A Low Carbon Society Scenario Development for Ratchaburi, Thailand

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JGSEE
The Joint Graduate School of Energy and Environment

CEE-PERDO
Center for Energy Technology and Environment

Objective

To develop a low carbon society (LCS) scenario for Ratchaburi with an objective to support the provincial vision of self-sufficiency economy for sustainable development.

Scope & Methodology

To quantify the GHG emissions vs. associated drivers

- Energy related activities ➔ ExSS Tools
- Agriculture ➔ IPCC 2006 Guidelines Methodology
- Land Use, Land Use Change, and Forestry ➔ IPCC 2006 Guidelines Methodology

Base Year: 2005

Target Year: 2030

Projection: BAU vs. CM

Ratchaburi: Facts&Figures

Location

latitudes 13º32'15" N

longitudes 90º49'09" E

Climate

SW monsoon with very dry zones

Mean Annual Temperature

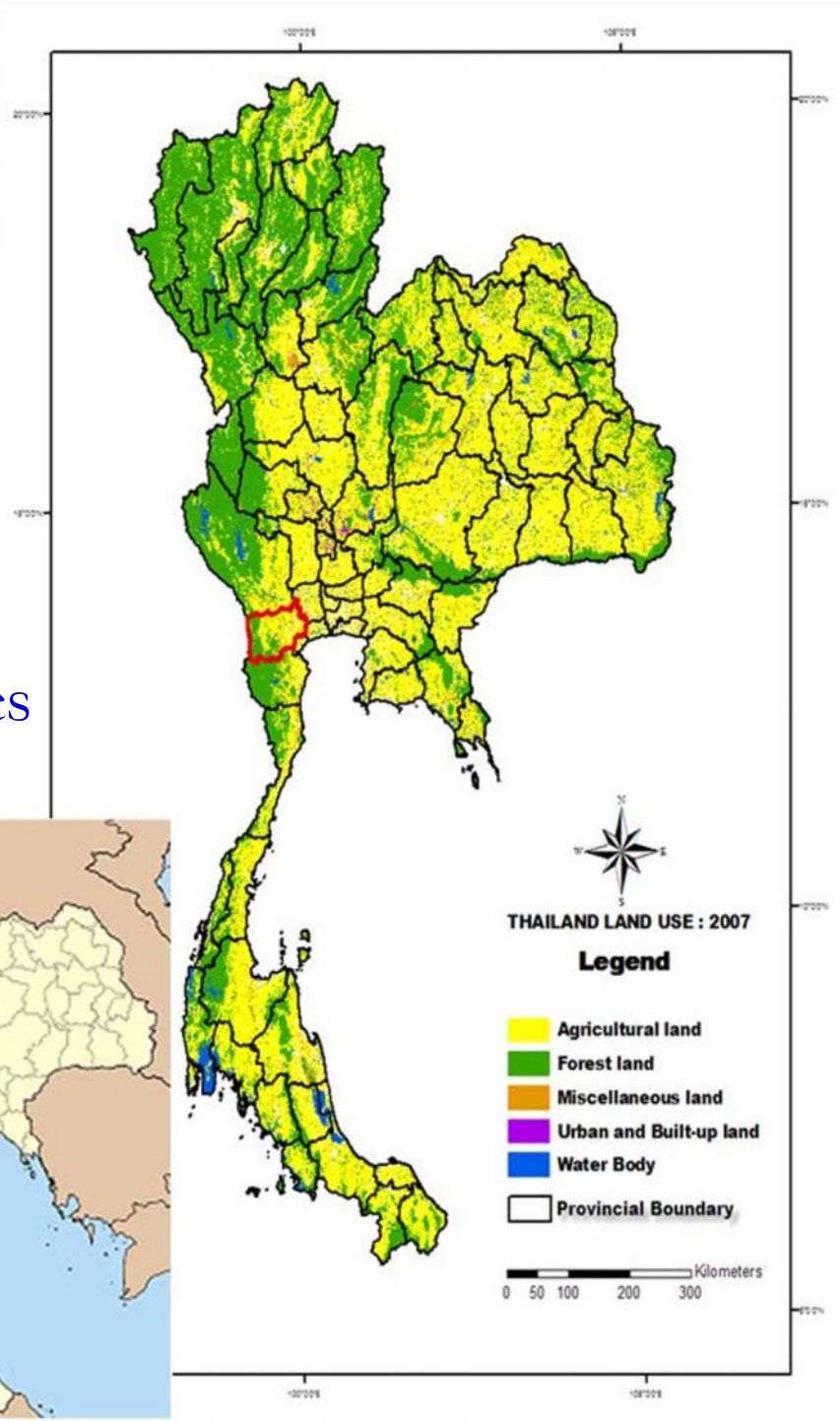
21-38ºC

Average Annual Precipitation

1,303 mm (131 days)

Total Land

5,196.5 km^2



Ratchaburi Facts & Figures

Population

795,255 pp (Yr 2005)

Density

160 pp/km^2 (Yr 2005)

