = 29.5%*1

＊1 Results of 2014 Cambodia Inter-Censal Economic Survey, Ministry of Planning,Cambodia
http://www.stat.go.jp/info/meetings/cambodia/c14f_tb1.htm
＊2 Overview of Urban Development in Phnom Penh Capital City, Urbanization Division, Phnom Penh Capital Hall

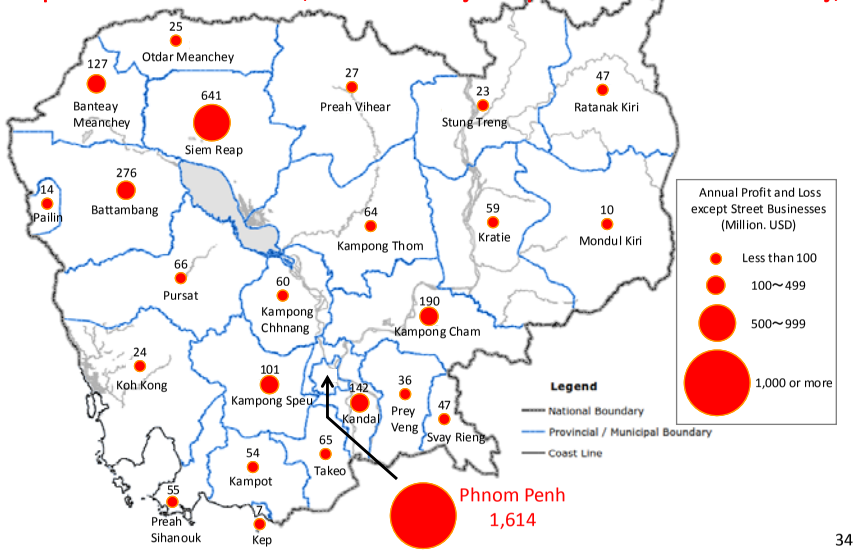
Cambodia's Second National Communications(MoE、Nov.2015)
Maximum reduction of CO_2 compared to baseline emissions

[GgCO2-eq]

Year	2010	2015	2020	2025	2030	2035	2040	2045
Total Baseline Emissions	5,533	5,987	7,551	9,601	11,599	14,043	17,075	20,848
Energy Industries								
Grid Connection REEs	3	12	30	51	80	106	140	172
Grid Connection Auto Producers	18	152	269	268	309	354	430	492
Grid Connection Battery Charging Stations		5	12	16	16	14	12	10
Solar Power Plant	0	0	1	2	5	9	18	36
Solar Home Systems	0	6	16	22	22	19	16	12
Mini and Micro Hydro		2	3	4	4	4	4	4
Rice Husks for Electricity Generation	27	67	167	417	445	463	481	498
Energy efficiency end users	22	55	138	344	592	797	1,002	1,264
Energy efficient buildings	50	85	193	285	354	443	557	702
Sub Total Savings	**120**	**384**	**829**	**1,409**	**1,826**	**2,210**	**2,659**	**3,191**
% savings compared to Baseline	2%	6%	11%	15%	16%	16%	16%	15%
Manufacturing Industries								
Rice milling ,Garment, Rice Mills, Brick Works	326	373	429	497	580	681	803	953
Biofuel	13	32	79	147	147	147	147	147
Sub Total Savings	**339**	**405**	**508**	**644**	**727**	**828**	**950**	**1,100**
% savings compared to Baseline	6.1%	6.8%	7%	7%	6%	6%	6%	5%
Transport Sector								
Hybrid Cars			2	6	15	37	92	229
Motor Vehicle Inspection	62	154	192	238	297	369	461	574
Electric scooters and Bicycles	4	9	22	54	78	95	116	141
Sub Total Savings	**66**	**163**	**216**	**298**	**390**	**501**	**668**	**944**
% savings compared to Baseline	1.2%	2.7%	3%	3%	3%	4%	4%	5%
Other Sectors								
Efficient Cookstoves, Biodigesters, Water Filters	3	7	17	39	96	136	160	170
Solar Lanterns	0.6	6.2	31	56	50	44	44	44
Wind Water Pumping	0.0	0.4	3	5	9	11	14	16
Sub Total Savings	**4**	**14**	**51**	**100**	**155**	**191**	**218**	**230**
% savings compared to Baseline	0.1%	0.2%	0.7%	1.0%	1.3%	1.4%	1.3%	1.1%
Total Savings	**528**	**966**	**1,603**	**2,452**	**3,098**	**3,730**	**4,495**	**5,465**
% savings compared to Baseline	9.5%	16.1%	21%	26%	27%	27%	26%	26%

Annual Profit and Loss except Street Businesses by Provinces of Cambodia (2014)

The establishment profit of the whole establishment in the Phnom Penh city is outstanding in comparison with other states. (Phnom Penh city occupies 42.7% of the whole country)



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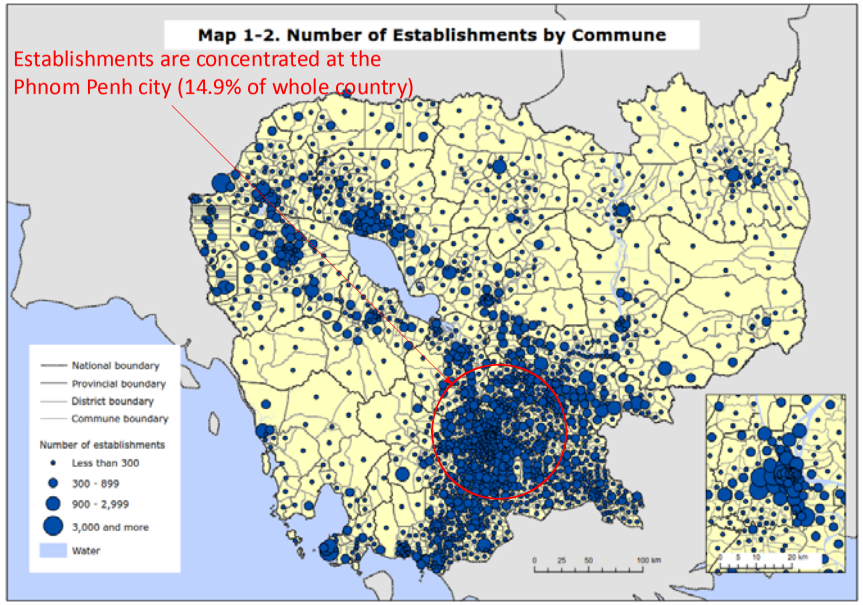
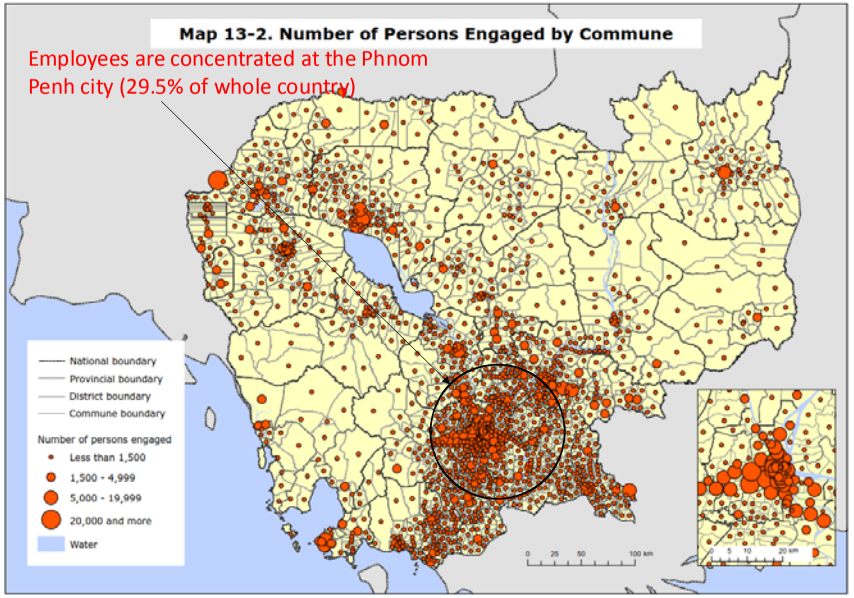
Distribution of the number of the Cambodian establishments(2011)



Source:http://www.stat.go.jp/info/meetings/cambodia/e11f0mp1.htm

Distribution of the number of the Cambodian Persons engaged(2011)



Source:http://www.stat.go.jp/info/meetings/cambodia/e11f0mp1.htm

Basis for setting numerical goals (proposal) (2/4)

3. Waste collection ratio and waste recycling ratio

The collection ratio for household solid waste in cities of the same scale as the future population of Phnom Penh (2020: 2,406,000 people; 2035: 2,868,000) is essentially 100%.※

Phnom Penh will work to also achieve a municipal solid waste collection ratio of 100% by 2035, and for the waste recycling ratio as well, they will work toward a ratio of more than 95%.

※Source: World Council on City Data Open Data Portal , http://open.dataforcities.org/

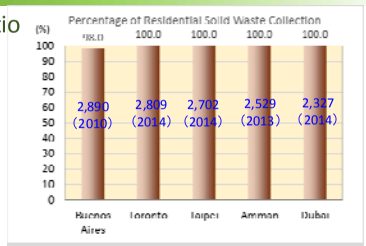


Fig. Percentage of Residential Solid Waste Collection

※The population of each city is shown in blue (thousand people)

4. Renewable energy amount

Cambodia's Second National Communications (MoE, Nov.2015) states the GHG reduction amount due to renewable energy for the entire country. This entire country GHG reduction amount was multiplied by the Phnom Penh income ratio (42.7%) to obtain the numerical goal.

Table GHG reduction amount (BaU ratio) due to use of renewable energy

Item	Entire country CO_2 reduction amount ($GgCO_2$)		Phnom Penh CO_2 reduction amount ($GgCO_2$)	
	2025	2035	2025	2035
Solar Power Plant	2	9	0.9	3.8
Solar Home Systems	22	19	9.4	8.1
Mini and Micro Hydro	4	4	1.7	1.7
Biofuel	147	147	62.8	62.8
Solar Lanterns	56	44	23.9	18.8
Wind Water Pump	5	11	2.1	4.7
Total	236	234	**100.8**	**99.9**

Basis for setting numerical goals (proposal) (3/4)

5. Public transportation utilization ratio

The numerical goal is set referring to the target value of 30% by 2035 stated in the Cambodia Phnom Penh Urban Transport Master Plan (Dec. 2014).

As a reference, the public transportation utilization ratio in cities of the same scale as the future population of Phnom Penh (2020: 2,406,000 people; 2035: 2,868,000) is around 40 to 70%

Source: World Council on City Data Open Data Portal , http://open.dataforcities.org/

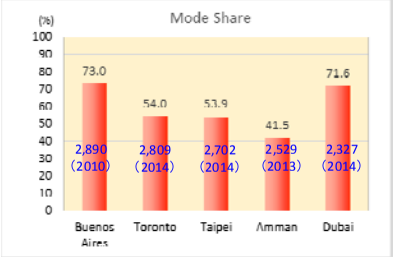


Fig. Percentage of Commuters traveling to work by a travel mode other than a personal vehicle

6. Ratio of potable water direct from water supply taps

The water supply system coverage (potable water) in cities of the same scale as the future population of Phnom Penh (2020: 2,406,000 people; 2035: 2,868,000) is essentially 100%.

In Phnom Penh as well, they are working to achieve water supply coverage ratio of 100% (potable water supply ratio of 100%) by 2035.

Source: World Council on City Data Open Data Portal , http://open.dataforcities.org/

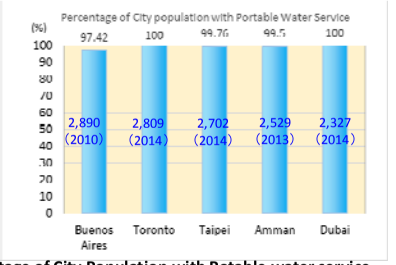


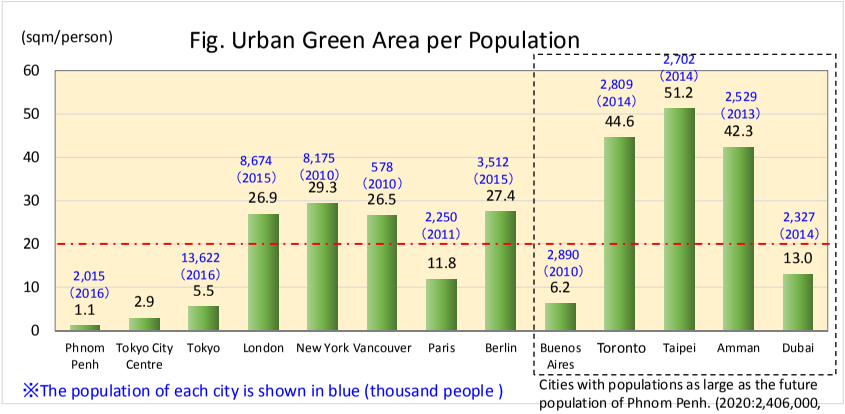
Fig. Percentage of City Population with Potable water service

※The population of each city is shown in blue (thousand people)

Basis for setting numerical goals (proposal) (4/4)

7. Green area

The green area per person of Phnom Penh is 1.1m², which is extremely small when compared to the world's major cities. Referring to the cases of the world's major cities, Phnom Penh has set a numerical goal for 2035 of 20m²/person. In Japan as well, the numerical goal is set at 20m²/person in many cases.



※The population of each city is shown in blue (thousand people)

Cities with populations as large as the future population of Phnom Penh. (2020:2,406,000, 2035:2,868,000)

Source:
+Phnom Penh, Tokyo, London, New York, Vancouver, Paris, Berlin: PPUTMP Project Team based upon the data from MLIT, Japan
+Buenos Aires, Toronto, Taipei, Amman, Dubai: World Council on City Data Open Data Portal , http://open.dataforcities.org/

Promotion system

1.Creation of a new organization for plan promotion

Since this plan spans diverse themes and since cooperation and coordination with relevant agencies of the central government is necessary, a new organization (new department) for climate change and promoting this plan will be established to centrally oversee the promotion of this plan and carry out the creation of organizations that can consistently implement the plan.

2. Development of human resources with an eye on realizing an environmental capital

Steady implementation of this plan requires a large number of personnel who are familiar with environmental policies. In order to realize becoming an environmental capital which is the aim of this plan and to become a model for the environmental policies of other states as the capital of Cambodia, the development of environmental policy professionals will be promoted in a planned and organized manner. The responsibility for this shall be a cooperative effort between the new department described above and the personnel management department.

3. Securing important financial resources for promotion of the plan

Regarding important financial resources for plan promotion, not only will requests be made to the central government, private sector know-how and funds will be actively utilized through methods such as PPP (Public Private Partnerships), etc. from the viewpoint of environmental business development. In addition, by gaining approval of this plan as the formal plan of the capital, it can be utilized as the basis for receiving support from various international organizations. For this issue, the Finance Department shall take main responsibility, and shall cooperate with the new department in striving to secure financial resources.

Promotion system

4. Understanding trends in relevant state-of-the-art technologies and their applications

In order to improve and resolve the problems and issues faced by each sector, the new department shall gather information, application examples, etc. of relevant state-of-the-art technologies and work to understand their trends. Furthermore, it shall investigate applicable technologies and provide information to related organizations in a timely manner.

5. Providing and sharing of information

In order to carry out this plan more effectively and efficiently, the content of this plan and its progress status shall be made available to businesses, citizens, NGOs, NPOs, etc. by utilizing various media such as TV, the internet, etc. with the aim of providing and sharing of information. The main responsibility for this issue shall rest with the Public Relations and International Affairs Department, which shall work in cooperation with the new department.

Roles of each principal

1. Government

(1) The government shall promote the development of infrastructure such as waste management, sewerage, roads, etc. which form the backbone of urban development, shall implement specific measures in each sector based on this plan in a planned and consistent manner, with the aim of achieving sustainable development for the realization of an environmental capital.

(2) The government shall fully explain to businesses and citizens the importance of environmental consciousness, shall make known the content, effects, and progress status of the measures positioned for implementation under this plan, and shall encourage the active participation and cooperation of businesses, citizens, etc.

(3) Furthermore, the government shall support the environmental protection activities (for example, cleanup activities in the capital, etc.) and environmental learning of businesses and citizens through provision of places, opportunities, funds, etc.

(4) The environmental improvement effects of measures which are relevant for businesses and citizens shall be publicized to businesses and citizens using examples of actual initiative results to promote their understanding in an effort to create an environment for obtaining further cooperation.

Roles of each principal

2. Businesses

(1) For businesses, it is necessary that they properly understand that their consumption of large amounts of energy and discharge of waste, exhaust gases, wastewater, etc. in their production activities leads to deterioration of the living environment of citizens and the natural environment.

(2) Therefore, businesses shall not just pursue economic benefits and efficiency in their production activities but shall also review their production processes in accordance with laws and regulations, and shall convert to production processes that minimize environmental loads as much as possible.

(3) The environmental consciousness of businesses shall in the end increase the value of products and the trust of society toward businesses, and lead to the sustainable development of businesses themselves.

Roles of each principal

3. Citizens

(1)For citizens, it is first necessary that they fully understand that their own daily activities and behavior have effects on their own living environment and the natural environment, in other words, that each individual citizen is part of the cause.

(2)With this awareness, they shall practice activities which will lead to improvements in public health and living environment (Eco Life) as citizens of an environmental capital, with their responsibility to pass down a good environment to future generations.

(3)Furthermore, citizens shall bear their fair share of costs (processing costs, etc.) related to waste disposal, rainwater/household wastewater treatment, etc. performed by public facilities.

■Eco Life

1) Waste reduction, reuse, and recycling (Promotion of waste 3R)
2) Utilization of ecological products and energy-conserving appliances.
3) Practice of energy-conserving activities (saving power, etc.)
4) Utilization of public transportation facilities such as buses, etc.
5) Participation in environmental learning activities
6) Urban cleanup activities
7) Participation in volunteer activities such as environmental awareness, etc.
8) Improving manners, etc.

Roles of each principal

4. Others (tourists, etc.)

(1) Recently, the number of domestic and international tourists and business visitors to Phnom Penh has been increasing, and economic activities are intensifying. On the other hand, the environmental loads from these activities have also been increasing, and it is necessary to reduce their effects as much as possible.

(2) In order to preserve the living environment, natural environment, and tourism resources of Phnom Penh, it is necessary to also ask visitors to bear some costs in the form of facilities fees or tourist taxes which will be used as financial resources devoted to infrastructure development, etc.

Tasks and Specific Measures by Field

Composition of specific measures

We propose the specific measures to be implemented to achieve the goals as follow.

Field	Specific measure
Waste	1. Reduction of final disposal volumes; 2. Administrative guidance to businesses; 3. Implementation of pilot project for waste sorting/recycling; 4. Establishment of "Garbage bank" for recycling; 5. Introduction of manifest system (industrial waste); 6. Development of Eco-Town projects (industrial waste); 7. Implementation of model project for proper treatment of hazardous waste + nurturing of human resources to spread proper treatment (government side); 8. Enhancement of legal system regarding hazardous waste; 9. Implementation of regeneration project at landfill sites such as landfill incineration disposal facilities, etc.; 10. Awareness-raising activities and human resource development
Energy	1. Energy conservation projects and projects for introduction of renewable energy targeting offices and commercial facilities; 2. Energy conservation projects and projects for introduction of renewable energy targeting public facilities; 3. Waste heat recovery power generation projects targeting factories; 4. Mega solar power generation projects; 5. Introduction of fixed-price purchasing system for renewable energy
Transportation	1. Introduction of public transport systems and development of transportation hubs; 2. Effective use of existing public transportation, such as railways and water transportation; 3. Road development; 4. Introduction of traffic management facilities; 5. Parking lot development; 6. Development of comfortable pedestrian space; 7. Driver education and traffic regulation enforcement; 8. Mobility management; 9. Increasing efficiency of logistics; 10. Measures against air pollution and vibration, or development of parks and green spaces in the city center for reducing CO2 emissions, etc.; 11. Roadway plan integrating waterworks development plan and waste recovery plan; 12. Establishment of appropriate transportation-related city organizations

Composition of specific measures

Field	Specific measure
Waterworks/ sewerage/ rainwater drainage	1. Introduction of metering equipment in the private water supply sector (suburbs); 2. Securing water sources and water quality preservation; 3. Introduction of energy-saving waterworks equipment and renewable energy; 4. Surface maintenance of sewers and early construction of sewerage treatment plants based on sewerage treatment master plan which is currently being compiled; 5. Strengthening of administrative guidance, clarification and proper operation of penalty regulations; 6. Urgent maintenance and improvement of rainwater drainage facilities; 7. Distributed wastewater treatment system development project
Environmental conservation	1. Development of air quality monitoring system and understanding of current situation based on it; 2. Setting of environmental standards related to vibrations; 3. Enhancement of the legal system for improvement of air pollution derived from exhaust gas; 4. Review of environmental standard application methods conducive to organized water pollution improvement; 5. Development of sewage treatment plants; 6. Implementation of periodic water quality monitoring in order to understand actual situation of water pollution; 7. Preservation of valuable ecosystems; 8. Formulation of Phnom Penh capital version of green growth action plan
Green production	1. Development of human resources for industrial development; 2. Promotion of cleaner production; 3. Fostering of small- and medium-sized businesses; 4. Sale of environmentally friendly products; 5. Expansion of green agriculture; 6. Effective utilization of biomass discharged from agriculture and livestock industries

Tasks and Specific Measures by Field

< Waste Field >

Waste / Current status and tasks

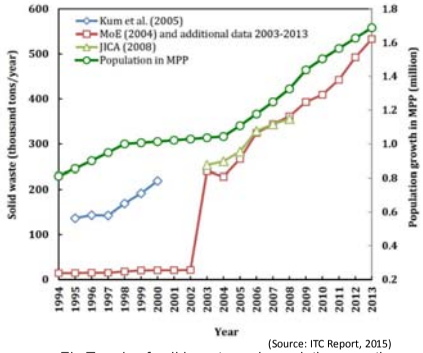
- In 2002, Phnom Penh and CINTRI concluded a 49-year concession agreement for collection/transportation. As a city, Phnom Penh recognizes that there are areas where collection is not performed or where the collection service is insufficient. On the other hand, CINTRI emphasizes that the contract between the company and the city covers only those districts with paved roads and that the waste collection coverage is approximately 80%, with the remaining 20% being districts which have been newly absorbed into the city and in which the roads are not paved, so that such districts are not subject to the collection agreement. In order to solve this problem, the document exchanged between Phnom Penh's 12 districts and CINTRI based on Ordinance 113 is not an agreement on collection/transportation, but the contents are related to garbage collection plans, road cleaning, and transportation methods, and only part of the authority is delegated to the districts.
- Based on the disposal amount at Dangkor Landfill, the only final disposal site in Phnom Penh, the amount of waste generated in the city in 2013 was 1,550 t per day, and it is estimated that by 2015 it will reach 2,000 t per day because of population increases and expansion of collection areas due to the transfer of some regions from Kandal State to the capital. The amount of generated waste has increased almost 2.5 times from the 800 t at the time the disposal site was established in 2009. This trend is expected to continue in the future, so reducing waste generation and reducing the amount brought to the disposal site is an urgent issue.
- Although sorting of waste is not done, for a fee Ejay (a valuable material recycling agent) will collect cans, bottles, PET bottles, etc. from the garbage put out on the side of the road in front of each house. However, when garbage brought to the disposal site was checked, not only is there vinyl materials and plastics in the mainly raw household garbage, but also fairly large amounts of cans, bottles, PET bottles, etc. mixed in.

