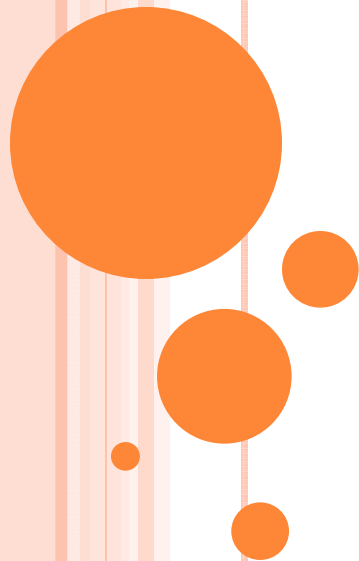


# **ENERGY SAVING IN TRANSPORTATION**

**Wang Xie-qing  
Research Institute of Petroleum  
Processing  
SINOPEC  
Dec. 2008  
Beijing, China**

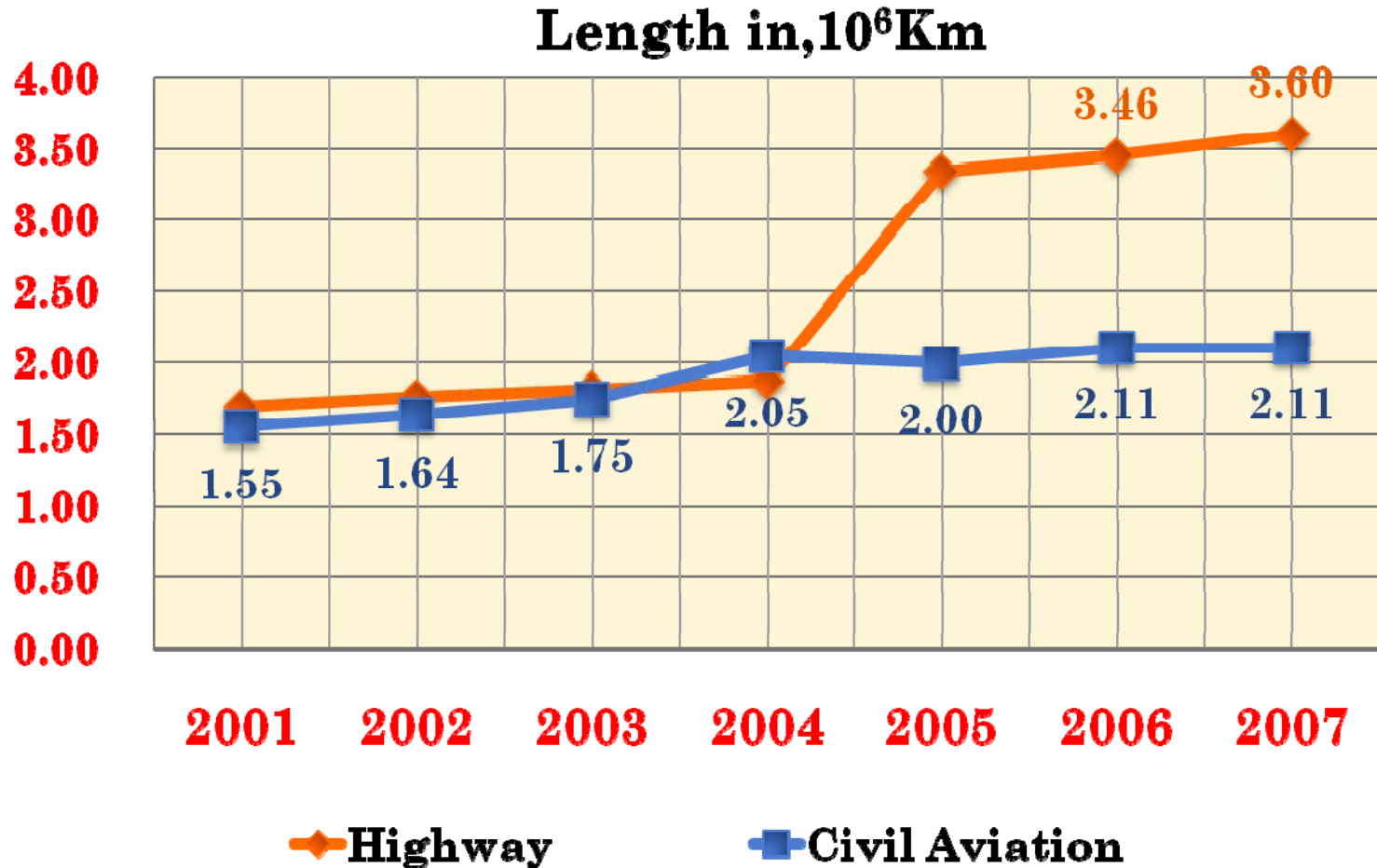


# IMPORTANT PRIORITIES ON ECONOMIC DEVELOPMENT IN CHINA

- Improving Energy security and curbing green house gas emissions.
- Implementing Energy Saving in all sectors of national economy, especially in transportation.
- Reducing Emissions, especially in industrial sectors.

