CAN THO LOW CARBON CITY

In Vietnam, cities demand eco-friendly and low-carbon development approaches and solutions, such as energy-efficient buildings, public transport, innovative environmental technology, waste treatment, energy recycling, etc. The development and application of science and technology innovation is one of strategic priorities. Being one of five central cities, Can Tho city has selected science and technology as a leverage for all socio-economic development aspects of city. Currently, the city is facing environmental challenges like salinization, unexpected weather events, lack of fresh water, etc., which affects the quality of life and gradually loses investors' attraction. In that context, promoting technology application to strengthen urban resilience has been emphasized by the city. Moreover, major cities like Can Tho in Vietnam are required to localize the initiatives of the Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC). The aim of NDC is to reduce 8-25% of total emissions in 2030 compared to Business as Usual (BaU). Based on the targets in master development plan of Can Tho city, two scenarios, namely Business as Usual (BaU) and Countermeasure (CM), are developed for the socio-economic vision of Can Tho by 2030, with the projection of energy consumption and CO2 emission in energy-related categories such as Power generation, Transportation, Residential, Commercial, and Industry. In which, in BaU scenario we do not consider the GHG emissions reduction target. Meanwhile, in CM scenario, mitigation projects in the above mentioned categories will be implemented in order to meet the GHG emissions reduction target as declared in the Vietnam's NDCs.

This study is one of the results of the research collaboration between Institute of Strategy and Policy on natural resources & environment (ISPONRE), Can Tho Climate Change Coordination Office (CCCO) in Vietnam and the Asian-Pacific Integrated Model (AIM) team in Japan including Rirsumeikan University, E-konzal, National Institute for Environmental Studies (NIES), Mizuho Information and Research Institute (MHIR), Institute for Global Environmental Strategy (IGES). The method and preliminary results of this research, we hope, would be provided to a policy making process as a starting point of discussion as well as support the discussion among stakeholders. As a result, more realistic and acceptable scenario would be defined from the discussion, evaluation and modification by various stakeholders.

Two scenarios are developed for the socio-economic vision of Can Tho city by 2030, with the projection of energy consumption and CO_2 emission in energy-related categories such as Residential, Commercial, Transportation, and Industry. The 2030BaU scenario (Business as Usual), where countermeasures for GHG emission reduction are not introduced. On the other hand, the 2030CM scenario (CounterMeasures), which additional low carbon countermeasures are introduced in order to assess the reduction effects of GHG emissions. In 2030BaU, the total GHG emissions increases 3.96 times, from 2,690 $ktCO_2$ in 2015 to 9,467 $ktCO_2$. In 2030CM, the low-carbon actions help Can Tho to reduce is 15%, accounting for 1,434 $ktCO_2$. Can Tho can reduce such emissions reductions by implementing 30 projects grouped in five actions.

Table 1: GHG emissions by sectors ($ktCO_2$) in Can Tho city

	2015		2030BaU		2030CM		Rate	
	Amount	Share	Amount	Share	Amount	Share	2030BaU/2015	2030CM/2030BaU
Industry	1,578	58.7	6,258	66.1	5,443	67.8	3.96	0.87
Commercial	253	9.4	1,017	10.7	805	10.0	4.02	0.79
Residential	542	20.1	1,214	12.8	992	12.4	2.24	0.82
Passenger transport	204	7.6	598	6.3	492	6.1	2.93	0.82
Freight transport	113	4.2	380	4.0	301	3.7	3.37	0.79
Total	2,690	100.0	9,467	100.0	8,033	100.0	3.52	0.85
CO_2 emission per GDP (tCO_2/bil. VND)		33.7		36.9		31.3	1.10	0.85
CO_2 emission per capita (tCO_2/person)		2.1		4.5		3.8	2.10	0.85

Socio-economic scenario

The estimation of social and economic growth in Can Tho city is based on the master development plan (Decision number 1533/QD-TTg). Table 2 shows the results of main socio-economic driving forces for base year 2015 and target year 2030.

