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# **Setting Goals and Action Plan for Energy Efficiency Improvement**

**(省エネ推進のための目標及び行動計画の設定について)**

**June 18, 2007**

**EAS Energy Efficiency and Conservation Conference**

**Kokichi Ito**

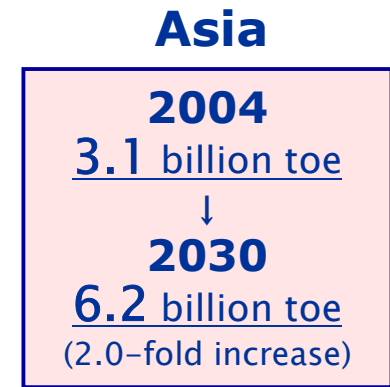
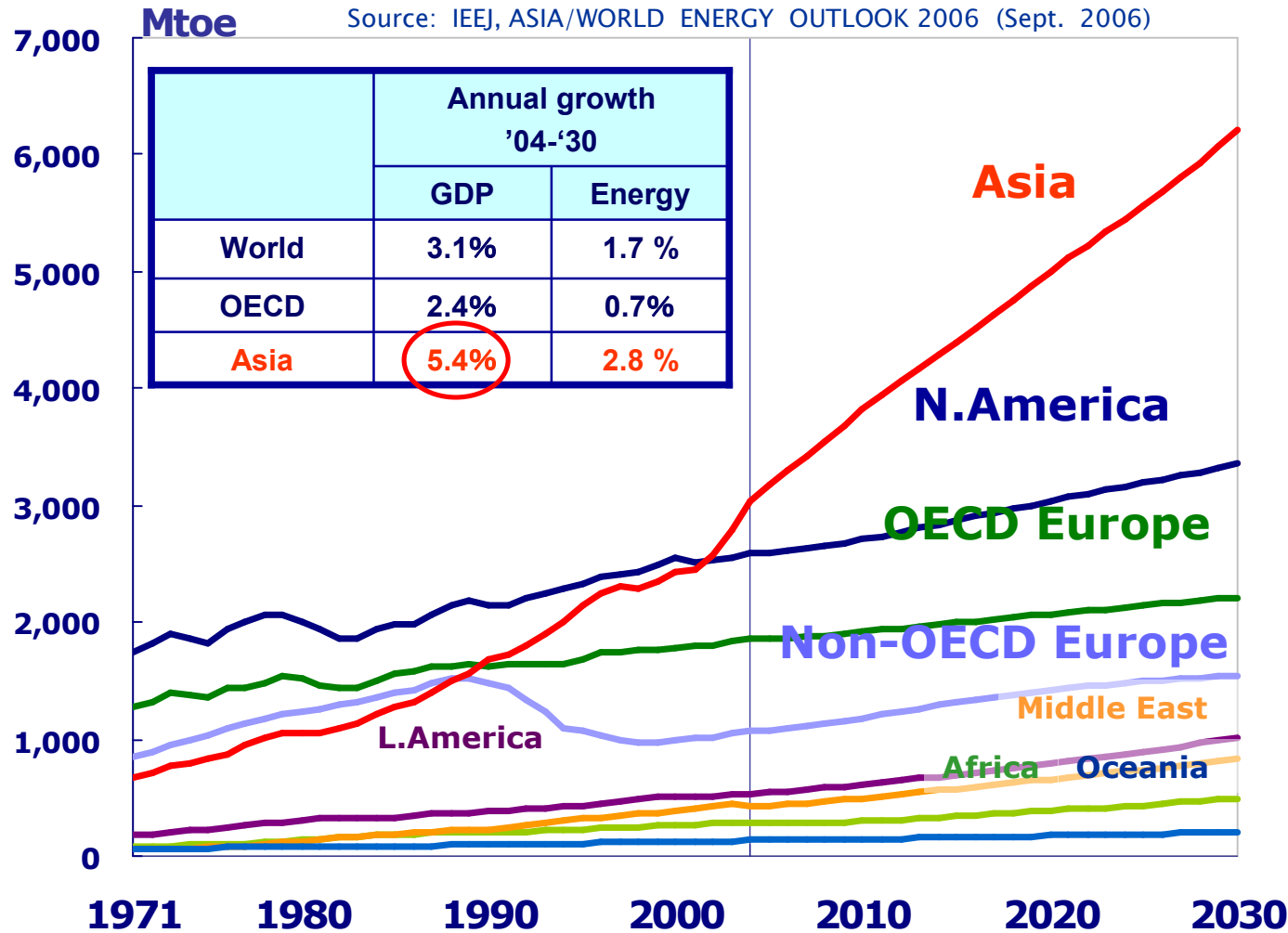
**Managing Director**

**The Institute of Energy Economics, JAPAN (IEEJ)**

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# **Impact of Asian Growth on the Global Energy Demand and Energy-Saving Potential in Asia**

# World Primary Energy Demand by Region



- In 2030, primary energy demand of Asia achieves twice as much as current level, reflecting on highly economic growth. 3.1 billion toe(2004) → 6.2 billion toe (2030)

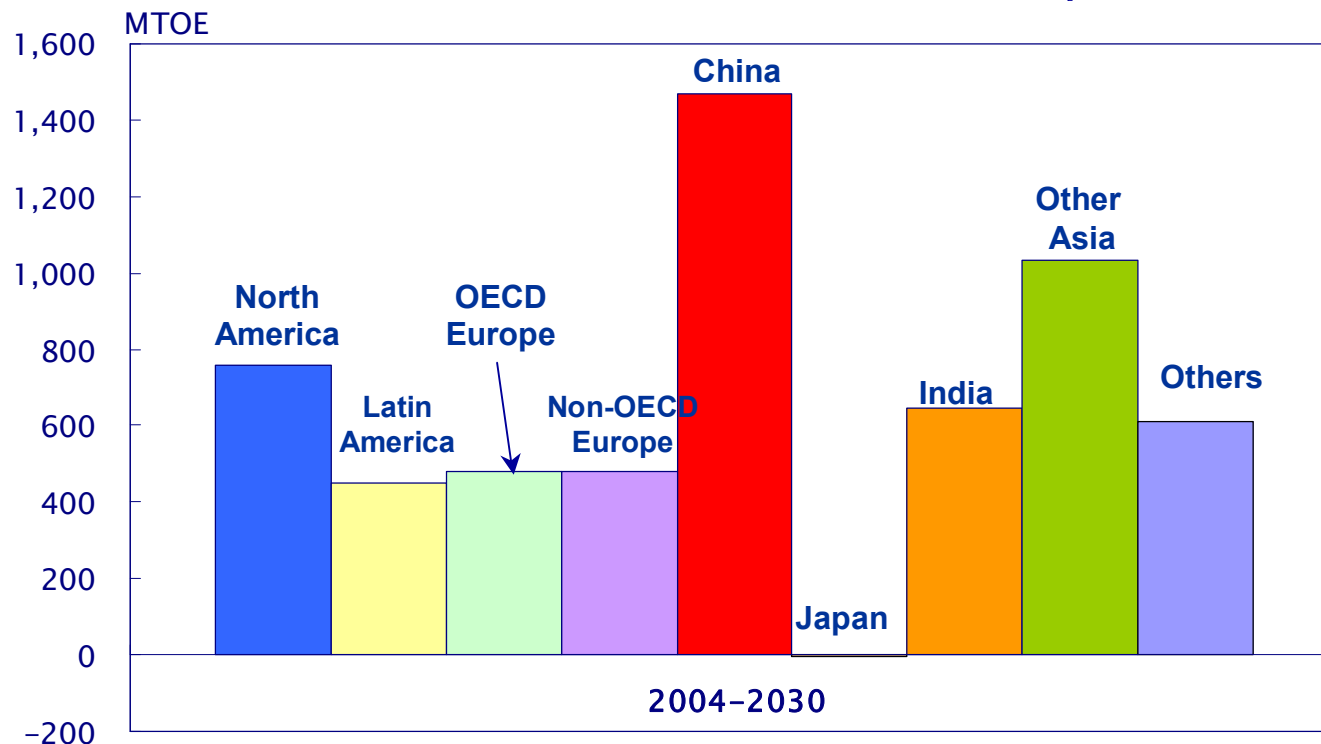
# Incremental Increase in World Primary Energy Demand



Share in total incremental increase, 2004–2030

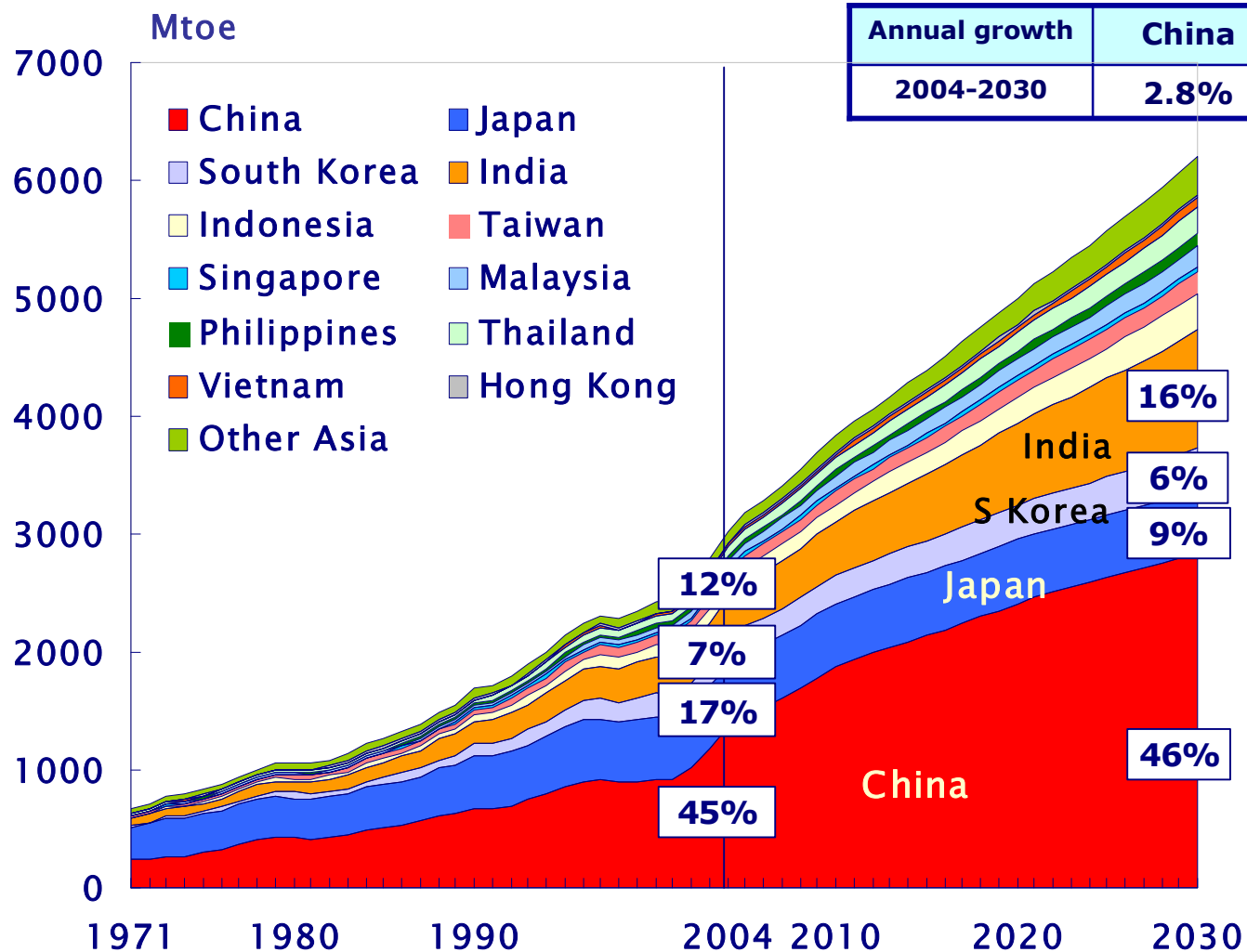
N.America	China	Japan	India	Other Asia
13%	26%	0%	11%	18%

**50%** of incremental increase driven by Asia



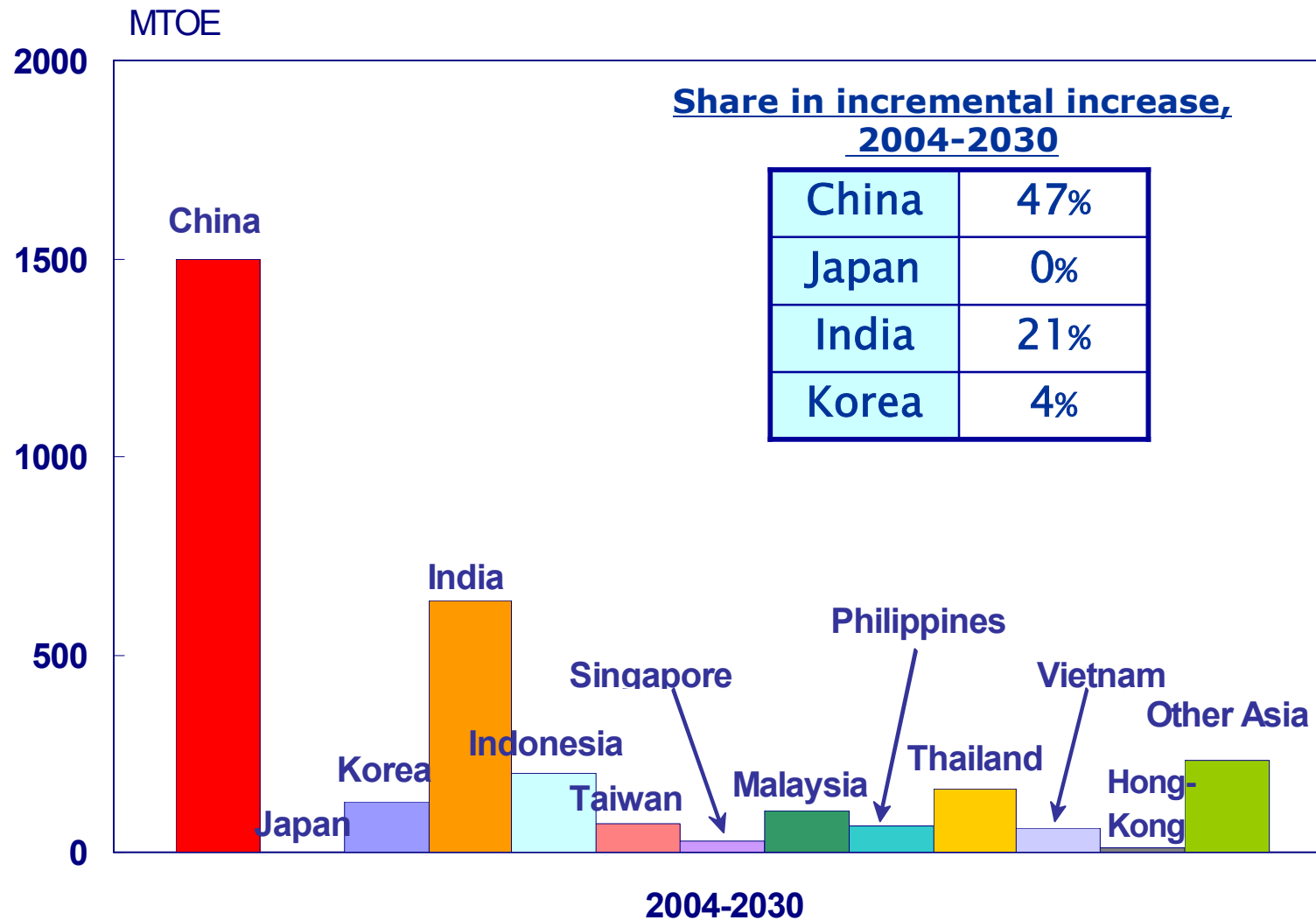
- Approximately half of incremental increase in primary energy demand is coming from Asia

# Asian Primary Energy Demand by Region



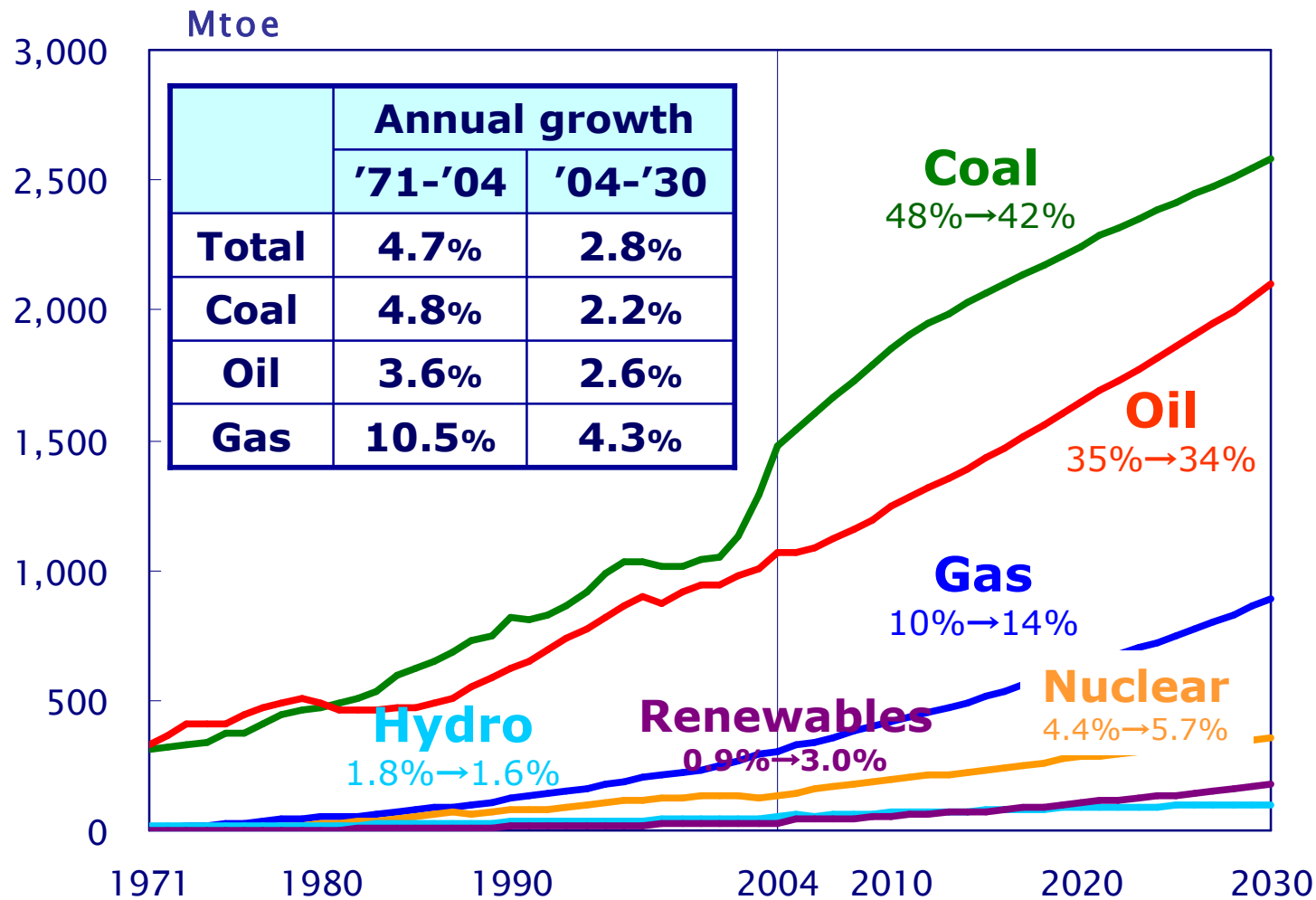
- Based on strong economic growth, share of China in Asia significantly increases to 46%, China and India 62%.
- Japan's energy share in Asia, with its slower-paced economic growth and depopulation, will decline from 17% in 2004 to 9% in 2030.