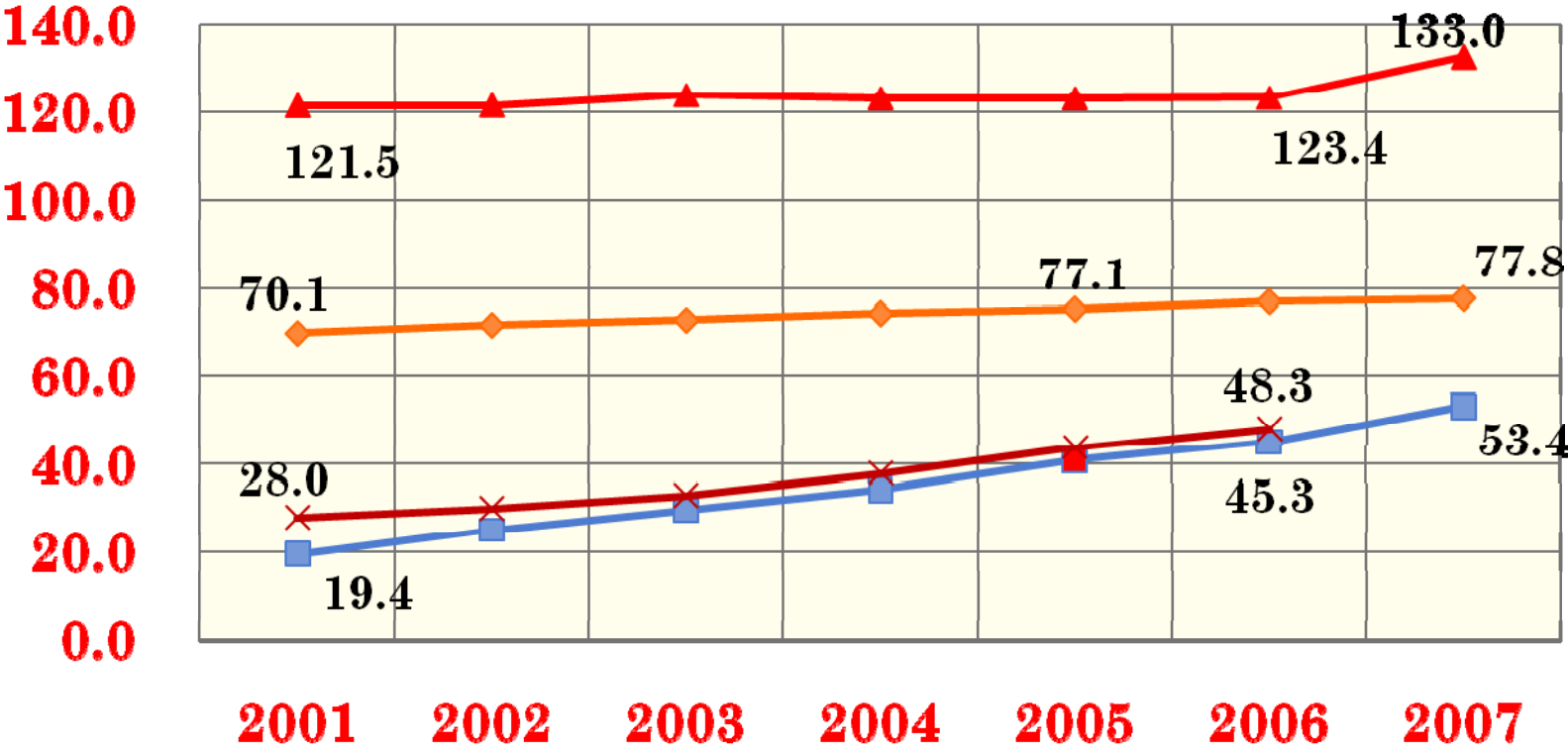


# TRANSPORTATION MEANS IN CHINA



# TRANSPORTATION MEANS IN CHINA

Length of Line, 