HAI PHONG LOW CARBON CITY

Based on the following strategies and plans: National Green Growth Strategy (1393/QD-TTg) approved by the Prime Minister in September 2012, Green Growth Action Plan (403/QD-TTg) approved by the Prime Minister in March 2014, and the Green Port City strategy (72-KL/TW) of the Communist Party Politburo, Hai Phong formulated the Green Growth Strategy Action Plan of the City of Hai Phong (1463/QD-UBND) in July 2014. With the target of the Intended Nationally Determined Contributions (INDCs) to the United Nations Framework Convention on Climate Change UNFCCC, which aims to reduce 8-25% of total emissions in 2030 compared to Business as Usual (BaU), major cities in Vietnam are required to develop Climate Change Action Plans (CCAP). The CCAP is necessary and should be integrated with the middle- and long-term master plan of socio-economic development, specific sectoral development plans.

This study is one of the results of the research collaboration between Asian-Pacific Integrated Model (AIM) team in Japan including Ritsumeikan University, Kyoto University, E-konzal, National Institute for Environmental Studies (NIES), Mizuho Information and Research Institute (MHIR), Institute for Global Environmental Strategy (IGES), and Institute of Strategy and Policy on natural resources & environment (ISPONRE), Department of Natural Resources and Environment of Hai Phong. We expect this brochure is useful for researchers and policy-makers who are interested in developing or updating their own CCAP.

We developed two scenarios with the projection of energy consumption and CO_2 emission in energy-related categories such as Residential, Commercial, Transportation, and Industry. They are 2030BaU (Business as Usual) and 2030CM (CounterMeasures). The 2030BaU scenario, where countermeasures for GHG emission reduction are not introduced, reflects the situation in which both, the levels of commitments to climate-friendly-energy production and technological breakthroughs are relatively low. Specially, countermeasures are assumed the same level as in 2013. On the other hand, the 2030CM scenario, which additional low carbon countermeasures are introduced in order to assess the reduction effects of GHG emissions. The socioeconomic assumptions about population, industrial structure, and economic growth are common to both scenarios. Information from many domestic sources is used to calibrate the parameters for base year 2013. In target year 2030, Extended Snapshot Tool (ExSS) is applied for the projection of future energy consumption and CO_2 emission in energy-related categories.

Hai Phong is expected under the rapid growth of driving forces such as population, transport demand, and especially industrial activities; the total GHG emissions increases 4.01 times, from 6,675 $ktCO_2eq$ in 2013 to 33,494 $ktCO_2eq$. The total GHG emissions reduction is 14%, accounting for $ktCO_2eq$, Hai Phong can reduce such emissions reductions by implementing 30 projects grouped in four actions (Green Industry, Green Building, Energy Efficiency and Clean Transport). Since the national reduction target has been shown in the Green Growth strategy (10-20% reduction in 2030CM) and in the Vietnam's INDC (8-25%), Hai Phong is expected to achieve such target by 2030 (14% reduction by 2030CM compared to 2030BaU)

Table 1 GHG emissions by sectors ($ktCO_2eq$) in Hai Phong city

	2013		2030		2030			
			BaU		CM		BaU/2013	CM/BaU
GHG emissions	$ktCO_2eq$	%	$ktCO_2eq$	%	$ktCO_2eq$	%		
Agricultural energy-related	2	0.1	10	0.1	10	0.1	4.83	1.00
Industry	2,483	37.2	15,920	47.5	14,413	50.0	6.41	0.91
Commercial	221	3.3	1,470	4.4	1,170	4.1	6.64	0.80
Residential	1,291	19.3	2,672	8.0	2,291	7.9	2.07	0.86
Passenger transport	604	9.1	1,634	4.9	1,350	4.7	2.70	0.83
Freight transport	2,075	31.1	11,797	35.2	9,626	33.4	5.69	0.82
Total GHG emissions	**6,675**	**100.0**	**33,494**	**100.0**	**28,850**	**100.0**	**5.02**	**0.86**
GHG emissions per GDP (tCO_2eq/bil.Dongs)	63.2		58.0		49.9		0.92	0.86
GHG emissions per capita (tCO_2eq/person)	3.5		11.2		9.6		3.22	0.86

Hai Phong socio-economic scenario

Population

Table 2 shows the results of main socio-economic driving forces for base year 2013 and target year 2030.