# Incremental Increase in Asian Primary Energy Demand



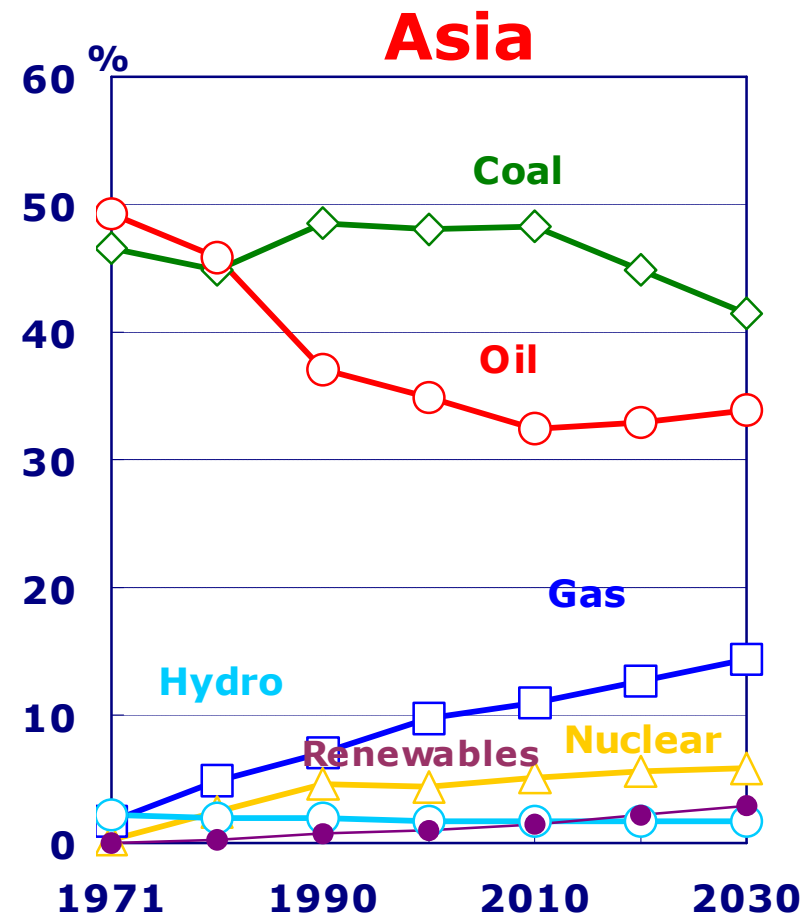
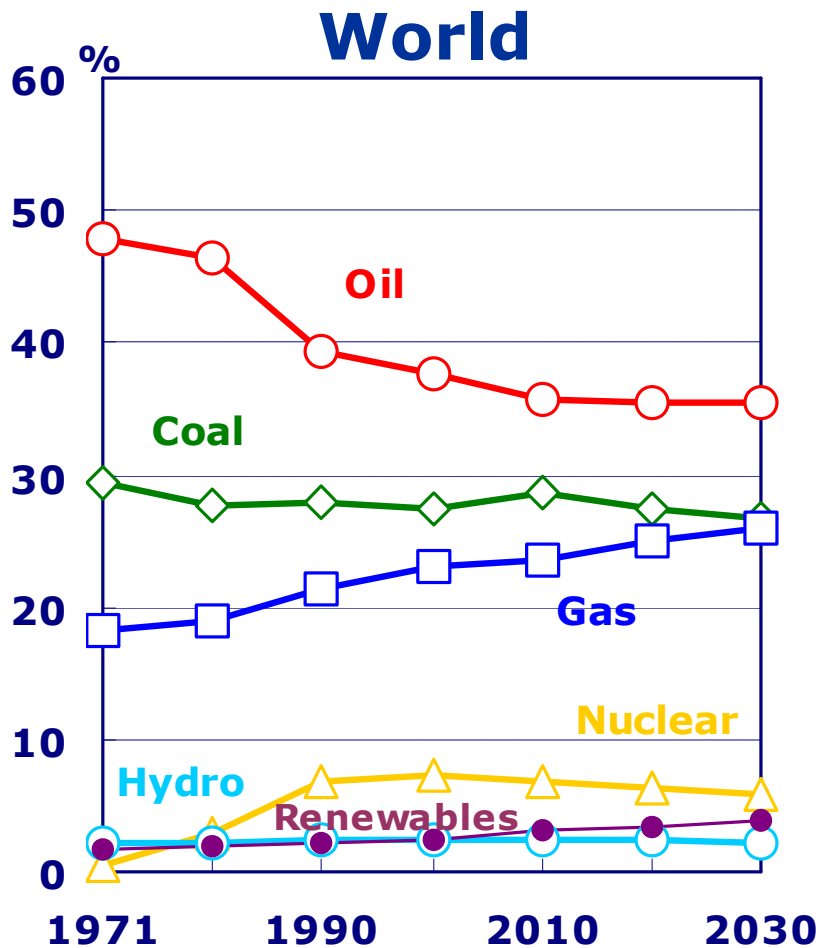
- Of total incremental increase in Asia, China and India, as prominent consumers, will account for approximately 70%.

# Asian Primary Energy Demand by Fuel



- Coal and Oil will continue to maintain its centrality over Asian energy demand by 2030
- The share of natural gas is forecast to grow substantially, driven mainly by power generation

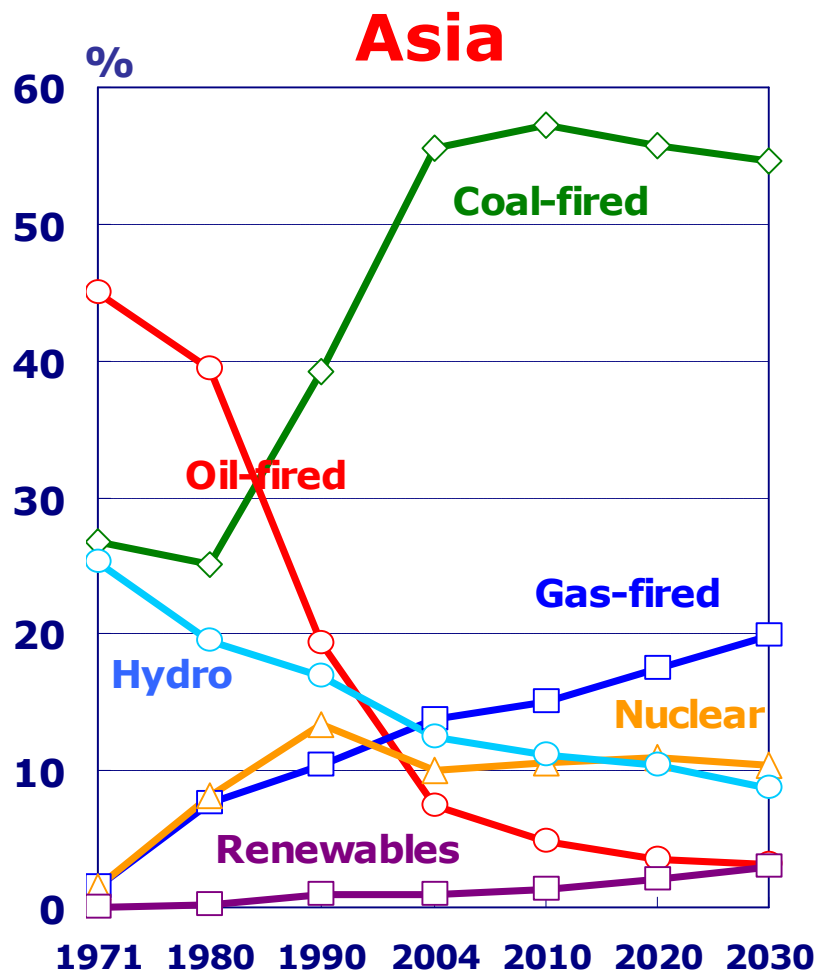
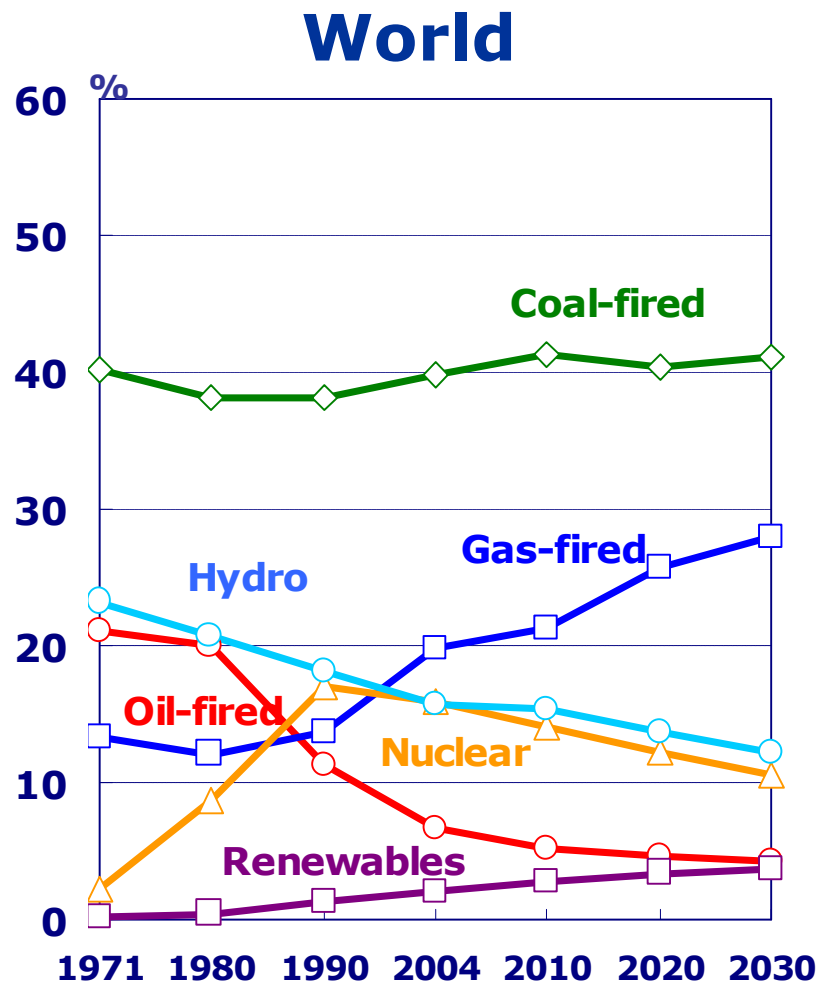
# Comparison of Primary Energy Mix by Fuel



- In Asia, coal remains the largest of primary energy due to electrical power demand increasing for 2030.(Coal share in Asia: 2004:48%→2030:42%)
- Nuclear share in Asia gradually increases with active building-up of nuclear power plants in China, India, Japan and South Korea.

