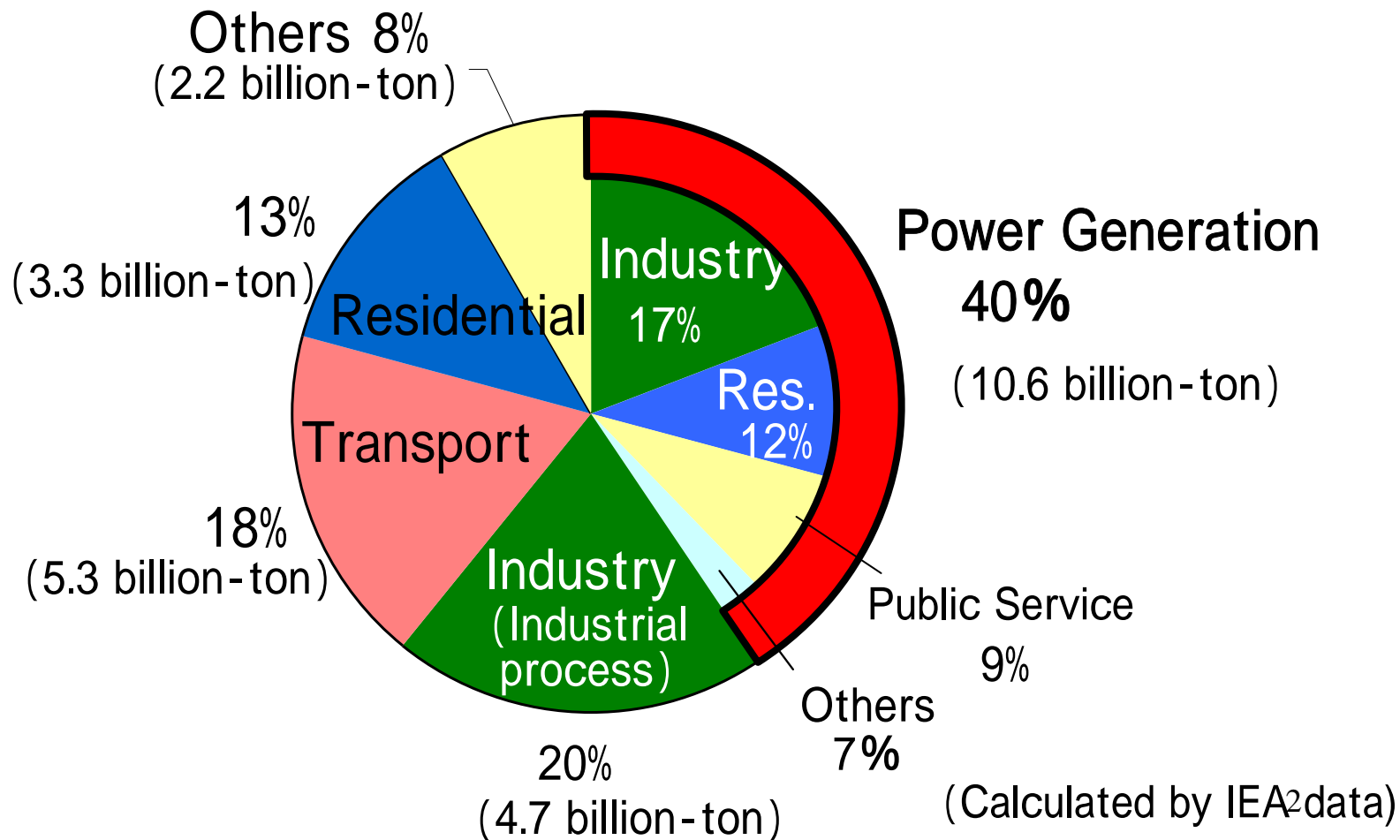# Barriers and opportunities: Approaches to sensitive LCS sectors

~An automotive industry's view~

14 February 2008

Masayuki Sasanouchi
Toyota Motor Corporation

World Energy-related CO2 Emissions by Sector in the Reference Scenario
(26 Billion Ton-CO2)

