FUTURE CLIMATE 2 –The Challenge Continues

Low-Carbon Pathways of Japan Scenarios of Promising Technology

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FUTURE CLIMATE2
- THE CHALLENGE CONTINUES.

Energy Consumption of Various Countries for One Person

Global Warming means Too Much Amount of Energy Consumption？
We are not sensitive for the amount of energy usage.

Japanese People is using energy of 5.2kW for one person constantly
World Average about 2kW （1993）
U.S.A. 9.8kW,
Germany & France 5.3kW
India 0.22kW (1/24 of Japan)
China 0.65kW

Total Energy Consumption,

Japan	506 Mtoe(5.7% of the World)
U.S.A	2205 Mtoe(25%)
Germany & France	579 Mtoe(6.5%)
India	261 Mtoe (2.9%)
China	961 Mtoe(10.8%) (1997)

LCA Analysis Based on Daily Life

Automobiles(Personal Use) Total:527W

Production of Automobiles:

Energy for Production Process＋Material Production＝90W／Person

Energy for Driving（Gasoline, Light Oil for Diesel Engines）:

＝437W／person（Equivalent for Gasoline29L／month）

Building（Buildings for Company, Factory, School and their Construction, Total Energy Usage of Electricity, City Gas) Total 652W

Necessary Energy for the Construction：327W

Energy Necessary for Using the Buildings：162W（Including Air-Conditioning）

Energy Released for Environment in case of Using Buildings：143W

Amount of Energy Usage from the Viewpoints of Our Daily Life

Contents from Viewpoints of Our Daily Life
(Total 5150W, LCA Analysis including Materials)

Clothes:137W (Clothes & Bed 86W, Washing:51W)

Eating :296W (Green House 128W, Cooking 59W, Refrigerator 50W, Restaurant 59W)

Living : 1576W(House Construction 148W,Autobobiles for Personal Use 527W, Air-conditioning 195W, Bath &Hot Water Supply 198W, Lightening 49W, TV& Electronics 301W)

Business & School:869W(Building & Construction 652W, Public Transportation 122W, Hotel 95W)

Society: 918W(Carriage 324W, Store 155W, Hospital 81W, Road Construction 103W, River-bank 92W, Movie 27W))

not cleared: 1354W

Possibility of Reducing the Energy Consumption based on Daily Life Analysis

Possibility of Reducing the Energy Consumption

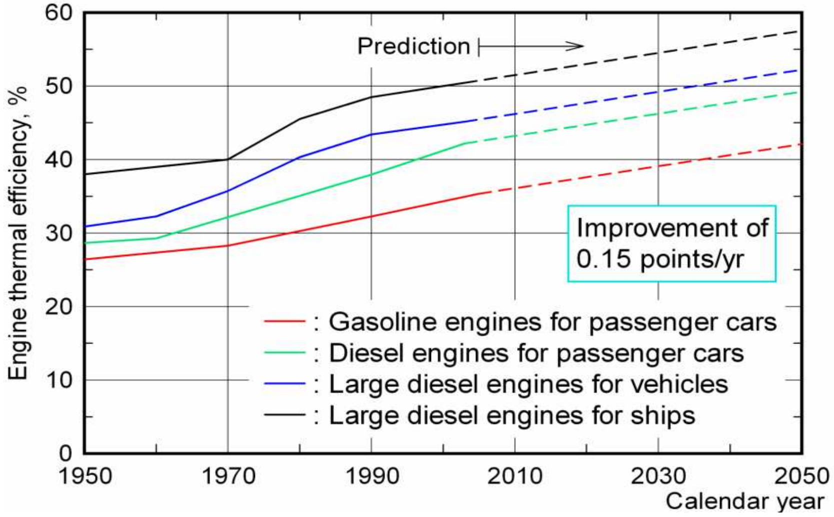
About 18% of total energy would be consumed by Automobiles for Personal Use (10%) , for Public Transportation (2%) and for Carriage(6%) and etc.

These 18% would able to be reduced by using the lower carbon exhaust technologies such as hybrid vehicles and electric automobiles.

Hypothesis of prediction for CO_2 reduction（1）

CO_2 reduction is predicted under maintenance of efficiency of automotive combustion engines and transition to diesel engines for passenger cars with hypotheses below.