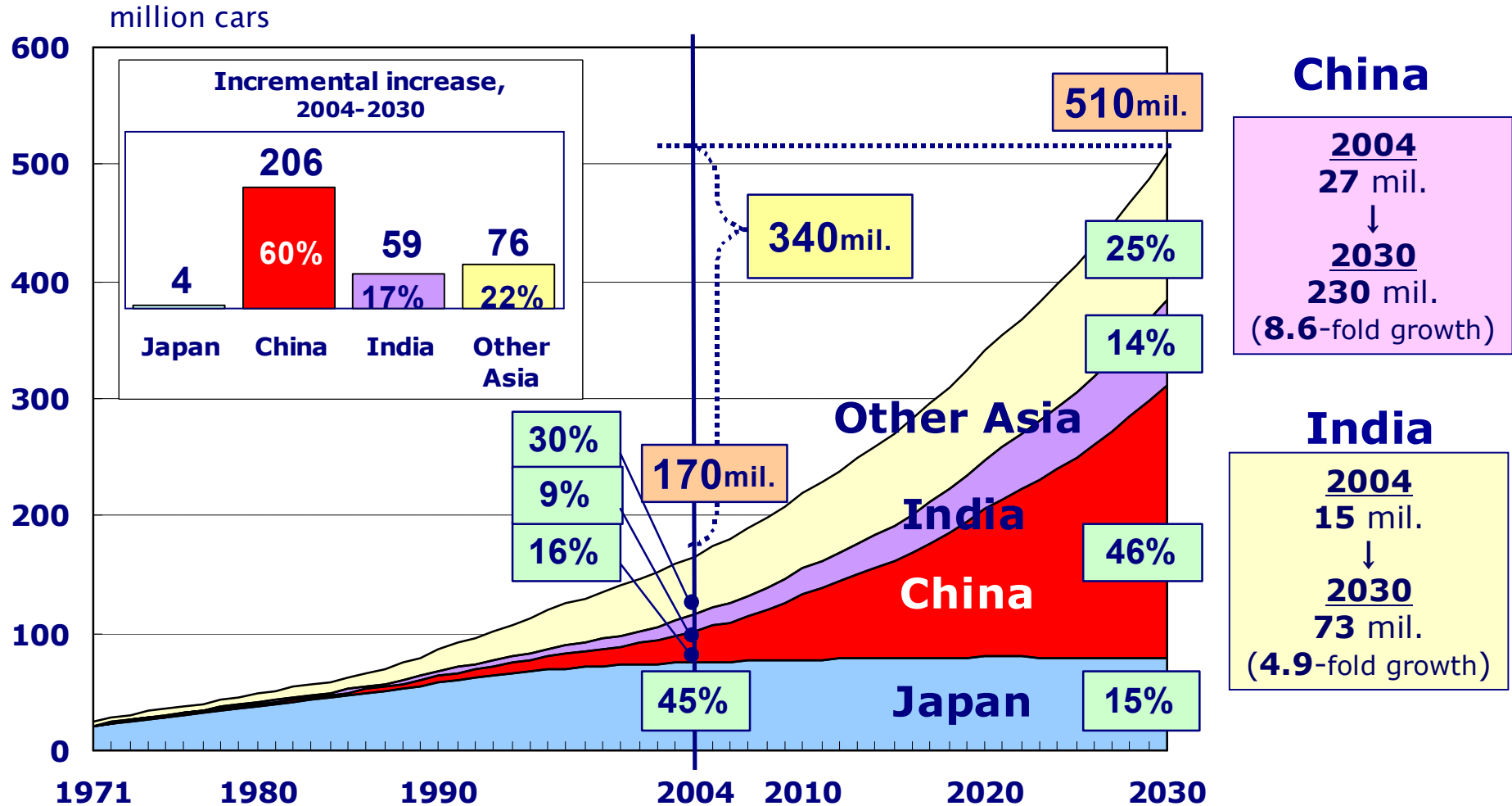


# Fuel Mix in Electricity Generation



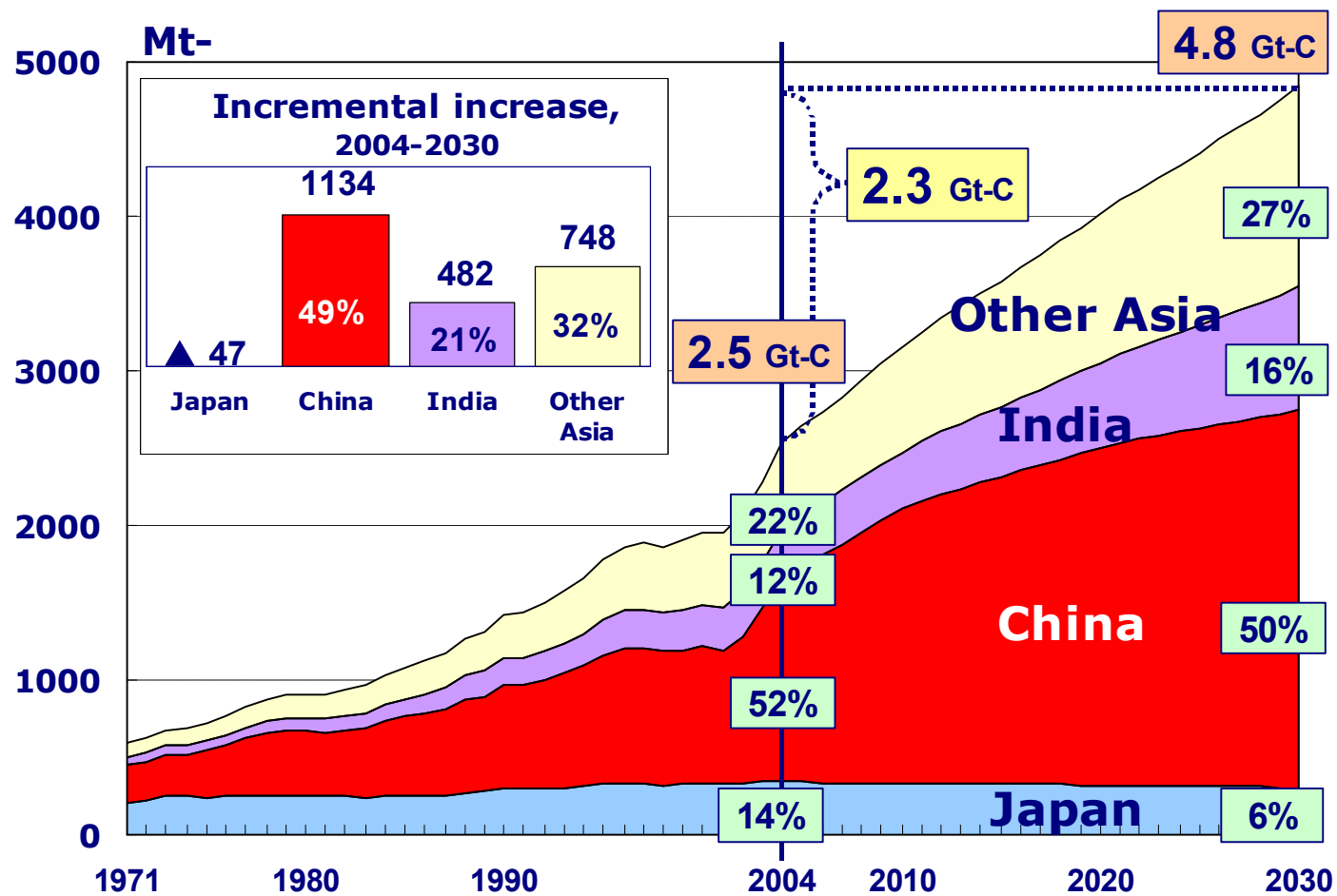
- Asian region need to address rapid growth of electricity demand mainly by coal and gas

# Vehicle Ownership in Asia



- China will register substantial growth of vehicle ownership, with Japan representing shallow rising trend

# CO<sub>2</sub> Emissions Forecast in Asia



**China**

**2004**  
1.3 Gt-C

↓

**2030**  
2.4 Gt-C  
(1.8-fold growth)

**India**

**2004**  
0.31 Gt-C

↓

**2030**  
0.79 Gt-C  
(2.5-fold growth)

- CO<sub>2</sub> emissions of China and India will steadily increase driven by coal consumption, the share accounting for 66% together in Asia.

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# **Advanced Technology Scenario of Asia - Energy-Saving Potential -**

## ■ Energy conservation in industry and residential/commercial sector

High efficiency boiler, Coke Dry Quenching equipment(CDQ), Top Pressure Recovery Turbine(TRT)、Demand side management, Thermal insulation, High efficiency heat pump etc

## ■ Energy–efficiency in transport sector

Hybrid–vehicle, ITS(Intelligent Transport System) etc.

## ■ Energy–efficiency in power generation sector

Coal–fired IGCC/IGFC、Gas–fired MACC etc.

## ■ Renewables

Bio–fuel for automobile, photovoltaic, Wind–power, Biomass power generation etc.

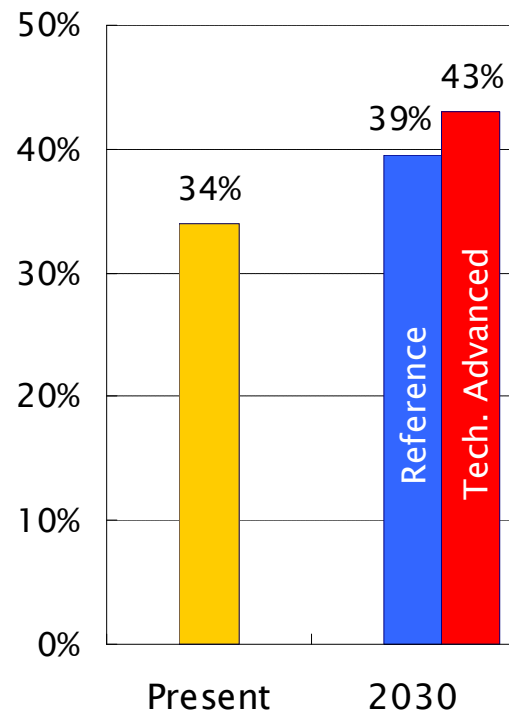
## ■ Nuclear

Building new nuclear power plant, Enhancement of operating ratio and safety control etc.

# Potential Areas for Energy Saving in China

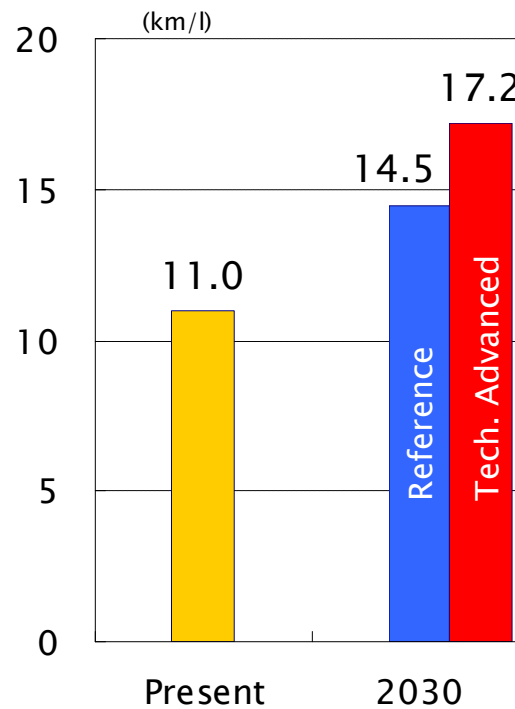


### Efficiency of fossil-fired Power Production



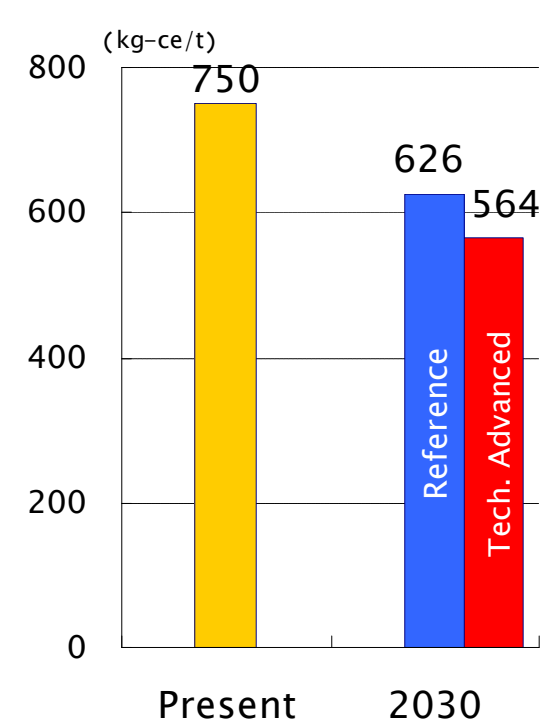
- Capacity Enhancement
- Technological Advance
- Improvement in fuel mix

### Fuel Efficiency of Vehicles



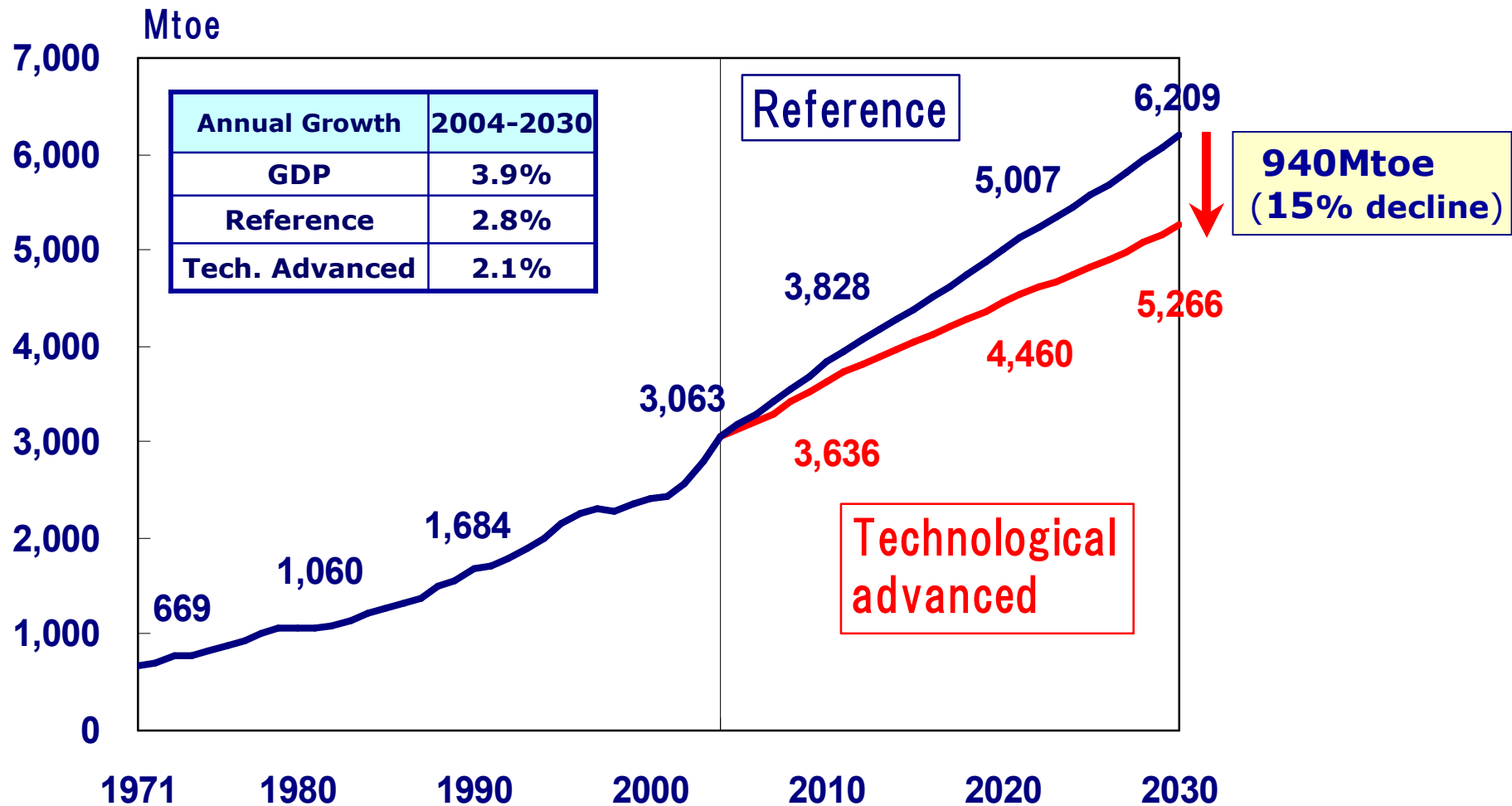
- Innovative Technologies, like Hybrid Engine
- Downsizing
- Clean Diesel Engine Implementation

### Energy Efficiency in Steel Production



- Scale Expansion
- Large-scale waste energy recovery (TRT, CDQ)
- Enhanced recovery of by-product gas

# Primary Energy Demand in Asia

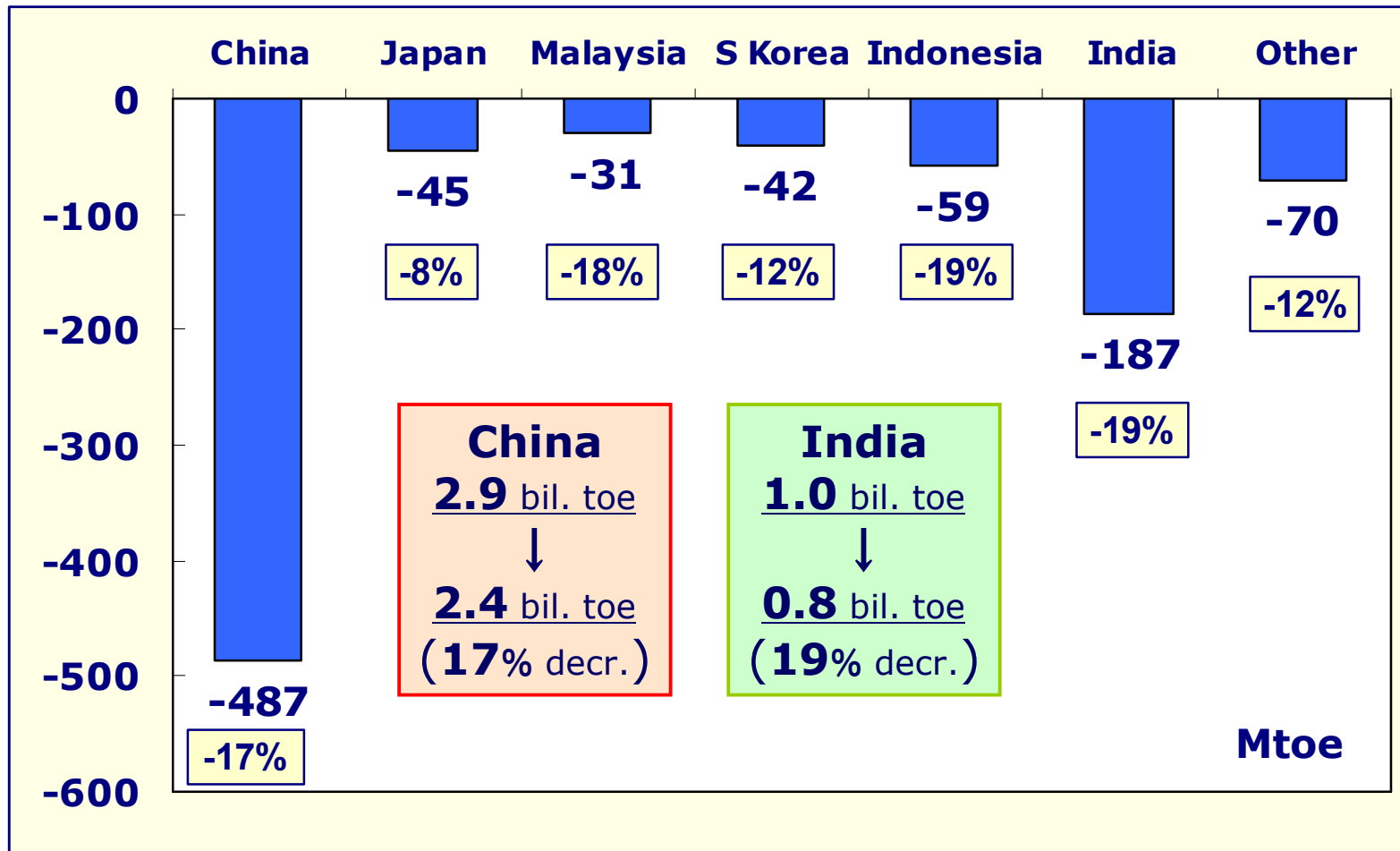


- In 2030, aggregate primary energy demand is reduced by around 15% (940 Mtoe, 1.8 times scale of Japan's current primary energy demand )

