

2009 KEEI's International Conference on "New Energy Options for Green Growth"
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Sustainable Automobile Technology and Energy

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Energy & Environmental Issues

1. Uncertain Crude Oil supply and Emerging demand

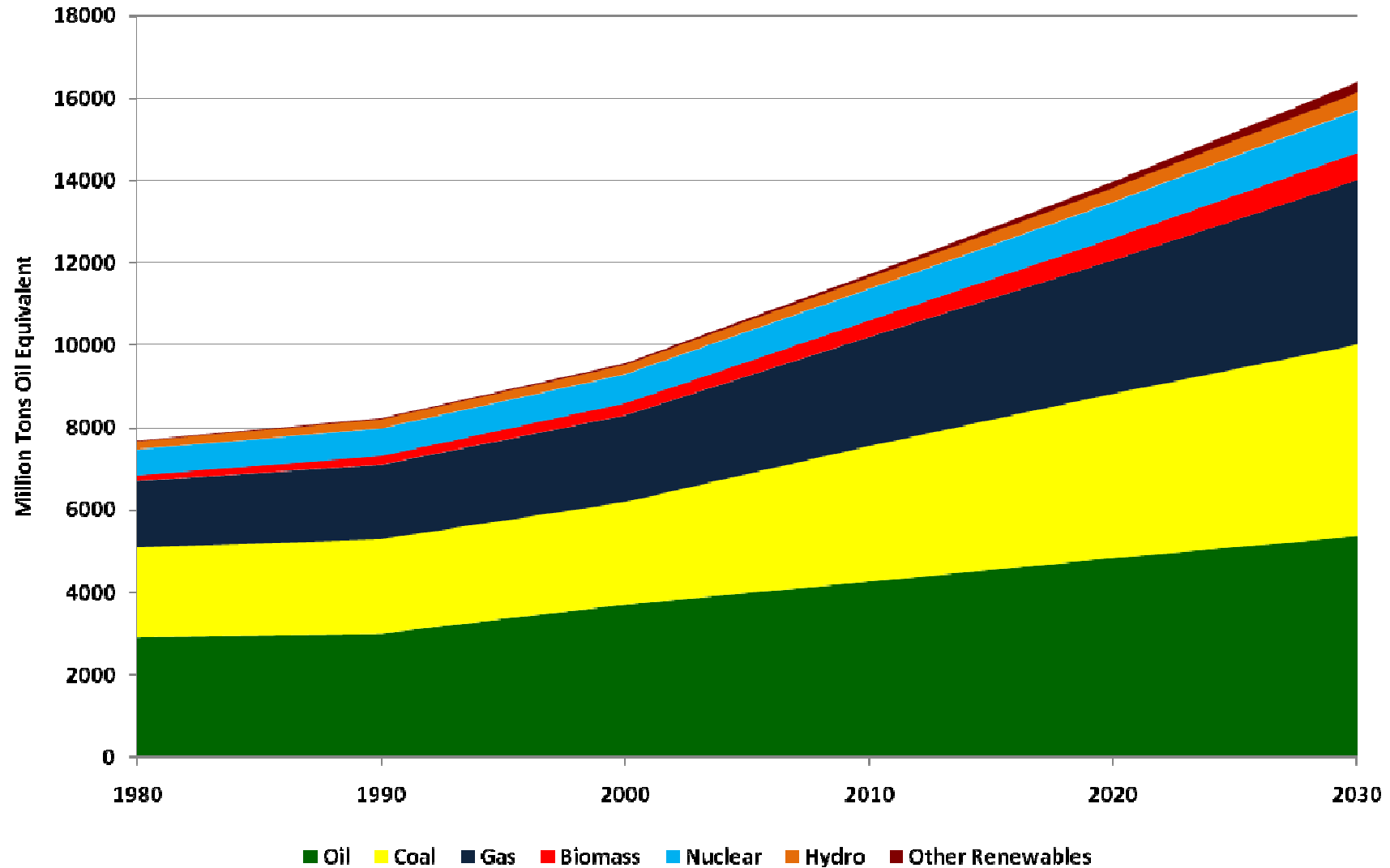
- Unsure the sufficient Oil supply and emerging demands
 - Increase oil price volatility by S/D balance and speculation
- Oil quality changes and increase refinery cost
- Alternative energy & fuels

2. Climate change by GHG emission

- Establish global system for sustainable GHG reduction
- GHG emission target by each government
- Assessment and Standardization of GHG
 - from vehicle and it's energy source

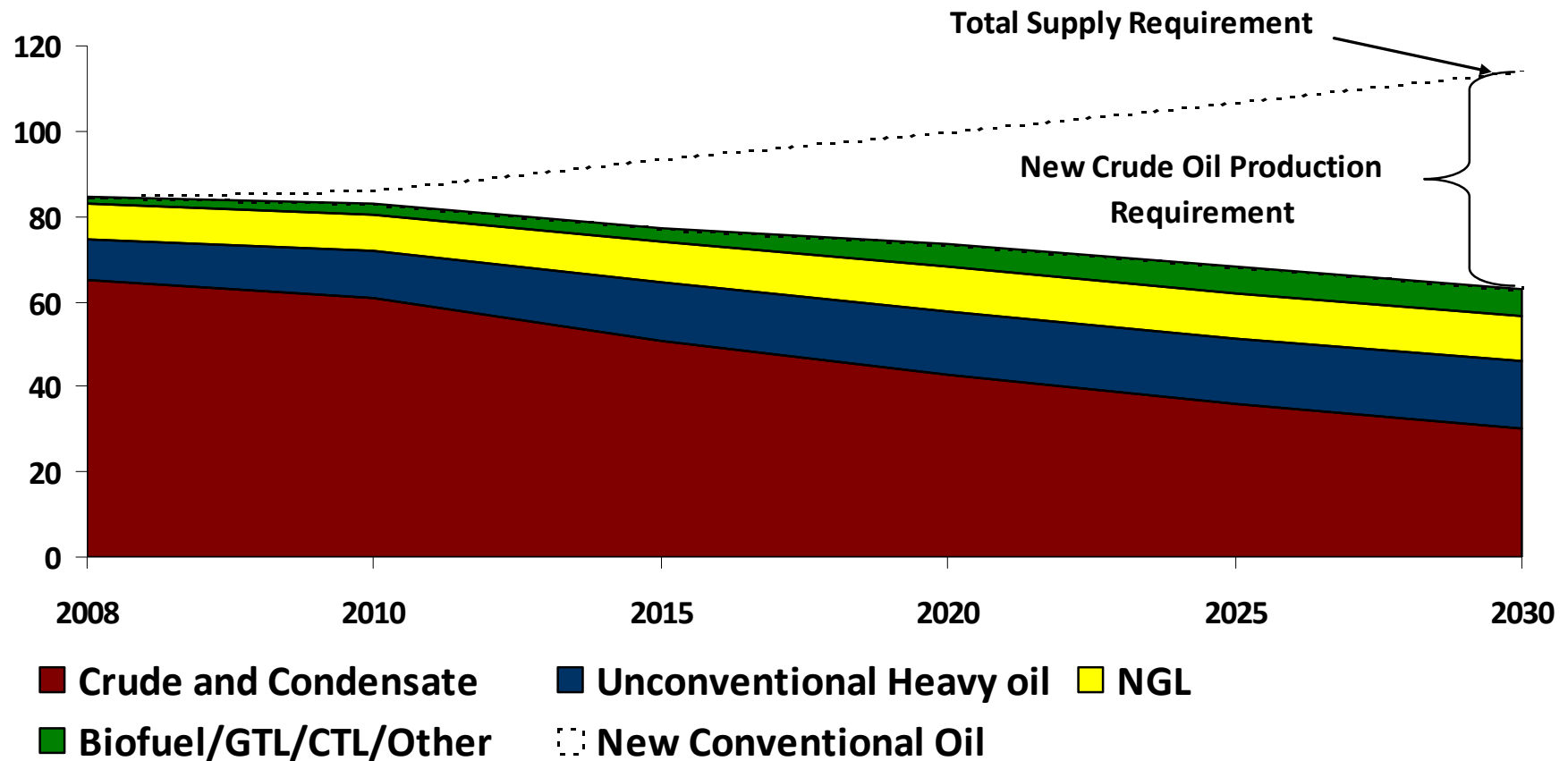
Balance between energy security and environment

