

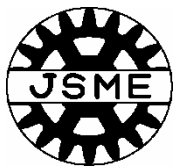
# ENGINEERING SOLUTIONS AND RECOMMENDATION FOR UN COP 15

## The Strategy of JAPAN SOCIETY OF MECHANICAL ENGINEERS (JSME)

Mutsuhiro ARINOBU (President of JSME)

**TARGETS**: To do our best for reducing the emission of CO<sub>2</sub> all over the world.

To realize **challenging energy technologies**, the wide application of **high efficiency energy systems**, the **estimation of future improvement of energy efficiencies** and the **financial payback period** For **accelerating the prevention effect for global warming.**



Future  
Climate

The quantitative targets of Japan at 2020:  
15% Reduction of Energy Consumption,  
Compared with 2005

Severe Targets of Energy Saving:

Transportation: 50% is High Efficiency Next-generation Vehicles & Continuous Mileage Improvement of 28%

Power Generation: Promotion of Nuclear

Power 9 New Power Plants with 80%

Operating Rate High Efficiency Thermal Power

Plants IGCC & Wind Power 5 Million kW



## The Targeted Image of 2020 (15% reduction of energy consumption, compared with 2005)

### Industry

- Introduction of cutting-edge technology
- State of the art R&D

### Transportation

- Continuous mileage improvement

ca 3% of improvement within 15 years by 2005



ca 28% of improvement within 15 years by 2020

- Accelerated popularization of next-generation vehicles

Share of the next-generation vehicles in new car market

ca 2% in 2005 → ca 50% in 2020



Next-generation automobile

### Power Generation

- Promotion of Nuclear Power

Operation rate in 2005: 60% → in 2020 80%

9 power plants to be newly constructed

- Higher-efficiency of thermal power systems

Introduction of high-efficient generators, e.g. IGCC

Wind-power generation

1.1 million kW in 2005 → 5million kW in 2020

(80% of on-shore potentials, 500% of 2005)



Wind power generation

### Social Activities

#### < Houses >

- Popularization of solar panels

28 million kW: 20 times of the present status

- Increase of new building constructions that meet the most strict standards

ca 30% in 2005 → ca 80% in 2020

#### <Home Appliances/Facilities>

- Displays, such as TV

Transition fro, Brown tubes to LC, Plasma, and to organic EL

TV with Brown tubes: ca 80% in 2005 → 0% in 2020

- Fluorescent lights, refrigerators, air-conditioners, etc.

All the appliances in the market are of the highest standard of 2005.

- Boilers/cogeneration

Popularization of high efficient boilers, cogeneration (inclusive of fuel cells) 0.7 million boilers in 2005 → 28 million boilers in 2020

(4000% of 2005, installed in more than half of the total families)

#### <Offices, etc. >

- Popularization of highly efficient and energy-saving machines

0% in 2005 → 98% in 2020 (in stock )

- Lighting

LED/organic EL lighting

ca 1% in 2005 → 14% in 2020 (in stock )

- Increase of new building constructions that meet the most strict standards

ca 60% in 2005 → 85% in 2020



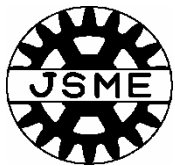
Fuel cells



Future  
Climate

## MEASURES

- 1) For **evaluating the technological innovation** correctly, **JSME Technology Roadmaps for Sustainable Society** would be used.
- 2) Quantitative estimations, such as economical payback period of energy technologies, necessary total budget of energy policy would be possible by disseminating the **JSME Technology Roadmap for Sustainable Society**



## NEW FINDINGS

The systematic organization of JSME Technology Roadmaps for Sustainable Society by various engineering divisions of JSME has been produced over several years.

Two good results have been obtained in the discussions by combining the several technological roadmaps as the new findings.