10<sup>3</sup>Km



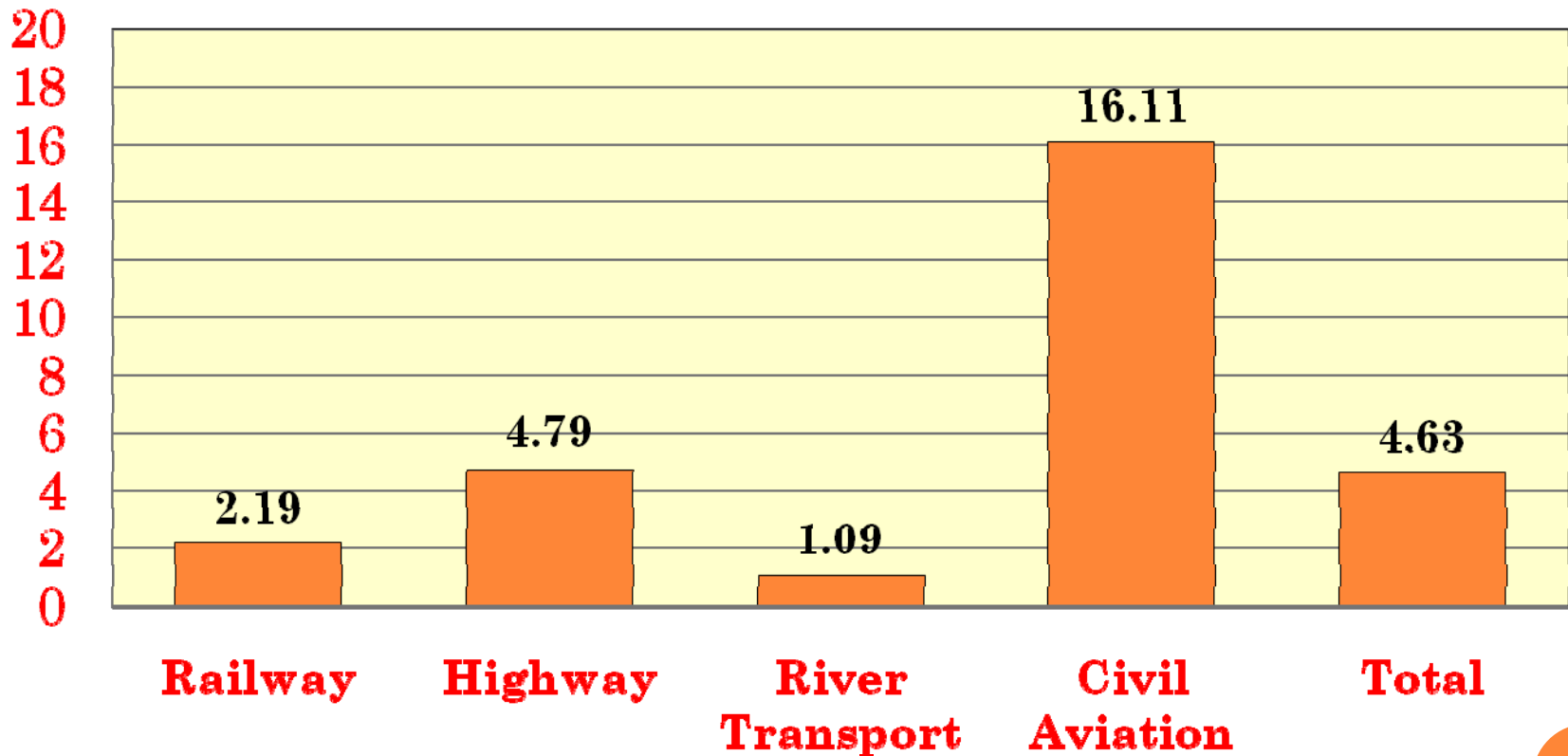
◆ Railway    ■ Expressway    ▲ River Transport    ✕ Pipeline