Demography

As shown in Table 2, the registered population in Can Tho increases 1.68 times compared to 2015, reaching 2.1 million people in 2030 (same as the projection in Master plan - Decision 1553/QD-TTG).

By assuming the household size in 2030 is 3 persons/household, the total number of households increases 1.94 times, reaching 700 thousand households in 2030.

Economy

Following the development targets in the master plan of Can Tho, it is estimated that the GDP in 2030 will increase 3.21 times compared to 2015. Secondary sector will still be main industry, though remarkable growth of tertiary sector. In 2015, the commercial sector dominates the GDP share with 47.9%, followed by industrial sector with 38.1%.

In 2030, due to the rapid growth rate in commercial compared to other sectors, the share of commercial in total GDP increases to 50.1%, and the share of industry grows to 42.0%. This economic structure follows the current trend and future vision of Vietnam towards the tertiary industrial economy.

The GDP per capita of Can Tho in 2015 is around 64 mil. Dongs , and increases 1.92 times by 2030. The GDP per capita in 2030 reaches 122 mil. Dongs due to the rapid GDP growth (8.1% per annual).

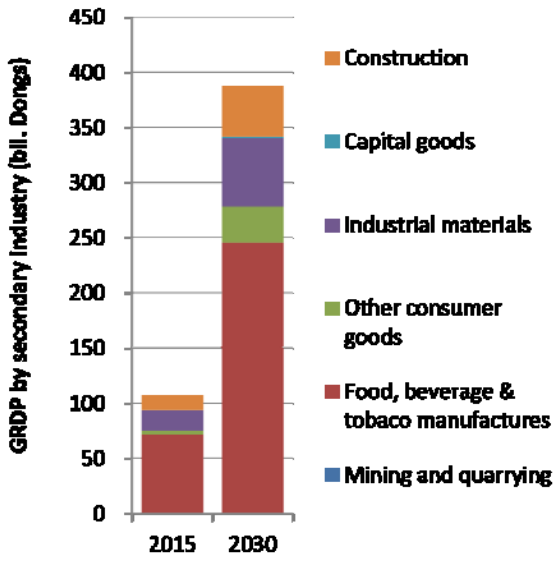


Figure 1: GRDP by secondary industry

Table 2: Main socio-economic indicators in Can Tho

	Unit	2015	2030	2030/2015
Population	persons	1,251,809	2,100,000	1.68
No. of households	household	357,660	700,000	1.96
GDP per capita	mil. Dongs	64	122	1.92
GDP	bil. Dongs	79,864	256,660	3.21
Agriculture		11,125	18,830	1.69
Industry		30,458	107,859	3.54
Commercial		38,281	129,971	3.40
Outputs	bil. Dongs	185,422	625,940	3.38
Agriculture		15,838	26,807	1.69
Industry		107,260	387,529	3.61
Commercial		62,324	211,604	3.40
Final consumption	bil. Dongs	53,405	181,562	3.40
Gross fixed capital formation	bil. Dongs	32,533	110,605	3.40
Export	bil. Dongs	69,731	237,069	3.40
Import	bil. Dongs	75,806	272,576	3.60
Passenger transport	mil.per.km	3,296	8,920	2.71
Freight transport	mil.ton.km	925	3,112	3.37

Transport demands

Due to the increasing population and industrial activities, the transport demand in 2030 also increases rapidly with 2.71 times of passenger transport demand and 3.37 times increase of freight transport demand compared to 2015.

In passenger transport, there is a rapid increase of demand on car (including taxi) to 8.23 times, even motorbike still dominates. The share of public transport (bus) increases from 11% in 2015 to 15.0% in 2030BaU and reaches 20.0% in 2030CM due to the contribution of bus system as urban transport planning.

In freight transport, the demand increases mainly in truck and waterway. Since we have no information about the plan for freight transport, we assume that the shares of freight transport modes in 2030 are the same as in 2015, in which truck contributes to about 48%, followed by waterway with 52% contribution.

