Tsinghua-ITPS Cooperation Research Project (TI-2010-03)

Is Low-Carbon Transport System for China in 2050 Achievable?

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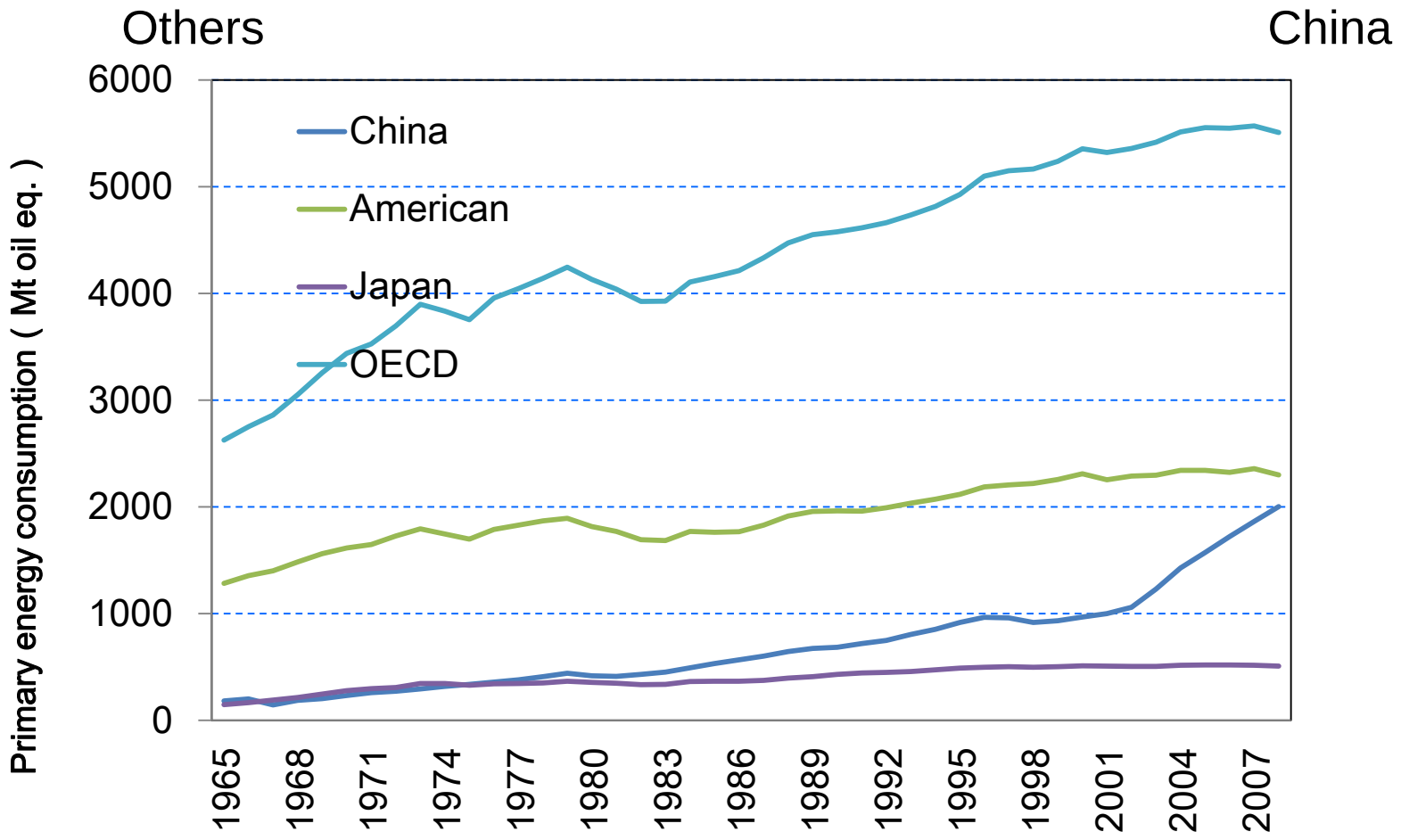
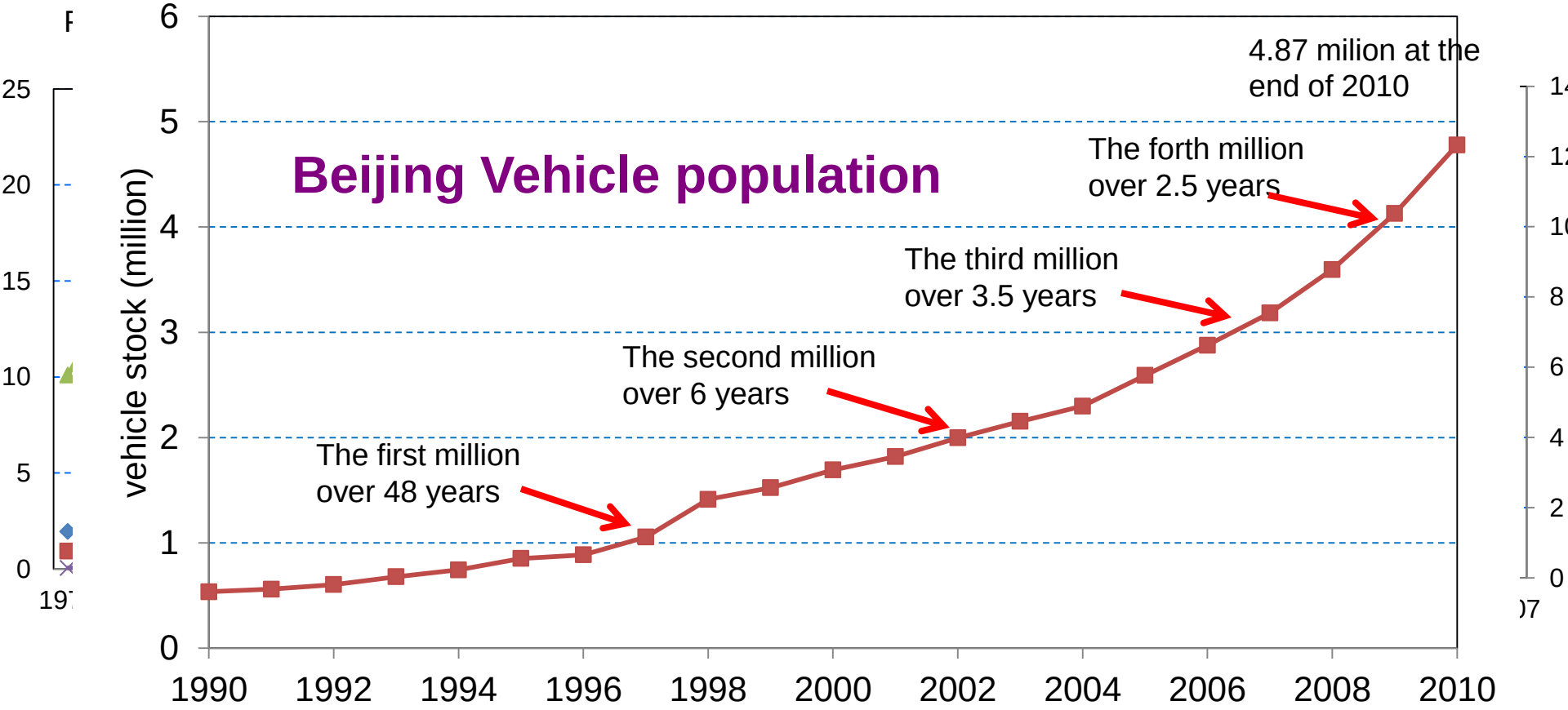
The Growth in Primary Energy Consumption in China is Fast



