# Study on the Low Carbon development of Guangzhou Towards 2030

A Joint Research Project by

Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences

and

Kyoto University, Japan

Prof. Zhao Daiqing & Dr. Wang Peng

13 Dec 2012
Tsukuba, Japan
The 18th AIM International Workshop

# Contents

# 1 Regulation and policy of low carbon development and emission reduction

## National

✓国务院关于印发“十二五”控制温室气体排放工作的通知（国发[2011]41号）：到2015年全国单 位国内生产总值二氧化碳排放比2010年下降17%。

**12th Five year plan on control greenhouse gas emissions issued by the state council**

✓国家发展改革委关于开展低碳省区和低碳城市试点工作的通知（发改气候[2010]1587号）：广东省、深圳市等五省八市试点，研究运用市场机制推动控制温室气体排放目标的落实。

**the notice about national development and reform commission (NDRC)on carry out low carbon provinces and low carbon city pilot work .**

✓国家发改委办公厅关于开展碳排放权交易试点工作的通知（发改办气候[2011]2601号）：广东省、深圳市等二省五市。

**the notice of General office of the national development and reform commission on carbon emissions trading in the pilot work.**

# 1 Regulation and policy of low carbon development and emission reduction

## Provincial

✓广东省人民政府关于印发“十二五”控制温室气体排放工作实施方案的通知（粤府[2012]96号）：到2015年全省单位生产总值二氧化碳排放比2010年下降19.5%

**Guangdong provincial people's government about distribute 12th five year plan on control greenhouse gas emissions work**

✓广东省人民政府印发广东省低碳试点工作实施方案的通知（粤府函[2012]264号）

**Guangdong provincial people's government print Guangdong province and low carbon pilot plan**

✓关于印发“十二五”广东省万家企业节能低碳行动实施方案的通知》（发改环资[2011]2873号）

**The notice of distribute 12th five year 10 thousand companies in Guangdong province energy saving low carbon action plan**

# 1 Regulation and policy of low carbon development and emission reduction

## Guangzhou City

- 关于印发广州市低碳城市实施方案通知

  **About print and distribute Guangzhou low carbon city plan**

- 《国家发展改革委关于开展第二批低碳省区和低碳城市试点工作的通知》(发改气候[2012年] 3760号文件)

  **The national development and reform commission carry out the second batch of low carbon provinces and low carbon city pilot work of the notice**

# 2 Difficulties and challenges of GZ Low-carbon development

- ✓ The stage of development in Guangzhou and high percent in industrial energy consumption determines the high growth of energy consumption and $CO_2$ emissions
- ✓ The low carbon development of Industry and infrastructure faced with technical and financial difficulties
- ✓ Clean energy proportion is low, gas pipeline and use cost is high
- ✓ Energy management, energy conservation and emission reduction are managed by many department, the department interest division lead to energy and environmental policy hard to general planning, policy coordination often not reach the desired effect

# 2 Difficulties and challenges of GZ Low-carbon development

**How to find the low carbon path and the suitable target for GZ ?**

- ✓ According to the low carbon development policy, Guangzhou should how to achieve a low carbon development .
- ✓ How to set the guidance goal of Guangzhou long-term future low carbon development
- ✓ What kinds of low carbon development measures can support Guangzhou low carbon's goals

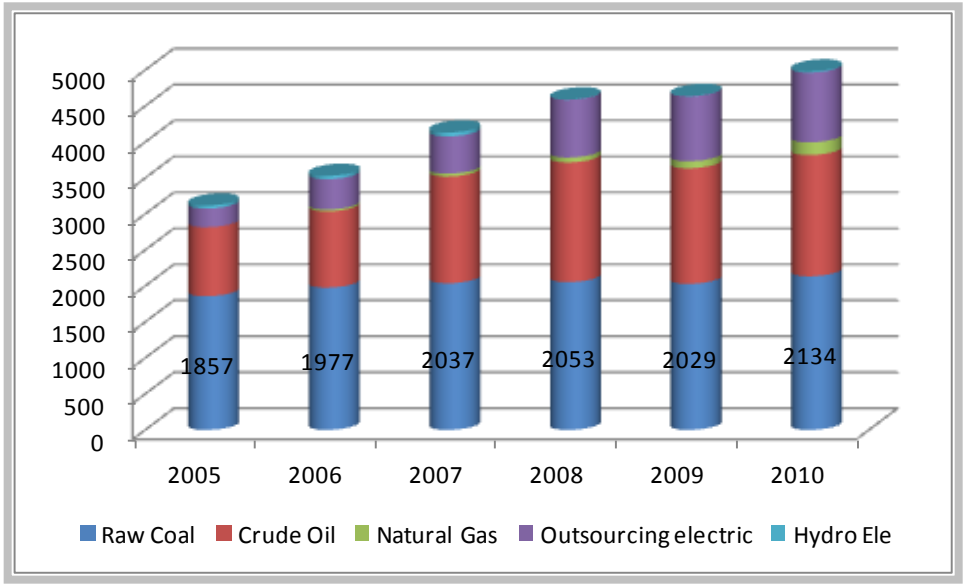
These problems are urgent for us to further research, so we carried out the guangzhou situational analysis research based on the model.