- Thermal efficiency of automotive combustion engines
- Growth rate of thermal efficiency：0.15 points/yr (See Figure)



Hypothesis of prediction for CO_2 reduction（2）

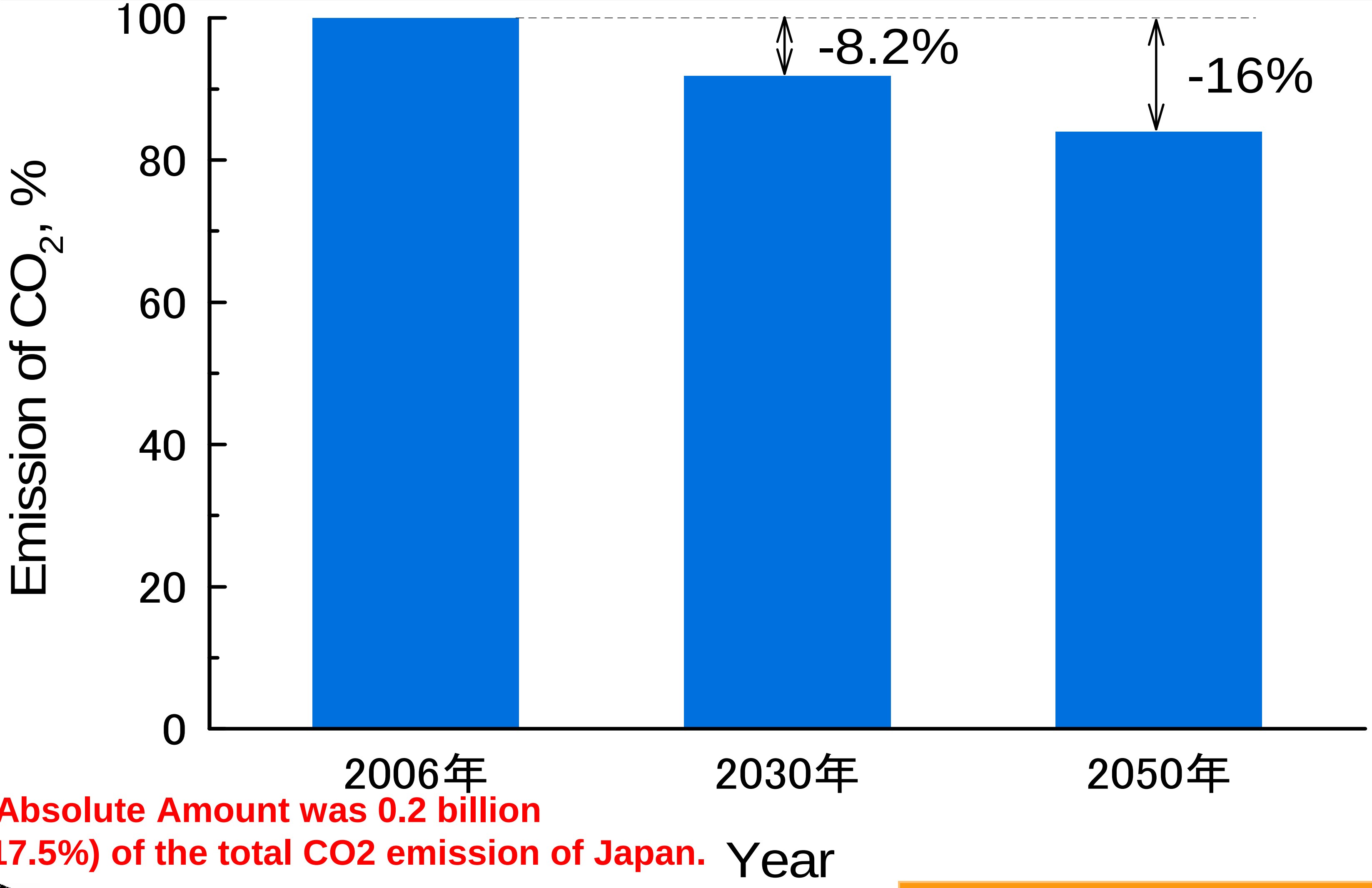
- Number of retained cars：80 million

  (For the case of Japan, the number would be saturated)
- Number of cars replaced to new one：3 million/yr

  (simulated by statistics of MLIT* from 2000-2006)
- Replacing Span：20 yr
- Amount of CO_2 by automobile in 2006：222 million ton
  (statistics of MLIT* in FY2006)
- Proportion of Vehicle Classification
  Not passenger cars: same as in 2006
  Passenger cars: Linearly Increased to 50% of small diesel engine in 2050 (from 10% in 2006)
- Ignore replacement from diesel to diesel of passenger cars.

(* Ministry of Land, Infrastructure, Transport and Tourism)

Result of CO_2 reduction under maintenance of efficiency of automotive combustion engines and transition to diesel engines for passenger cars



The Absolute Amount was 0.2 billion ton(17.5%) of the total CO2 emission of Japan.

CO_2 Reduction Technology Roadmap Categories

CO_2 emission quantity =
(movement quantity) ×
(energy requirement per unit movement) ×
(CO_2 emission per unit energy requirement)

Total Length of Traveling would be constant , which would be hypothesized.

Energy Requirement per Unit Movement (1)

Reducing energy required per unit of movement	Reducing energy required for movement	Use materials with high specific strength.

