# Phnom Penh's Low Carbon Society Scenario Toward 2030
## - Tentative Result -

## BACKGROUND AND OBJECTIVE

In 2013, the Royal Government of Cambodia developed "National Policy on Green Development and National Strategic Plan on Green Development 2013-2030" and "Cambodia Climate Change Strategic Plan 2014-2023 (CCCSP)". CCCSP is the first comprehensive national plan regarding climate change. Cambodia intends to reduce its carbon emission and vulnerability to impact of climate change, and then aims for sustainable economic growth based on these plans. Moreover, the government submitted its "Intended Nationally Determined Contribution (INDC)" to United Nations Framework Convention on Climate Change (UNFCCC) Secretariat in 2015. A target which aims to reduce GHG emission by 27 % compared with Business-as-Usual (BaU) scenario by 2030 is set in INDC of Cambodia.

Phnom Penh has also started to tackle climate change issue. Phnom Penh prepared "Action Plan for the Climate Change Strategy in Phnom Penh Capital City" through collaboration between Kitakyushu City in Japan. Tasks and policies for reducing carbon emission in various fields are considered in the plan. However, GHG emission and reduction are not analyzed sufficiently. It is significant to make a quantified scenario for the city to reduce carbon emission steadily and substantially. Therefore, this study was conducted to develop a low-carbon society (LCS) scenario of Phnom Penh by estimating GHG emission and assessing carbon reduction effect by LCS projects.

## FRAMEWORK OF RESEARCH

This study focuses on energy-related $CO_2$ emission from industry, commercial, residential and transport sectors. The base year for estimation is 2014 and the target year for $CO_2$ reduction is 2030. The base year was decided based on data availability. The target year was set in accordance with INDC of Cambodia. Then we prepared two scenarios, namely BaU scenario and Countermeasure (CM) scenario to analyze carbon reduction potential in future. In BaU scenario, it is assumed that there is no policy or technology intervention to reduce carbon emission, while implementation of projects for reducing $CO_2$ emission is assumed in CM scenario.

## DATA COLLECTION

Variety of data and information of Phnom Penh and Cambodia were collected to prepare input data for estimation of future socioeconomic indicators, energy consumption and $CO_2$ emission.

Because there are few available economic data of Phnom Penh such as current GDP and industrial output, we estimated them based on Cambodia National Accounts and Economic Census of Cambodia by downscaling. Energy consumption in Phnom Penh in 2014 was also estimated by downscaling of Cambodia National Energy Statistics.

Regarding economic growth and energy mix in future, we set parameters for estimation based on previous researches like "Background Report on a Design of Low Carbon Development Action in Cambodia towards 2050: Energy Policy " (Ministry of Environment of Cambodia, Kyoto University, *et al.*, 2015).

## LCS SCENARIO OF PHONM PENH

Future status such as socioeconomic indicators, energy demand and carbon emission were estimated based on collected data and assumed parameters.

### Macro Economy

Population and GDP continues to grow by 2030 in Phnom Penh. Population will amount to about 2.5 million in 2030. GDP per capita will increase by 2.2 times compared with 2014. Then GDP in 2030 will become 3 time as large as that in 2014. Secondary and tertiary sector will grow remarkably and tertiary sector will still be main industry. Transport demand of both passengers and freights will also increase.

Table 1. Main socioeconomic indicators in Phnom Penh

| | Unit | 2014 | 2030 | 2030 /2014 |
|---|---|---|---|---|
| Population | persons | 1,770,131 | 2,450,717 | 1.38 |
| No. of households | households | 368,777 | 583,504 | 1.58 |
| GDP per capita | mil. Riels | 15 | 33 | 2.23 |
| GDP | bil. Riels | 26,576 | 81,879 | 3.08 |
| Primary | | 130 | 143 | 1.10 |
| Secondary | | 9,816 | 30,706 | 3.13 |
| Tertiary | | 16,631 | 51,029 | 3.07 |
| Outputs | bil. Riels | 63,884 | 199,117 | 3.12 |
| Final consumption | bil. Riels | 7,100 | 20,961 | 2.95 |
| Gross fixed capital formation | bil. Riels | 8,814 | 26,022 | 2.95 |
| Export | bil. Riels | 23,598 | 69,666 | 2.95 |
| Import | bil. Riels | 16,005 | 44,245 | 2.76 |

| | Unit | 2014 | BaU | CM | BaU /2014 |
|---|---|---|---|---|---|
| Passenger transport demand | mil. pass-km | 7,140 | 12,652 | 13,964 | 1.77 |
| Freight transport demand | mil. ton-km | 1,538 | 4,869 | 4,869 | 3.17 |



Figure 1. GDP by economic activity

Legend:
- Agriculture, forestry, and fisheries
- Mining
- Food, beverage and tobacco
- Non-metallic mineral
- Textile
- Other manufacturing
- Construction
- Trade
- Transport and communication
- Finance, real estate and business
- Other services