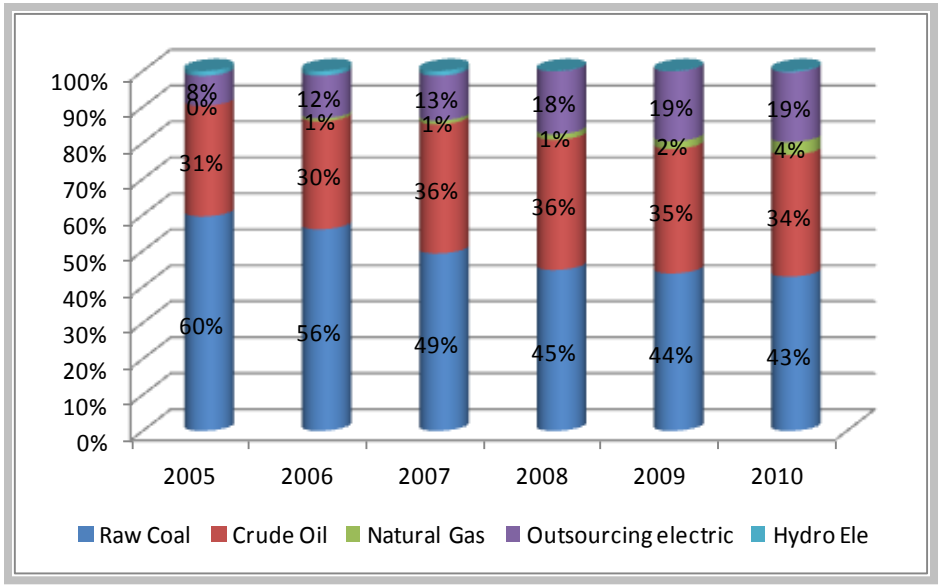
# 3 The current situation of energy and $CO_2$ emissions

## 3.1 General situation of GZ city

| Guangzhou | |
|---|---|
| Economic | • Has 7434.4 square kilometers land ;<br>• Contains 10 districts and 2 satellite cities ;<br>• GDP has reached 1011 billion Yuan in 2010 ;<br>• In the mid- to late stage of industrialization, the economy will continue to grow. |
| | |
| Population | • Has 10.50 million population and maintained an average growth rate of 2% for last 30 years. |
| | |
| Energy consumption | • In 2010, the energy consumption is 60.3 million tons of standard coal, with the $CO_2$ emission of 134.8 million tons. |

# 3.2 Primary energy consumption

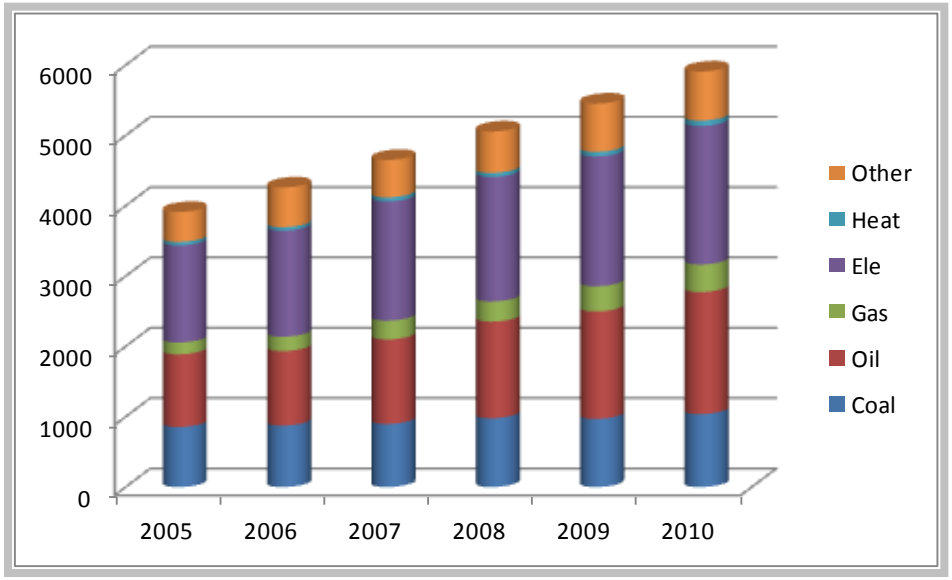


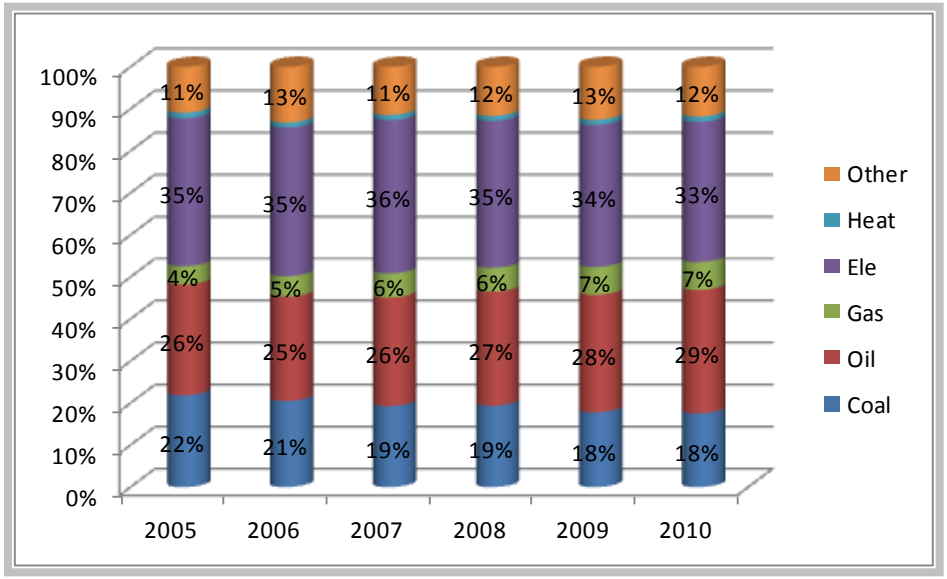




For the primary energy consumption of Guangzhou in 2005-2010, we can see that:

- The primary energy consumption from 2005 to 2010 increased year by year;
- The proportion of coal consumption reduced year by year, from 60% in 2005 reduce to 43% in 2010;
- The proportion of Crude oil increased from 31% to 34%;
- Natural gas ratio increased from 0% to 4%;
- Outsourcing power consumption increased from 8% to 19%.

# 3.3 Final energy consumption by different kinds fuels

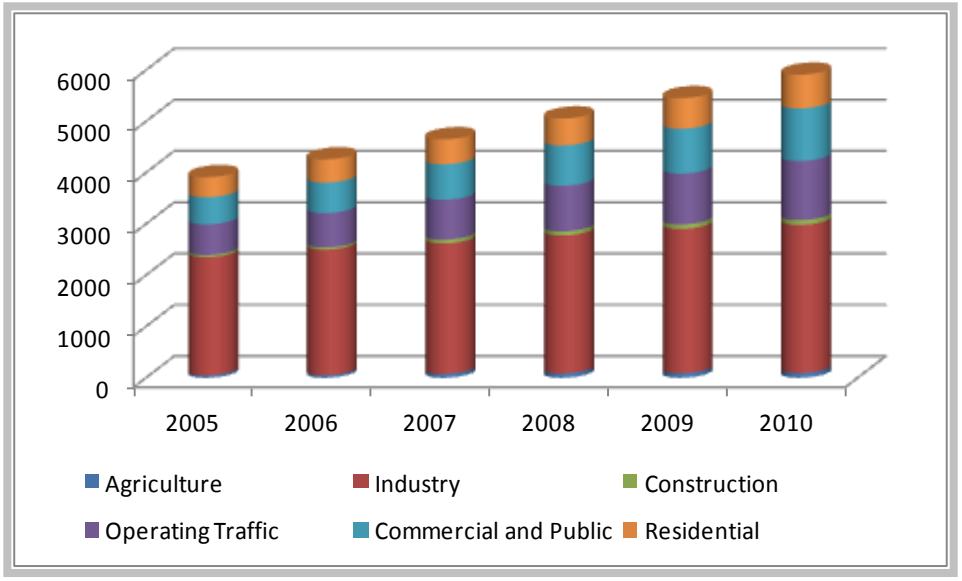


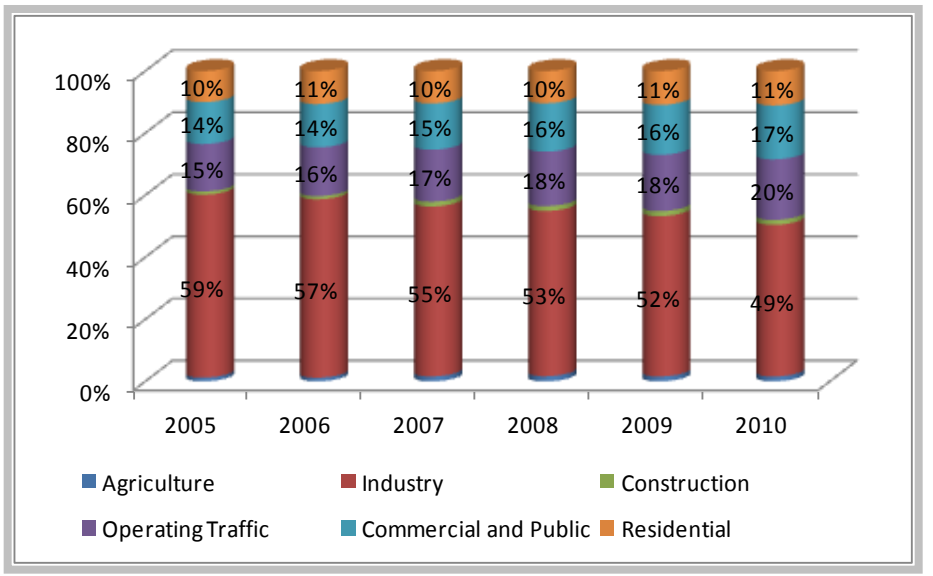




For the final energy consumption data of 2005-2010 , we can see that

- Terminal energy consumption from 2005 to 2010 increased year by year;
- Oil consumption ratio increased from 26% to 29%;
- Gas including LPG and NG, its proportion increased from 4% to 7%;
- Power consumption between 35% and 33%;
- Other energy including other petroleum products , refinery dry gas and coke products, proportion are in 11% between 13%;
- The proportion of oil consumption has been greater than the proportion of coal consumptio.

# 3.4 Energy consumption structure in different Industry




About the industrial energy consumption from 2005- 2010, It shows that:

- Industrial energy consumption decline from 59% in 2005 to 49% in 2010;
- Operating traffic proportional increase from 15% in 2005 to 20% ;
- The energy consumption of Commercial and public institutions increased from 14% in 2005 to 17% in 2010;
- The proportion of residents energy consumption basically unchanged, maintain between 10% and 11%.