GPP

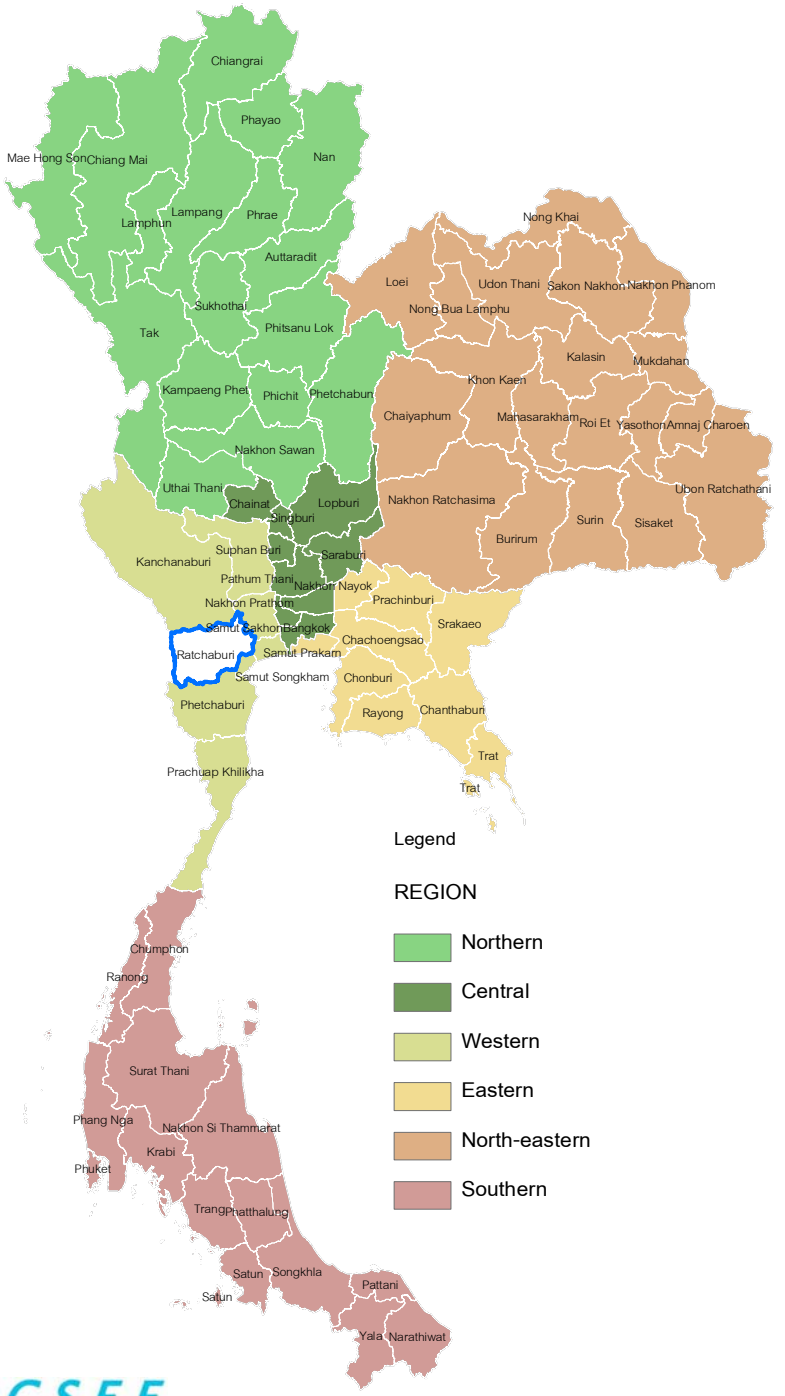
2,976 million US$

(17th rank)

GPP/capita

3,634 US$

(13th rank)