Source: BP statistical review of world energy full report 2009

Trends in Transport Activity



Source: China Transportation Yearbook

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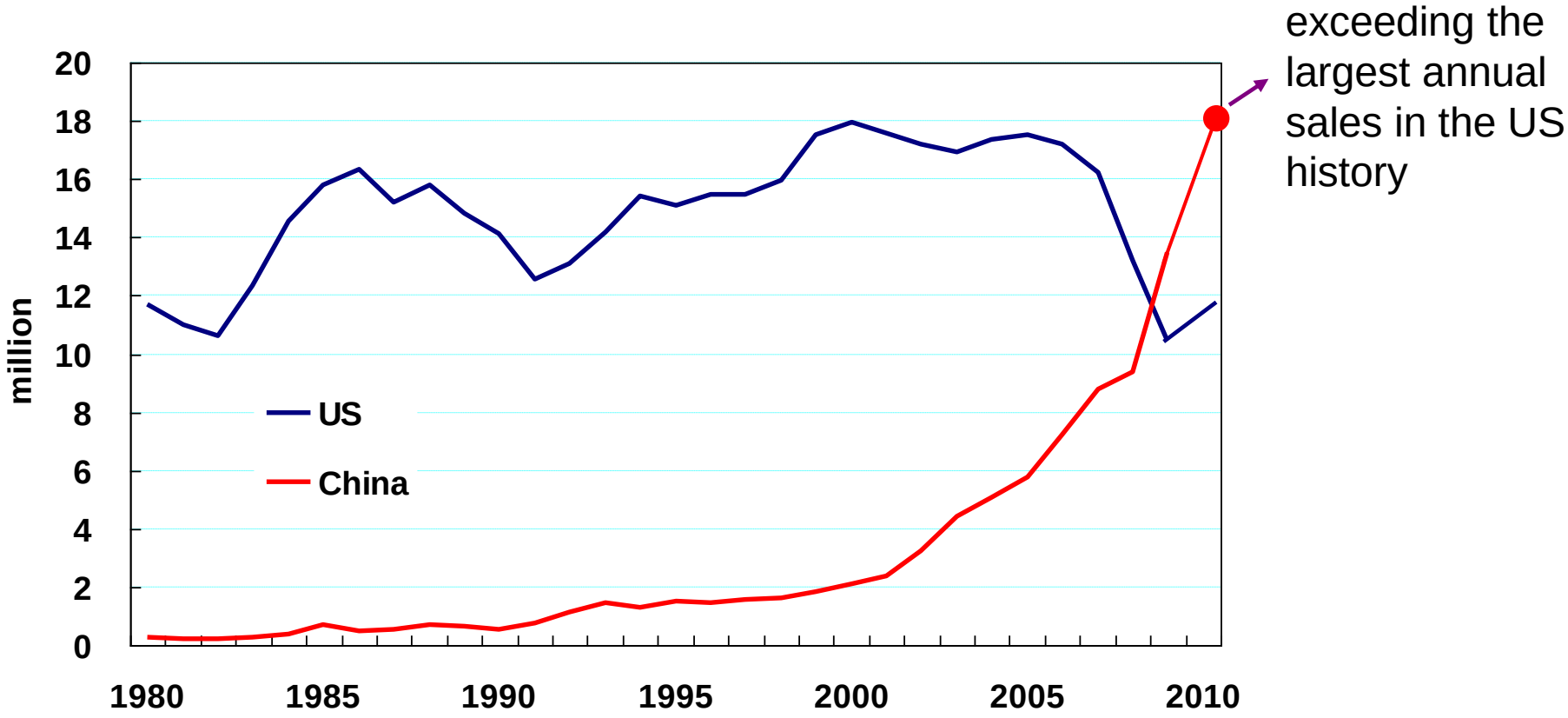
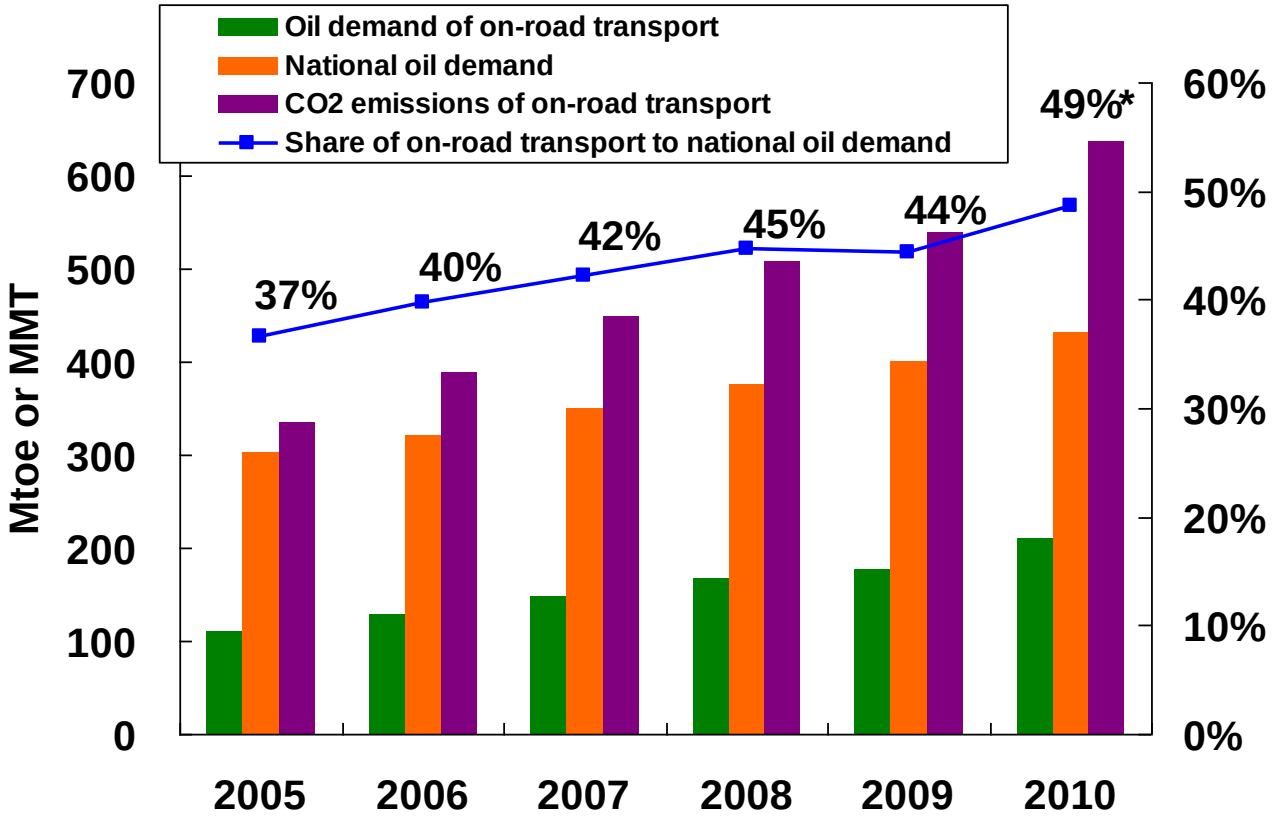
Vehicle Sales in China Vs. the U.S.