# TRAFFIC PASSENGERS IN CHINA

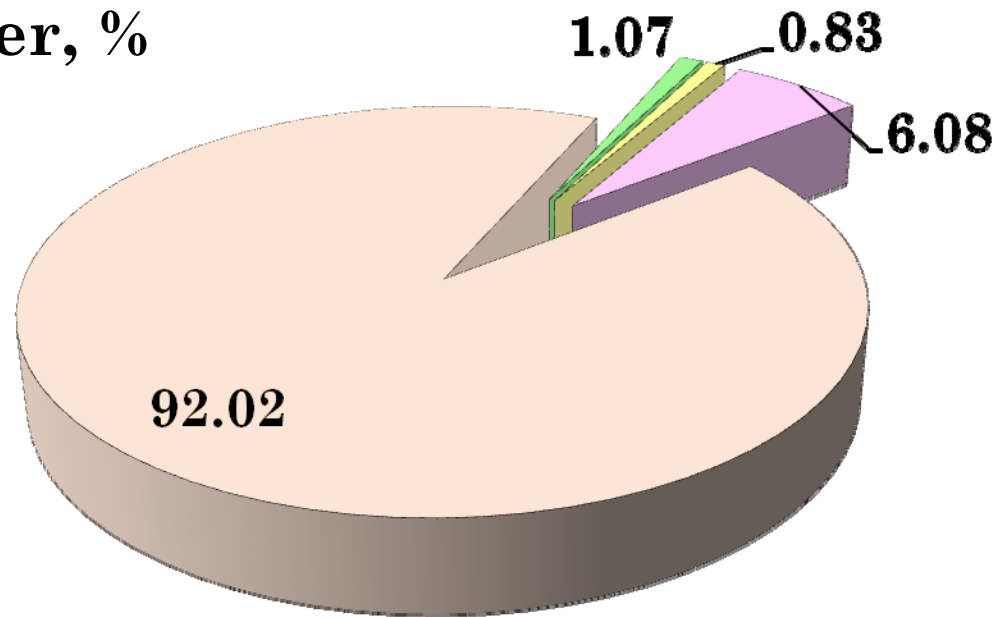
Type of Transportation	passengers, (million people)			Structure for Passengers(%)		
	2005	2006	2007	2005	2006	2007
<b>Total</b>	<b>18,470.18</b>	<b>20,241.58</b>	<b>22,370</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
<b>railway</b>	1,155.83	1,256.56	1,360	6.26	6.21	6.08
<b>highway</b>	16,973.81	1,8604.87	20,580	91.90	91.91	92.02
<b>river transport</b>	202.27	220.47	240	1.10	1.09	1.07
<b>Civil aviation</b>	138.27	159.68	185.76	0.75	0.79	0.83

# AVERAGE GROWTH RATE IN THE 2000-2005 PERIOD (%)



# STRUCTURE OF PASSENGER TRANSPORTATION IN CHINA(2006)

Passenger, %



■ Railway

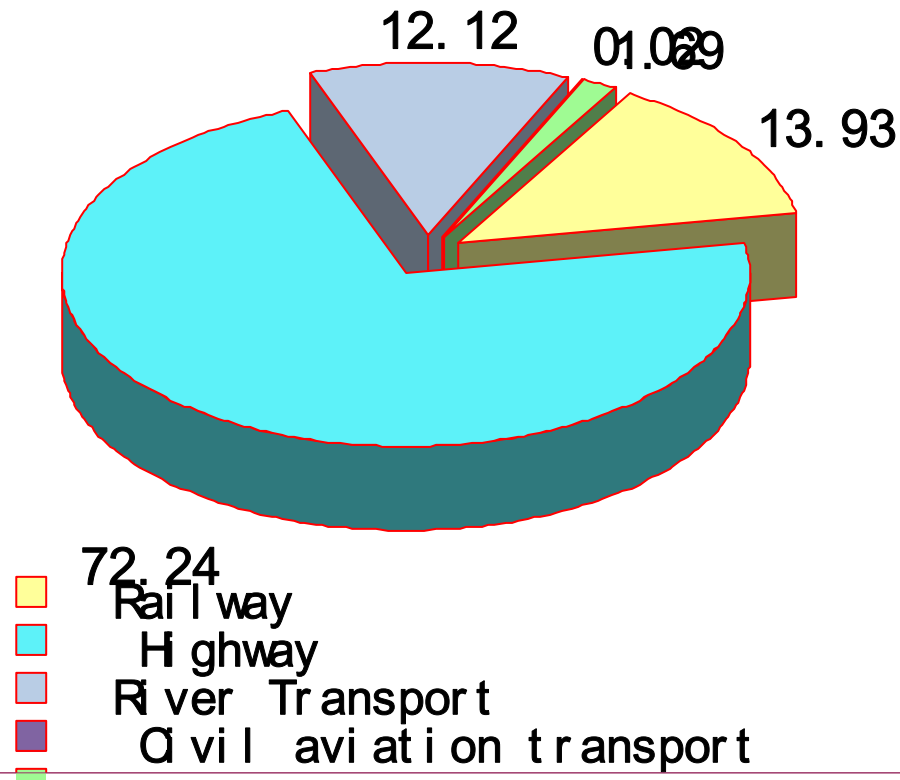
■ Highway

■ River Transport

■ Civil aviation transport

# STRUCTURE OF FREIGHT TRANSPORTATION IN CHINA(2006)

freight transport, %



# PROMOTING VEHICLE FUEL QUALITY IN LINE WITH INTERNATIONAL STANDARD

- Since 1998, Phase-out of low-grade gasoline and diesel, and phase-in of unleaded gasoline were realized.
- Striving for the quality in line with international advanced fuel quality standard.
- Gasoline: Enhancing Octane Number, Reduction of sulfur and benzene contents and appropriate reduction of olefin content .
- Diesel fuel: Enhancing cetane number, Reduction of sulfur and polyaromatics contents.