# LCS SCENARIO OF PHNOM PENH
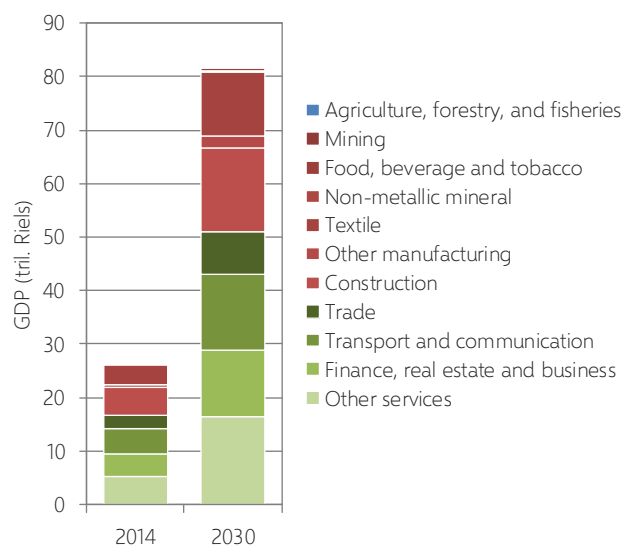
## Energy Consumption

Energy demand will increase in proportion as population and economic growth. Energy consumption in BaU scenario will increase by 5 times as much as 2014. On the other hand, in CM scenario, energy consumption can be reduced by 14% from BaU scenario. Use of natural gas and solar heat are expanded in CM scenario.
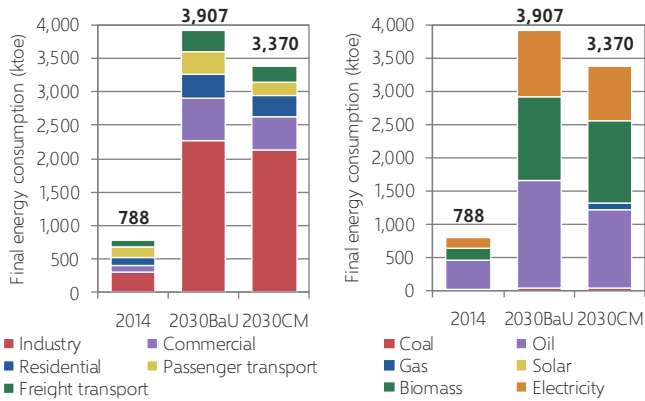


Figure 2. Final energy consumption by sector/fuel type

## CO₂ Emission and Reduction

CO₂ emission in BaU scenario will amount to 4.7 times as much as 2014, where as, in CM scenario, CO₂ emission can be reduced by 29% compared with BaU scenario. The commercial sector and the passenger transport sector will lead emission reduction.

Table 2. CO₂ emission by sector

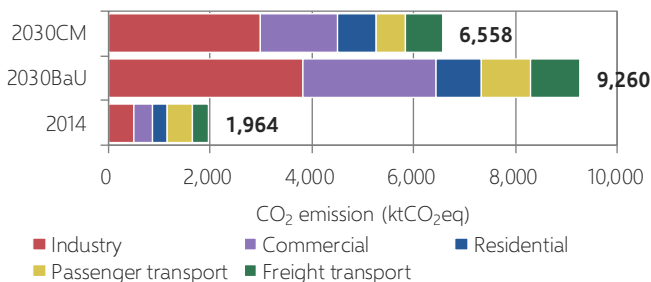|  | 2014 | 2030 BaU | 2030 CM | BaU /2014 | CM /BaU |
|---|---|---|---|---|---|
| CO₂ emission (ktCO₂eq) | 1,964 | 9,260 | 6,558 | 4.72 | 0.71 |
| Industry | 491 | 3,828 | 2,971 | 7.80 | 0.78 |
| Commercial | 382 | 2,600 | 1,538 | 6.81 | 0.59 |
| Residential | 280 | 902 | 749 | 3.22 | 0.83 |
| Passenger transport | 509 | 971 | 579 | 1.91 | 0.60 |
| Freight transport | 303 | 959 | 721 | 3.17 | 0.75 |
| CO₂ emission per GDP (tCO₂eq/bil.Riels) | 73.9 | 113.1 | 80.1 | 1.53 | 0.71 |
| CO₂ emission per capita (tCO₂eq/person) | 1.1 | 3.8 | 2.7 | 3.41 | 0.71 |



Figure 3. CO₂ emission in each scenario

## CONCLUSION

A preliminary research of LCS scenario for Phnom Penh has been made. It is indicated that the city has a potential to reduce CO₂ emission corresponding to INDC of Cambodia. Although the estimation includes a lot of assumption due to lack of data and information, this research can be used as a basis for discussion. We hope it will help sustainable development and transition to low carbon society in Phnom Penh.