Waste / Current status and tasks

【Solid wastes (household + business wastes)】

- Waste-related projects are being conducted by various donors including international development aid organizations from various countries, but the results have not been improved. It is important to understand that for waste management, the issue must be looked at as the entire system from sorting/reduction at household disposal level, collection/transportation, intermediate treatment, and final disposal, and partial approaches will not lead to radical solutions. Because of this, the creation of a master plan for waste disposal is urgently required.

- Priorities for waste management are firstly the suppression of waste generation, followed by reuse/recycling and utilization as an energy resource, with landfill disposal as a last resort, and it is necessary to aim for the creation of a recycling society through these efforts.
- In August 2015, the “Ordinance concerning solid waste management in urban area" was issued, in which solid waste was separated into the two types of general waste and hazardous waste, and it was clarified that solid waste was the responsibility of district administrative authorities which are the basic local government. For waste management, the ordinance stipulated sorting of waste, collection/transportation, and recycling, and in addition, also included monitoring of final disposal sites.



(Source: ITC Report, 2015)

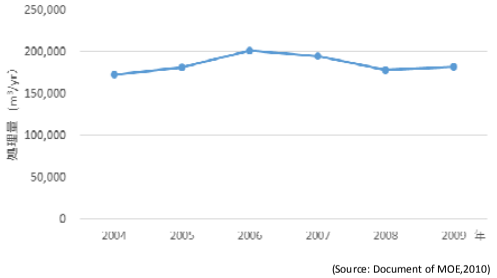
Fig.Trends of solid waste and population over time

Waste / Current status and tasks

【 **Hazardous waste**(including industrial wastes)】

- Under the "Ordinance concerning solid waste management in urban area", waste would be separated into general waste and hazardous waste, and hazardous waste other than medical waste would be accepted solely by Salom Trading Company with the approval of the Ministry of the Environment. The actual situation of industrial waste treatment and disposal is not grasped, and ensuring traceability using a manifest system, etc. is important.

- The industrial structure of Cambodia is at the stage focused mainly on light industry and there is little industrial waste requiring sophisticated treatment, but it is important to not just perform treatment and disposal but also to promote utilization of emitted industrial wastes through industrial waste resource recovery and conversion to resources, such as conversion to fuel for cement plants, etc.



(Source: Document of MOE,2010)

Fig.Trend of industrial waste treatment volume
(portion handled by Salom)

Waste / Current status and tasks

- According to a survey by the United Nations University, the per-person generation of electrical and electronic waste (E-waste) in East Asia and Southeast Asia in 2015 was about 10 kg, but in Cambodia it was 1.10 kg and in Vietnam, 1.34 kg. The Cambodia government is expecting rapid increases in the future due to economic growth and in addition to starting work on formulating laws concerning E-waste, they are also taking measures to prohibit the importation of E-waste and the importation of used electrical and electronic equipment. However, treatment is performed mainly by the informal sector, and the current situation is far from proper treatment.
- In 2008, the "Ordinance concerning medical waste management" was issued, and although the system is that hospitals and clinics would separate medical waste from garbage and store it for a certain period of time, and it would then be collected by the Red Cross, problems such as hospitals and clinics disposing of medical waste together with general garbage have also been found. In addition, there is no system for separation and collection of mercury-containing fluorescent lamps from general garbage, and there is also a fear of contamination of the final disposal site.

【Educational activities for citizens】

- Although the cooperation of citizens is indispensable for promoting suppression of waste generation, recycling and reuse as resources, sorting and 3R, etc., educational activities are insufficient for citizens.

Fig. D'Angkor Landfill Site

(Source: Document of MOE,2010)

Fig. Final industrial waste disposal site in operation

Waste: Introduction of efforts in Kitakyushu

■**How to reduce household waste in Kitakyushu**

New recycling system was carried out

1. Carried out plastic container recycling

(1993)

(1997)

(2006)

45 liter	20 ¢
25 liter	12 ¢

2. Increased the price of designated garbage plastic bag.

45 liter	15 ¢

(Until 2006)

45 liter	50 ¢
30 liter	33 ¢
20 liter	22 ¢

(2006)

45 liter garbage plastic bag
Average Weight : 6 kg/one bag
Treating cost : 2.5US$/one bag
(Collection and Incineration)

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Waste: Introduction of efforts in Kitakyushu

■**Waste reduction civil awareness appears**

Before

After

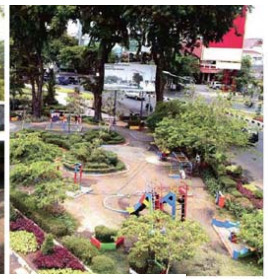
Waste: Introduction of efforts in Kitakyushu

■**Development of Waste management Project in Surabaya**

We achieved a reduction of over 30% in household waste.

We launched the waste management project in 2004 in Surabaya, Indonesia's second largest city with a population of three million. The project entailed proactive steps to encourage residents to compost the organic matter that comprises over half of Surabaya's total waste. As a result of the project, more than 20,000 households now have composting baskets and more households are separating their rubbish into different types, leading to a reduction of over 30% in annual volume of household waste.

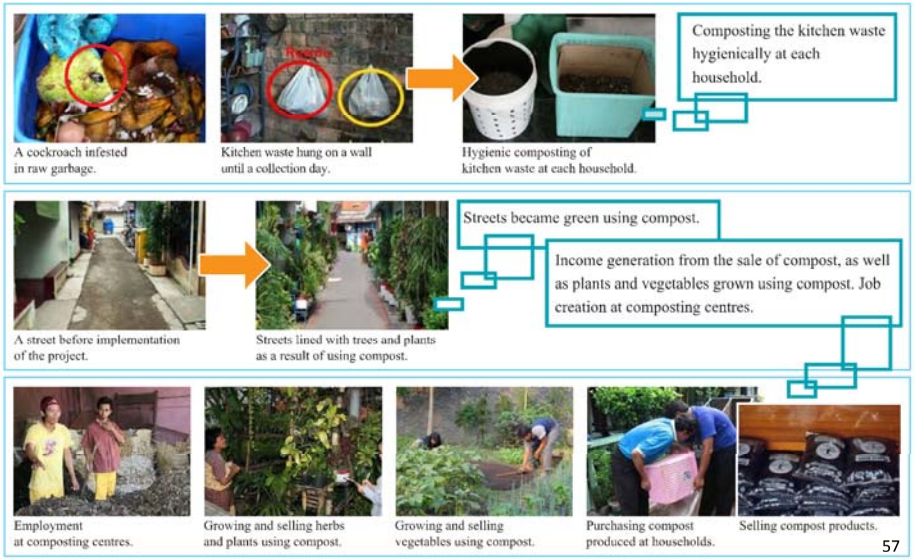
City in 2001
Streets overrun by garbage



Surabaya's streets today
Increased greenery in parks and along roads using compost

Waste: Introduction of efforts in Kitakyushu

■Social and Environmental Impact Caused by the Promotion of Composting Practices



Waste: Introduction of efforts in Kitakyushu

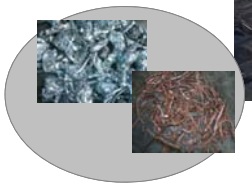
■Taking on the Challenge of a Resource Recycling SocietyKitakyushu Eco-Town Project

Japan's Largest Eco-Town(Recycling Park)

【Automobile recycling】

1997: Certified 1998: Operations start
Number of business facilities:24
Number of research institutes: 10

【R&D on recycling technologies for photovoltaic power generation systems】



【Recovery and treatment of rare metals 】

- **Investment: Approx. JPY 71.4 billion**
- **Employees: Approx. 955**
- **Visitors: Approx. 1.52 million (1998 to Nov 2016)**

【Recycling of fluorescent tubes】

Waste: Introduction of efforts in Kitakyushu

■Recycling of Electrical and Electronic Waste (Nippon Magnetic Dressing Co., Ltd.)

Nippon Magnetic Dressing has developed technologies for the concentrated recovery of rare and precious metals (secondary treatment) from household waste electronic circuit boards, mobile phones, and small electronic devices, and started plant operations in Kitakyushu Eco-Town in May 2012. As part of this project, Nippon Magnetic Dressing imports waste electronic circuit boards from overseas with the aim to treat this waste together with electronic waste in Japan.

India

In order to prevent the improper recovery of rare metals that may have adverse impacts on health and the environment, waste electronic circuit boards, such as computers, started to be imported to Japan which possesses proper advanced recovery technologies

Viet Nam

Expansion of recycling of electrical and electronic equipment waste, such as mobile phones and computers that generate large amounts of waste due to the rapid introduction of new products.

Philippines

Installation of collection boxes in communities and large-scale commercial facilities in Cebu and Manila for small electrical/electronic household waste, such as cell phones, and implementation of collection projects with the participation of the public.

Import of electrical and electronic waste from India and Viet Nam are the first cases in the world under the Basel Convention.

Business Scheme

Waste/Specific Measures(Draft)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
1.Creation of waste management master plan	A waste management master plan will be created in order to construct a waste management system consisting of sorting/reduction at household disposal level, collection/transportation, intermediate treatment, and final disposal and promote proper treatment of wastes from a comprehensive perspective.	PPWMD	Medium to long term	
2.Improvement of collection/transportation	In order to perform management appropriately for collection of waste suppliers and transportation suppliers, delegation of authority is promoted to the ward, area without collecting and transporting waste is dissolved. The service to the metropolitan citizens is improved by these actions.	PPWMD	short-term	Waste Collection Rate
3.Implementation of model project for household garbage sorting/reduction	In order to promote sorting/reduction at the household disposal level, proper sorting of household garbage and popularization of raw garbage composting will be performed in a model district.	Same as above	short-term	Waste Recycle Rate Amount of GHG reduction
	A regional composting center will be established as a composting center for raw garbage generated by markets and pruned branches, leaves etc. from trees along city streets. In addition, it will also be a base for incentivized collection of compost generated by households.		short-term	
	The model district will be gradually expanded and sorting/reduction will be promoted throughout Phnom Penh, and work will be performed on creation of the above waste management master plan concept.		mid-long term	

※Establishment of mechanism for employing waste pickers who make a living collecting valuable materials at composting centers or garbage banks. Such a system may lead to supporting the economic independence and preventing health hazards of waste pickers.

PPWMD : Phnom Penh Waste Management Division

Waste/Specific Measures(Draft)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
4.Establishment of "Garbage bank"	In order to promote community-level separation and recovery of valuable materials such as PET bottles, cans, bottles, metals, plastics, etc. generated from households and other sources, a "Garbage bank" will be established.	PPWMD Private Company	short-term	Waste Recycle Rate
5. Introduction of waste power generation as intermediate treatment	For handling the increasing quantities of municipal garbage, there are limits to using landfill disposal alone, and in order to promote volume reduction through intermediate treatment, waste power generation projects will be introduced. There are methods for generating power using steam generated through waste incineration in a stoker furnace or utilizing methane gas generated by separating out raw garbage only, so investigations will be conducted for introduction of the most suitable facilities taking into consideration regional characteristics.			
6. Proper treatment at final disposal site	At the current Dangkor final disposal site, constant monitoring and proper treatment is performed to prevent environmental contamination from leached water, etc. Furthermore, in constructing the next disposal site, it will be changed to a sanitary landfill with the aim of reducing environmental impact.	PPWMD	mid-long term	Disposal amount of Waste Amount of GHG reduction

PPWMD : Phnom Penh Waste Management Division, MOE: Ministry of the Environment

Waste/Specific Measures(Draft)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
7.Recycling of electrical and electronic waste (E-waste)	The country is urged to prepare laws regarding electrical and electronic waste (E-waste) to shift from informal sector handling to proper treatment and recycling of E-waste will be performed by businesses approved by the country	PPWMD	mid-long term	Waste Recycle Rate Recycle Rate
8.Recycling of industrial waste	Together with utilizing industrial waste by converting it to fuel for cement plants, production of roadbed material from construction waste or fuel from sludge will also be performed to facilitate industrial cycles.	PPWMD Private Company	mid-long term	Waste Recycle Rate Recycle Rate
9. .Proper treatment of industrial wastes	In order to properly treat hazardous waste such as mercury-containing fluorescent lamps, businesses that can perform proper treatment of hazardous wastes will be nurtured.	MOE PPWMD	mid-long term	Disposal amount of Waste Amount of GHG reduction

PPWMD : Phnom Penh Waste Management Division, MOE: Ministry of the Environment

Waste/Specific Measures(Draft)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
10. Awareness-raising activities and human resource development for sorting and 3R	• Practicing of environmental education at elementary schools, etc. and training of teachers for that purpose. • To promote educational activities for sorting and 3R, practicing of environmental education at elementary schools, etc. and training of teachers for that purpose will be performed. In addition, environmental education at the regional community level will be carried out in collaboration with private businesses, NGOs, NPOs, etc.	PPWMD NGO NPO	short-term	The Number of Training and trainees

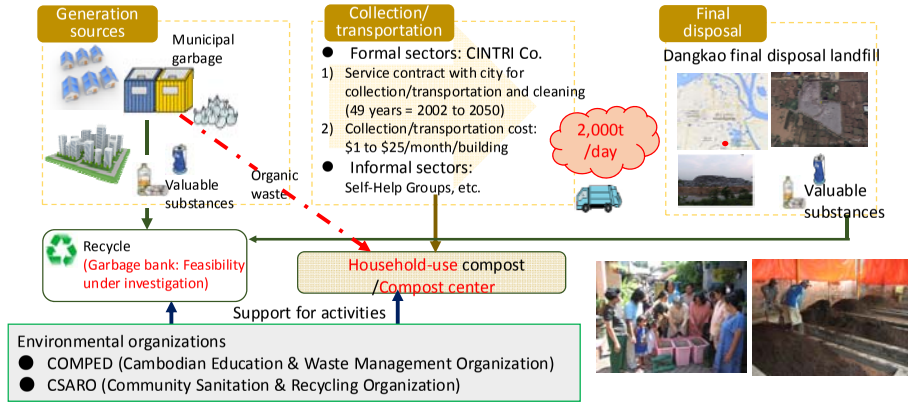
PPWMD : Phnom Penh Waste Management Division, MOE: Ministry of the Environment

Encouragement of composting the kitchen waste in Surabaya, Indonesia

Kogasaki Incineration power plant(Kitakyushu City)

Eco Center of Kitakyushu city
http://www.kitaq-ecotown.com/
(Base of enlightenment activity)

Pilot Project in waste field(1)
Municipal waste reduction and recycling (Step 1)



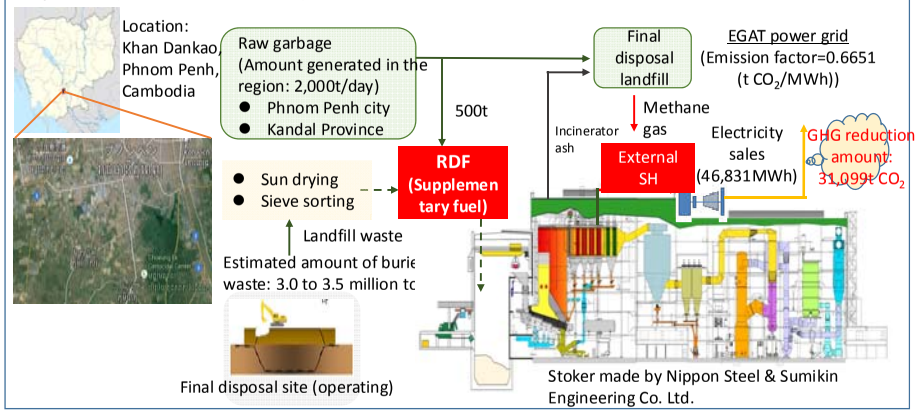
This project is intended to promote waste recycling and reduction in a model district under governmental guidance with the cooperation of residents and resident organizations. Thereafter, the model district will be gradually expanded throughout the city.

1. In the model district, composting of household waste will be popularized through suitable sorting of municipal waste.
2. Distribution of household-generated compost shall also be an objective, and compost centers targeting markets, etc. which produce regular quantities of raw garbage will be constructed.
3. In local communities, garbage banks will be constructed to promote the sorting and collection of valuable substances such as plastic, cans, bottles, metals, etc. generated by households, etc.

Pilot Project in waste field(2)

Introduction of waste power generation for municipal waste (Step 2)

Project site (Dankao landfill: 30 ha)



- The amount of generated waste has increased to nearly 2.5 times the 800t amount at the time that the disposal landfill opened in 2009, and since this trend is expected to continue in the future, reducing the amount of generated waste together with reducing the amount of waste transported to the disposal landfill has become an urgent issue.
- Because of this, focus has also been placed on a waste power generation project (with introduction of a 500t incinerator as the first step) for intermediate waste processing to promote optimization of waste management with an integrated approach.

RM-17

Tasks and Specific Measures by Field

< Energy Field >

Energy / Current status and tasks

【Occurrence of power outages】

- Although the frequency of power outages in the city has decreased, in some regions power outages still occur frequently.
- Although the frequency of the power outages in the PPSEZ has decreased to about once per month for about 10 minutes, problems are occurring in some factories. Tenant companies are strongly demanding the complete elimination of power outages.
- In regions outside the PPSEZ where Japanese companies are operating, power outages occur frequently.

【Voltage instability】

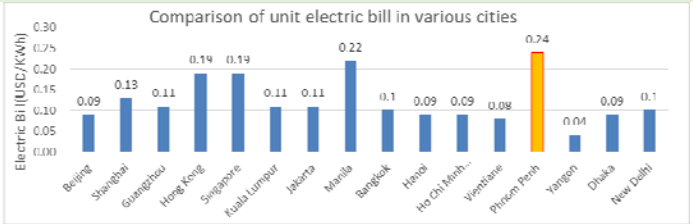
- Problems with factory equipment are occurring due to the effects of power outages and voltage instability caused by insufficient supply capacity.

【High electric bill】

- Many businesses expanding into Phnom Penh metropolitan area view high electric bill as a problem.

【Utilization of renewable energy】

- Although the government has plans to utilize renewable energy in order to secure diversified power sources, the efforts are from now on.



Notice : Basic monthly charges are not included. Source : JETRO, 25th Comparison of investment-related costs in the Asia-Oceania major cities and regions

Energy / Current status and tasks

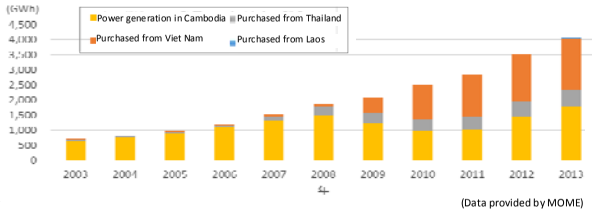


Fig. Trend of power supply volumes in the Kingdom of Cambodia

Fig Volume of power that can be generated under EDC jurisdiction

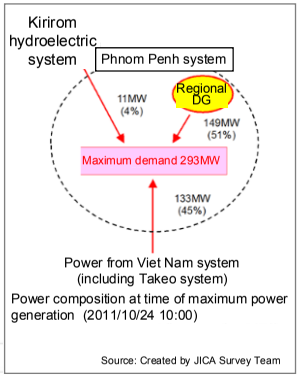


Fig Power composition at time of maximum power generation

Energy: Introduction of efforts in Kitakyushu

■Collaborative environmental urban planning in Yahata-Higashida district


Higashida blast furnace No. 1 under construction (1900)

Yahata-Higashida District Collaborative Environment-friendly Urban Planning

Next-generation urban planning will be promoted with both advanced urban infrastructure and environmental harmony enabled by redeveloping an immense former factory site.


Main office and factories of Yahata Seitetsujyo in 1912

Local Consumption of Locally Produced Energy

Local Consumption of Locally Produced Energy
Collaborative supply of electric power to towns and steam to factories
Higashida cogeneration (33,000 kW)
Low-carbon power generation with clean natural gas fuel. Supplies electricity generated by cogeneration as core energy for the district.

Hydrogen supply generated from the factory as a fuel
Kitakyushu Hydrogen Station
A next-generation energy station that supplies hydrogen secondarily produced in steel plants to hydrogen vehicles as fuel. The Kitakyushu hydrogen town project is also in to the process of effectively using hydrogen in the entire district.

Active introduction of photovoltaic power generation
Environmentally friendly housing—Livio
Higashida Ville Courte (approximately 170 kW)
Museum of Natural History and Human History (approximately 160 kW)
achieved CO_2 reduction by more than 30% compared with typical housing complexes by such measures as the use of natural energy as well as improved insulation and airtightness.

A Whole Town Functioning as an Environmental Stage

Urban planning starring citizens
Local community linked by the environment
Active environmental activities are expanded by organizing the Higashida Urban Planning Council with companies located within the district along with regional inhabitants.


Confidently conducted trash collection with official approval of the president
Eco-driving seminar
Tree planting activities by citizens and others

Enjoyable learning space for everyone
Environment Museum
An educational facility for environmental study well received by many citizens where people can learn about the history of Kitakyushu City's control of environmental pollution and about the ecological life familiar to them. An environment-friendly model house for the 21st century—an eco-house—next to the museum opposes an energy-saving lifestyle

Jointly operated public-private Higashida Eco-club promotes environment-friendly urban planning
The club was established as a base to promote the Yahata-Higashida Green Village Concept. The ecological building is operated by a nonprofit group as a community center and urban planning salon established and operated by the private sector.

Low carbon traffic system
Car Sharing / Bicycle Sharing
Under the keywords "from possession to sharing," a nonprofit group promotes sharing of vehicles and bicycles to companies located in Higashida and residents of the environmentally friendly house.

High energy saving realized by green IT
Asian Frontier
It is one of the largest environment-friendly next-generation data centers in Japan. Its proprietary air-conditioning optimization technology enables optimum operation of high-integration servers and high energy-saving effects.