Energy Requirement per Unit Movement (2)

Reducing energy required per unit of movement	Increasing transport efficiency	Improve traffic flow.
		Increase the efficiency of modal shift systems.
		Improve road infrastructure.
		Enhance ITS control technology.

CO_2 emission per unit of energy used

Reducing CO_2 emission per unit of energy used	Improvement or Enhancement of Mechanical Elements Efficiency	Reduce air resistance.
		Increase power transmission efficiency.
		Increase engine efficiency.
		Increase air conditioning efficiency.
		Reduce rolling resistance. (Tribology)
		Reduce exhaust loss.
		Enhance engine control technology.
		Enhance electric vehicle control technology.
		Increase prospective control technology
		Increase motor efficiency.
		Increase power conversion efficiency.
		Increase efficiency of electrical equipment. (eg. Road navigation system)
		Increase recovery efficiency.

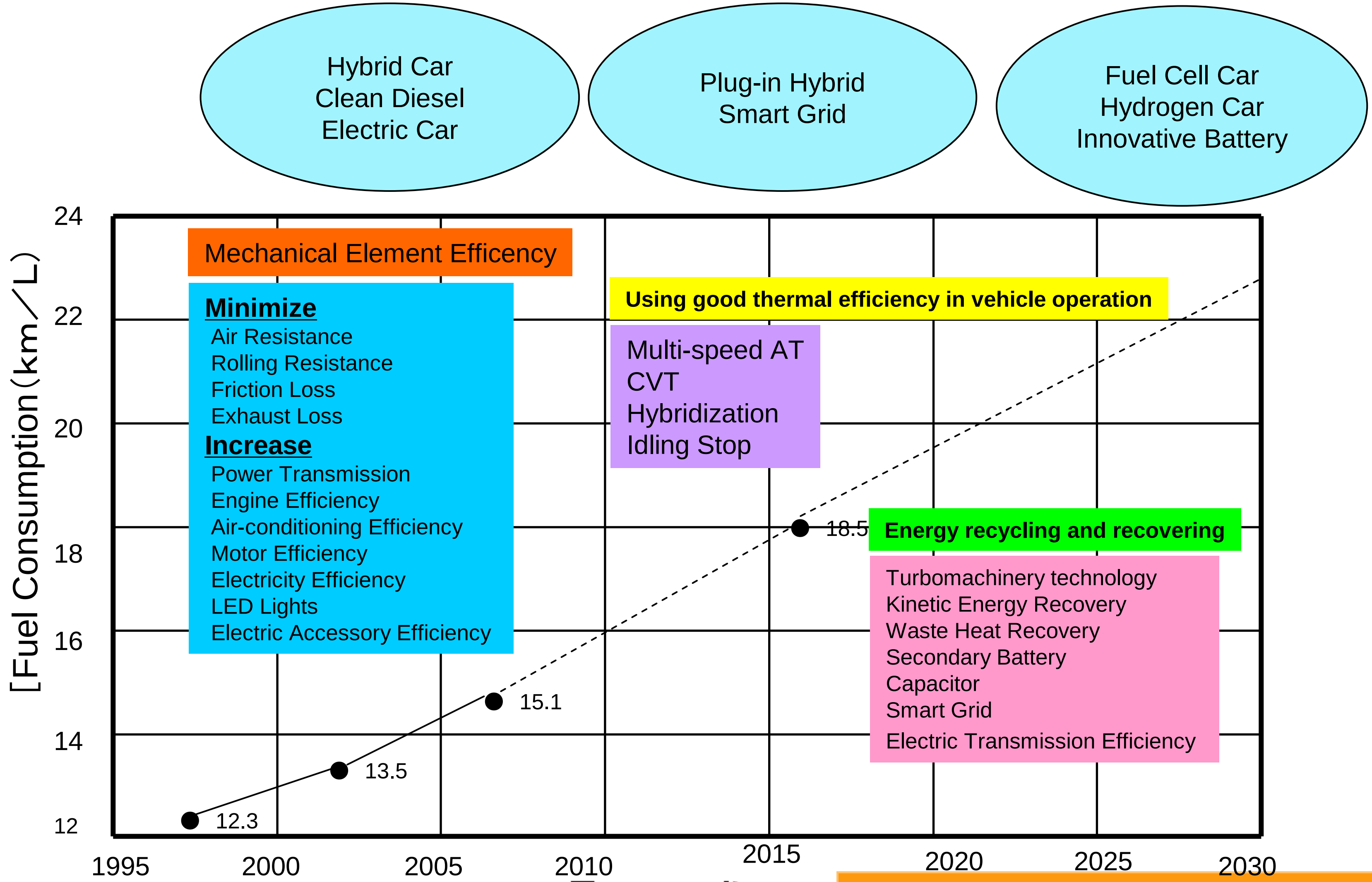
CO_2 emission per unit of energy used

Reducing CO_2 emission per unit of energy used	Increase energy conversion efficiency.	Dieselize drive power
		Enhance electric vehicle control technology.
	Using good thermal efficiency in vehicle operation	Increase the number of drive train gear ratios.
		Hybridize drive power.
		Enhance hybrid drive power control technology.
	Reducing unnecessary driving	Perform automatic idling stop.
		Minimize standby electricity