Table 3: Transport demand in Can Tho city

	2015	2030BaU	2030CM	BaU/2015	CM/BaU
Passenger transport (mil.per.km)	3,296	8,920	9,037	2.71	1.01
Walk	7	17	31	2.47	1.82
Bicycle	82	203	268	2.47	1.32
Motorbike	2,434	5,097	4,446	2.09	0.87
Car	186	1,533	1,533	8.23	1.00
Bus	587	2,070	2,759	3.53	1.33
Freight transport (mil.ton.km)	925	3,112	3,112	3.37	1.00
Truck	386	1,298	1,298	3.37	1.00
Waterway	539	1,814	1,814	3.37	1.00

Energy consumption and CO_2 emissions

Final energy consumption

In 2030BaU, the total energy consumption is 3.62 times higher than 2015 (Table 4), increasing from 730 ktoe to 2,379 ktoe. In which, industry is still the main energy consumer with 55.0% (3.96 times increase), followed by residential sector with 23.2%. Commercial has the highest speed of energy consumption with 4.02 times increase and its share is 7.9%.

The energy intensity by GDP reduces from 9.1 toe/bil. Dongs in 2015 to 8.1 toe/bil. Dongs in 2030CM due to the lower increasing rate of energy consumption compared to the rapid growth of GDP. This reduction follows the target to reduce 1% to 1.5% per year as mentioned in Decision 1393/QD-TTg for "National Green Growth Strategy".

In term of energy consumption mix, there is a switch from coal and oil consumption to electricity. However, coal is still one of the main energy sources with the share of coal consumption from 24.6% in 2015 to 29.0% in 2030BaU, especially for industrial activities. Share of biomass consumption for some purposes in residential and commercial sectors slightly reduces from 24.4% in 2015 to 18.3% in 2030BaU.

Table 4: Final energy consumption by sector (ktoe)

	2015	2030BaU	2030CM	BaU/2015	CM/2015
By sector					
Industry	331	1,310	1,144	3.96	0.87
Commercial	47	187	169	4.02	0.90
Residential	246	551	523	2.24	0.95
Passenger transport	69	203	138	2.93	0.68
Freight transport	38	129	102	3.37	0.79
By energy type					
Coal	179	689	585	3.84	0.85
Oil	167	537	398	3.22	0.74
Natural gas	20	76	68	3.89	0.89
Solar	0	0	38	0.0	0.0
Biomass	178	436	419	2.45	0.96
Electricity	186	642	569	3.45	0.89
Total	730	2,379	2,076	3.26	0.87

CO_2 emissions

Total GHG emission in 2030BaU is projected about 9.5 $MtCO_2$, accounting for 2.6 times higher than base year 2015 (2.7 $MtCO_2$).

Main contributors to GHG emissions in the 2030BaU scenario are industrial sector (6.3 $MtCO_2$), followed by residential, commercial and transport, sectors which account for 1.2, 1.0 and 0.9 $MtCO_2$, respectively. GHG emissions in 2030CM, is estimated to reduce by 15% from the 2030BaU emissions.

As can be seen from table 1 that per capita GHG emissions in 2015 in Can Tho was only 2.1 tCO_2, though, in BaU scenarios, it is projected to increase up to 4.5 tCO_2. In 2030CM scenario it can be reduced to 3.8 tCO_2.

Table 5: CO_2 emissions by sector and fuel

Year	Sector	Coal	Oil	Gas	Electricity	Total
2015	Industry	644.9	76.5	45.8	769.9	1,537.1
	Commercial	30.0	47.3	0.0	175.8	253.0
	Residential	62.0	34.1	0.0	445.7	541.7
	Passenger transport	0.0	203.8	0.0	0.0	203.8
	Freight transport	0.0	113.0	0.0	0.0	113.0
	Total	737.9	492.6	45.8	1,413.5	2,689.8
2030BaU	Industry	2,572.9	306.1	178.1	3,124.8	6,181.9
	Commercial	120.5	190.1	0.0	706.8	1,017.4
	Residential	138.8	76.3	0.0	998.8	1,214.0
	Passenger transport	0.0	597.8	0.0	0.0	597.8
	Freight transport	0.0	380.4	0.0	0.0	380.4
	Total	2,834.1	1,583.7	178.1	4,871.2	9,467.2
2030CM	Industry	2,167.7	273.3	158.6	2,774.0	5,373.6
	Commercial	98.3	148.5	0.0	558.4	805.1
	Residential	138.1	68.6	0.0	785.7	992.4
	Passenger transport	0.0	352.9	0.0	138.8	491.7
	Freight transport	0.0	300.7	0.0	0.0	300.7
	Total	2,405.8	1,174.7	158.6	4,293.7	8,032.7