Energy: Introduction of efforts in Kitakyushu

■Composition of Kitakyushu Smart Community Creation Project

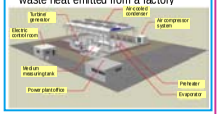
Realization of an energy community participated in by regional blocks → **Society capable of full use of energy** → **CO_2 reduction by 50%**

Blocks using 10% new energy

Town Mega Solar
Infrastructure will be developed to enable photovoltaic power generation of 1,000 kW within the community

Kitakyushu Hydrogen Town
Hydrogen supply using the hydrogen byproduct pipeline (used for fuel cells, etc.)

Binary power generation
Demonstration project for binary power generation using low-temperature waste heat emitted from a factory



【Roles and Form】
- New energy will be systematically introduced into urban design
- Civilian use of factory energy

Introduction of energy-saving system with all block functions

Introduction of bioelectric management systems and home energy management systems compatible with the demand
20 smart houses, 4 smart stores, 4 smart schools,
1 next-generation service station, 1 smart hospital, etc.


5 smart offices　1 smart data center　10 smart factories

Photovoltaic power generation
Small-scale wind power generation
Battery chargers for electric vehicles and plug-in hybrids
Intensive greening area

Regional society planning for a next-generation traffic system

Total mobility management system
- A total mobility management system will be constructed that enables linkage with public transportation systems and community buses as well as the introduction of a large number of electric vehicles, promotion of the use of bicycles, and the use of small fuel-cell vehicles.


General energy station　Bicycle rental station　On-demand transportation system Community bus

【Roles and Form】
- Enabling both efficient energy use at individual facilities and energy use by the whole community
- Standardization of smart meters beyond the differences among factories, buildings, etc.

【Roles and Form】
- Development of the next-generation mobility station
- A traffic system that considers aged people, such as on-demand community buses linked with hospitals

Construction of regional energy management

The Regional Energy-saving Station
The Regional Energy-saving Station will be constructed with the following functions as the foundation for managing regional energy:
- Optimum energy distribution in accordance with power-generating status
- Rationalization of control from the demand side for optimization of the demand in the entire community
- Visualization of energy and CO2
- Granting incentives to motivate consumers

Demand-side Management
- Dynamic Pricing
- Incentive Program


Peak Integration　Saving Energy
Peak Shift

Introduction of a large number of smart meters
Introduction of smart meters to approximately 50 companies and 230 households

【Roles and Form】
- Maximum use of new energy in accordance with the demand within the community
- Minimization of energy use in the entire community
- Minimization of the impact of unstable new energy on core electric power

Energy: Introduction of efforts in Kitakyushu

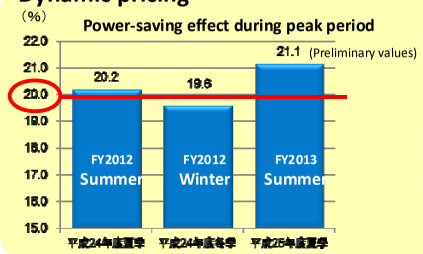
■Introduction of Energy Saving System in the Whole Region

Intensive introduction of system for two-way communication and control with the center, and corresponding HEMS and BEMS

Energy: Introduction of efforts in Kitakyushu

■Demonstration results until now

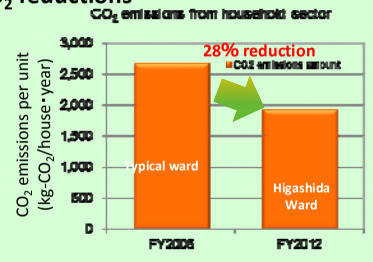
Dynamic pricing

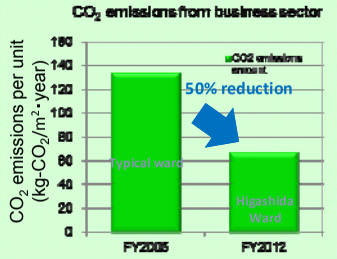


Dynamic pricing was applied from the summer of FY 2012, and a peak-period reduction effect of roughly 20% was confirmed.

Highly evaluated by Stanford University, etc. as high-accuracy academically valuable data

CO_2 reductions





Energy: Introduction of efforts in Kitakyushu

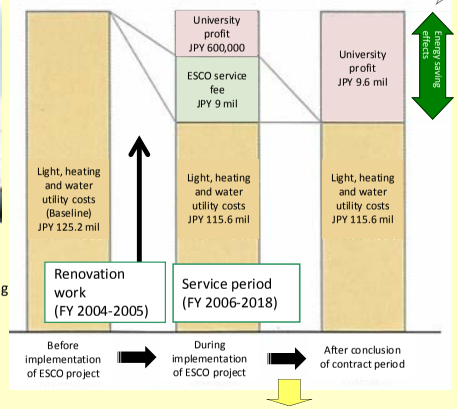
■ESCO (Energy Service Companies)

ESCO companies comprehensively offer all points necessary to improve energy savings, including technology, equipment, human resources, and funding.

ESCO companies guarantee energy-saving effects (cost reductions, etc.)

ESCO projects at The University of Kitakyushu

〔Project details〕
- Increase efficiency of transformers
- Develop inverters for lighting
- Reduce number of fluorescent lamps with the use of reflection plates
- Attach solar radiation adjustment film to window surface, other



Examples of ESCO projects by businesses in Kitakyushu

Steel Memorial Yawata Hospital

〔Project details〕
High-efficiency boiler
Kerosene-fired flue and smoke boiler ⇒ Updated to small, natural gas-fired, high efficiency once-through boiler

Expectation of reductions of 138 k ℓ annually in crude oil equivalent (CO2: about 360 tons) 13 years after the end of construction in comparison with earlier equipment updates. ESCO companies guarantee about a JPY 9 million/year reduction in expenses for heat and water annually.

Energy: Introduction of efforts in Kitakyushu

■Murasakigawa My Town, My River Project

[10 bridges on Murasakigawa River]

[Suhama Plaza]

[Murasakigawa Bashaku District Redevelopment]

[Flood (1953)]

[Riverbank (Around 1965)]

■ Projects
(1) Flood prevention: Expansion of river, dredging of river floor
(2) Bridges: 10 bridges with natural themes (Themes: Ocean, Fire, Trees, Stones, Water Birds, Sun, etc.)
((1) Widening of river leads to insufficient bridge length, (2) Relief of traffic congestion, (3) deteriorated Bridges)
(3) Creating river banks where people can gather:
Water Environment Museum, Waterfall, Suhama Plaza, Riverfront Promenade, etc.
(4) Creating areas where people can gather: Castle Road, Kokura Castle Garden, Matsumoto Seicho Museum, Comprehensive Health and Welfare Center, Kokura Kita Ward City Office, Redevelopment of Murasakigawa Bashaku District, Redevelopment of Muromachi 1-chome District, etc.
■ Period FY 1990 - 2005

Energy: Introduction of efforts in Kitakyushu

■Heat Island Measures for Downtown Kokura

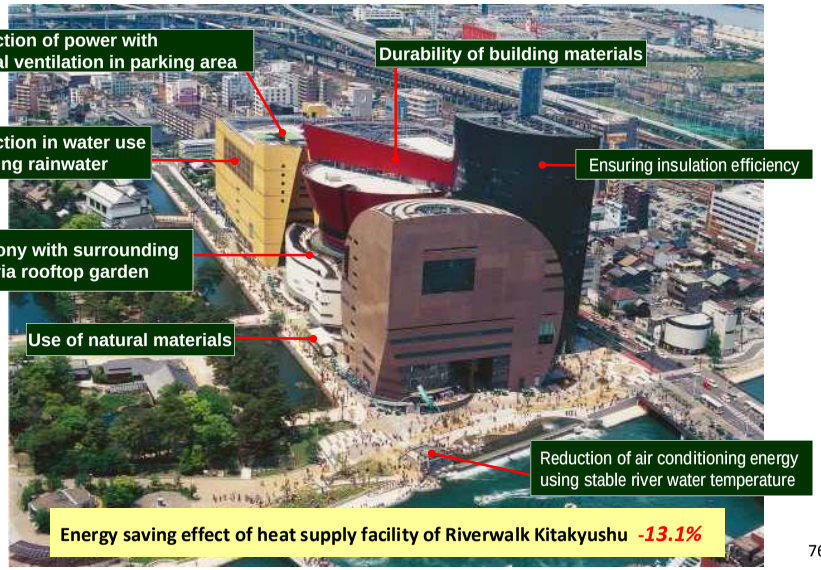
View of Murasakigawa area

Riverwalk Kitakyushu

Item	Major Heat Island Measures
Promote use of unused energy	Heat pumps using river water* (Riverwalk) Regional cooling and heating (Asano Heating & Cooling Energy Center)
Promote greening on buildings	Rooftop gardens (Riverwalk, etc.)
Promote greening in public space	Katsuyama Park improvement project
Promote measures for water use	Carry out a “water sprinkling campaign” using reclaimed sewage water
Promote creation of water and greenery network	*My Town, My River* Project Project to create avenues lined with flowers and greenery
Promote the use of an Urban Planning System	Use of porous asphalt pavement in Downtown Kokura

Energy: Introduction of efforts in Kitakyushu

■Environmental Symbiosis Urban Redevelopment (Riverwalk Kitakyushu)



Energy/Specific Measures(Draft)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
1. Energy conservation projects and projects for the introduction of renewable energy targeting offices and commercial facilities	Increase the efficiency of energy utilization through implementation of energy conservation diagnosis and introduction of energy-saving equipment. In addition, the introduction of renewable energy such as solar power generation, etc.	Private Company	short-term	Amount of Energy reduction and GHG reduction
2. Energy conservation projects and projects for the introduction of renewable energy targeting public facilities	Carrying out the above projects at water treatment plants, schools, etc.	PPWSA	short-term	Same as above
3. Waste heat recovery power generation projects targeting factories	Waste heat power generation projects targeting cement factories, etc.	Private Company	short-term	Same as above

PPWSA : Phnom Penh Water Supply Authority, EDC: Electricite du Cambodge

Energy/Specific Measures(Draft)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
4. Mega-solar power generation projects	Mega-solar projects and solar heat utilization projects to take advantage of the sunlight conditions with which the country is blessed	Private Company	mid-long term	Same as above
5. Introduction of fixed purchase price system for renewable energy	Introduction of fixed-price purchasing system for the purpose of power supply diversification and popularization of renewable energy such as solar power generation, biomass power generation, etc.	EDC	mid-long term	Establishment of the system

PPWSA : Phnom Penh Water Supply Authority, EDC: Electricite du Cambodge

Photovoltaic system (Phnom Penh capital water supply authority)

Photovoltaic system (The roof of bicycle parking lot of AEON mall)

Waste heat recovery power generation in cement factory

High efficient chilling machine

Source: http://www.enecho.meti.go.jp/about/whitepaper/2016html/1-1-4.html

Pilot project in energy field(1)

Introduction of solar large power generation and high efficiency chiller for large shopping mall

NTT Data

Project Outline ~ AEON mall Cambodia No.2 ~

- Introduction of solar power generation and high efficiency chiller for AEON mall No.2 PPC(Tentative name, It will open in the summer of 2018) which AEON Cambodia is planning to construct.
- Reduction of CO_2 emissions which is produced from the combustion of the fossil fuel when the grid electricity is generated by introducing renewable energy (solar power generation) and energy saving device (high efficiency chiller).

Expected Effects

Solar Power： CO2 Reduction ：948.7[tCO2/year] High Efficiency Chiller： CO2 Reduction ：615.6 [tCO2/year]

Method for Raising Funds

Application of JCM scheme ： Solar Power System ;Subsidy rate 40% High Efficiency Chiller System; Subsidy rate 50%

Pilot project in energy field(1)

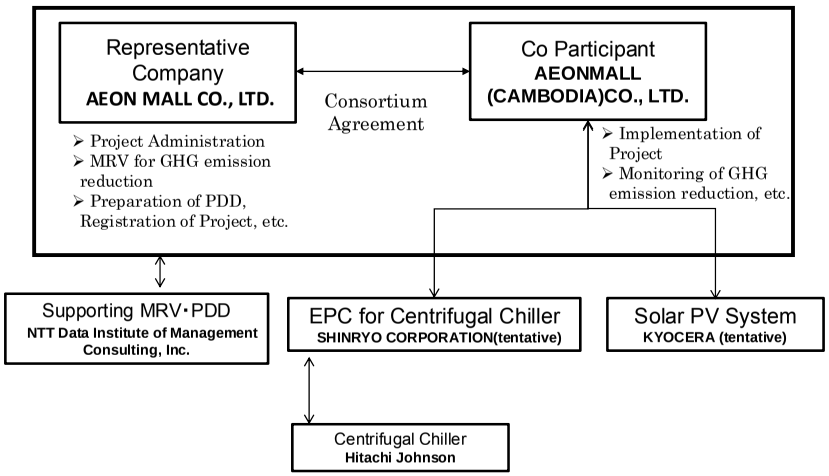
Introduction of solar large power generation and high efficiency chiller for large shopping mall

~ AEON mall Cambodia No.2 ~

NTT Data

Business Structure

International Consortium



Pilot project in energy field(2)

Introduction of promotion of shift to low-carbon society through energy-saving measures, etc. targeting large hospitals

Assumed project (Khmer Soviet Friendship Hospital)

Project overview (assumed)

- With the Khmer-Soviet Friendship Hospital, which would be counted among facilities with large energy consumptions, as the assumed target, the feasibility of a JCM subsidized project is being investigated.
- Installation of solar panels on the hospital roof space (approx. 1,800m^2) is assumed.

Expected effects (assumed)

Based on rough estimation, the following effects are expected:

- Yearly Power Generation: approximately 250,000 kWh/year
- Yearly Electricity Cost Reduction: approximately 47,500 USD
- Yearly CO_2 Emission Reduction: approximately 160 tCO_2/year

*Note that these figure are based on rough estimation. Detail design with PV panel manufacturer and EPC company are needed for actual project.

Funding procurement methods (assumed)

- Based on rough estimation, initial cost is approximately 300,000 USD.
- It is assumed that around 30 ~ 40% of the initial cost is subsidized by JCM equipment subsidy project.
- As results of hearing with hospital, financing by themselves may be difficult.
- As one of the solution of initial cost, we started discussion with local bank using ESCO or lease scheme.
- After power generation is started, monthly lease fee which is commensurate with cost reduction by power generation will be paid by hospital to the bank

Pilot project in energy field(3)

Introduction of waste heat recovery power generation system for cement plant

Assumed project (CHIP MONG INSEE CEMENT CORPORATION)

Project overview (assumed)

- We conduct feasibility study of a JCM subsidized project for cement plant which have high potential for the CO2 reduction by using waste heat recovery power generation system.
- CHIP MONG INSEE CEMENT is a joint venture company of Chip Mong Group (CMG): 60% and Siam City Cement Company (SCCC): 40%.
- The plant will start production in mid Q4/2017.
- Around mid 2018, tendering exercise for suppliers of waste heat recovery (WHR) system will be stated.
- Commissioning of WHR system is expected in Q1 to Q2 of 2020.

Google Map: Cement Plant in Kampot(125km from Phnom Penh)

Expected effects (assumed)

- Power generation of around 8MW of electrical power is expected.
- Yearly CO_2 Emission Reduction of around 30,000 tCO_2/year is expected.

Funding procurement methods (assumed)

- Initial cost of equipment would be financed by the cement company.
- It is assumed that 50% of the initial cost, as maximum, is subsidized by JCM equipment subsidy project.

Tasks and Specific Measures by Field

< Transportation Field >

Transportation/Current status and tasks

【Public Transportation】

- PPCH and DPWT(Department of Public Works and Transport) have taken over the management of city buses with 3 routes currently being operated. However, private passenger cars, motorcycles or Remorque are still main players as travel modes due to the limited bus route network and bus fleet. Hence the mobility of citizens is still low.(Especially, mobility-impaired people like ladies and the senior citizens)
- There are several ferry transport services in Mekong River on the east side in the city. However, access to the passenger jetties is chiefly by motorcycles, which is rather inefficient. An efficient, reliable and comfortable mode of transfer is very necessary. For this reason, public transport system should provide direct linkages to these ferry jetties.
- Currently, access to Phnom Penh International Airport is via the relatively low capacity travel modes of passenger cars, taxis and para-transits. In view of the future rapid growth of passengers, it is very necessary to begin preparing a public transport system that can provide efficient access to the airport with large travel capacity.

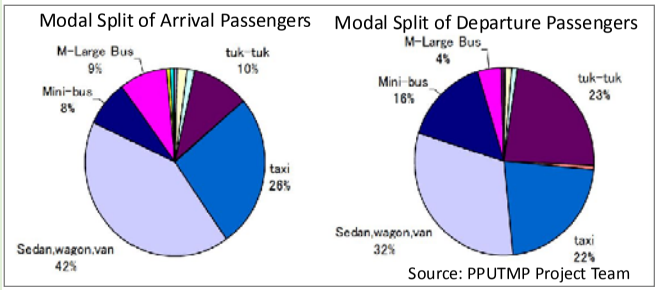
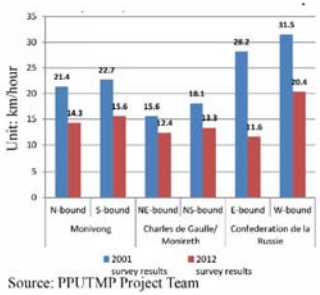


Fig. Share of Phnom Penh International Airport Access Modes

Transportation/Current status and tasks

【Road Development】

- Traffic conditions on roads in the city center deteriorate very rapidly such that, roads face serious space constraint while traffic demand increases exponentially.
- The continuity of several primary and secondary roads in the city is disrupted due mainly to geographical reasons such as presence of rivers and built-up areas.
- Road density in the suburban areas is low (City center: 12.2 km/sq. km and suburban area: 1.6 km/sq. km).Most of the existing secondary roads in these areas are not paved, making travels on such roads very difficult during the rainy season. Furthermore, widths of these roads are too narrow for the safe passage of two opposing vehicles.



Source: PPUTMP Project Team

Change in Travel Speed between 2001&2012

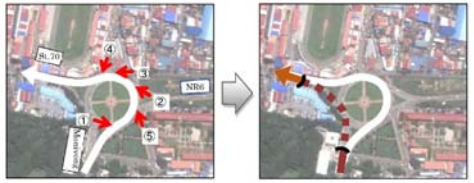

Source: PPUTMP Project Team

Current Traffic Conditions in the City Center

Transportation/Current status and tasks

【Traffic Management】

- While problems at many major intersections have been improved through the "Phnom Penh Urban Transportation Improvement Project", etc., there are still intersections（Chamkar Morn、Neang Kong Heang、Chrouy Changvar）where problems continue to exist.
- All signals in the city are isolated signals operating independently without coordination with neighboring signals. This type of signal operation becomes inefficient.
- There are a lot of drivers who don't obey traffic rules.
- In the Central Business District (CBD), there is currently a shortage of 12,000 parking spaces for motorcycles and another 6,000 spaces for cars.
- Pedestrian Walking Environment is very poor because sidewalks are often taken over by illegally parked vehicles or cafes as their outdoor terraces, or for the display of merchandise by shops or as planter areas by residents.(Pedestrians are thus forced to risk their lives walking on the roadways.)
- In the city of Phnom Penh, many accidents are found to have been caused by human error or unsafe behavior such as drunk driving and speeding.



Proposed Improvement Measure at Chrouy Changvar Roundabout (Underground Passageway)


Source: PPUTMP Project Team

Fig. Sidewalk Parking

Transportation/Current status and tasks

【Freight Transport】

- The road surface along the trucking routes is badly damaged because of poor maintenance and management. As a result, trucks travel at low speed and safety level is not satisfactory.
- Freight transport facilities are located in the heavily built-up areas of the city. Freight trucks have to mix with the general urban traffic. As a result, its service and safety level are adversely affected.
- There are still some roads with narrow widths among the freight transport routes. Large and heavy trucks are thus forced to travel at very low speed.
- There is also no sufficient space for loading and unloading of freights by the trucks. Trucks are forced to do so by the roadsides, causing severe interference to the traffic flows and creating hazardous situations for other road users.


Source: PPUTMP Project Team

Fig. Badly Damaged Trucking Route (Veng Sreng Road)

Transportation/Current status and tasks

【 Environmental and Social Considerations etc.】

- The rapid urbanization of suburban areas has caused a rapid decline of green areas. Meanwhile, in the city center, nature parks and green lungs are also decreasing, while emission of greenhouse gases such as the exhaust gases from vehicles is on the increase.
- Traffic volumes in the city are increasing year after year causing a serious deterioration of the air quality and elevated levels of vibration in the urban areas. There are still many factories located within the urban areas, and exhaust and other particulates emitted by vehicles coming in and out of these factories are also a major concern.
- There are areas in the suburbs still without water supply simply because there are no roads leading to these areas. Since development of water distributing pipe is closely related, it is necessary to coordinate with road development plans adequately.
- In suburban area that fee of collection waste can not be collected, waste is not collected sufficiently and illegal dumping to the sidewalk and drainage is found. Therefore, countermeasures against illegal dumping should be considered with road environment improvements integrally.



Transportation: Introduction of efforts in Kitakyushu

■**Low-carbonization in the transportation sector**

Promoting the use of public transportation


Super “No Car” campaigns


Short drives Car sharing
Eco-cycling

Public transportation is convenient and can reduce CO_2 emissions.

Economical and safe driving that anyone can do.

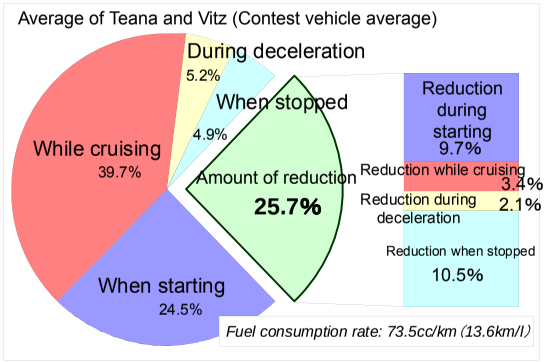
Eco-Drive

Gentle acceleration:
Saves ~9,860 yen (Reduces CO_2 94 kg)
Driving with little acceleration/deceleration:
Saves ~3,460 yen (Reduces CO_2 68 kg)
Stop accelerating early:
Saves ~2,130 yen (Reduces CO_2 42 kg)
Idling stop
Saves ~2,040 yen (Reduces CO_2 40 kg)


Electric vehicle

Transportation: Introduction of efforts in Kitakyushu

■**Effects of Ecodriving**



Source: The Energy Conservation Center, Japan

Improved fuel economy
- Reduced costs (economic benefit)
- Reduced CO_2 (environmental effects)

Reduced traffic accidents

10 rules for ecodriving

1. Stop idling.
2. Drive at economical speed.
3. Keep tires at proper pressure.
4. Do not load unnecessary items.
5. Stop unnecessary revving.
6. Stop sudden starts, sudden acceleration, and sudden braking, and maintain appropriate distance between vehicles.
7. For manual transmissions, shift up as soon as possible.
8. Do not cause traffic jams by parking illegally.
9. Use air conditioning moderately.
10. For car owners, try to share the ride. Also, use public transportation as much as possible when available.