Others 8%
2.2 billion-ton

13%
3.3 billion-ton

Residential

Transport

18%
5.3 billion-ton

Industry
17%

Industry
Industrial
process

20%
4.7 billion-ton

Res.
12%

Power Generation
40

10.6 billion-ton

Public Service
9%

Others
7

Calculated by IEA2 data)

Kaya Identity

$$CO_2 = CO_2/E \times E/GDP \times GDP/P \times P$$

CO2: Total carbon dioxide emission

E: Energy,   P: Population

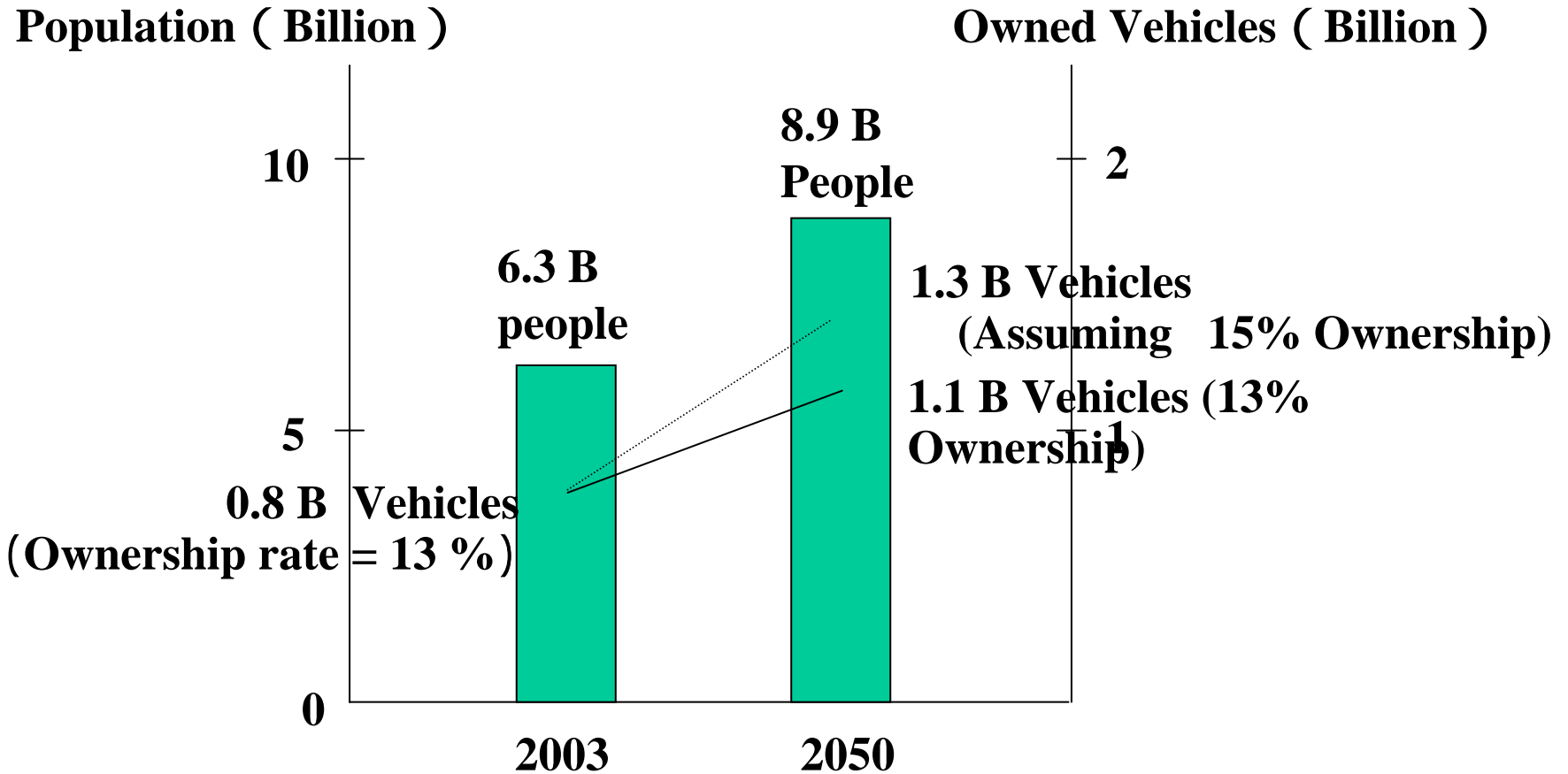CO_2 :   Back casting target (-50% by 2050)