China became the largest vehicle market in the world since 2009

Oil Demand and GHG Emissions of Chinese On-Road Transport Has Increased Significantly



Source: Fuel Economy and Environmental Impacts (FEEI) model results

On-road transport in China contributes more and more to national energy demand and GHG emissions

This Study is Intended to

- **Use a back-casting approach to construct policy paths**
  - To fulfill the transport demand in the future in China
  - To meet the CO_2 reduction targets set by ITPS for the transport sector by 2050

The Back-Casting Methodology Sets the Targets First, then Propose Measures to Achieve the targets

- **ITPS sets two CO_2 emission targets for the transportation sector**

Year	*2050*	
Region	Global	China
Population (Million)	9,266	1,409
Target One: CO_2 emissions (MT) <-0%>	5,621	855
Target Two: CO_2 emissions (MT) <-50%>	2,810	427

According to the estimates from IEA, the CO_2 emissions from transport sector were 680 million tons in China in 2010.

Current Energy-Saving Policies in China

date	Issuer	Policy/regulation/criterion
01/08/1986	Ministry of Railways	Provisional Detailed Rules on the Management of Energy Conservation in Railways
01/06/1992	Ministry of Transportation	Rules for the Publication of Energy Conservation Products of Automobiles and Vessels
15/07/1997	State Planning Commission, State Economic and Trade Commission, etc.	Standards for the scrapping of motor vehicles
09/07/1999	Ministry of Railways	Policy on Energy Conservation Technologies in Railway
01/01/2000	General Administration of Quality and Technology supervision	Limits for Automobile Emission of Pollutants and Their Testing Method
16/06/2000	Ministry of Transportation	Detailed Rules on the Implementation of Energy Conservation Law in the TransportationIndustries
01/06/2002	Ministry of Railways	Criterions on Energy Conservation in Railway Engineering Design
20/09/2004	General Administration of Quality Supervision and Standardization Administration	Passenger car fuel consumption limit
25/11/2004	National Development and Reform Commission	Mid- and Long-term Specific Plan on Energy Conservation

Potential Policy Options

Plan

- Co-ordinate transport and land use
- Integrated transportation planning
- Reasonable hierarchy road network
- Strategic plan of urban transportation development

Management

- Applying polities and measures
- Reducing VMT and new vehicle population
- Implementing travel demand management (TDM)
- Scientific and modern road traffic management
- Parking planning and management

Technology

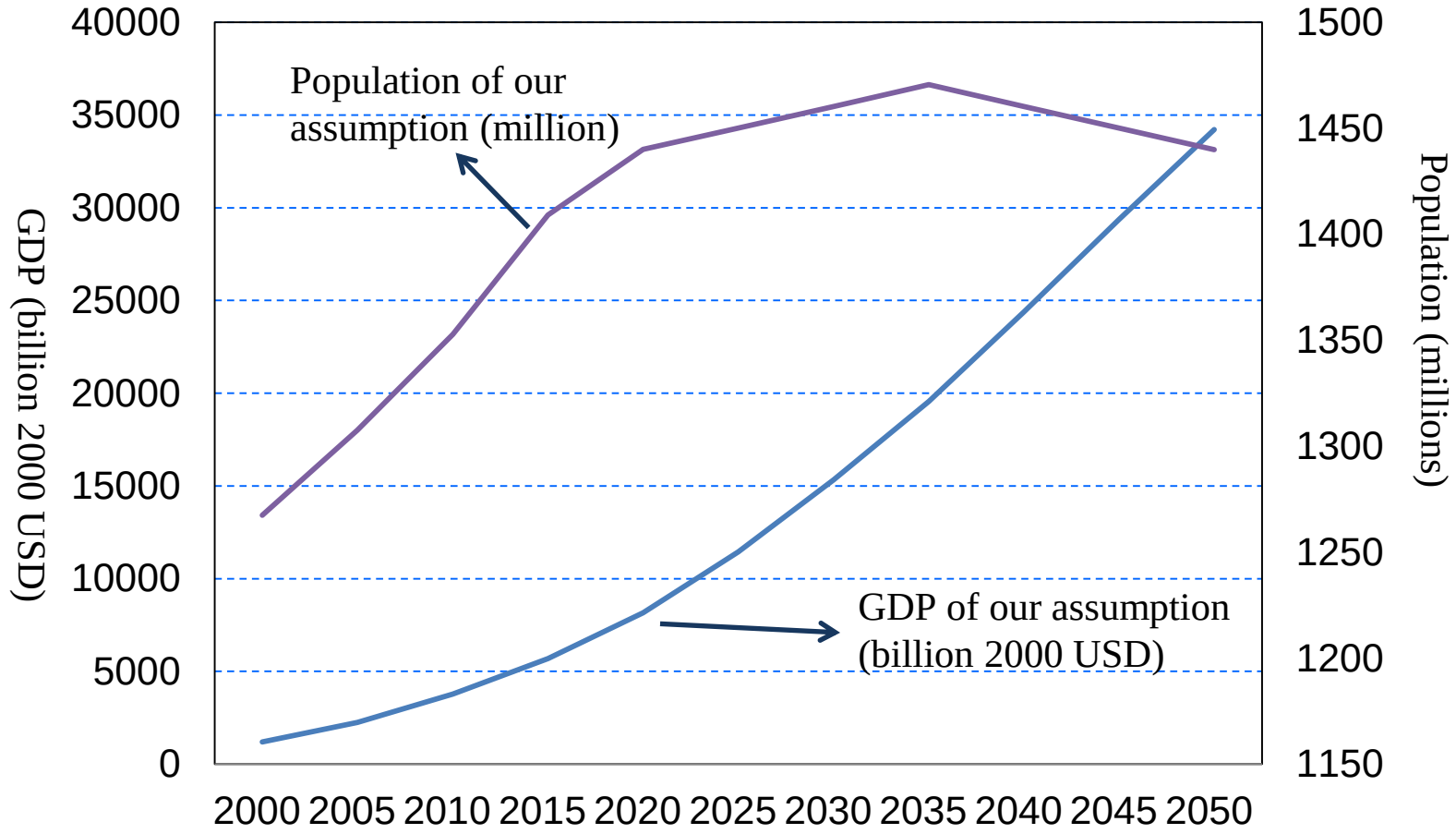
- Vehicle technologies
- Urban road traffic facilities
- Intelligent transportation system

The red ones are achievable for developing countries.