Regarding to GHG emission intensity, in 2015, estimated GHG emission intensity is 33.7 tCO_2/bil.dongs.

In 2030BaU, emission intensity increased to 36.9 tCO_2/bil.dongs.

In 2030CM scenario, which introduces implementation of the projects and actions, emission intensity is estimated to 31.3 tCO_2/bil.dongs.

More details of the projects and actions are described in the next pages.

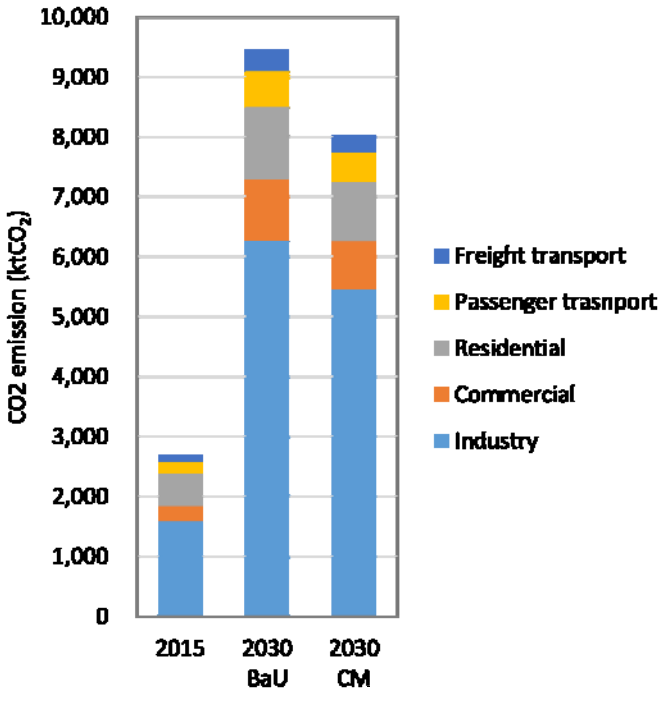


Figure 2: CO_2 emissions

CO_2 emission reduction by Actions

Action 1. Green Industry

Low carbon projects regarding promotion of energy efficient equipment and fuel shift in the industry sector are included in Action 1. Total reduction of CO_2 emissions is 808 $ktCO_2$. Improvement of kiln and furnace technology such as waste heat recovery is one of the main project in Action 1.

Action 2. Green Building

Action 2 covers low carbon projects related with diffusion of low-energy houses and buildings. This action reduce 104 $ktCO_2eq$. Energy demand in houses and buildings through projects such as diffusion of energy management system and installation of insulated glasses. Introduction of insulating material to houses is a project that reduce the largest GHG emission in this action.

Action 3. Energy Efficiency

Projects about promoting energy efficient device and appliance like lighting and air conditioners for houses and buildings are covered in Action 3. Total reduction of GHG emission by this action is 265 $ktCO_2$.

Action 4. Smart transport

It is estimated that projects in Action 4 can reduce 236 $ktCO_2$ in total, which is the largest reduction among all actions. This action covers variety of projects regarding both passenger and freight transportation. Not only improvement of fuel efficiency of vehicles but also promotion of modal shift to public transportation and deployment of EV bus are listed. Projects for freight transport such as promotion of energy-efficient trucks have large potential to reduce GHG emissions. Meanwhile, projects like introduction of electric motorbike and EV bus contribute to reduce GHG emission from passenger transport.