GDP/P, P: To be projected (fundamental human rights)
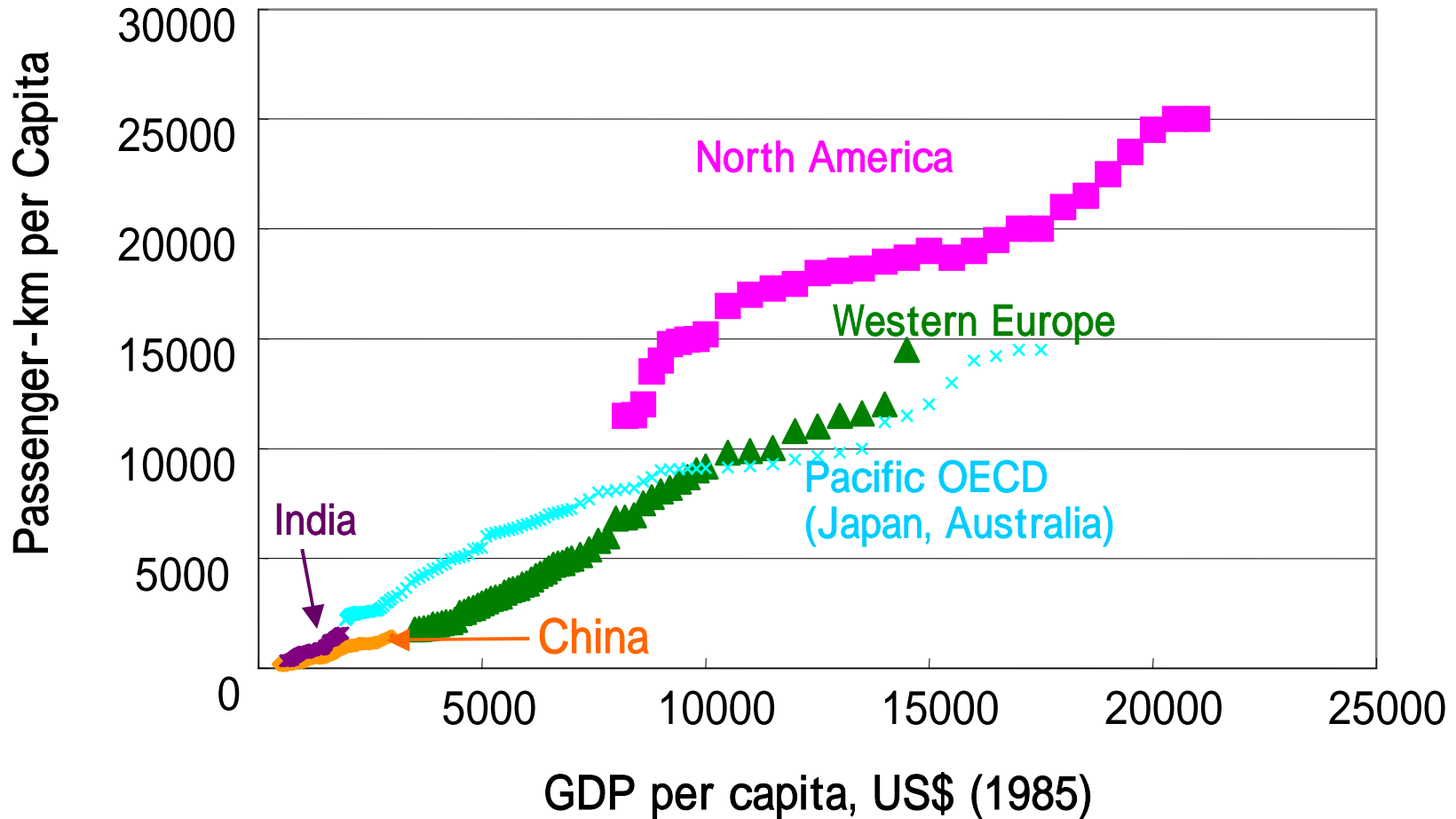
CO_2/E, E/GDP: To be challenged
    (innovation, evolution, and deployment of technologies)