Global Energy Demand Outlook



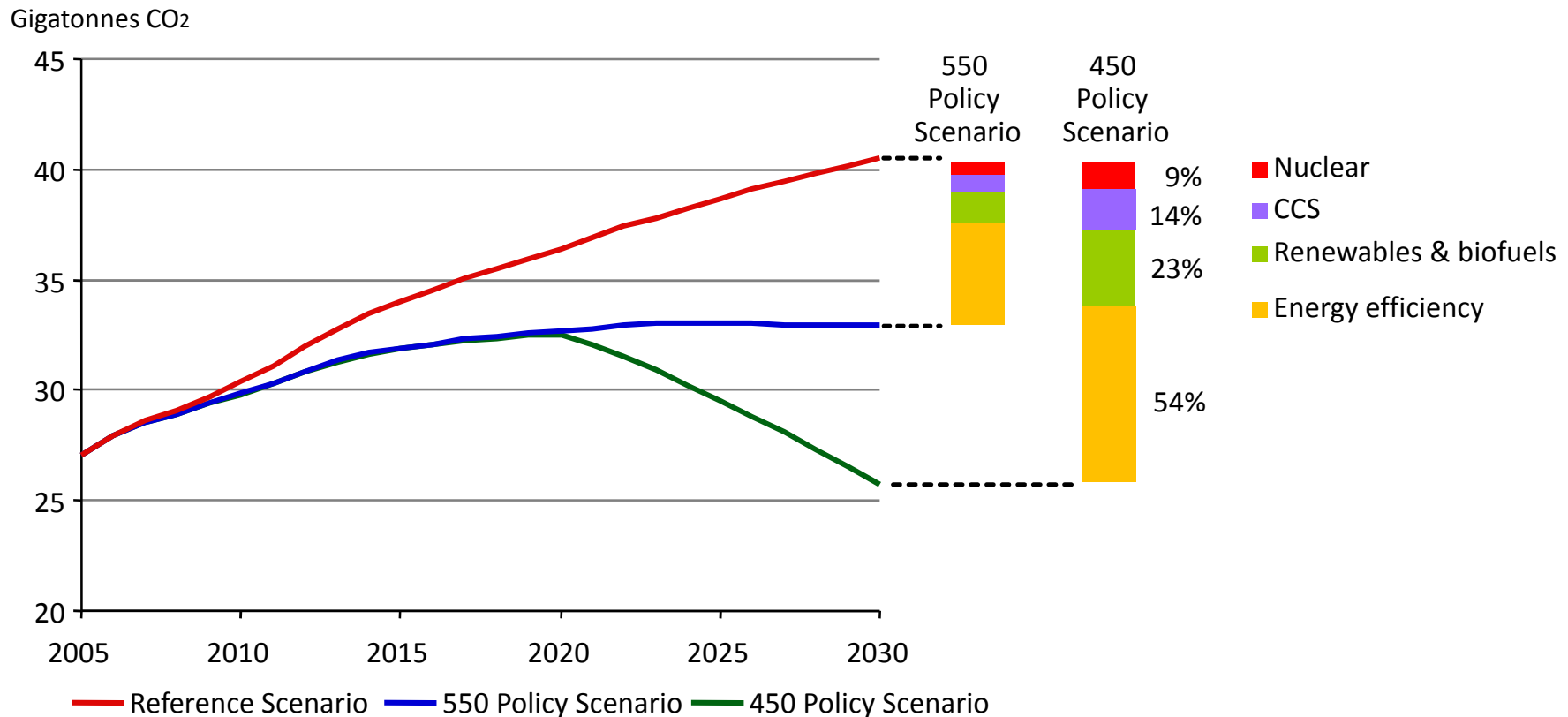
Global Crude Oil Demand Outlook

New Crude & Condensate Needed to Meet Demand



Solution for issues

Strong Policies Required at National and International Levels

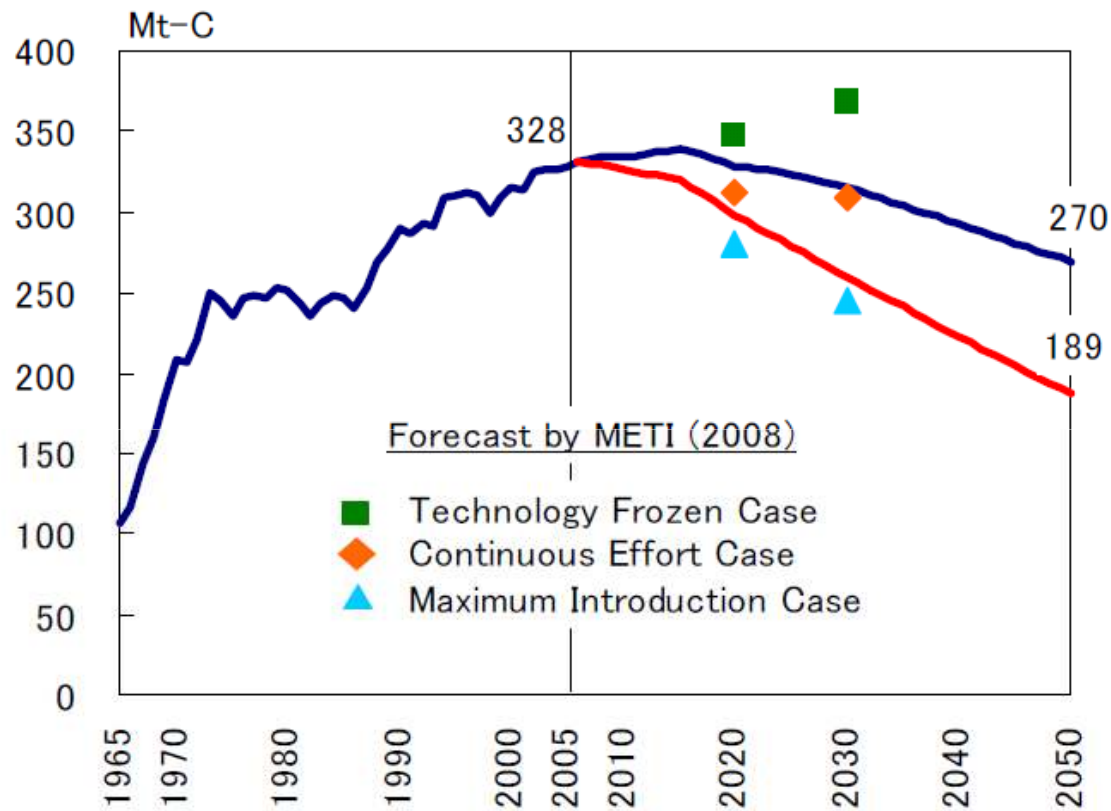


Presented by Hart Energy consulting, May 2009

Source: IEA WEO 2008, Lew Fulton Hart's World Refining & Fuels Conference Brussels

Possibility of CO₂ emission reduction

Figure 6.7: CO₂ emissions

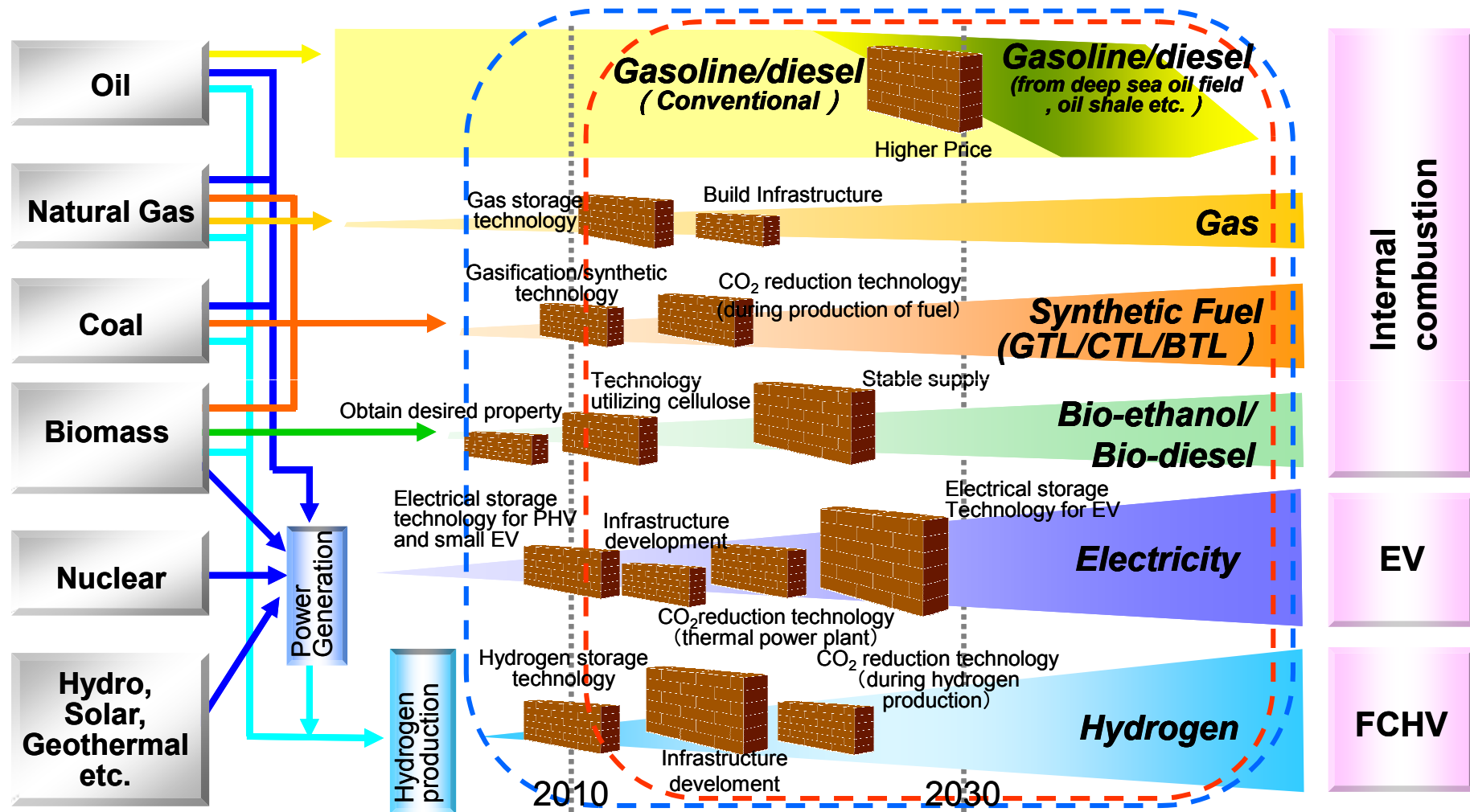


• It is Potentially possible to decline the picture of reducing CO₂ by more than 40% from the current level of CO₂ emissions up to 2050

