



# **Issues and Options for High Efficiency and Low Carbon Urbanization in China**

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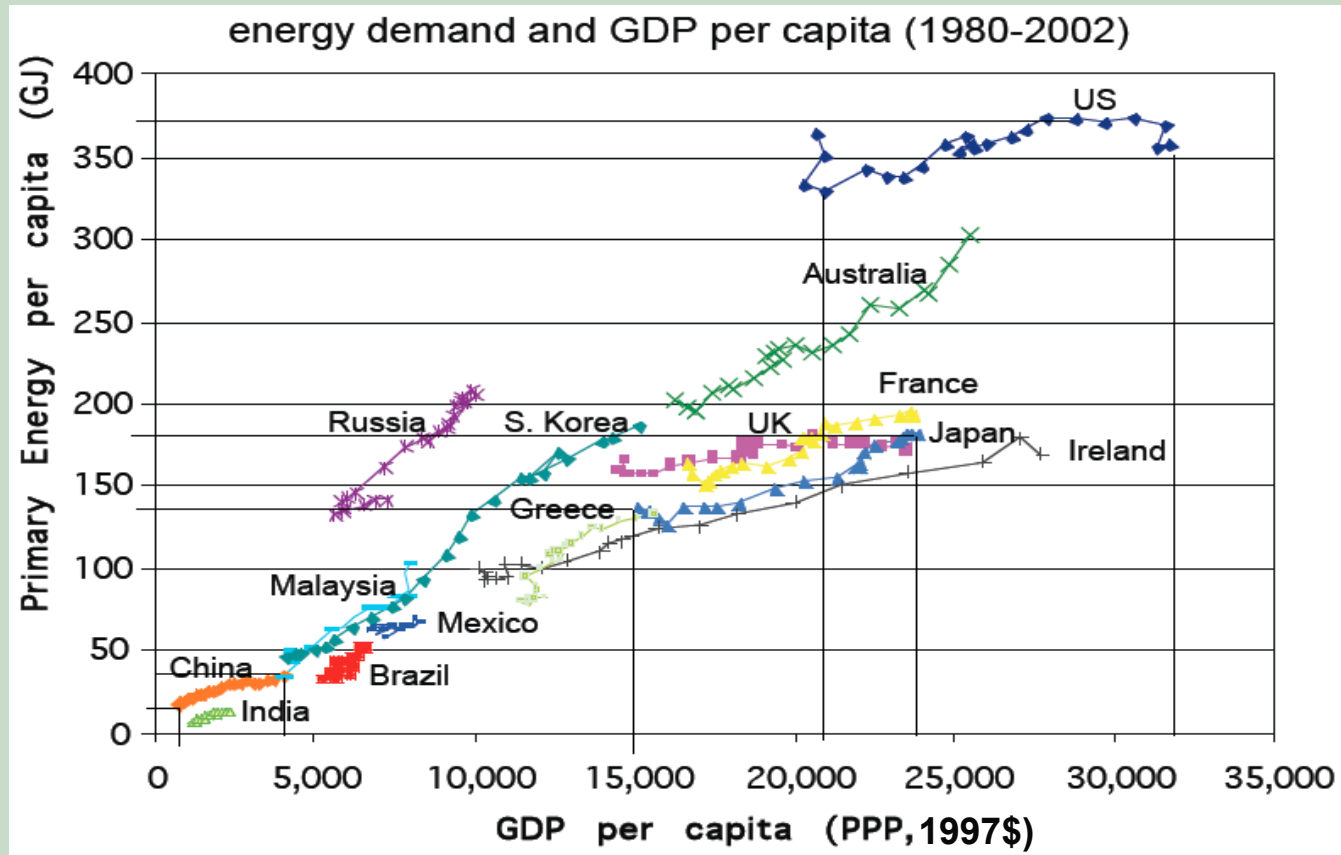
**May 11, 2007**

# Contents

- **Trends and Challenges**
- **Policies and Measures**
- **Future Demands**



# GDP and primary energy consumption, on per capita base, are still low in China



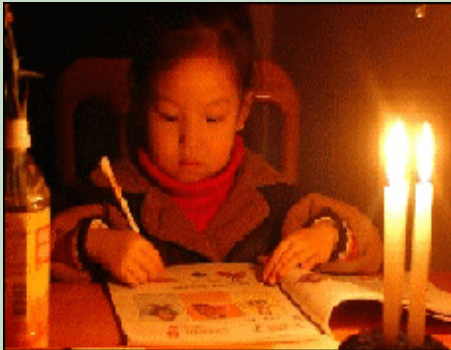
Source:  
Li Zheng,  
Tsinghua Univ.



- Still in low stage according to U.N. standards
- Further development is expected