Images of the Future

- **Scenario 1 (Tokyo model)**
  - highly concentrated urban
  - highly efficient multi-level public transportation: comfortable, rapid, and convenient.
- **Scenario 2 (L.A. model)**
  - numerous towns located further apart than in scenario 1
  - large stock of the private cars
  - urban areas: convenient public transportation

GDP and Population projections by ITPS



Policy package selection

Policies	Scenario 1 Tokyo model	Scenario 2 L.A. Model
Low-Emission Vehicles	★	★★
Alternative Fuels	★★	★★
Public Transportation	★★★	★★
Walking and Cycling	★★★	★★
Parking charges	★★	★★★
Road Pricing	★★★	★★★
Congestion Charging	★★★	★★
Strategic and Local Urban Planning	★★★	★★★
ICT	★★★	★★
Soft Measures, Smarter Choices	★★★	★★
Ecological Driving and Slower Speeds	★★★	★★
Long-Distance Travel Substitution	★★★	★★
Freight Transportation	★★★	★★★

Notes: ★ Base-case ★★ Enhanced ★★★ aggressive

Design policy pathways for Scenario 1

	Pathway 1			Pathway 2			Pathway 3		
Transportation mode	Volume	Fuel	Tech.	Volume	Fuel	Tech.	Volume	Fuel	Tech.
Road passenger	★★★	★	★★	★★	★★	★★	★	★★★	★★★
Road freight	★★★	★	★	★★	★★	★★	★	★★★	★★★
Rail passenger	★★	★	★★	★★★★	★★	★★	★★★★	★★★	★★★
Rail freight	★★★	★	★★	★★★	★★	★★	★★★★	★★★	★★★
Air	★★★	★	★	★★	★★	★★	★	★★★	★★★
Ship	★	★	★	★	★★	★★	★	★★★	★★★