(Source) Actual value is cited from the database of EDMC, IEEJ (IEEJ,2007)

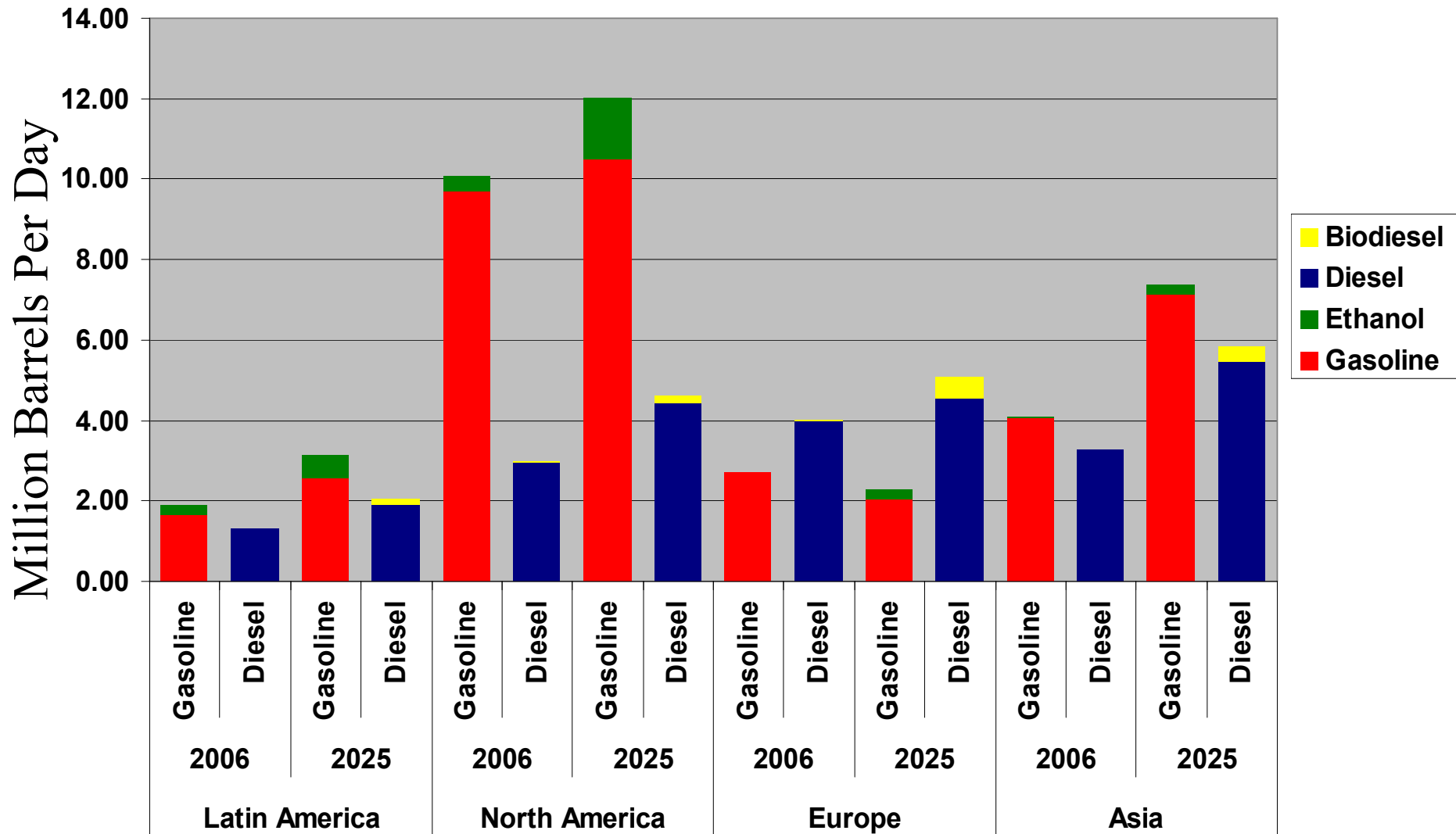
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Alternative Energy source for Automobiles



- All of alternative fuels are facing significant issues & barriers.

Future Demand Conventional Fuel vs. Biofuel



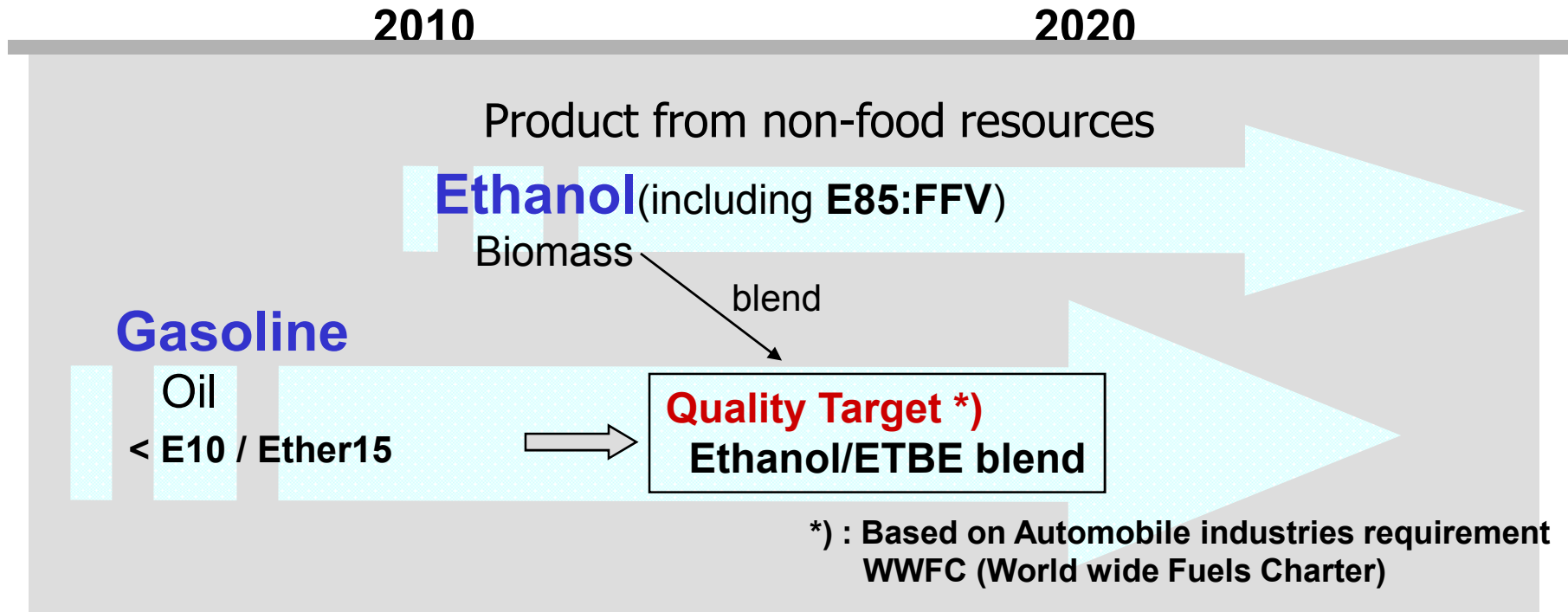
Vehicle Fuel Perspectives

Alternative fuel to save Oil and reduce GHGs

Issues to be discussed

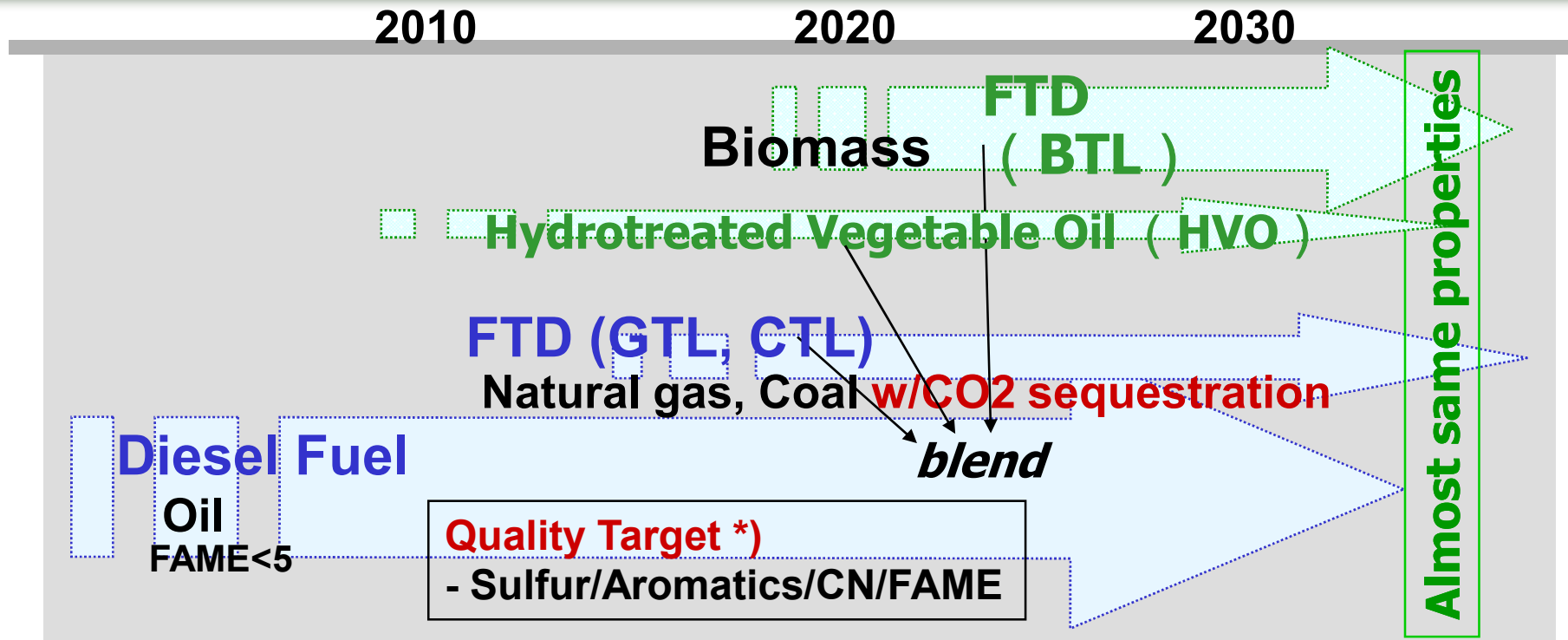
- Production perspective of alternative Fuel (World)
- Fuel supply Infrastructure in the City
- Fuel Quality standard
- Energy for Fuel production and CO₂ emissions (WTW)

