LCS scenario in Ratchaburi, Thailand

Greenhouse gas (GHG) emission reduction is increasingly becoming a challenge in many countries. To achieve this national target, control and mitigation options should be developed and deployed at all governance levels, i.e. national, regional or provincial, and city or local levels. Thailand is divided into 6 regions and 76 provinces, including Ratchaburi situated in the Western part of the country, about 100 km from Bangkok. Ratchaburi covers a superficie of 5,196.5 km^2, with a population composed of 795,255 inhabitants as of record in 2005, i.e. a population density of 160 inhabitant/km^2, ranking this province at the 21st position at the national level. Ratchaburi constitutes the biggest economy of the western region, with a Gross Provincial Product (GPP) at current market price of 2,976 million US$ in 2005 with an increase of about 4% from 2004, placing Ratchaburi at the 17th rank of the country. Considering sector by sector, the primary industry has a GPP of 514 million $US, the secondary industry 899 million $US, and the tertiary industry of 1,564 million $US, respectively. The GPP per capita is 3,634 US$ corresponding to the 13th Thailand's rank.

This study proposed to develop a low carbon society (LCS) in Ratchaburi with an objective to support the provincial vision of self-sufficiency economy for sustainable development. The year 2005 was selected as the base year, and 2030 as the target year. Economic activity sectors taken into account to model the socio-economic development towards resource and energy consumption, and GHG emissions of Ratchaburi were Energy related activities sector, Agriculture and Land-Use, Land-Use Change and Forestry (LULUCF). The socio-economic indicator statistics of Ratchaburi are summarized in Table 1.

Table 1 Socio-economic indicator statistics of Ratchaburi

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%

Energy related activities sector includes energy production and use in industrial, passenger transport, freight transport, commercial, and residential sectors. The GHG emissions from the energy related activities are estimated using Extended Snapshot (ExSS) Tool with socio-economic data of the base year as input data. Extended

Snapshot (ExSS) was used to quantify the energy consumption and associated GHG emissions based on the socio-economic indicators and their projection for the base and target years in the context of 2 scenarios for the target year: 1) 2030 BAU (Business As Usual, development scenario without mitigation options as countermeasures) and, 2) 2030 CM (with countermeasures).

Agricultural activities include livestocks related activities composed of enteric fermentation and manure management, and cropland related activities comprising rice cultivation, agricultural residues field open burning, and agricultural soil. For LULUCF, this study focuses on 1) forestland remains forestland, 2) other land (as crop land, grass land, wet land, and settlement) converts to forestland, and 3) forestland converts to other land. The IPCC 2006 Guidelines for national GHG emissions inventory were used for estimation of GHG emissions from Agriculture and LULUCF sectors for the base year and target year in the context of both scenarios, i.e. 2030 BAU and 2030 CM.

The 2030 BAU scenario was developed based on different historical socio-economic data analysis. The countermeasures for Ratchaburi's LCS were designed based on different Development Plans and National Policy and Plan used by Ratchaburi's Administration. Seven countermeasures were set by the Ratchaburi's Administration to achieve the sustainable development: 1) Modal Shifting in Transport sector 2) Fuel Switching in transport sector 3) Fuel Switching to renewable energy in industrial sector, commercial sector, and residential sector 4) Energy Efficiency Improvement 5) Good Agricultural Practice (GAP) 6) Changing Manure Management and 7) Changing abandoned land to forest plantation land.

The obtained results are summarized in Table 2

Table 2 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**	