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Industrial Structural Change Impact on Energy Demand and Carbon Dioxides Emission: A Case Study of Dalian City

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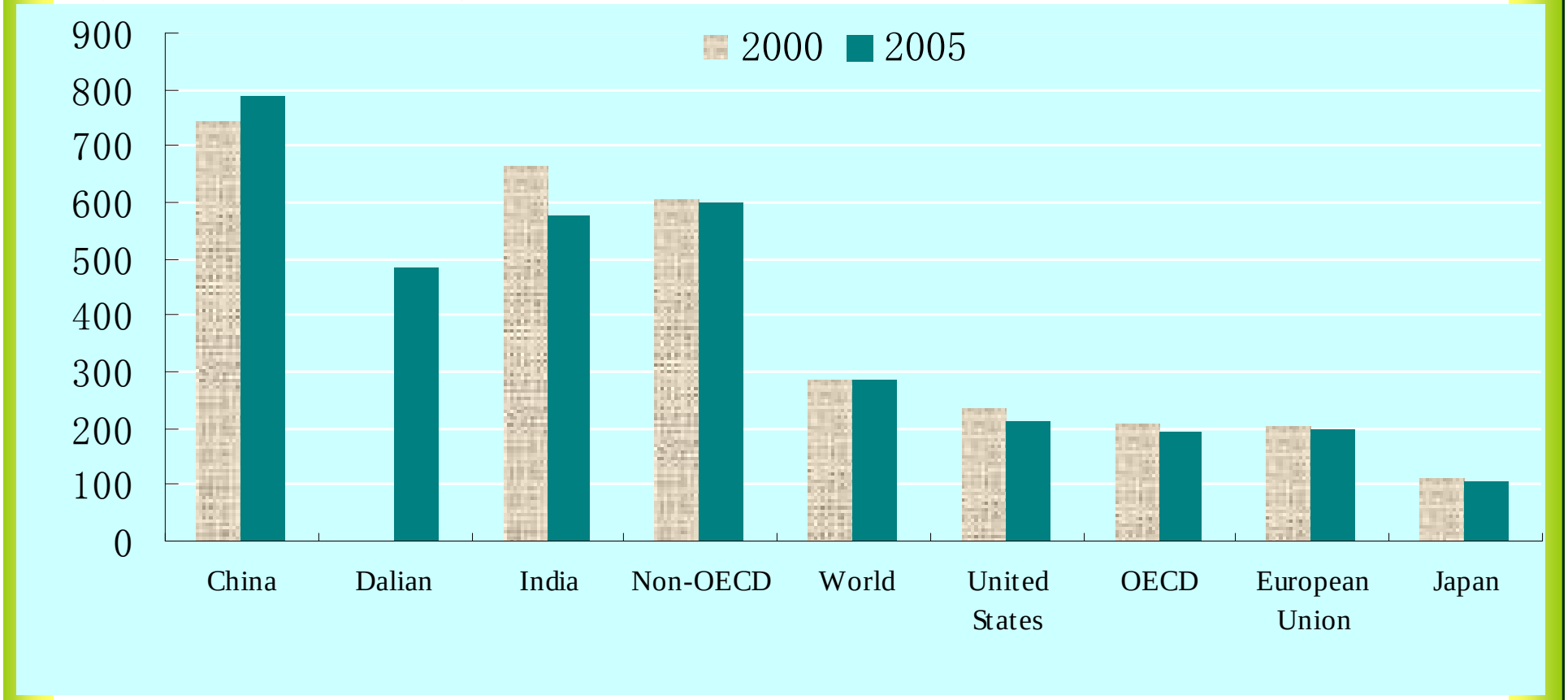
Table of Contents (Con't)

1. Introduction

- Global Climate Change and CO_2 Emission: CO_2 emissions have grown between 1990 and 2004 by about 28% and represented 77% of total GHG emissions in 2004. (IPCC Fourth Assessment Report)
- China's Carbon Mitigation Target: President Hu Jintao committed to decrease the CO_2 -GDP ratio by 40%-45% between 2005 and 2020 in the Copenhagen Climate Summit.
- The Role of Local Government: As the most advanced city in northeast China, Dalian should take concrete measures in order to meet the national goal.
- Purpose of the Study: To find out the impact of industrial structural change on energy intensity and CO_2 emission.

