Fuel Cell Vehicle

(1)Purpose

It is anticipated that in the 21st century, today’s fossil-based energy society will change to a hydrogen-based energy society, which will utilize the ultimate clean energy source. Fuel cell vehicles are expected to play a very important role in this change. Therefore, establishing this technological field is a matter of great social and academic significance and is expected contribute to the development of mechanical engineering.

(2) Social and technological requirements for technical issues

Currently, automotive manufacturers are leading the development of fuel cell vehicles. Some vehicles capable of operating on public roads already exist, although their supplies are limited. Additionally, various companies are working in a number of engineering fields to generate power from fixed and installed fuel cells, and to supply hydrogen.

(3) Potential mechanisms for achieving advanced key parameters

The primary issues related to fuel cell vehicles include the **[1]** durability of fuel cell stack and costs. However, improvements to hydrogen storage methods are also important from safety perspectives and suppliers must establish an infrastructure for producing, transporting, and stocking hydrogen.

Reductions to the amount of precious metals required for fuel cell stack is especially important in terms of costs and stable supply and its achievement will require a major technological breakthrough. As sources of driving force, motors for hybrid vehicles must be made as efficient and compact as possible. Therefore, new technologies, including those related to structural mechanics and materials, must be comprehensively improved.

(4) Future society outlook

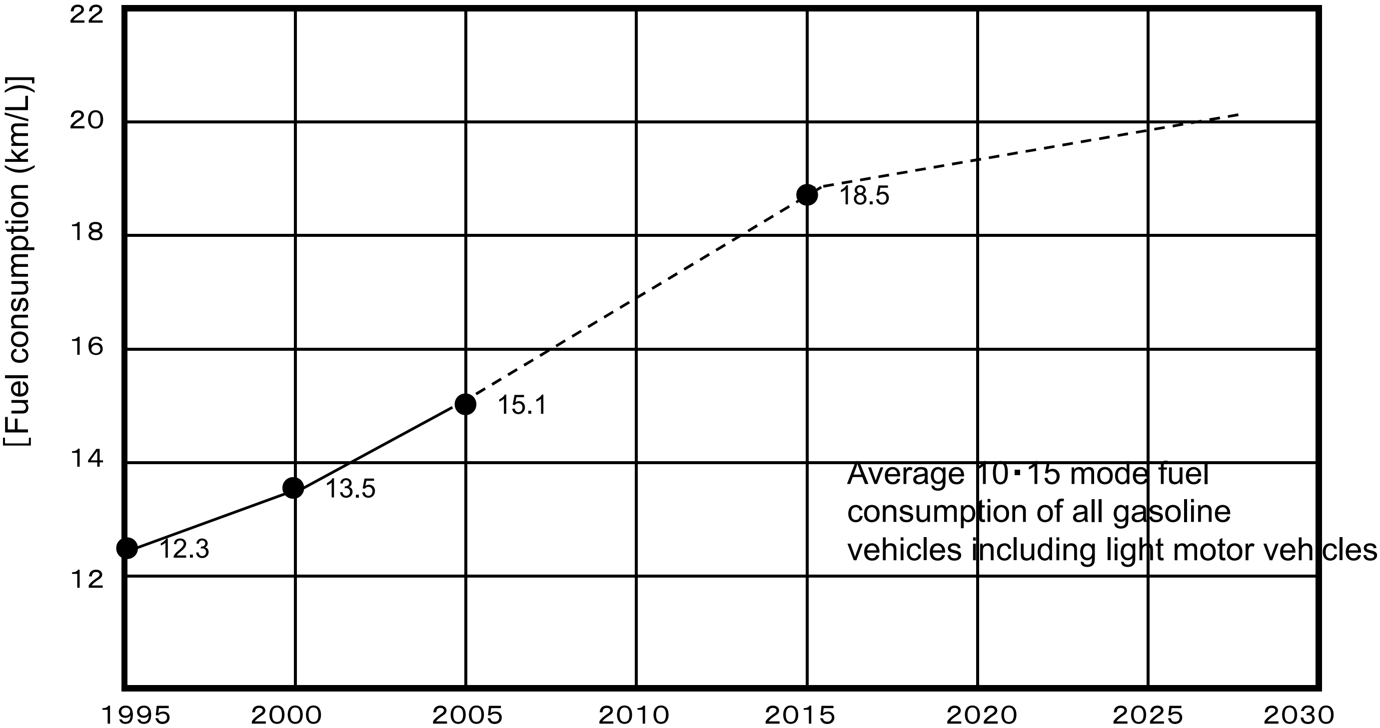
Currently energy conservation and reducing exhaust emissions are the most important issues. **[2]** During the transition from internal combustion vehicles to hybrid and electric vehicles, various changeover technologies will be needed, including new technologies related to internal combustion.