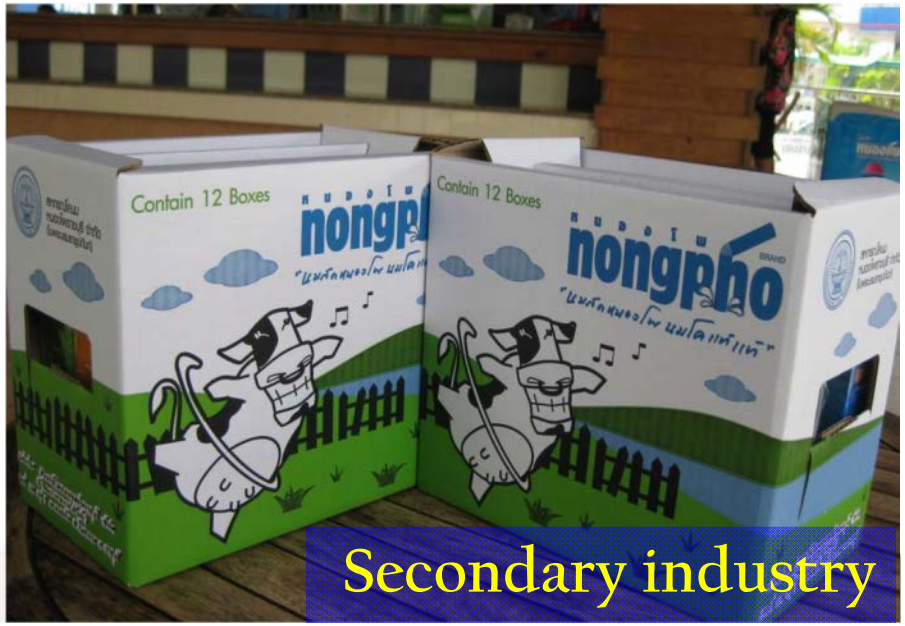
Ratchaburi Facts & Figures

Industry	GPP (million $US)
Primary	450
Secondary	905
Tertiary	1,621

Year 2005


Primary industry


Tertiary industry



Secondary industry

Energy Related Activities

1) Industrial

3) Commercial

2) Transportation

Freight


Passenger

4) Residential

Agriculture Related Activities

Enteric Fermentation

Manure Management

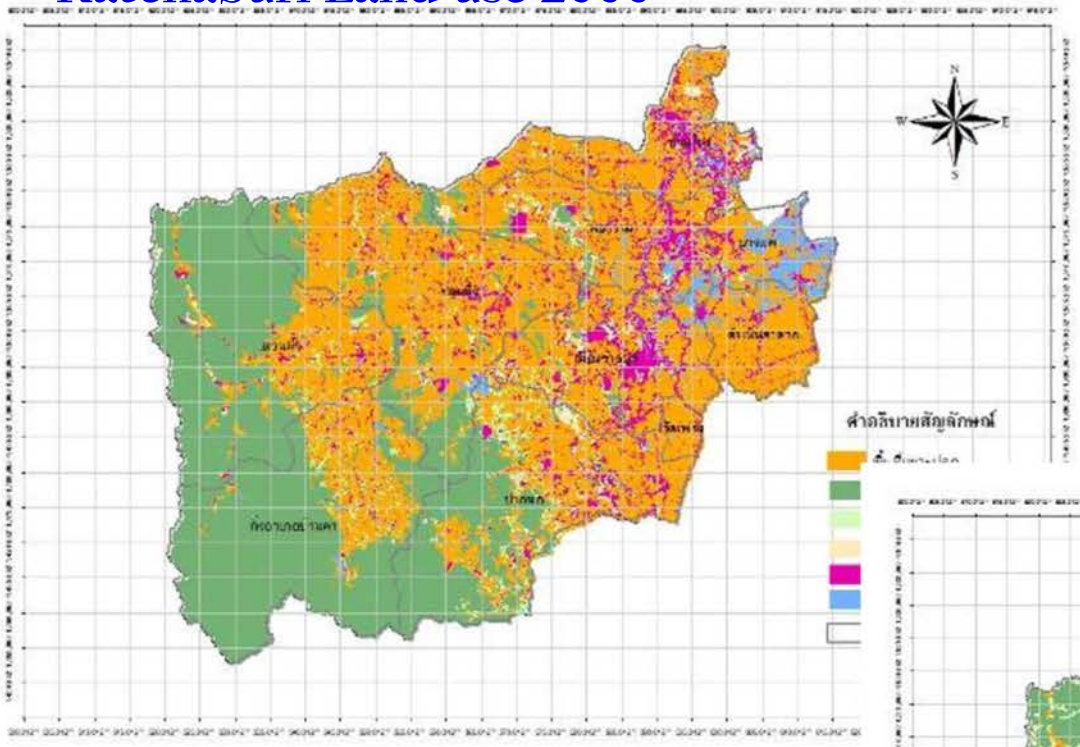
Rice Cultivation

Agricultural Residues Open Burning

Agricultural soil

LULUCF Related Activities

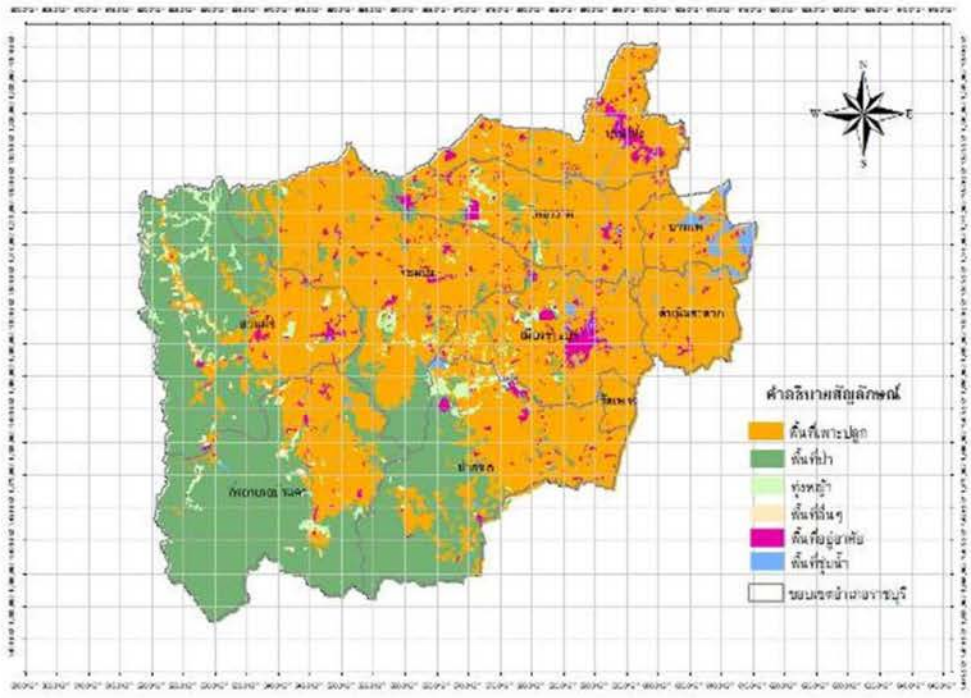
Ratchaburi Land use 2000



- Crop land
- Forest land
- Grass land
- Other land
- Settlement
- Wet land
- Ratchaburi boundary

1. Other land (Crop land/Grassland/ Settlement/Wetland) converts to forest land
2. Forest land converts to other land (Crop land/ Grass land/ Settlement/ Wetland)
3. Forest land remains forest land

Ratchaburi Land use 2007