Action 5. Green energy

This action covers projects for increasing electric power generation by renewable energy including photovoltaic power, wind power and small-scale hydropower. Total reduction of GHG emission by Action 5 is 21 $ktCO_2$. Photovoltaic power generation systems are assumed to install on rooftop of houses and buildings. Hydropower generation is introduced to public facilities such as water distribution station.

Table 6: Climate change actions ($ktCO_2$)

	Industry	Commercial	Residential	Passenger Transport	Freight Transport	Total ($ktCO_2$)
Action 1. Green Industry Promotion of energy efficient equipment and fuel shift	808					808
Action 2. Green Building Diffusion of low-energy building (EMS, Insulation, Fuel shift)		93	11			104
Action 3. Energy Efficiency Promotion of energy efficient device/appliance		101	164			265
Action 4. Clean Transport Energy efficient vehicle and modal shift				106	130	236
Action 5. Green Energy Deployment of renewable electricity		18	3			21
Total ($ktCO_2$)	808	194	175	106	130	1,434

References

	Organization, Author	Title
Population and macro economy	General Statistics Office of Vietnam	Vietnam Statistical Yearbook 2016
	General Statistics Office of Vietnam	Can Tho Statistical Yearbook 2016
	Can Tho department of commerce	Project on trade development plan of Can Tho city 2015, and a vision to 2020
	Prime Minister of Vietnam	Decision number 1515/QD-TTg on approval of development plan for Can Tho 2030 and vision up to 2050
	Prime Minister of Vietnam	Decision number 1533/QD-TTg on approval of socio-economic development plan for Can Tho 2020 and vision up to 2030
	Can Tho People Committee	Decision number 3814/QD-UBND on approval of solution to transfer economic structure of Can Tho city 2020
Energy	CP TVXDD3 company	Master plan on development of power sector in Can Tho in period 2011-2015
	International Energy Agency	IEA Energy Balances of Non-OECD in 2015
Transport	Can Tho People Committee	Decision number 2012/QD-UBND on approval of public transport by bus in Can Tho 2020 and vision to 2030
	Can Tho department of transport, Center of research on transport development	Report on development plan of transportation in Can Tho 2030
Environment	Can Tho People Committee	Plan number 83/KH-UBND on sustainable development of Can Tho 2016
	Can Tho People Committee	Action plan on air quality management in Can Tho

Low carbon projects in Can Tho city

Action			Project	Sector	Reduction ($ktCO_2$)
1		1-01	Energy savings in factory	Industry	239.1
	Green Industry	1-02	Installation high energy efficiency facilities	Industry	94.6
		1-03	Regional energy supply system	Industry	204.8
		1-04	Improvement of kiln and furnace technology	Industry	269.8
			Total		808.3
2		2-01	Installation of insulated glasses to commercial buildings	Commercial	8.5
		2-02	Installation of insulated glasses to households	Residential	10.1
		2-03	Introduction of incentive to low energy buildings	Commercial	2.0
	Green Building	2-04	Introduction of insulating material to houses	Residential	5.3
		2-05	Energy efficiency technology applied to buildings	Commercial	5.5
		2-06	Introduction of solar water heater to commercial buildings	Commercial	27.9
		2-07	Introduction of solar water heater to households	Residential	44.9
			Total		125.1
3		3-01	Energy savings in commercial facilities	Commercial	25.2
		3-02	Conversion of street lights to LED lighting	Commercial	3.3
		3-03	High efficiency lighting in commercial buildings	Commercial	44.3
		3-04	High efficiency lighting in households	Residential	26.2
	Energy Efficiency	3-05	High efficiency air conditioners in commercial buildings	Commercial	21.1
		3-06	High efficiency air conditioners in households	Residential	31.7
		3-07	Promotion of energy-efficient appliances (refrigerator and other appliances)	Residential	111.8
		3-08	Promotion of energy-efficient appliances (cooking appliances)	Residential	1.4
			Total		265.1
4		4-01	Promotion of eco-driving with digital tachographs	Transport	8.6
		4-02	Smart traffic management	Transport	11.4
		4-03	Expansion of frequencies and routes of bus transportation	Transport	3.2
		4-04	Development of Bus Rapid Transit (BRT)	Transport	1.6
	Clean Transport	4-05	Introduction of EV buses	Transport	10.3
		4-06	Introduction of electric motorbikes	Transport	23.4
		4-07	Promotion of energy-efficient vehicles (cars for passenger)	Transport	26.3
		4-08	Promotion of energy-efficient vehicles (motorbikes)	Transport	63.9
		4-09	Promotion of energy-efficient vehicles (trucks)	Transport	87.1
			Total		235.9
5		5-01	Introduction of photovoltaic power generation to commercial buildings	Commercial	18.3
	Green Energy	5-02	Introduction of photovoltaic power generation to households	Residential	2.6
			Total		20.9
	Total				**1,434.5**