- 1) Energy Usage and CO2 Emission Reduction for the Automobiles
- 2) Energy Saving for Air-conditioning and Hot Water Supply by Utilizing High Efficiency Heat Pump Systems



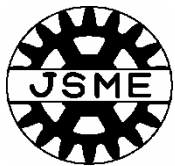
# 1) Energy Usage and CO2 Emission Reduction for the Automobiles

The **specific strength of materials** and **new materials** such as **Aramic fiber** would be **useful for reducing the weight of automobiles**.

The **thermal efficiency of engines** has been increased gradually by many kinds of breakthrough.

The **average traveling speed** has been increased by the improvement of **traffic control technology**.

The total amount of CO2 reduction potential would be **100MT/year** and the **most effective method** would be the **increase of the traveling speed**.



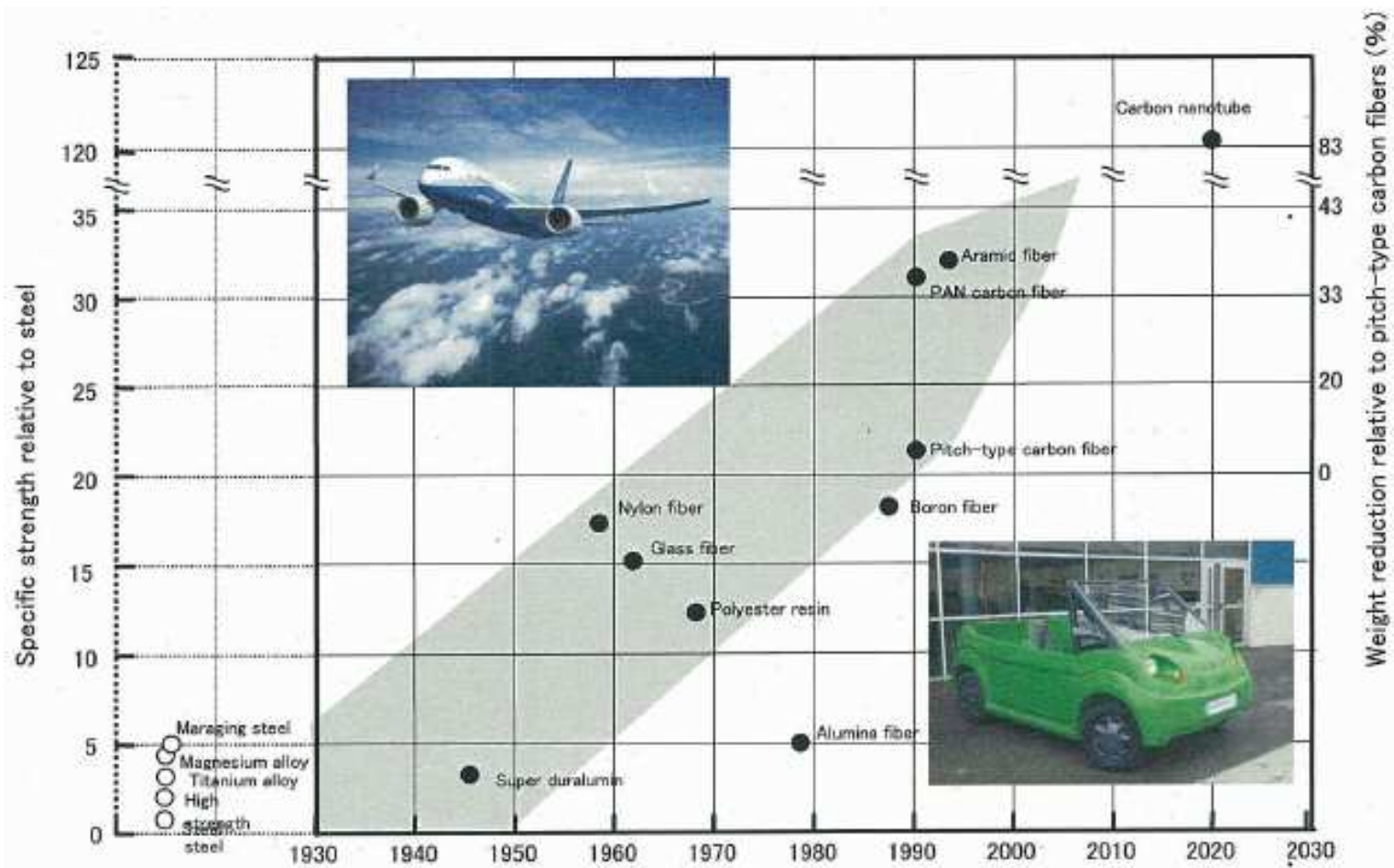
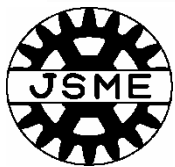
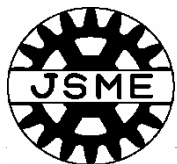
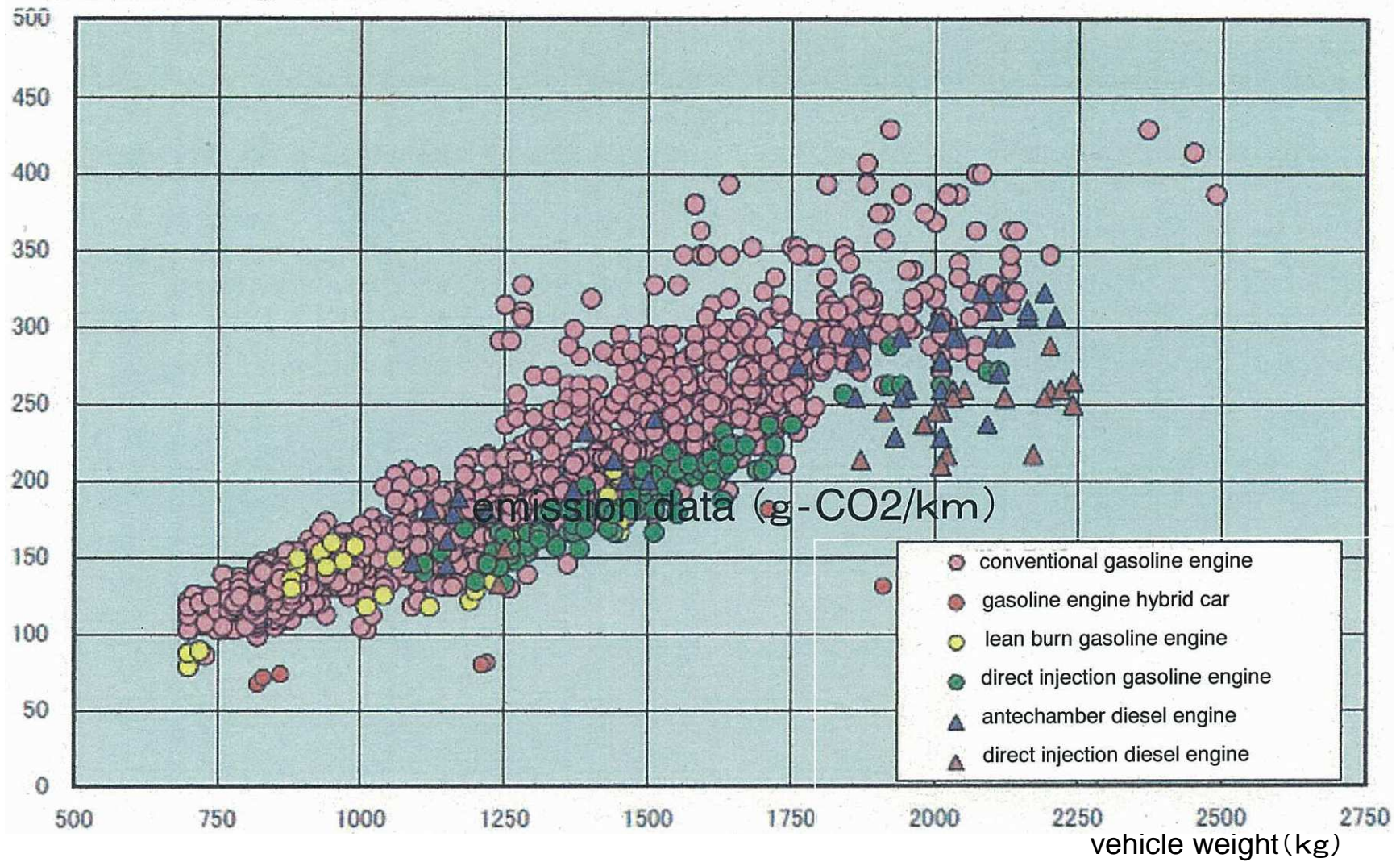