Source: Garivait and Boonman, 2010

Ratchaburi Land use change

(during 2000 to 2007)

2007 / 2000	Ratchaburi Land use change from 2000 to 2007 (1000 Ha)								%
	Crop land	Grass land	Forest land	Other land	Settlement	Wet land	Forest Plant	Total area (2000)	
Crop land	214.17	16.75	9.34	4.10	37.35	16.12	0.96	298.79	**57.7**
Grass land	5.46	1.78	5.23	0.63	0.98	0.32	0.01	14.41	**2.8**
Forest land	17.55	6.60	134.85	2.92	6.04	3.33	1.11	172.40	**33.3**
Other land	0.62	0.16	1.71	0.41	0.14	0.06	0.00	3.10	**0.6**
Settlement	7.56	1.12	0.83	0.83	6.44	1.08	0.08	17.93	**3.5**
Wet land	2.43	0.18	0.21	0.07	1.36	3.31	0.00	7.56	**1.5**
Forest plantation	1.36	0.12	0.87	0.00	0.10	0.01	0.87	3.33	**0.7**
Total area (2007)	249.15	26.71	153.04	8.95	52.41	24.21	3.04	**517.52**	**100.0**
%	**48.1**	**5.2**	**29.6**	**1.7**	**10.1**	**4.7**	**0.6**	**100.0**	-
%Change	**-9.6**	**+2.4**	**-3.7**	**+1.1**	**+6.7**	**+3.2**	**-0.1**	-	-