Automotive Fuel Scenario (Gasoline)



- **Short term :**
 - Ethanol blend in Gasoline <E10.
- **Medium term :**
 - Higher Ethanol and ETBE blend to reduce GHG.
 - It is expected that harmonization of high concentration ethanol fuel specifications.

Automotive Fuel Scenario (Diesel)



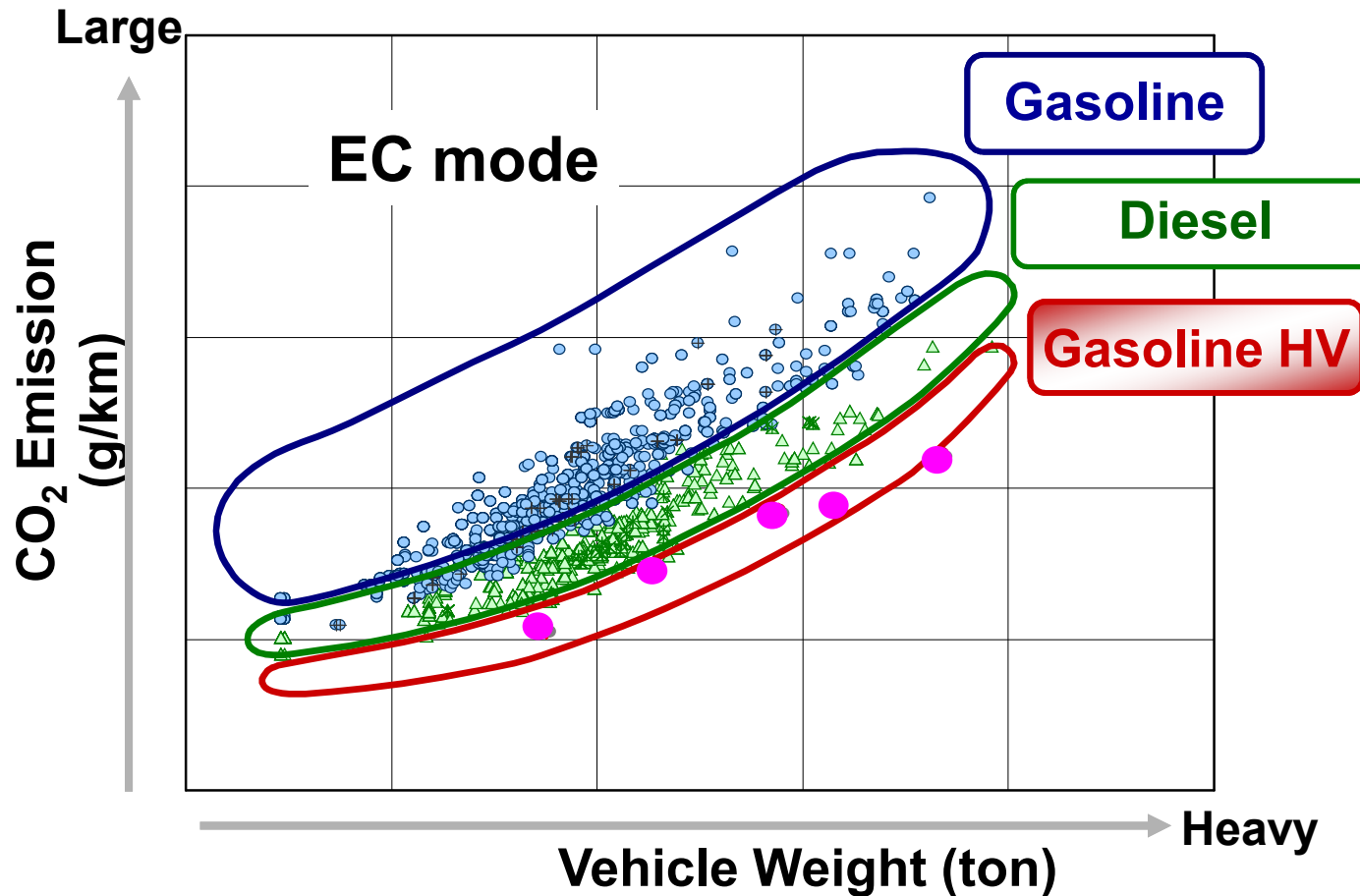
- **Short term :**
 - Cleaner diesel fuel (S, Aromatics, CN & <5%FAME) .
- **Medium term :**
 - Various type of alternative diesel fuel will be introduced.
 - However, these fuels' properties will be able to controlled by same specification ("zero" S, Aromatics and high CN)
 - Expand usage of Bio-fuels to reduce GHG

Overview of Vehicle Technology

Improve Efficiency to save Oil and Reducing GHGs

- Reducing vehicle weight
- Improving Engine Efficiency
- Hybrid Technology

Vehicle CO2 Emissions



- Vehicle weight reduction is very important to reduce CO2.
- Improvement engine efficiency can contribute to reduce CO2.
- HVs have large advantages of CO2 Reduction (= Higher Efficiency).

Reducing Size and Weight of Vehicles



Differential gear reverse placement



Center take-off gearbox



Placement of ultra-thin fuel tank under floor



Slimmed seat backs



Compact air conditioning unit

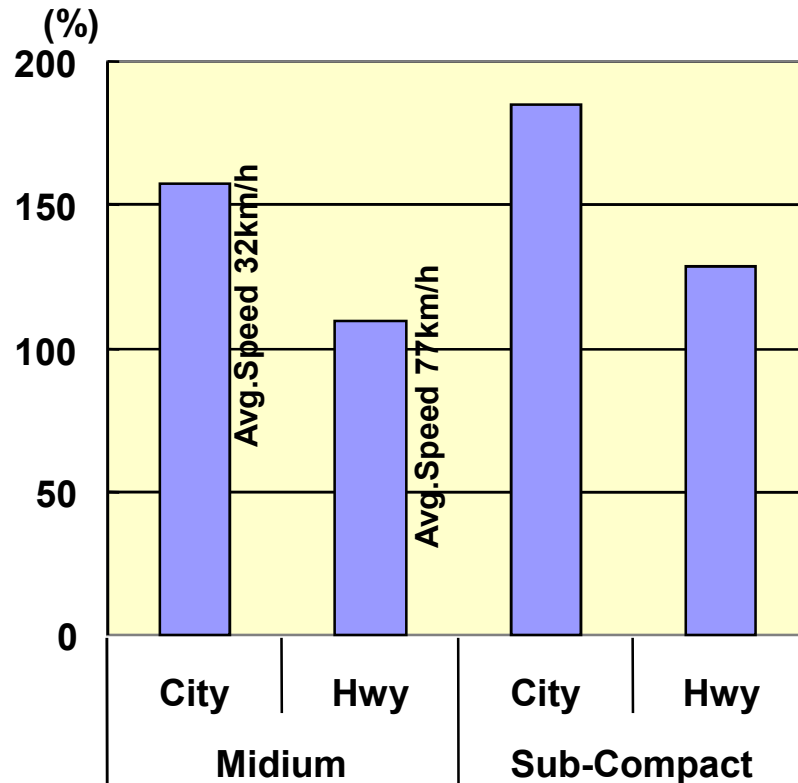


Asymmetric installment panel

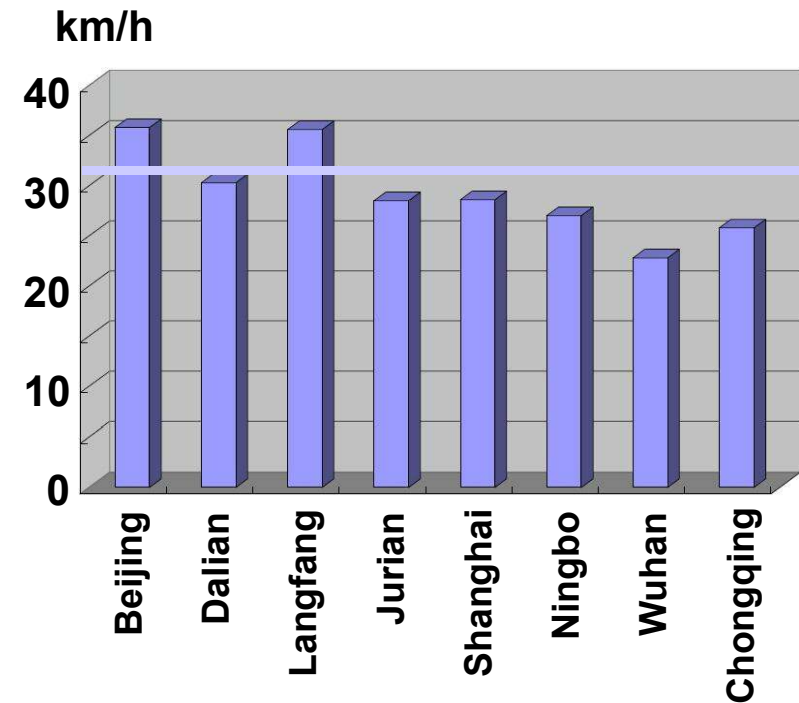


- Size and weight reduction is crucial to energy conservation and lower CO2 emissions