Fig.1 JSME Technological Roadmap for Specific Strength of Materials

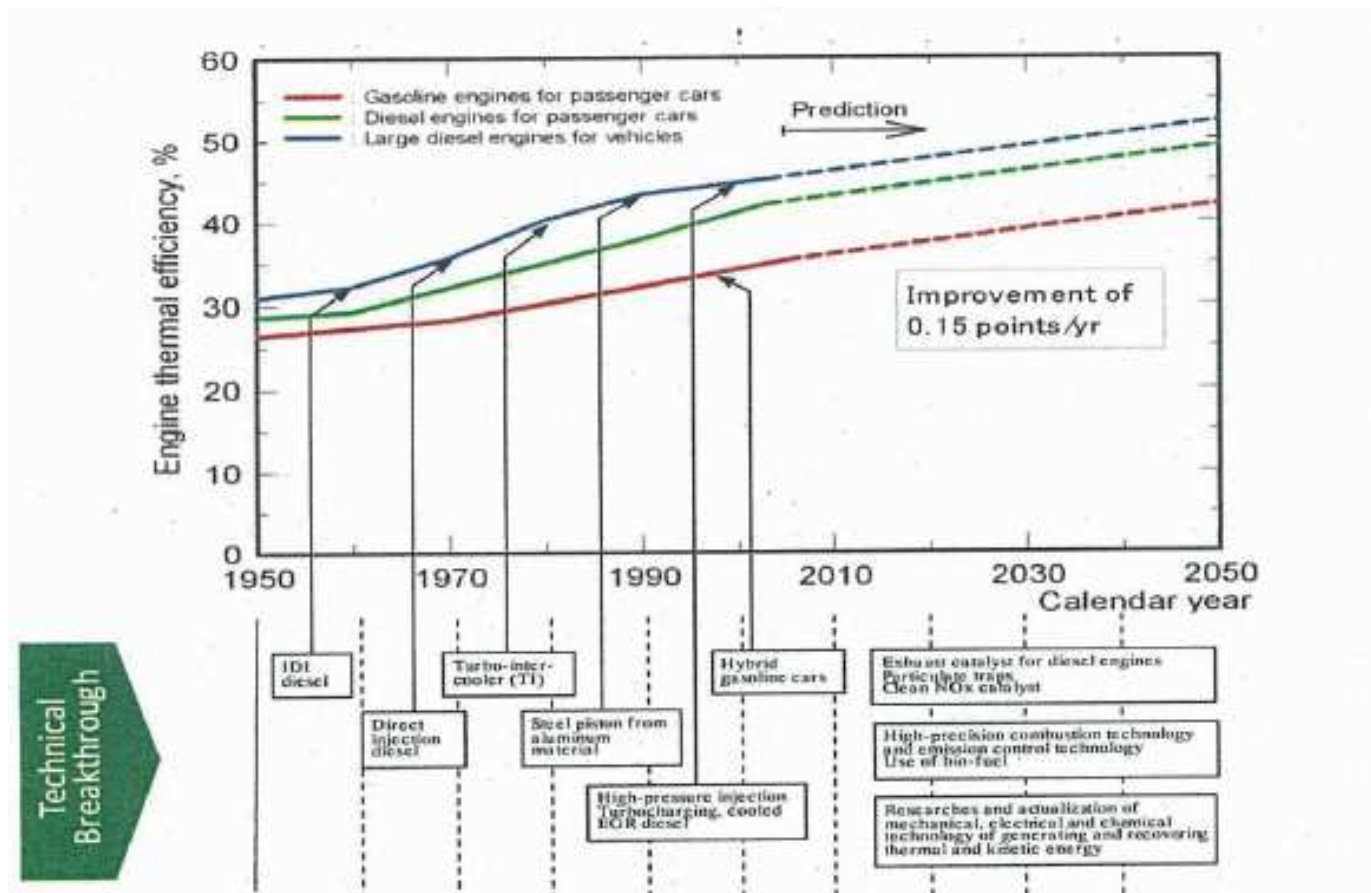


# CO2 emission data of passenger cars according to