World Energy Intensity

➢ Comparison of major countries' energy intensity levels (tce/ million US$)



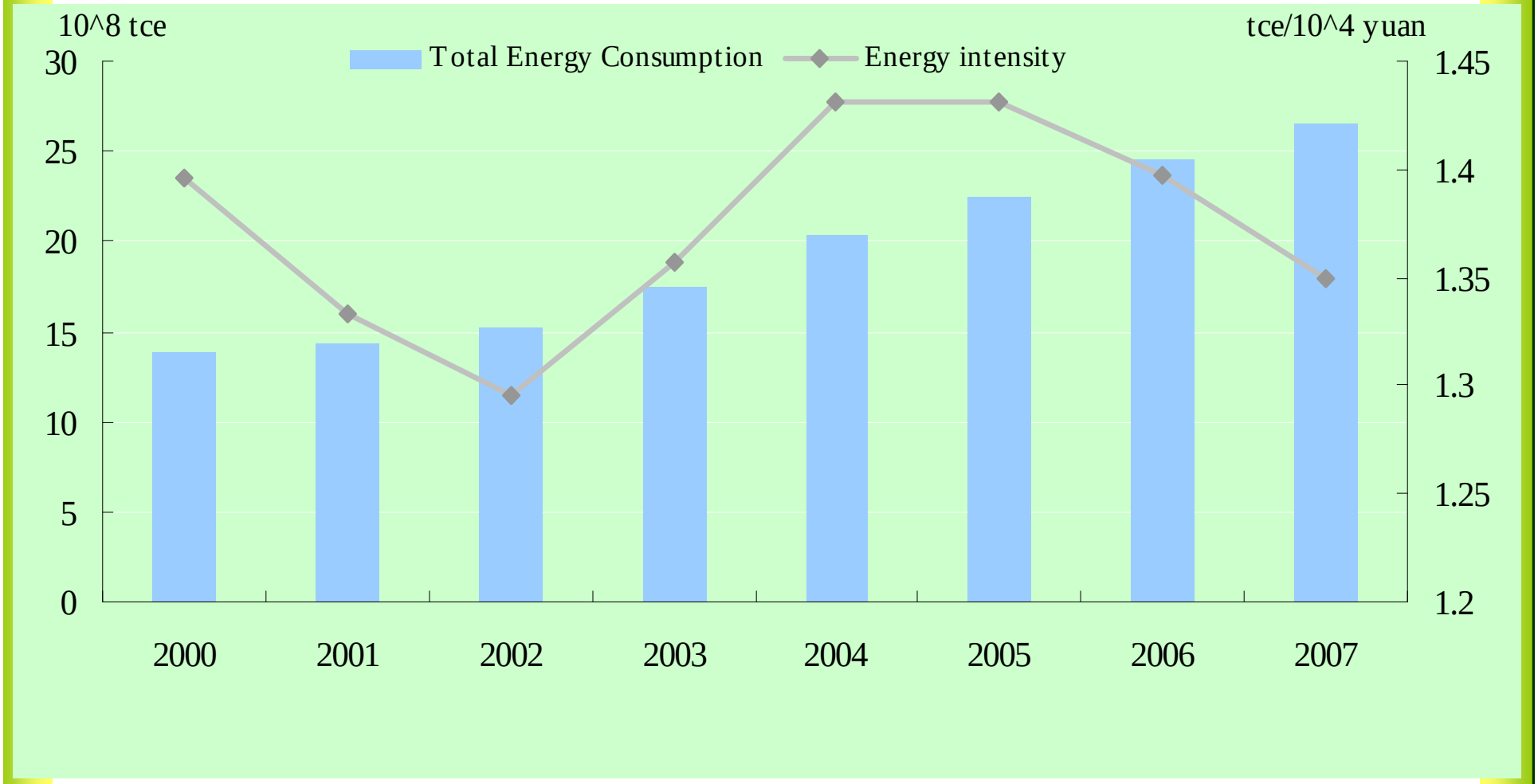
Source: Task Force on 2050 China Energy and CO2 Emissions,2009, "2050 China Energy and CO2 Emissions Report", Beijing Science Press.

Note:1 According to the 2000 US dollar value.

2 Energy consumption of Dalian is estimated from Dalian Statistical Yearbook 2008.

Trends in China's Energy Intensity

- China's energy consumption and energy intensity (2000-2007)