HV Advantages in City Driving



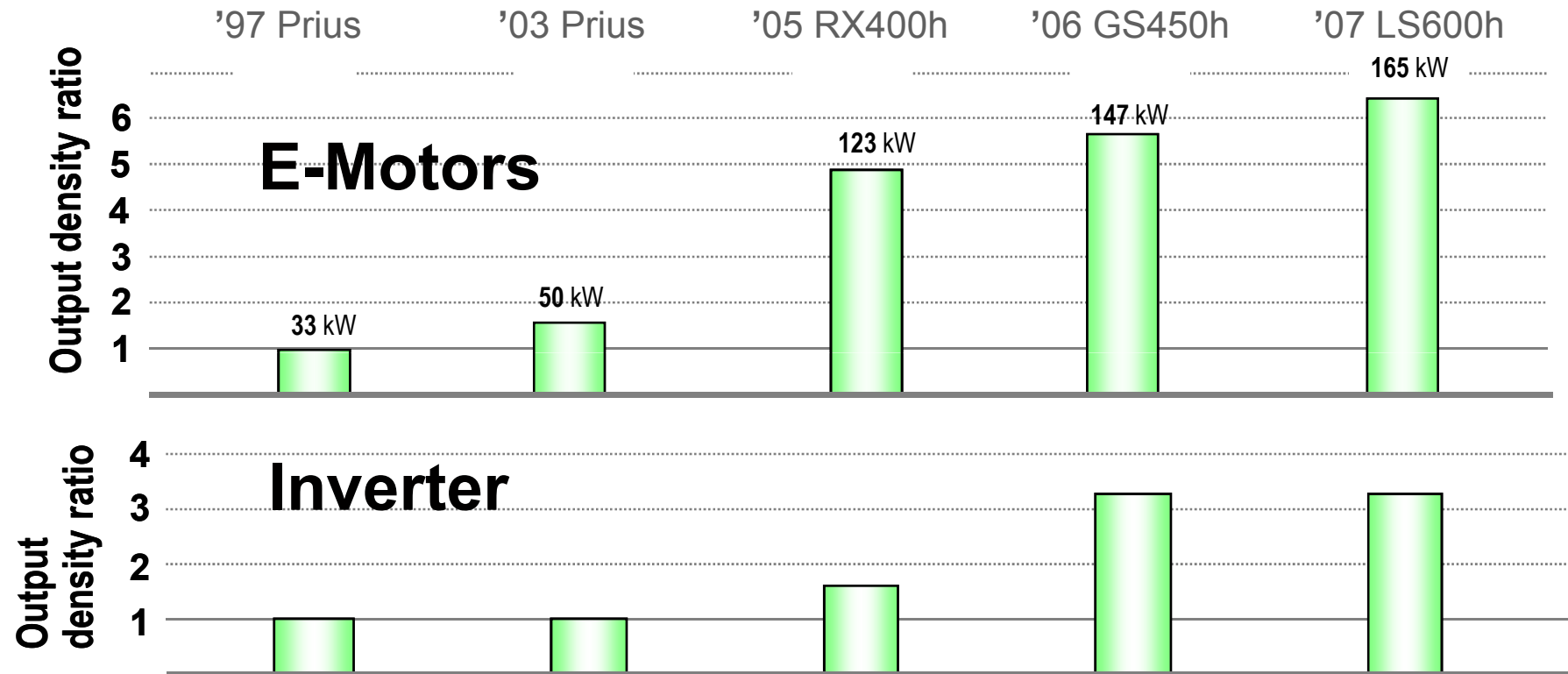
Improvement FE by HV
(EPA:<http://www.fueleconomy.gov/>)



Average speed in Cities (km/hr)
SUMO Report

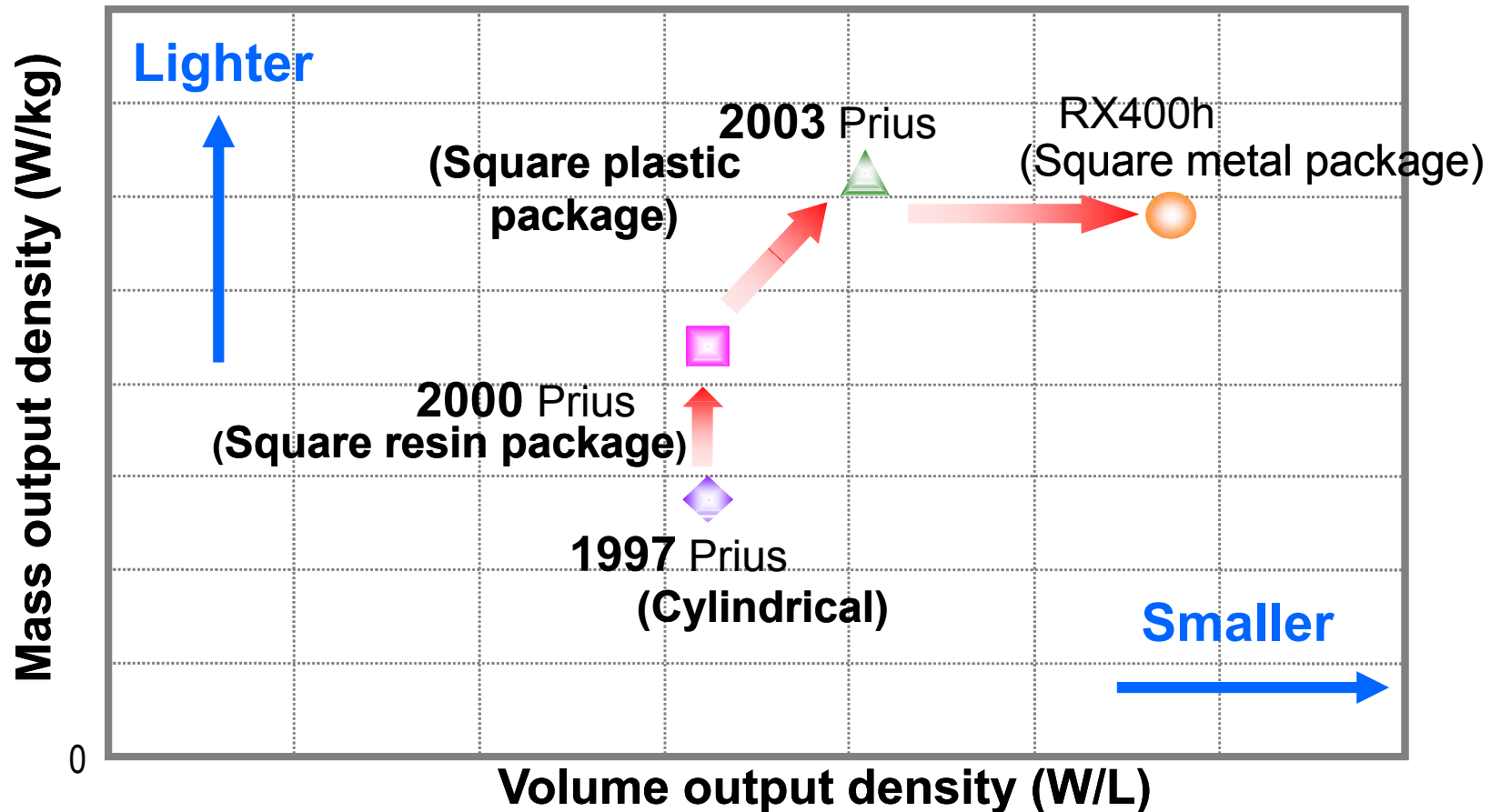
- HV vehicles are very effective to improve FE in city driving.