# Change in Total Primary Energy Demand in Asia



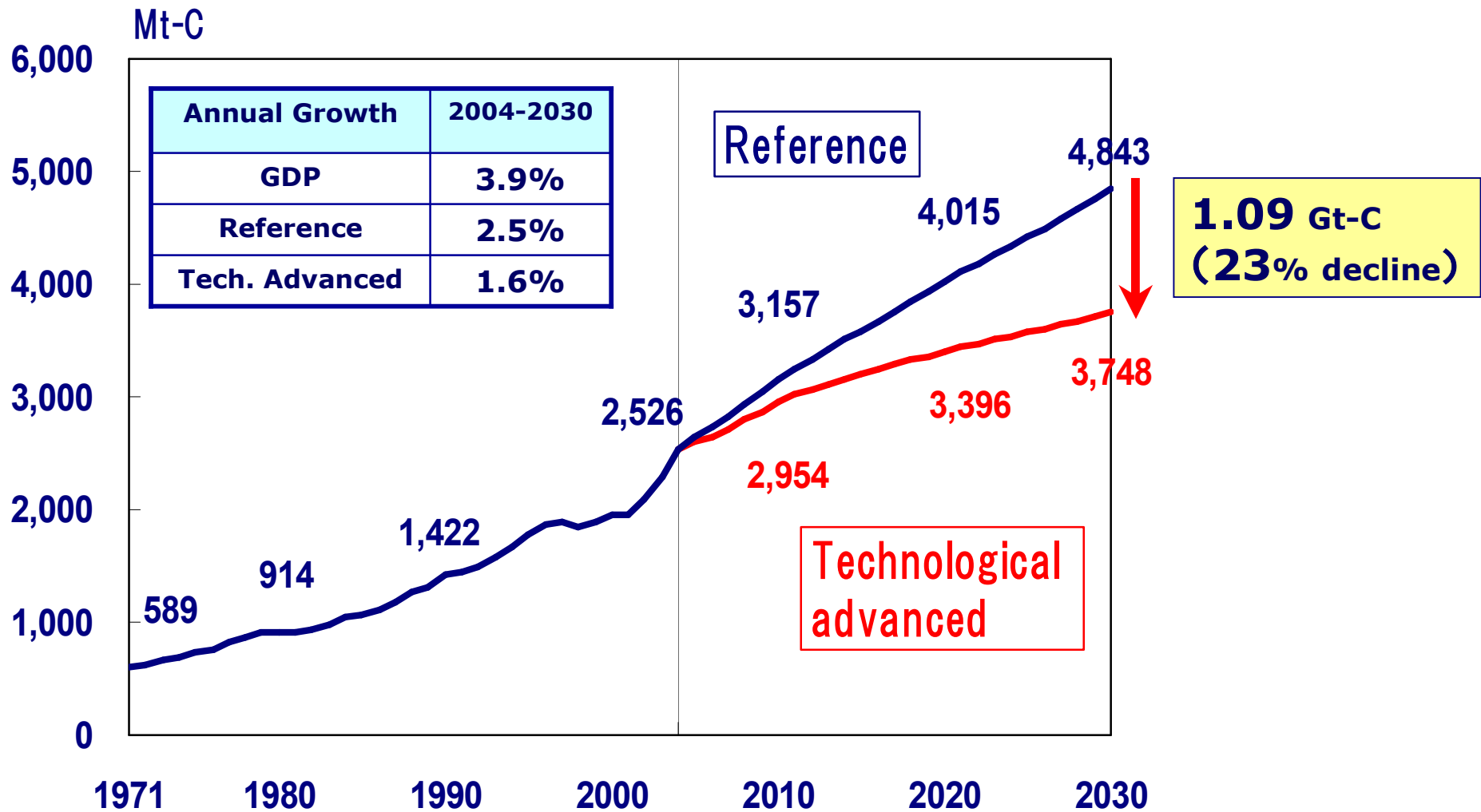
## Change of Total Primary Energy Demand in 2030



- Potential of energy conservation is large in both China and India through enhancing energy consumption efficiency

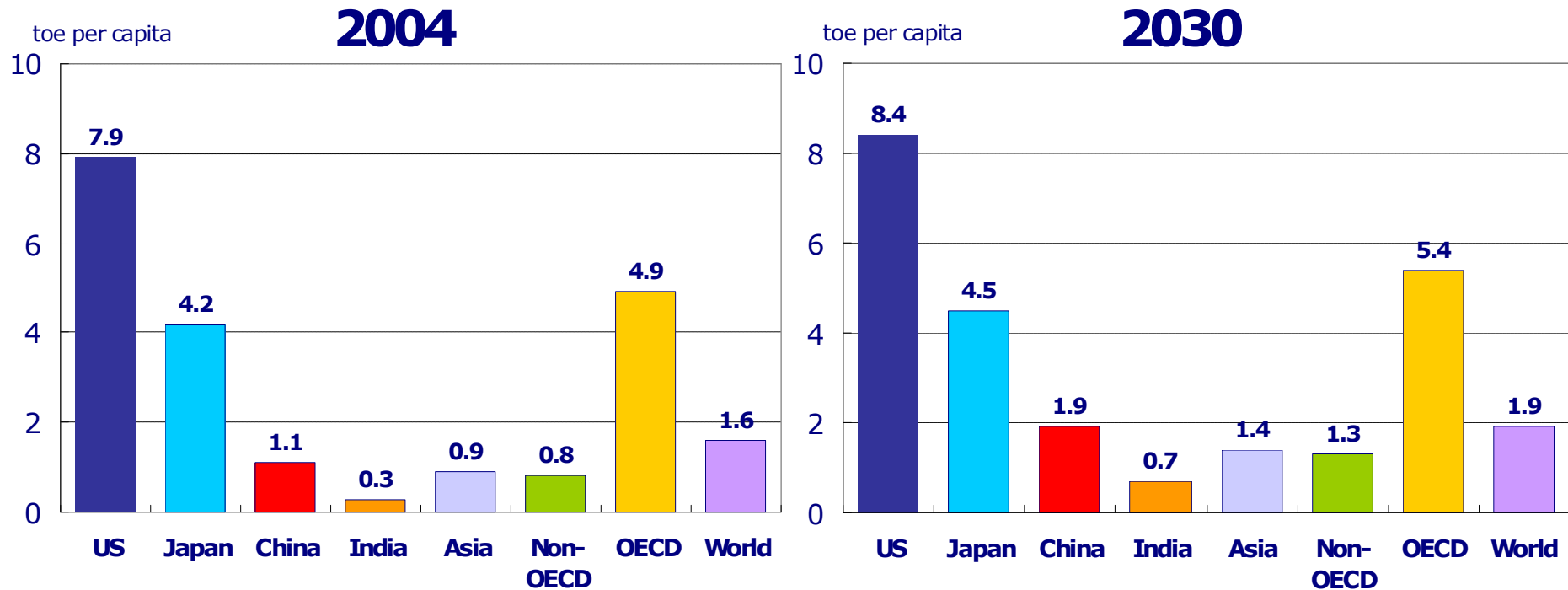


# CO<sub>2</sub> Emissions in Asia



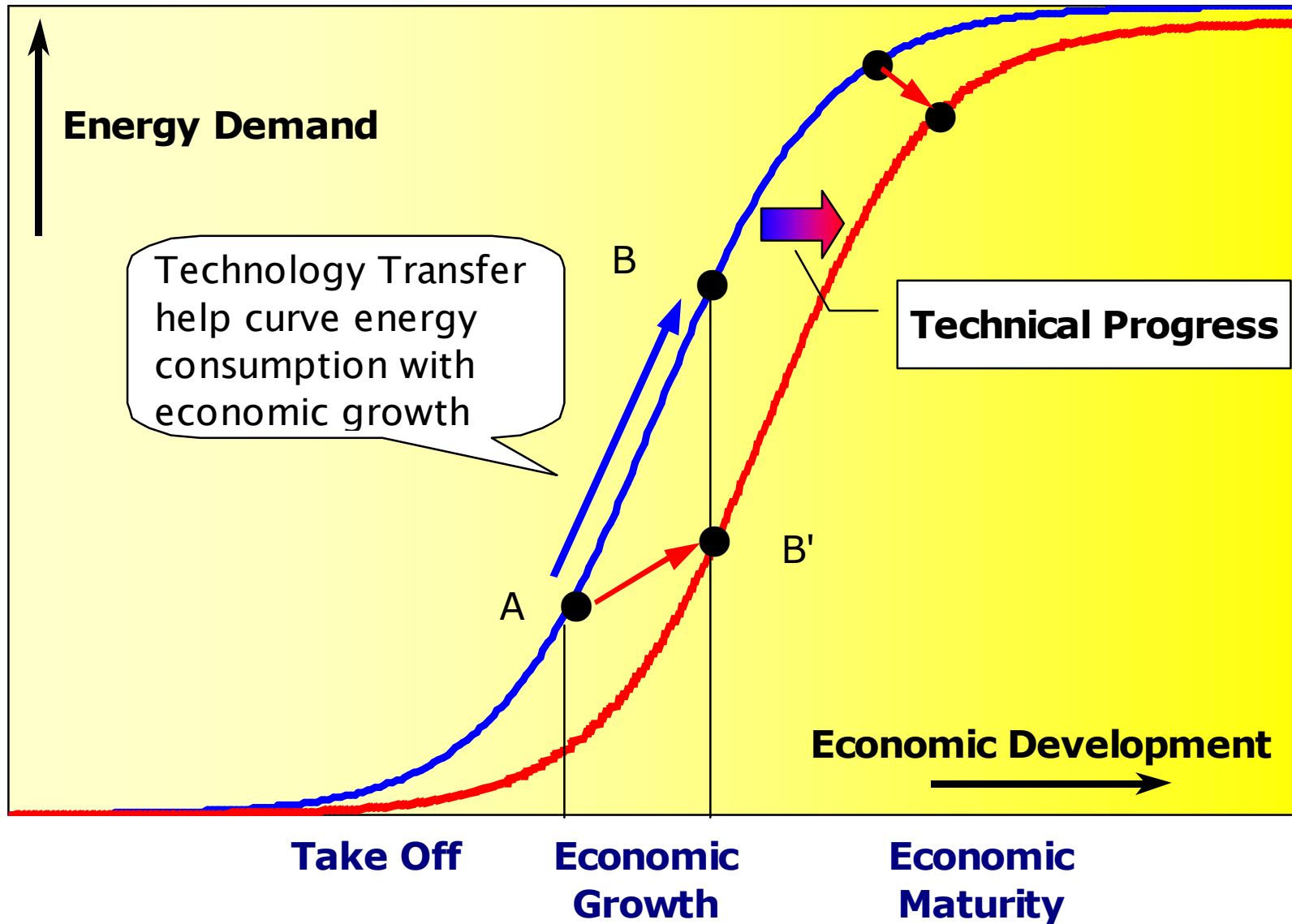
- In 2030, mitigation of CO<sub>2</sub> emissions achieves about 22% (1.09 Gt-C), roughly equivalent to the emissions of whole China or 3.2 times of Japan

# Energy Consumption per capita



	<u>2004</u>	→	<u>2030</u>
<b>World</b>	<b>1.6</b>	→	<b>1.9</b>
<b>OECD</b>	<b>4.9</b>	→	<b>5.4</b>
<b>China</b>	<b>1.1</b>	→	<b>1.9</b>
<b>India</b>	<b>0.3</b>	→	<b>0.7</b>

- In 2030, energy consumption per capita in China and India will still be below that in developed countries, which means that China and India have a huge potential to grow in energy demand

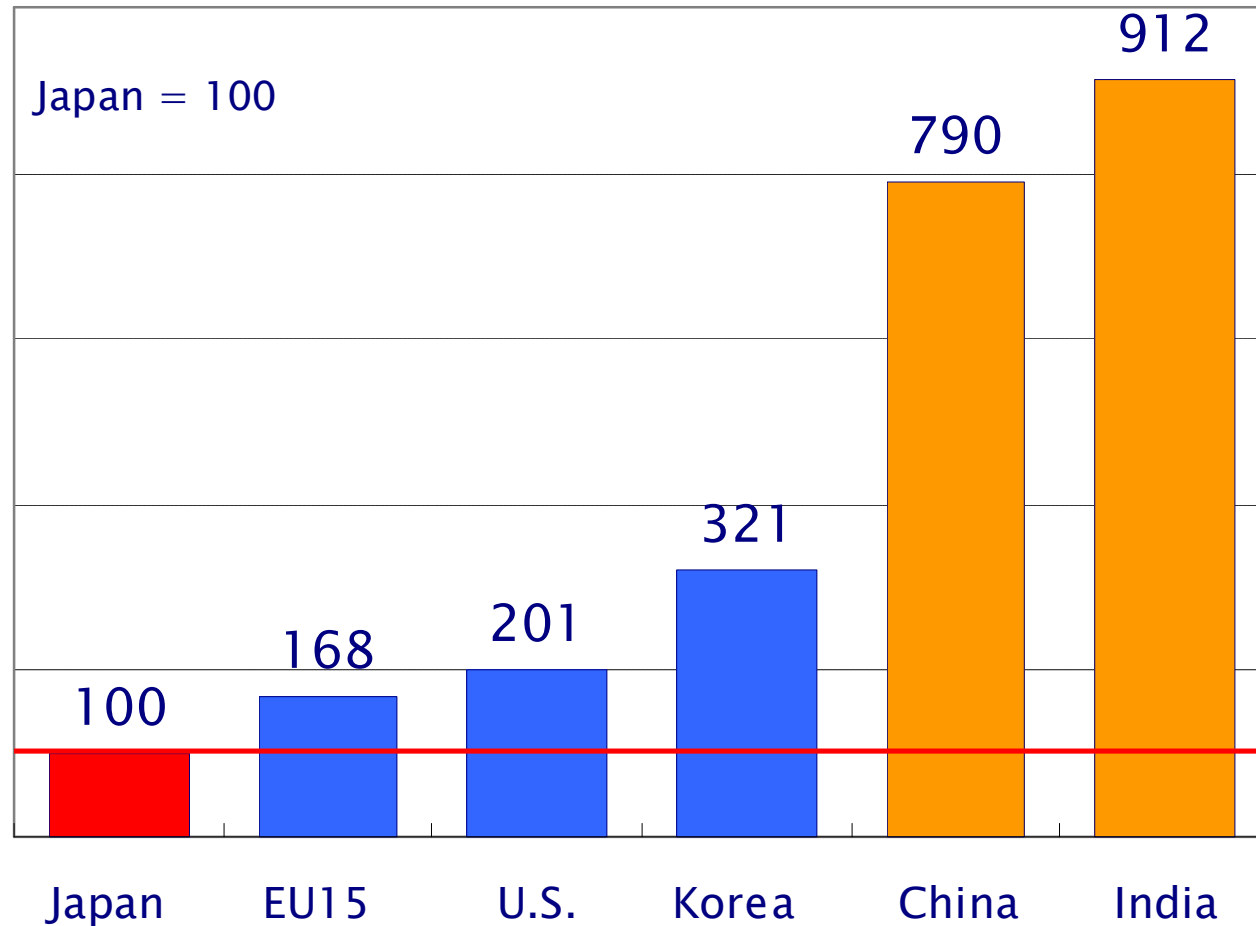


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# **Energy Conservation in Japan - Policy and Experience -**

# Total Primary Energy Supply per GDP

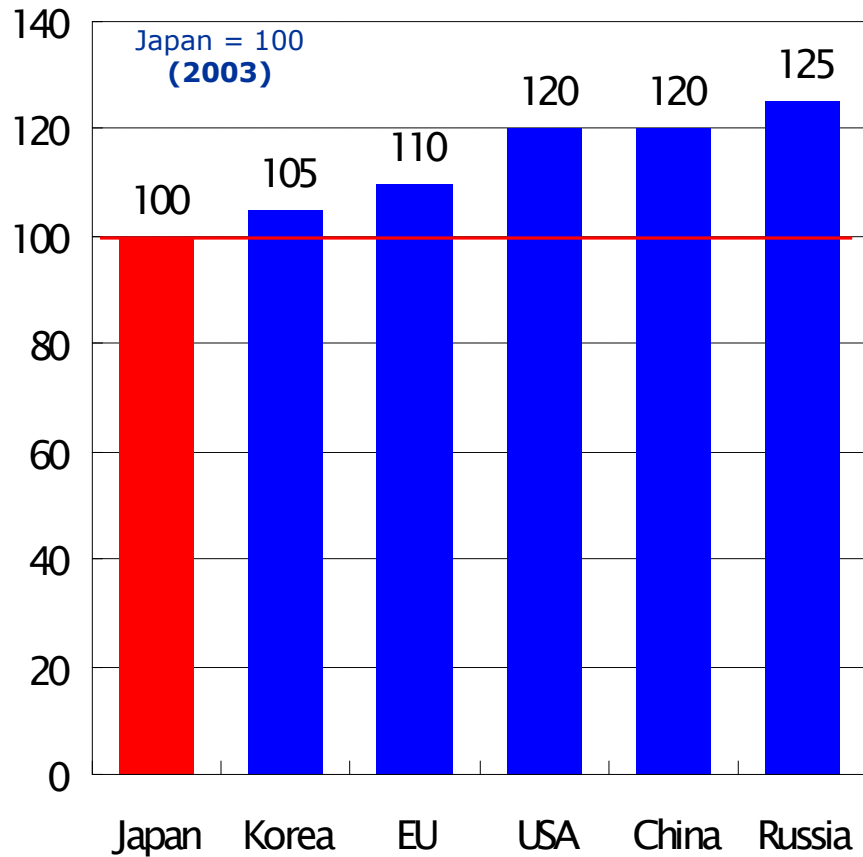
Commercial Energy



- Japanese primary energy consumption per GDP is the lowest among major country in the world
- Asian countries have potential to improve energy efficiency, making full use of Japan's experience and technology