Source: Garivait and Boonman, 2010

Scenarios Formulation

BAU ➔ Historical Trends Analysis

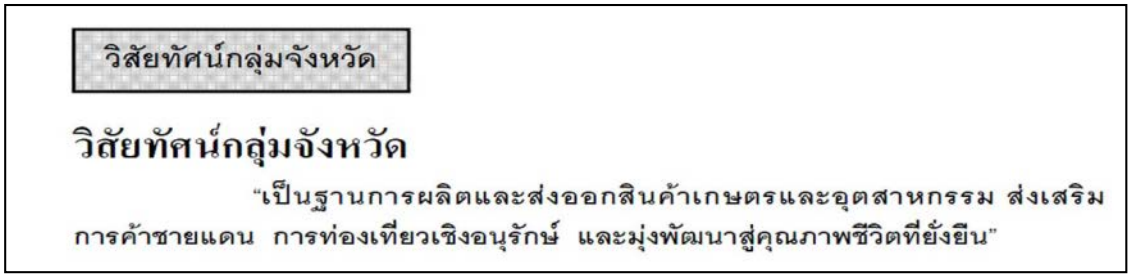
Indicator	Annual Change
Demographic	
Population	+0.88%
Demographic composition	0-14: -1.49 %, 15-64: +1.22 %, >65: +3.14 %
Economic	
GPP	+3.03%
Transportation	
Trip generation	+1.6%
Modal share of passenger transportation	Walk/bike: 9.30%, Motor cycle: 26.00%, Car: 17.00%, Pick up: 17.00%, Van: 17.00%, Small public vehicle: 3.00%, Large public vehicle: 10.70%

Scenarios Formulation

CM ➔ Adapted from the following Plans used/may be referred to Ratchaburi Administration

Ratchaburi's Development Plan 2010-2013

Western Region Plan



State Railway of Thailand's Plan

National Renewable Energy Development Plan (2008-2022)

Power Development Plan

Source of Input Data

- **Demography data:** population/household
  - The National Statistics Office
- **Economic data:** Thailand IO table, Thailand GDP, Ratchaburi's GPP
  - Office of the National Economics and Social Development Board
- **Transportation data:** trip generation/mode share
  - Office of Transport and Traffic Policy and Planning
- **Building:** commercial area (applied from land use data)
  - Land Development Department
- **Energy:** Ratchaburi's energy consumption-supply/Thailand energy supply
  - Provincial Energy Agency/ Department of Alternative Energy Development and Efficiency

Source of input data

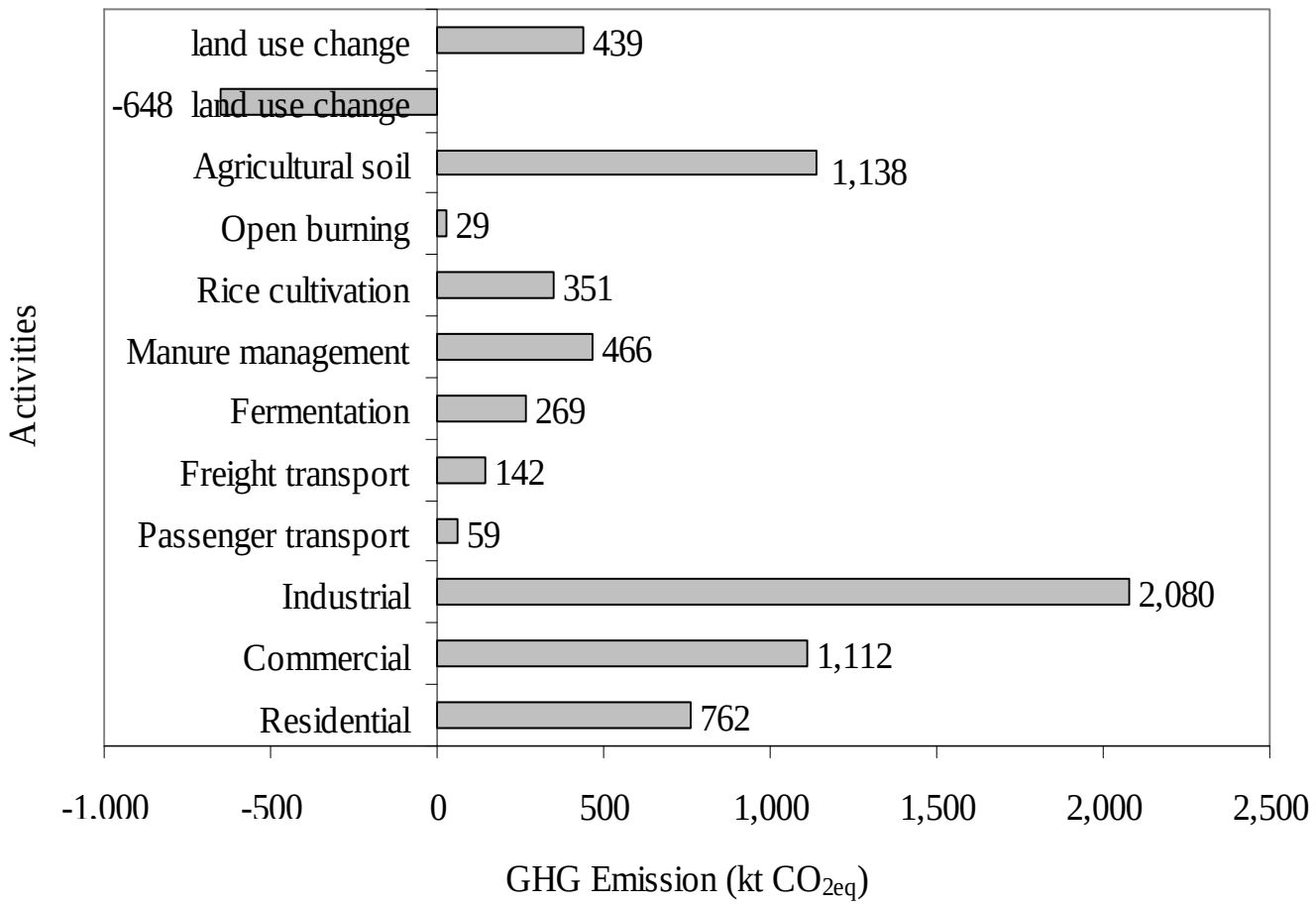
- Agricultural livestock: No. of animal
  - Office of Agricultural Economics
- Agricultural crop: Area/Production/Fertilization/ Residue/Residue utilization
  - Office of Agricultural Economic/Literature review/Field survey
- Land use: Land use characteristic (GIS-based)
  - Land development department
- Emission factor
  - 2006 IPCC Guidelines