Growing World Population and Owned Vehicles

Population   Billion

Owned Vehicles   Billion

10

8.9 B People

2

6.3 B people

1.3 B Vehicles (Assuming   15% Ownership)

1.1 B Vehicles (13% Ownership)

5

1

0.8 B Vehicles Ownership rate = 13 %

0

2003   2050

Economic Growth and Mobility Demand
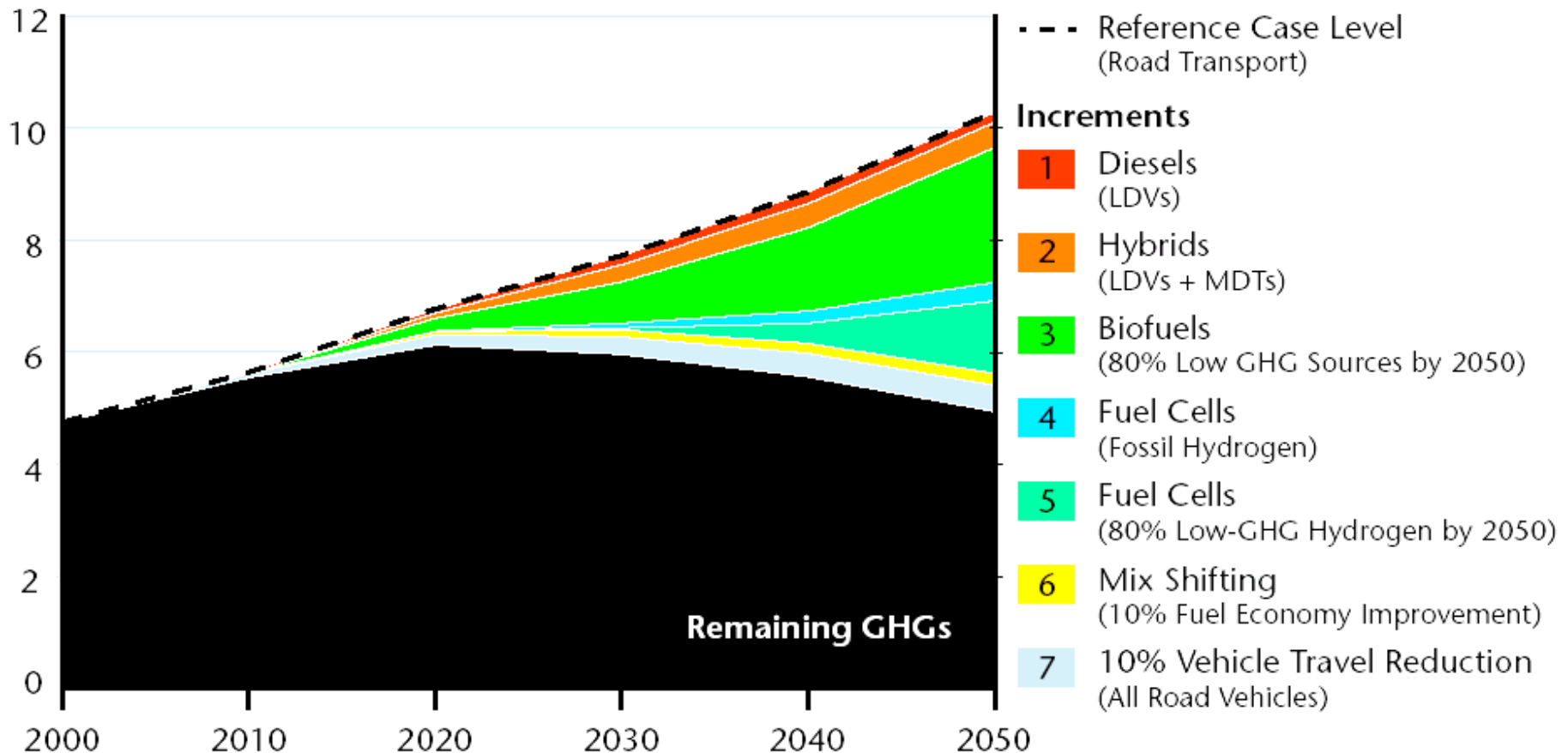
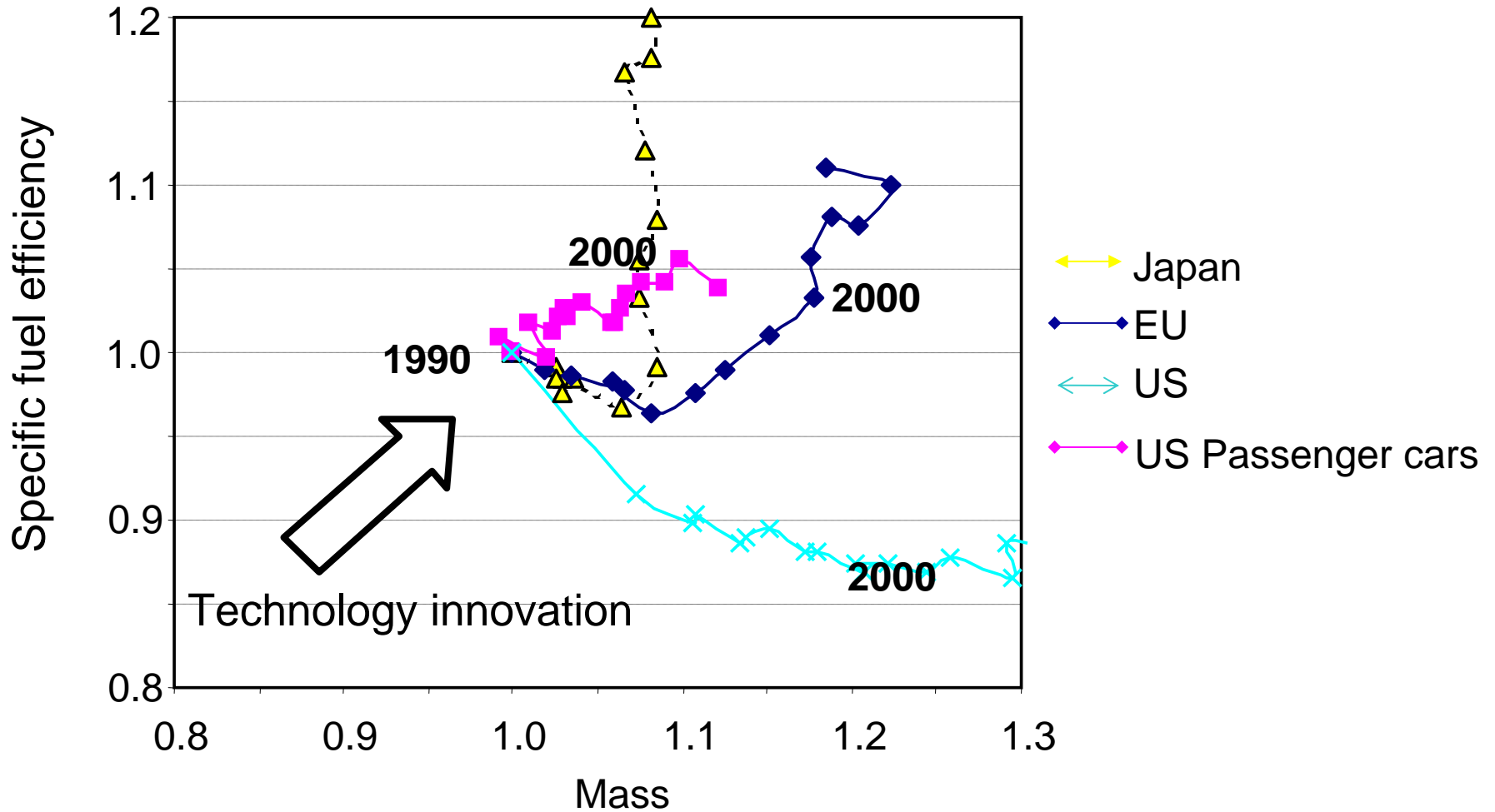Passenger Travel and GDP by Region: 1950-1997