## Projects to Achieve Low Carbon Society

Table 3. Reduction of carbon emission by action/project

| Project | | Sector | CO₂ reduction (ktCO₂eq) |
|---|---|---|---|
| Action 1: Green Production | | | 485.1 |
| 1-01 | Energy saving support scheme for industries | Industry | 199.0 |
| 1-02 | Installation high energy efficiency facilities | Industry | 9.1 |
| 1-03 | Regional energy supply system | Industry | 84.2 |
| 1-04 | Improvement of kiln and furnace technology | Industry | 181.3 |
| 1-05 | Promotion of fuel shift of furnaces and boilers from coal to natural gas | Industry | 11.5 |
| Action 2: Sustainable Building and Infrastructure | | | 251.7 |
| 2-01 | Installation of insulated glasses to commercial buildings | Commercial | 56.5 |
| 2-02 | Installation of insulated glasses to households | Residential | 13.1 |
| 2-03 | Introduction of incentive to low energy buildings | Commercial | 11.8 |
| 2-04 | Introduction of insulating material to houses | Residential | 0.6 |
| 2-05 | Energy efficiency technology applied to buildings | Commercial | 47.9 |
| 2-06 | Shift to natural gas in buildings | Commercial | 0.6 |
| 2-07 | Shift to natural gas in households | Residential | 37.7 |
| 2-08 | Introduction of solar water heater to commercial buildings | Commercial | 48.6 |
| 2-09 | Introduction of solar water heater to households | Residential | 14.2 |
| 2-10 | Introduction of photovoltaic power generation to commercial buildings | Commercial | 13.1 |
| 2-11 | Introduction of photovoltaic power generation to households | Residential | 6.6 |
| 2-12 | Introduction of small-scale hydropower generation | Commercial | 0.9 |
| Action 3: Energy Efficient Houses and Offices | | | 422.2 |
| 3-01 | Energy saving support scheme for commercial buildings | Commercial | 151.2 |
| 3-02 | High efficiency lighting in commercial buildings | Commercial | 129.8 |
| 3-03 | High efficiency lighting in households | Residential | 15.1 |
| 3-04 | High efficiency air conditioners in commercial buildings | Commercial | 103.4 |
| 3-05 | High efficiency air conditioners in households | Residential | 6.1 |
| 3-06 | Promotion of energy-efficient appliances | Residential | 16.6 |
| Action 4: Clean and Efficient Transport | | | 650.3 |
| 4-01 | Promotion of eco-driving | Transport | 13.9 |
| 4-02 | Wide-range traffic control | Transport | 26.9 |
| 4-03 | Expansion of bus transportation | Transport | 94.8 |
| 4-04 | Development of public transportation like MRT | Transport | 48.0 |
| 4-05 | Shift to EV bus | Transport | 0.2 |
| 4-06 | Introduction of electric motorbikes | Transport | 110.7 |
| 4-07 | Promotion of energy-efficient passenger car | Transport | 56.3 |
| 4-08 | Promotion of energy-efficient motorbikes | Transport | 81.6 |
| 4-09 | Promotion of energy-efficient trucks | Transport | 218.0 |
| Improvement of CO2 emission factor of electricity | | | 919.3 |
| Total | | | 2,728.7 |

## METHODOLOGY

Extended Snapshot Tool (ExSS), developed by AIM team, was used to estimate future CO₂ emission. It has been used in a lot of nations and regions. The model is specialized for quantifying LCS scenario. It is effective to quantify the future vision for discussion with stakeholders. Quantification also makes it clear that how we can achieve GHG reduction target. The model describes current and future status such as socioeconomic activity (population, Economy, Transport), energy consumption, power generation, and GHG emission and reduction.
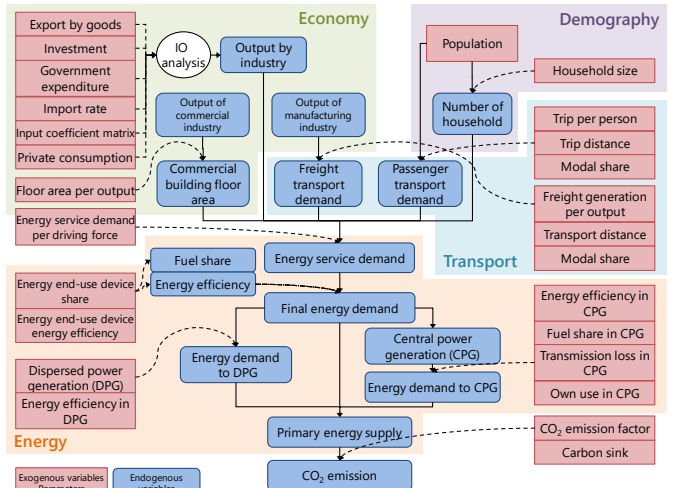


Figure 4. Structure of ExSS