weight

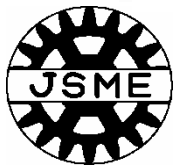
emission data (g-CO2/km)



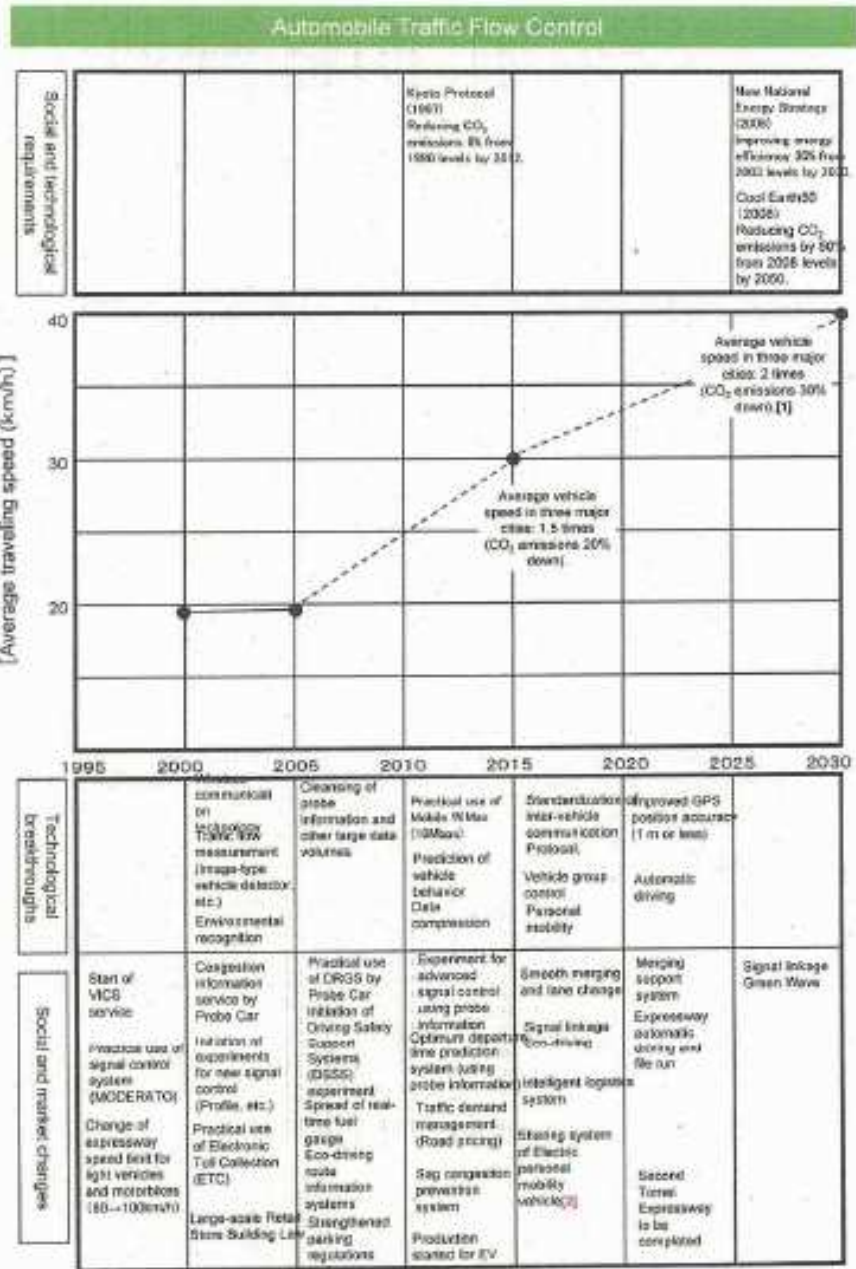
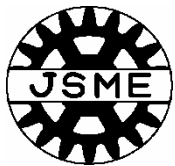