# 3.5 The $CO_2$ emission comparison of New York, London, Tokyo, GZ

| Index | New York (2008) | London (2006) | Tokyo (2003) | Guangzhou (2009) |
|---|---|---|---|---|
| $CO_2$ emissions (10000 t) | 5217 | 4400 | 7044 | 11445 |
| Area /$km^2$ | 790 | 1572 | 2187.09 | 7434 |
| Population (10000per) | 830 | 751.24 | 1238.82 | 1025.82 |
| $CO_2$ Per capita ($tCO_2$/per) | 6.29 | 5.86 | 5.69 | 11.16 |

Source: Inventory of New York city greenhouse gas emissions (2009), Tokyo renewable energy strategy (2006), Shanghai energy and carbon emissions2050.

## Quantitative socio-Economic Assumption in 2030

| Indicator | 2005 | 2030 | 2030 Tendency depiction |
|---|---|---|---|
| Population | 9.5 million | 13.12 million | Growth rate at 1.2% per annum |
| Demographic composition | 0-14: 14.8%<br>15-64: 77.6%<br>65 and over:7.6% | 0-14:8%<br>15-64: 80.5%<br>65 and over:11.5% | Birth and death rate are declined |
| Urbanization rate | 82% | 95% | Urbanization increases |
| Average number of person per household | Urban: 3.2<br>Rural:3.55 | Urban: 2.6<br>Rural: 3 | Significant decrease in average size of household |
| GDP | 515.4 billion | 2158．6billion | Growth rate is 6% per annum |

Source: Guangzhou statistical book (2005-2010), NDRC,ERI. China low carbon road 2050. 2009.

# 4 Energy and $CO_2$ emissions scenario simulation and analysis

## Summary of main variables

| Variable | Unit | 2005 | 2030BAU | 2030CM | 2030BAU/ 2005 | 2030CM/ 2005 | 2030CM/2 030BAU |
|---|---|---|---|---|---|---|---|
| Population | Million | 9.6 | 13.1 | 13.1 | 1.4 | 1.4 | 1.0 |
| Household | Million | 2.9 | 4.8 | 4.8 | 1.7 | 1.7 | 1.0 |
| GDP | Billion RMB | 506 | 2605 | 2159 | 5.1 | 4.3 | 0.8 |
| Primary | | 13 | 32 | 16 | 2.5 | 1.3 | 0.5 |
| Secondary | | 204 | 889 | 773 | 4.4 | 3.8 | 0.9 |
| Tertiary | | 289 | 1684 | 1369 | 5.8 | 4.7 | 0.8 |
| Passenger_trs | Billion passenger-km | 173 | 236 | 237 | 1.4 | 1.4 | 1.0 |
| Freight_trs | Billion t-km | 273 | 1162 | 1029 | 4.3 | 3.8 | 0.9 |
| Energy_demand | Million tce | 34 | 118 | 70 | 3.5 | 2.1 | 0.6 |
| CO2_emissions | Million tCO2 | 98 | 345 | 169 | 3.5 | 1.7 | 0.5 |
| CO2_intensity | kgCO2/RMB | 19 | 13 | 8 | 0.7 | 0.4 | 0.1 |
| Per capita CO2 emissions | tCO2/Person | 10 | 26 | 13 | 2.6 | 1.3 | 0.5 |

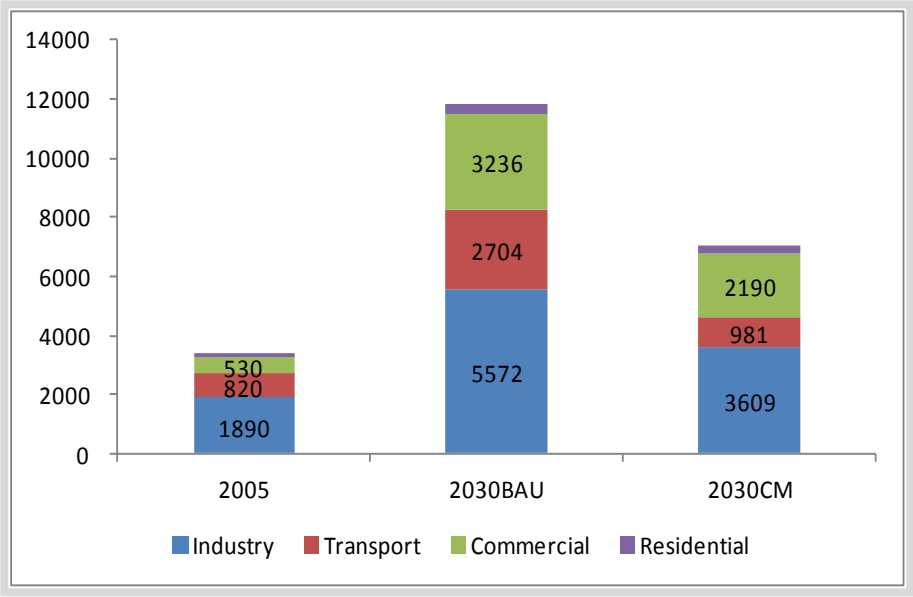
This study applied Extended Snapshot Tool (ExSS) as a quantification tool of future development of GZ in 2030.