## Steel

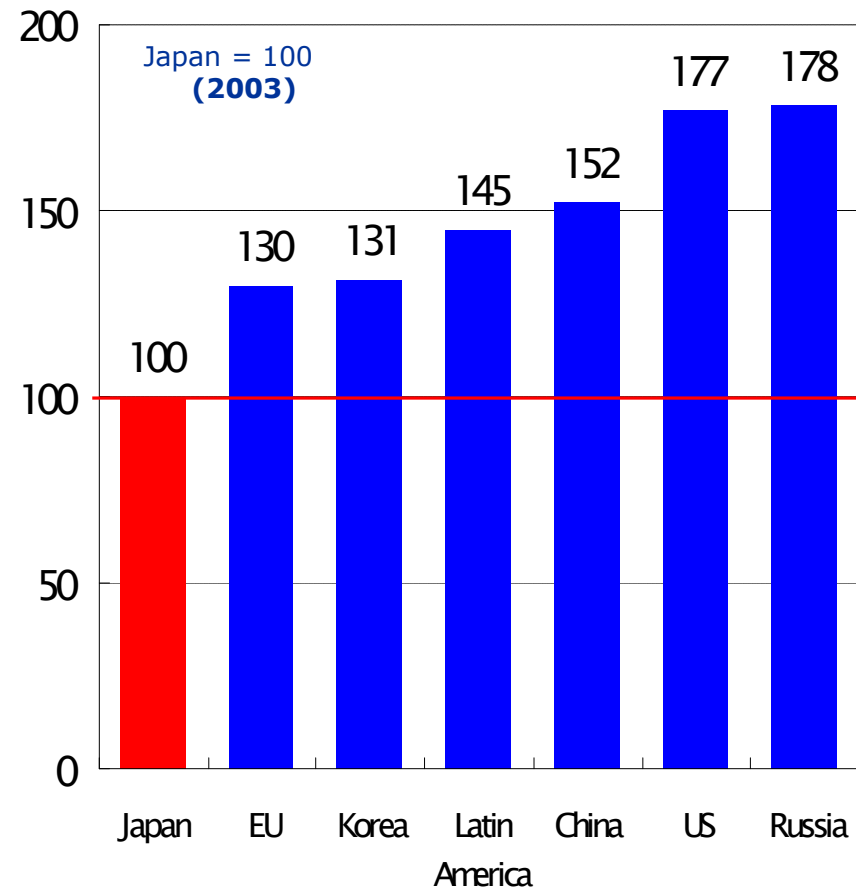
Energy Consumption/Steel Production



Source: JISF

## Cement

Energy Consumption/Clinker



Source: Battelle

## ■ Objective

- In the 1970's, efforts to improve energy efficiency were made to ensure **energy security**
- In recent years, energy efficiency is one of the important measures to **reduce CO2 emissions**

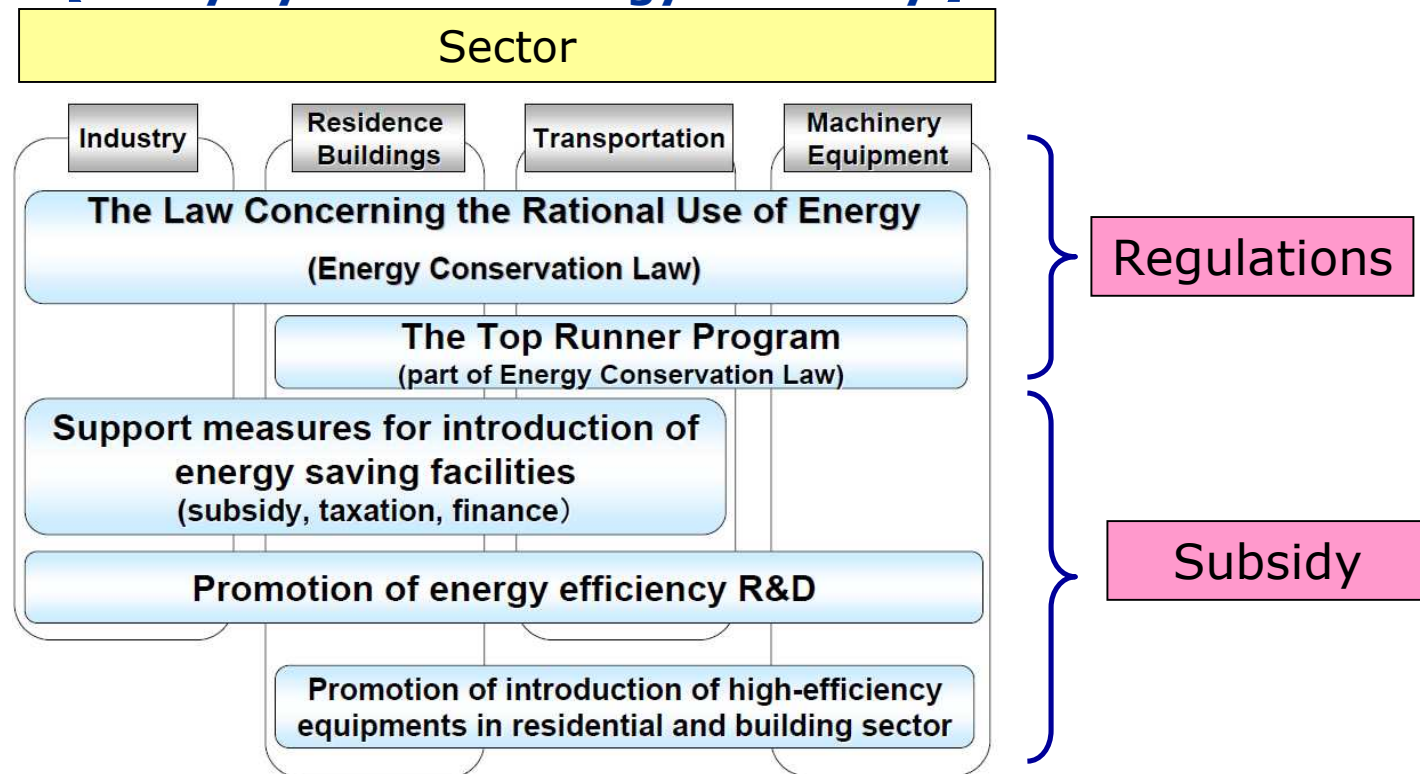
## ■ Key Features

- In close cooperation with private sector, Japanese government takes advantage of its self-initiative and business vitality
- Carefully crafted policy on a sector by sector basis
- Contributed to competitiveness in the market, improving productivity and developing innovative technologies



1. Regulations by Government (Energy Conservation Law)
2. Support and subsidy system (finance, tax, subsidiary aid)
3. Voluntary Action (Keidanren Voluntary Action Plan on Environment, Cost reduction efforts)

## 【Policy System for Energy Efficiency】





- High Dependence on Imported Energy and Middle East Oil
- High Crude oil prices
- High Share of heavy industries in energy structure



Secure **Energy Security**

Urgent need for drastic **"Energy Conservation"**

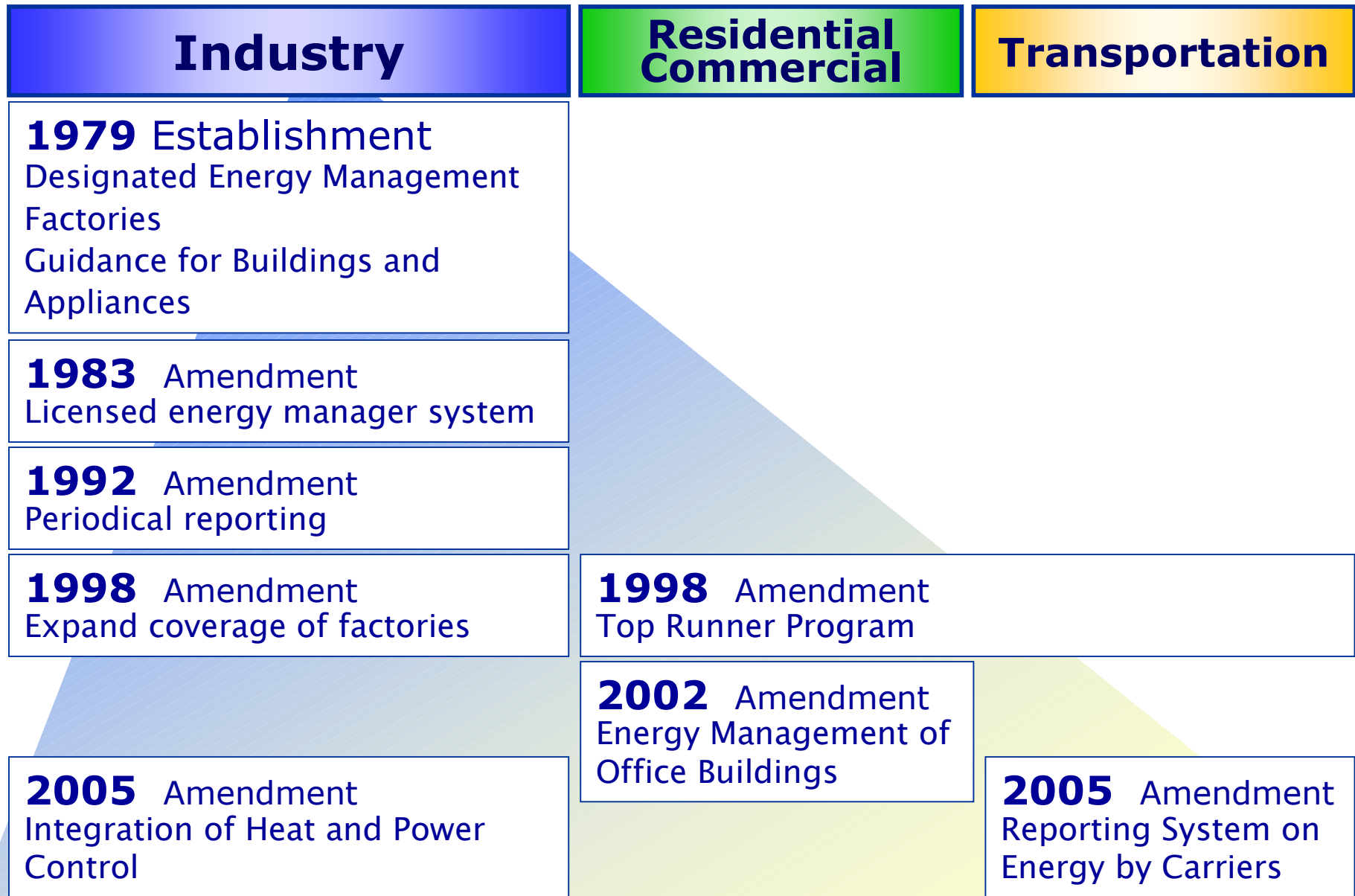
**Energy Conservation Law** was established in 1979 with Industry Sector as its primary target.



After 1979

- Review and Revision Energy Conservation Law
- Additional measures (Top Runner Program, Periodical Report on Energy Consumption, Energy Manager System)
- Expanded sector coverage (Transportation, Residential/ Commercial)

# Historical Development of Energy Conservation Law



Sector	Specific Measures
Industry	<ul style="list-style-type: none"> <li>• <b>Voluntary Action Plan on the Environment</b></li> <li>• <b>Introduction of energy efficient equipment (e.g. High-performance industrial furnace, High-performance boiler, and Next-generation coke oven)</b></li> <li>• <b>Energy Management System in factory</b></li> </ul>
Transportation	<ul style="list-style-type: none"> <li>• <b>The “Top Runner Program” is a key driver to improve fuel efficiency of vehicles</b></li> <li>• <b>Promotion of clean energy automobiles</b></li> <li>• <b>Energy conservation measures for cargo owners and carriers</b></li> </ul>
Buildings	<ul style="list-style-type: none"> <li>• <b>Improvements in energy efficiency of buildings, incl. promotion of High-Efficiency Air Conditioning Systems</b></li> <li>• <b>Expanding ESCO Market</b></li> <li>• <b>Improved efficiency of appliances in line with the “Top Runner Program”</b></li> </ul>
Household	<ul style="list-style-type: none"> <li>• <b>Energy-Saving Labeling System promotes energy efficient appliances</b></li> <li>• <b>Improved efficiency of appliances in line with the “Top Runner Program”</b></li> <li>• <b>Energy Efficient Product Retailer Assessment System</b></li> </ul>
Energy Conversion	<ul style="list-style-type: none"> <li>• <b>Improve energy intensity of power generation</b></li> <li>• <b>Develop clean and efficient technologies (e.g. IGCC)</b></li> </ul>

## **KEIDANREN, Voluntary Action Plan on Environment**

### ■ **Philosophy**

Positive involvement in environmental issues is essential to the survival of companies as well as their activities.

### ■ **Participants**

35 industries (CO2 Coverage Ratio : 83% in 1990)

### ■ **Overall Target in FY2010**

Reduce CO2 emissions from Industrial and Energy– conversion sectors below the amount in 1990

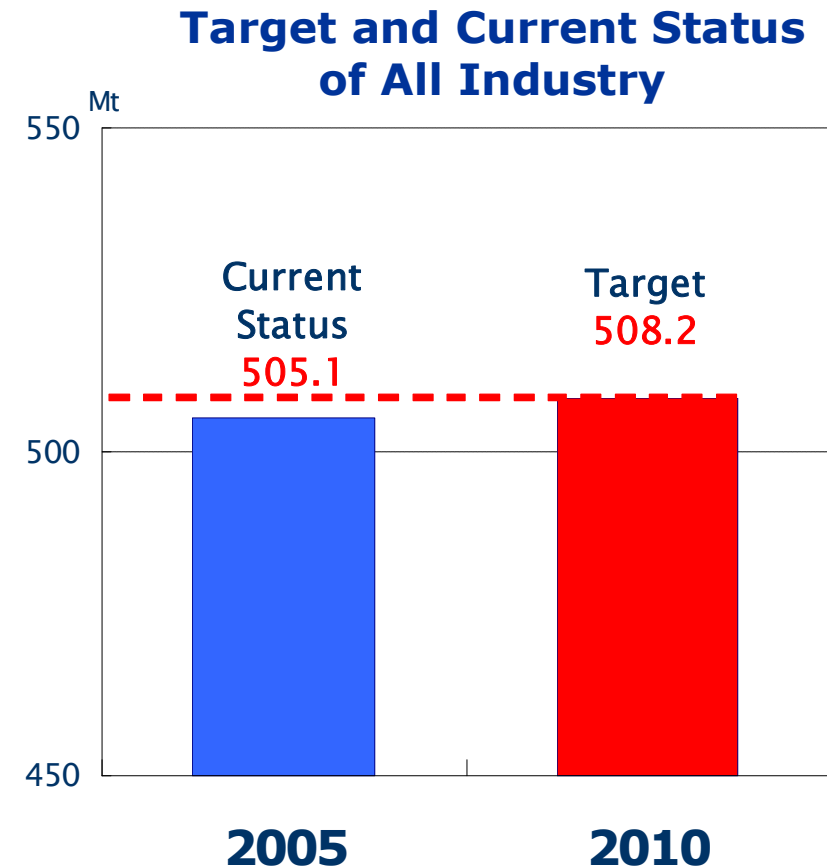
### ■ **Implementation of Energy Conservation Measures**

Each industry sets the target respectively. The progress is jointly reviewed with the government and third party at the regular follow–up meetings

KEIDANREN :Japan Federation of Economic Organizations

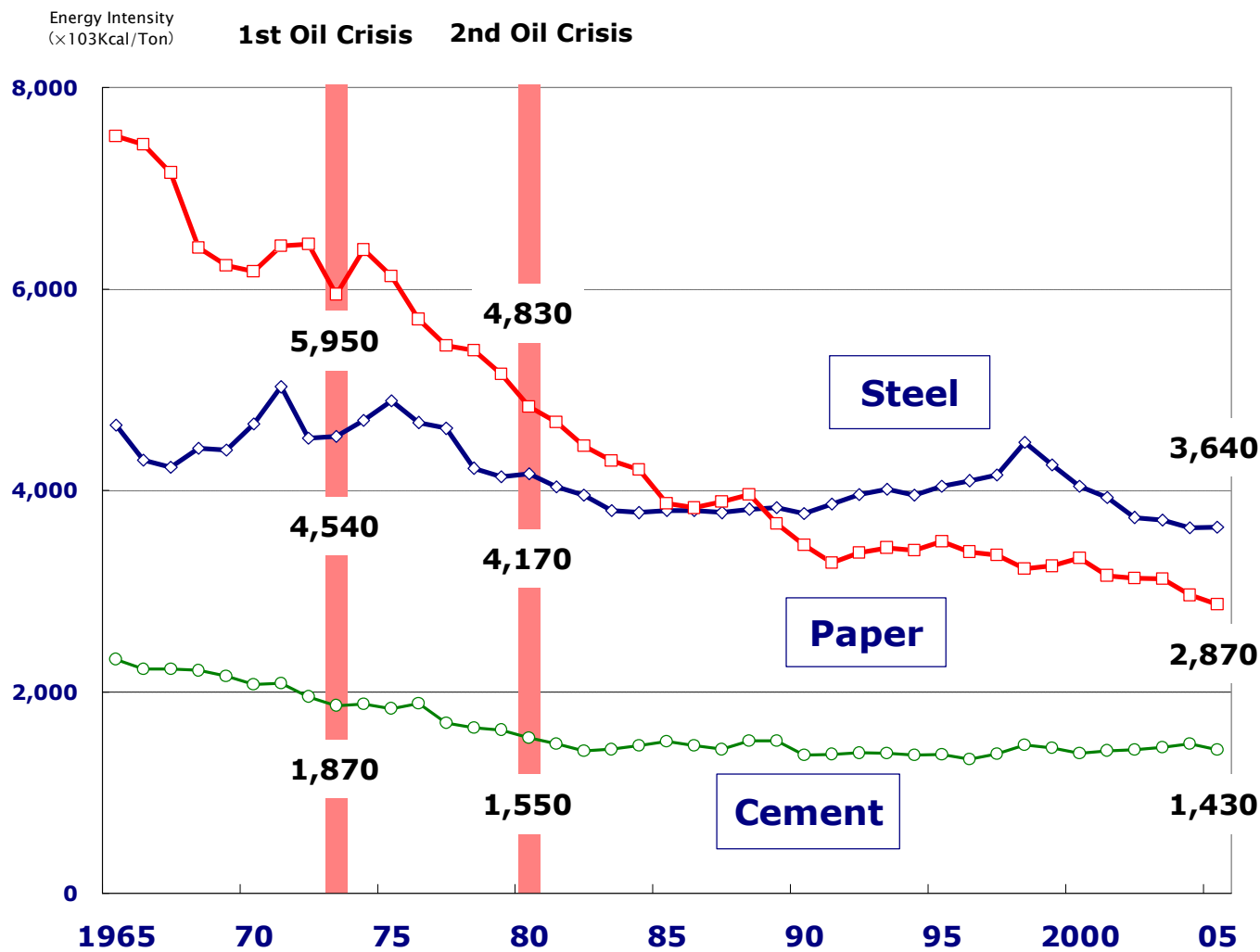
## KEIDANREN, Voluntary Action Plan on Environment (Cont.)