# Imbalance: eastern and western

*Some rural area in China's west*



Services

Buildings

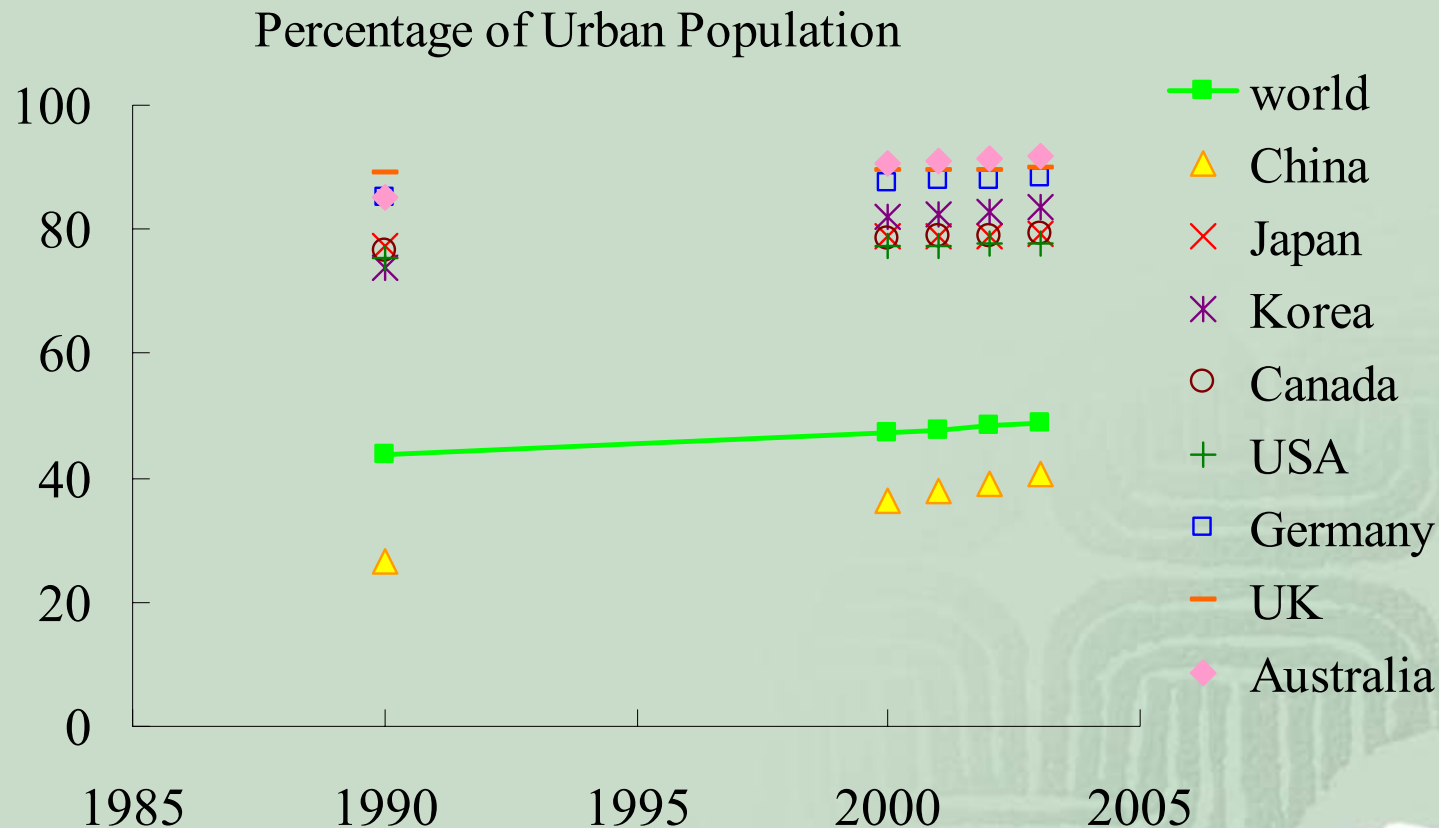
Transportation

Education



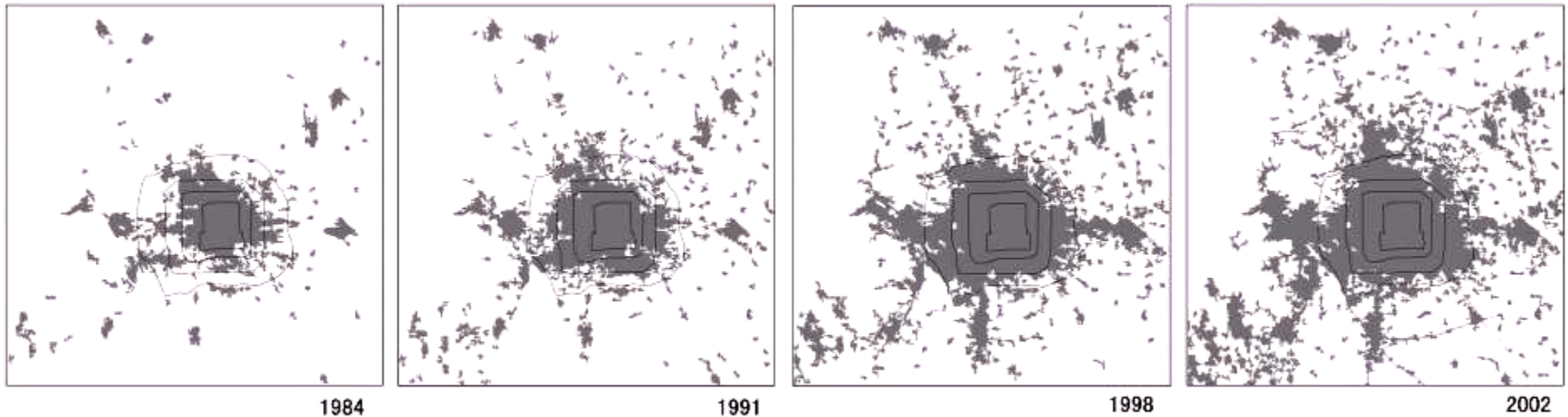
*Some urban area in China's southeast*

# Still in Rapid Development Period



- **Urban population in China: 19.4% in 1980, 26.23% in 1990 , 41.76% in 2004;**
- **Proper ratio of urbanization percentage and GDP per capita**
- **Urbanization level in China is still low**

# Trends and Challenges(1): Urbanization



北京城市“摊大饼”——根据1984—2002年卫星遥感图像制作的北京城市中心区蔓延示意图

## Beijing urban built-up areas extension, 1984-2002



Urban area in 1982, 1999 and 2002 in China

# Trends and Challenges(2): Building and transportation



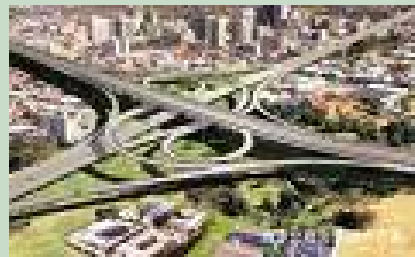
Urbanization



Building



Energy pressure



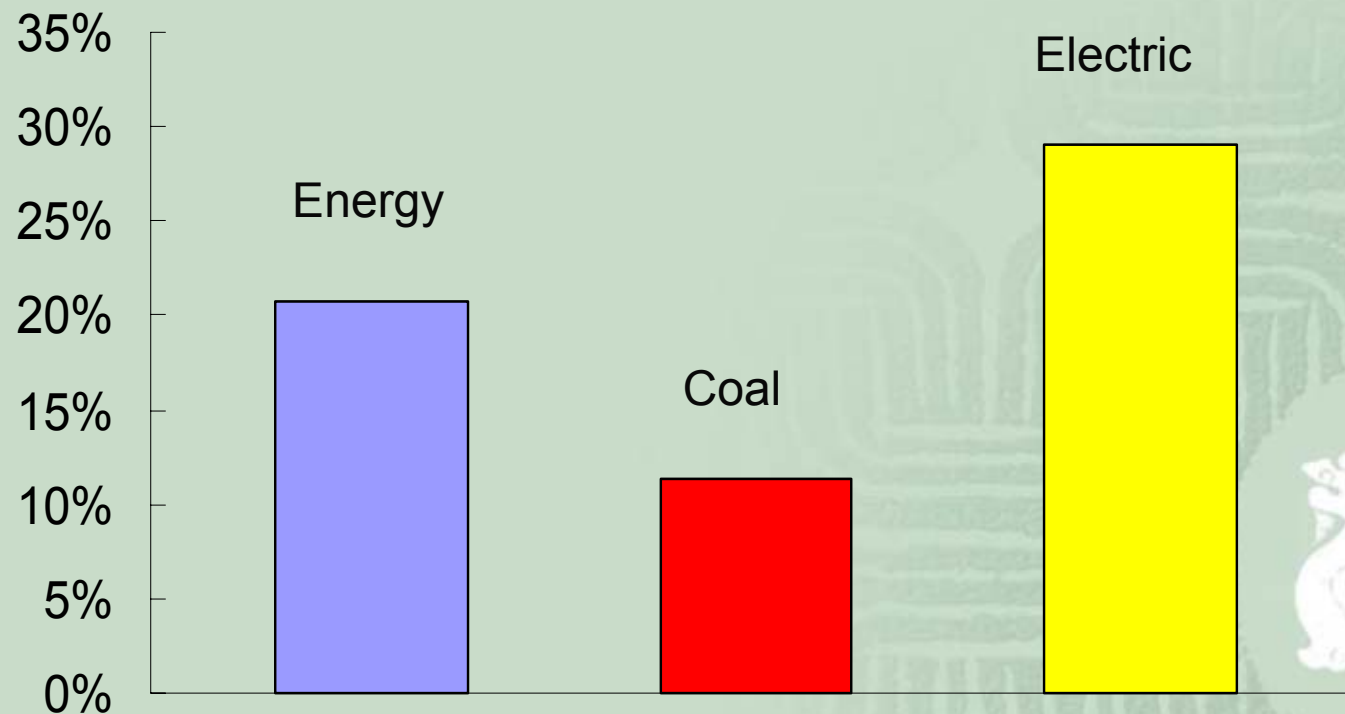
Motorization



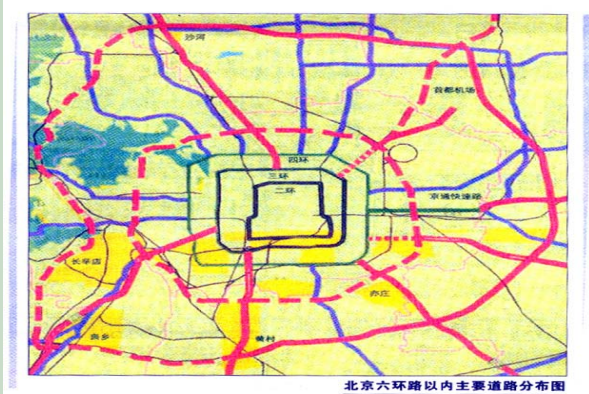
CO<sub>2</sub> emissions

# Trends and Challenges(3): Building energy consumption

- Building Energy/primary energy consumption
- Northern building heating coal/total coal consumption
- Building electric consumption/total electric consumption



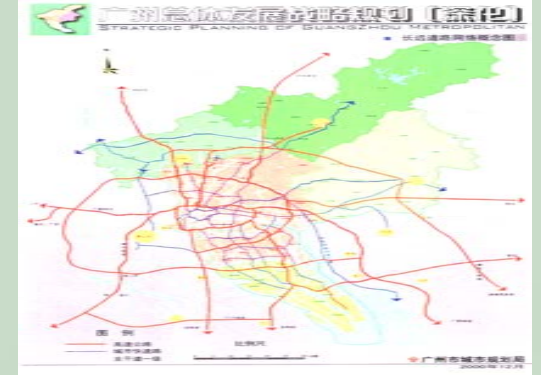
# Trends and Challenges(4): Transportation