Transportation: Introduction of efforts in Kitakyushu

■**Introduction of Urban Monorail: Japan’s first urban monorail**

Successful case of public transit-oriented development (TOD) leading to urban development along railways ～OECD Report～

- Reduced traveling time: Traveling time from Tokuriki, Shii area in Kokura Minami district to Kokura city centre has been reduced by approximately 30 minutes.
- Car traffic reduction/Traffic congestion moderation: After monorail has been introduced, car traffic in national highway of 322 has been reduced by 14,920 cars per day.
- Promotion of development along railway line: Promotion of site location for residential and commercial complex along monorail line/ Population growth/ Growth of employment population and merchandise sales etc.

Reduction in vehicular traffic in the city limits due to the convenience of public transportation
Reduction of automobile exhaust gas

Transit Oriented Development or TOD is defined as a mixed-use residential or commercial area designed to maximize access to public transport, and often incorporates features to encourage transit ridership. A well planned TOD would turn a rail or bus station from a transport hub into an activity hub so that people could easily access the development by means of convenient public transport, in particular, railways or metros, for longer distance and by walking/cycling, if walkways and cycle network are provided.

Transportation: Introduction of efforts in Kitakyushu

■Promotion of public transport usage and development along railway line

Promote the use of public transportation systems


Extension of monorail to JR Kokura Station


Kikugaoka Station Park and Ride

Season-ticket holders of the Kitakyushu monorail , can receive discount service of parking charges, when they use the park-n-ride facilities.

Improve roads with the construction of urban monorail

Transportation/Specific Measures(Draft)

Specific measures are in accordance with Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
1. Introduction of public transportation systems and development of transportation hubs	1) Development of bus transportation • Position bus transportation as a short-term basic public transit system for Phnom Penh and enhance the route network.	DPWT PPUD	short-term	Number and Ratio of Public Transportation utilization
	2) Development of railway systems • For the long term, develop a loop public transportation system and reorganize bus routes as feeder lines to the loop system.		mid-long term	
	3) Development of transportation hubs • Create good urban areas through urban development centered on public transportation nodes, such as transit-oriented development, etc. • Develop car and bicycle parking lots at public transportation nodes to enable smooth transfers between public transportation facilities and cars, paratransit, bicycles, etc.		mid-long term	

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division

Transportation/Specific Measures(Draft)

Specific measures are in accordance with Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
2. Effective use of existing public transportation, such as railways and water transportation	1) Development of railway lines connecting Central Station and PPSEZ station; Development of area in front of Central Station ・Establish a new station will be established in the PPSEZ which is expected to have a worker population of 20,000 people in the future, and promote reuse of the commuter railroad between the central station and the PPSEZ station.	DPWT PPUD	mid-long term	Number and Ratio of Public Transportation utilization
	2) Formation of a regional transportation network utilizing water transportation ・Promote the development of low-cost, environmentally friendly water transportation as a transportation network between Phnom Penh and its surrounding areas divided by the Mekong River and Tonle Sap River.			
3. Road development	Promotion of the formation of a city framework and road improvements with the aim of smooth cooperation between cities in the Mekong region. 1) Development of inter-city roads: Improvement and widening of national highways (NR1 to NR6) 2) Development of roads in cities: Widening of main roads in city centers; Development of ring roads (RR-Ⅲ, RR-Ⅳ); Development of radial roads 3 Effective utilization of roadway space in the city center (construction of flyovers, etc.) 4) Road development in suburban areas	DPWT	short-term	Road improvement ratio

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division

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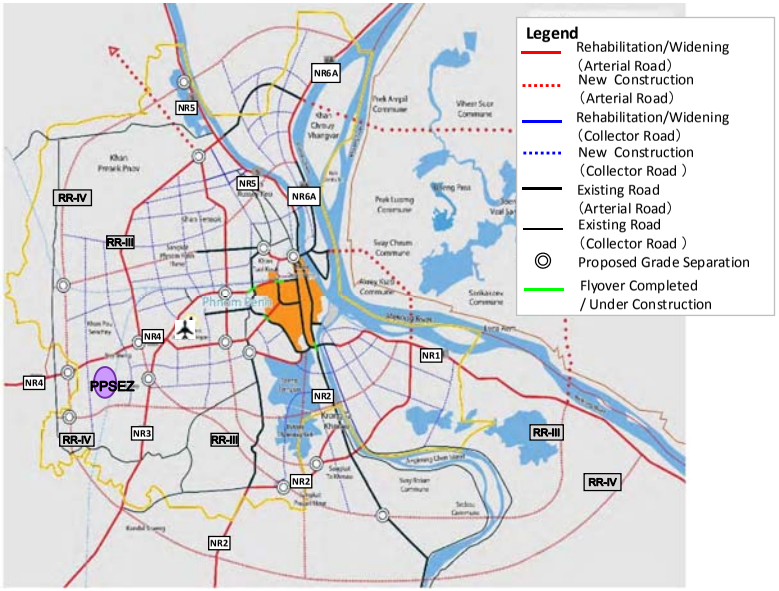
Comprehensive Urban Transport Plan in Phnom Penh

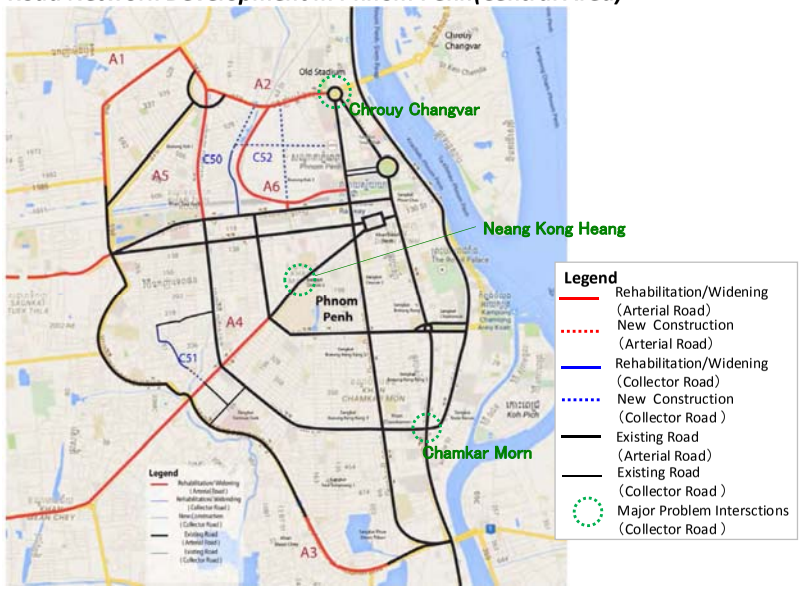
Inter-Regional Road & Ring Road



Source: JICA, PPUTMP Project Team December 2014

Comprehensive Urban Transport Plan in Phnom Penh

Road Network Development in Phnom Penh(Central Area)



Source: JICA, PPUTMP Project Team December 2014

Transportation/Specific Measures(Draft)

KitakyuShu City Bus

Source : KitakyuShu City
http://www.city.kitakyushu.lg.jp/koutsuu/08200089.html

KitakyuShu City Passenger Ship

Source : KitakyuShu City
http://www.city.kitakyushu.lg.jp/san-kei/file_0046.html

KitakyuShu City Monorail

Source : Kitakyushu Urban Monorail Co.,Ltd
http://www2.kitakyushu-monorail.co.jp/news/detail.php?id=198

National Road (Japan)

Flyover (Phnom Penh)

Source: The Phnom Penh Post
http://www.phnompenhpost.com/real-estate/flyovers-subway-drawing-board-phnom-penh

Transportation/Specific Measures(Draft)

Specific measures are in accordance with Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
4. Introduction of traffic management facilities	1) Development of a traffic control system: Optimal control of traffic signals at intersections in the metropolitan area from the traffic control center to promote alleviation of traffic congestion. 2) Changing narrow streets to one-way streets (to ensure smooth passage) • Promote a change to one-way traffic in order to alleviate traffic congestion on narrow streets and reduce traffic accidents.	DPWT JICA	short-term (2015～)	Travel Speed in main Road
5. Development of comfortable pedestrian space	• Promote the development of parking lots and restrictions on illegal parking to create spaces where pedestrians can walk in peace.	DDWT PPUD	short-term	Illegal parking number in sidewalk
6. Mobility management	• In addition to hard measures, implement soft measures such as thorough driver education at time of license renewal, traffic manner PR, etc. to make the citizens themselves give more consideration to traffic congestion and environmental/health problems and promote a shift from the current overdependence on automobiles to the wise use of public transportation, bicycles, etc.	Police	short-term	The number of times carried out driver education

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division

Transportation/Specific Measures(Draft)

Specific measures are in accordance with Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
7. Increasing efficiency of logistics	1) Appropriate location of logistics facilities ・ In order to alleviate traffic congestion and improve logistics efficiency, inter-regional logistics facilities shall be located at key junctions for suburban transportation and urban logistics facility will be consolidated on the city outer edge. ・On roads with sufficient road shoulder for parking, space for cargo trucks shall be secured using road surface markings, traffic cones, etc. 2) Increase efficiency of logistics networks ・In order to improve the efficiency of logistics networks, cargo transportation trucks shall be separated from private daily traffic, and in addition, development of roads that will become logistics routes (two lanes or more) will be promoted.	DPWT PPUD	mid-long term	Transportation and delivery time Logistics cost

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division

Transportation/Specific Measures(Draft)

Specific measures are in accordance with Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
8. Measures against air pollution and vibration, or reducing CO_2 emissions, etc.	・Thorough compliance with vehicle inspection system	DPWT	short-term	Rate Automobile inspection
	・Promotion of vehicle CO_2 emission absorption by developing urban parks and green spaces and planting roadside trees.	DPWT PPUD	mid-long term	Green area
	・Environmental monitoring shall be implemented in order to grasp the pollution situation and status of compliance with environmental standards and to utilize such data as criteria for judging traffic volume and speed regulations, etc. ・Become involved with the popularization of low-pollution vehicles and encourage eco-driving in order to deal with air pollution and noise from vehicles.	MOE	short-term	The Number of Point and implementation frequency of monitoring
9. Roadway plan integrating waterworks development plan and waste collection plan	・ Sufficiently coordinate waterworks development plans, waste collection plans, and road development plans to promote the spread of waterworks and waste collection.	DPWT PPWSA PPWMD	short-term	Penetration rate of water supply and Waste Collection Rate in suburban area

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division
PPWSA: Phnom Penh Water Supply Authority, PPWMD: Phnom Penh Waste Management Division, MOE: Ministry of the Environment

Transportation/Specific Measures(Draft)

Specific measures are in accordance with Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)

Classification	Description	Implementing entity	Timing of implementation	Evaluation index
10. Establishment of appropriate transportation-related city organizations	Since it is difficult for all of the traffic problems of Phnom Penh to be handled by the single institution of the DPWT, the PPUTA (Phnom Penh Urban Transport Authority) will be established as a new institution at the city level **<Function and responsibilities of PPUTA>** • Monitoring of development action plans defined in the master plan • Coordinating with the various agencies regarding traffic • Supervising maintenance projects related to urban traffic • Designing of traffic mode policies • Realization of traffic-related development plans, etc.	Phnom Penh Capital	short-term	—

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division
PPWSA: Phnom Penh Water Supply Authority, PPWMD: Phnom Penh Waste Management Division, MOE: Ministry of the Environment

Pilot project in transportation field Introduction of Electric tricycle

1. Project overview

Technology overview	・In the Phnom Penh metropolitan area, gasoline Remorque (around 10,000 to 20,000 vehicles) are running around as a transportation mode for tourists and the general public. ・Replace gasoline Remorques which are a cause of air pollution, with electric tricycle in order to reduce CO_2. In addition, a study of solar charging stands for electric tricycle will also be conducted.
Total project cost	1) Electric tricycle: 100 vehicles 2,200 USD/vehicle × 100 vehicles = Approx. 220,000 USD (Approx. 22 million yen) 2) Interchangeable batteries for 100 vehicles 1,000 USD/vehicle × 100 vehicles = Approx.100,000 USD (Approx. 10 million yen) 3) Solar charging stands(70kW): Around 5 locations in metropolitan area 300,000 USD/location×5 locations＝Approx.1,500,000USD (Approx.165 million yen) Total: Approx.1,830,000USD (Approx. 197 million yen)
CO_2 reduction effect (Assumption)	1)In the case of Not installing solar charging stands(E-tricycles will be charged by Power gird) 0.223tCO_2/vehicle/year ×100vehicles×5year = 111.5tCO_2 2) In the case of installing solar charging stands 0.854tCO_2/vehicle/year ×100vehicles×5yaer = 427tCO_2 ※Japanese statutory service life: Transport business & Passenger vehicle; 5years, ※Annual mileage 11,999km(≒40km/day×300day)

Pilot project in transportation field Introduction of Electric tricycle

You get profits with a fare of 2 dollars*

- Eco car attract tourists
- Inexpensive electric tricycle with Japanese quality
- Reduction of initial cost burden with subsidy from Japanese government (JCM Project)

* When you operate six times with a fare of 2 dollars a day
* We do not consider management of solar charging stations.

Pilot project in transportation field Introduction of Electric tricycle

Year	0	1	2	3	4	5
1. Income(USD)	0.0	3,600.0	3,600.0	3,600.0	3,600.0	3,600.0
Fare income(300USD/month×12months = 3600USD)		3,600.0	3,600.0	3,600.0	3,600.0	3,600.0
※ 2USD/time×6 times×25days = 300USD						
2. Expenses(USD)	1,540.0	2,436.6	3,436.6	2,436.6	3,436.6	2,436.6
Electric tricycle(Tariff is included) JCM Subsidy (30%)	1,540.0					
Battery replacement cost			1,000.0		1,000.0	
Fuel cost (electricity charge) (11,999km=40km/day×300day)		196.6	196.6	196.6	196.6	196.6
Maintenance cost		240.0	240.0	240.0	240.0	240.0
Other operating expenses (Personnel expenses etc.)		2,000.0	2,000.0	2,000.0	2,000.0	2,000.0
3. Profit before depreciation(USD)	-1,540.0	1,163.4	163.4	1,163.4	163.4	1,163.4
4 . Depreciation(USD)	0.0	308.0	308.0	308.0	308.0	308.0
Japanese statutory durable years of electric tricycle		308.0	308.0	308.0	308.0	308.0
5. Profit after depreciation(USD)	-1,540.0	855.4	-144.6	855.4	-144.6	855.4
6. Tax(USD)	0.0	171.1	-28.9	171.1	-28.9	171.1
Corporation Tax(20%)		171.1	-28.9	171.1	-28.9	171.1
7. Profit of the current term(USD)	-1,540.0	684.3	-115.7	684.3	-115.7	684.3
8. Cash flow(USD)	-1,540.0	992.3	192.3	992.3	192.3	992.3
	-1,540.0	-547.7	-355.4	637.0	829.3	1,821.6

IRR・Recovery period of initial investment	
IRR (5years)	34%
Recovery period of initial investment	3年

Cash flow will be positive in 3 years (Recovery of initial investment will end in 3years)

Pilot project in transportation field
Introduction of Electric tricycle

2. Project implementation structure

It is assumed that an international consortium of the representative businesses (Japanese companies) and the taxi company (Phnom Penh) will be formed and will operate the project.

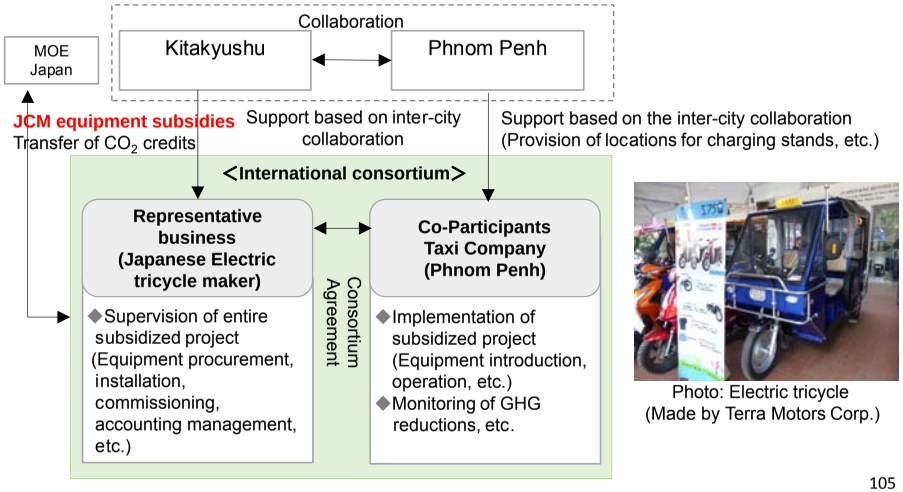


Photo: Electric tricycle
(Made by Terra Motors Corp.)

Pilot project in transportation field
Introduction of Electric tricycle

3. Investigation results (Terra motors, Distributor, Remorque association)

(1) Electric tricycle cost and specifications (Terra Motors Y6)

Item	Details
Selling price	2,200 USD (Vehicle: 1,200 USD; Batteries (5 pcs.): 1000 USD)
Batteries	Equipped with 5 lead-acid batteries (Voltage: 60V; Capacity: 140Ah) * To be replaced around once every 1.5 years
Travel distance	Capability to travel around 100 km on a single charge (Charging time: 8 to 12 hours)
Maintenance cost	About 1,000 USD/year (Maintenance240USD/year + Electrical charges 200USD/year + Replace of battery 1,000/2year ※Charging:3times in 4days, Mileage:40km/day×300days)
Specifications	Overall length: 2,950mm, Overall width: 1,090mm,Overall height: 1,800mm, Vehicle weight: 278kg,Maximum travel distance: 100km, Rated output: 1kw Maximum speed: 40km/h,Practical climbing capability: 10°

(2) Local Gasoline Remorque (Result of interview with the Remorque association)

Item	Details
Purchase price	1,000 to 2,000 USD (Basket: 600 to 800 USD, Bike: 300 to 1,000USD)
Travel distance	50km to 75km/day (There are also drivers who travel 100km)
Driver revenue and expenses	Around 1,800 USD/year (Expenses including gasoline and maintenance are around 150 USD/month; Profit is 150 USD/month)
Other	Development of charging stations is important. Showing the performance (including travel distance) and safety of Electric tricycle is important.

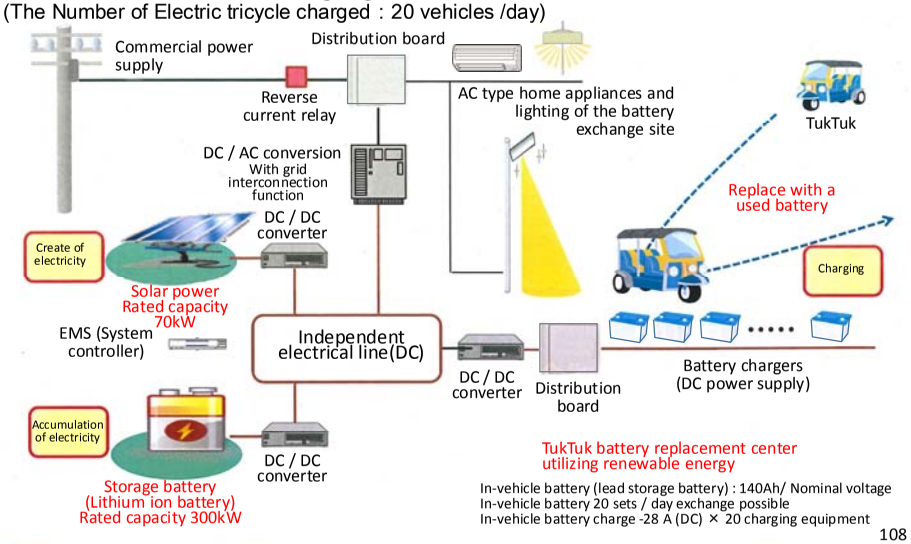
Pilot project in transportation field
Introduction of Electric tricycle

4. Test ride

Pilot project in transportation field
Introduction of Electric tricycle

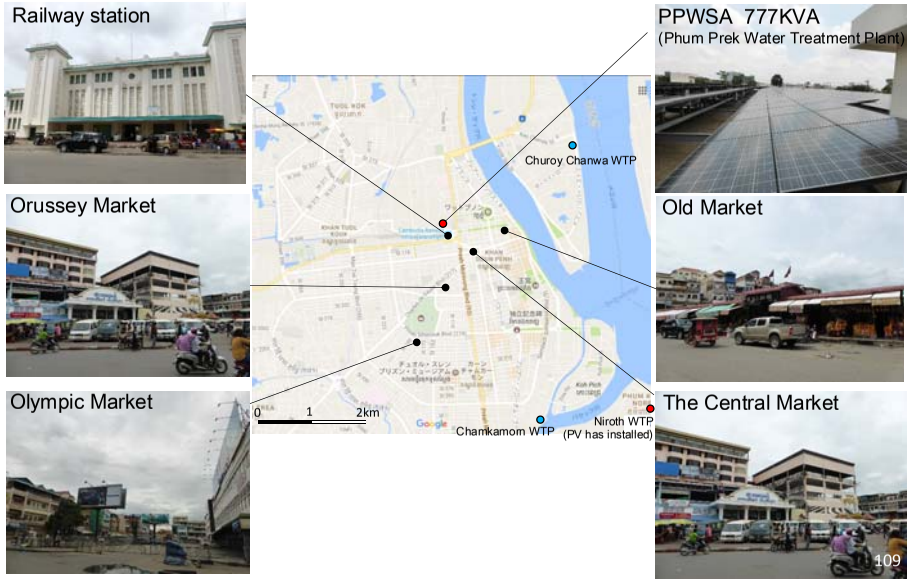
5. Outline of Solar charging stands

(The Number of Electric tricycle charged : 20 vehicles /day)



Pilot project in transportation field
Introduction of Electric tricycle

6. Survey of Candidate sites for Solar charging stands



JCM project study: Transportation field pilot project
Introduction of E-TukTuks

5. Case study of introduction of electric three-wheeled vehicles (1): Philippines

In the Philippines, there are more than 3.5 million three-wheeled taxis (tricycles) driving around, and air pollution due to exhaust gas is worsening. The Philippine Government is introducing electric three-wheeled vehicles (E-Trikes) with the intention of improving the living environment and increasing driver income.
In January 2016, Uzushio Electric Co., Ltd. of Japan received orders for 3,000 units from the E-Trike Project of the ADB (Asia Development Bank) and DOE (Philippine Department of Energy).
→ Electric three-wheeled vehicles are more expensive than gasoline vehicles, so it may be difficult to spread their use only through the power of private companies. It is important that vehicles with high environmental impact be regulated through strong governmental leadership to switch to low-pollution vehicles such as electric vehicles, etc.