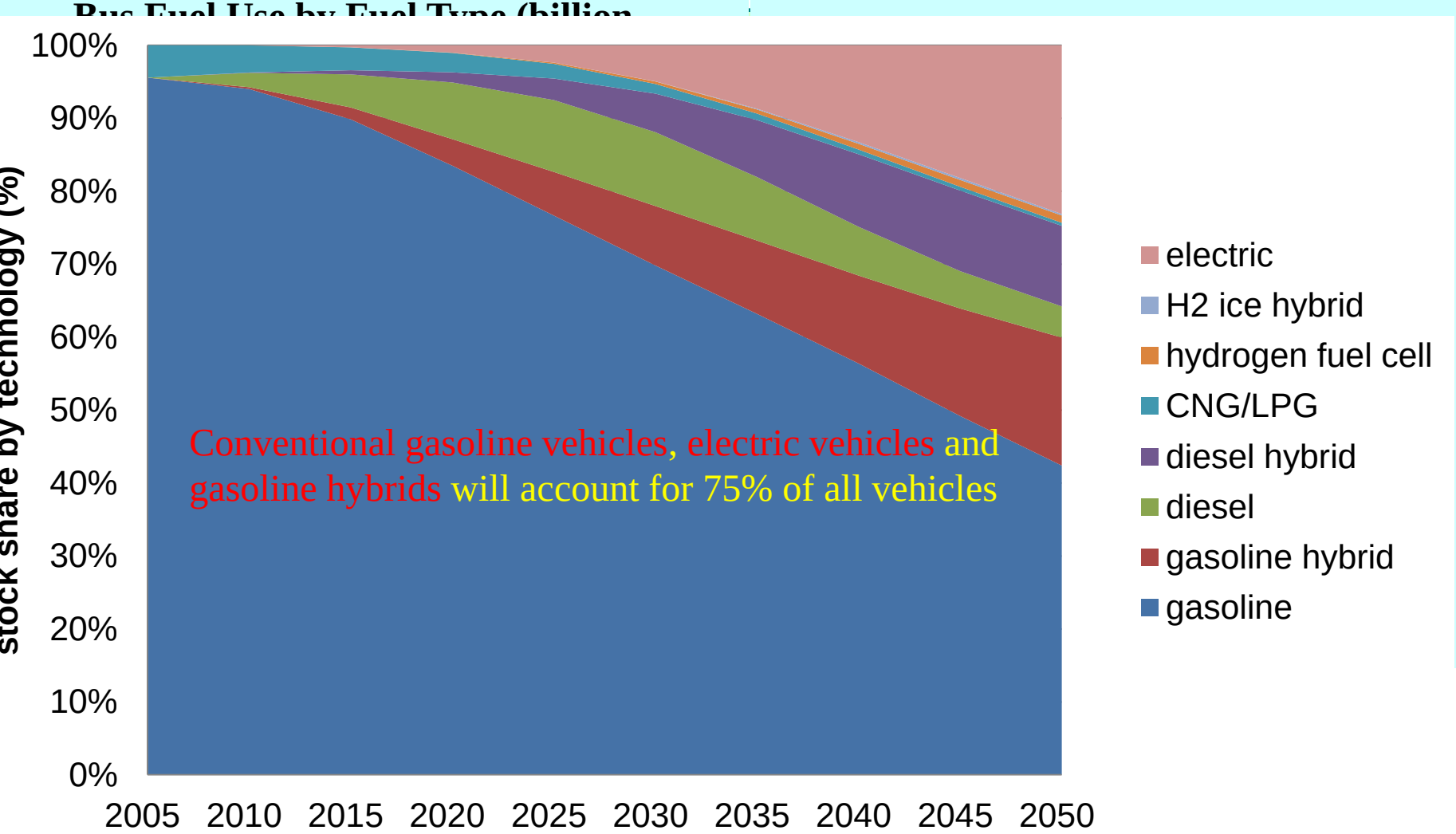
Notes: ★ Base case

★ ★ Enhanced

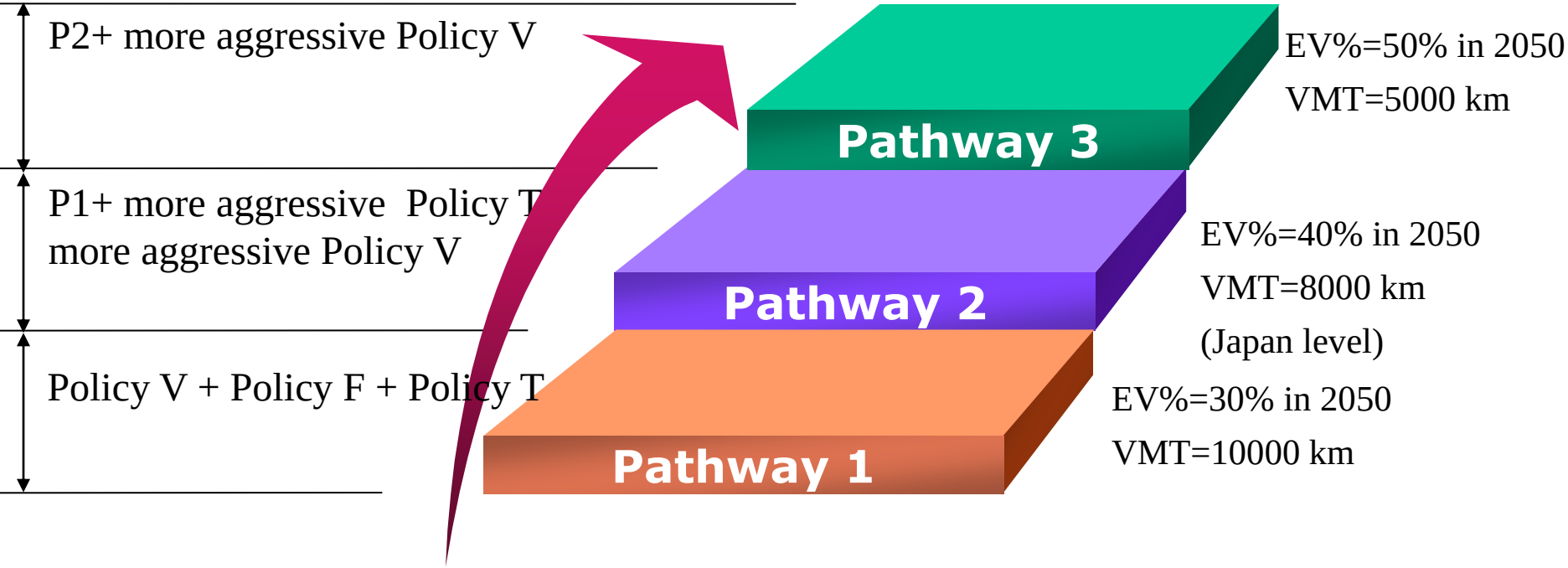
★ ★ ★ aggressive

★ ★ ★ ★ more aggressive

Policy Package of BAU (taking on-road transport as an example)

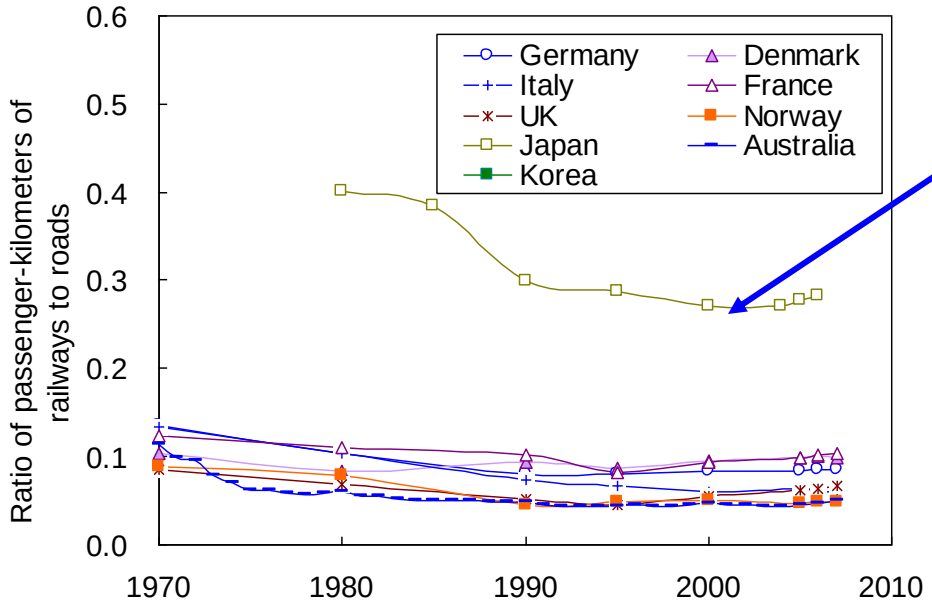


Scenarios Design



How difficult are Pathways 2 & 3?

- **Under Pathway 3, the ratio of passenger-kilometers of railways to roads will be 2.8 by 2050, which is almost impossible given the experiences of other countries**