Source: China Energy Statistical Yearbook 2008

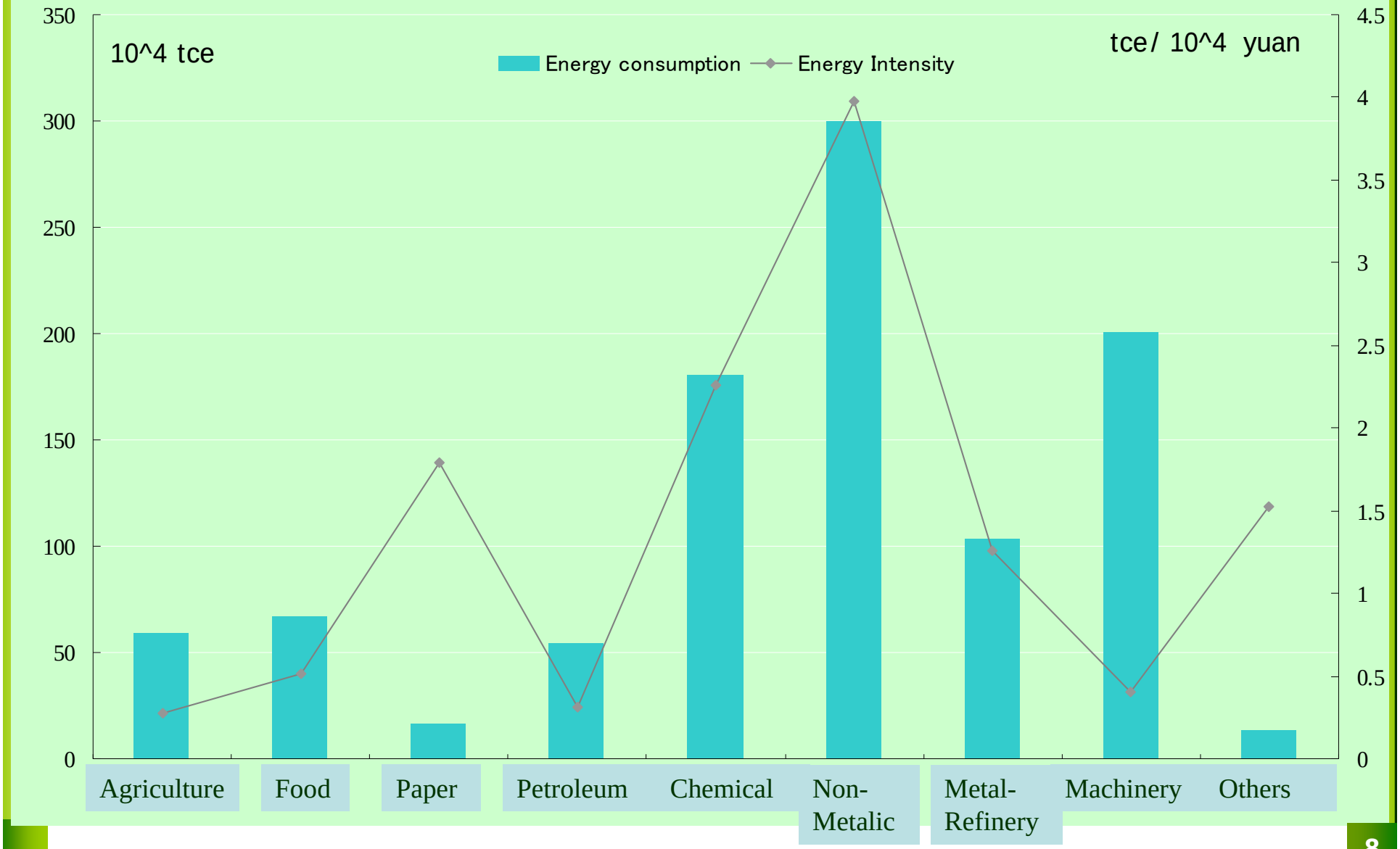
2. General Description of Dalian

➢Comparison of major socio-economic indicators between Liaoning province and Dalian city (2007)