In this study, population in 2030 is referred to the projection of population in the report of Master Plan of Construction in Hai Phong up to 2025 and reach 3 million people (1.56 times higher than that in 2013).

Household size in 2030 is assumed by 3 persons/household. Therefore, the total number of households is about 1 million, increases 1.81 times compared to that in 2013.

Transport demands

Due to the increasing population and industrial activities, the transport demand in Hai Phong in 2030 increases dramatically from 10236 to 22490 million person per kilometer (mil.per.km) of passenger transport and 8470 to 48158 million ton per kilometer (mil.ton.km) of freight transport compared to 2013.

Regarding to passenger transport, there is a rapid increase of demand on car to 8.25 times. In 2030BaU, transport demand of car and motorbike is similar. According to the projection of Department of Transport of Haiphong, the share of public transport such as bus by trip increases from 0.26% in 2013 to 10.0% in 2030BaU and reaches 15.0% in 2030CM. Freight transport relies predominantly on roads and followed by waterway. The share of freight transport mode is assumed unchanged in 2013 and 2030, in which road is still dominates and contributes to 91%, followed by waterway with 8% contribution.

Table 3: Transport demand in Hai Phong city

	2013	2030BaU	2030CM	BaU/2013	CM/BaU
Passenger transport (mil.per.km)	**10,236**	**22,490**	**22,453**	**2.20**	**1.00**
Walk	84	130	130	1.56	1.00
Bicycle	988	1,540	1,540	1.56	1.00
Motorbike	7,908	9,232	8,367	1.17	0.91
Car	1,204	9,932	9,932	8.25	1.00
Bus	52	1,655	2,483	31.68	1.50
Freight transport (mil.ton.km)	**8,470**	**48,158**	**48,158**	**5.69**	**1.00**
Car	7,174	40,789	40,789	5.69	1.00
Waterway	1,296	7,369	7,369	5.69	1.00

Table 2: Main socio-economic indicators in Hai Phong city

	Unit	2013	2030	2030/2013
Population	persons	1,925,217	3,000,000	1.56
No. of households	household	553,406	1,000,000	1.81
GDP per capita	mil. Dongs	55	193	3.51
GDP	bil. Dongs	105,651	577,829	5.47
Outputs	bil. Dongs	282,310	1,595,478	5.65
Final consumption	bil. Dongs	67,644	369,309	5.46
Gross fixed capital formation	bil. Dongs	38,607	210,777	5.46
Export	bil. Dongs	111,247	607,360	5.46
Import	bil. Dongs	111,847	609,616	5.45
Passenger transport demand	mil.per.km	10,236	22,490	2.20
Freight transport	mil.ton.km	8,470	48,158	5.69