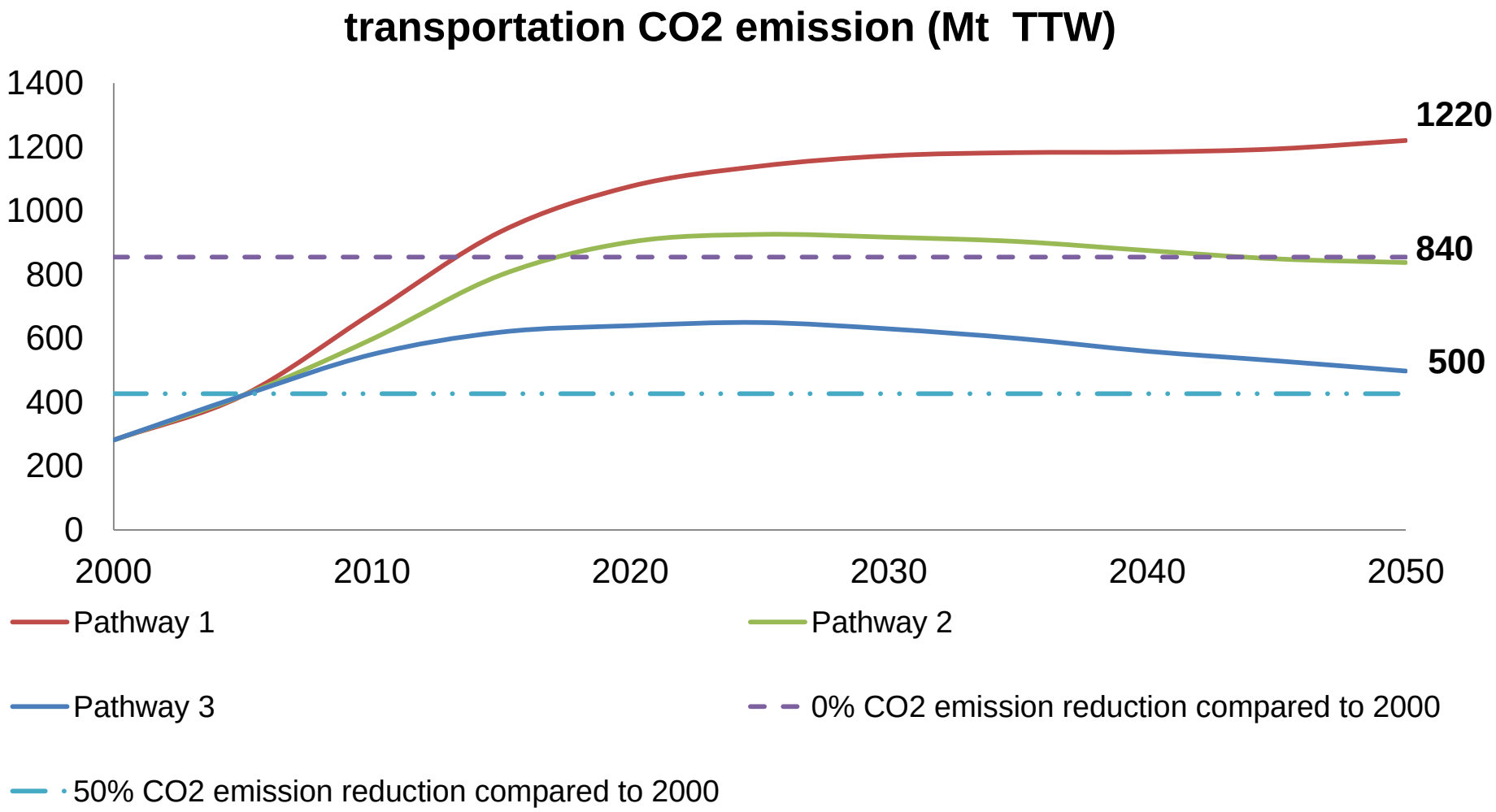


Even in Japan where the railway system is highly developed, this ratio is only 0.3

Sources: Korea National Statistical Office, Statistics Bureau of Japan
U.S. Federal Highway Administration, European Commission
Bureau of Infrastructure, Transport and Regional Economics of Australia

- **Under Pathway 2, this ratio will be more than 1.2, which is a huge challenge for China**

IEA' MoMo model Is Employed: Results for Scenario 1



Summary

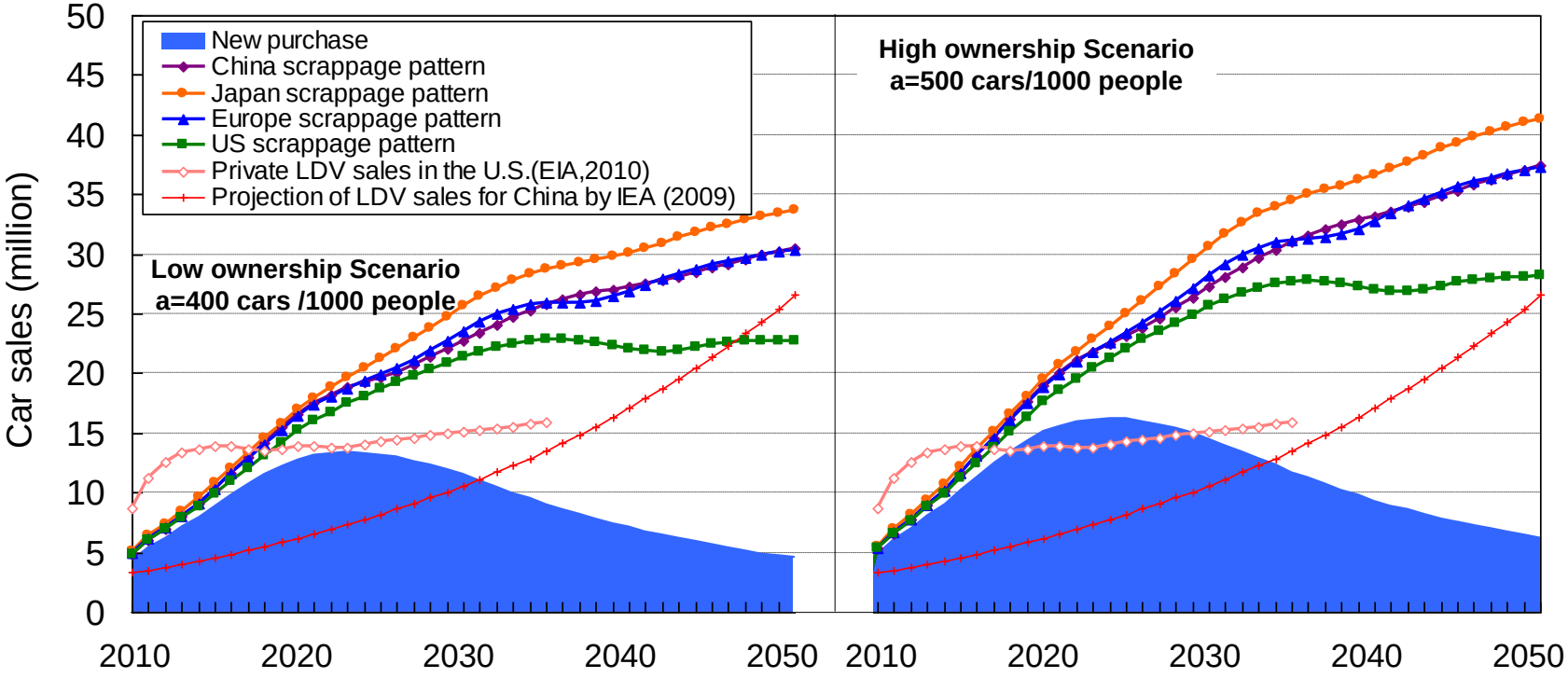
In order to achieve the CO_2 target:

- The 855 Mt target of CO_2 emission in 2050 is difficult to achieve for China.
- The 427 Mt target of CO_2 emission in 2050 is extremely difficult to achieve, almost impossible for China.
- Promoting high-efficient, low-carbon technologies are necessary, and technology transfer from developed countries is important for developing countries.

Further work is need

- The forecasting approach and policy scenarios need to be further improved to better reflect the potential future development patterns in China