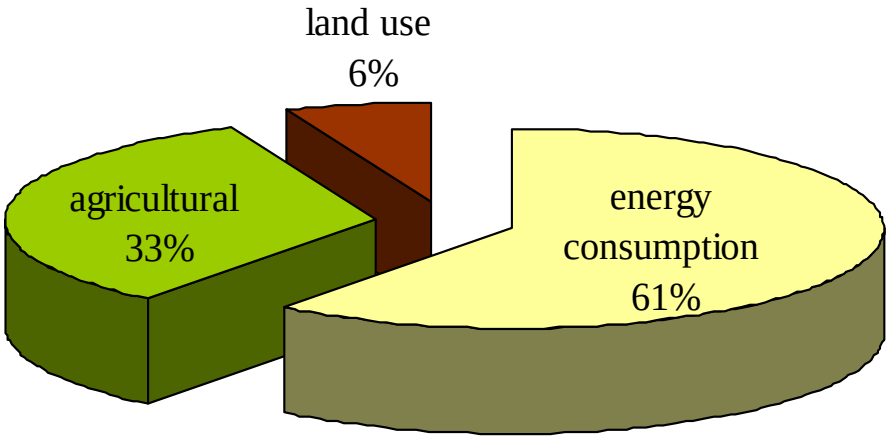
Results

Ratchaburi Emission, 2005

Total GHG emission

6,848 $ktCO_{2eq}$



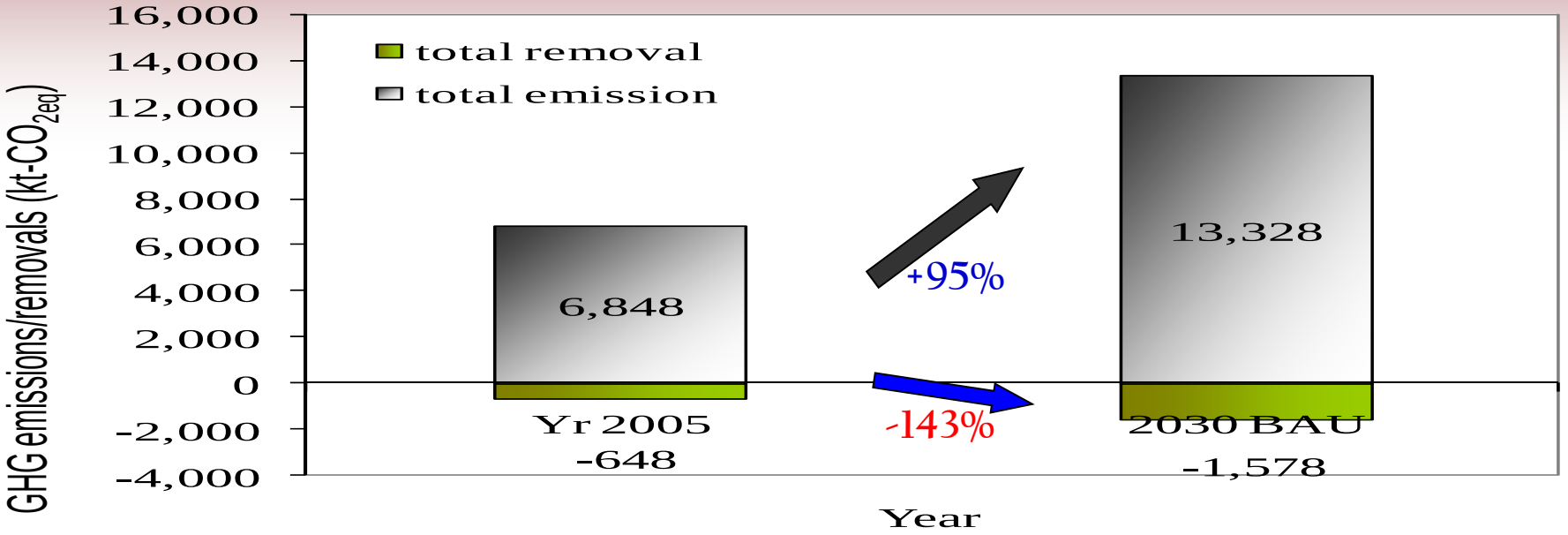


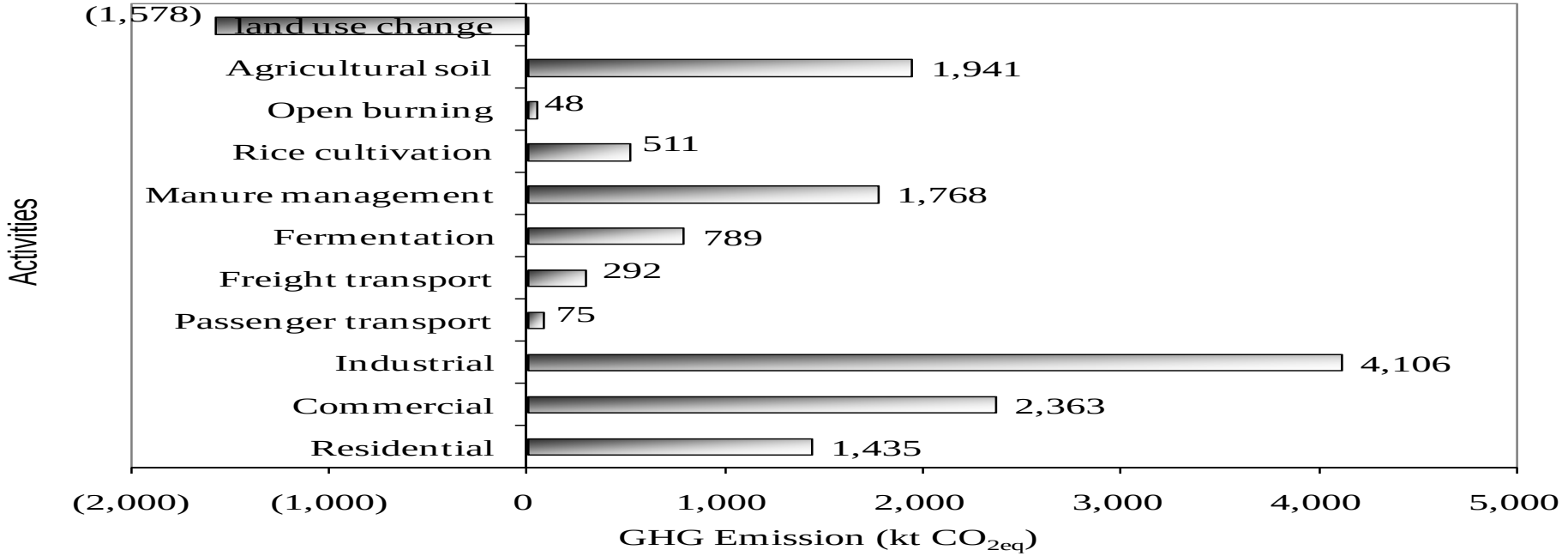
Total removal

-648 $ktCO_{2eq}$

Results

Ratchaburi Emission, 2030 (BAU)





Countermeasures (CM) ➔ 7 Actions for Ratchaburi LCS

Action 1 Modal Shifting in Transportation

- ✓ 50% of passenger-small vehicle in inner area switches to walk/bike in 2030/2005
- ✓ 25% of freight-large vehicle that transport goods within Ratchaburi switches to freight-small vehicle in 2030/2005
- ✓ 25% of freight-large vehicle that transport goods outside Ratchaburi switches to train in 2030/2005

Action 2 Fuel Switching in Transportation

- ✓ 50% of passenger-small vehicle switches to biofuel, 70% of bus switches to biofuel in 2030/2005
- ✓ 70% of large vehicle switches to biofuel

Countermeasures (CM) ➔ 7 Actions for Ratchaburi LCS

Acttion 3 Fuel Switching in Industrial

- ✓ 22.2 ktoe (max.) from Biomass

Action 4 Energy efficiency improvement

- ✓ 30% of refrigerator, air-condition, fan, and lighting in residential and commercial uses high efficiency equipment (Label No. 5)

Action 5 Good agricultural practice (GAP)

- ✓ use of pre-fermented organic matter instead of green manure or readily decomposable organic matter