# FACING THE CHALLENGE OF INCREASING DEMAND

- In the 2002-2006 period the consumption of gasoline, kerosene and diesel increased rapidly at an average annual growth rate of 8.5%.
- To meet this growth rate, China has to increase an annual crude processing capacity of over 16 MTA to satisfy the market demand for gasoline, kerosene and diesel.
- Gasoline consumption in 2008 will reach 64MTA, an increase of 5 million tons compared to last year.
- Diesel fuel consumption will reach 133MTA in 2008.

# PAYING OUT SIGNIFICANTLY FOR IMPROVING VEHICLE FUEL QUALITY

- Dozens of billion RMB were spent for revamping refinery facilities in order to upgrade automotive fuel quality in compliance with the national III standard (equivalent to EN III).
- Beijing has enforced gasoline standard IV (equivalent to EN IV) since 2008.

# KEEPING PACE WITH MORE STRICT INTERNATIONAL FUEL STANDARD

- Fuel Quality of European Union Standard for Vehicle Emission:

- ◆ **Gasoline (EN IV):**

S  $\leq$  50ppm; Benzene  $\leq$  1%; Aromatics  $\leq$  35%;

Olefins  $\leq$  18%; Oxygen  $\leq$  2.3% ;

- ◆ **Diesel Fuel(EN IV):**

Cetane Number  $\geq$  58; Specific Gravity 820-845;

Polyaromatics  $\leq$  1 vol%; S  $\leq$  50ppm;

# PRIORITY OF TRAFFIC MEANS IN URBAN- PUBLIC TRANSPORT

- Public traffic: Fueled with CNG or driven by Hydrogen fuel cell, if possible, in the future;
- Very cheap ticket for encouraging people to take this means.
- Underground Railway: Worthwhile despite enormous investment, especially in metropolitan cities.

# SUGGESTIONS ON AUTOMOBILE INDUSTRY

- According to Chinese situation, i.e. high density of population in big cities, limited land and resources, especially shortage of petroleum, it is necessary to find a sustainable development mode.
- For passenger cars: Low powered (small total-displacement engine), energy saving, comfortable and safe vehicles.
- For trucks: All equipped with modern diesel engine.
- For policymakers: Study the experiences and lessons from developed countries, like Japan, and CAFE in USA.

# SETTING CEILING OF CAR POPULATION IN METROPOLIS

- Beijing boasts 3.4 million vehicles to date, including 2.1 million private cars.
- Traffic jams and air pollutions make residents complain about quality of living.
- For supporting a healthy and comfortable life, achieving sustainable development and keeping ecological environment, a limitation of car population in metropolises, like Beijing, Shanghai, Guangzhou etc, is absolutely necessary.
- Mode of thinking on consumption should be changed, especially for the rich people.

# FOR LONG DISTANCE TRAVELLING—EXPRESS RAILWAY EMPHASIZED

- Express Railway travel should be the first choice between metropolises.
- From Beijing to Tianjin 30 min needed only;
- Most railway stations are located in the city (uptown or mid town), provided with very convenient connection with other transportation means.

# FOR LONG DISTANCE TRAVELLING-EXPRESS RAILWAY EMPHASIZED

- Construction of Express Railways with high speed between 250-350 km/h is underway.
- Saving Energy, Saving Time and Saving Money.
- The Chinese Government plans to build 150 new railway lines, with investment amounting to 1200 billion RMB.