Evolution of E-Motors & Inverter



- Reducing size and weight by increasing output density

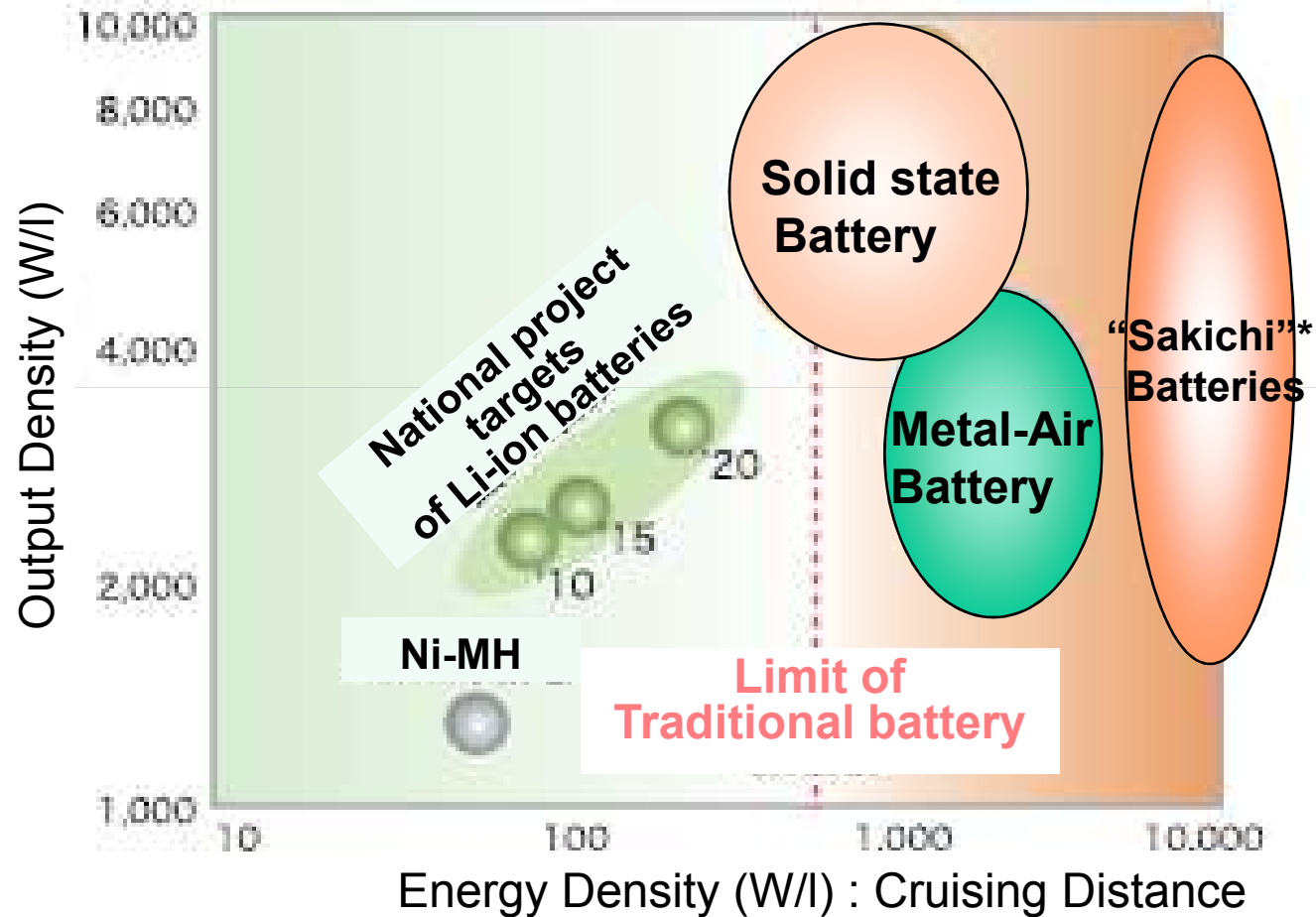
Battery's Evolution for Hybrid Vehicles



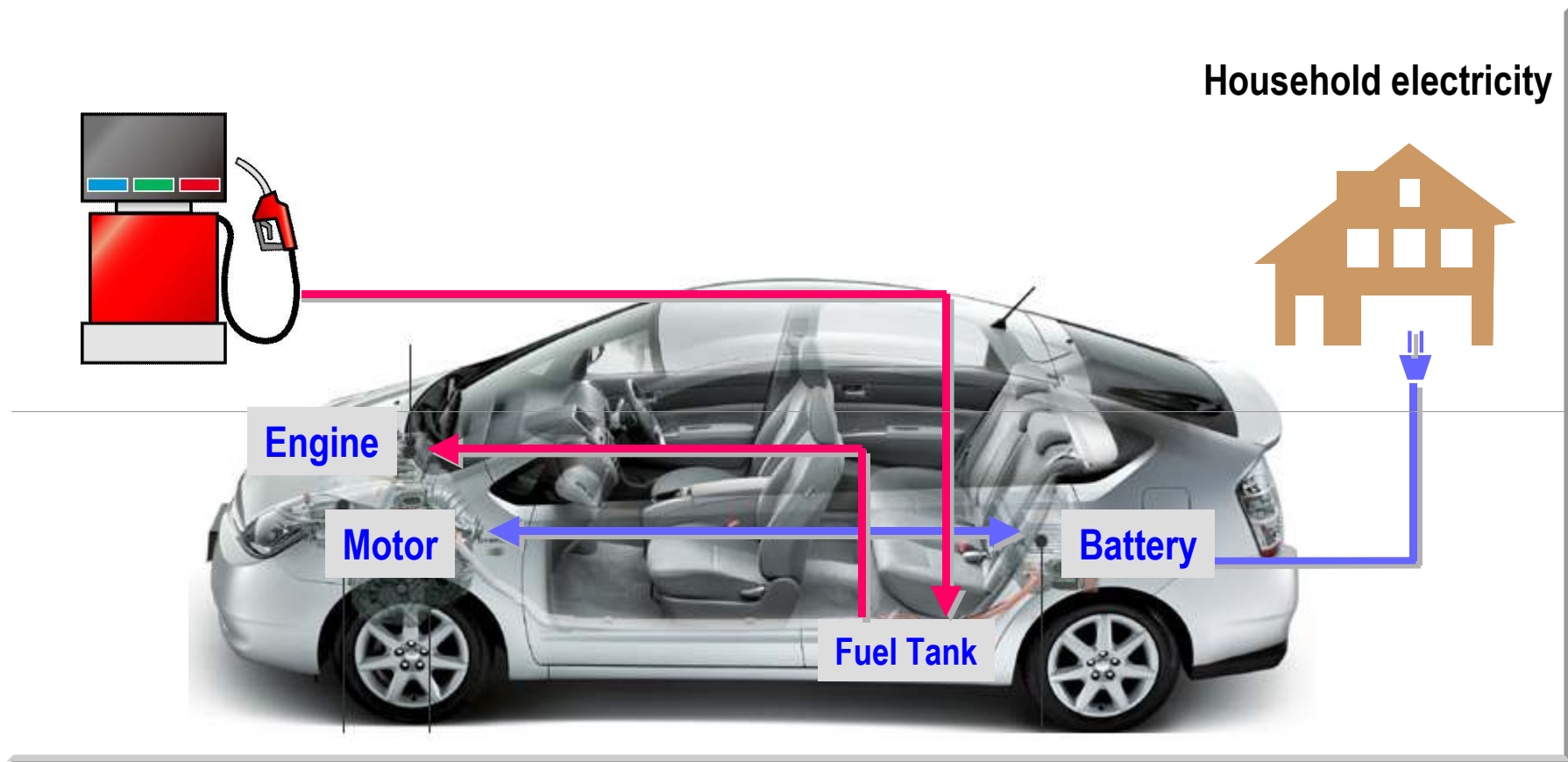
- Decreasing size and weight by increasing output density

R&D for Next-generation Batteries

*Sakichi Toyoda was the founder of the Toyota Group.