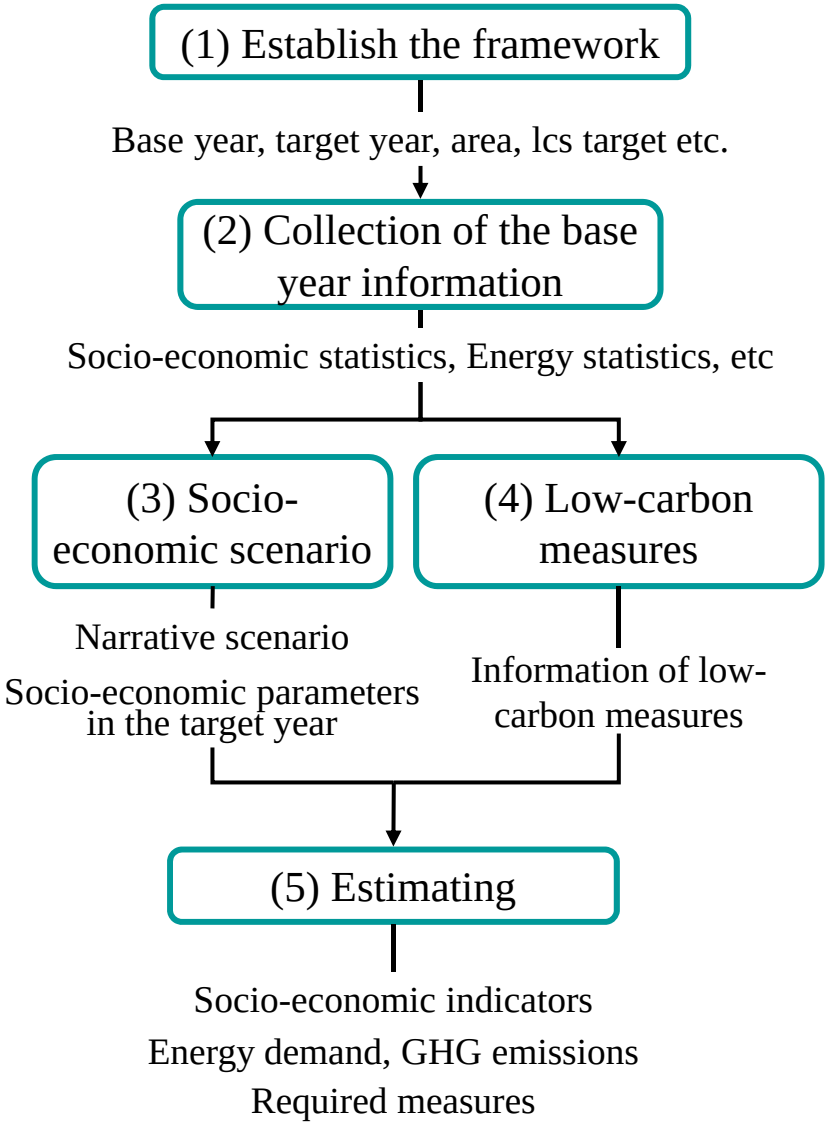
	Land Area	Population	GDP	Primary	Secondary	Tertiary	Energy Consumpt.
Unit	10^4 km²	Million	Billion RMB	Billion RMB	Billion RMB	Billion RMB	Million tce
Dalian	1.26	5.8	313.3	24.8	153.7	134.7	19.9
Liaoning	14.6	55.8	1102.2	100.4	519.9	481.9	96.7
Dalian/ Liaoning	8.6%	10.4%	28.4%	24.7%	29.6%	28.0%	20.6%

Dalian's Industrial Energy Intensity (2007)