Beijing Road Transport



Guangzhou Rail Transport



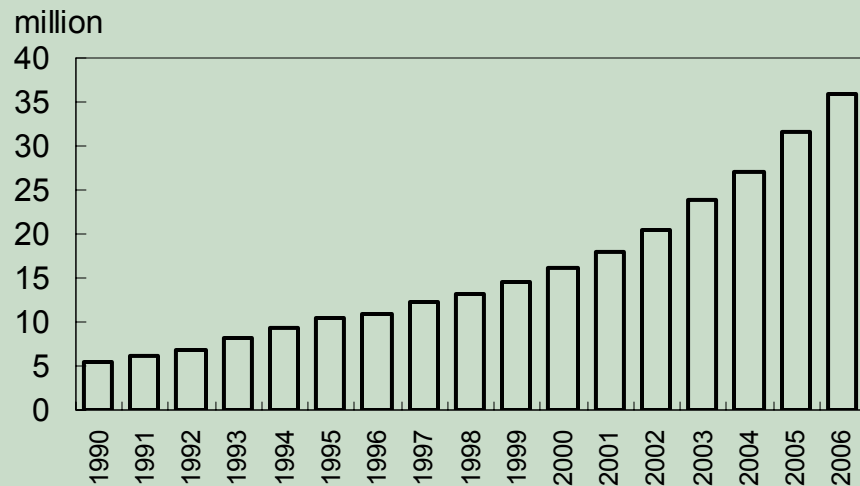
Guangzhou Road Transport



Beijing Subway Transport



# Trends and Challenges(5): Motorization



**From the early 1990s to today:**

annual growth rate ----13%

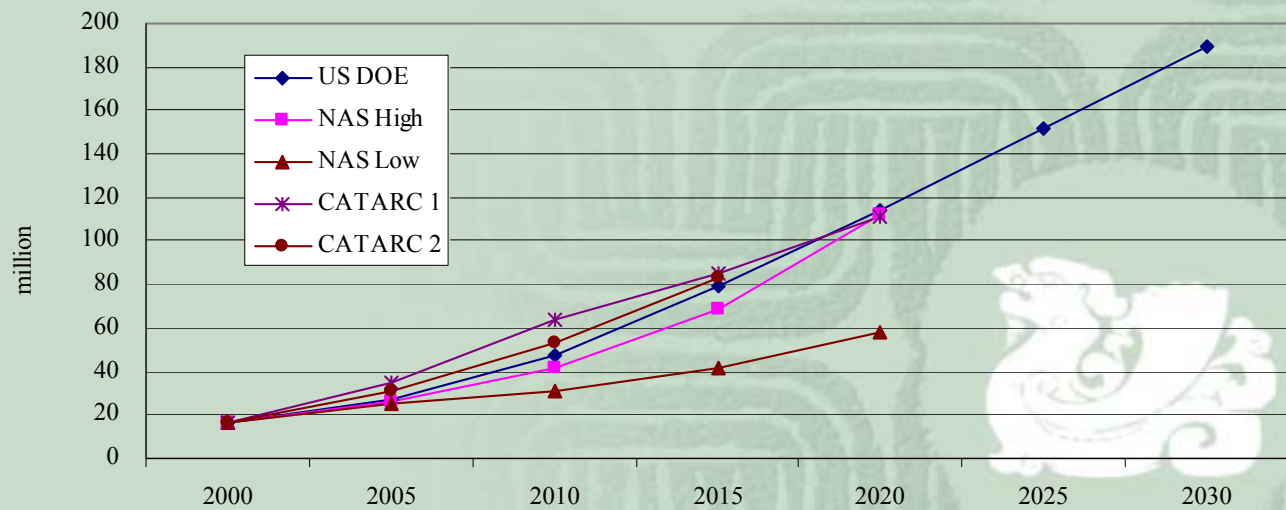
**By the end of 2006:**

total automobiles 35.9 millions;

total private cars 11.5 millions.