CO_2 emission per unit of energy used

Reducing CO_2 emission per unit of energy used	Energy recycling and recovering	Turbomachinery technology
		Recover kinetic energy.
		Recover waste heat.
		Increase recovering kinetic energy performance
		Increase secondary battery performance and reduce secondary battery cost.
		capacitor
	Power source diversification	Biomass
		Plug-in hybrid
		Electric only
		Fuel cell（Fuel cell＋secondary bettery＋high-pressure hydrogen tunk）

Increase of automobile fuel consumption by maximization of mechanical efficiency



Future Climate

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- THE CHALLENGE CONTINUES.

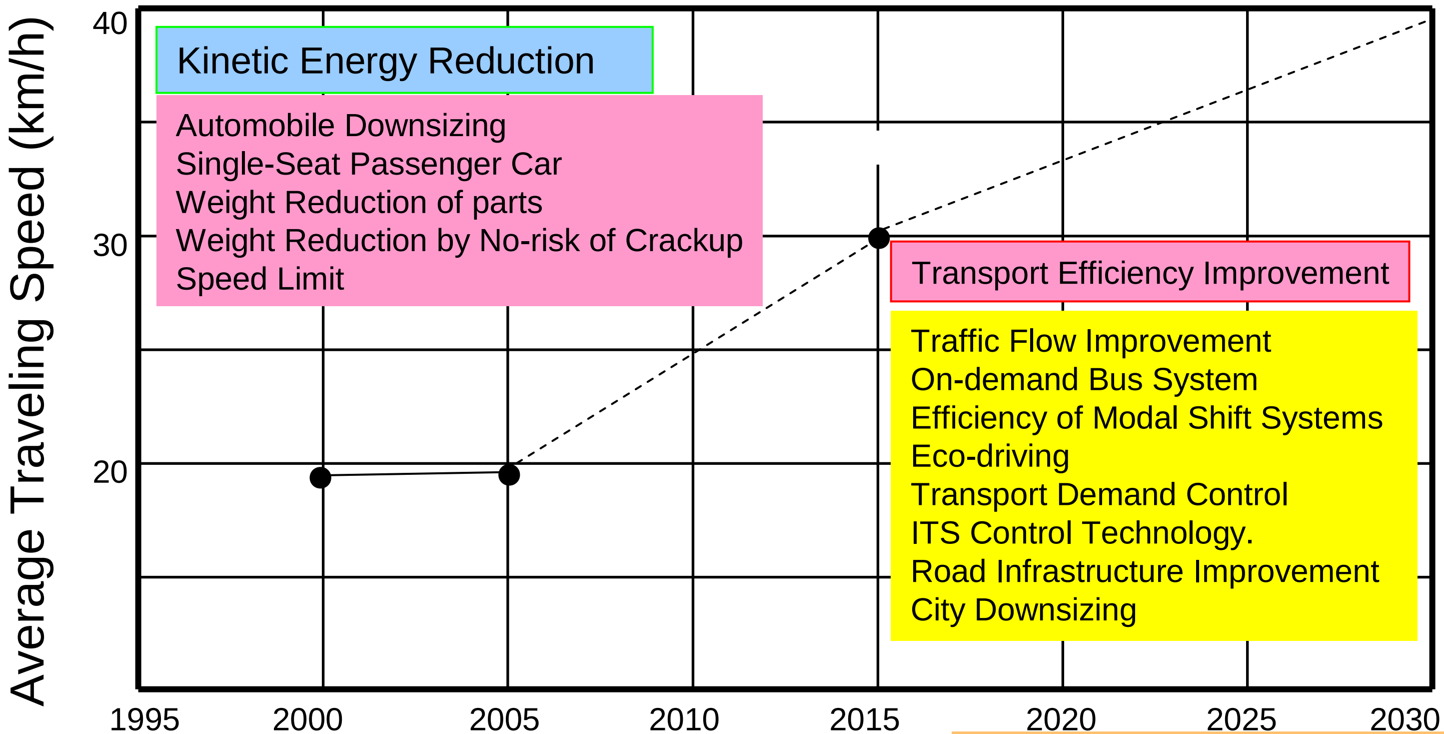
Realization of Harmonious Traffic Flow by Maximizing Total Transport Efficiency