$ 1 = ¥ 250 (1985 Year)

Source: WBCSD Mobility 2001

Projected CO2 Emission from Transport with Combined Technology
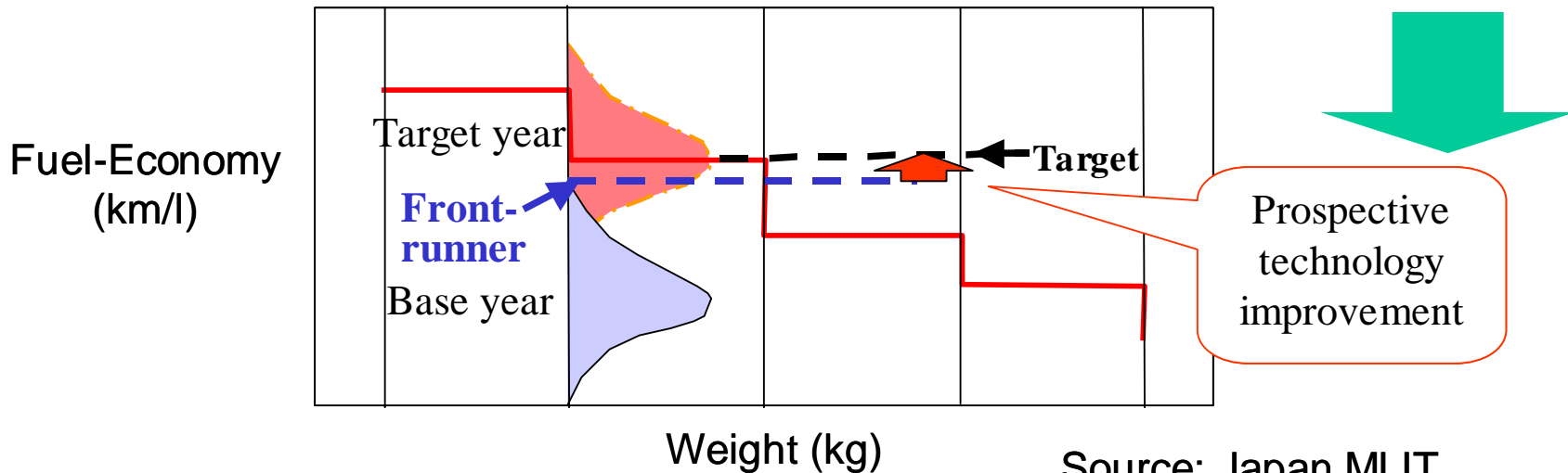

Gigatonnes CO_2-Equivalent GHGs

Legend:
- - - Reference Case Level (Road Transport)

Increments

1. Diesels (LDVs)
2. Hybrids (LDVs + MDTs)
3. Biofuels (80% Low GHG Sources by 2050)
4. Fuel Cells (Fossil Hydrogen)
5. Fuel Cells (80% Low-GHG Hydrogen by 2050)
6. Mix Shifting (10% Fuel Economy Improvement)
7. 10% Vehicle Travel Reduction (All Road Vehicles)