Work procedure

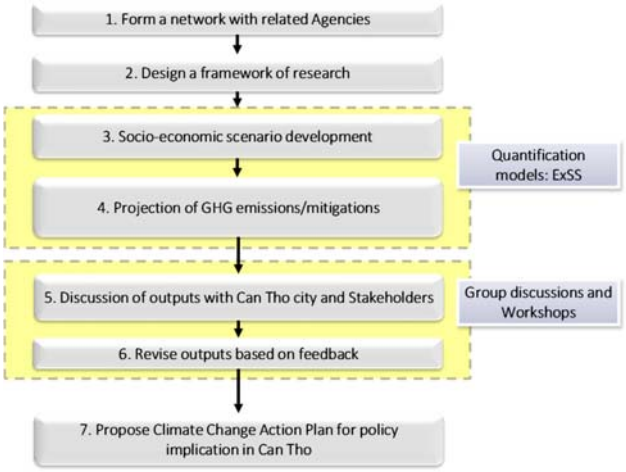
In order to identify the necessary actions, an "integrated modeling" based on "back-casting" approach is used.

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.

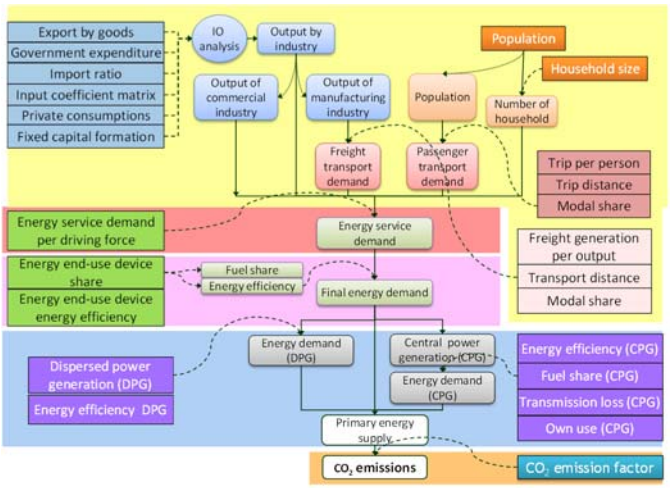
Socio-economic information as well as environmental information for the base year (2015) was collected and analyzed in order to estimate current carbon emissions. Besides this, feasible low carbon measures for Can Tho low carbon 2030 were also collected.

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 tool

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. In this simulation model, population is decided by demand from outside of the region 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. 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.



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Acronyms and Abbreviations

AIM	Asia-Pacific Integrated Modeling
BaU	Business as Usual scenario
CC	Climate Change
CCAP	Climate Change Action Plan scenario
CCCO	Can Tho Climate Change Coordination Office
EBT	Energy Balance Table
ExSS	Extended Snapshot Tool
GDP	Gross Domestic Product
IEA	International Energy Agency
IGES	Institute for Global Environmental Strategies
NDCs	Nationally Determined Contributions
IOT	Input-Output Table
$ktCO_2$	kilo-ton Carbon dioxide
RU	Ritsumeikan University
LCC	Low Carbon City
MHIR	Mizuho Information and Research Institute
NIES	National Institute for Environmental Studies
SYB	Statistical Yearbook
toe	ton of oil equivalent

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