Sources: http://www.bemac-beet.com/en/tricycle/ ; http://www.bemac-uzushio.com/activities/ev.html

JCM project study: Transportation field pilot project
Introduction of E-TukTuks

5. Case study of introduction of electric three-wheeled vehicles (2): Bangladesh

In 2015, Terra Motors Corp. of Japan established a joint venture with the local top motorcycle maker in Bangladesh, and began manufacturing and sales of electric three-wheeled vehicles. With relatively inexpensive pricing and good performance to match local needs, its sales have steadily increased, and a cumulative total of 10,450 units (17 months from the start of sales) have been sold.

＜Current situation in Bangladesh＞

- As the population increases, the increasing number of gasoline motorcycles and CNG tricycles is a cause of air pollution.
- Although there is widespread use of Chinese-made electric three-wheeled vehicles in the region, they break down easily. In addition, since the price of natural gas is increasing, there is a demand for high-quality electric three-wheeled vehicles.

Source:http://www.terra-motors.com/jp/i/news/2015/

Tasks and Specific Measures by Field

< Water Works & Sewerage Field >

Waterworks / Current status and tasks

【Waterworks water supply penetration rate; Non-revenue water rate】

- The major part of Phnom Penh is supplied with water by the Phnom Penh Water Supply Authority. In the area under the jurisdiction of the Phnom Penh Water Supply Authority, the waterworks water supply penetration rate has reached approximately 85% (as of May 2016).
- In addition, the waterworks water supply quality meets the WHO standards and it is possible to drink water directly from the tap, and the non-revenue water rate and fee collection rate are outstandingly excellent compared to cities of other ASEAN countries (Non-revenue water rate: 5.94%; Fee collection rate: 99.9%; 2009 data) 。

【Current status of private water supply sector in the suburbs】

- In the suburbs of Phnom Penh such as farming villages, etc., water is supplied by the private water supply sector.
- However, in the private water supply sector, since there is no measuring equipment, water leakage, faulty water output, and wasteful power generation occurs. For proper operation and maintenance management, the development of the necessary measuring equipment is required.

【Increased demand volumes】

- The Phnom Penh Water Supply Authority owns four water purification plants, with a total waterworks water treatment capacity of 430,000 m3/day (as of September 2013). It has been forecast that the demand volume in 2025 will increase to approximately 710,000 m3/day. Securing water sources to meet the increased demand and preserving water quality is required.

【 Introduction of energy-saving waterworks water supply equipment and renewable energy 】

- It is desirable to promote the introduction of energy-saving waterworks water supply equipment and renewable energy such as solar power generation, etc. in order to reduce GHG. 。

Fig. Solar Power Generation (Phnom Penh Water Supply Authority)

Sewerage/rainwater drainage field: Problems

【Household sewerage】

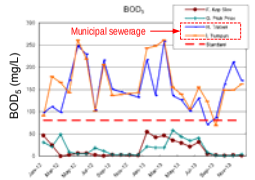
- Sewerage is discharged through city sewerage systems to treatment facilities (supported by the European Community) etc. that use marsh/stabilization pond methods. With population growth and urbanization, the amount of sewerage is increasing, and the water quality environment is severely degraded.
- It is necessary to promote development of sewerage and wastewater treatment plants, improvement of public hygiene, and environmental conservation.

【Industrial wastewater】

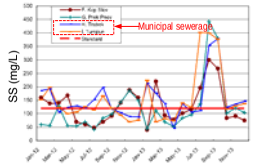
- It is presumed that many factories outside the PPSEZ do not have wastewater treatment facilities installed.
- It is necessary to promote the application of administrative guidance and penalties related to wastewater standards compliance.
- For almost all hospitals, the discharged wastewater has medical liquid wastes mixed in and is discharged untreated into local waterways, etc., which is extremely problematic in terms of public hygiene.

◇Condition of sewerage discharge into stabilization ponds (Tumpun)

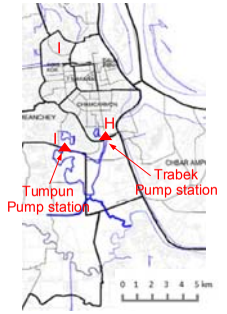
◇Illegal disposal of sewerage



◇Water quality status (BOD) of municipal sewers



◇Water quality status (SS) of municipal sewers



◇Map showing locations of test points for municipal sewer water quality

(Source: TAKEUCHI et al. , Journal of Water and Environment Technology, Vol.3, No.1, 2005)

(Original material: Phnom Penh sewerage/drainage improvement project, June 2016, JICA)

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Sewerage/rainwater drainage field: Problems

◇List of major hospitals in Phnom Penh

N⁰	Name	Beds	Manage
①	Kantha Bopha Children Hospital	1,032	Under MOH
②	Calmet Hospital	530	Under MOH
③	Cambodian-Soviet Friendship Hospital	465	Under MOH
④	Preah Kossamak Hospital	250	Under MOH
⑤	National Pediatric Hospical	150	Under MOH
⑥	National Maternal and Child Health Center	145	Under MOH
⑦	Ang Duong Hospital	80	Under MOH
⑧	Preah Ket Mealea Hospital	1,000	Under MOH
⑨	Aurora Poly Clinic	18	Private
⑩	Royal Phnom Penh Hospital	580	Private
⑪	Cho Ray Phnom Penh Hospital	500	Private
⑫	Sen Sok International University Hospital	250	Private
⑬	National Center for Tuberculosis and Leprosy (CENAT)	400	Under MOH
⑭	Phnom Penh Referral Hospital	142	Under MHD
⑮	Cambodia-Chines Friendship Sen Sok Referral Hospital	60	Under MHD
⑯	Meanchey Referral Hospital	42	Under MHD
⑰	Porchentong Referral Hospital	35	Under MHD
⑱	Chamkar Doung Health Centre	25	Under MHD
⑲	Samdach Ov Referral Hospital	19	Under MHD
⑳	Praek Pnov Referral Hospital	13	Under MHD

(Original materials: Written in materials from Phnom Penh branch of Ministry of Health)

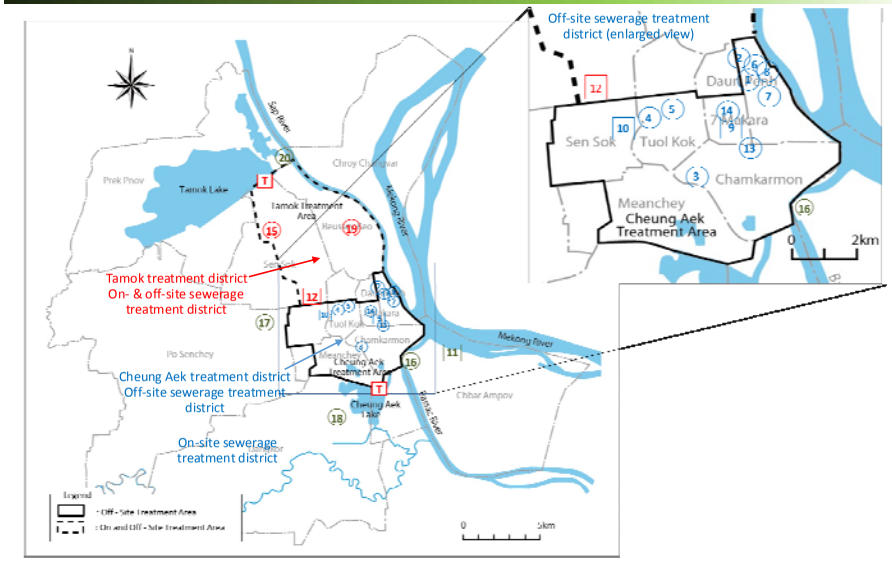
Legend

- ○ : Public hospital (Off-site sewerage treatment district)
- □ : Private hospital (Off-site sewerage treatment district)
- ◯ : Public hospital (On- & off-site sewerage treatment district)
- □ : Private hospital (On- & off-site sewerage treatment district)
- ○ : Public hospital (On-site sewerage treatment district)
- □ : Private hospital (On-site sewerage treatment district)

◇Sewerage tank at Cambodian-Soviet Friendship Hospital (with progressive deterioration)

◇ Sewerage pump building of same hospital. Discharge performed by temporary pump due to equipment failure.

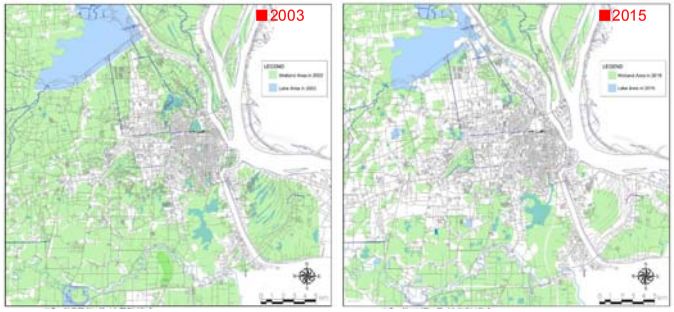
Sewerage/rainwater drainage field: Problems



◇Relationship between hospital locations and treatment districts of sewerage treatment master plan

Sewerage/rainwater drainage field: Problems

【Rainwater drainage】
- Phnom Penh city has the characteristics that rainwater is likely to collected and difficult to drain because it is in low-lying area.
- The obstruction of drainage is getting worse and the function of the drainage is dropping because of the civil war and the aging cleaning equipment.
- Furthermore, as a result of an increase in surface runoff due to the increased impermeable area, reduced marsh and lake area accompanying urbanization, various parts of the capital have been flooded even with daily rainfall of about 20 mm that occurs about 20 times during the rainy season



(Source material: Phnom Penh Sewerage/Drainage Improvement Project, June 2016, JICA)

◇Comparison of marsh and lake areas in Phnom Penh

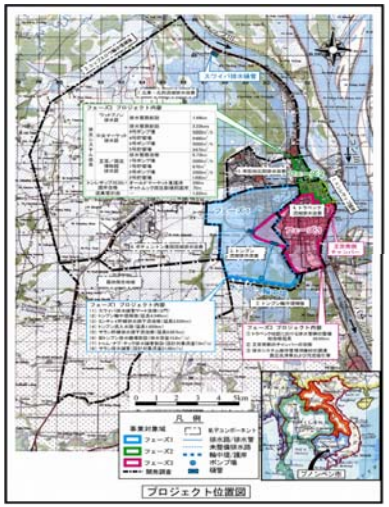
◇Flooding of Charles de Gaulle Boulevard (April 2010)

◇ Flooding of intersection of Street 63 and Street 352 (Sept. 2009)

Sewerage/rainwater drainage field: Problems

(Source material: Phnom Penh Sewerage/Drainage Improvement Project, June 2016, JICA)

◇Inland inundation map of Phnom Penh



(Source: JICA Report, 2011)

◇ Phnom Penh Flood Prevention/Drainage Improvement Plan: Project locations for Phases I to III

Waterworks/sewerage and rainwater drainage field: Introduction of efforts in Kitakyushu

■ **Onga River water source water-treatment know-how (U-BCF)**

Upward Biological Contact Filtration patented in Japan by Kitakyushu
（Upward Biological Contact Filtration : U-BCF）

Dam at mouth of Onga River

Honjo Water-Treatment Plant

【Kitakyushu waterworks water sources】
Waterworks source water intake is at the most downstream point of the river which is affected by household wastewater.

Original development of a new water-treatment technology (U-BCF) over 11 years as a measure for Onga River as a water source
Patent Number 3831055 (Application: 1997; Registration: 2006)

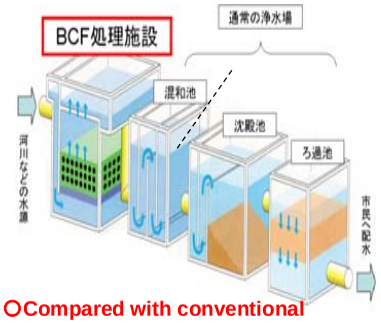
【Upgrading of main water-treatment plants to U-BCF】
Honjo Water-Treatment Plant (2000 & 2010): 106,500m³/day
Anoo Water-Treatment Plant (2003): 171,000m³/day

【Features】
Running cost = ¥3.6/m³
Compactness (economical construction cost)

Waterworks/sewerage and rainwater drainage field: Introduction of efforts in Kitakyushu

■**Introduction of U-BCF to main water-treatment plants**

Introduction of U-BCF from small-scale water-treatment plant in Hai Phong to main water-treatment plants (utilizing grant aid)



○Compared with conventional advanced treatment:
・Construction costs: 1/2
・Running costs: 1/20

Main water-treatment plant
(An Duong water-treatment plant)

Expansion within Vietnam and throughout various countries in Southeast Asia

Waterworks/sewerage and rainwater drainage field: Introduction of efforts in Kitakyushu

■Overview of Kitakyushu sewerage system

【History】

- ・Feb. 1963 Establishment of Kitakyushu ⇒ **Start of full-scale development**
- ・July 1963 Start of Kogasaki Treatment Cente
- ・March 1977 Sewerage coverage ratio reaches
- ・Jan. 1982 Total length of installed culverts re
- ・March 2005 Total length of installed culverts reaches 4,000 km.
- ・**March 2006** Sewerage coverage ratio reaches 99.8% (general sewerage development)

More than 600 billion yen invested in construction costs over approx. 40 years.

【Main sewerage facilities】

・**treatment centers: 5 locations**
(Treatment capacity: 621,000 m³/day)
・Pump stations: 36 locations
・Culverts: 4,361 km
Sewerage: 3,197 km
Rainwater drainage: 321 km
Mixed flow: 843 km

【Treatment district area】

・16,191 ha

(Including mixed flow district area of 3,422 ha)

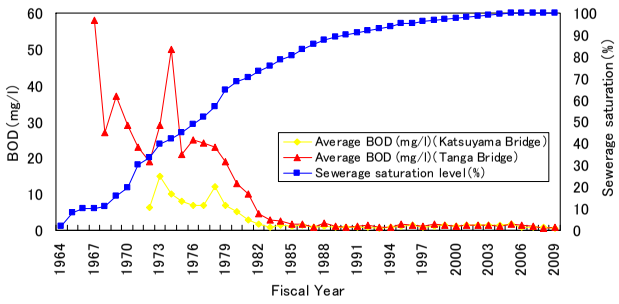
Waterworks/sewerage and rainwater drainage field: Introduction of efforts in Kitakyushu

■ Results of sewerage system development

◆The government and citizens worked together as one over approx. 40 years to promote sewerage system development

- Government: Development of sewage treatment plants and sewerage syste
- Citizens: Thorough clean water conversion (connection to sewerage systen

As sewerage coverage spread, the water quality of Murasaki River improved dramatically.



Ayu, fish who live in clear streams, returned.

RM-31

Specific measures for waterworks/sewerage and rainwater drainage field (draft proposal)

【Waterworks】

Project classification	Project description	Project implementing entity	Implementation timing	Evaluation indexes
1. Introduction of measuring equipment in the private waterworks sector (suburbs)	・Introduce measuring equipment into the private waterworks sector to eliminate leakage and flood problems and reduce energy consumption.	Private waterworks sector	Short-term	Amount of energy consumption reduction GHG reduction amount
2. Securing water sources and water quality preservation	• Secure water sources to cope with forecast major increases in demand volumes • In conjunction with the above, preserve water quality of water sources	Phnom Penh Water Supply Authority Private waterworks sector Ministry of the Environment	Medium-long term	Quantity and quality of water source water
3. Introduction of energy-saving waterworks equipment and renewable energy	• Promote GHG reduction through the use of energy-saving models of waterworks equipment such as pumps, etc. and introduction of renewable energy such as solar power generation, etc.	Phnom Penh Water Supply Authority	Short-term	Amount of energy consumption reduction Amount of GHG reduction

Solar power system (existing Phnom Penh Water Supply Authority equipment)

Example of high-efficiency inverter-control motor
http://www.e-mechatronics.com/download/datas/catalog/ka-p920-1/ka-p920-1d_7_0.pdf

Examples of electromagnetic flow meters with excellent accuracy
http://www.aichitokei.co.jp/products/02_water/05_elemag_sv/

Specific measures for waterworks/sewerage and rainwater drainage field (draft proposal)

【Sewerage/rainwater drainage】

Project classification	Project description	Project implementing entity	Implementation timing	Evaluation indexes
4. Surface maintenance of sewers and early construction of sewerage treatment plants based on sewerage treatment master plan which is currently being compiled	Actively promote JICA projects related to wastewater treatment currently being implemented.	Department of Public Works and Transport Phnom Penh Urbanization Division	Medium-long term	Sewerage system coverage ratio
5. Strengthening of administrative guidance and clarification and proper application of penalty regulations	Perform periodic site inspections of factories and businesses, promote efforts for compliance with environmental standards, and severely punish companies who do not comply with guidance and continue to be in violation.	Ministry of the Environment	Short-term	Number of effluent inspections Effluent quality River water quality
6. Urgent maintenance and improvement of rainwater drainage facilities	Actively promote JICA projects related to sewerage treatment currently being implemented.	Department of Public Works and Transport Phnom Penh Urbanization Division	Medium-long term	Sewerage system coverage ratio
7. Distributed wastewater treatment system development project	Introduce distributed wastewater treatment systems in facilities such as hospitals, factories, etc. where rapid countermeasures for wastewater treatment are necessary, or in rural areas where installation of sewers is delayed.	Department of Public Works and Transport Phnom Penh Urbanization Division	Medium-long term	Sewerage system coverage ratio

Source: Kitakyushu
Example of energy-saving improvements at final treatment plant

Example of improvements of industrial park wastewater treatment facilities (PPSEZ)

http://jokaso.kubota.co.jp/en/product/k_hc_t.html
Example of distributed wastewater treatment facility system (septic tank)

1. Current situation of Phnom Penh metropolitan area

◇ Water environmental problems and flooding problems have manifested due to rapid urbanization.

⇒ While maximizing existing facility capacity, facility maintenance and management to contribute to flood damage mitigation and educational activities to raise public awareness are necessary.

2. Project overview

◇Objective : To raise citizen awareness and suitable, efficient maintenance and management of sewerage and drainage facilities for the "sustainable development of sewers" and "flood damage mitigation" of the Phnom Penh metropolitan area.

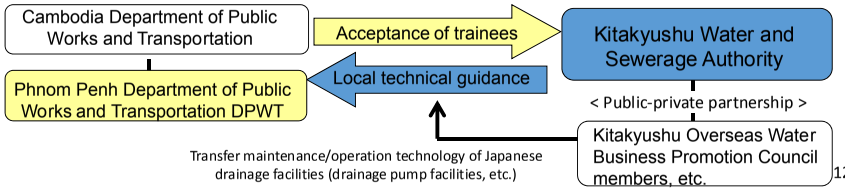
◇Period: 2016 to 2019 (planned)

◇Activities:Public awareness activities/environmental studies, local technical guidance, acceptance of trainees, holding of seminars

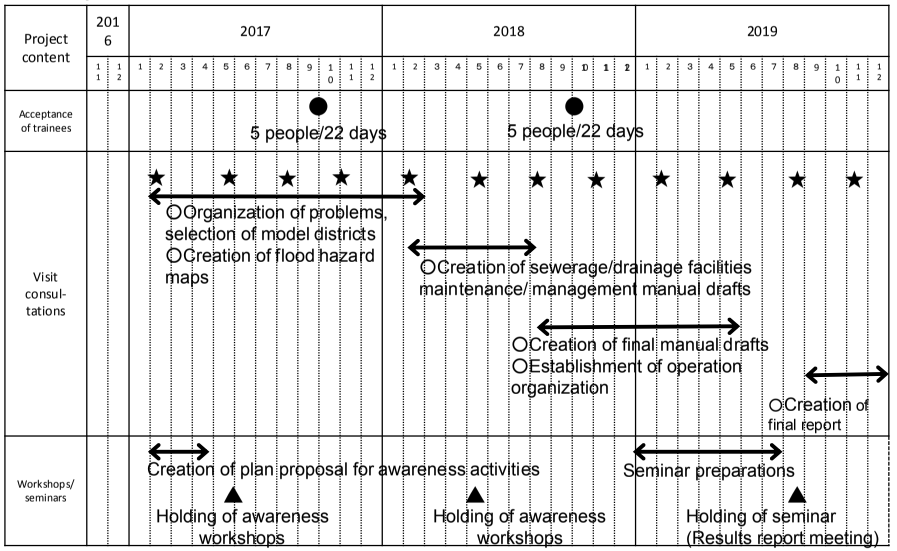
＜Output＞

- Raise public awareness through awareness activities, flood hazard map creation, etc.
- Creation of maintenance/management manuals, etc. and operation of sewerage/drainage facilities

＜ Implementation scheme ＞



3. Project schedule (1/2017 to 12/2019)

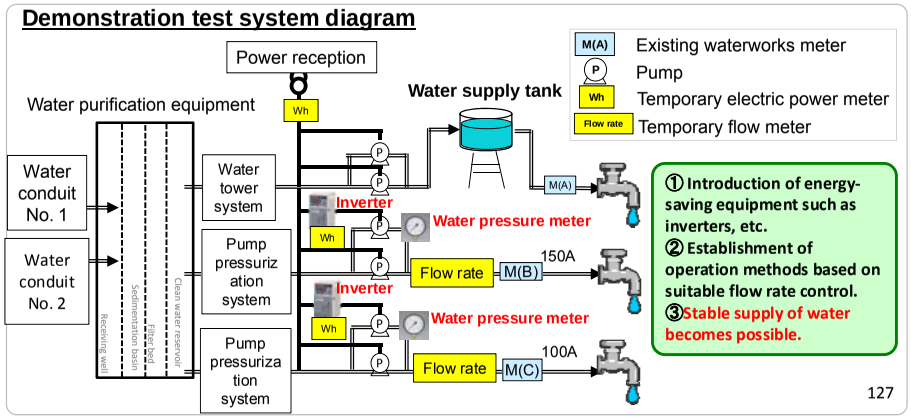


1. Project overview

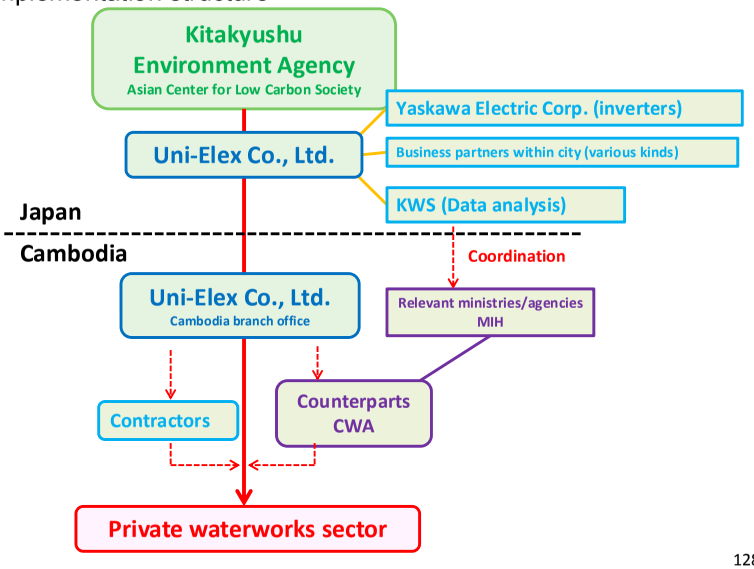
Many companies in the Cambodia private waterworks sector (approx. 150 companies) have problems with steadily supplying safe water. According to the FS survey conducted by Uni-Elex Co., Ltd., by introducing inverter pump systems to the Cambodia private waterworks sector, a high electricity consumption reduction effect can be expected.