Sector	Target
<b>All Industry</b>	<b>CO2 emissions below 1990 level</b>
Steel	▲ 10% Energy Consumption below 1990 by 2010
Chemical	▲ 10% Energy Intensity below 1990 by 2010
Paper and Pulp	▲ 10% Energy Intensity below 1990 by 2010
Power	▲ 20% CO2 Intensity below 1990 by 2010



- Total CO2 emissions in 1990 : 1,144.1 million t-CO2
- Total CO2 emissions in the Industrial and Energy-conversion sectors in 1990 : 612.7 million t-CO2

# Energy Intensity in Basic Material Industry



(Source) IEEJ, EDMC Handbook of Energy & Economic Statistics in Japan 2007

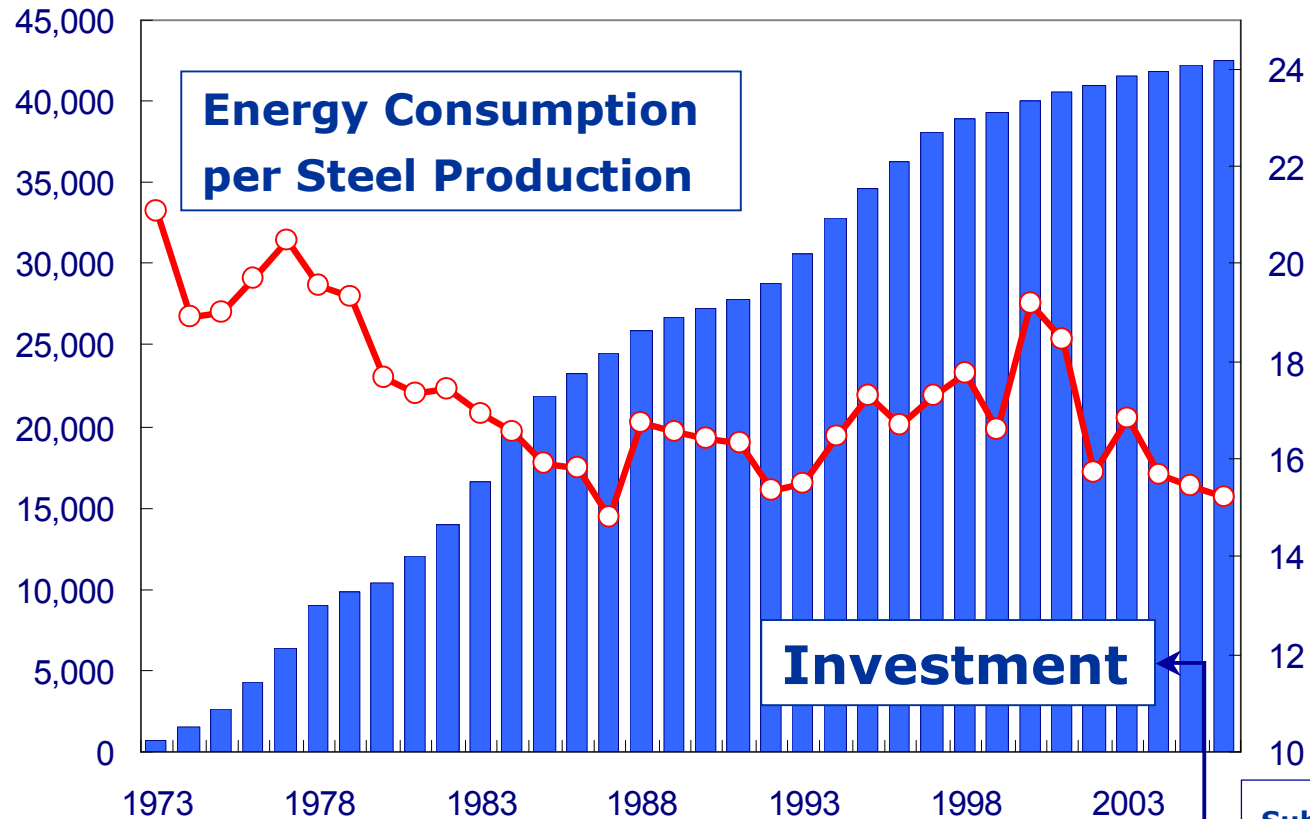
- Basic material industries such as Steel, Paper / Pulp and Cement Industries have improved their energy intensity after the 1st Oil Crisis

# Investment and Energy Consumption in Steel Sector



(100 million yen)

(GJ/t)



Source: JISF, IEEJ

Subsidy facilitates investment in energy saving facilities

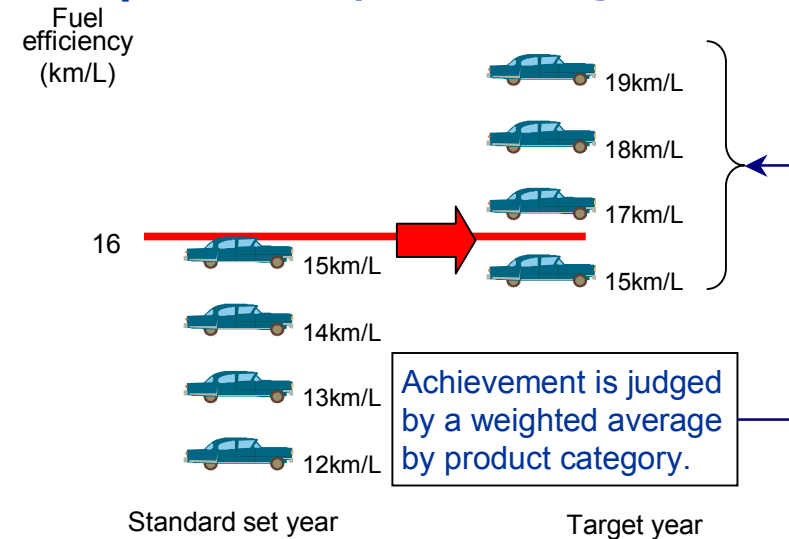
## Energy Saving Measures

- Process continuation
- Enhanced recovery of by-product gas
- Large-scale waste energy recovery (TRT, CDQ)
- Expand utilization of soft coking coal (PCI)

# Top Runner Program: Overview

Enforcement	21 Appliances
1999	Air conditioners
	Fluorescent lights
	Television sets
	Copying machines
	Computers
	Magnetic disk units
	Video cassette recorders
	Passenger vehicles
	Freight vehicles
	Electric refrigerators
	Electric freezers
2002	Space heaters
	Gas cooking appliances
	Gas water heaters
	Oil water heaters
	Electric toilet seats
	Vending machines
	Transformers
2006	Electric rice cookers
	Microwave ovens
	DVD recorders

## Example of the Top Runner Program



## Top Runner Program

The top runner program was introduced in 1999 based on the Energy Conservation Law for home / office appliances and automobiles. Under this system, targets are set based on the value of the most energy-efficient products on the market at the time of the value setting process. Standard values are set by considering potential technological improvements added as efficiency improvements.

Manufacturers who have not achieved the standards are given advise, publicly announced, given an order, or fined (one million yen or less).

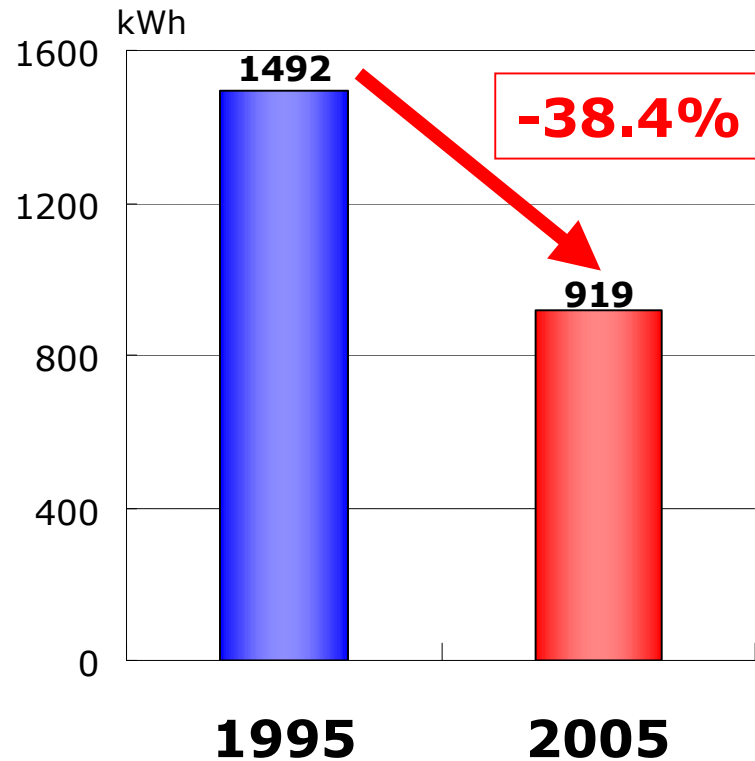


# Top Runner Program, Target and Actual Results

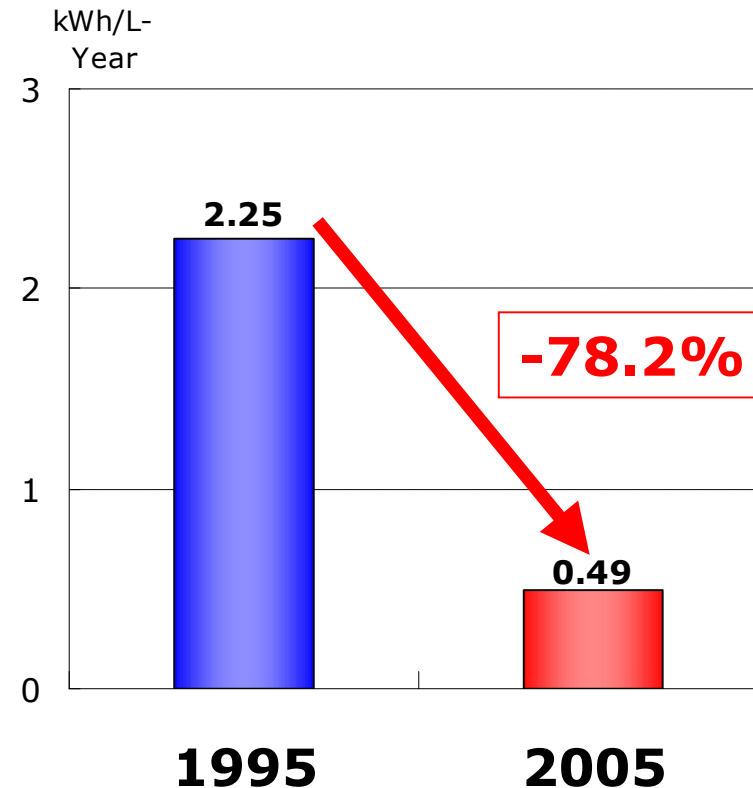


Appliance	Improvement of Efficiency	
	Target	Actual
TV Set	16.4% (2003)	25.7% (2003)
Videotape Recorder	58.7% (2003)	73.6% (2003)
Air-Conditioner (COP)	66.1% (2004)	67.8% (2004)
Refrigerator	30.5% (2004)	55.2% (2004)
Freezer	22.9% (2004)	29.6% (2004)
Gasoline-powered Passenger Car	23.0% (2010)	22.8% (2004)

## Air Conditioner

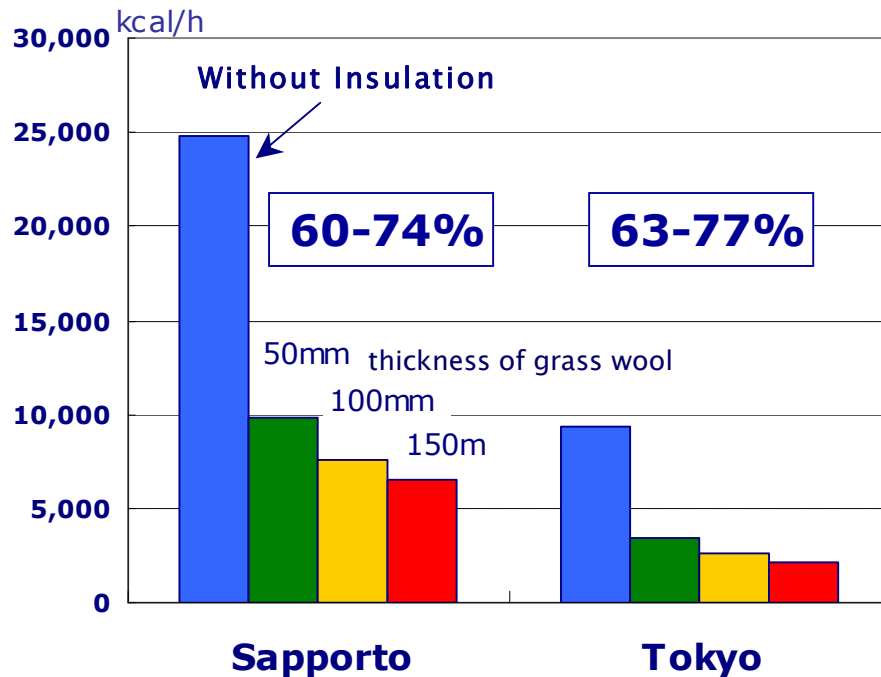


## Refrigerator

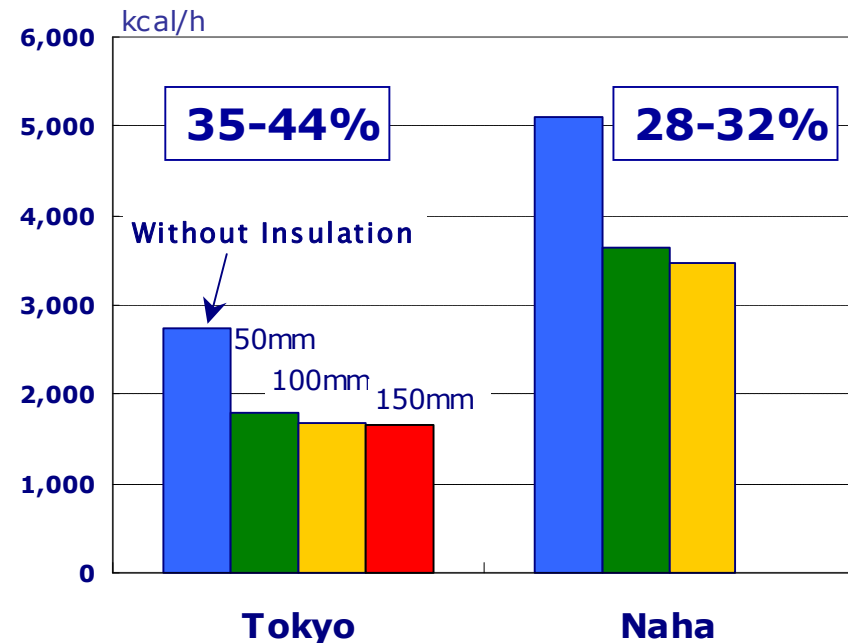


- As a result of efforts made by manufacturers, etc. the efficiency of each piece of equipment has been improved to a level higher than it was initially expected.