- Final energy consumption and industrial energy intensity in Dalian



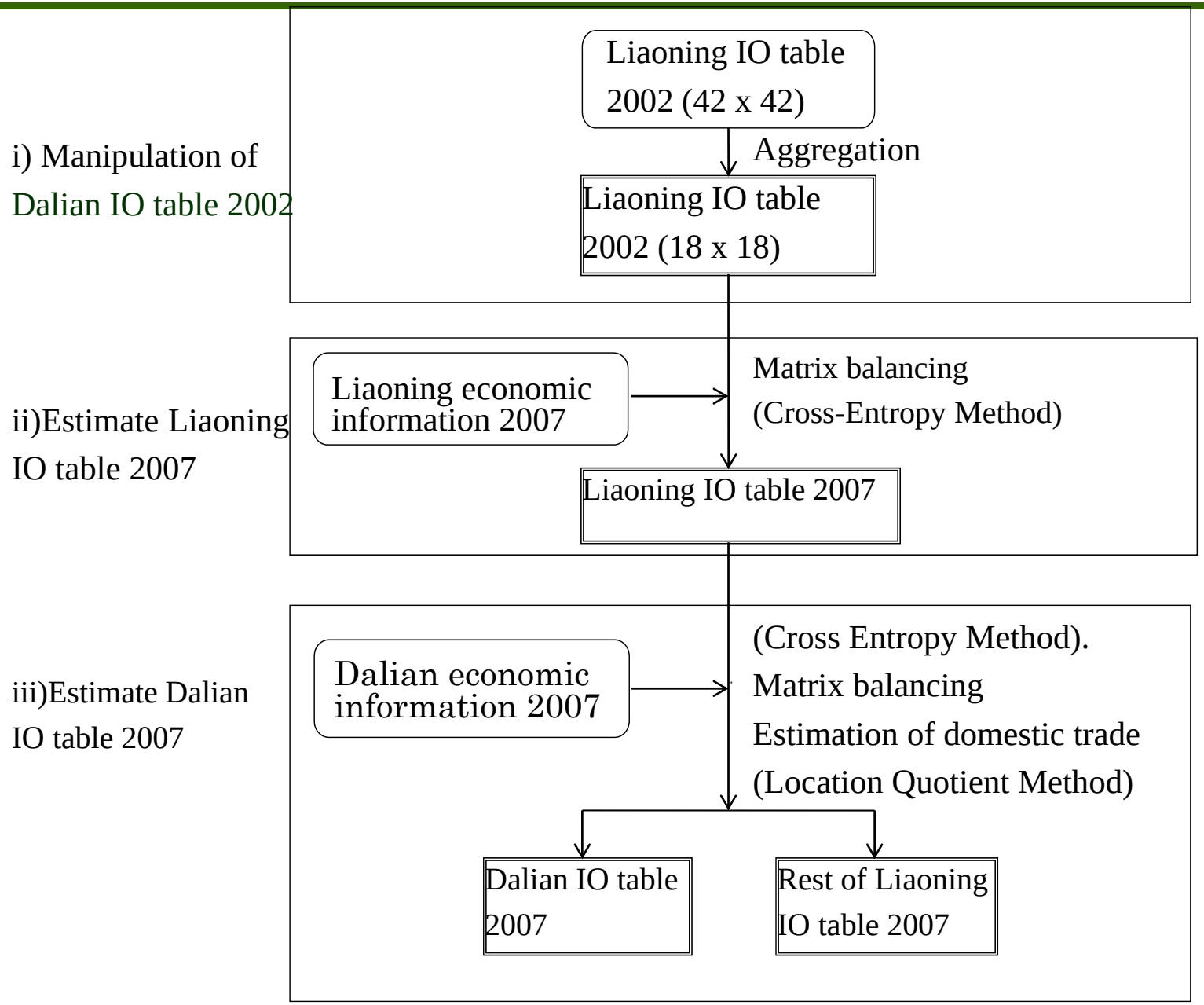
3. Methodology



Framework of the Study

- Base Year: 2007
- Target Year: 2020
- GHG Emission Target: Compared with base year, CO_2-GDP ratio will be reduced by 40% by 2020.
- Target Activities: Residential sector, Industry sector, Commercial sector.

Estimating Dalian IO Table 2007



4-1 Scenario Formulation

Common Socio-economic assumptions:

- Population : 6.5 million
- Family size: 2.7people / household
- GDP by Expenditure:

  Consumption : Investment : Net Exports = 50 : 45 : 5
- Household energy consumption: Increase by 3 times
- Primary energy composition of electricity supply:

	Coal-fired thermal	Gas-fired thermal	Nuclear	Renewable
2007	90%	9.50%	0%	0.50%
2020	68%	20%	10%	2%

4-1 Scenario Formulation (Con't)

- Economic growth rate:

  In scenario L: 10% in average (annually)

  In scenario H: 12.5% in average (annually)

- GDP by Sector

  In 2007: Primary : Secondary : Tertiary = 8 : 49 : 43

  In scenario L: Primary : Secondary : Tertiary = 5 : 50 : 45

  In scenario H: Primary : Secondary : Tertiary = 5: 43 : 52

- Technological Improvement (Counter Measures):

  In BAU case: no technological improvement

  In CM case: the share of original technology, Japanese technology and best available technology is 20:60:20