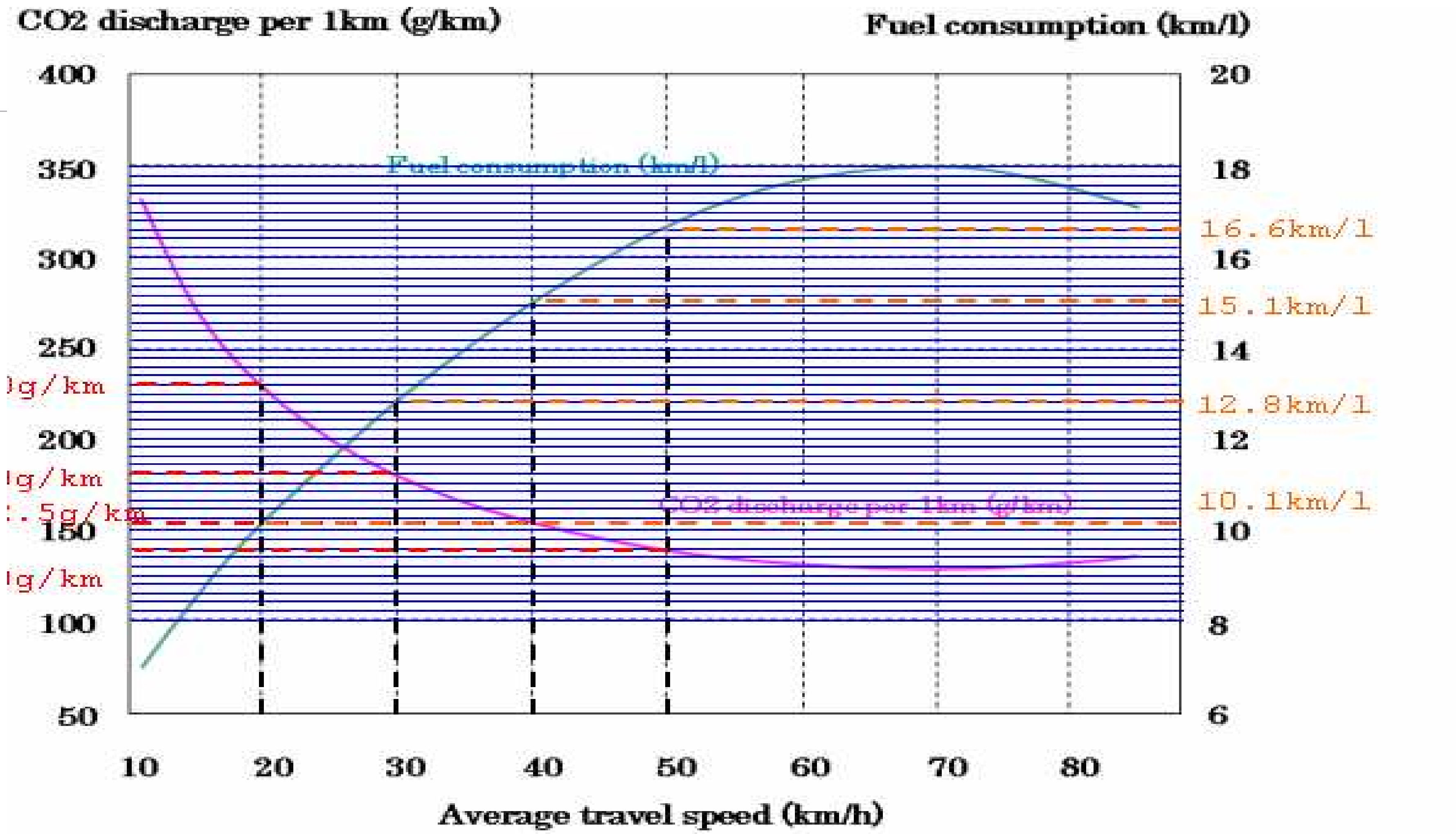
Radio Communication Technology
Traffic Flow Measurement Technology
Environmental Recognition Technology

Mobile WiMax
Automobile Behavior Prediction
Data Compress Technology

Protocol Standardization
Automobile Crowd Control
Personal Mobility

GPS
Positioning Accuracy
Improvement





Reference materials:【伊東大厚のトラフィック計量学】 http://response.jp/issue/2006/1030/article87808_1.html