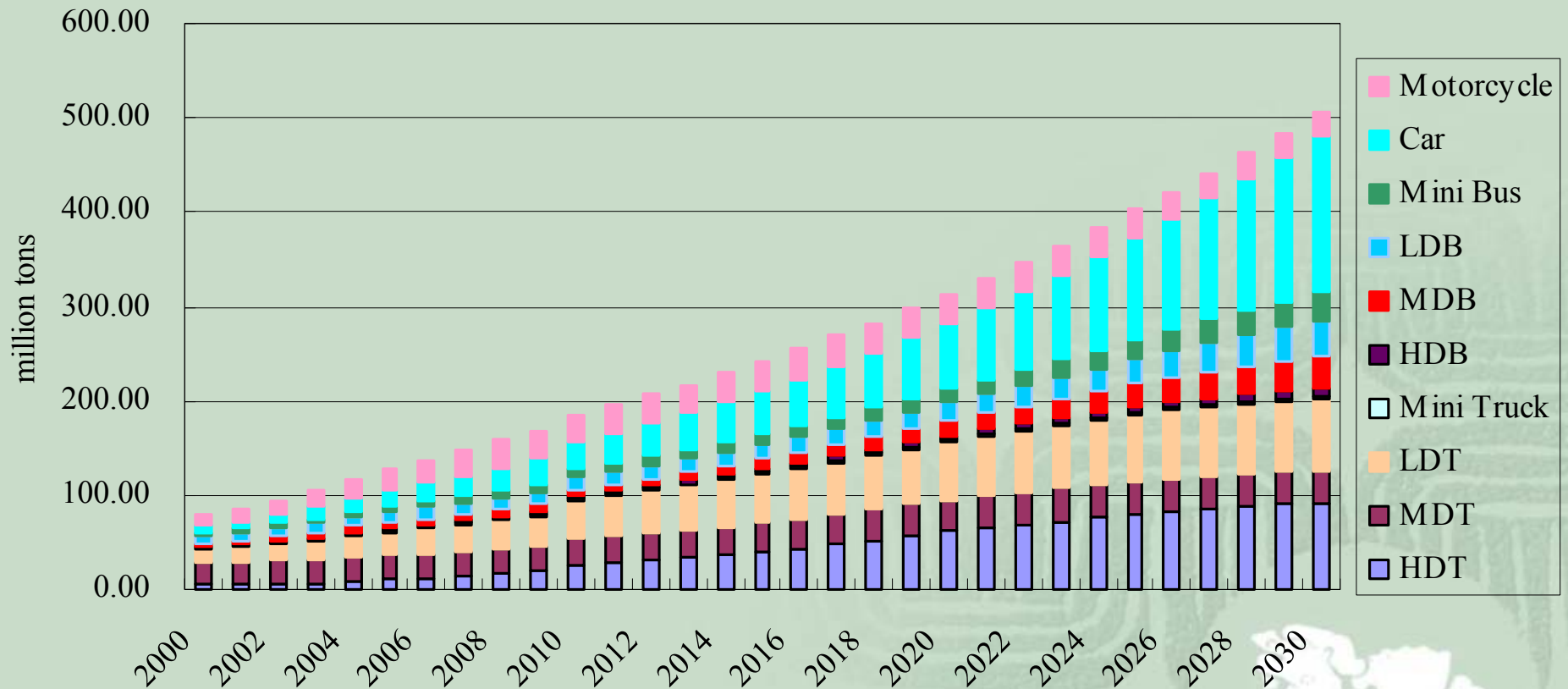
**2020:**

1-1.3 billion vehicles



# Trends and Challenges(6): Fuel Consumption in Road Transportation

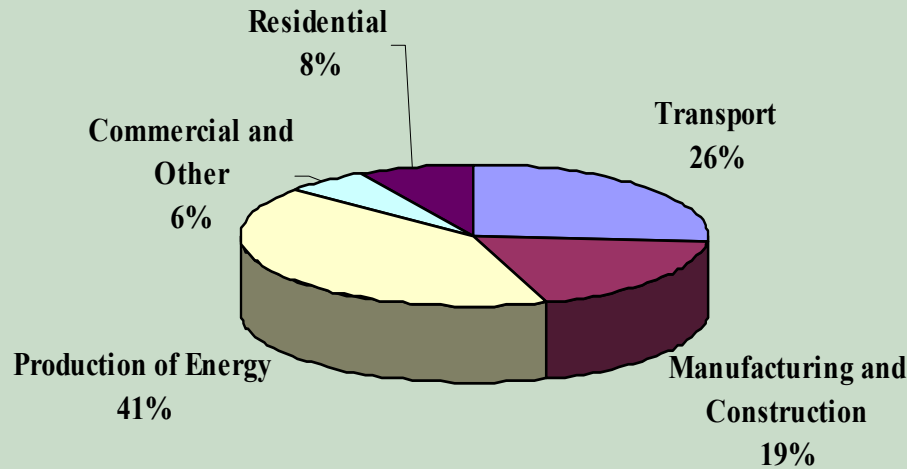
BAU



**300 million tons in 2020**  
**500 million tons in 2030**

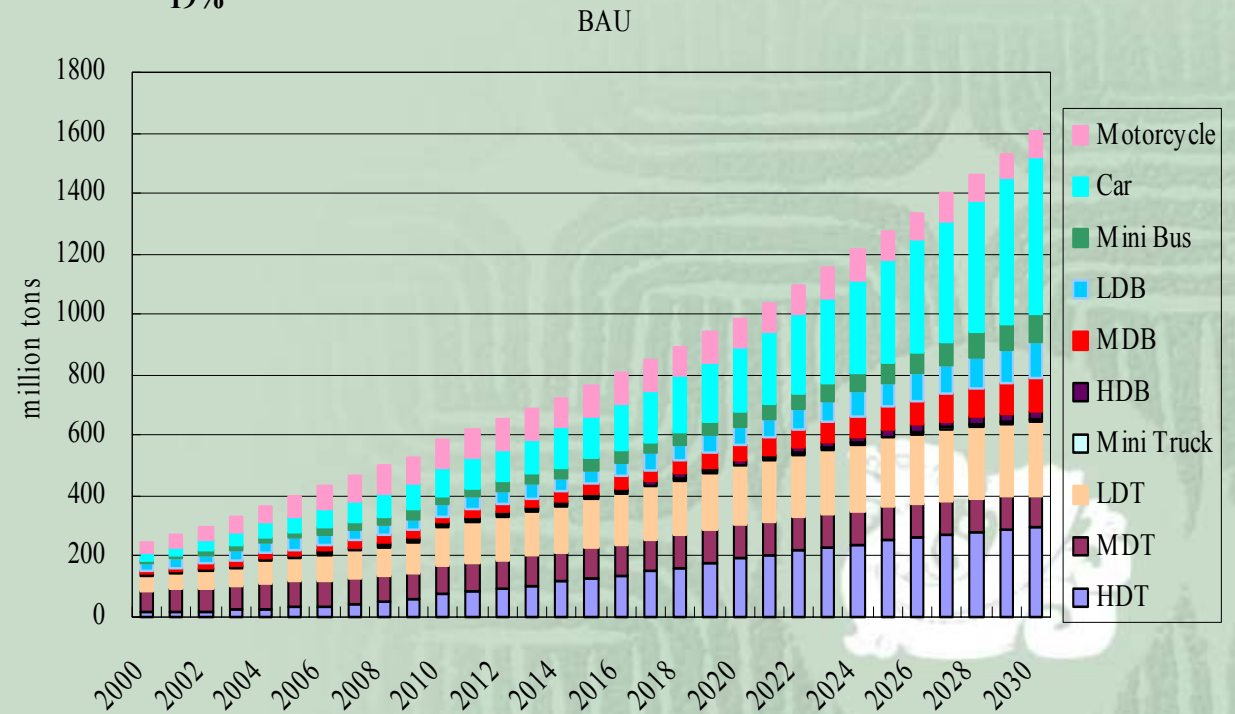


# Trends and Challenges(7): Emissions: CO<sub>2</sub>



## Transportation sector:

**1.0 billion tons in 2020**  
**1.6 billion tons in 2030**



# Contents

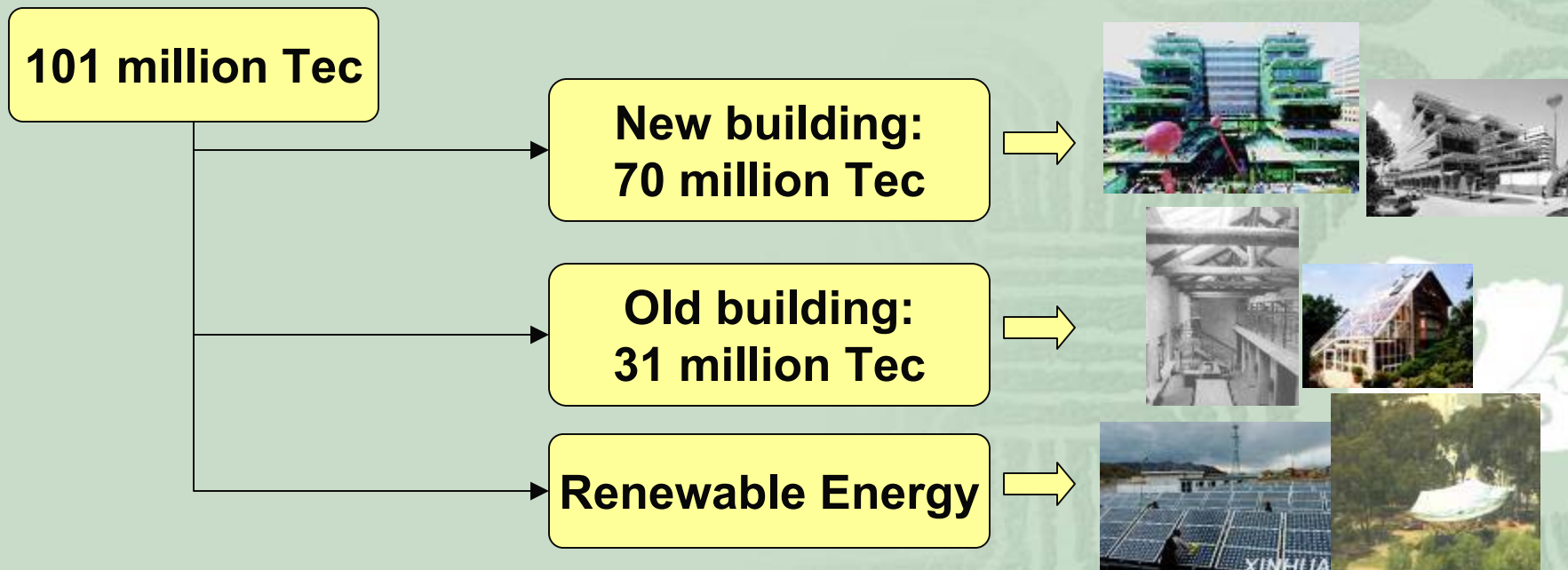
- Trends and Challenges
- Policies and Measures
- Future Demands



# Policies and Measures (1)

## Building energy efficiency

- “11th-five-years”:
  - ∞ energy saving target for buildings 101 million Tec
  - ∞ 42% of total energy saving target