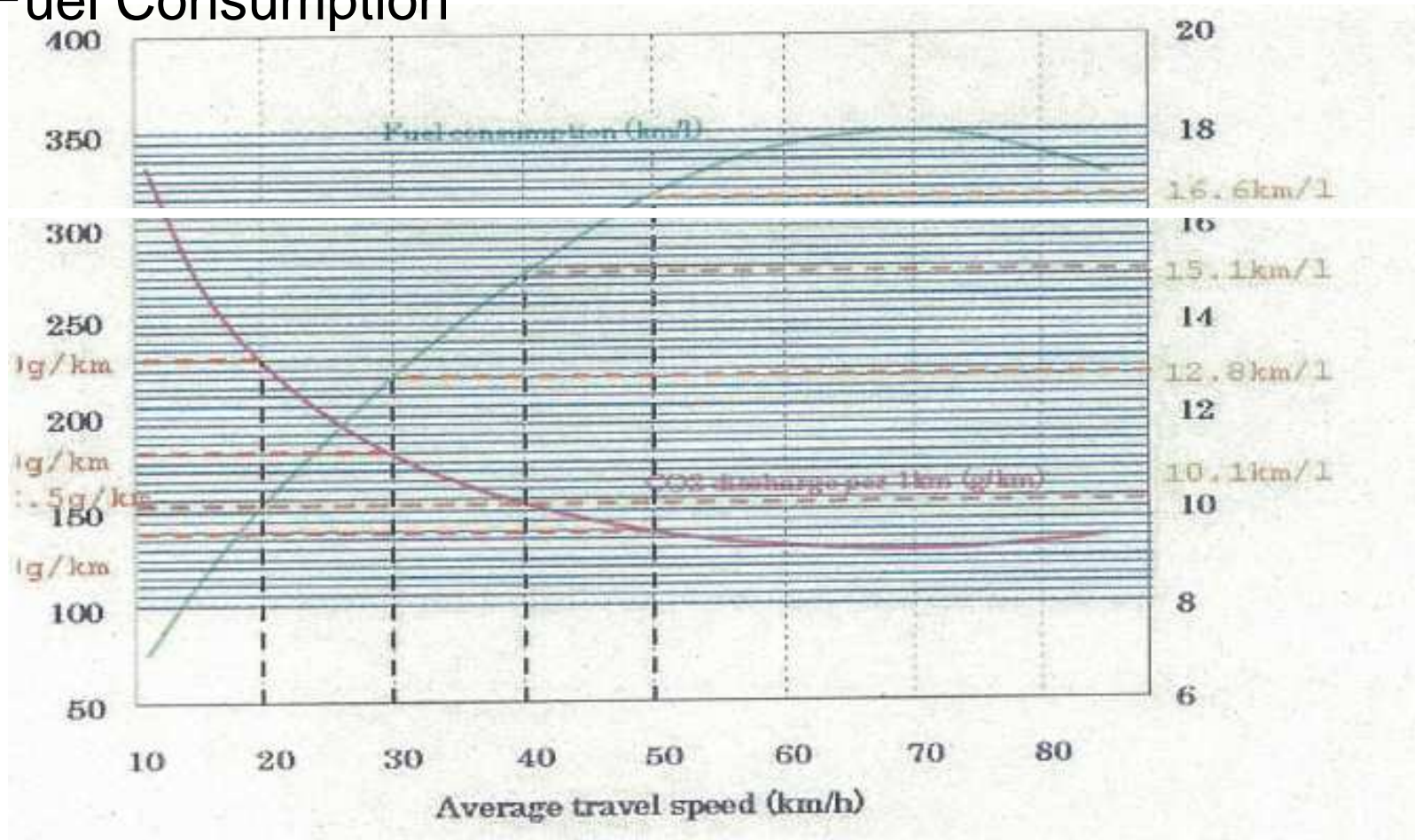
## JSME Technology Roadmap of Thermal Efficiency of Engines