Countermeasures (CM) ➔ 7 Actions for Ratchaburi LCS

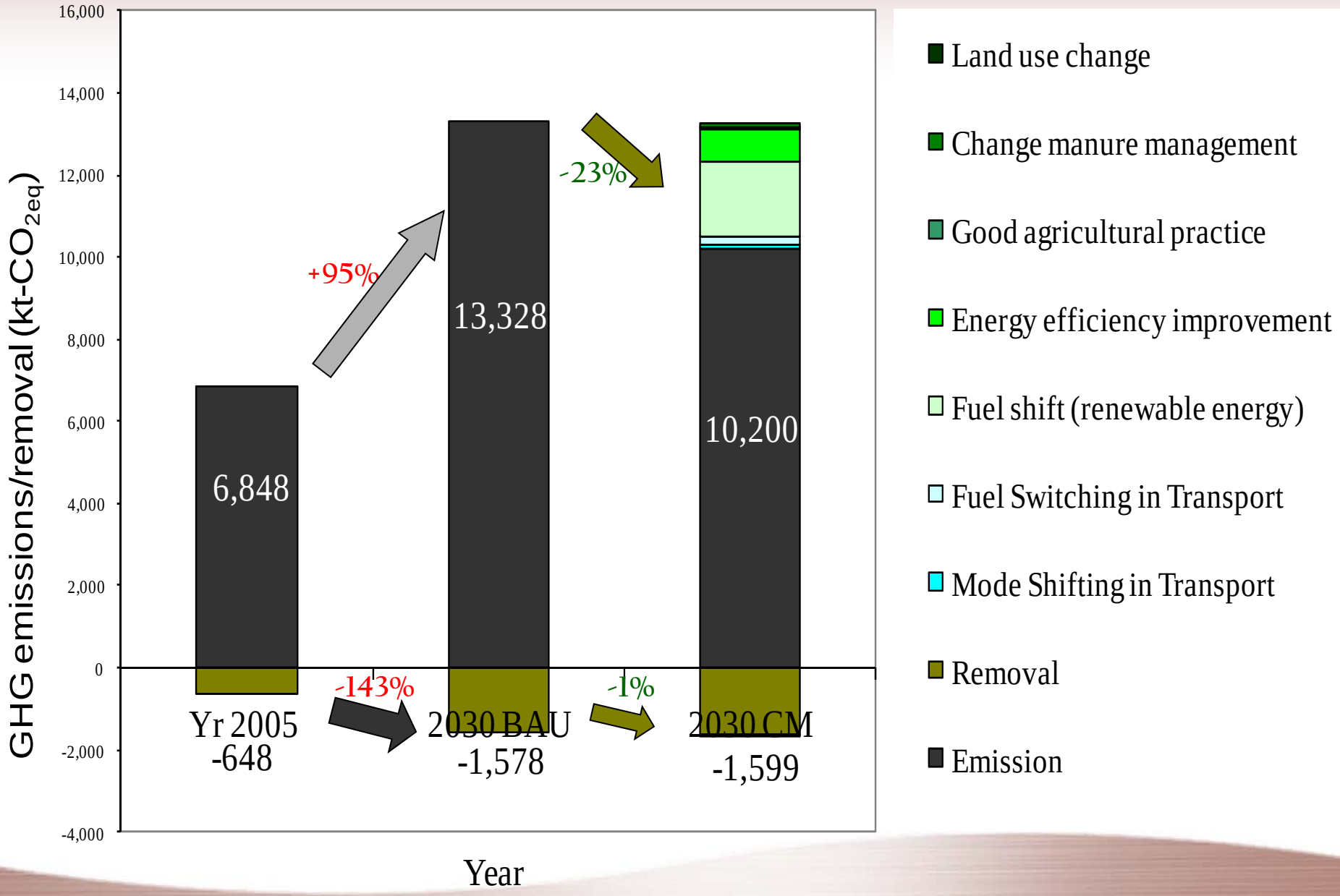
Action 6 Change in Manure Management

✓swine manure used as an organic fertilizer.

Action 7 Land use change

✓Develop 1,291 ha of abandoned paddy land to forest plantation

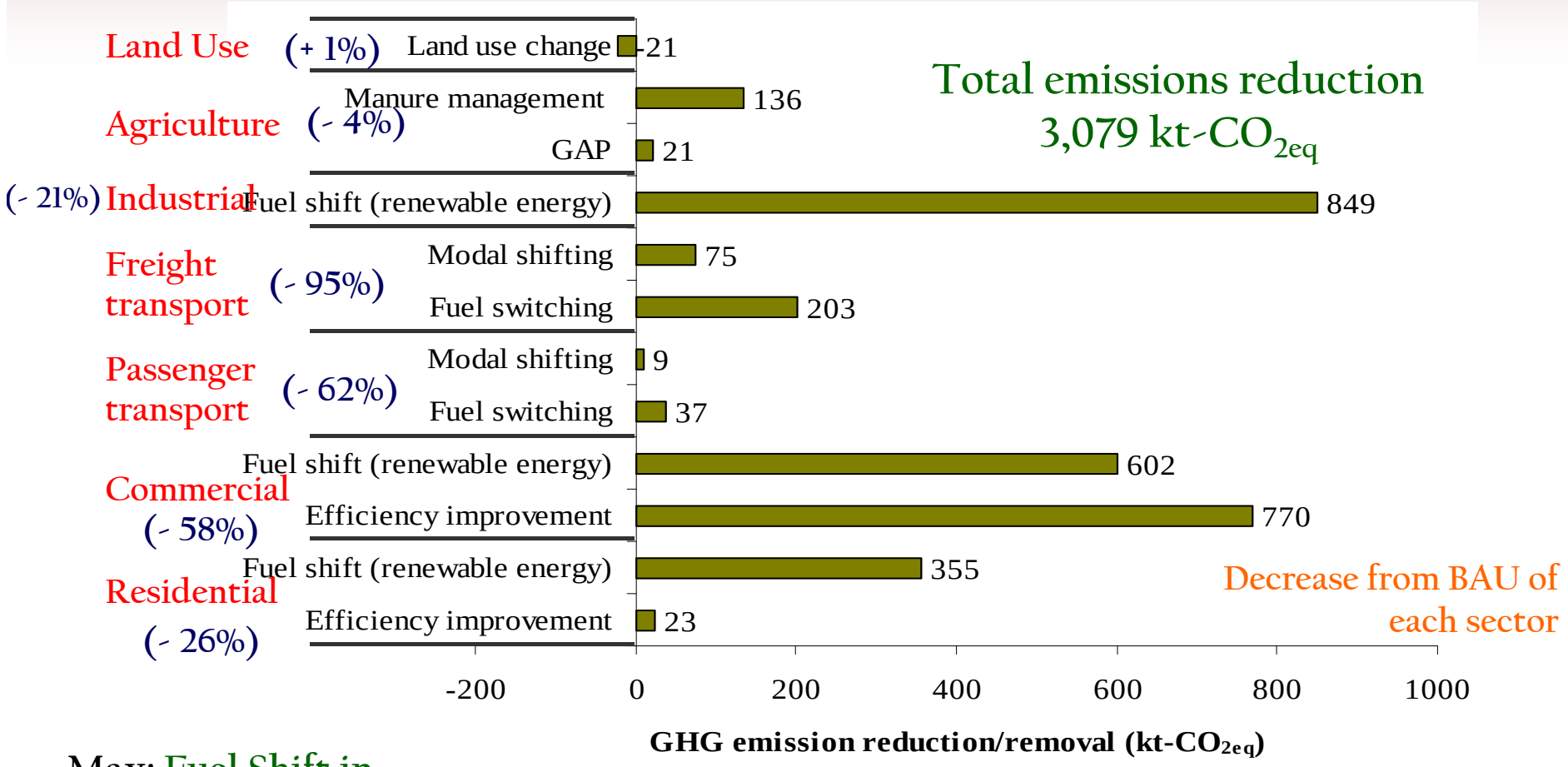
Results


16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
-2,000
-4,000
GHG emissions/removal (kt-CO2eq)
+95%
-23%
-143%
-1%
6,848
13,328
10,200
-648
-1,578
-1,599
Yr 2005
2030 BAU
2030 CM
Year
Land use change
Change manure management
Good agricultural practice
Energy efficiency improvement
Fuel shift (renewable energy)
Fuel Switching in Transport
Mode Shifting in Transport
Removal
Emission