# 4.1 Energy demand in 2030

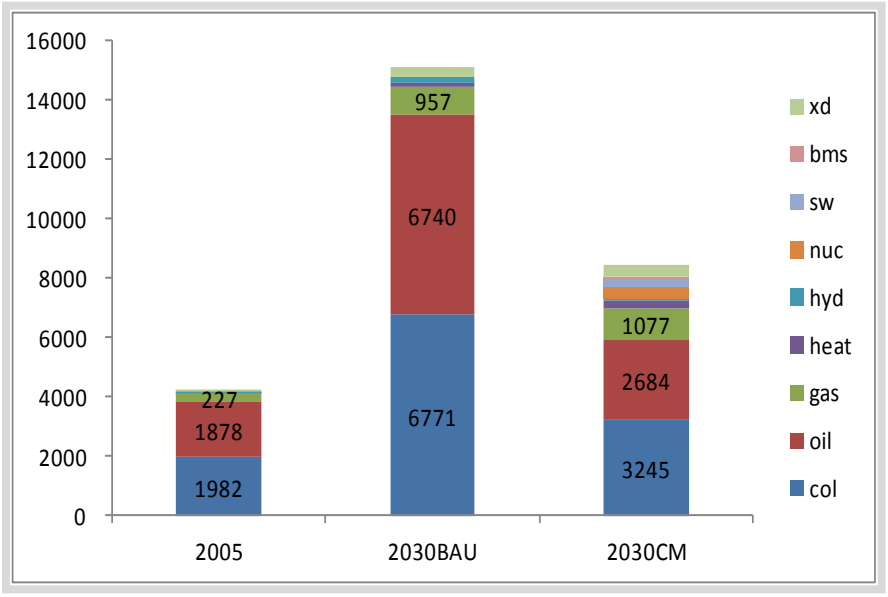
The total energy demand of Guangzhou is projected to increase about 3.5 times from 2005 to 2030 BAU. In CM scenario it is reduced about 41% from BAU.

In 2030 BAU, the energy system of Guangzhou would rely more on coal and oil, the share of coal would rise to 24%, followed by oil (51%), natural gas(8%).

In CM scenario, the share of gas and electricity rise to 10% and 31%.