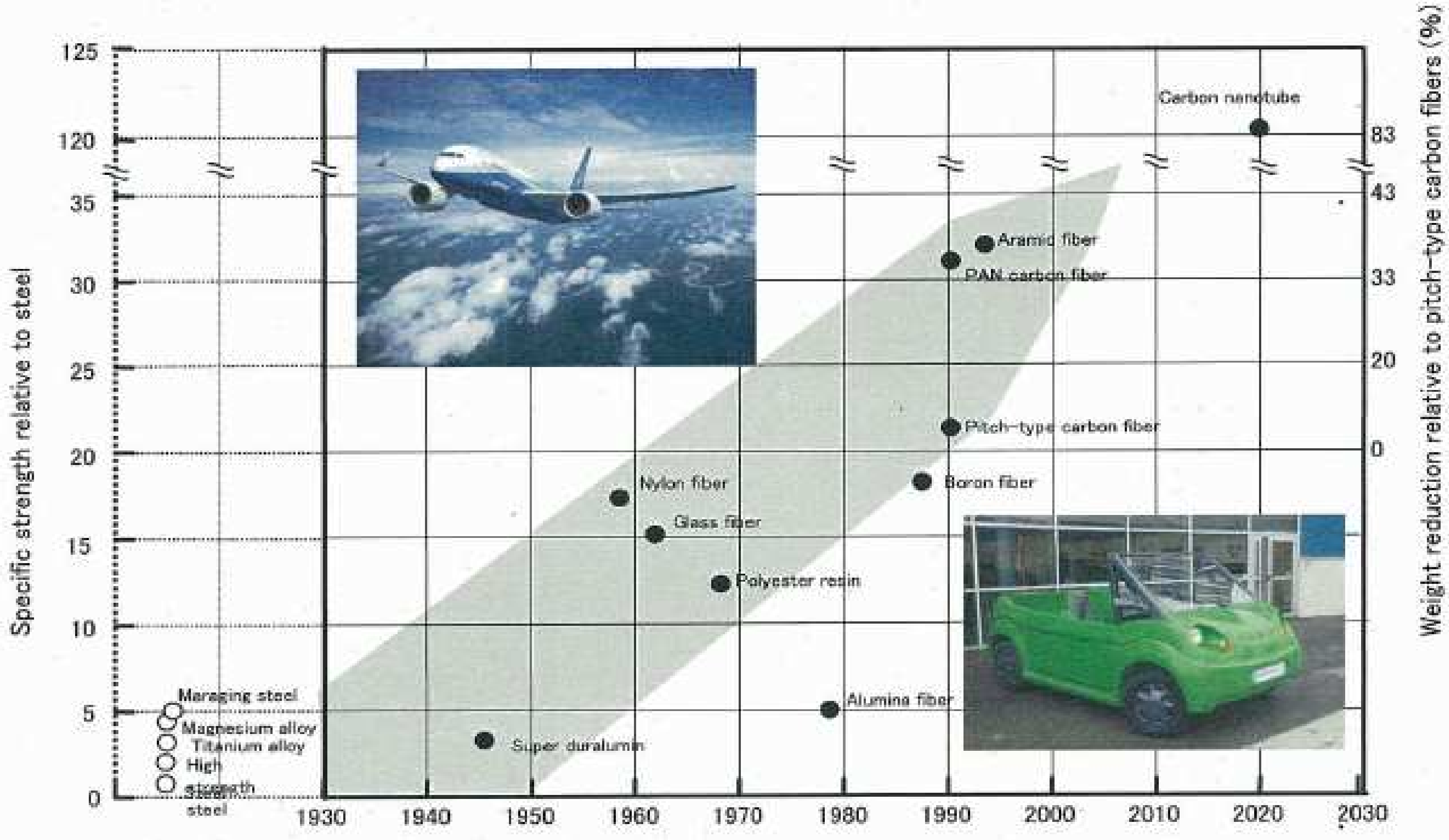