Economy

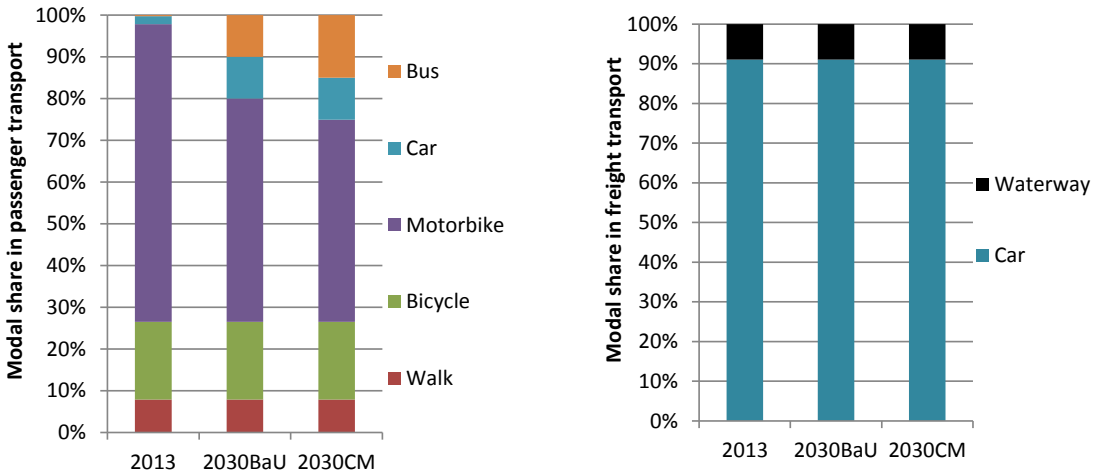
According the projection by Department of Investment and Planning of Haiphong, GDP growth rate up to 2030 is 10.5% per year. The GDP in 2030 will increase 3.51 times compared to 2013. Service sector still dominates in the economic structure of Hai Phong city, accounting for about 55.4%, following by industrial sector (about 37.4%).

Industrial output is expected to increase by 5.65 times in 2030 (1,595,478 billion Dongs) compared to 2013 (282,310 billion Dongs)

The GDP per capita of Hai Phong in 2013 is around 55 mil. Dongs , and increases 3.51 times by 2030. The GDP per capita in 2030 reaches 193 mil. Dongs due to the rapid GDP growth (10.5% per annual).

In 2030, export and import in Hai Phong expected to similarly increase 5.46 and 5.45 times compared to those in 2013, respectively. Final consumption increases from 67,644 (in 2013) to 369,309 billion Dongs (in 2030), in which main consumption is from households for industrial commodities and services while the government consumption is mainly for science, technology, and other services.

Figure 1: Modal share of transportation in Hai Phong



Final energy consumption and GHG emissions

Energy consumption

Final energy consumption is protected to increase significantly in 2030 of 9308 ktoe (1904 ktoe in 2013). In 2030CM, final energy consumption is about 8090 ktoe.

The energy intensity by GDP reduces from 18.0 toe/bil. Dongs in 2013 to 16.1 toe/bil. Dongs in 2030BaU and 14.0 toe/bil. Dongs in 2030CM due to the lower increasing rate of energy consumption compared to the rapid growth of GDP.

Table 4: Relationship of energy consumption and GHG emissions

	2013	2030BaU	2030CM
Energy intensity (toe/bil. Dongs)	18.0	16.1	14.0
GHG emissions per GDP (tCO2eq/bil. Dongs)	63.2	58.0	49.9
GHG emissions per capita (tCO2eq/ person)	3.5	11.2	9.6
Final energy consumption (ktoe)	1,904	9,308	8,090
GHG emissions (ktCO2eq)	6,675	33,494	28,850

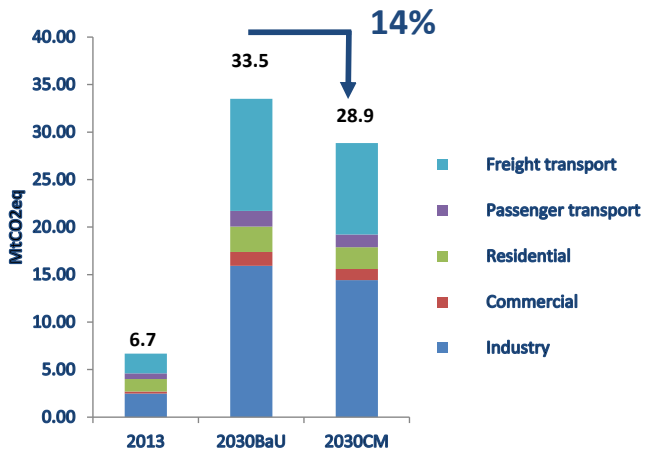


Figure 2: GHG emissions in Hai Phong

GHG emissions

Total GHG emission in 2030BaU is projected about 33.5 $MtCO_2eq$, accounting for fivefolds higher than base year 2013 (6.7 $MtCO_2eq$).