4-2 Estimation Result

scenario L

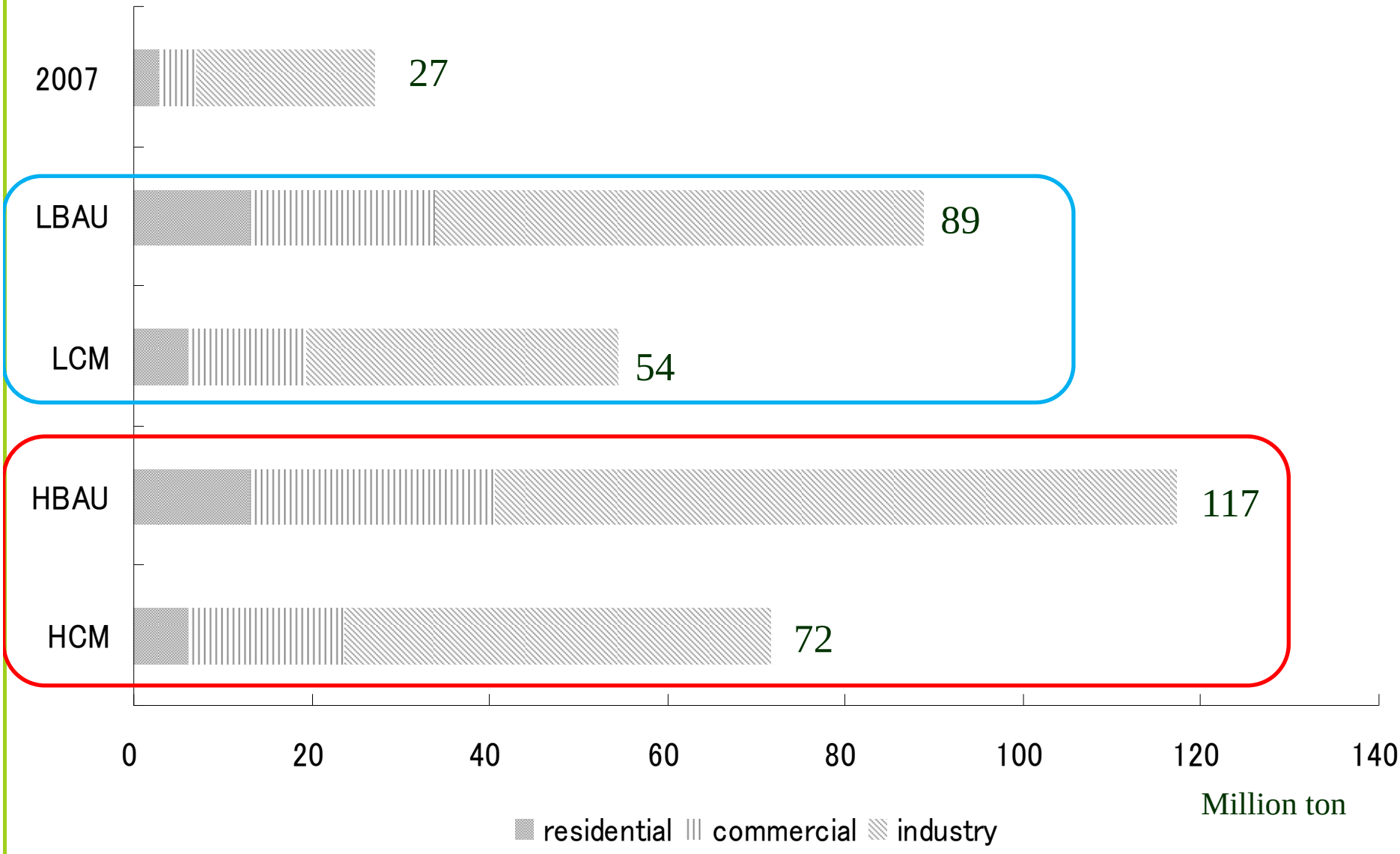
	Unit	2007	BAU	BAU/ 2007	CM	CM/ 2007
GDP	10^8 RMB	2573	8558	332.6 %	8558	332.6 %
Energy Demand	ktce	1103	3767	341.5 %	2181	197.7 %
CO_2 emissions	10^4 ton	2709	8867	327.3 %	5448	201.1 %
Energy Intensity	tce/10^8 RMB	0.43	0.44	102.7 %	0.25	59.4%
CO_2/GDP	ton/10^8 RMB	1.05	1.04	98.4%	0.64	60.5%

4-2 Estimation Result (Con't)

