The Environment and the Automobile Industry

1 Introduction

The Japanese automotive market suffered a major drop after the Great East Japan Earthquake and flooding in Thailand in 2011. However, the rebound that occurred the following year exceeded expectations, with more than 5 million vehicles being sold in 2012 for the first time in four years. Furthermore, sales in 2013 increased to 5.69 million vehicles, aided by the depreciation in the yen due to the so-called Abenomics policies enacted by the second administration of Prime Minister Abe from December 2012 and last minute demand ahead of the consumption tax hike in April 2014. In particular, fuel-efficient and easy-to-maintain mini-vehicles were sold in record numbers and accounted for 40% of all vehicle sales in Japan.

A large proportion of the Japanese vehicle market consists of fuel-efficient, low-emission vehicles such as hybrids and clean diesels. As a result, the CO_2 emissions of the transport sector are declining every year. However, despite this trend, road vehicles account for virtually all CO_2 emissions in the transport sector and continued efforts will be required to establish laws and develop technology to further reduce fuel consumption and emissions.

Active measures are being carried out to restrict CO_2 and harmful pollutants generated by the automotive industry. These measures are making a major contribution to reducing the emissions of Japanese industry as a whole. However, considering the operational status of Japan's nuclear power stations, it will be necessary to implement further energy saving measures in the future and facilitate the introduction of renewable energy sources.

2 Environmental Trends

2. 1. Japan

2. 1. 1. Reduction of greenhouse gas (GHG) emissions

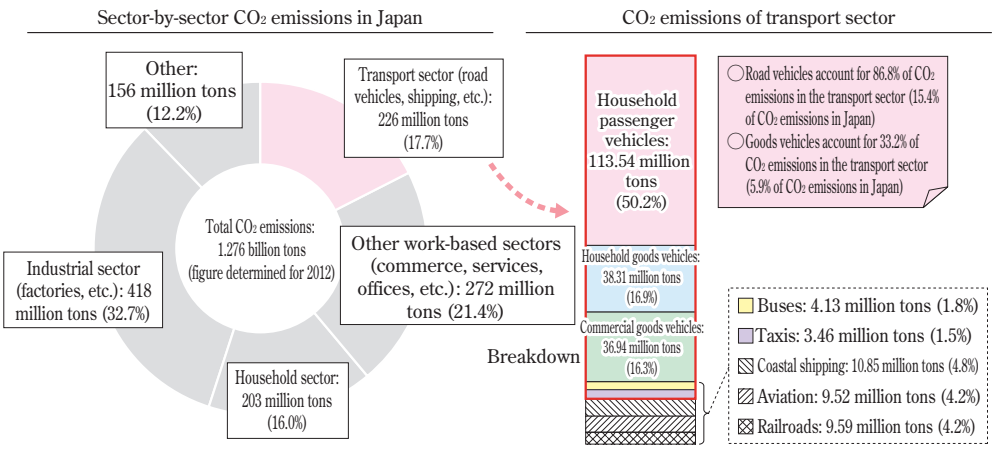
At the 19th United Nations Climate Change Conference (COP 19) held in Warsaw, Poland in November 2013, Japan reported that it had achieved an 8.2% reduction in GHG emissions, meeting the 6% target under the first commitment period of the Kyoto Protocol. Japan also announced a reduction target of 3.8% compared to the 2005 figure for 2020. Then, in December 2013, in the wake of the Fukushima Daiichi nuclear disaster, the Strategic Policy Committee of the Agency for Natural Resources and Energy published a review ahead of the release of the Strategic Energy Plan. The specific policies affecting the automotive industry include a target for next-generation vehicles (70% of new vehicle sales by 2030) and the establishment of around 100 hydrogen refueling stations for fuel cell vehicles in 2015.

Although the Great East Japan Earthquake caused a drop in industrial output, the increase in fossil fuel consumption due to the greater role of conventional fuel-fired power stations caused Japan's total CO_2 emissions in 2012 to rise by 2.8% from 2011 to 1.276 billion tons. The CO_2 emissions of the transport sector in 2012 sector fell by 1.4% from 2011 to 226 million tons, or 17.7% of the country's total CO_2 emissions. Road vehicles accounted for 86.8% of these emissions, with household passenger vehicles accounting for 50.2% and goods vehicles accounting for 33.2% of this amount (Fig. 1).

2. 1. 2. Japan's preferential tax scheme for environmentally friendly vehicles

In 2009, Japan enacted a preferential tax scheme (affecting the motor vehicle weight tax and vehicle acquisition tax) to encourage the spread of environmentally friendly vehicles. In 2012, the fuel efficiency standards of the applicable vehicles were adjusted into a new preferential tax scheme to emphasize a lower tax burden on vehicles with particularly high environmental performance.