## Effect of Insulation For Heating

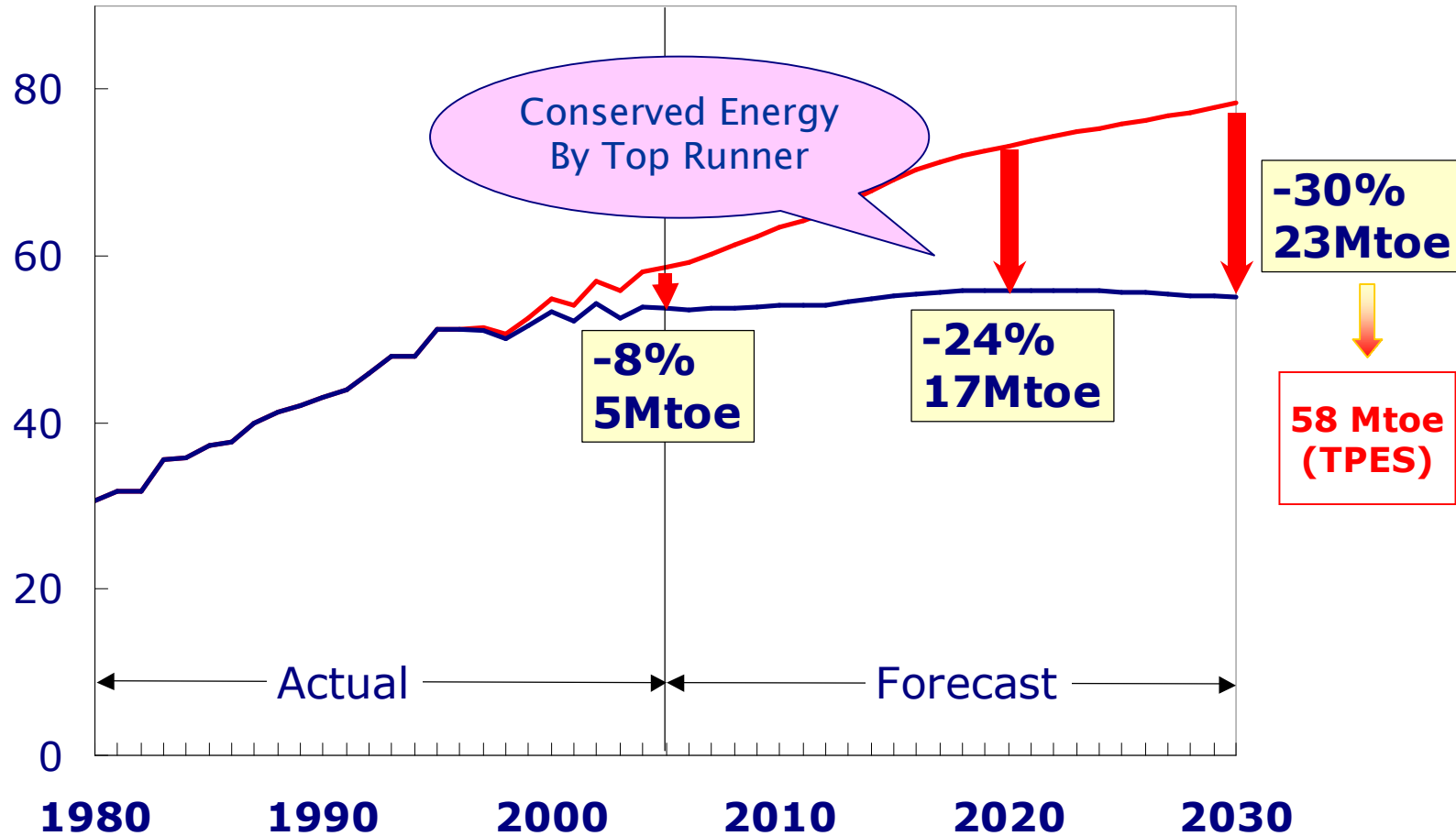


## Effect of Insulation For Cooling



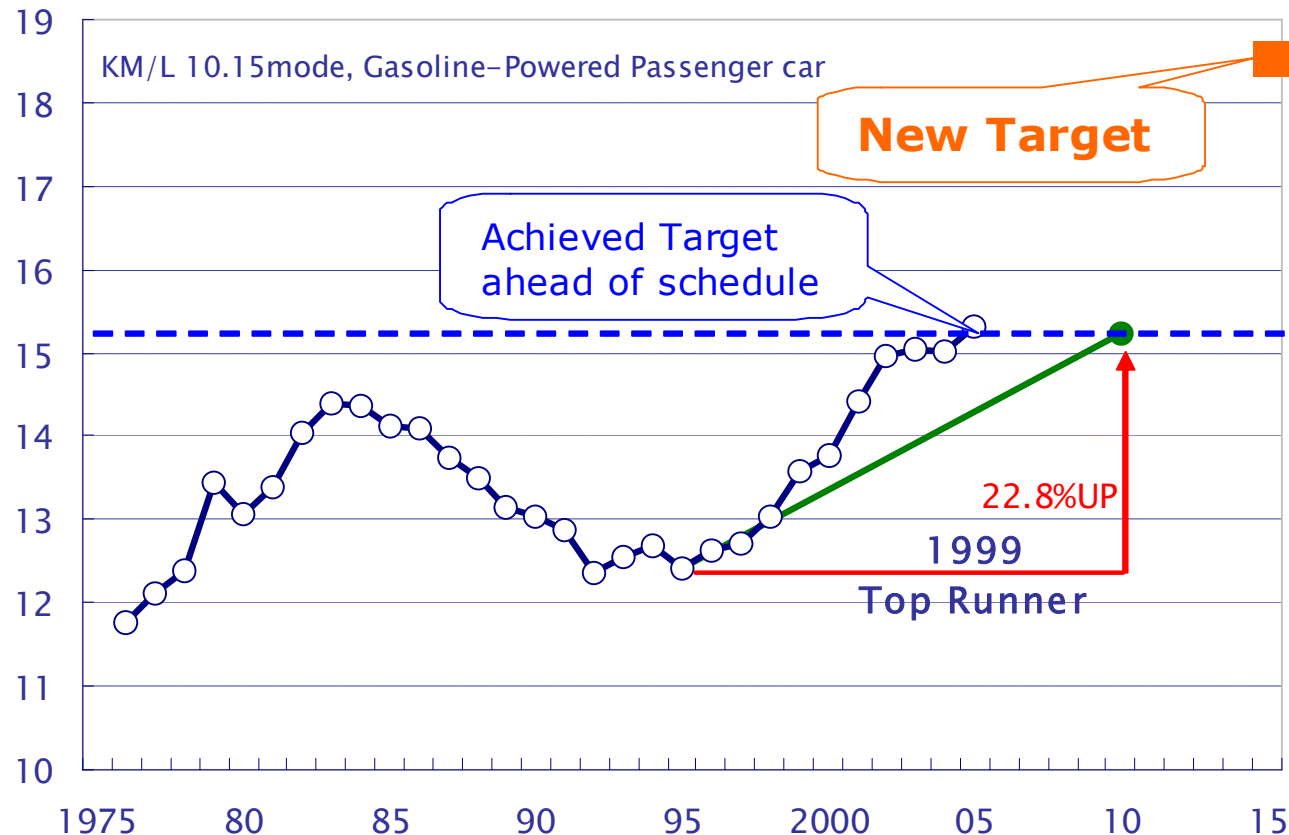
- Insulation reduces heat flow through the building, which improves energy efficiency. The appropriate amount of insulation depends on the building design, climate, price of energy, and cost of materials.

## Energy Consumption in Residential Sector Mtoe



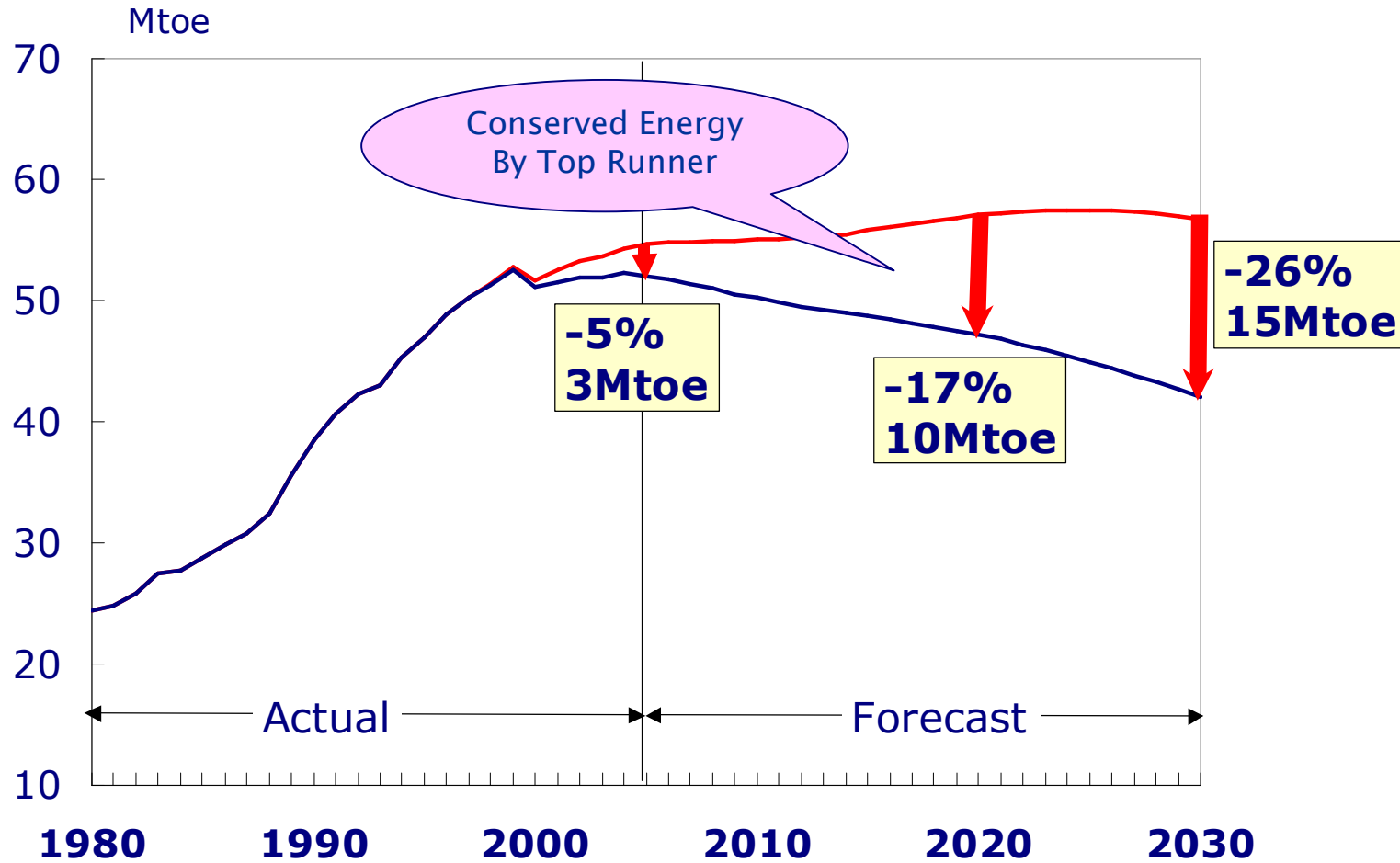
- Energy Saving Labeling helps consumer choose energy efficient products, which facilitate implementation of Top Runner Program

## Fuel Efficiency of Passenger Cars (Shipment Base)



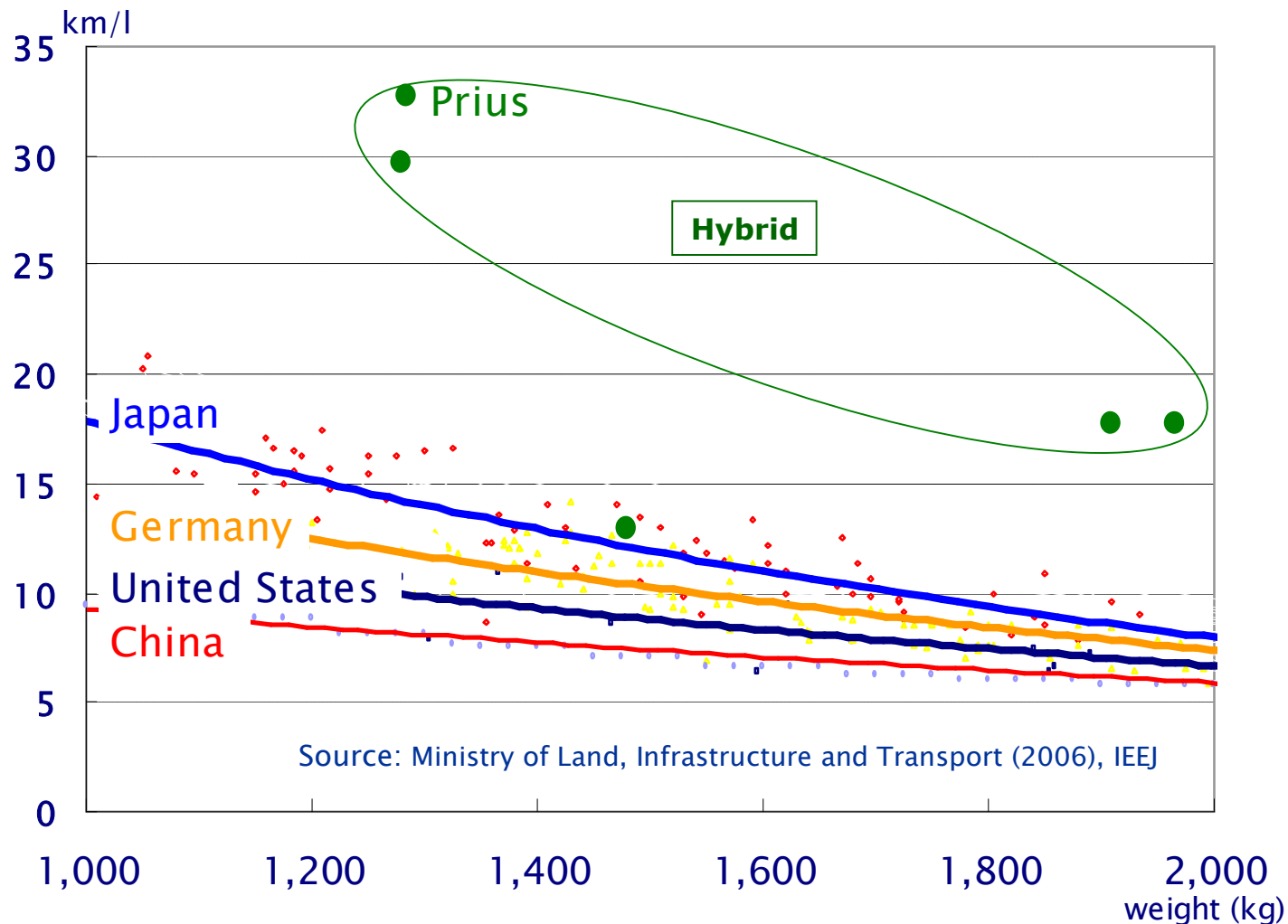
- Improvement of fuel efficiency is one of the most effective strategies to curve energy demand
- The Top Runner fuel efficiency standard was introduced in April 1999 with the target year of FY 2010. Approximately 80% (shipment base) of gasoline passenger vehicles achieved the 2010 standard in 2004

## Energy Consumption in Road Transport



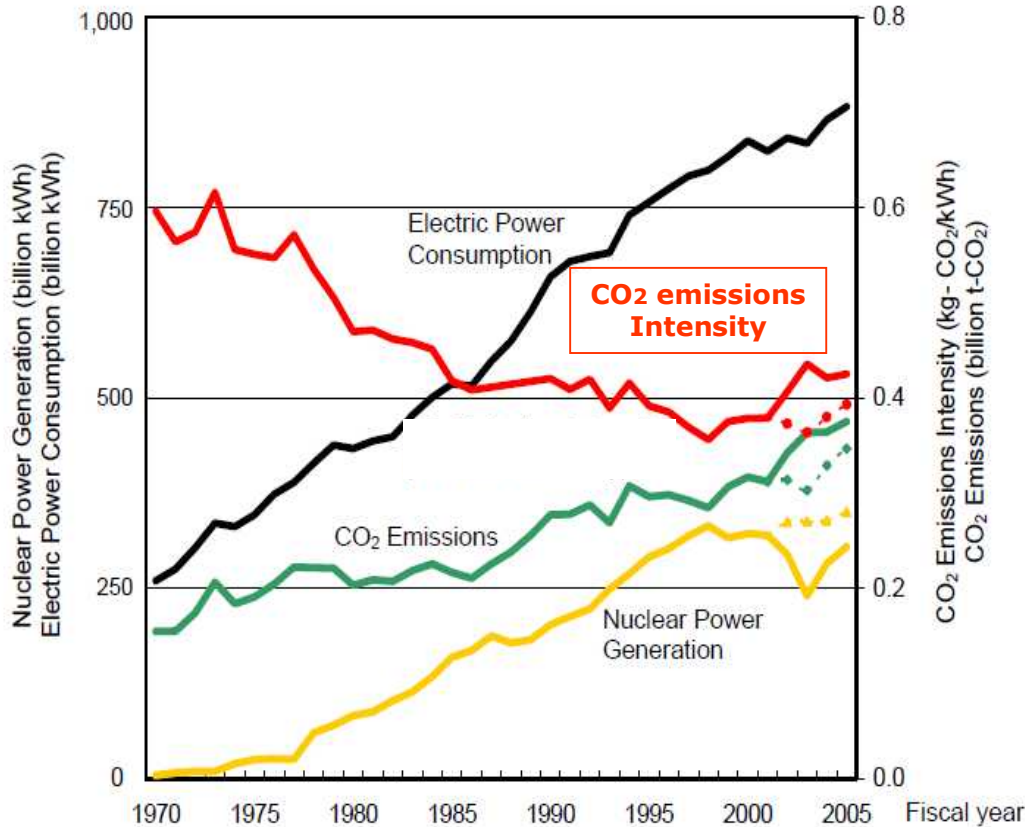
- In total, the Top Runner Program currently in place in Japan had an effect to save a 2700ktoe in 2004, or 3.3% of the consumption of gas to that year
- As time passes, the effect becomes bigger and bigger due to the replacement effect