scenario H

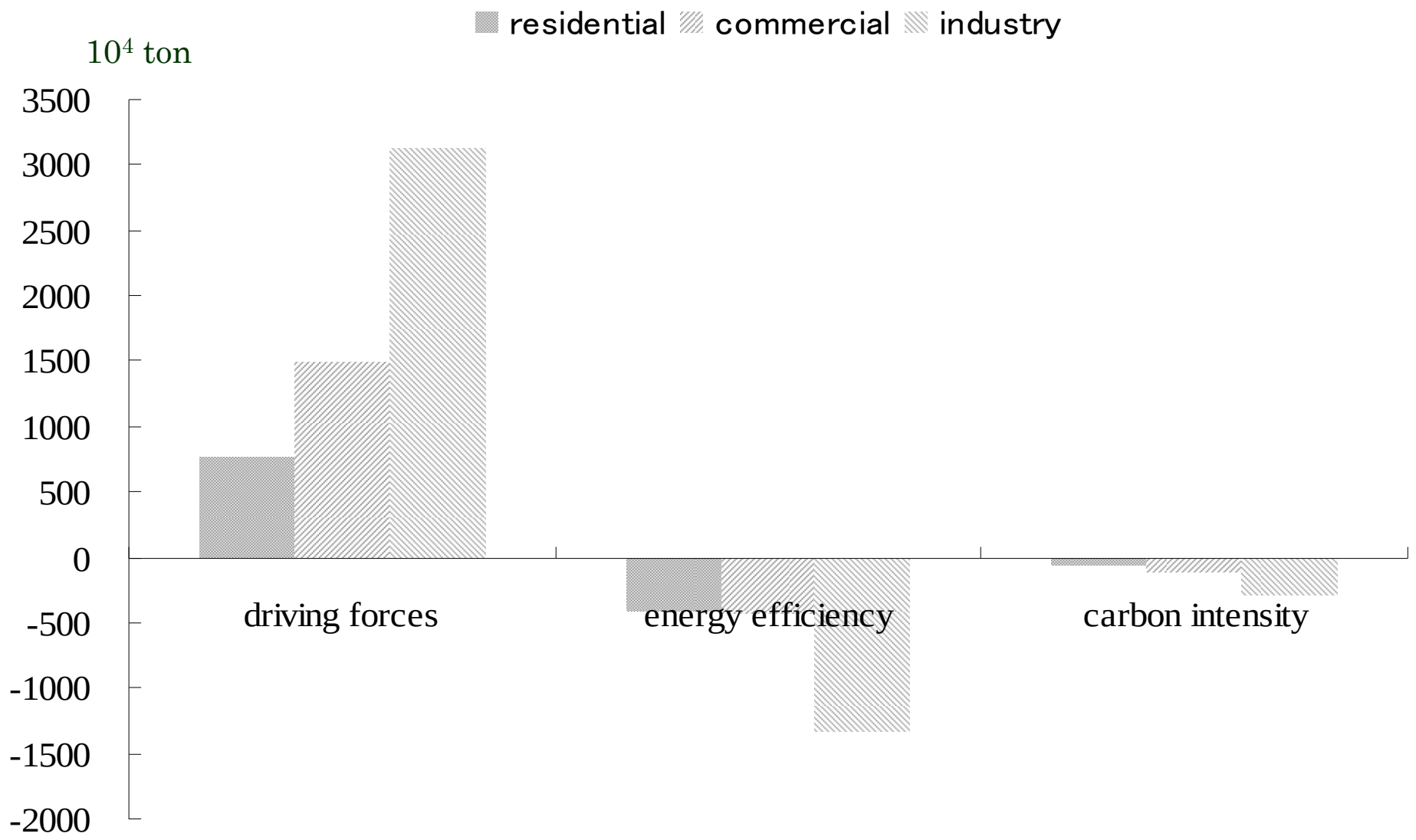
	Unit	2007	BAU	BAU/ 2007	CM	CM/ 2007
GDP	10^8 RMB	2573	13250	515.0 %	14846	577.0 %
Energy Demand	ktce	1103	5127	464.8 %	2995	271.5 %
CO_2 emissions	10^4 ton	2709	11709	432.2 %	7155	264.1 %
Energy Intensity	tce/10^8 RMB	0.43	0.39	90.3%	0.20	47.1%
CO_2/GDP	ton/10^8 RMB	1.05	0.88	83.9%	0.48	45.8%

CO_2 emission reduction effects by sectors



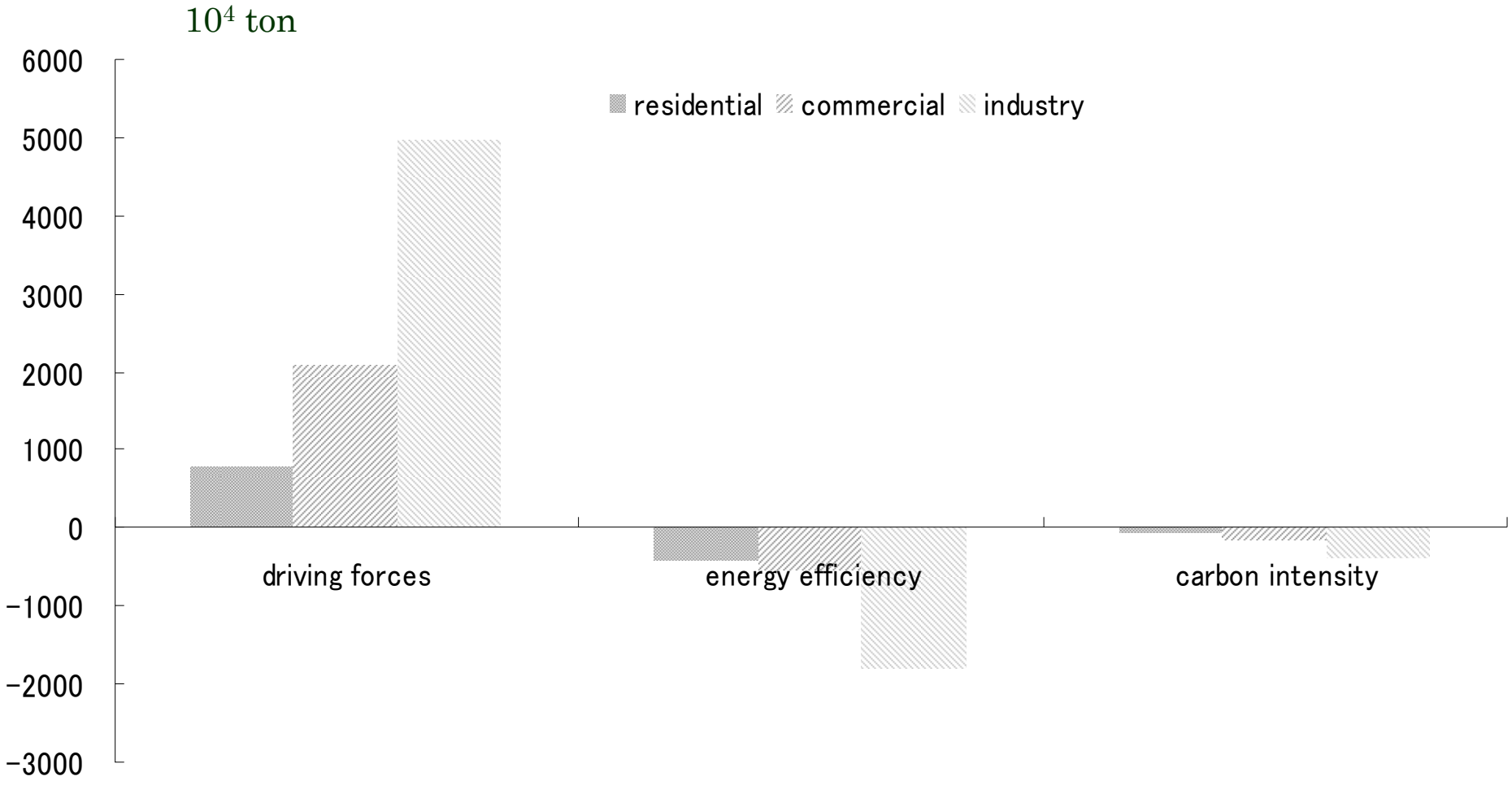
Factor decomposition of CO_2 emission change