The special provisions for environmental measures in the vehicle tax system that started in 2001 reduced the size of the taxation in accordance with emissions and fuel



※Emissions caused by power generation by power companies and heat generation by heat service utilities are included in the sector responsible for the final demand in accordance with the volume of emissions.
※Created by the Environmental Policy Division of the Ministry of Land Infrastructure and Transport (MLIT) based on the National Greenhouse Gas Inventory Report of Japan published by the Greenhouse Gas Inventory Office of Japan.

Fig. 1 Breakdown of transport sector CO_2 emissions.

economy. These provisions were combined with higher taxation on vehicles a set number of years after new vehicle registration. These measures are being continued.

2. 1. 3. Incentive system to purchase environmentally friendly vehicles

The incentive system for environmentally friendly vehicles established in 2011 ended on September 21, 2012 when the budget was exhausted. In May 2013, this was replaced by subsidies for promoting clean energy vehicles aimed at electric vehicles, plug-in hybrid vehicles, and clean diesels. This system accepted applications between May 30, 2013 and March 7, 2014 (Fig. 2).

2. 2. Outside Japan

The U.S. government issued an advance notice of the new Tier 3 emissions standards in March 2013. California also introduced separate zero-emission vehicle (ZEV) standards mandating the sale or lease of electric or fuel cell vehicles. In 2010, the National Highway Traffic Safety Administration (NHTSA) and Environmental Protection Agency (EPA) formulated Corporate Average Fuel Efficiency (CAFE) and GHG emissions standards covering passenger and light commercial vehicles between 2017 and 2025. The final regulations were issued in August 2012. In addition, final fuel economy and GHG emissions standards covering heavy duty vehicles were also issued in August 2011.

Europe plans to adopt the Euro 6 regulations for emissions covering passenger vehicles and light commercial vehicles from 2014. An amendment to Euro 6 in June

The upper limit of the subsidy is defined as the lowest figure of i, ii, and iii below.	
i. (set price of vehicle in 2013 – reference price) × incentive rate(Note 1)	
ii. Upper limit set for each vehicle category:	
Electric vehicles (mini-vehicles, compact vehicles, regular size vehicles, plug-in hybrid vehicles)	850,000 yen
Electric motorcycles with sidecars	300,000 yen
Clean diesel vehicles	350,000 yen
Motorized bicycles	70,000 yen
iii. Price of base vehicle	

Note 1: Incentive rate

Category		Incentive rate
Clean energy vehicles launched in or before 2012	A≦B−(B−C)/4	Within 1/1
	A>B−(B−C)/4	Within 2/3
Clean energy vehicles launched in 2013		Within 2/3
Motorized bicycles		Within 1/4

Remark:
A：Set vehicle price in 2013
B：Set vehicle price in 2012
C：Reference price (a+b)
a：The following adjustment amounts
・Electric vehicle: 500,000 yen
・Plug-in hybrid vehicle: 400,000 yen
・Clean diesel vehicle: 200,000 yen
b：Basic amount (with respect to the difference between the applicable vehicle and base vehicle, the price of the base vehicle calculated by adjusting the difference in specifications other than those required to classify the vehicle as a clean energy vehicle)

Fig. 2 Concept behind incentives applied to promote introduction of clean energy vehicles.

2012 studied introducing a more stringent standard for particulate matter (PM) in gasoline vehicles and simultaneously adopting a NO_2 standard, the Real Driving Emissions (RDE) standards, and the Worldwide Harmonized Light-Duty Test Procedure (WLTP). For heavy-duty vehicles, Euro V was replaced by Euro VI at the end of 2012. Euro VI calls for NOx reductions of 80% and PM reductions of 50%. The details of on-board diagnostics

(OBD) standards and requirements for NOx reduction systems were decided in June 2011. The EU is also studying long-term targets for CO_2 emissions standards beyond 2020. Targets of 95 g/km for passenger vehicles and 147 g/km for light commercial vehicles have been fixed. Specific details of these standards were proposed by the EU committee in July 2012.

In China, emissions standards are based on those determined by the Economic Commission for Europe (ECE) and EU directives. Although current Chinese standards are equivalent to Euro 4, standards equivalent to Euro 5 have been introduced in Beijing ahead of the rest of the country. The mandated average fuel economy for passenger vehicles is 6.9 L/100 km by 2015 and 5.0 L/100 km by 2020. To achieve these targets, Stage 3 fuel economy standards were announced in December 2011 and Stage 4 standards are currently being studied. The Chinese Ministry of Industry and Information Technology also introduced fuel economy standards for heavy-duty commercial vehicles in 2012.