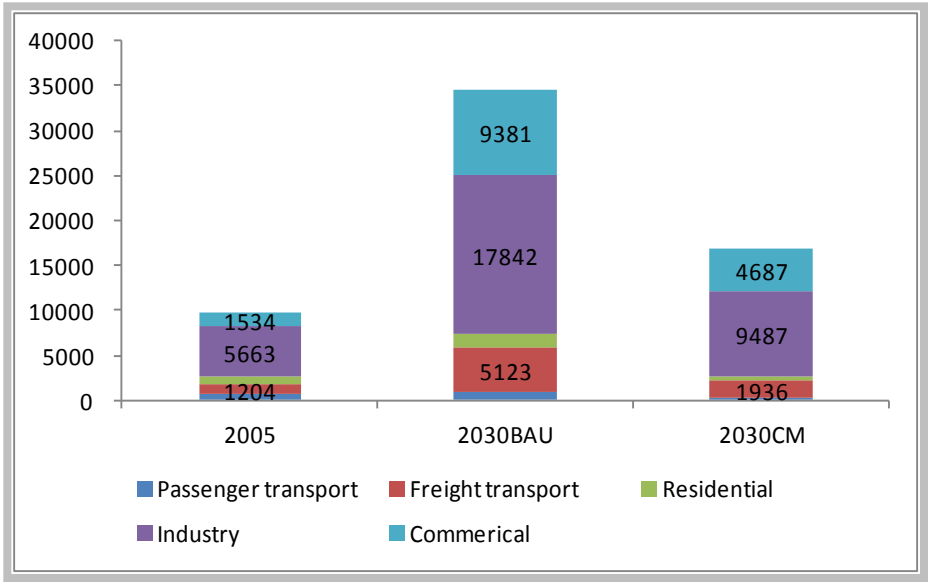



Final energy demand by sector

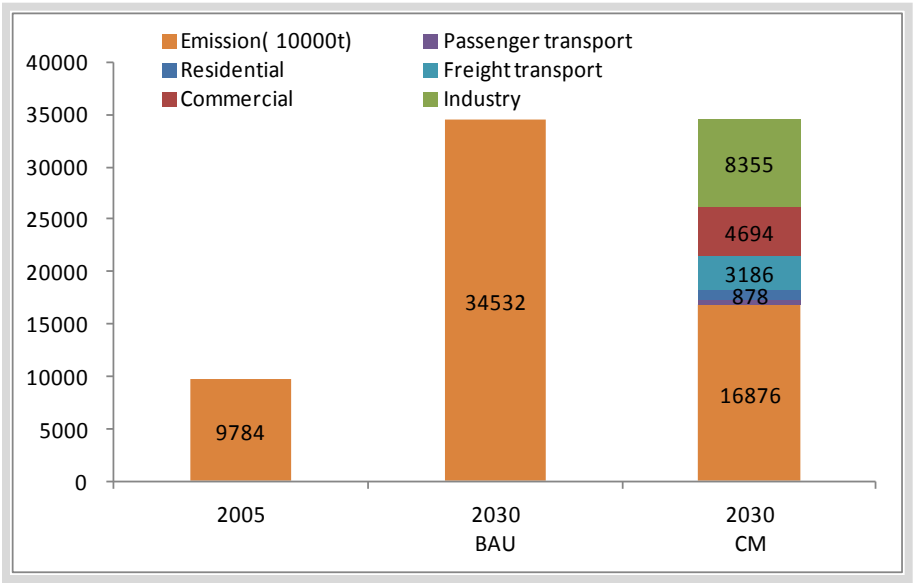



Final energy consumption by different kind

# 4.2 GHG emissions



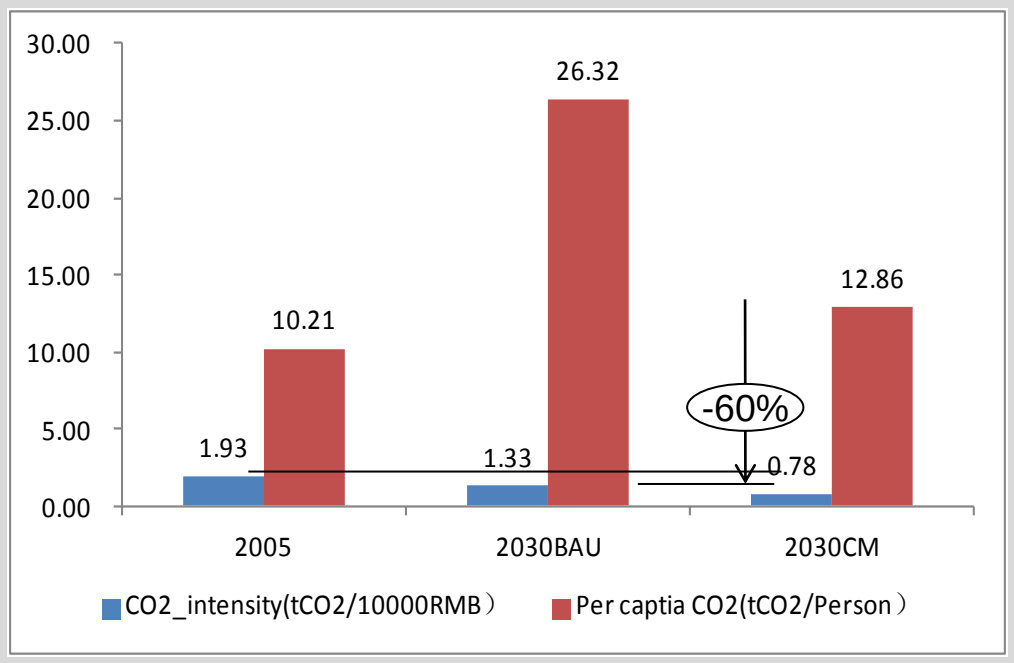

$CO_2$ emissions by sector




$CO_2$ emissions in BAU & CM

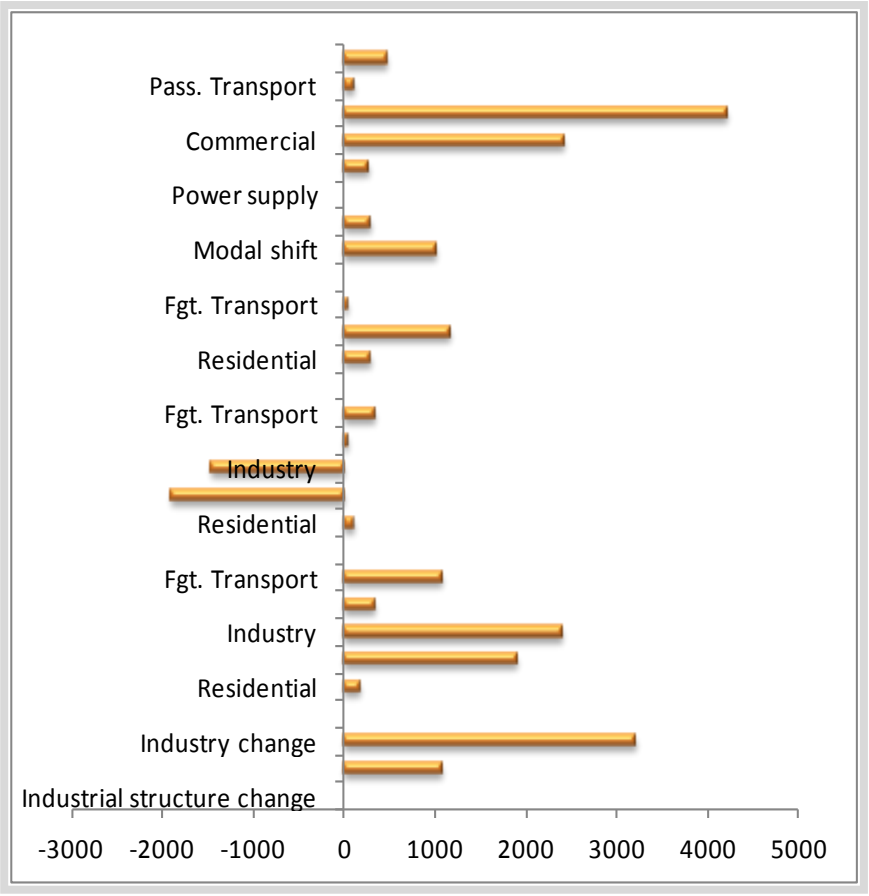
- Projected $CO_2$ emission in Guangzhou will be 345 $MtCO_2$ in 2030 BAU and 169 $MtCO_2$ in 2030 CM ,which reduced by 177Mt $CO_2$.
- $CO_2$ emission from industry is the largest in total emission both in 2030 BAU and CM scenarios even though industrial structure has shifted to commercial and service industries.
- Improving energy efficiency of industry sector is therefore crucial for development of Guangzhou as a low carbon city.