Remaining GHGs

Fuel Efficiency and Mass Trend

Source : IEA "Review of International Policies fro Vehicle Fuel Efficiency"   7

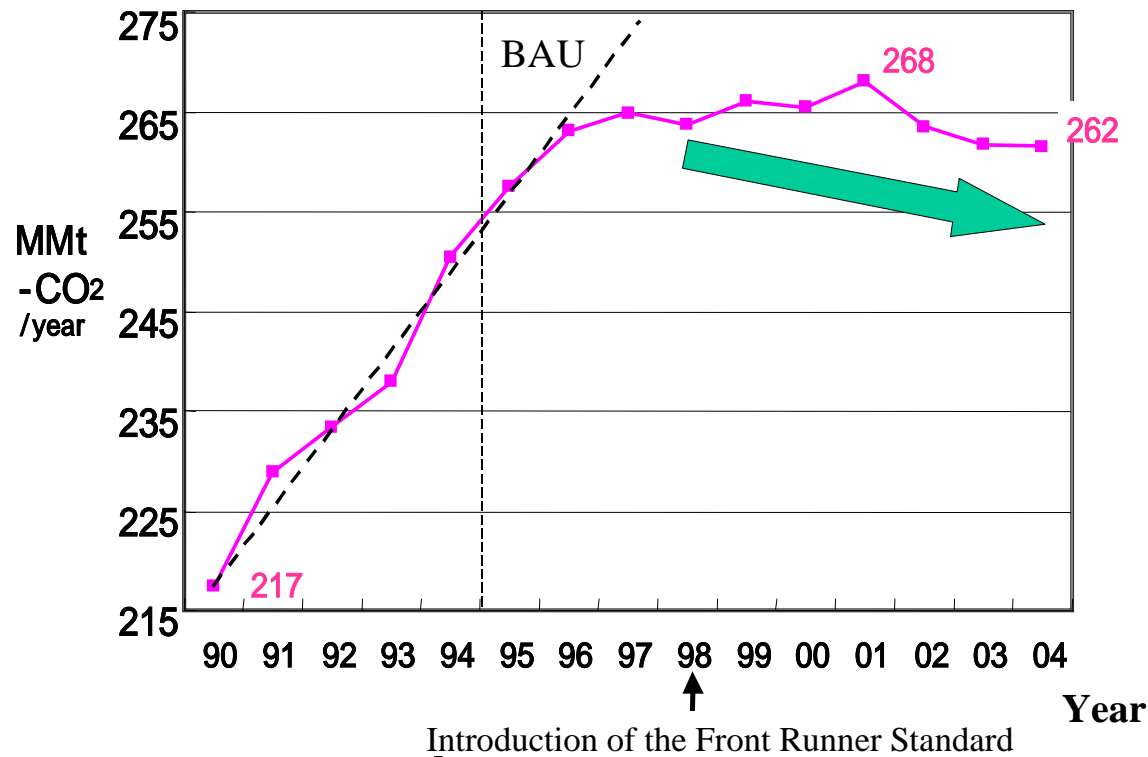# Importance of Benchmarking

Bottom Up >>Top Down

-Improvement of engine efficiency
   e.g. Direct-injection engine, Reduction of friction loss, etc.
-Improvement of driving-train
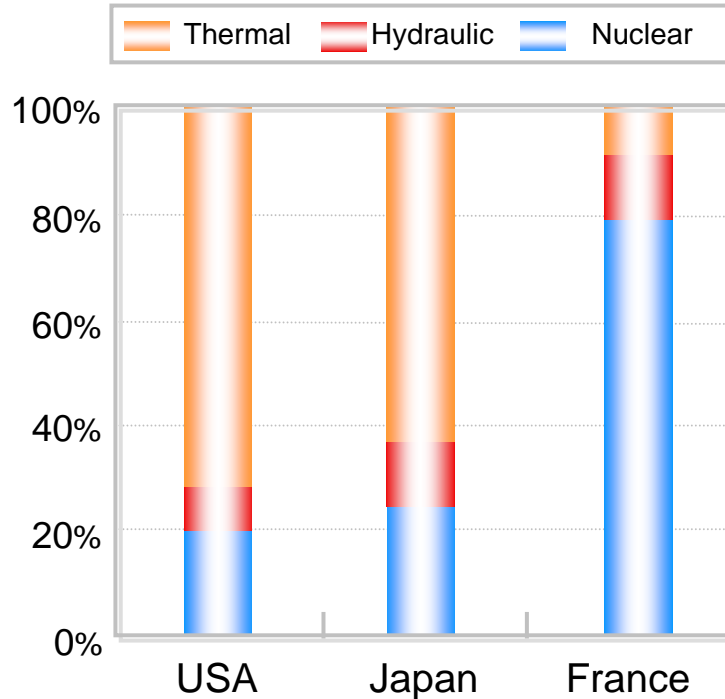   e.g. Multiple AT (5AT, 6AT)
-Dissemination of hybrid system

Fuel-Economy (km/l)

Target year

Front-runner

Base year

Target

Prospective technology improvement

Weight (kg)

Source: Japan MLIT

8

Status of Front Runner Approach