# **Policies and Measures (2)**

## **Energy saving from transportation**

**Four ways to improve energy efficiency  
and limit carbon emissions:**

- ∞ Fuel Economy**
- ∞ Fuel Quality**
- ∞ Fuel Diversity**
- ∞ Reducing VKT**



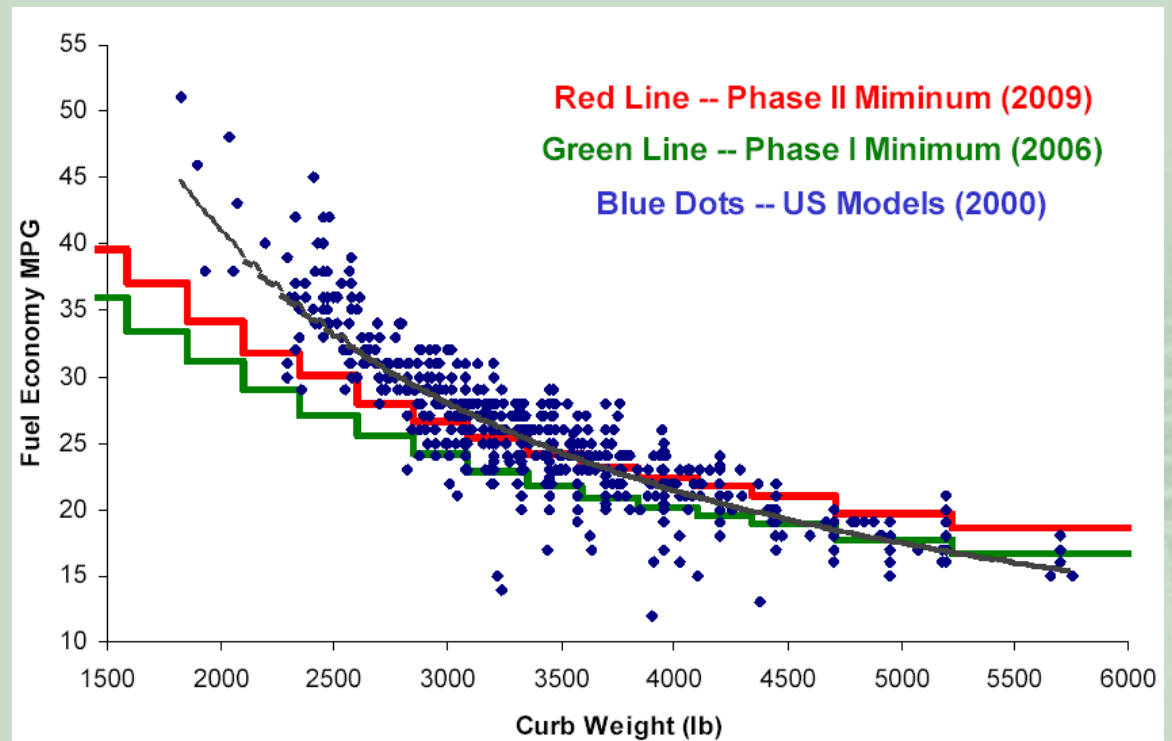
# Fuel Economy (1): National Fuel Efficiency Standard (issued by SDPC in 2003)

**2005 to 2008:**

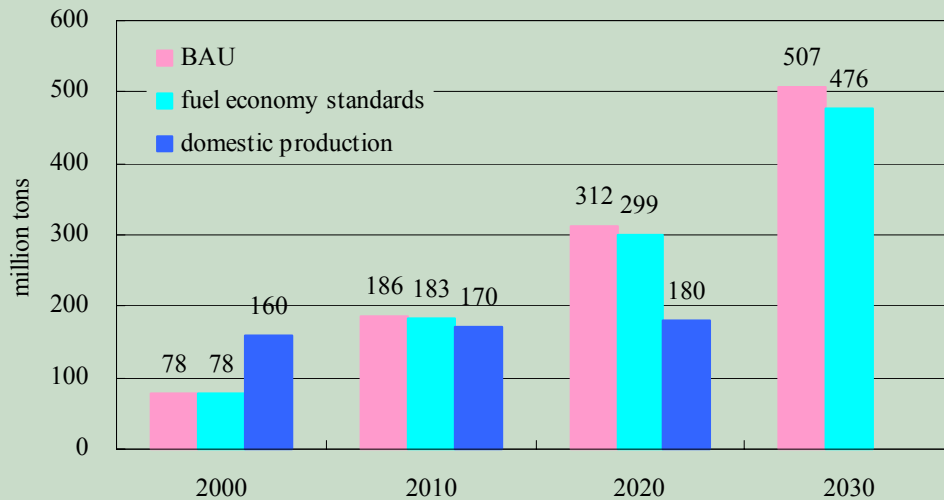
**reduce per-VKT fuel  
consumption by 5%~10%**

**after 2008:**

**further reduce by 15%**



# Fuel economy (2): Effectiveness

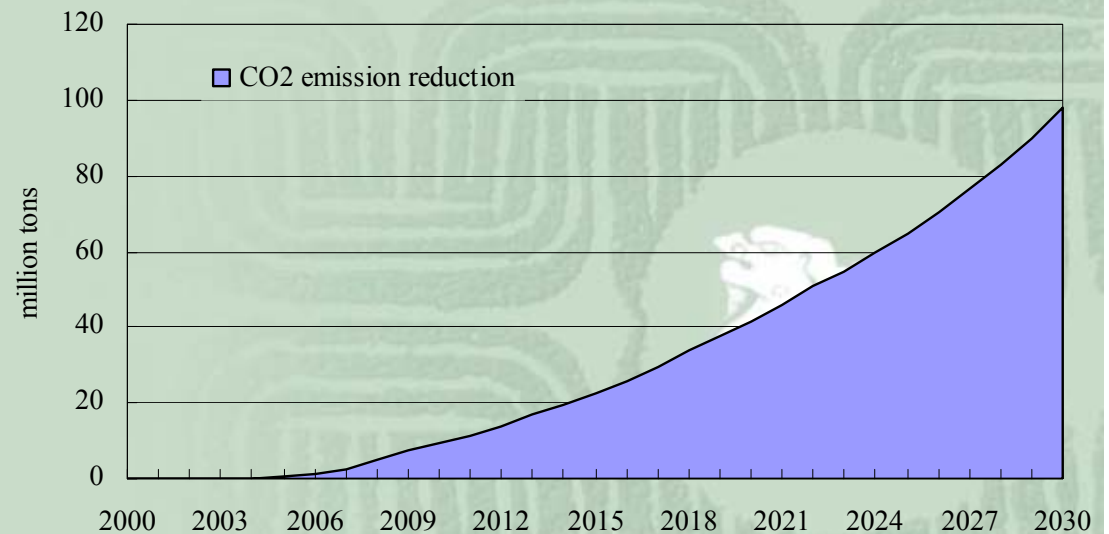


**Fuel saving:**

**13 million tons in 2020**

**31 million tons in 2030**

**CO<sub>2</sub> emission reduction:  
100 million tons  
in 2030**



# Fuel Economy (3): further improvements

(under consideration)

## Measures:

### 2012 , light-duty passenger cars:

Further reduction 25% to 5.6 L/100km (European requirement for 2008)

### 2016 , light-duty passenger cars:

To 4.8 L/100 km (catch up with Europe and Japan )

## Effects:

### Fuel saving:

Additional 19 million tons oil in 2020; 60 million tons in 2030

### CO2 emission reduction:

Additional 61 million tons in 2020; 189 million tons in 2030

# **Fuel Economy (4): for heavy-duty**

**(under consideration)**

## **Measures:**

**2010: reduction of 20%**

**2012: Further reduction of 25**

**2016: Catch up with developed countries**

## **Effects:**

### **Fuel saving:**

**Additional 25 million tons oil in 2020; 52 million tons in 2030**

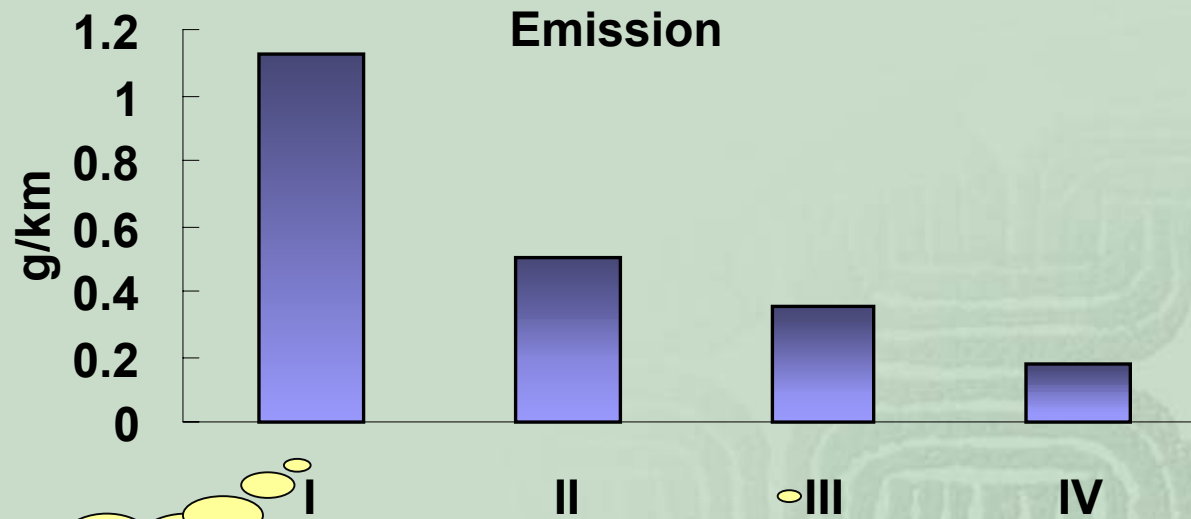
### **CO2 emission reduction:**

**166 million tons in 2030**



# Fuel Quality

## Vehicle emission standards in China



Unleaded petrol  
(gasoline) for motor  
vehicles

Low sulfur fuels



# Fuel Diversity (1)

## ■ Liquid fuels

- ∞ Ethanol made from bio-plants
- ∞ Rapeseed oil (bio-diesel) from bio-plants

## ■ Gaseous fuels

- ∞ CNG, LNG and LPG, but low specific power

## ■ Problem and Perspective

- ∞ High cost to produce the bio-fuels



## Fuel Diversity (2)

- **Optimization of Traditional Technologies**

- ☞ Future small cars

- ☞ Efficiency of internal combustion engine achieve 45%-55

- **Battery Electric Vehicles**

- ☞ “Zero-emission” vehicle;