# 4.3 Carbon intensity and $CO_2$ per capita




- In 2005, the carbon intensity is 19.3 kg $CO_2$ /RMB, the $CO_2$ per capita is 10.21 t $CO_2$ /person.
- In the 2030BAU, projected carbon intensity will be 13.3 kg $CO_2$ /RMB and in 2030CM, can be reduced by 60% compared with 2005 and the carbon intensity is 7.8 kg $CO_2$ /RMB.
- In 2030CM, the $CO_2$ per capita will be increased by 21% compared with 2005 .

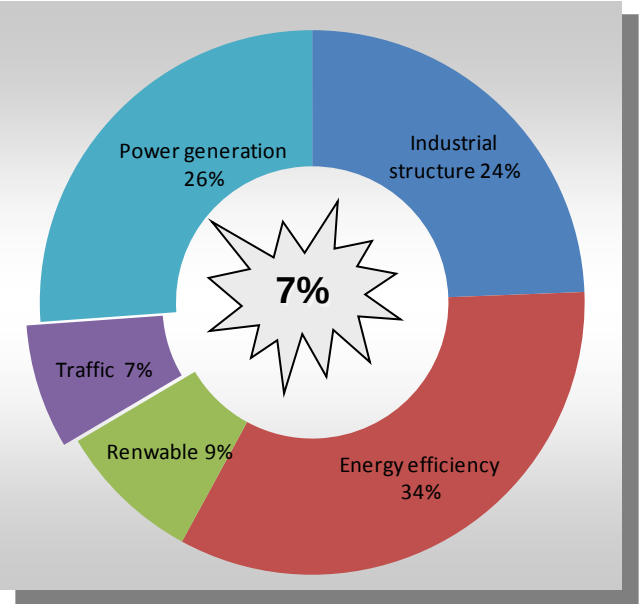
# 4.4 Mitigation potential of GZ in 2030




- This picture identified a set of low carbon measures which achieves 30% reduction of $CO_2$ emissions from 2030BAU.
- In these reduction measures, the contribution of fuel shift is negative, as many electric equipments will be used in the industry structure adjust, while the emission factor of electricity is bigger than the fuel.

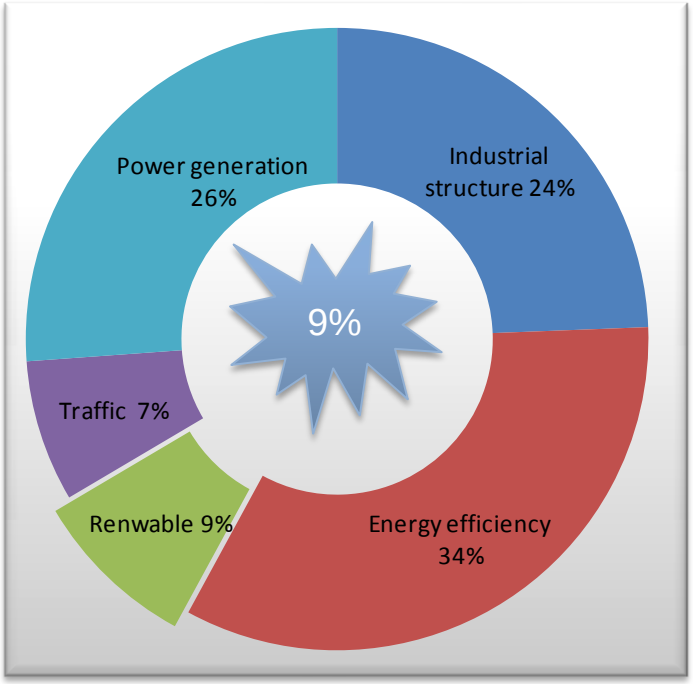
# 5 Emission reduction measures

## Action 1: Convenient Transport in Traffic structure conversion



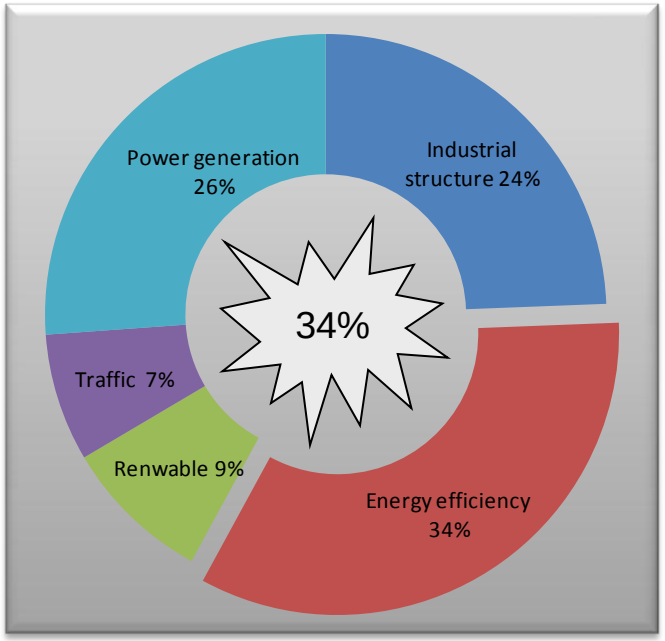

- Passenger transport: the share of private vehicles reduce 25%, bus and train increase 20%, bicycle and walk increase 5%; Energy efficiency improve 50%.
- Freight transport: the share of vehicles reduce 25% and 30% in domestic and cross border respectively, train increase 26%, ship increase 4%; Energy efficiency improve 50%.