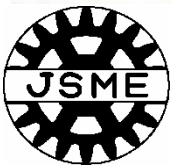
# JSME Roadmap of the Increase of Average Traffic Speed By Traffic Flow Control and the Reduction of CO2 Emission



# Fuel Consumption



Average Traveling Speed and Fuel Consumption



## Appendix B: Data sheet for the climate plans

Country: JAPAN Population(2008) 127.8million, Area377,923km<sup>2</sup>, GDP: 4384billion\$

		Baseline				
		2007	2015	2030	2050	
GHG emissions (tons CO <sub>2</sub> -eq.)	CO <sub>2</sub>					
	<b>Total</b>	1,371MT				
GHG emissions by sector (tons CO <sub>2</sub> - eq.)	Transportation fuels					
	<b>AUTOMOBILES</b>					
	FIG.1	New Materials: such as Aramic Fiber (Specific Strength Relative to Steel) Weight Reduction(%)	0%	0.35%	1.00%	1.30%
	Fig.2	Engine Thermal Efficiency (Gasoline Engine)	35%	37.20%	39.50%	42.50%
		Average Traveling Speed by Traffic Flow Control Technology	20km/h	30km/h (20% Red CO <sub>2</sub> )	40km/h (30% Red CO <sub>2</sub> )	50km/h (40% Red of CO <sub>2</sub> )
		Estimated Total CO <sub>2</sub> Emission from Automobiles	222MT	178MT	151MT	122MT
		<b>CO<sub>2</sub> Reduction Potential</b>		44MT	71MT	100MT
	Residential, commercial and other sources					
HEAT PUMP HEATING & HOT WATER SUPPLY	CO <sub>2</sub> Reduction Potential		50% Replace	100% Replace	COP=6 100% Replace	
Fig.3	Heat Pump Hot Water		33MT	65MT	77MT	

## 2) Energy Saving for Air-conditioning and Hot Water Supply by Utilizing High Efficiency Heat Pump Systems

### JSME Roadmap of Heat Pump Hot Water Supply

COP of supplying hot water :the value of 5 or higher.

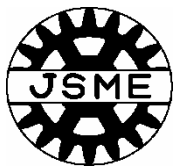
Efficiency of electric power generation of about 40%,

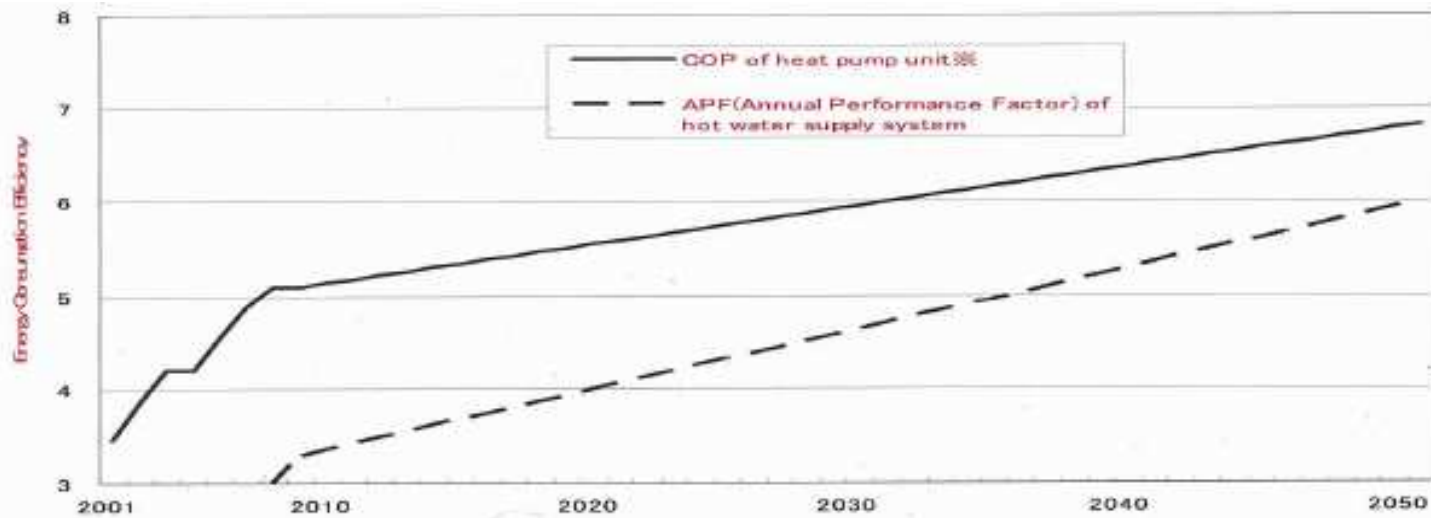
over twice of the total heat release by combustion