Main contributors to GHG emissions in the 2030BaU scenario are industrial sector (15.7 $MtCO_2eq$), followed by transport, residential and commercial sectors which account for 13.4, 2.7 and 1.5 $MtCO_2eq$, respectively.

GHG emissions in 2030CM, is estimated to reduce by 14% from the 2030BaU emissions. Breakdown of GHG emission reduction is shown in Figure 3.

As can be seen from table 4 that per capita GHG emissions in 2013 in Hai Phong was only 3.5 tCO_2eq, though, in BaU scenarios, it is projected to increase up to 11.2 tCO_2eq. In 2030CM scenario it can be reduced to 9.6 tCO_2eq.

Regarding to GHG emission intensity, in 2013, estimated GHG emission intensity is 62.3 tCO_2eq/bil.dongs. In 2030BaU, emission intensity decreased to 58.0 tCO_2eq/bil.dongs mainly because of greater share of tertiary industry in GDP. In 2030CM scenario, which introduces implementation of the projects and actions, emission intensity is estimated to 49.9 tCO_2eq/bil.dongs. More details of the projects and actions are described in the following pages of this report.

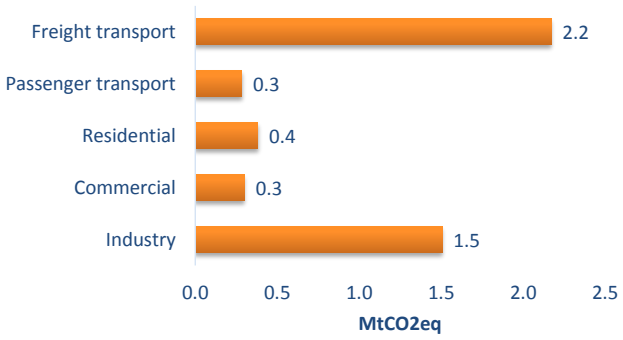


Figure 3: Breakdown of GHG emission reduction by sector in 2030

Table 5: Energy consumption

Unit: ktoe

	2013	%	2030BaU	%	2030CM	%	BaU/2013	CM/BaU
Total	**1,904**	**100.0**	**9,308**	**100.0**	**8,090**	**100.0**	**4.89**	**0.87**
By sector								
Agriculture	11	0.6	43	0.5	42	0.5	3.98	0.97
Industry	565	29.7	3,628	39.0	3,309	40.9	6.43	0.91
Commercial	47	2.5	313	3.4	290	3.6	6.64	0.93
Residential	373	19.6	772	8.3	728	9.0	2.07	0.94
Passenger transport	205	10.8	554	5.9	458	5.7	2.70	0.83
Freight transport	703	36.9	3,998	42.9	3,262	40.3	5.69	0.82
By energy type								
Coal	280	14.7	1,753	18.8	1,542	19.1	6.27	0.88
Oil	1,147	60.3	5,354	57.5	4,406	54.5	4.67	0.82
Gas	41	2.2	257	2.8	253	3.1	6.24	0.98
Solar	0	0.0	0	0.0	79	1.0		
Biomass	167	8.8	643	6.9	632	7.8	3.85	0.98
Electricity	269	14.1	1,301	14.0	1,178	14.6	4.84	0.91