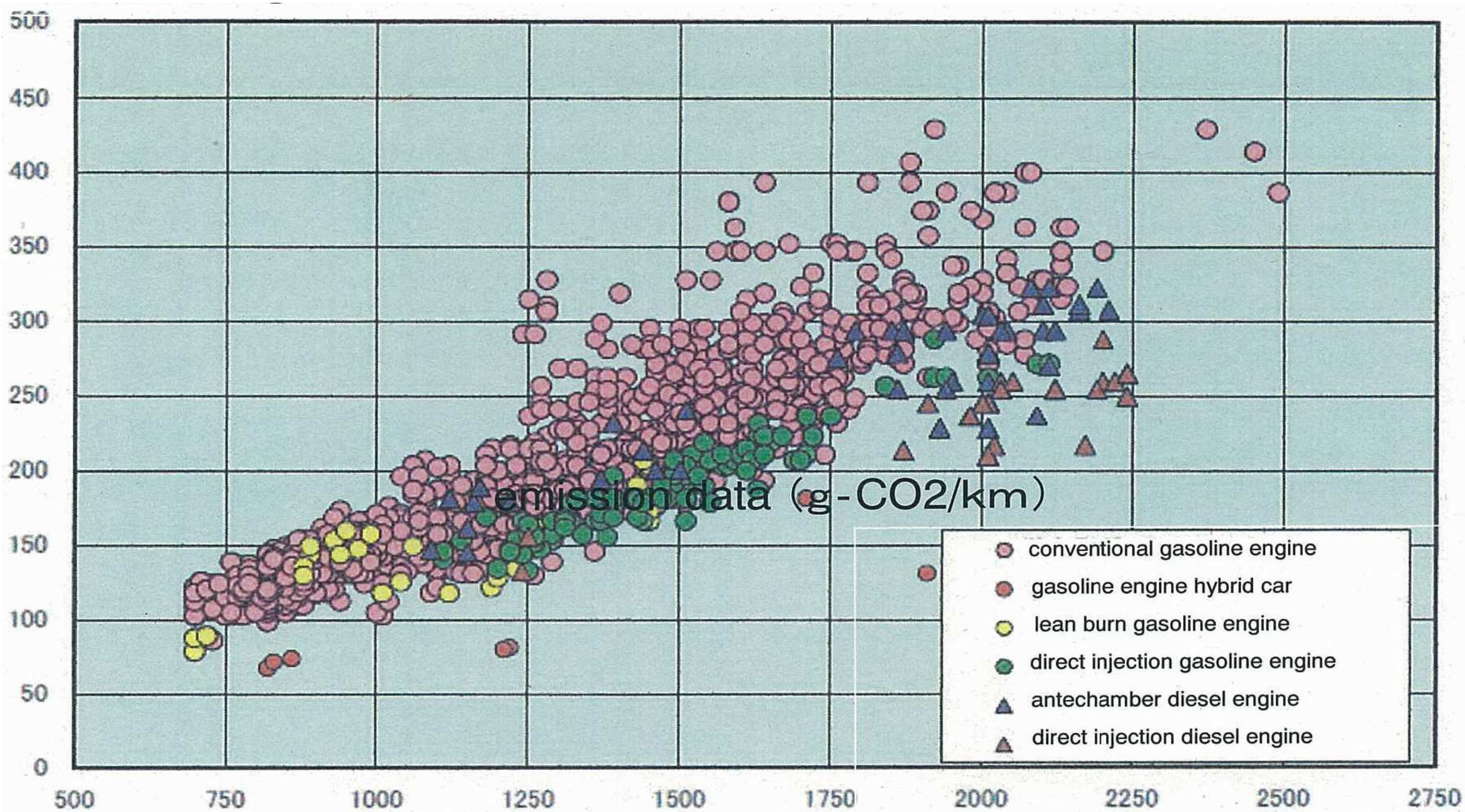