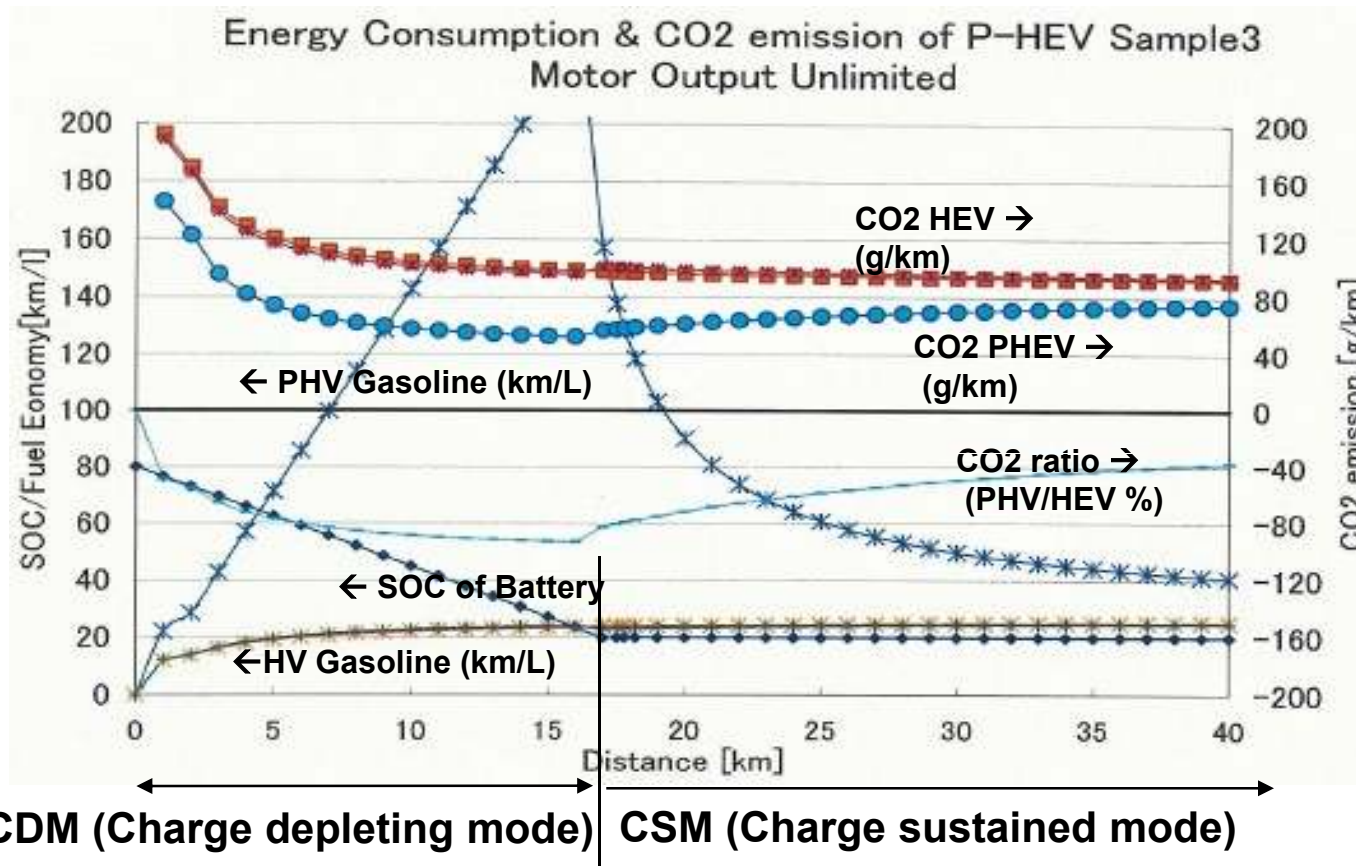


Electricity Application for Vehicles



- Recharging battery using an external power source
- Short distance:EV, Long distance:HV

Effect of PHV for Reducing CO2 Emissions

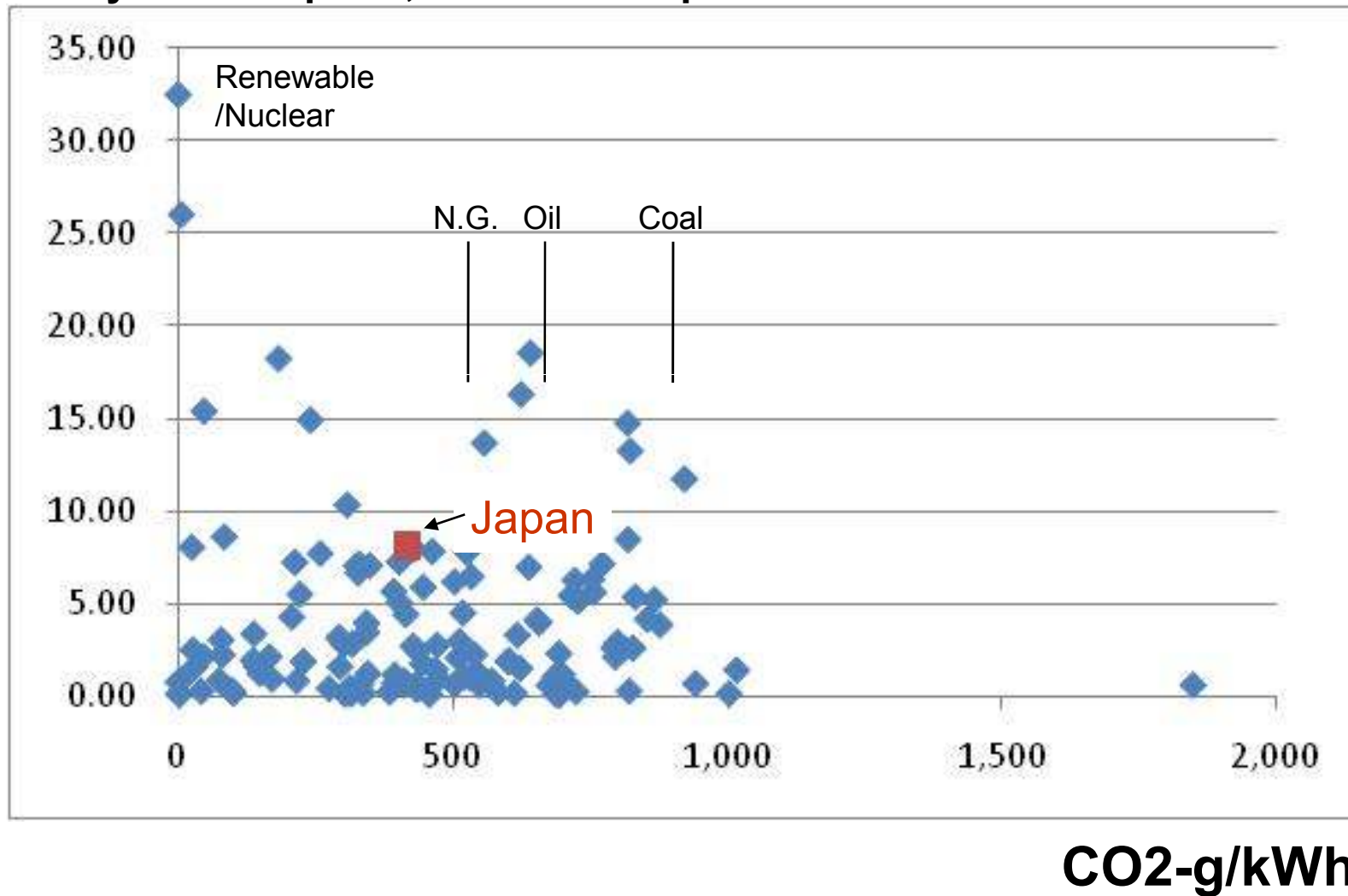


Driving in Tokyo area
Electricity mix in Japan

- In the short distance PHV has large advantage with normal HV.
- In a longer distance, it come with normal Hybrid Vehicles.
- Effect of CO2 reduction depends electricity mix

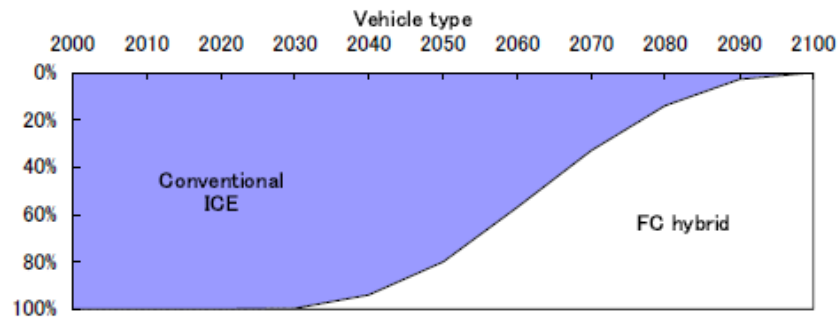
Electricity in each Country

Electricity Consumption, 1000kWh/Population

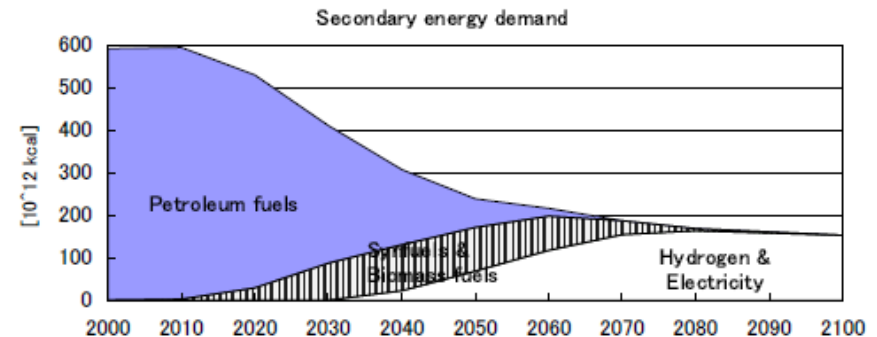
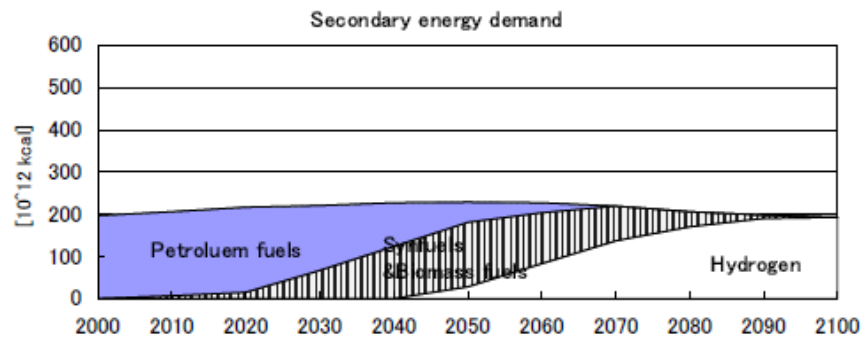
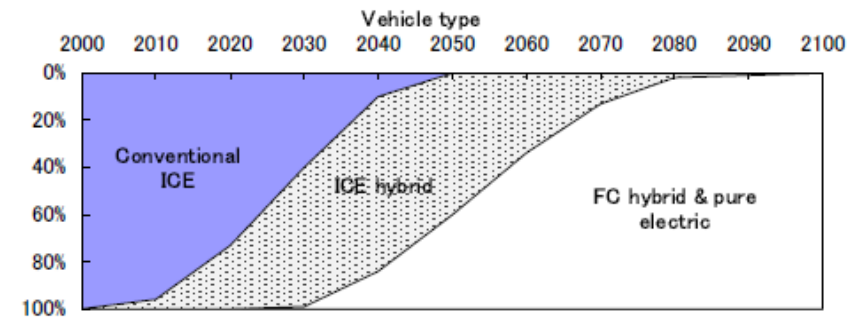


Long term Energy Scenarios (Japan)

Long distance vehicles (heavy-duty truck etc.)