Table 6: GHG emissions and reduction

Unit: $ktCO_2eq$

Year	Sector	Coal	Oil	Gas	Electricity	Total
2013	Agriculture	1.2	24.5	0.0	17.2	**42.9**
	Industry	1,074.9	126.1	96.8	1,142.2	**2,440.0**
	Commercial	36.8	66.7	0.0	117.9	**221.4**
	Residential	37.2	489.1	0.0	765.2	**1,291.4**
	Passenger transport	0.0	604.3	0.0	0.0	**604.3**
	Freight transport	0.0	2,074.8	0.0	0.0	**2,074.8**
	Total	**1,150.2**	**3,385.4**	**96.8**	**2,042.4**	**6,674.8**
2030 BaU	Agriculture	4.9	97.5	0.0	68.4	**170.8**
	Industry	6,883.0	816.3	603.6	7,446.0	**15,749.0**
	Commercial	244.6	443.1	0.0	782.7	**1,470.3**
	Residential	76.9	1,011.9	0.0	1,583.3	**2,672.1**
	Passenger transport	0.0	1,634.3	0.0	0.0	**1,634.3**
	Freight transport	0.0	11,797.4	0.0	0.0	**11,797.4**
	Total	**7,209.4**	**15,800.5**	**603.6**	**9,880.3**	**33,493.8**
2030 CM	Agriculture	4.7	94.3	0.0	66.1	**165.1**
	Industry	6,082.9	743.1	548.9	6,872.9	**14,247.7**
	Commercial	199.8	346.7	0.0	623.7	**1,170.2**
	Residential	53.8	903.8	0.0	1,333.3	**2,290.9**
	Passenger transport	0.0	1,289.4	45.3	15.3	**1,349.9**
	Freight transport	0.0	9,626.4	0.0	0.0	**9,626.4**
	Total	**6,341.3**	**13,003.6**	**594.2**	**8,911.3**	**28,850.3**

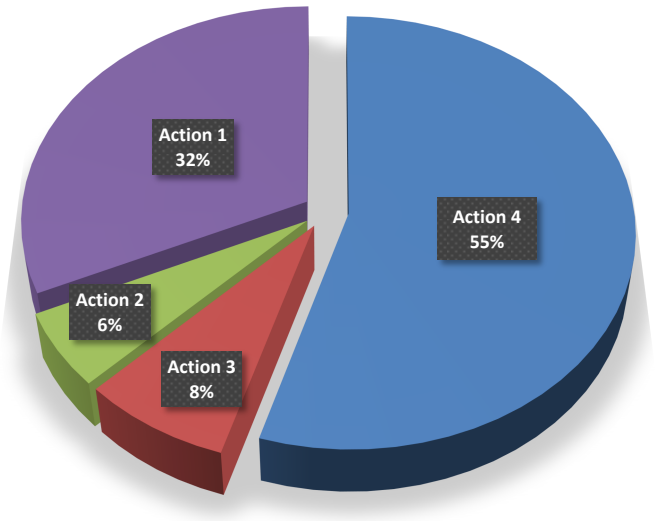
Five Low Carbon Actions in Hai Phong

Action 1. Green Industry

Action 1 is comprising all low carbon projects regarding promotion of energy efficient equipment and fuel shift in the industry sector. Total reduction of GHG emissions by this action is 1477 $ktCO_2eq$. Energy saving in factories is one of the main project in Action 1, which contributes to reduce about 602 $ktCO_2eq$ with assumption of diffusion ratio is 30%.

Action 2. Green Urban

Low carbon projects related to diffusion of low-energy households and buildings are grouped into this Action. Action 2 is expected to reduce 262 $ktCO_2eq$. Introduction of insulating solar water heater to households is expected to reduce the largest GHG emission in this action. Diffusion ratio of this project in 2030 is assumed by 20%. Energy demand in households and buildings is saving through the diffusion of energy management system and installation of insulated glasses.



Action 3. Energy Efficiency

Action 3 is expected to reduce 363 $ktCO_2eq$, which including all projects of promoting energy efficient device and appliance like lighting and air conditioners for houses and buildings. Promotion of energy-efficient appliances like refrigerator and others contributes the biggest amount of CO_2 reduction of 172 $ktCO_2eq$. Replacement of conventional lighting by high efficient one such as LED lighting in houses and buildings also contributes to reduce significant amount of CO_2 emissions.