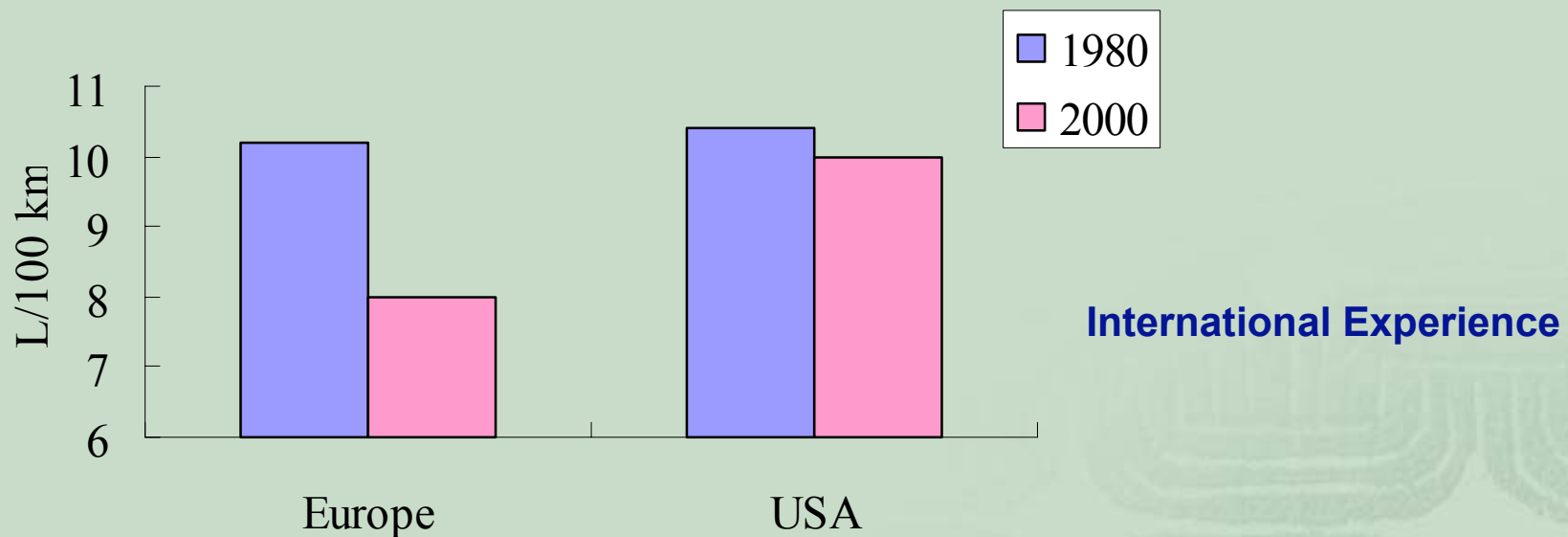
- **Fuel Cell Vehicles**

- ☞ High efficiency, low emission electrical power system;

- ☞ Long-term potential, obstacles for commercialization.



## Fuel Diversity (3): Diesel vehicles



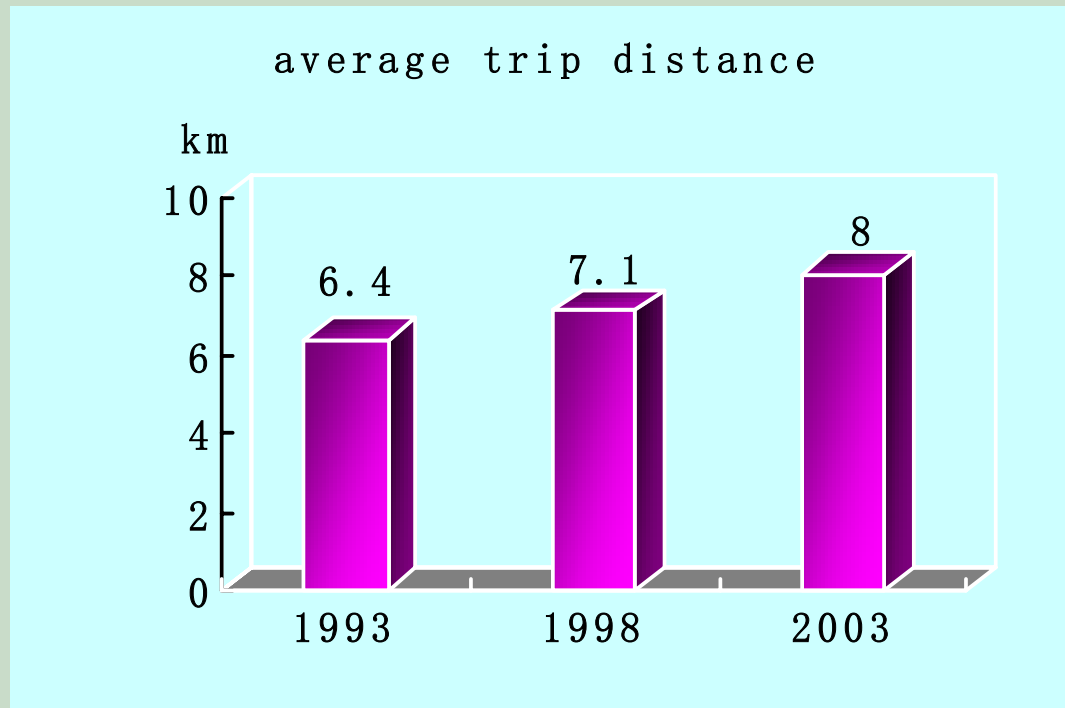
### ■ In China:

- ⌘ 23.7% of all vehicles are diesel but only 0.2% of cars are diesel
- ⌘ diesel percentage in passenger vehicles is proposed to increase to 5%, 15% and 30% in 2010, 2015 and 2020
- ⌘ If 20% of PC were diesel, 30 million tons oil would be saved



# Reduce VKT(1)

## --- Urban and transportation planning



◇ Trip distance increased in Beijing

◇ How to make the trip more efficient?