Fig.1 JSME Technological Roadmap for Specific Strength of Materials

emission data（g-CO_2/km） CO_2 emission data of passenger cars according to weight



vehicle weight（kg）

Data sheet for the climate plans

Country:JAPAN Population(2006) 127.8million, Area377,923km2,GDP:4384billion$

			Baseline			
			2007	2015	2030	2050
GHG emissions (tons CO2-eq.)	CO_2					
	Total		1,371MT			
GHG emissions by sector (tons CO2-eq.)	Transportation fuels					
	AUTOMOBILES					
	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)	36%	37.20%	39.50%	42.50%
		Average Traveling Speed by Traffic Flow Control Tecnology	20km/h	30km/h (20% Red CO2)	40km/h (30% Red CO2)	50km/h (40% Red of CO2)
		Estimated Total CO2 Emission from Automobiles	222MT	178MT	151MT	122MT
		CO2 Reduction Potential		44MT	71MT	100MT

JSME Technology Roadmaps

http://www.jsme.or.jp/English/jsme%20roadmap/index.html

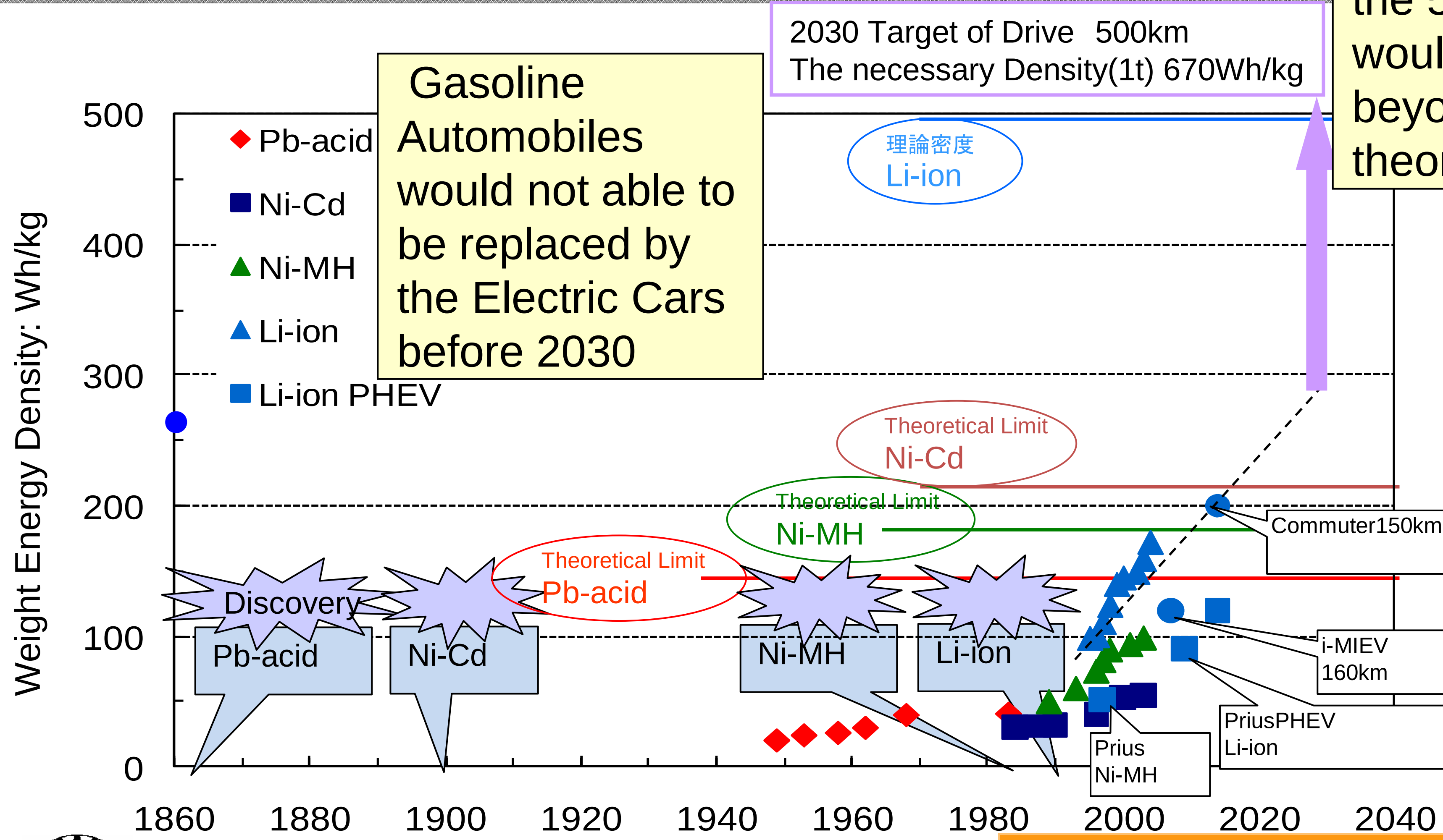
Roadmap of high-temperature heat flux heat reduction technology	Thermal Engineering div.
Roadmap of heat pump hot water supply technology	Environmental Engineering div.
Roadmap of micro- & nano-biomechanics in Tissue Engineering	Bioengineering div.
Roadmap of automobile fuel efficiency technology	Transportation & Logistics div.
Roadmap of industrial robot technology	Robotics & Mechatronics div.
Roadmap of micro- & nano-processing technology	Materials & Processing div.
Roadmap of engine thermal efficiency technology	Engine Systems div.
Roadmap of energy machine efficiency/output technology	Materials & Mechanics div.
Roadmap of design engineering technology	Design & System div.
Roadmap of dynamic phenomenon analysis technology	Dynamics, Measurement & Control div.

Technology Roadmaps for Realizing the Sustainable Society

1. For evaluating the technological innovation correctly, JSME Technology Roadmaps for Sustainable Society would able to be used.
2. Quantitative estimations, such as economical payback period of energy technologies, necessary total budget of energy policy would be possible by organizing the JSME Technology Roadmaps of Various Technical Divisions for Sustainable Society
3. By accumulating many aspects of JSME Technology Roadmap, we would able to estimate the future low-carbon society.

Importance of Technological Roadmap for the Research and Development

Technology Roadmap of Cell Battery



Gasoline Automobiles would not able to be replaced by the Electric Cars before 2030

For Lithium-Ion Cell Batteries, the 500km drive would be beyond the theoretical limit.

By 2030 the density would be the order of 300Wh/kg and the drive length would be about 250km for commuter car.

Future Climate

FUTURE CLIMATE

- THE CHALLENGE CONT

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Utilization Method of Technology Roadmap

Reduction of CO2 Emission of Automobiles by Research and Development of Cell Battery

Estimation of Advancement of Future Weight Energy Density by Technology Roadmap
(Role of Researchers) 270Wh/kg

×

Estimation of Spread
(Hybrid Vehicles and Electric Vehicles)
11 million vehicles spread by 2030

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Reduction of CO2 Emission
12 million ton of CO2

Technology Potential for the Contribution to the Best Mix of Energy Resources and to the Reduction of CO2 Emission

(1)Quantitative Estimation of Renewable Energy
(2) Reduction Potential of Fossil Fuel Utilization by Improving the Conversion Efficiency
(3)Quantitative Estimation of Reducing the contribution of Nuclear Power

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