Action 4. Clean Transport

Action 4 is expected to reduce the largest amount of CO2 emission (2541 $ktCO_2eq$), which includes variety of projects regarding both passenger and freight transportation such as improvement of fuel efficiency of vehicles, promotion of modal shift to public transportation and deployment of EV bus. Projects for freight transport such as promotion of energy-efficient trucks have large potential to reduce GHG emissions, because GHG emission from freight transport sector is very high (more than fourfold of passenger transport). This project is expected to reduce 2060 ktCO2eq (more than 80% of total contribution in this Action)

Table 7: Climate change actions ($ktCO_2$) for Hai Phong city

	Industry	Commercial	Residential	Passenger Transport	Freight Transport	**Total (ktCO2eq)**
Action 1. Green Industry Promotion of energy efficient equipment and fuel shift	1,477					**1,477**
Action 2. Green Building Diffusion of low-energy building (EMS, Insulation, Fuel shift)		199	63			**262**
Action 3. Energy Efficiency Promotion of energy efficient device/appliance		130	233			**363**
Action 4. Clean Transport Energy efficient vehicle and modal shift				284	2,257	**2,541**
Total (ktCO2eq)	**1,477**	**329**	**296**	**284**	**2,257**	**4,643**

Mitigation projects in Hai Phong to achieve Low Carbon City

Table 7: Emission reductions by project

Action		Project	Sector	Emission reduction ($ktCO_2eq$)
1 Green Industry	1-01	Energy savings in factory	Industry	601.9
	1-02	Installation high energy efficiency facilities (such as compressors and motors)	Industry	93.4
	1-03	Regional energy supply system	Industry	514.8
	1-04	Improvement of kiln and furnace technology	Industry	266.6
		Total		**1,476.8**
2 Green Building	2-01	Installation of insulated glasses to commercial buildings	Commercial	19.5
	2-02	Installation of insulated glasses to households	Residential	35.5
	2-03	Introduction of incentive to low energy buildings	Commercial	3.5
	2-04	Introduction of insulating material to houses	Residential	13.4
	2-05	Energy efficiency technology applied to buildings	Commercial	9.7
	2-06	Introduction of solar water heater to commercial buildings	Commercial	44.5
	2-07	Introduction of solar water heater to households	Residential	102.4
	2-08	Introduction of photovoltaic power generation to commercial buildings	Commercial	29.2
	2-09	Introduction of photovoltaic power generation to households	Residential	4.2
		Total		**262.0**
3 Energy Efficiency	3-01	Energy savings in commercial facilities	Commercial	35.4
	3-02	Conversion of street lights to LED lighting High efficiency lighting in public lighting	Commercial	3.2
	3-03	High efficiency lighting in commercial buildings	Commercial	43.0
	3-04	High efficiency lighting in households	Residential	36.4
	3-05	High efficiency air conditioners (such as air conditioners with inverter controllers) in commercial buildings	Commercial	22.7
	3-06	High efficiency air conditioners (such as air conditioners with inverter controllers) in commercial households	Residential	48.8
	3-07	Promotion of energy-efficient appliances (refrigerator and other appliances)	Residential	172.2
	3-08	Promotion of energy-efficient appliances (cooking appliances)	Residential	1.1
		Total		**362.8**
4 Clean Transport	4-01	Promotion of eco-driving with digital tachographs	Transport	169.7
	4-02	Smart trafic management	Transport	5.4
	4-03	Expansion of frequencies and routes of bus transportation	Transport	7.6
	4-04	Development of Bus Rapid Transit (BRT)	Transport	3.8
	4-05	Introduction of EV buses	Transport	7.8
	4-06	Introduction of electric motorbikes	Transport	39.9
	4-07	Promotion of energy-efficient vehicles (cars for passenger)	Transport	160.2
	4-08	Promotion of energy-efficient vehicles (motorbikes)	Transport	87.0
	4-09	Promotion of energy-efficient vehicles (trucks)	Transport	2,060.1
		Total		**2,541.3**
Total				**4,642.9**

Methodology

In order to identify the necessary actions, an "integrated modeling" based on "back-casting" approach is used.