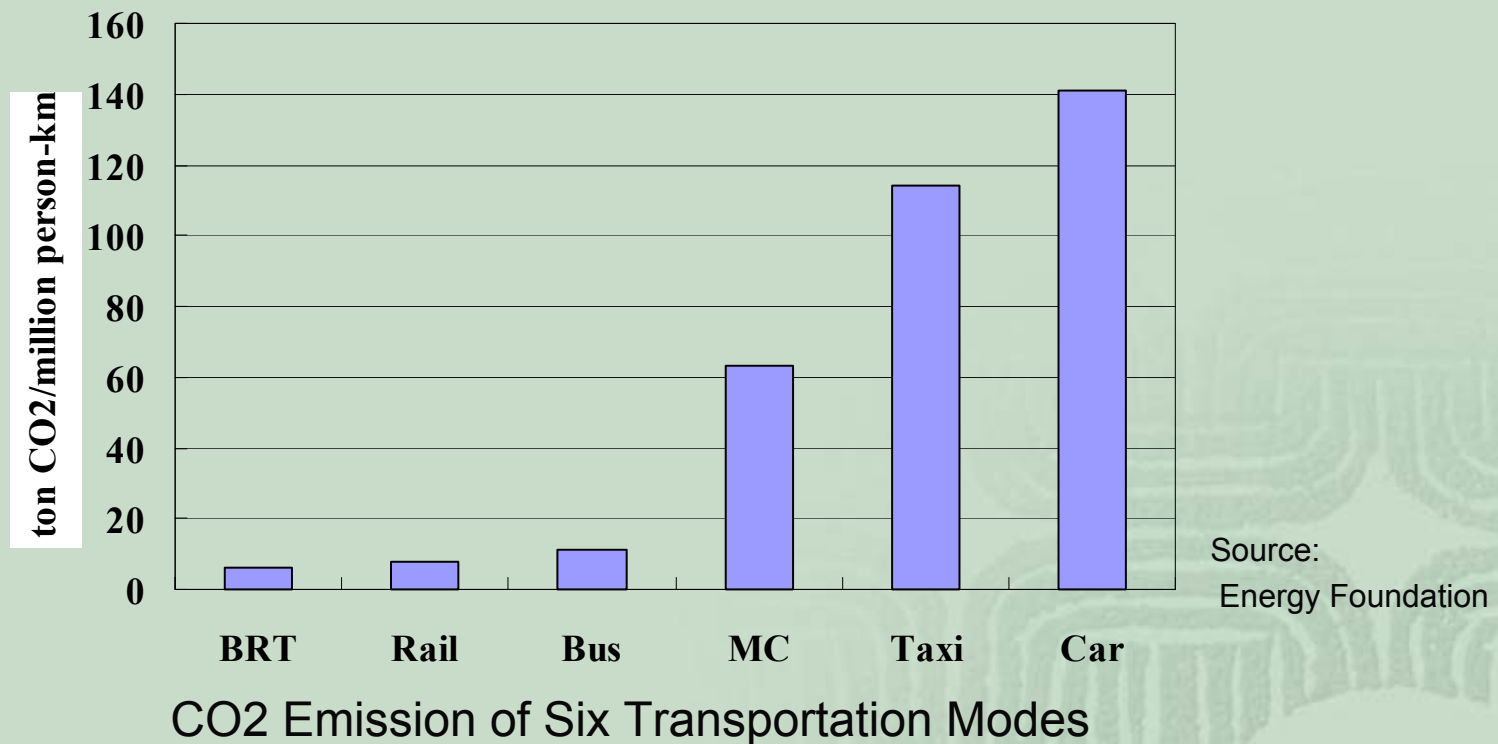


## Reduce VKT(2) --- TDM

- National Fuel tax proposed to be increased
- Car ownership controls already in Shanghai
- Off Street parking provision limited for new developments
- Differential parking pricing in Beijing & Shanghai
- Development of subway/BRT systems in major urban areas

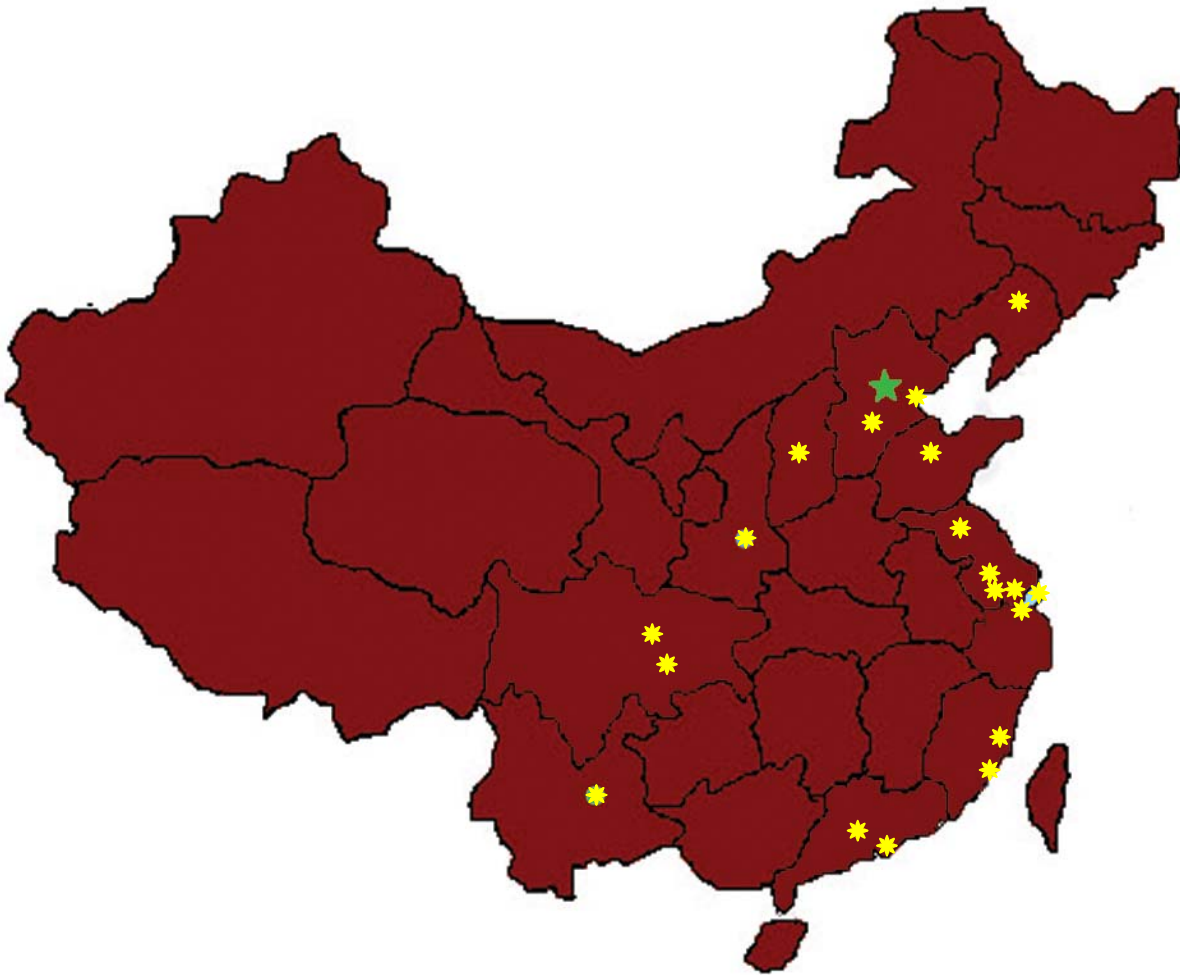


## Reduce VKT(3) -- Trip mode shift



- Cars produce the largest CO2 emission per passenger-kilometer, 7 times of the buses
- Promotion of mass public transfer tool: light rail, subway or BRT