The same company conducted demonstration tests in 2016 (at Prey Kub Water Supply Co.), and plans to promote the spread of inverter equipment, etc. to the private waterworks sector based on the results of that test.

Demonstration test system diagram



2. Project implementation structure



Pilot project in water/sewerage and rainwater drainage field (3)
Hospital wastewater treatment project

1. Project overview

- In view of the fact that hospital wastewater is being discharged without even undergoing sterilization, with the exclusion of hospitals located in the Cheung Aek treatment district which will undergo off-site sewage treatment (construction of sewage treatment plants) under JICA's sewage master plan, septic tanks packaging together various kinds of treatment equipment will be introduced to the other hospitals and proper treatment of hospital wastewater will be performed.
- In the Tamok treatment district, wastewater treatment combining on- and off-site treatment was investigated under the current plan, but since the conclusion presumes on-site treatment, hospitals located in this area will also be subject to the above plan. There are 7 hospitals in the district, with a total bed count of approximately 940 beds.

Subject hospitals and bed counts

N⁰	Name	Beds	Manager
11	Cho Ray Phnom Penh Hospital	500	Private
12	Sen Sok International University Hospital	250	Private
⑮	Cambodia-Chinese Friendship Sen Sok Referral Hospital	60	MHD
⑯	Meanchey Referral Hospital	42	MHD
⑰	Porchentong Referral Hospital	35	MHD
⑱	Chamkar Doung Health Centre	25	MHD
⑲	Samdach Ov Referral Hospital	19	MHD
⑳	Praek Pnov Referral Hospital	13	MHD
	Total	936	


Cambodia-Chinese Friendship Sen Sok Referral Hospital


Cho Ray Phnom Penh Hospital


Sen Sok International University Hospital

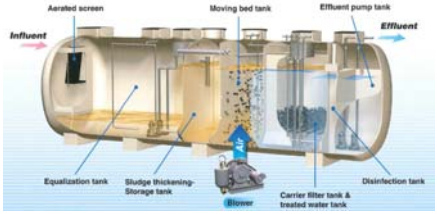

Porchentong Referral Hospital

Pilot project in water/sewerage and rainwater drainage field (3)
Hospital wastewater treatment project

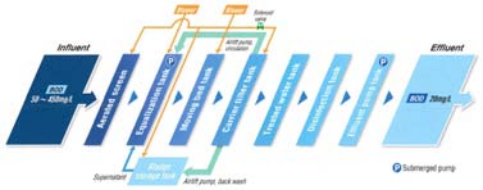
■Cross-section view

◇Q=10～30m³/day (For small- to medium-scale use)

◇Q=20m³/day～ (For large-scale use)



■Example of flow sheet (when using model for large-scale use)



Treated water: BOD < 20mg/L

・Hospital wastewater example

・Q=50m³/day

・Factory wastewater example

・Q=80m³/day

Pilot project in water/sewerage and rainwater drainage field (3)
Hospital wastewater treatment project

◇Approximate septic tank scale for each hospital

No	Hospital name	Type	Treatment water volume (m³/day)	Necessary electrical capacity (kW)	Annual power consumption (kWh/y)
11	Cho Ray Phnom Penh Hospital	Large	500	22	106,800
12	Sen Sok International University Hospital	Large	250	14	54,540
⑮	Cambodia-Chinese Friendship Sen Sok Referral Hospital	Medium	60	4.5	20,660
⑯	Meanchey Referral Hospital	Medium	42	3.8	20,440
⑰	Porchentong Referral Hospital	Medium	35	2.5	12,260
⑱	Chamkar Doung Health Centre	Medium	25	2.0	12,150
⑲	Samdach Ov Referral Hospital	Medium	19	1.6	12,100
⑳	Praek Pnov Referral Hospital	Medium	13	1.6	8,920

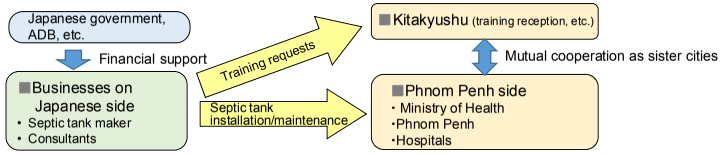
- The estimated treatment water volume and septic tank scale are shown in the table at left.
- Since the septic tank is a package system, installation is simple.
- For large-scale septic tanks, sludge removal will be performed once per week. For medium-scale tanks, the frequency would be once every two weeks.
- Tank maintenance inspection needs to be performed once every two weeks, and it is necessary to cultivate personnel who will be capable of properly performing such maintenance and inspection in order to ensure stable septic tank operation.

+Facilities expense(total)=approx. 3.8M USD
+Maintenance cost(total)=approx. 0.4M USD*
*Estimate based on conditions in Japan

2. Project scheme (proposal)

- Since the urgency of this problem is high, it is important to apply a scheme that can be implemented as a project in a short period of time.
- Although the project scheme is not yet determined, grant aid from the Foreign Ministry of Japan and support from ADB, etc. is being considered.
- Together with installation of the septic tank, cultivation of personnel capable of proper facility operation is essential.

3. Project implementation organization (proposal)



Tasks and Specific Measures by Field

< Environmental Conservation Field >

Environmental Conservation
Current status and tasks

【Air pollution】

- With the spread and increase of automobile and motorcycles, air pollution is progressing since appropriate inspections are not being carried out. At the current time, air pollution from factories is not progressing.
- Although environmental standard values were met in previous surveys, it is questionable whether appropriate monitoring is being performed.
- There is only one air pollution monitoring site, so the actual situation is not grasped (jurisdiction of the Ministry of the Environment).

【Noise/vibration】

- Although environmental standards for noise have been set, periodic monitoring is not being performed.
- At locations where traffic volume outside the city is larger than in the downtown area, environmental standards for noise are not being met. (JICA survey results)
- No environmental standards for vibration have been set, and the current situation is unclear.

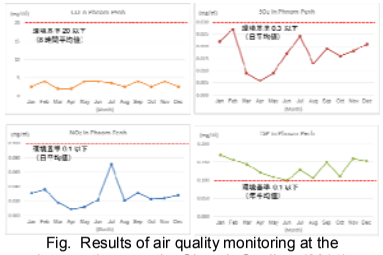


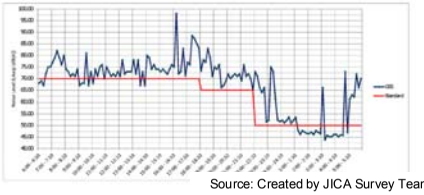
Fig. Results of air quality monitoring at the intersection near the Olympic Stadium (2014)

Fig. Map of locations of noise and vibration monitoring points in Phnom Penh metropolitan area

Environmental Conservation
Current status and tasks

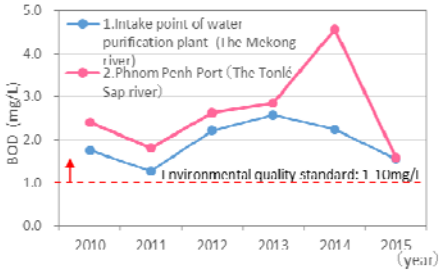
【Water pollution】

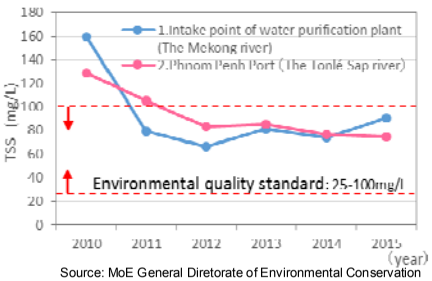
- Environmental standard values are not set properly according to the usage of the bodies of water.
- The sewerage from homes, etc. flows untreated into the small rivers and canals of the old city and water pollution is progressing severely.
- Periodic water quality surveys are not being conducted in the above bodies of water.
- The actual water pollution situation of ponds and wetlands is unclear.



Source: Created by JICA Survey Team

Fig. Changes in equivalent noise level over time at Point 7





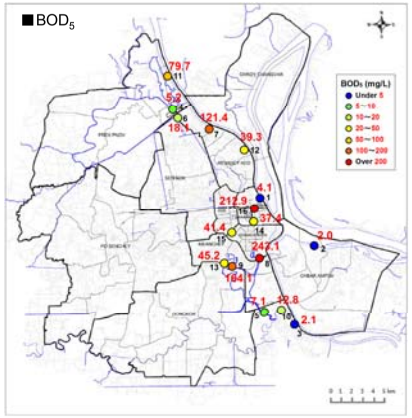
Source: MoE General Diretorate of Environmental Conservation

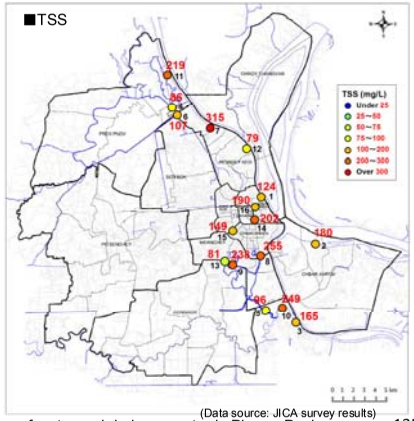
Fig. Example of water quality survey results at Rivers in Phnom Penh Cityarea

Environmental Conservation
Current status and tasks

No.	Category	Monitoring Point	Analysis items	Remarks
1	River	Sap River (Phnom Penh Port)	pH,DO,BOD_5,COD D_{Cr},COD_{Mn},TSS,T-N,T-P,Total Coliform	Sampling of surface water from river bank.
2		Mekong River (Kien Svay)		
3		Bassac River (Thakhmao)		
4	Lake/ swamp	Tamok Lake (Discharge Point)		Sampling of surface water at the point where lake water flows into the river.
5		Cheung Aek Lake (Discharge Point)		
6	Small Channel	Kop Slov Pumping Station	pH,DO,BOD_5,COD D_{Cr},TSS,T-N,T-P,Total Coliform	Sampling of surface water at the center of the waterway for small waterways. Factories and commercial facilities were selected jointly with DOE/PPCC.
7		Svay Pak Sluiceway		
8		Trabek Pumping Station		
9		Tumpun Pumping Station		

No.	Category	Monitoring Point	Analysis items	Remarks
10	Small Channel	Prek Thnot River (Thakhmao Bridge)	pH,DO,BOD_5,COD D_{Cr},TSS,T-N,T-P,Total Coliform	Treatment facility
11	Factory	Men Sarun (Noodle Factory)		Septic tank
12		SKD (Liquor)		Digesting tank + Lagoon
13		SL (Garment and Washing)		Activated sludge process + Chemical treatment
14	Commercial Facilities	Phnom Penh Tower (Office Building)		Activated sludge process
15		Intercontinental Hotel		Septic tank + Aeration equipment
16		Central Market		Septic tank





(Data source: JICA survey results)

◇Example of water quality survey results of main bodies of water and drainage water in Phnom Penh
(Average values for total of 6 times of measurement between November 2015 and January 2016)

Environmental Conservation
Current status and tasks

【Ecosystem】

- There are important wetlands which are the habitat of valuable bird species such as the Philippines pelican, Oriental darter, etc.
- There were instructions to clarify areas in each city district that should be protected from ecological and cultural points of view (September 2015)
- Systematic surveys of the ecosystem have not been carried out so the current situation is unclear.

【Others】

- Growth Promotion Plan (tentative name). There is no master plan for environmental conservation. They have not started working on establishment of a plan due to insufficient technology, personnel, and budget.
- Action plans have been established for the 14 ministries related to promotion of the Cambodia Climate Change Strategic Plan 2014-2023.
- The Climate Change office of the Ministry of the Environment which has jurisdiction over this plan has requested support by Kitakyushu City for the establishment of a Green

Fig Pollution situation of Waterway in urban area

Fig Situation draining the sewage into the stabilization pond

Fig Pollution situation of Wetland

Fig. Important Wetland in Phnom Penh City

Wetlands identified	Location	Province/ Municipality	Elevation AV (m) (max)	Area (ha)
Prasant Tuyo Lake	About 57km East of Kampong Cham town	Phnom Penh	7	72,000
Boeung Veal Samnap	About 10m NE Phnom Penh	Phnom Penh	9	10,850
Boeung Prang	11m NE Phnom Penh	Phnom Penh	6	12,600

出典：Statistical Yearbook of Cambodia 2011

Environmental conservation field : Introduction of efforts in Kitakyushu

■Dokai Bay Cleanup

Dredging of Dokai Bay

Dredged sediment:
Sediment with total mercury concentration of 30 mg / L or more: 350,000 m³

Total project cost: 1.8 billion yen
Burden ratio:
- **Operator: 71%**
- **Public: 29% (Country: 1/2; Prefecture: 1/4; City: 1/4)**

Environment monitoring

(Ocean region, rivers)

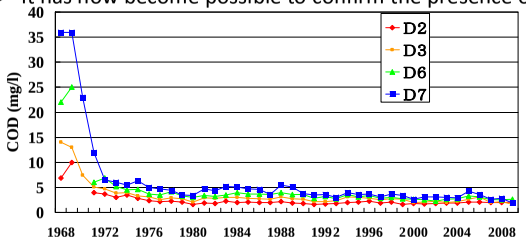
Monitoring of various items such as COD, BOD, etc. is being performed.

Ocean regions: pH, COD, total nitrogen, total phosphorus, dissolved oxygen, amount of suspended matter, transparency, number of coliform bacteria groups, etc.
Rivers: pH, BOD, electrical conductivity, dissolved oxygen, amount of suspended matter, transparency, number of E. coli groups, etc.

Environmental conservation field : Introduction of efforts in Kitakyushu

■Change over time of Dokai Bay water quality (COD)

- The water quality of Dokai Bay is improving as a result of various countermeasures.
- It has now become possible to confirm the presence of many types of marine products.



Dokai Bay had been heavily polluted by wastewater from steel and chemical plants, etc. Because it had reached the condition where no living thing could survive, it was nicknamed the "Sea of Death".

Environmental conservation field : Introduction of efforts in Kitakyushu

■Air pollution countermeasures

On-site inspection based on the Air Pollution Control Law

Installation status of soot-generating facilities (as of March 31, 2010)

Large-scale facilities※1	Medium-scale facilities※2	Small-scale facilities※3	Total
120	221	1230	1571

※1 Large-scale facilities: Exhaust gas volume ≥ 40,000 m^3_N/h
※2 Medium-scale facilities: 10,000 m^3_N/h ≤ Exhaust gas volume < 40,000 m^3_N/h
※3 Small-scale facilities: Exhaust gas volume < 10,000 m^3_N/h

On-site inspection plans are formulated every fiscal year

【 Selection criteria 】
(1)Large-/medium-scale facilities: All facilities (Approx. 90% of total city exhaust gas volume
(2)Small-scale facilities: Factories/businesses who did not respond to survey on fuel usage amount

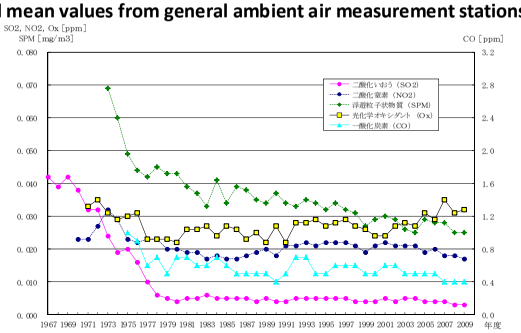
Companies develop pollution control equipment and energy-saving production processes.

Network for constant air pollution monitoring/measurement

Environmental conservation field : Introduction of efforts in Kitakyushu

■Trend of air pollution situation

(annual mean values from general ambient air measurement stations)



Specific measures for environmental conservation field (draft proposal)

Project classification	Project description	Project implementing entity	Implementation timing	Evaluation index
1. Development of air-quality monitoring system and understanding of current situation based on such system	• Air-quality (including noise) monitoring system development project	Ministry of the Environment	Short-term	Environmental standard achievement ratio GHG reduction amount
2. Setting of environmental standards related to vibrations	• Investigation and setting of vibration environmental standards for various land applications and development of monitoring system.	Ministry of the Environment	Medium-long term	Environmental standard achievement ratio
3. Enhancement of the legal system for improvement of air pollution derived from exhaust gas	• Review and reliable implementation of automobile inspection system • Review and enhancement of exhaust gas regulation values and strengthening of regulation conformance and violation penalties	Ministry of the Environment	Short-term	Automobile inspection reception ratio Exhaust gas achievement ratio
4. Review of environmental standard application methods conducive to organized water pollution improvement	• Revision of laws to subdivide standard values and achieve type-based directives according to water region use conditions.	Ministry of the Environment	Medium-long term	Environmental standard achievement ratio

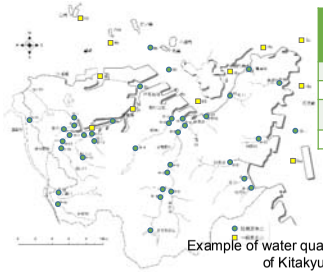
Source: Horiba, Ltd.
Example of air quality observation vehicle (mobile station)

http://svmeas.rion.co.jp/download/catalog/VM-55#VM-55
Example of vibration measurement equipment (stationary station)

https://www.do-blog.jp/riseup/article/29/
Example of measurement of exhaust gas during automobile inspection

Specific measures for environmental conservation field (draft proposal)

Project classification	Project description	Project implementing entity	Implementation timing	Evaluation index
5. Development of sewage treatment plants	• Actively promote JICA projects related to wastewater treatment currently being implemented.	Department of Public Works and Transport Phnom Penh Urbanization Division	Medium-long term	Sewage treatment ratio GHG reduction amount
6. Implementation of periodic water quality monitoring in order to understand actual situation of water pollution	• Establishment and implementation of water quality monitoring plan in order to understand water contamination conditions at water regions within the city.	Ministry of the Environment Phnom Penh environment-related departments	Short-term	Environmental standard achievement ratio
7. Preservation of valuable ecosystems	• Establishment of ecosystem preservation plan	Ministry of the Environment	Medium-long term	Wetland area Green land area
8.Establishment of Phnom Penh version of green growth action plan	• Establishment and support of climate change strategic action plan using the Kitakyushu model.	Phnom Penh Urbanization Division	Short-term	Establishment of plan



Water area	Environmental reference points	General land points
Rivers	27	5
Lakes	1	0
Marine areas	7	11
Total	35	16

Example of water quality monitoring situation of Kitakyushu (2014)

https://www.aeon.info/ef/sp/greening_activities/other_countries/phnom_penh_cambodia/
Tree-planting activity by volunteers at Phnom Tamao Wildlife Rescue Center (Aeon Environmental Foundation)

Pilot project in environmental conservation field
Project for development of air quality and noise monitoring system

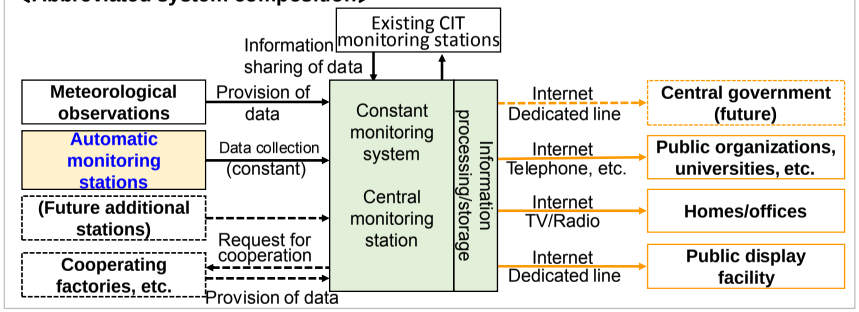
1.Project outline

- In order to understand the air quality and noise conditions in Phnom Penh, automatic monitoring equipment for air and noise will be introduced (around 3 units in fixed locations and 1 mobile unit). In addition, the monitoring data will be shared with the Cambodia Institute of Technology (CIT)'s monitoring station. The research on air pollution and the training of experts will also be supported.
- In conjunction with this, in order to develop a specialist for environmental monitoring, training will be performed at Kita Kyushu City.
- For the funding of this project, the use of ODA grant aid will be investigated.

<Observation items>

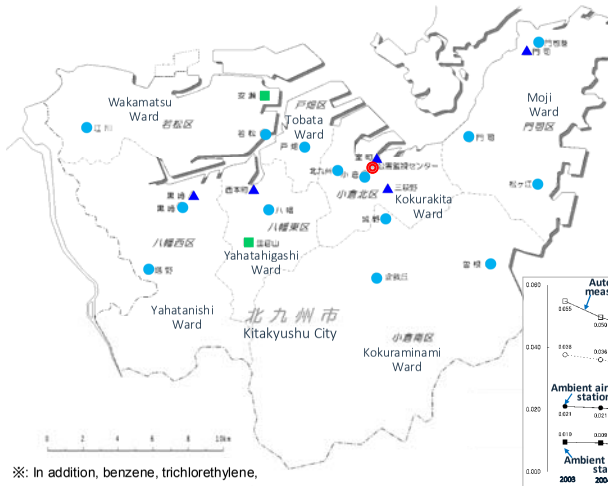
Sulfur dioxide (SO_2), Carbon monoxide (CO), Nitrogen oxides (NOx), Ozone (O_3), Suspended particulates (TSP, PM2.5), Noise

<Abbreviated system composition>



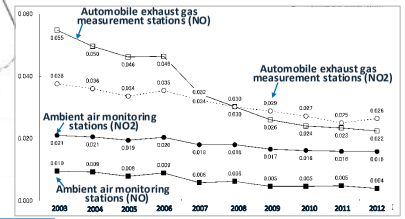
Pilot project in environmental conservation field
Project for development of air quality and noise monitoring system

Reference: Air monitoring conditions in Kita Kyushu City



●: Target items for ambient air monitoring stations
- Sulfur dioxide (SO2)
- Nitrogen dioxide (NO2)
- Carbon monoxide (CO)
- Suspended particulate matter (SPM)
- Photochemical oxidants (Ox)
- Fine particulate matter (PM2.5)

▲: Target items for automobile exhaust gas measurement stations
- Nitrogen dioxide (NO2)
- Carbon monoxide (CO)
- Suspended particulate matter (SPM)
- Fine particulate matter (PM2.5)



Air measurement result example (NO2; Average value)

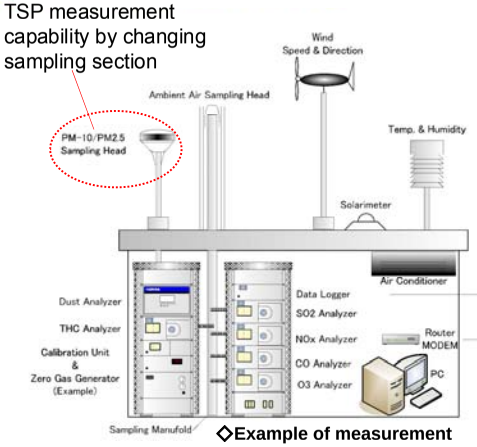
※: In addition, benzene, trichlorethylene, hazardous air pollutants and dioxins of tetrachlorethylene and dichloromethane are also measured at four stations.