Advantages of Plug-in Hybrid Car

Electricity mix by country

Thermal · Hydraulic · Nuclear

USA · Japan · France

Well to Wheel CO_2 reduction

USA

Gasoline

E85

Japan

France

Prius · Plug in Hybrid Car

When driving for 25km (13km by electricity)

Toyota estimates)
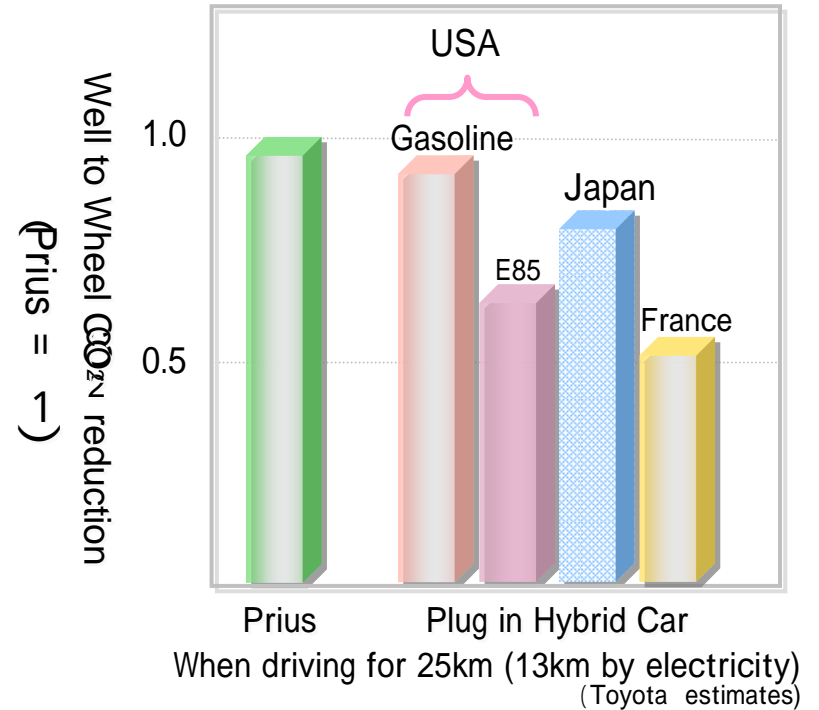
Social advantages: Well to Wheel CO2 reduction is possible.

Combining with biofuel will further increase the effect.

"Parallel Approach"

The Ultimate Eco-car

Hybrid

Hybrid Technology

CNG

Diesel DI

Direct Fuel injection.

VVT-i

EV

Alternative fuel

Diesel

Gasoline

Electricity