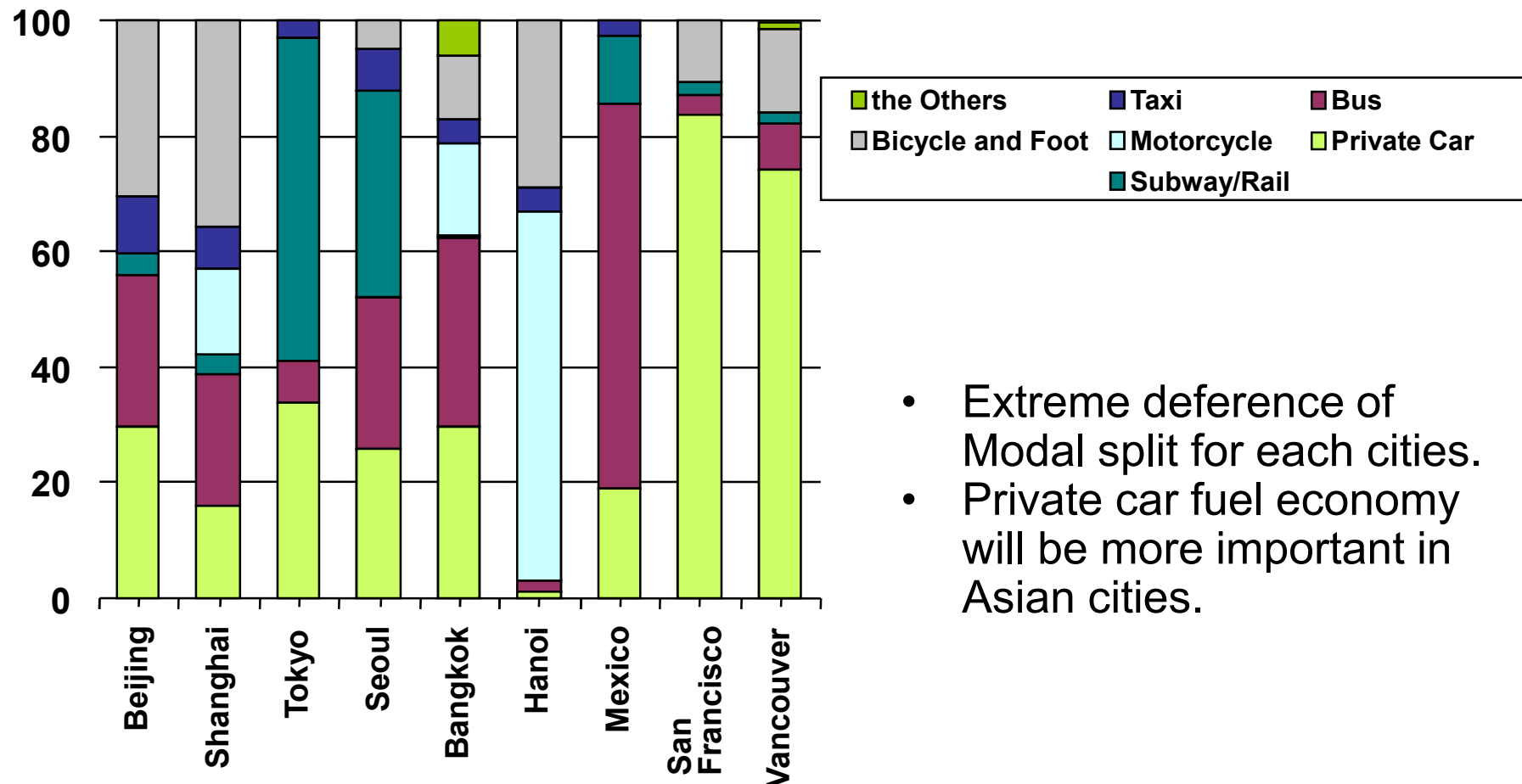


Intraregional running cars (passenger cars and pickup trucks, etc.)



Modal Split for Passenger Transport

Based on Modal split for all passenger transport, passenger-trips

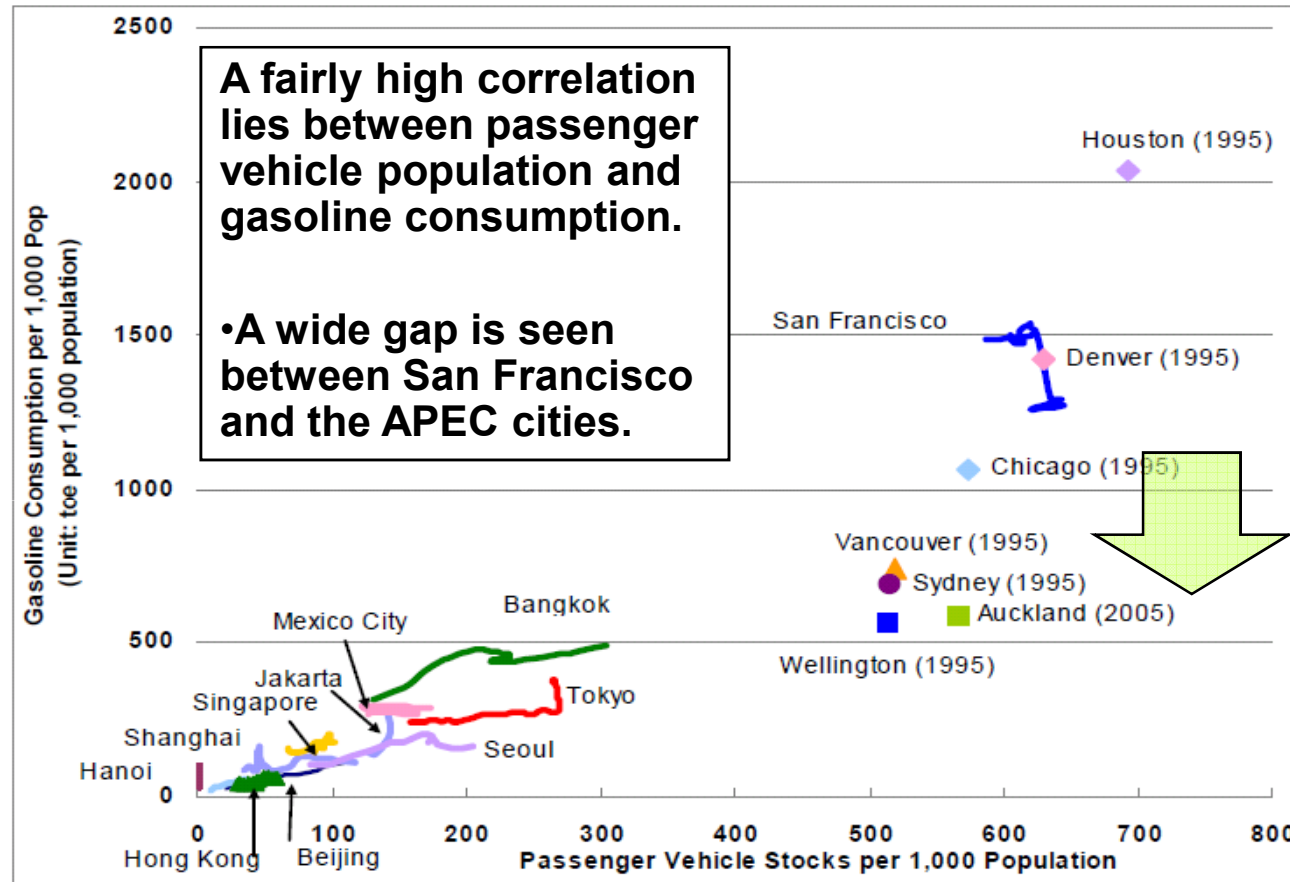


- Extreme deference of Modal split for each cities.
- Private car fuel economy will be more important in Asian cities.

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Future Mobility

per 1,000 Population, 1990-2005



- People in USA are enjoying the car utility, but spend much of energies.
- It suggests that **high efficiency vehicles will contribute to consist with utility and CO2 reduction**

Summary

- Automobile manufactures are facing very serious energy security and environmental issues.
- Modal shift in mega-city might be important solution, however, if advanced vehicle technology applied, personal transportation system that is extremely convenient for people can survive in mega-city.
- Especially, hybrid vehicles are very effective on personal transportation in mega-city because it doesn't require additional infrastructure and it can coexistent with normal vehicles.
- Existing vehicle should be concerned when new type of fuel/energy introduced.
- Bi-fuel vehicles will be contribute as a practical solution.
E85 FFV, PHV and Bi-fuel NGV - - -
- It is needed to prepare post Oil era by FCV and EV (PHV).
& Infrastructure of Hydrogen, Electricity charging system.