# BRT Practice in China



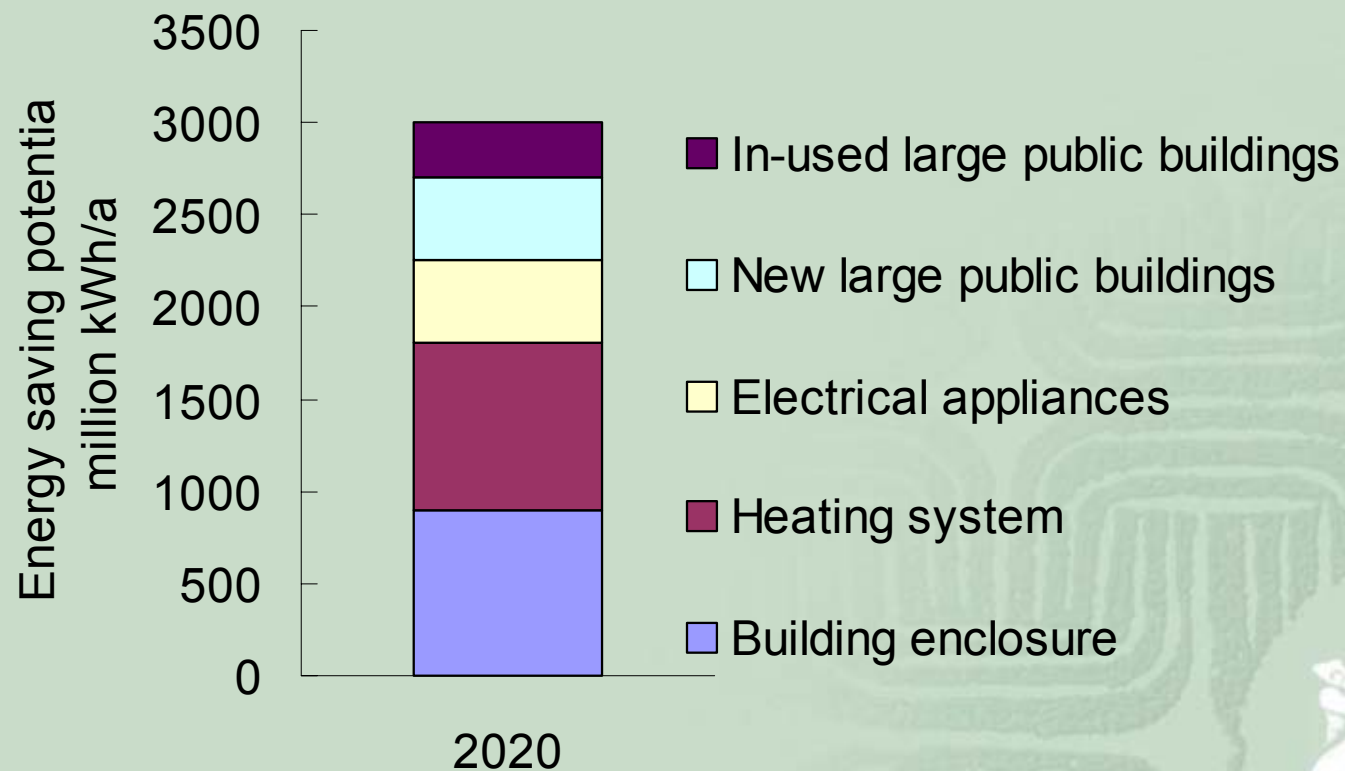
**Under Operation:**  
**BJ, HZ, and KM**

**Under Construction:**  
**Jinan**

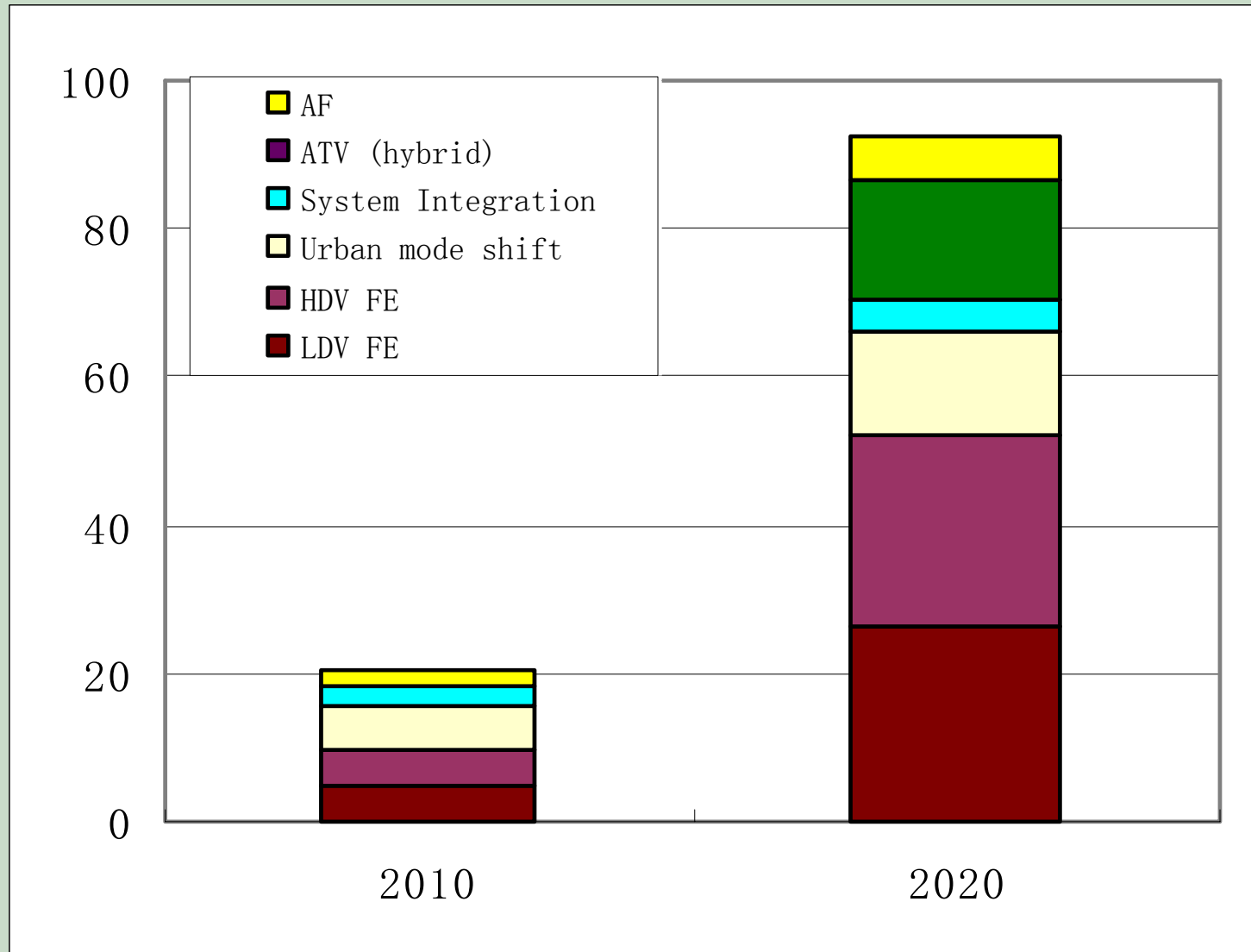
**Under planning:**

<b>CD</b>	<b>FZ</b>
<b>CQ</b>	<b>NJ</b>
<b>TJ</b>	<b>SZ</b>
<b>SY</b>	<b>SZ</b>
<b>XA</b>	<b>WX</b>
<b>GZ</b>	<b>HA</b>
	<b>XM</b>
	<b>TY</b>

# Technical potential to reach the target (1) building



# Technical potential to reach the target (2) transportation



# Contents

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# **Demands for International supports**

## **Technical (1)**

- **Mid-term, long-term technologies to improve building energy efficiency:**
  - ❧ new technologies in building fabrics
  - ❧ ventilators and exhaust heat recovers
  - ❧ heat pumps
  - ❧ technologies to reduce energy consumption in distribution systems
  - ❧ temperature and humidity independent control system
  - ❧ energy saving optimizing control of building automatic systems
  - ❧ building combined power
  - ❧ heating & cooling system (BCHP)
  - ❧ new type of configuration of district heating system as well as high efficiency lightings



# **Demands for International supports**

## **Technical (2)**

- **Mid-term, long-term technologies to improve fuel economy**

### **Engine technologies**

- 1. Multi-valve, overhead camshaft
- .....
- 15. Direct injection diesel engine

### **Transmission technologies**

- 16. 4 and 5 speed automatic transmission
- .....
- 22. Advanced Continuously variable transmission

### **Vehicle Unit technologies**

- 23. Aerodynamic improvement
- .....
- 28. Safety enhancing weight reductions

### **Engine-Transmission-Vehicle technologies**

- 29. Engine-Transmission-Vehicle technologies



# **Demands for International supports**

## **Methodology**

### ■ **Building**

- ∞ building energy consumption model
- ∞ energy estimation for commercial buildings
- ∞ energy label system for residential buildings
- ∞ energy label system for home appliances

### ■ **Transportation**

- ∞ Evaluate the effect of advanced technologies, including alternative fuels
- ∞ Evaluate the effect of transportation system optimizing



# **Demands for International supports**

## **Financial**

- ☞ **Demo projects for**
  - energy saving building**
  - advanced vehicle technologies**
  - low carbon transport mode (i.e. BRT)**
  - eco-friendly town or city development**
- ☞ **Capacity building**



# Conclusion

- **China's Urbanization Process is in a normal and relatively low development stage; there is very serious Imbalance of developments between east and west China; Future development is expected and necessary.**
- **Great efforts have been made in China to promote sustainable urbanization process, especially for energy saving and emission reduction in building and transportation sectors.**
- **Technical, scientific and financial supports from international society are needed for further efforts to improve energy efficiency and reduce emissions.**



Thank you!