●: Ambient air monitoring stations (14)
▲: Car exhaust gas measurement stations (5)
■: Weather stations (2)
◎: Pollution monitoring center (1)

Pilot project for environmental conservation field
Project for development of air quality and noise monitoring system

◆Example of equipment composition for fixed station

TSP measurement capability by changing sampling section



◇Example of measurement equipment composition

◇Interior of station

◇Exterior of fixed monitoring station

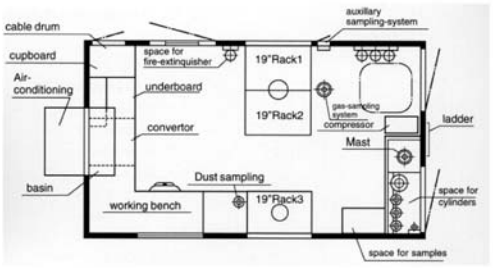
◇Material source: Horiba Ltd.
(The same company has already delivered 10 stations to MONRE. Horiba specifications have effectively become Vietnam's standards)

Pilot project for environmental conservation field
Project for development of air quality and noise monitoring system

◆Outline of mobile station

- The mobile station consists of a 2t-class truck equipped with monitoring equipment which can perform air monitoring at any desired location.
- Since it is assumed that from the cost aspect it would be difficult to install fixed-location stations at all areas within the city, a mobile station will be introduced and efforts will be made to understand the actual conditions of air pollution and noise in the city.

◇Example of mobile station



◇Example of composition of mobile station measuring equipment

◇Material source: Horiba Ltd.

Pilot project for environmental conservation field
Project for development of air quality and noise monitoring system

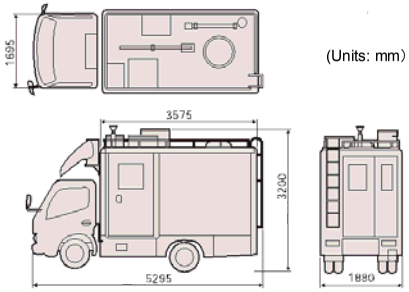
◆Outline of mobile station

◇Example of mobile station

◇Target items: Same as fixed stations (measurement of desired items possible)

◇Example of vehicle specifications

- Vehicle class: 2t class
- Overall length: 5 to 5.5m
- Overall width: 1.8 to 2.0m
- Overall height: 2.8 to 3.2m
- Engine size: Approx. 2,700cc (Gasoline vehicle)
- Overall weight: Approx. 5 tons



◇External dimensions of mobile station

◇Material source: Horiba Ltd.

Pilot project for environmental conservation field
Project for development of air quality and noise monitoring system

2. Results, etc.

◇**Facility development**

- Understanding of actual conditions of air pollution and noise (status of achievement of environmental standards), accumulation of measurement data
- Confirmation of effects when countermeasures have been implemented
- Provision of information to citizens, etc. in case of emergencies
- Possibility to perform monitoring at any desired location using the mobile station Etc.

◇**Human resource development**

- Acquisition of technique regarding maintenance of equipment and the way to take advantage of the monitoring data. Supporting the research on air pollution and noise and training of experts in association with Cambodia Institute of Technology (CIT)

3. Implementation system, etc.

ODA grant aid (agreement between Japanese government and Cambodian government)

◇Cambodia: Ministry of the Environment (MOE), CIT
- Installation of automatic monitoring measurement equipment
- Establishment of central monitoring office
- Information network, Installation of public announcement lighted signboards
- Operation of facilities
- Planning countermeasures
- Establishment of the system of training experts in association with CIT

◇Japan side
(Kita Kyushu City, consultant, manufacturers)
- Investigation of monitoring methods
- System design, provision of equipment

（Kita Kyushu City, manufacturers）
- Acquisition of technique regarding maintenance of equipment and the way to take advantage of the monitoring data. Training of experts.

4.Funding procurement

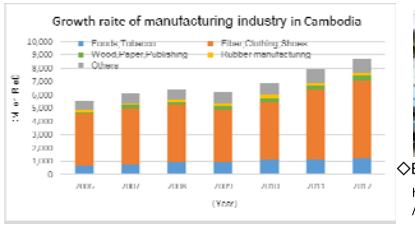
- Investigation of utilization of ODA grant aid
- Taking advantage of the JICA Partnership Program for the human resource development
- Total project cost: Approx. 1.6 million USD (excluding the cost of human resource development)
  + Fixed station (3 stations) and central monitoring station: Approx. 1.2 million USD
  + Mobile station (1 station): Approx. 0.4 million USD

Tasks and Specific Measures by Field

＜ Green Production Field ＞

Green Production
Current status and tasks

- In order to achieve solid economic development, first it is important to make use of foreign direct investment as a driving force for changing the industrial structure, and for this purpose the investment environment for special economic zones and industrial parks should be improved to attract superior enterprises. As part of that process, it is necessary to nurture small- and medium-sized enterprises and personnel in the local area and work to further improve their technical capabilities.
- Furthermore, in production activities, it is important to ensure the work environment and safety of workers as well as switch to environmentally friendly production activities such as effectively utilizing raw materials and energy and actively suppressing the environmental impact of exhaust gases, wastes, wastewater, etc.



◇Example of transporting laborers

http://www.sankeibiz.jp/macro/news/141126/mcb1411260500007-n1.htm

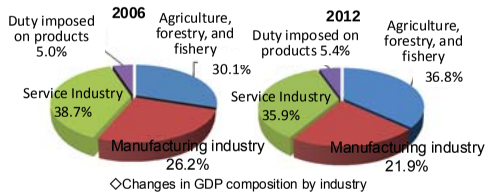
◇Example of working conditions inside factory (Garment factory)

http://www.fukuoka-cambodia.jp/ohtsubo_blog/2010/01/post_4.php

Green Production
Current status and tasks

【Industrial field】

- In Cambodia, secondary industry (manufacturing industry) occupies 27.1% of the GDP and 24.3% of employment, which is not a large ratio compared to other ASEAN countries, and this industry accounts for more than 60% of production value through sewn products and shoes. Because of this, the nurturing of industrial personnel with the aim of changing the industrial structure by diversifying industries, adding value, and promoting trade has become an important issue.
- The “Cambodia Industry Development Policy (2015 - 2025)” was announced in August 2015, with the main vision being the transformation and evolution of Cambodia‘s industries from labor-intensive to technology-driven. As specific approaches for achieving this goal, development in the manufacturing sector and agricultural product processing sector would be promoted. For this purpose, the policy aims to promote integration into international and regional production chains, development of industrial areas, increasing efficiency of special economic zone operating procedures, development of new industrial parks and industrial clusters, etc. Furthermore, it specifies the following as priority industries: 1) New industries that produce creative, highly competitive products with high added value, 2) small- and medium-sized enterprises, 3) agricultural product processing industry, 4) supporting industries related to the supply chain, 5) industries that contribute to international production lines, etc.



◇Changes in GDP composition by industry

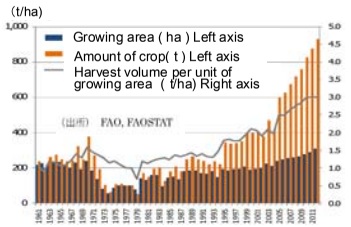
Source: Euro News.com

◇Example of dormitory accident at garment factory

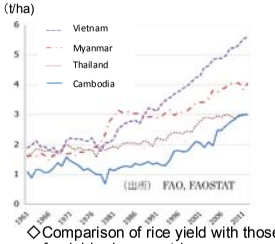
Green Production
Current status and tasks

【Agricultural field】

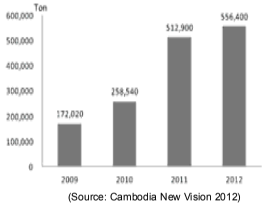
- Rice production is the main agricultural products of Cambodia, and it has been increasing steadily. But yield is low compared to neighboring countries.
- In Cambodia‘s farmland, productivity is low, and as a result the amount of chemical fertilizer usage has increased significantly in recent years. On the other hand, it is a dilemma that with the increased use of fertilizer, the fertility of the soil is conversely decreasing. Problems such as health damage due to misuse, overuse, etc. of agricultural chemicals and problems with food safety, etc. are occurring.
- For farmers, chemical fertilizers and agricultural chemicals are extremely expensive, and occupy a considerable portion of production costs. From the economic aspect as well, it is desirable to spread organic agriculture technology that can achieve reduced chemical fertilizer usage.
- Agriculture is also prosperous in the suburbs and outskirts of the Phnom Penh capital, and it is necessary to increase the added value of agricultural products by cultivating organic vegetables and fruits. In addition, not only agricultural production but also strategies to increase added value through processing of such agricultural products are required.



◇Rice production amount, etc. in Cambodia



◇Comparison of rice yield with those of neighboring countries



(Source: Cambodia New Vision 2012)

◇Imported amounts of chemical fertilizer (nationwide)

Green Production
Current status and tasks

【Tourism field】
- The tourism industry comprises 20% of Cambodia's GDP. In 2014, 4.5 million foreign tourists visited Cambodia, making tourism one of the main industries. The main destination is Siem Reap with the ruins of Angkor Wat, but many foreign tourists are also seen in the Phnom Penh capital, which has an environment where tourists can enjoy not only Cambodian cuisine but also all kinds of dishes from various countries, and there is great potential for the tourism industry to become a main industry of Phnom Penh as well.
- From now on, it is also necessary to fully utilize suburban areas and investigate popularization of green tourism, etc. which focuses on the environment and food education.

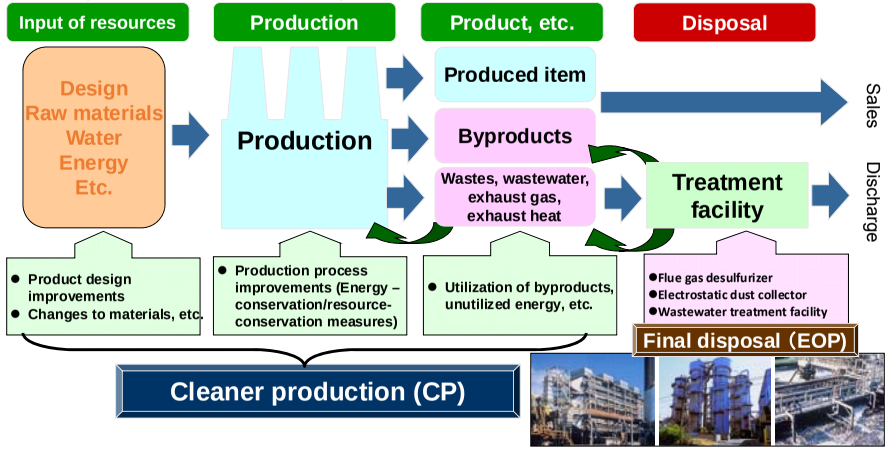
(Source: Final Report of Survey for ODA Proposal on Spreading Utilization of Carbonized Rice Husks in Cambodia; 2014, Kansai Corp., et al)
◇Breakdown of production costs for farmers


◇Scene of conducting interview with pesticide retailer
(Source: Evaluation study report at the time of completion of plan for Cambodia agricultural materials (chemical fertilizers and pesticides) quality control capability improvement; 2012, JICA)


(Source: Agricultural Mechanization to Increase Yield and Farmer's Independence Support in the Kingdom of Cambodia Project Preparation Survey (BOP Business Cooperation Promotion) Report, 2015, JICA)
◇Training scene at Royal Agricultural University

Green Production Field:
Introduction of efforts in Kitakyushu

■Green production and final disposal

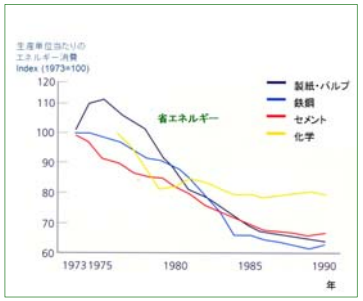


What is noteworthy in the process of overcoming pollution is that many companies have shifted from so-called end-of-pipe pollution prevention measures as final treatment facilities to cleaner production by reviewing the production process. As a result, production efficiency is improved by using raw materials and fuel without waste and at the same time pollutants are reduced. Although final treatment facilities require additional expenses, cleaner production is a win-win approach that achieves both reductions in corporate cost (improved profitability) and reduction of pollutants and waste.

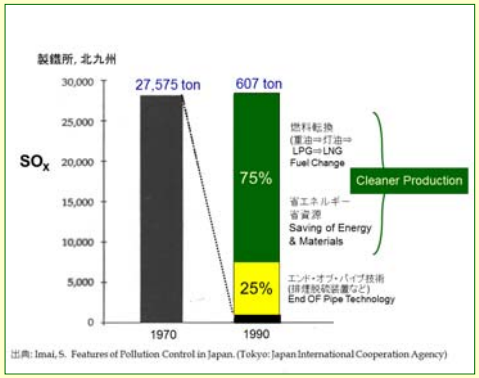
Green Production Field:
Introduction of efforts in Kitakyushu

■Development of cleaner production (CP)

【Cleaner production concept】
- Low-pollution-type production technology that provides both economic benefits and environmental conservation
- Comprehensive evaluation and improvements
  - Raw material usage
  - Production processes
  - Maintenance management
  - Personnel training (workplace activities)



Various industrial fields have achieved energy savings of nearly half in about 20 years since the early 1970s.



出典: Imai, S. Features of Pollution Control in Japan. (Tokyo: Japan International Cooperation Agency)

In the case of iron and steel industry in Kitakyushu, SOX emissions were reduced from 27,575 t to 607 t in the period from 1970 to 1990. 75% of this reduction was the effect of cleaner production, and the remaining 25% was due to final disposal measures.

Green Production Field:
Introduction of efforts in Kitakyushu

■Kitakyushu Eco Premium Industry Creation Project

■ Outline
Of the products and services offered by the industrial and technology field, products (Eco Products) and services (Eco Services) that lead to a reduction in the environmental load will be selected as "Eco Premium," and through their expansion and diffusion, will help to promote environmental consideration activities for all city industries.
* Eco Premium:
Products, technology and industrial activities with the added value of a lowered environmental load

Past Achievements (FY 2004 - 2016)
- Selection: Eco Products – 163 (Field: Domestic, machinery and plants, engineering and construction, etc.)
  Eco Services – 40 (Field: Targeting consumers and business entities)
- PR Method: Introduction at Eco Town Center, Display at Eco Techno Exhibition and Eco Products Exhibition, Creation of pamphlets and booklets

Green Production Field: Introduction of efforts in Kitakyushu

■Kitakyushu Eco Premium[Services・Products]

1	Repair and maintenance service for household appliances from all makers
2	Rental apartment with photovoltaic power generation, the first in Japan (Received the FY 2005 New Energy Award from METI)
3	Refill service for printer ink
4	Community-based food waste recycle system
5	Thermal analysis service of heater appliances that leads to energy conservation

2

7

6	Hybrid city lamps generated by wind and solar energy
7	Automatic water-saving taps with self power generation function
8	Luminescence tube for ceramic metal halide lamps that are long-life and have very effective energy conservation features
9	Energy conserving high ceiling HID light system that enables a significant reduction in electricity use for lighting

Specific measures for green production field (draft proposal)

Project classification	Project description	Project implementing entity	Implementation timing	Evaluation index
1. Promotion of industry diversification and high added value	• For industry diversification and high added value, not only the sewn products industry but also various other diverse manufacturing industries such as automotive products, electronics, precision machinery, etc. will be cultivated by attracting foreign investment in order to change the industrial structure. • In order to attract superior overseas enterprises, the investment environment of special economic zones and industrial parks will be improved. • In order to handle changes in the industrial structure, vocational training schools, etc. will be established and operated in order to train diverse industrial personnel.	Private enterprises	Short-term	Manufacturing industry employment ratio
2. Promotion of green production	• When introducing production equipment for shifting from light industry to process assembly industries, from the initial stages introduction of energy-saving, resource-saving equipment, etc. will be undertaken as efforts toward green production and environmentally friendly production activities will be promoted. • Environmentally friendly renewable energy will be used as much as possible, such as using factory roofs for solar power generation, etc.	Business operators	Short-term	Amount of energy consumption reduction GHG reduction amount
3. Nurturing of small- and medium-scale businesses	• Promote Phnom Penh's autonomous industrial development by improving the technical capabilities and production management capabilities of small- and medium-sized enterprises and nurturing supporting industries. • Establish mechanisms for supporting entrepreneurs such as venture companies.	Business operators	Medium-long term	Amount of energy consumption reduction GHG reduction amount

Specific measures for green production field (draft proposal)

Project classification	Project description	Project implementing entity	Implementation timing	Evaluation index
4. Sales of environmentally friendly products	• In order to avoid the generation of useless garbage in cooking, shopping, and other activities in daily life, the use of excessive packaging, store-provided shopping bags, etc. will be reduced as much as possible. • Prohibition of excessive packaging at large stores and retail stores • Actively utilize recyclable containers such as glass containers and bottles • Collection of food plastic containers at stores • Prohibition of plastic bags and promotion of bringing own bag (shopping cart)	Business operators Citizens	Short-term	Amount of energy consumption reduction GHG reduction amount
5. Development of green agriculture	• Use organic fertilizers such as compost to reduce chemical fertilizers and promote the growing of rice with drastic reductions in the amount of agricultural chemicals used and it will be made a brand. • Promote sixth-order industrialization through the participation of processing (secondary industry) and distribution/sales (tertiary industry) in addition to the production of agricultural products (primary industry).	Agriculture workers Ministry of Agriculture and Fisheries NPO	Short-term	Amount of energy consumption reduction GHG reduction amount
6. Effective utilization of biomass emitted from agriculture and raising of livestock	• Promote power generation projects utilizing the husks of rice, Cambodia's largest agricultural product. • To promote resource recycling in agricultural areas, biomass power generation utilizing livestock manure and raw garbage will be promoted together with organic farming using the liquid fertilizer that is generated.	Agriculture workers Ministry of Agriculture and Fisheries Private businesses	Short-term	Amount of energy consumption reduction GHG reduction amount

Specific measures for green production field (draft proposal)

Project classification	Project description	Project implementing entity	Implementation timing	Evaluation index
7. Popularization of green tourism	• To promote the tourism industry, one of Cambodia's major industries, the popularization of green tourism focused on the environment and food education will be promoted.	Farmers Ministry of Agriculture and Fisheries Private businesses	Short-term	Number of projects Number of participants

Scene of automotive technology training (Kitakyushu)

Source: http://car-el.ksrp.or.jp/training/index.html

Biomass gasification power generation

Source: NEDO,http://www.nedo.go.jp/hyoukabu/articles/201302chugai/index.html

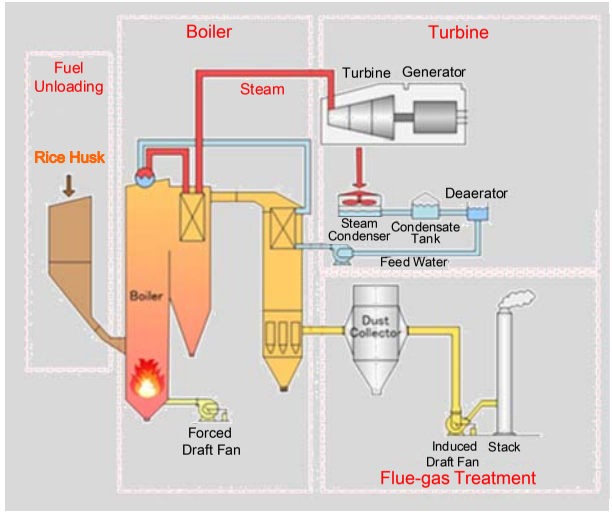
Scene of organic vegetable cultivation in Cambodia

Source: http://ivyivy.org/act/cambodia/

1.Project outline

Outline of technology	・Introduce biomass power generation facilities that utilize rice hulls at rice milling plants to reduce consumption of fossil fuel (lighter fluid) and CO_2 emission. ・For power generation method, direct combustion system in which rice husks are burned directly to make the steam which will rotate the turbine to generate power will be adapted.
Power generation capacity and total project cost	1)Power generation capacity : 2.0MW (Generating-end output:2.4MW, Loss factor of plant-home use:15%) 2)Total project cost : Approx.10.0million USD
CO_2 reduction effect	Annual CO_2 emission reduction amount: 4,441 tCO_2 CO_2 emission reductions during the statutory service life: 4,441tCO_2 /year×10year※ = 44,410tCO_2 ※Statutory service life：10years(a facility which polishes grain) <Assumed conditions> Annual days of operation: 336days
Cost-effectiveness	Cost-effectiveness of subsidy related to energy-derived CO_2 emissions Subsidy: 5millionUSD/44,410tCO_2 = 112USD/tCO_2

Direct Combustion System



【Outline of technology】

・Direct combustion is a system in which rice husks are burned directly to make the steam which will rotate the turbine to generate

RM-41

Economic Advantage

■Total Annual profit； About 1 million USD

Benefits of reducing fuel consumption- Loss of benefit from sales of rice husk
= 1,120,392USD - 116,463USD
= 1,003,929USD

■Benefit of reducing fuel consumption

	Before (Diesel Power Generation)	After (Rice Husk Power Generation)
High Season (Sep.-Jan. 140days)	756,000USD (9,000L/day × 140days × 0.6USD/L)	126,000USD (100L/hour × 15hour/day × 140day × 0.6USD/L)
Low Season (Feb.-Aug. 196days)	588,000USD (5,000L/day × 196days × 0.6USD/L)	97,608USD (100L/hour × 8.3hour/day × 196day × 0.6USD/L)
Total	1,344,000USD	223,608USD