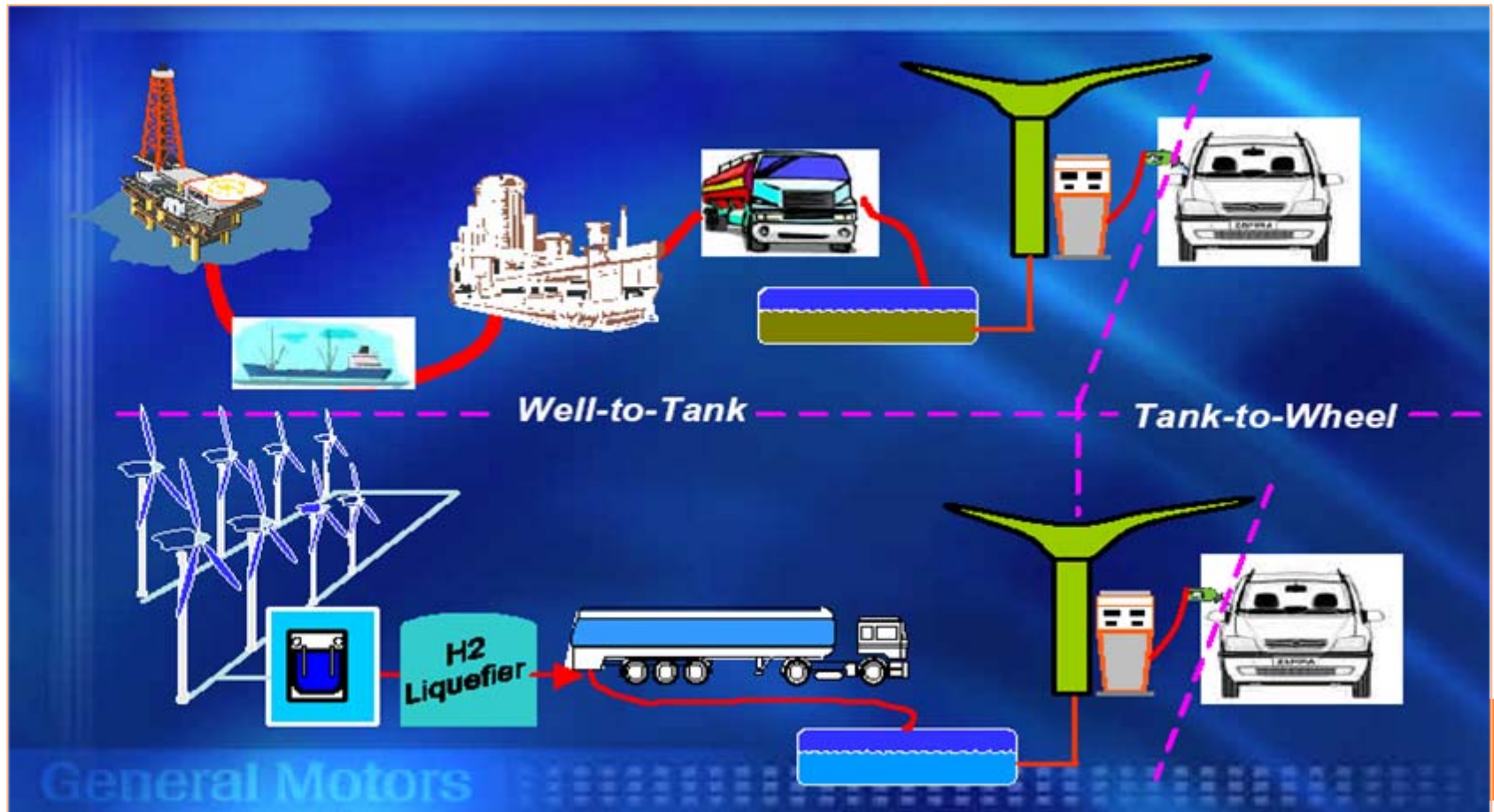
# FOR CARGO TRANSPORTATION— ESTABLISHING AN OPTIMAL MATERIALS FLOW

- Railway is still the major transport means;
- Waterborne transport has to be improved, expanded and connected with railway and truck transportation in a reasonable way, i.e. faster and cheaper;
- Computerized information technique should be used to form a network to provide an optimal materials flow.