by utilizing high efficiency heat pump.

The CO<sub>2</sub> reduction potential by replacing the boiler, heater and absorption heat pumps would become the order of 200MT/year.

This value would be over 10% of the total CO<sub>2</sub> emission in Japan.





**Technical Breakthrough**

- 2001~2010
  - Development of CO<sub>2</sub> refrigerant Heat Pump Water Heater
  - ④ High-efficiency ejector cycles
  - ⑤ Optimum design of high-efficiency, Small-size DC motors
  - ⑥ SiC power devices
  - ⑧ Vacuum heat insulators
  - ⑩ Utilization of underground heat
- 2010~2020
  - ① High-efficiency refrigerant circuit design technology
  - ⑥ High-efficiency matrix converter
  - ⑫ Exhaust heat recovery
  - ⑬ Load forecast control
  - ⑭ Using solar heat panels together
  - ① Advanced refrigerant control technology
  - ② Further size reduction using surface tension
  - ③ Micro-channel type heat exchangers
  - ④ Power recovery compressors with integrated expanders
  - ⑬ Decompressed-boiling solar panel evaporators
- 2020~2030
  - ① Development of new refrigerant
  - ⑤ Next-generation sensor-less PM motors
  - ⑧ High-density thermal storage and latent thermal storage
  - ① Water refrigerant double-bundle condenser hot water supply systems (heat recovery systems)
  - ⑫ Heat recovery from wastewater



Fig.3 JSME Technological Roadmap for Heat Pump Hot Water Supply System (Trends of COP & Technical Breakthrough)



Commercial and other sources					
HEAT PUMP HEATING & HOT WATER SUPPLY	CO2 Reduction Potential		50% Replace	100% Replace	COP=6 100% Replace
Fig.3	Heat Pump Hot Water Supply (COP=5) for Houses replacing Boiler and Heater		33MT	65MT	77MT
	Heat Pump Heating (COP=5) for Houses replacing Boiler and Heater		25MT	51MT	59MT
	Heat Pump Hot Water Supply (COP=5) for Buildings replacing Boiler and Heater		17MT	34MT	39MT
	Heat Pump Heating & Cooling (COP=5) for Buildings replacing Boiler and Heater, Absorption Heat Pump		26MT	40MT	47MT
	Total CO2 Reduction Potential		95MT	190MT	222MT
<b>Total</b>		<b>270MT</b>	<b>175MT</b>	<b>80MT</b>	<b>58MT</b>

nsity -

# RECOMMENDATIONS

- 1) Produce **the reliable technology roadmaps** for **estimating the future technological performance**, for **selecting the future energy and environmental policy** and for **accelerating the prevention effect for global warming**.
- 2) By presenting the **comprehensible quantitative engineering data of energy usage and CO2 emission in public**, we should **promote the quantitative discussion for accelerating the reduction of the CO2 emission**.