Benefit = 1,344,000 USD - 223,608 USD= 1,120,392USD

■Loss of benefit from sales of rice husk

	Before (Diesel Power Generation)	After (Rice Husk Power Generation)
High Season (Sep.-Jan. 140days)	0	65,625USD (2.5ton/hour × 15hour/day × 140day × 12.5USD/ton)
Low Season (Feb.-Aug. 196days)	0	50,838USD (2.5ton/hour × 8.3hour/day × 196day × 12.5USD/ton)
Total	0	116,463USD

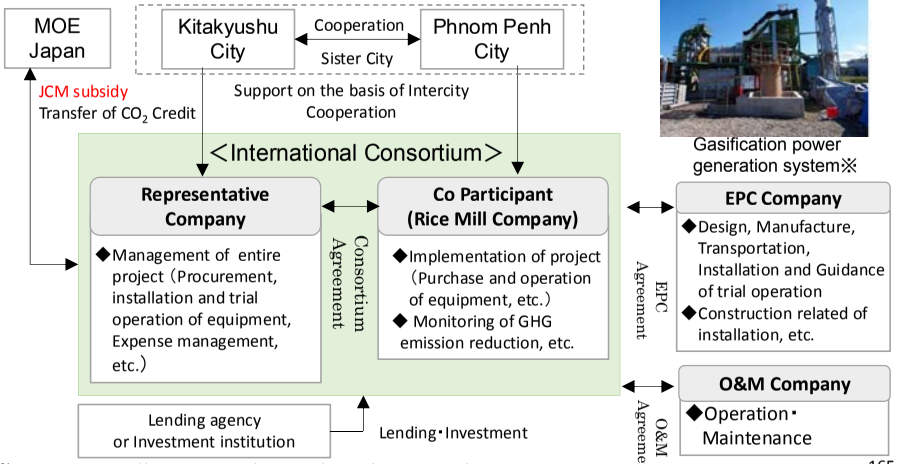
Loss of benefit from sales of rice husk = 116,463 USD

Notes；
Operation time of rice husk power generation
＝Amount of fuel consumption (L/day) / Fuel consumption per generation amount (L/kWh) / Capacity of rice power generation
→Operation Time in high season =9000 (L/day) /0.3 (L/kwh) /2,000kW =15 hour
→Operation Time in low season =5000 (L/day) /0.3 (L/kwh) /2,000kW=8.3 hour

Pilot project in green production field
Introduction of power generation facilities utilizing agricultural biomass

2.Business Structure

- The representative company (Japanese company) and the co participant (Cambodian company) will organize the international consortium to do the project.
- This project will be applied JCM subsidized project supported by MOE of Japan.(Maximum Subsidy: 50% of the initial equipment installation costs)



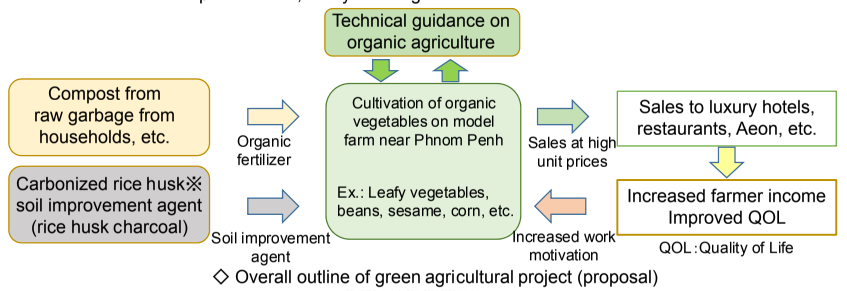

Gasification power generation system※

※Source: NEDO, http://www.nedo.go.jp/hyoukabu/articles/201302chugai/index.html

Green Production Field Pilot Project (2)
Development of green agriculture

1. Project overview

◇In this project, model districts are set up in agricultural areas in the suburbs of Phnom Penh and organic vegetables are cultivated utilizing compost (organic fertilizer) produced in the waste field pilot project.
◇In addition, soil improvement will be performed using carbonized rice husk charcoal in order to increase the income of farmers and provide safe, worry-free vegetables.



◇ Overall outline of green agricultural project (proposal)


Compost from raw garbage (organic fertilizer)


Rice husk charcoal: Microscope photograph (right) ※
(High porosity provides excellent water retention, water permeability, breathability, and fattening)


Scene of agricultural crop cultivation tests using rice husk charcoal※
(Left: Corn; Right: Soybeans. In both cases, plants on left are with rice husk charcoal use)

※Survey for ODA Proposal on Spreading Utilization of Carbonized Rice Husks in Cambodia. 2014, Kansai Corp., et al

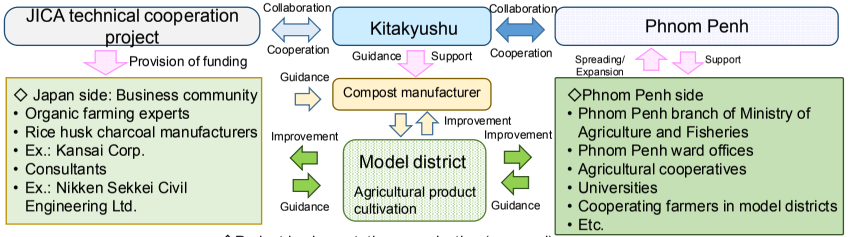
Green Production Field Pilot Project (2)
Development of green agriculture

2. Project results

◇Utilization of compost derived from raw garbage realized final disposal garbage amount reduction and resource recycling.
◇Through realization of organic agriculture including soil improvement by rice husk charcoal in model districts, yield increased and it became possible to aim at reduced use of chemical fertilizers and agricultural chemicals to improve the working environment of farmers.
◇It became possible to provide safe, tasty fresh crops to consumers (luxury hotels, restaurants, Aeon Malls, etc.)
◇By selling agricultural products at high unit prices, farmer income was increased and QOL was improved, and work motivation was increased.
◇It is planned to expand and develop the achievements of the model district to other districts to spread green agriculture.

3. Project scheme (proposal) and implementation organization (proposal)

◇For the business scheme, a JICA technical cooperation project or grassroots project is assumed.
◇The project period is around 2 to 3 years, with the aim of starting in 2017 if possible.
◇The assumed project implementation (proposal) is as shown in the diagram below.



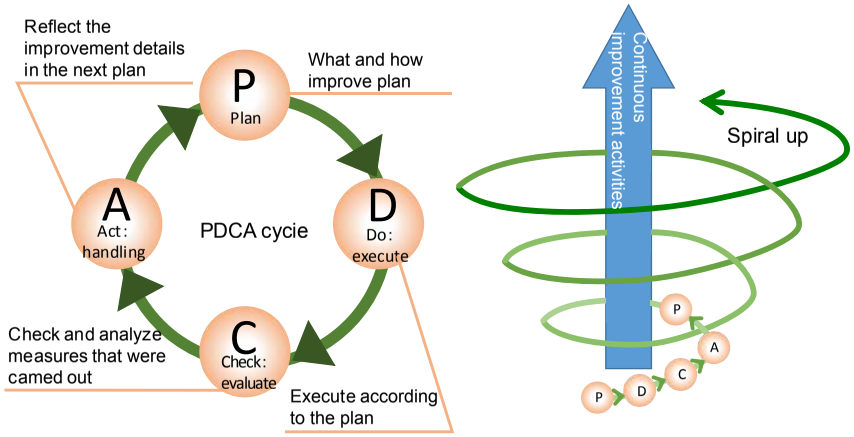
◇Project implementation organization (proposal)

Verification methods of the Strategy Measures

PDCA Cycle (1/2)

・To achieve the goals on schedule, constant monitoring of implementation of the measures is needed. It is also important to resolve any issues that may arise.

・As method of verification, introduction of PDCA cycle is recommended. This PDCA cycle is a method to provide continuous improvement by repeatedly carrying out the four-phases of activity, namely Plan → Do → Check → Action.



PDCA Cycle (2/2)

Item	Implementation Item	Points to Consider
Plan (Plan)	◇Specific planning of the project ex) Waste separation and recycle in urban areas ◇Setting the evaluation indicators and monitoring method which can confirm progress ex)・Rate of waste recycle rate ・Operation rate of facility operation ・Reduction amount of GHG ・Obligation to report regarding the amount of waste generated recycled to business operators (every month)	・Predict current risks, details from previous cases, and future prospect, etc. and reflect these in the plan. ・The purpose of the plan is to determine problems, and establish improvement methods.
Do (Execute)	・Implementation of the project ・Monitoring and recording of evaluation indicators	・Evaluation indicators must be recorded
Check (Evaluation)	・Confirmation of the project achievement ・Extraction of the project problem ex) The achievement status of the project is not satisfied with the goal→Identification of the cause → Consideration of improvement measures.	・Objective analysis of the problem by the evaluation indicators, etc., is needed.
Action (Handling)	・Specification of improvement measures ・Identification of points which can confirm the effectiveness of the improvement measures. ・Reflection in the next planning	・Objective analysis and accurate reflection in the next plan are important.

Order and Fund Procurement Methods

Ordering/Financing Method

■Ways of utilizing private financing and know-how

The administration, etc. can utilize private funds and know-how to reduce the burden of initial costs, and PPP/PFI or ESCO businesses, etc. are available as ways to improve infrastructure facilities and save energy in existing facilities.

■Ways to use administrative policies to encourage voluntary efforts by private companies

It is extremely important for the government to instruct companies periodically to comply with environmental standards. At the same time, it is also desirable to introduce economic means such as environmental surcharges, etc. to provide economic motivation for companies to reduce emissions of pollutants.

It is also important to introduce a tourism tax along with environmental surcharges in order to secure resources to provide subsidies and low-interest loans to companies which introduce pollution prevention facilities.

Furthermore, it is possible to encourage voluntary efforts by companies through utilizing an environmental labeling system or existing certification systems (ISO 14001, etc.) and introducing a mechanism in which governmental and public agencies procure products and services from companies which are engaging in environmentally friendly activities.

PPP / PFI (1/3)

(1) Overview

・The scheme in which public agencies and private organizations cooperate to provide public services is called PPP (Public · Private · Partnership), and PFI (Private Finance Initiative) is a typical PPP method.

・PFI is a way of thinking in which public services are provided through private initiatives utilizing private funds and know-how for the design, construction, maintenance and operation of public construction projects, etc., for the purpose of providing efficient and effective public services.

(2) Results

・It is expected to provide high-quality public services while reducing costs.

・ New public-private partnerships are formed based on the appropriate division of roles between public and private sectors.

・Invigoration of the economy is expected through the creation of opportunities for private businesses.

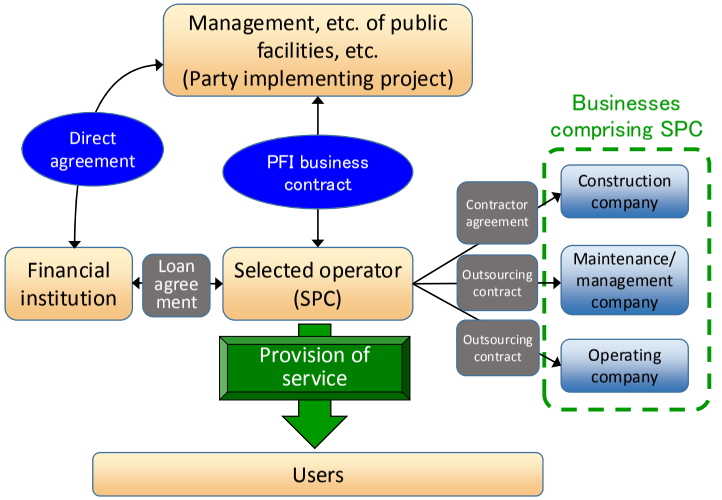
Case 1: Kitakyushu City: Renovation and maintenance of deteriorated Shiei Junior High School (pool, gymnasium, dojo)

Case 2: Kitakyushu City: Maintenance and management of library and halls; Maintenance of open spaces and green areas

Source：http://www8.cao.go.jp/pfi/141010_100_ikkatsu.pdf

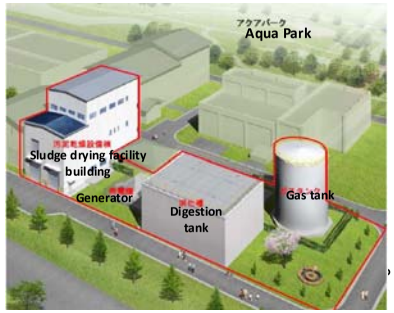
PPP / PFI (2/3)

(3) Typical PFI scheme



PPP / PFI (3/3)

Business for maintenance and operation of municipal sewerage biomass energy utilization facility in Kurobe

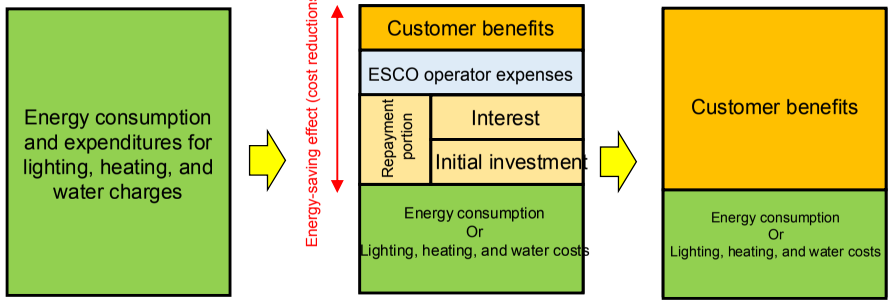
Order issuer	Kurobe (Toyama Prefecture)	Facility appearance
Facility outline	Facility scale: 2,050㎡ Biomass energy utilization facility (mixing tank, digestion tank, generator equipment, boiler, etc.), footbath	
Business description	Development, maintenance, and management of facilities to generate biogas from sewage sludge, etc. and coffee grounds for use by sludge drying facilities and on-site power utilization.	
Business period	17 years (maintenance and management period: 15 years)	
VFM	Approx. 4.1% (when selected as a designated project)	
Contract amount	Approx. 3.6 billion yen	
Implementation policy announcement	January 31, 2008	
Characteristics	・Methane generation facility utilizing sewage sludge, etc. and local biomass (coffee grounds). ・Utilizes approx. 1 million m³ of biogas produced annually as energy for sludge drying fuel and electricity generation. ・Dry materials derived from sewage sludge is registered and sold as fertilizer. In addition, efforts are being made to utilize it as fuel for power plants, etc. ・The generated power is used as power for the facilities and supplies 50 to 80% of the total power used. ・As a contribution to the community, a footbath that utilizes biogas was installed as a facilities amenity. ・Concentrated sludge volume of sewage sludge, etc.: 25,810 m³/year ・Amount of local biomass accepted: 2,800 m³/year	

Source： http://www.city.kurobe.toyama.jp/event-topics/svTopiDtl.aspx?prev-1&servno=1124

ESCO project

・ In an ESCO project, the basic concept is to cover all costs (construction costs, interest fees, expenses of ESCO project operators) through reductions in lighting, heating, and water charges achieved through energy-saving renovations. Because of this, the emphasis is placed on project profitability so that customers (local governments, factory owners, etc.) do not suffer losses due to the implementation of the ESCO project and there are no new financial expenditures required of customers. In addition, after the end of the contract term, all of the reductions in lighting, heating, and water charges benefit the customers.

・When utilizing funding procurement by ESCO project operators, from the initial year of the project, there will be no cost burdens that exceed conventional lighting, heating, and water costs, and at the same time it can promote energy conservation and achieve reductions in greenhouse gas emissions.



Before implementation of ESCO project

During ESCO project period

After end of contract term

Source:https://www.env.go.jp/council/35hairyo-keiyaku/y352-01/ref06-2.pdf

Environmental surcharges (1/2)

(1) Overview

- Environmental surcharges impose financial burdens on companies according to the amount and quality of environmental pollutant emissions, and are intended to give companies economic motivation toward reducing emissions.
- For factory wastewater, environmental surcharges will be higher as the discharge amount increases or the quality of discharged water worsens.
- The collected surcharges will be used as subsidies or low-interest loans for the introduction of pollution-prevention facilities.

(2) Examples

Country	Taxes / Surcharges
Japan	Sewerage fees and forest/water source replenishment taxes (both by local governments)
China	Emission surcharges, automobile fuel taxes
Korea	Overall water quality excess charges, overall air emissions excess charges, traffic environmental taxes
Vietnam	Environmental taxes

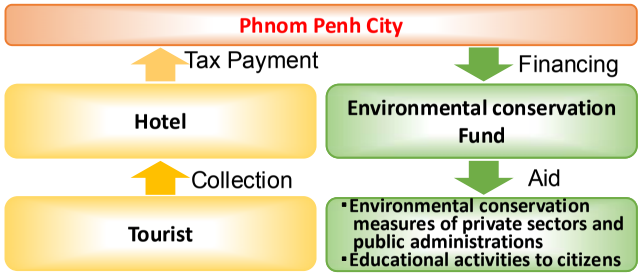
Environmental surcharges (2/2)

Table: Vietnam - Taxable items and tax amounts in environmental tax laws (Examples)

Taxable item	Tax amount (VND/unit)
1. Fossil fuels (L)	
1.1 Automobile-use gasoline (L)	1,000－6,000
1.2 Aviation fuel (L)	1,000－6,000
1.3 Light oil (L)	500－2,000
1.4 Kerosene (L)	300－2,000
1.5 Fuel oil for cooking (L)	300－2,000
1.6 Lubricating oils (L)	300－2,000
1.7 Coal (kg)	6－30
1.8 Natural gas, coal gas (m^3)	35－100
2. HCFC solutions (kg)	1,000－3,000
3. Plastics (kg)	500－2,000
4. Agricultural chemicals (kg)	500－5,000
5. Bleach detergents (kg)	400－2,000
6. Inorganic acid solutes (L)	600－3,000
7. Industrial paints (kg)	500－2,000

Sight-seeing Tax

The preservation of natural environment is an important element for sightseeing in Phnom Penh city. We'd like to propose that Sight-seeing tax is introduced and used for the environment conservation business in the whole Capital.



Dresden (Germany)・ Sight-seeing tax 1.8USD(per person per stay)

Capri(Italia)・Entrance tax 2.1USD(per person per stay)

Introduction of environmental labeling system and utilization of existing certification systems

(1) Environmental labeling system

- Environmental labels are labels given to products or services with low environmental impact, and are expected to raise environmental consciousness while helping consumers to choose products with low environmental impact.
- Although there are many types of environmental labels, the ones whose acquisition have the largest impact on a company's business are those defined in ISO 14024. This type of label has a system in which a third-party organization conducts an examination and determines whether or not to give certification based on whether or not the criteria for specific environmental labels are satisfied.
- Environmental labels not only provide company appeal but can also beneficially promote trading, funding procurement, and recruitment.
- The introduction of environmental labels is progressing in Europe, America, and Asian countries, and systems are being introduced in Indonesia and the Philippines with the support of JICA.

Blue Angel (Germany)

Nordic Swan (Northern Europe)

Eco mark (Japan)

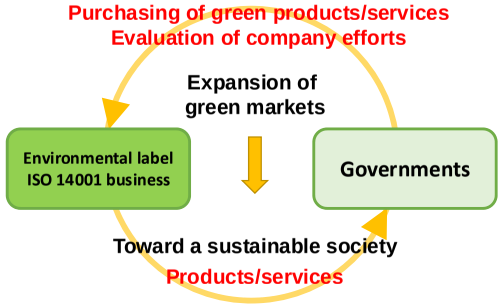
Introduction of environmental labeling system and utilization of existing certification systems

(2) Existing public certification systems

- Public certification systems for environmentally friendly activities include environmental management certifications such as ISO 14001, EMAS (EU Eco-Management and Audit Scheme), etc.
- Both are international standards that check the voluntary efforts of businesses toward environmental management from objective standpoints.

(3) Preferential policies for companies which have acquired environmental labels and public certification

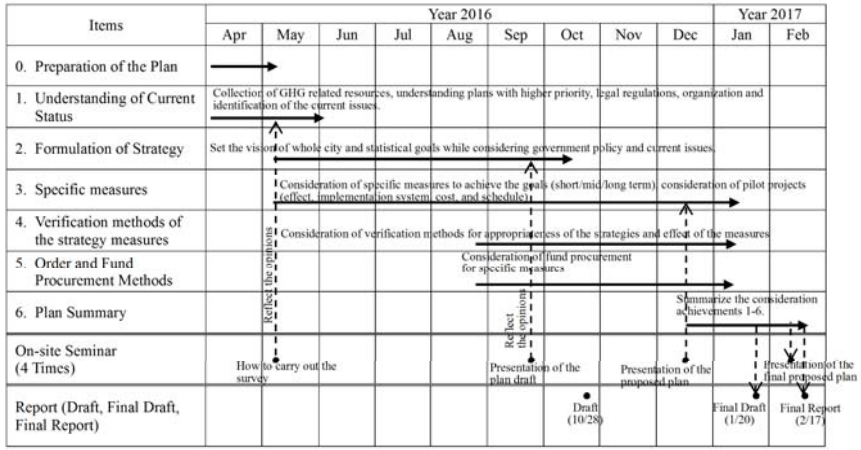
- Governments preferentially procure products and services from businesses who have acquired environmental labels and public certification (Green Public Procurement (GPP). In addition, they introduce companies inside and outside of the country and support increased profitability of companies.
- Green public procurement is being performed in Asia in Japan, Indonesia, Thailand, the Philippines, Vietnam, Malaysia, China, Korea, etc.



Source:http://gpn.jp/about/index.html

Schedule

Schedule



Holding of Seminars in Phnom Penh City

Number	Date	Contents of Discussion(Draft)	Participants
1st	May 12, 2016	＜**Inception Conference**＞ ・How to proceed planning, Confirmation of requirements ・ Request of material and data	・Related bureau of the capital ・Related bureau of the central government ・Other related enterprisers
2nd	September 9, 2016	＜**Interim Report Meeting 1**＞ ・Propose of the essential features of the action plan, Exchange of opinions ・Propose of the Project by field	・Same as above
3rd	December 15, 2016	＜**Interim Report Meeting 2**＞ ・Propose of the action plan (Draft), Exchange of Opinions ・Explanation of the pilot project(Draft) by field, Exchange of opinions	・Same as above ・Enterpriser related to the pilot projects
4th	February 14, 2017	＜**Final Report Meeting**＞ ・Explanation of the final action plan based on the opinions given at the previous meeting. ・ Discussion aimed at implementing JCM project after the next year, etc.	・Same as above