Summary of GHG Emissions Reduction in 2030 based on CM compared to BAU

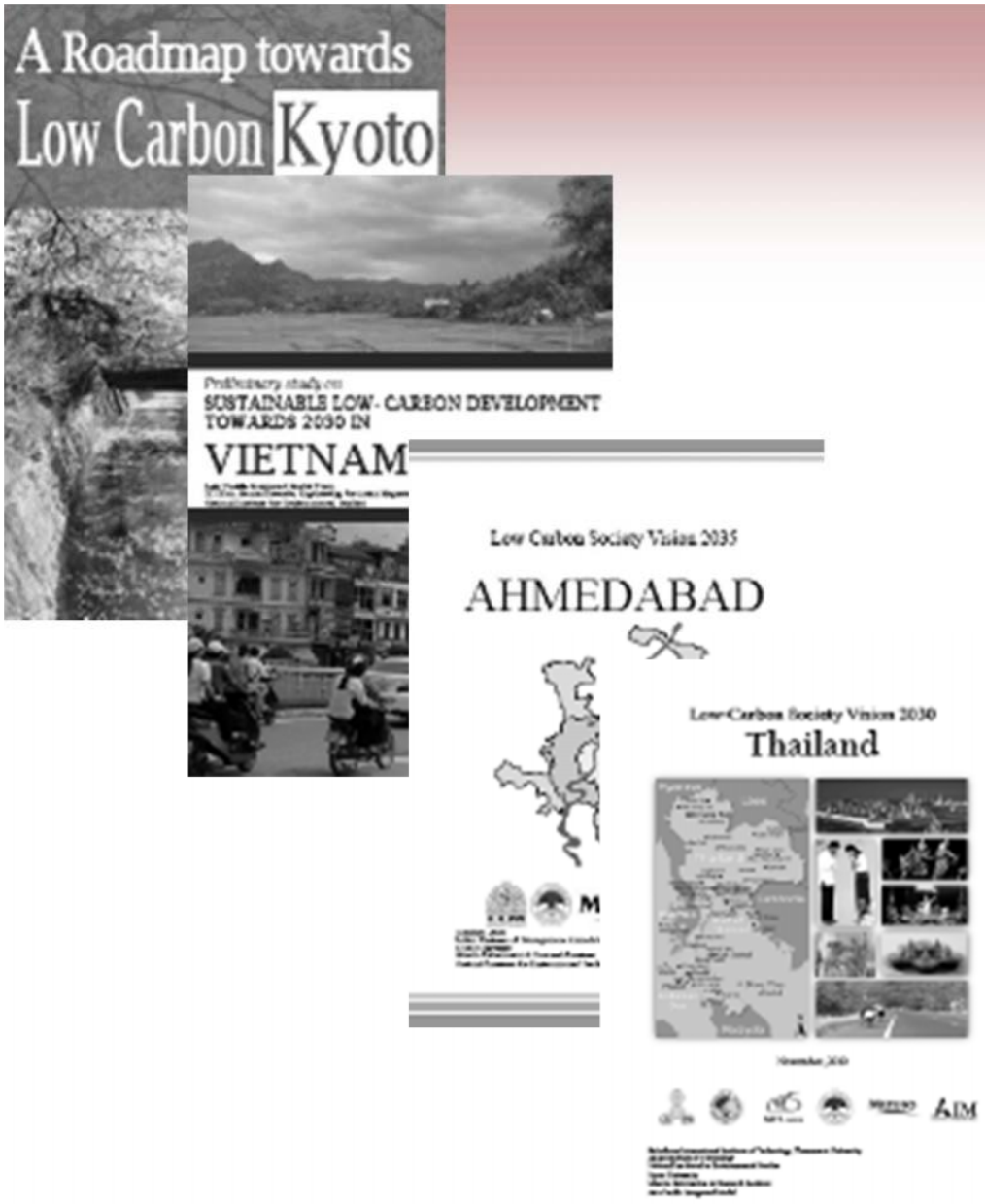
Mitigation option	GHG reduction ($kt\text{-}CO_{2eq}$)	% reduction / removal from target year
1. Modal shifting	-83.89	-0.63%
2. Fuel switching in transportation	-239.90	-1.80%
3. Fuel shift (renewable energy)	-1,805.73	-13.53%
4. Energy efficiency improvement	-793.11	-5.94%
5. Good agricultural practice (GAP)	-20.65	-1.55%
6. Change manure management	-135.66	-1.02%
7. Land use change	+21.30	+1.35%
Total GHG mitigation in 2030	**-3,078.94**	**-23.45%**
Total GHG removal in 2030	**+21.30**	**+1.35%**
Total GHG emission in 2030 (CM)	**10,200**	
Total GHG removal in 2030 (CM)	**-1,599**	
Net emission	**8,601**	

Summary of GHG Emissions Reduction in 2030 based on CM compared to BAU



Max: Fuel Shift in Renewable energy

Take consideration on the potential of province



THE 2030 SCENARIOS:

RATCHABURI LOW CARBON SOCIETY

Asia-Pacific Integrated Model Team (AIM)

National Institute for Environmental Studies (NIES)

Kyoto University

Institute for Global Environmental Strategies (IGES)

The Joint Graduate School of Energy and Environment (JGSEE)