Simulation Results of the FEEI model versus IEA results



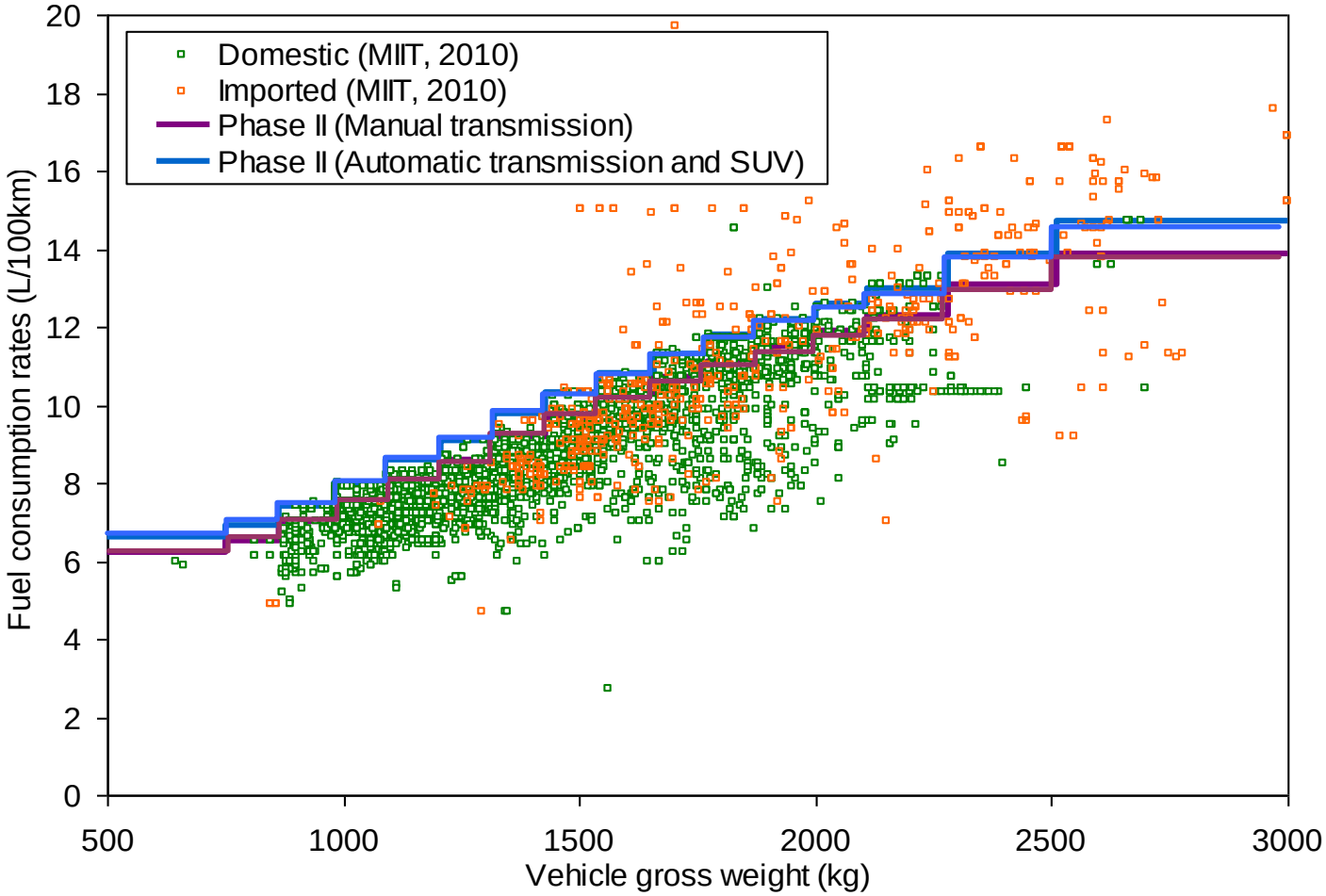
Instead of simply assuming a moderate growth rate for sales, the new approach projects vehicle sales by modeling the impact of shift in income distribution, changes in car price, and scrappage schemes

The two approaches generate two different growth trajectories

Further work is need

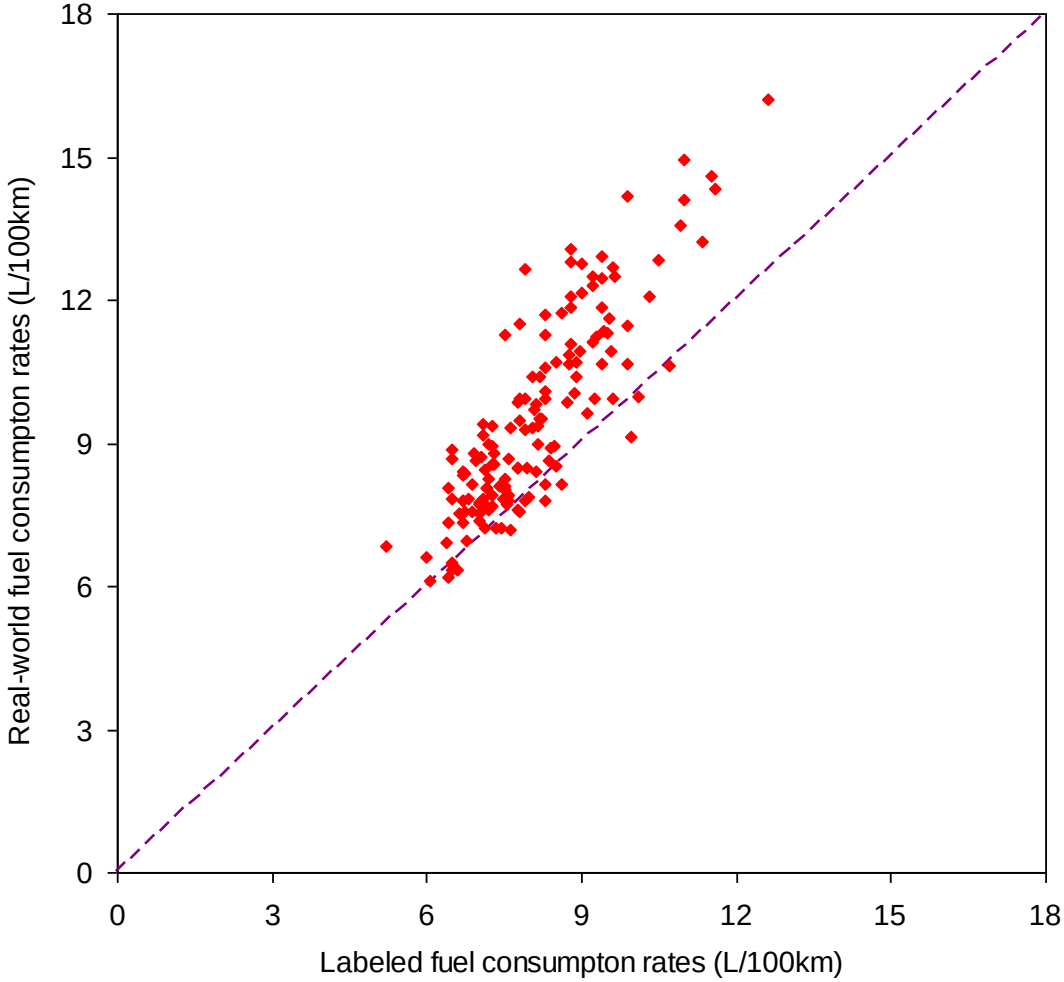
- The forecasting approach and policy scenarios need to be further improved to better reflect the potential future development patterns in China
- Basic data (e.g. fuel consumption rates and vehicle activity) need to be refined for more accurate results.