# Comparison of Fuel Efficiency



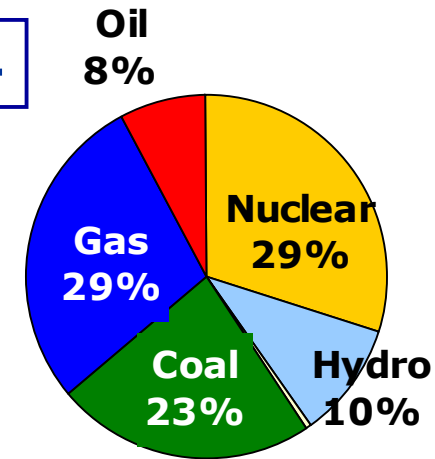
- Combination of fuel economy standard, including Top Runner Program, and green taxation system helped improve energy efficiency of vehicles
- Intensive competition between Japanese manufactures were another factor

## CO2 Emissions in Power Sector

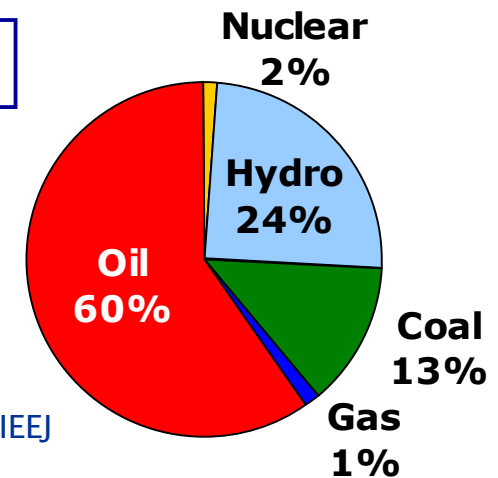


Source: The Federation of Electric Power Companies

**2004**



**1970**

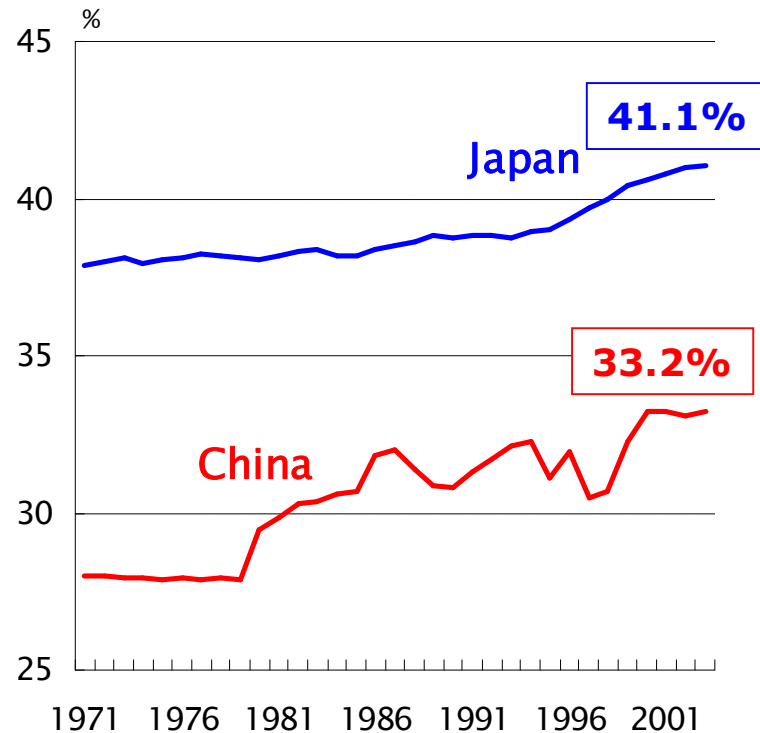


Source: IEEJ

- CO2 Emission Intensity shows lasting improvement mainly by fuel switching and efficiency gain in generation and transmission

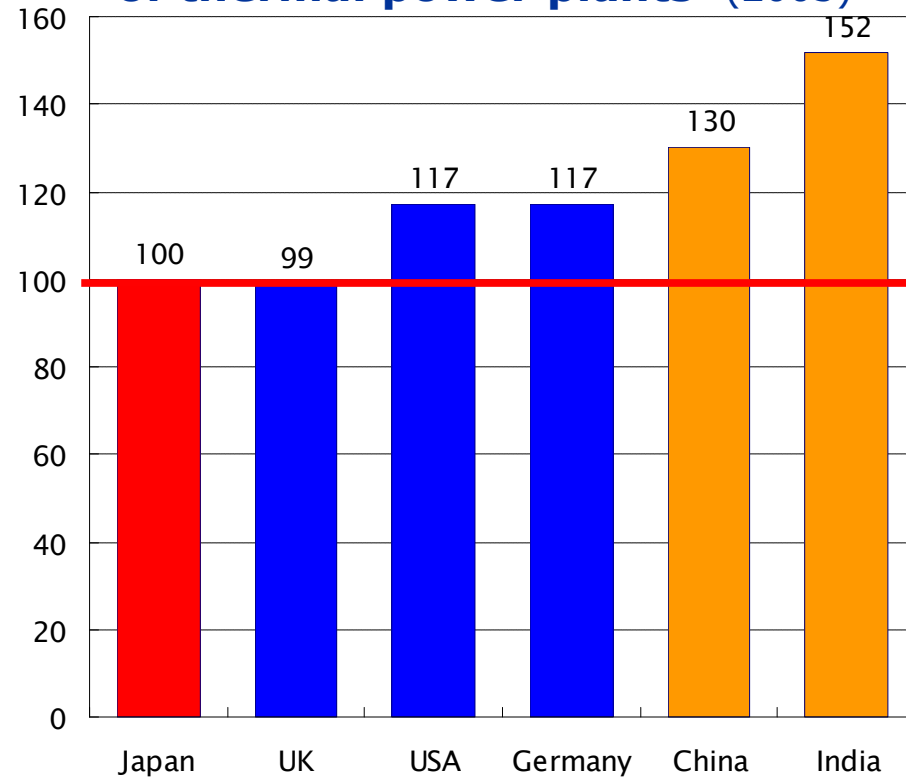


## Efficiency of thermal power plants



Source: IEA, IEEJ

## CO<sub>2</sub> emissions intensity of thermal power plants (2003)



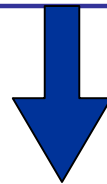
Source: ECOFYS

- Efficiency of thermal power generation keeps improving, which contributed to CO<sub>2</sub> emissions reduction from power sector
- Japan's electric power industry achieved the lowest CO<sub>2</sub> emission intensity among major countries

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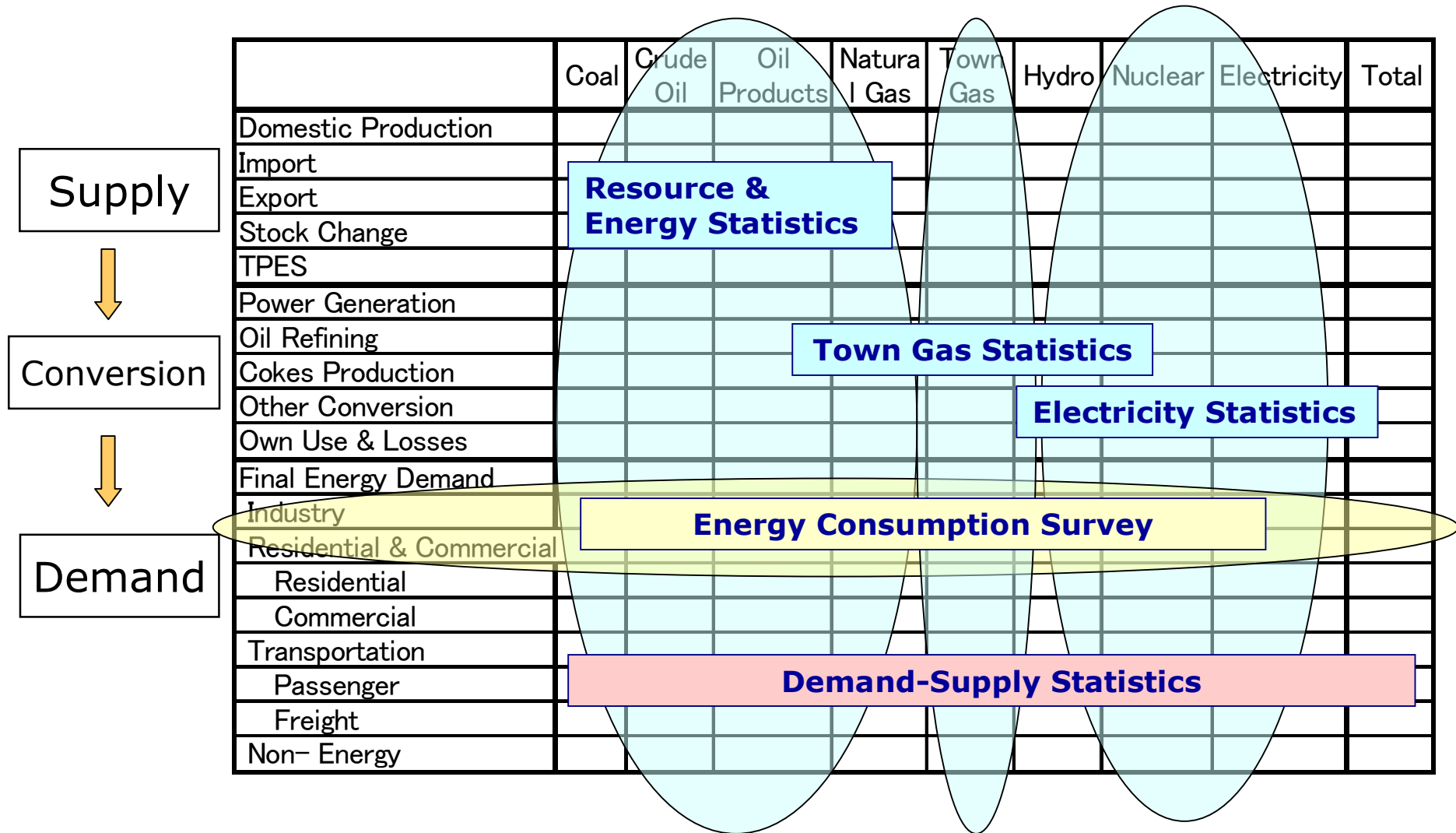
# **Necessity of Data Collection toward the goals and action plan**

- Understanding energy supply/ demand balance is essential for “**Energy Security**” strategy designing as well as monitoring the achievement of “**Energy Conservation (Efficiency Improvement) Policies**”.
- “Energy Data” AND related “Activity Data” are essential tool for energy demand & supply analyses.
- Analytical models and outlook can be designed and estimated based on such data.



Accurate, consistent, thorough and timely energy, economic and social data should be collected via sound national statistical system.

## Energy Balance Table



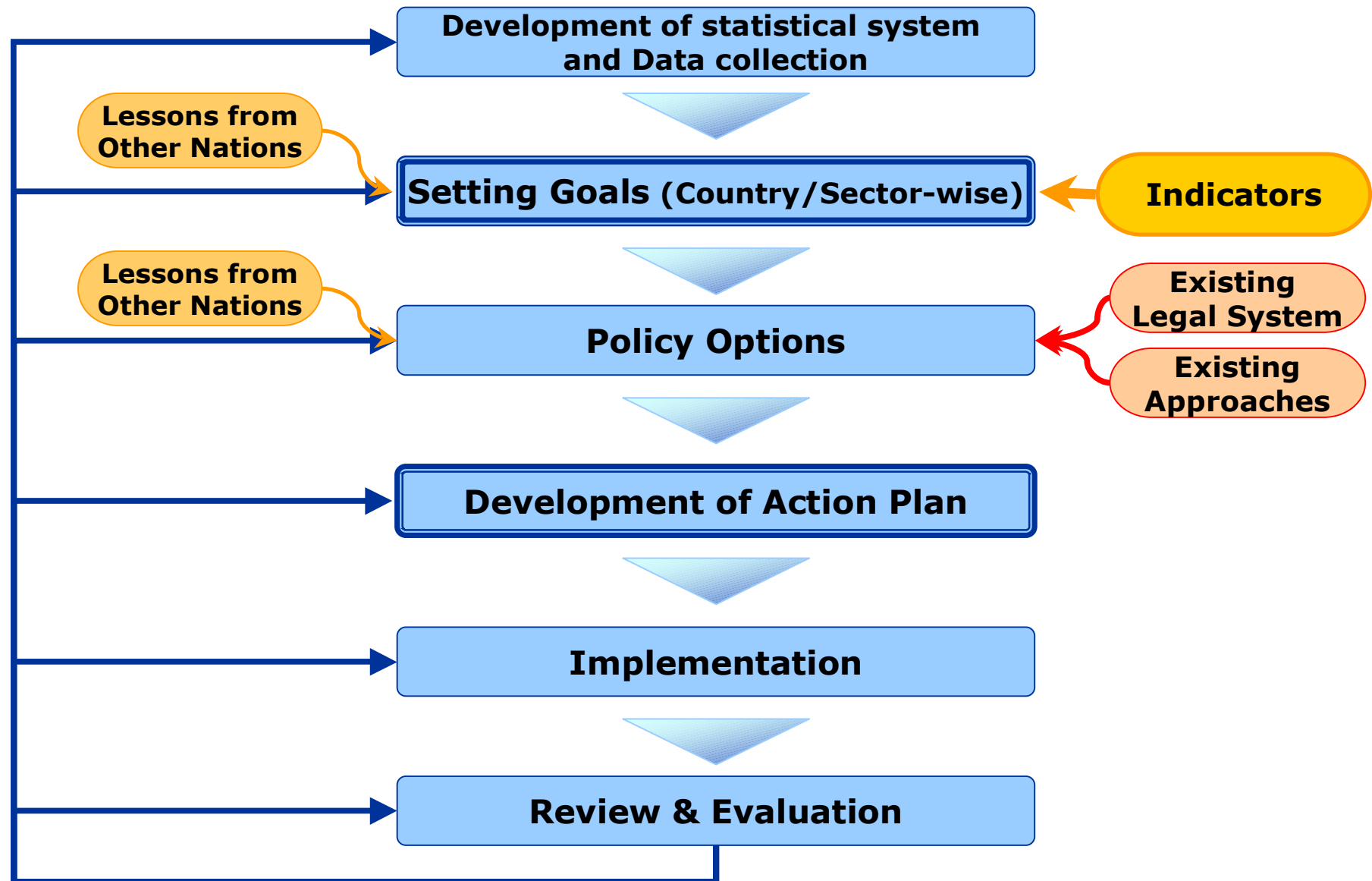
- APEC Energy Statistics Workshop
- JODI (Joint Oil Data Initiative) Training Seminars  
(as APEC with EUROSTAT, IEA, OLADE and UN)
- China–Japan Economic Statistics Workshop
- APEC Energy Supply & Demand Outlook Seminar  
(1993– )
- Training on Energy Demand Outlook Model in  
ASEAN (with ESSPA, 2003–)

.... and many others

# **Toward the Goals and Action Plan**

- Target setting (Sectoral Approach)
- Action Plan preparation to achieve the target
- Pledge and Review process
- National policies and measures to be chosen
- Regional cooperation to reach the target together and take a step further

# Setting Goals and Action Plan





# Basic Ideas for setting goals

- To promote energy efficiency, country-wise goal setting would be effective. Following items can be considered as a goal.

## Country Level

### Gross Energy Consumption

- As the size of economy increases, gross energy consumption could grow even if efficiency improves

### Energy Intensity (GDP, per capita)

- Indicators of energy efficiency consistent with economic growth

### GDP Elasticity

- Measured as the percentage change in energy consumption that occurs in response to a percentage change in GDP.
- Difficulty in comparison with other countries.

## Sector Level

### Sector-wise Target

- To accelerate energy saving in energy intensive industries, setting sector specific targets would be effective

## Industry

- **Energy Standards for plant facilities**
- **Energy Management System**
- **Energy Efficiency Law**
- **Incentives for investment in energy saving facilities  
(Subsidy, Tax benefits, Preferential Interest Rate)**
- **Research and Development**
- **Sector Initiative for voluntary actions**

## Residential/Commercial

- **Labeling Systems for Buildings and Appliances, including Top Runner Program**
- **Energy Efficiency Law**
- **Incentives for purchase of energy efficient appliances (Subsidy, Tax Benefits)**
- **Consumer Awareness**
- **Development of ESCO business**
- **Government procurement of energy efficient products**

## Transportation

- **Energy Standards (incl. Top Runner Program) and Labeling**
- **Energy Management System for Carriers**
- **Energy Efficient Law**
- **Incentives for purchase of vehicles with higher fuel efficiency**
- **Government procurement of fuel efficient vehicles**

## All Sectors

- **Energy Prices (Market Price System)**
- **Development of Energy Statistics**
- **Capacity Buildings in policy-implementation organization and development of support system for energy efficiency**

## Goals

- Improve energy efficiency **X%** or **Y** ktoe/\$ (Energy Consumption per GDP) by 20XX
- In **Z** sector, improve energy efficiency **X%** or **Y** ktoe/production by 20XX (Set goals in energy intensive industries)

## Action Plan

- Enhance Energy Efficiency Law with Energy Management System and Energy Standards by 20XX.
- Establish Subsidy system (Tax benefits or Low interest loan) for energy efficient facilities/appliances by 20XX
- Establish X policy-implementation organizations across the country by 20XX
- Develop voluntary action plan of private sectors by 20XX
- Review energy subsidy system by 20XX
- Develop energy statistics with the coverage of major energy intensive sectors by 20XX