Scenario LCM



Factor decomposition of CO_2 emission change (Con't)

Scenario HCM



5-1 Major Findings

- In scenario LBAU: a slight industrial structural change increased the energy intensity by 2.7 percent, and fuel structural change contributed 4.3 percent to the decrease of the CO_2-GDP ratio.
- From scenario LCM: it can be seen that the technology improvement contributed 38 percent to the decrease of the CO_2-GDP ratio.
- Scenario HBAU shows that the effect of given industrial structural change is 12 percent decrease in the CO_2-GDP ratio.
- Scenario HCM shows the comprehensive effect of industrial structural change, technology improvement and fuel structural change, that the CO_2-GDP ratio dropped by 54 percent, which is 9 percent higher than the national target.

Energy efficiency gap

Comparing the energy consumption of major energy-intensive industrial products

Energy consumption indicator	China		Advanced international level	2007 Gap	
	2000	2007		Energy consumption	%
Coal consumption of thermal generators (grams of coal equivalent/kWh)	363	333	299	34	11.4
AC power consumption of aluminum electrolysis (kWh/tonne)	15480	14488	14100	388	2.8
Cement (kg coal equivalent/tonne)	181	158	127	31	24.4
Plate glass (kg coal equivalent/weigh box)	25	17	15	2	13.3
Crude processing (kg coal equivalent/tonne)	118	110	73	37	50.7
ethylene (kg coal equivalent/tonne)	1125	984	629	355	56.4
Synthetic ammonia (kg coal equivalent/tonne)	1699	1553	1000	553	55.3

Source: Task Force on 2050 China Energy and CO2 Emissions, 2009, "2050 China Energy and CO2 Emissions Report", Beijing: Science Press.

Notes: International advanced level is the average of the advanced countries in the world. The 2006-2007 energy consumption of steel, building materials, petrochemicals, paper and paper boards is estimated.

5-2 Policy Implications

- Compared with other cities in northeast China, Dalian's has advantages in the so-called "green industries" such as equipment manufacturing, software, real estate and financial. Faster development of these sectors can help to decrease the general energy intensity.
- Technology improvement is a necessary and urgent task in order to meet the target of carbon mitigation. On one hand, Dalian needs to strengthen its capacity for endogeneous innovation, and introduce mature technology from advanced countries. On the other hand, cutting down the obsolete production by old energy-intensive facilities will help to the average energy efficiency.
- The effect of fuel structural change is obvious. Dalian should make full use of its advantage in developing nuclear power plant and gas-fired thermal.

5-3 Further challenges

- The relationship between urbanization and industrial structural change:

  The future development trend of urbanization should be observed carefully and its effect on energy demand should be evaluated.

- The cost and driving force for technology innovation:

  The government should evaluate the cost for technology research and equipment updating, and issue concrete policies to help enterprises.

- The relationship between energy sector input coefficient and energy efficiency:

  The quantification of this relationship will be interesting and helpful for the understanding and comparison of energy intensity between two different economies.