# WATERAGE EMPHASIZED

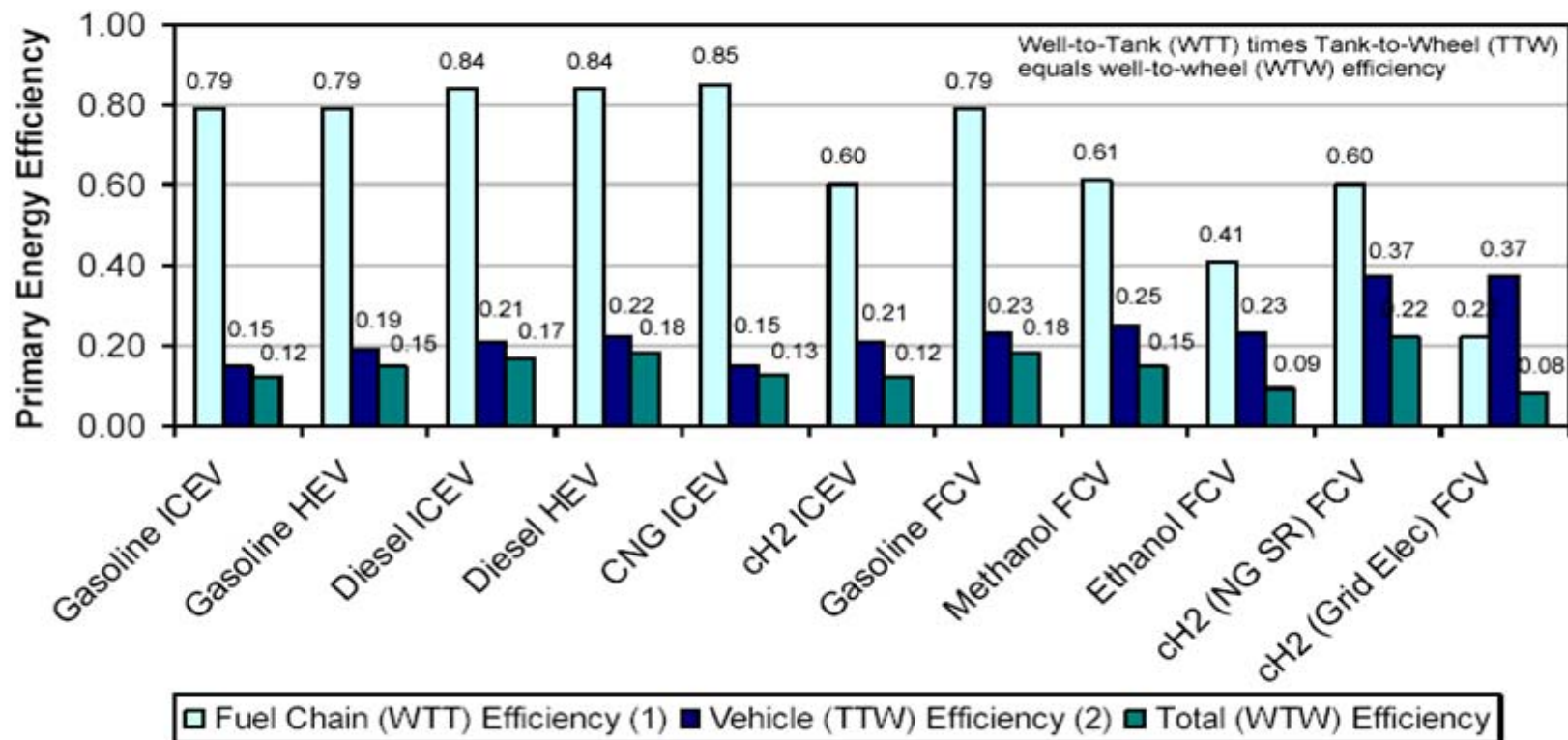
- Using River transportation means is far from enough.;
- Numerous water conservation facilities are not only for irrigation and guarding against flooding, but also for expanding and extending transportation.
- The Tree Gorges Dam on Yangtze River, the biggest one in the world, provides shipping with larger vessels and extending ways of