# Action 2: Renewable energy increasing in Building




- This action focuses on measures of efficiency improvement and renewable energy utilization of residential and commercial sectors. $CO_2$ emission reduction by this action contributes to 9% of the total.
- In order to realize the measures in this action, a set of policies is required such as:
  - Subsidy for introducing distributed renewable energy system (PV and wind energy);
  - Low interest loan for investment of energy efficient buildings and renewable energy;
  - Environmental performance standard and evaluation of houses and buildings.

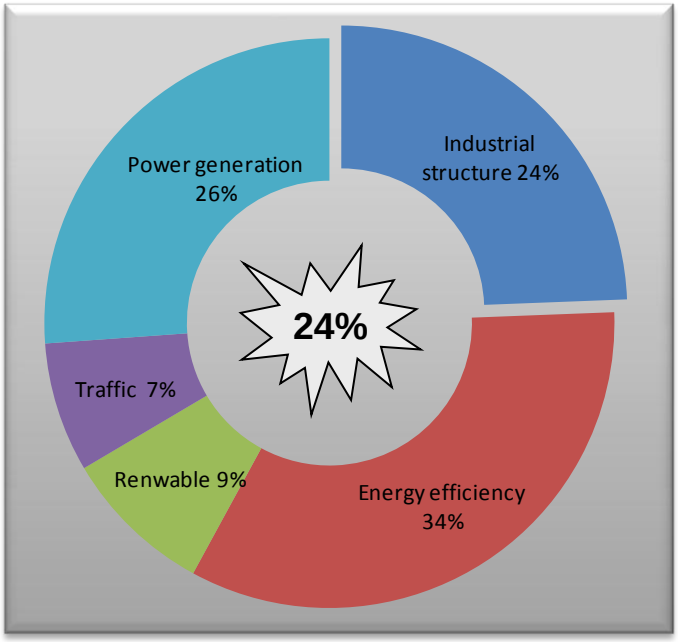
# Action 3: Energy efficiency improvement




The measures of energy efficiency improvement include following measures:

- Optimization and innovation of industrial technology, equipment and process;
- Improvement of device-level energy efficiency
- Accelerating transformation of large-scale equipment;
- Strengthening energy management
- Waste heat and energy resource recycling

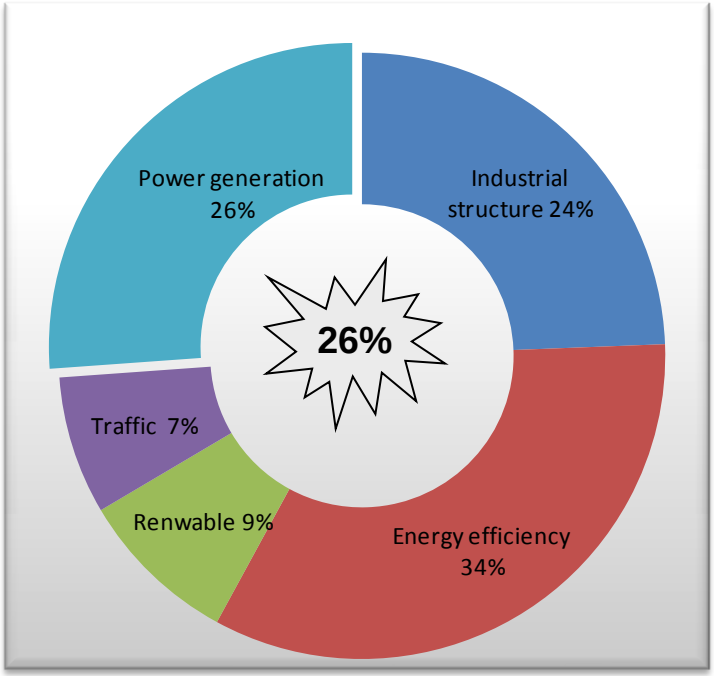
# Action 4: Industrial structure adjustment




The measures of industry restructure are as follows.

- Eliminating backward production capacity
- Enhancing the scale of the industries
- Converting the investment from the energy intensive industries into the tertiary industry

# Action 5: Power generation efficiency improving




- The main measures are power generation efficiency improvement and fuel switch
- Power generation efficiency improvement: energy efficiency improvement, expand power generation capacity, reduce transmission loss
- Fuel switch: increase the use of renewable energies, develop nuclear power plant, and to promote the creation of energy from wastes.

# 6 Work summary

- GZ energy and $CO_2$ emissions scenario are simulated and analyzed by ExSS model, the results show that the model is very helpful to design the scenario and find the reduction measures for GZ.

- This study further considers the following aspects about the model application:

- Considering the factor of out source power
- Considering the effect of industry structure adjustment
- Modifying the carbon emission factor

## 7 Opinion & Further work

- ✓ Model function is very powerful, further to be continuous years operation model.
- ✓ To further improve the model application, strengthens to learn the adjustment of industry structure and technical parameter.

Thanks for Prof. Matsuoka ~
Thanks for Prof. Masui ~
Thanks for Gomi san ~

# Thanks for your attention!