The back-casting approach sets a vision of the future society as a goal, and then seeks a pathway towards achieving that goal.

We used ExSS (Extended Snapshot tool) for socio-economic indicators, energy related sectors. Information collection is the first step in the modeling work.

Socio-economic information as well as environmental information for the base year (2013) was collected and analyzed in order to estimate current carbon emissions. Besides this, feasible low carbon measures for Hai Phong low carbon 2030 were also collected.

For the future projection, information is based on planned developments, as the model estimates socio-economic activity levels including population, number of households, land area, transport demand and other variables. Based on the collected information, GHG emissions are calculated with or without countermeasures.

ExSS estimates future GHG emissions and reductions based on two approaches, which are top-down and bottom-up approaches.

- Top-down approach is used to estimate socio-economic activities (such as population, number of household, economic development, industrial structure and transport demand) and energy demand and GHG emissions from a macroscopic point of view.

- Bottom-up approach is used to assume the technology-related information (such as diffusion rate and energy saving rate) and to estimate GHG emission reduction and GHG absorption capacity by project.

We improve estimation by repeating model simulation through information sharing and exchanging with Hai Phong city.

Extended Snapshot Tool (ExSS)

ExSS is a simplified simulation model for low carbon study and projects socio-economic activity, energy demand and supply, GHG emissions and emission reduction by measures. While each part of the tool is relatively simple, it can describe whole picture of future society as a LCS in a quantitative and consistent manner with a greater flexibility than many other models. It also can consider most of the low carbon measures existing and expected in near future. In this simulation model, population is decided by demand from outside of the region, labor participation ratio, demographic composition and relationship of commuting with outside of the region. To determine output of industries, input-output approach is applied. Passenger transport demand is estimated from the population and freight transport demand whereby it is a function of output by manufacturing industries. Floor area of commerce is determined from output of tertiary industries. Other than driving force, activity level of each sector, energy demand by fuels determined with three parameters. One is energy service demand per driving force, energy efficiency and fuel share. Diffusion of counter measures changes the value of these parameters, and so GHG emissions.

Team members

HAIPHONG DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENT (DONRE)

Pham Quoc Ka

Nguyen Van Can

Vu Thi Thu Huong

INSTITUTE OF STRATEGY AND POLICY ON NATURAL RESOURCES & ENVIRONMENT (ISPONRE)

NGUYEN Tung Lam

RITSUMEIKAN UNIVERSITY (RU)

NGUYEN Thai Hoa*

Koji SHIMADA

KYOTO UNIVERSITY (KU)

Yuzuru MATSUOKA

E-KONZAL

Yuki OCHI

Tomoki EHARA

INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES (IGES)

Junichi FUJINO

NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES, JAPAN (NIES)

Toshihiko MASUI

MIZUHO INFORMATION AND RESEARCH INSTITUTE (MHIR)

Kazuya FUJIWARA

Acronyms and Abbreviations

AIM	Asia-Pacific Integrated Modeling
BaU	Business as Usual scenario
CC	Climate Change
CCAP	Climate Change Action Plan scenario
EBT	Energy Balance Table
ExSS	Extended Snapshot Tool
GDP	Gross Domestic Product
IEA	International Energy Agency
IGES	Institute for Global Environmental Strategies
INDC	Intended Nationally Determined Contributions
IOT	Input-Output Table
ktCO$_2$eq	kilo-ton Carbon dioxide
KU	Kyoto University
LCC	Low Carbon City
MHIR	Mizuho Information and Research Institute
NIES	National Institute for Environmental Studies
RU	Ritsumeikan University
SYB	Statistical Yearbook
toe	ton of oil equivalent

Acknowledgement

This research is supported by the Ministry of the Environment, Japan.

***Contact address:**

NGUYEN Thai Hoa: *envi.jp@gmail.com*

Yuki OCHI: *ochi.ekonzal@gmail.com*