# COMPARING ENERGY EFFICIENCY AND EMISSIONS—DIFFERENT ENGINES AND FUELS





## Well-to-Wheel Energy Efficiency of Vehicles

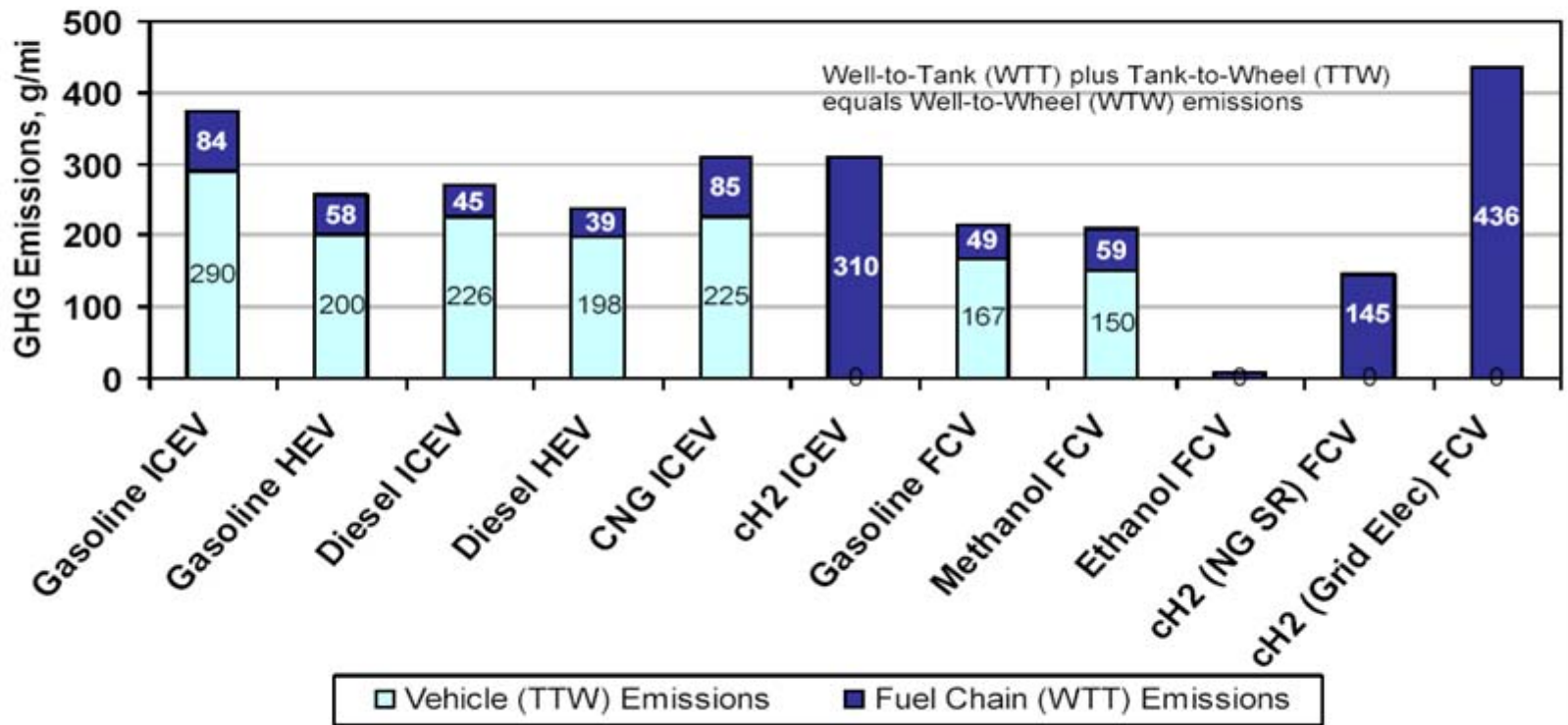


<sup>1</sup> Fuel chain efficiency is equal to the lower heating value of the fuel divided by the lower heating value of the primary energy inputs.

<sup>2</sup> Vehicle efficiency is equal to the energy required to propel the vehicle on the road (over a drive cycle) divided by the lower heating value of the fuel.



# Well-to-Wheel Greenhouse Gas Emissions of Vehicles



<sup>1</sup> Well-to-wheel greenhouse gas emissions per mile driven, weighted by global warming potential relative to carbon dioxide. Note: ethanol fuel cell vehicle results are based on the net emissions from ethanol made from corn stover including byproduct credits.

# COMPARISON RESULTS

- From the comparison of energy efficiency and green house gas emissions of 12 different type engines and fuels provided by the U.S. Department of Energy, it can be seen that the hybrid engine used both in internal-combustion engine or diesel engine has the priority.
- Chinese automakers are making strenuous efforts to develop hybrid engines and other electric engines.
- Application of such cars is encouraged by the government.

# BURYING CARBON DEEP UNDERGROUND

- Not so long ago, capture of carbon dioxide at oil production site was just a theory;
- Now it is very much a reality.
- Leading CCS (carbon capture and storage) experts including Dr. Richard Pike from UK argue that the project economics has played a pivotal factor.
- China has planned to carry out this research project at some petroleum well sites.

# CONCLUSIONS

- Energy saving in transportation is one of the important ways to alleviate green house gas emissions.
- With regard to the energy saving issues, urban traffic and long distance transportation both for traffics and materials flows were analyzed according to the practical situation in China.
- In urban area, especially in metropolises, a ceiling should be made for cars due to the high density population, traffic jams on highways and air pollutions.

# CONCLUSIONS

- There are two areas for improving energy saving: energy quality ( clean fuel standard) and driving system ( high efficiency engine).
- For long distance traffics, express railway is the first choice.
- For cargo transportation, a computerized network should be set up.

# CONCLUSIONS

- Taking the advantage of achievements from all industrial sectors to improve energy efficiency in transportation, including manufactures and water conservation facilities.
- Using renewable fuels and burying carbon dioxide may be the ultimate solutions for reducing emissions, which we are striving for.





THANKS