Laboratory Fuel Consumption Rates of Nearly 5,000 Vehicle Models



In 2010, the Chinese government started to require new light-duty vehicles with window sticker label of the fuel consumption rate

Comparison between Label and On-Road Fuel Consumption Rates of 153 Car Models



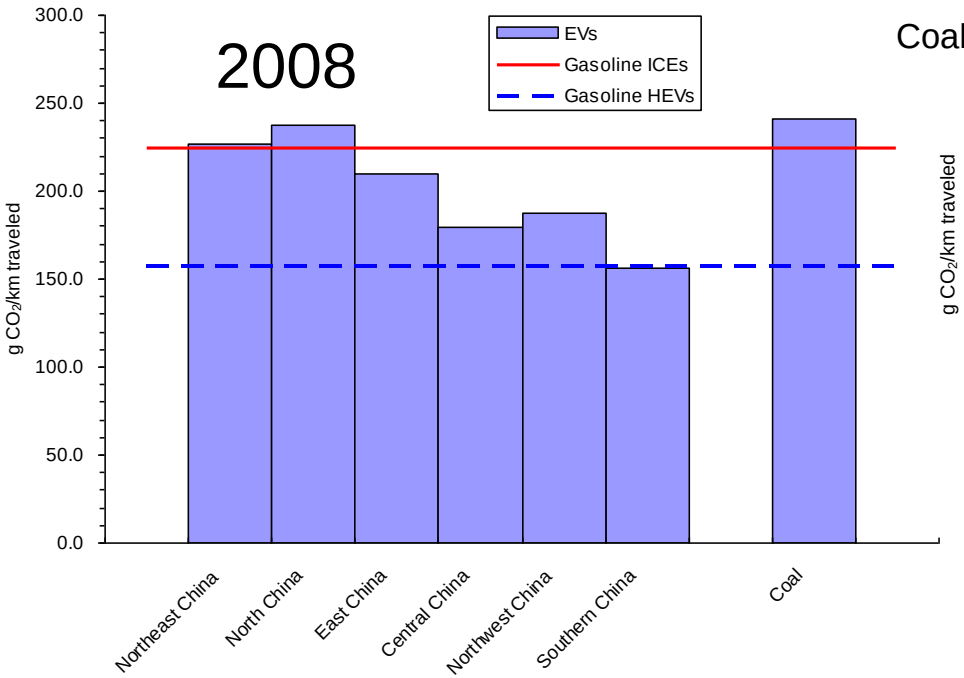
More than 60,000 on-road fuel consumption data are collected

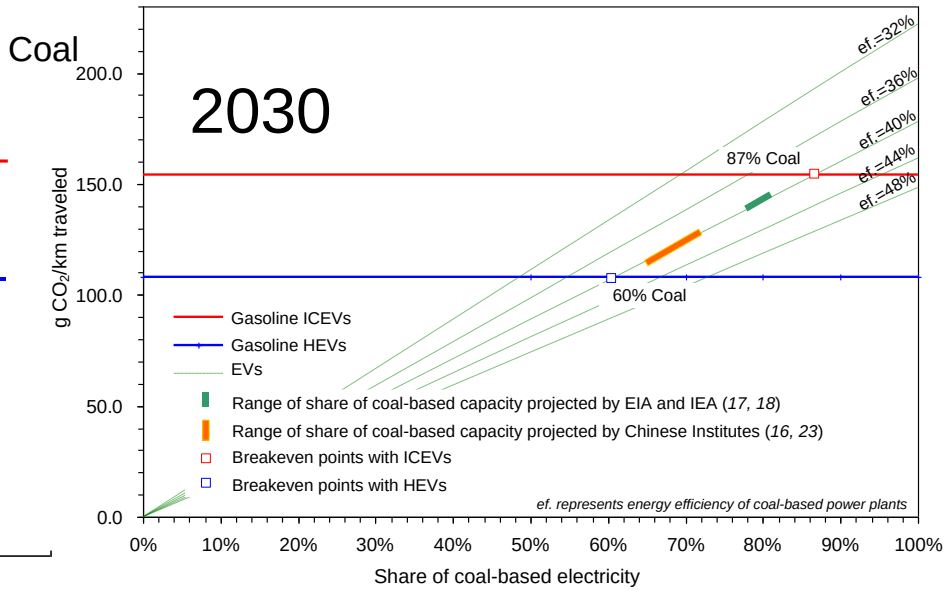
On-road fuel consumption is 15.5% higher than label values in China

Further work is need

- The forecasting approach and policy scenarios need to be further improved to better reflect the potential future development patterns in China
- Basic data (e.g. fuel consumption rates and vehicle activity) need to be refined for more accurate results.
- Life-cycle emissions of EVs should be evaluated in China and other developing countries

CO_2 Emissions from EVs depend on fuel share of electricity generation and combustion efficiencies of coal-fired power plants





Huo et al, EST, 2010

- *According to the model results, Pathways 2&3 could offer significant benefits in CO_2 reduction, partly attributed by introducing EVs.*
- *The MoMo model doesn't account for up-stream CO_2 emissions, so the life-cycle CO_2 reduction benefits could be much lower.*

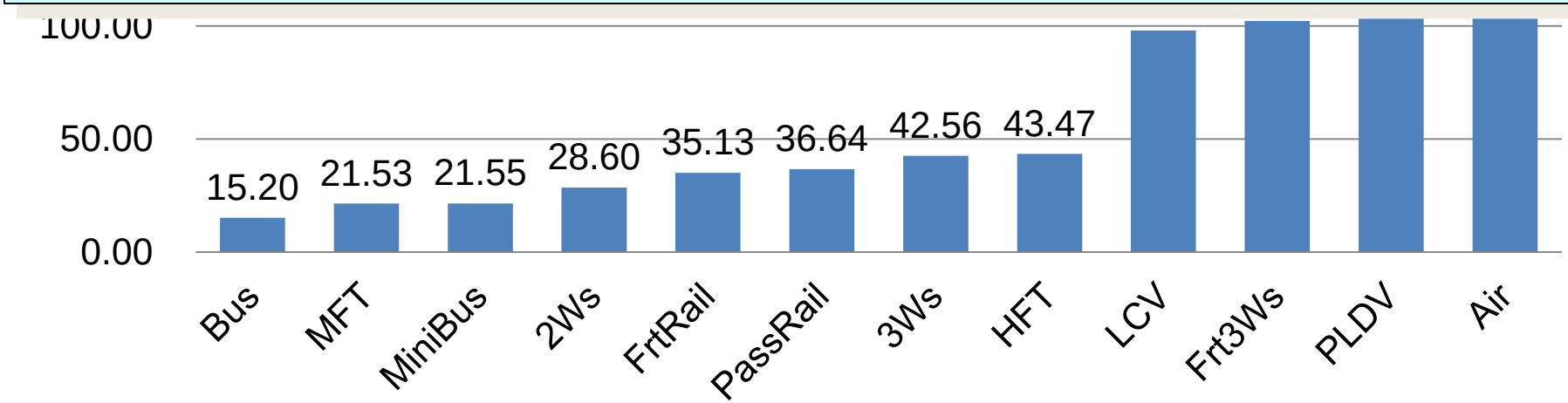
Thank you !
Discussion and comments

CO_2 Emission Intensities by Mode

CO_2 emission intensity of air is the highest of all modes. The Transportation demand is still high and the mode split should be changed. The share of railways, especially high speed railways, should be enlarged.

Application of advanced technologies is effective to reduce CO_2 emissions. High speed railways is a good example.

Improving fuel efficiency is also effective in reducing CO_2 emissions.



Under the scenario 1 in Pathway 1