There are issues to solve in each technological field. Without dramatic breakthroughs, **[3]** the system for transportation and logistics will be formed on the basis of the advantage of each field.

Fuel cell vehicles are considered ideal because of their efficiency and zero CO_2 emissions. Resolving the above issues will enable the rapid propagation of these vehicles.

2009年度版

	1995–2000	2000–2005	2005–2010	2010–2015	2015–2020	2020–2025	2025–2030
Social and technological requirements	Reduction of exhaust emissions	Reduction of exhaust emissions	Reduction of exhaust emissions Regulations for exhaust emissions and fuel consumption in Japan, USA and Europe will be greatly strengthened (problem for automobile industry in 2009) Euro 5 (new EU automobile emission regulation)	Reduction of energy consumption to half New tax to reduce CO_2 emission from aircraft in EU	Achievement of new fuel consumption standard by government (passenger vehicle: 16.8 km/L, small bus: 8.9 km/L, small truck 15.2 km/L)		(Reducing energy demand 60% by 2050)



	1995–2000	2000–2005	2005–2010	2010–2015	2015–2020	2020–2025	2025–2030
Technological breakthrough		Hybridization (gasoline and diesel)		Integration of DPF and urea SCR methods for emission gas purification		Practical use of NO_X direct decomposition technology	Practical use of gasoline HCCI combustion Practical use of HFCV
Social and market changes	Automobile NOX Law (1992) Tokyo's campaign for no diesel vehicles (since 1999) Revised Energy Conservation Law (1999)	Automobile NOX･PM Law Domestic automobile production: 10.5 mil., sales: 5.87 mil.	Commercialization of next-generation electric vehicles that suppress operating costs to 1/8 that of gasoline vehicle. "Urea SCR system" (reducing NOx into nitrogen and water) becomes the primary device in measures for reducing gas emissions Bioethanol for use as automobile fuel to reach an oil equivalent of 500,000 kiloliters (2010)	Domestic automobile production: 10.52 mil., sales: 5.6 mil. Spread of electric vehicles with fuel cells. (Number of such vehicles registered in Japan: 50,000) Market scale of rechargeable batteries for hybrid vehicles reaches 300 bill. yen Number of hybrid vehicles in Japan, USA, and Europe markets: 2.19 mil.	Domestic automobile production: 10.65 mil., sales: 5.43 mil. Spread of fuel cells for environment-friendly and efficient use Portable power cell (for electric vehicle, etc.) Global market scale of diesel vehicles to grow to 29 mil. cars/year Global market of hybrid vehicles: 5.37 million cars	Spread of in-area transportation by very lightweight compact vehicles Total traffic volume in 2020 to 2030 up 16% from the present, reaching a peak Number of fuel cell vehicles registered in Japan: 5 mil. Infrastructure network for hydrogen supply to fuel cell vehicles	Total share of fuel cell, hybrid, and electric vehicles to account for about 40% (2050) Cell performance improves; plug-in electric vehicles spread Total traffic volume in around 2030 up 20% from the present, reaching a peak Number of fuel cell vehicles registered in Japan: 15 mil.

			Baseline	Climate plan			
			2007		2015	2030	2050
[Name of the technology/solution] Fuel cell vehicle	Savings	Consumption if old technologies are sustained (BAU)	100		120	130	150
		Consumption after implementing new technology and measures			120	125	135
		Net saving			0	5	15
	Cost (Investment, operation & maintenance, fuel)				5	0.5	0.2
	Cost Per PJ saved				－	－	－
	GHG reduction potential	Emission if old technologies are sustained and with current trends (BAU)	100		130	150	200
		Emission after implementing new technology and measures			130	147	180
		Total Reduction			0	3	20
	Cost of GHG reduction				5	0.5	0.2

Using a value of 100 for the year 2007.

[2] The above listed effects are limited to the fuel cell vehicles and the extent to which fuel cell vehicles spread is not considered. The costs provided are relative to a value of 100 for the prototype in 2007, including manufacturing and other infrastructure expenses.