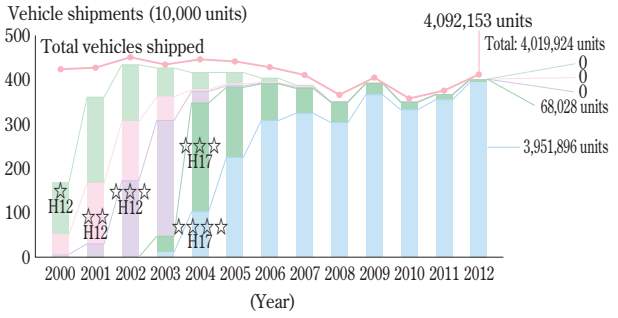
More stringent standards for emissions and fuel economy are being introduced in other countries around the world as well. In consideration of this trend, the United Nations (UN) is accelerating the harmonization of international standards, including the formulation of test methods for emissions and global technical regulations (GTR) for unified test modes, based on a 1998 agreement. Formulation of the Worldwide Harmonized Motorcycle Emissions Certification (WMTC) procedure, Worldwide Harmonized Heavy-Duty Certification (WHDC) procedure, Off-Cycle Emissions (OCE) procedure, and Non-Road Mobile Machinery (NRMM) procedure have been completed, and efforts are currently under way to draw up the WLTP.

3 Automotive Environmentally Friendly Measures

3. 1. Urban environmental issues

3. 1. 1. Gasoline vehicles

A key modern way of achieving extremely high environmental performance is to combine direct fuel injection and stoichiometric combustion with a 3-way catalyst. The number of certified low-emission gasoline passenger vehicles exceeded 98% of new vehicle sales in 2012. Of these, approximately 97% achieved emissions 75% lower than the standards set in 2005 (i.e., vehicles awarded four stars (☆☆☆☆)) (Fig. 3). In contrast, direct injection gasoline vehicles emit at least 10 times the particles (soot) as conventional gasoline vehicles and countermeasures are required to identify and help address the current situation as soon as possible.



Note: low-emissions vehicles based on certification procedure
H17☆☆☆☆: 75% lower than the emissions standards set in 2005
H17☆☆☆: 50% lower than the emissions standards set in 2005
H12☆☆☆: 75% lower than the emissions standards set in 2000
H12☆☆: 50% lower than the emissions standards set in 2000
H12☆: 25% lower than the emissions standards set in 2000

Fig. 3 Proportion of low-emission vehicles in new vehicle sales.

3. 1. 2. Diesel vehicles

To comply with the post new long-term regulations, most heavy vehicles have adopted high-pressure multi-stage fuel injection, variable geometry turbochargers, and exhaust gas recirculation (EGR) to control combustion, in combination with aftertreatment systems such as diesel particulate filters (DPF) or selective catalyst reduction of NOx using urea as a reduction catalyst (urea SCR). In addition, the Central Environmental Council has published a report about future automotive emissions reductions measures (the 11th guidelines) in response to the urgent need to prohibit so-called defeat strategies, i.e., functions that disable emissions reduction devices outside of official test cycles. These guidelines address the prohibition of these functions, conditions that are not defined as defeat strategies, and the verification of whether these functions are present. It has also been confirmed that vehicles that comply with the new post long-term regulations using an onboard urea SCR system exceed the regulated value for NOx emissions due to poisoning of the system by unburned hydrocarbons (HCs). As a result, the relevant automakers voluntarily introduced a temperature-raising strategy into the system to eliminate HC poisoning from August 2013.

3. 2. Global environmental issues

3. 2. 1. Improving fuel economy

One recent trend to improve the fuel economy of gasoline passenger vehicles is engine downsizing combined

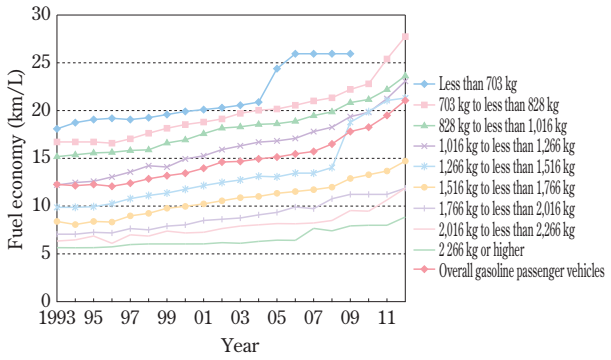


Fig. 4 Trends for average 10-15 test cycle fuel economy of gasoline passenger vehicles.

with the adoption of direct injection and turbochargers. Competition over fuel economy is particularly fierce for mini-vehicles, some of which have substantially improved fuel economy by introducing regenerative systems to recover energy on deceleration. As a result, the average overall fuel economy for gasoline passenger vehicles reached 21.1 km/L in 2012, substantially higher than the corresponding standard for 2015 (18.6 km/L) (Fig. 4). In addition, the passenger vehicle fuel economy standards for 2020 were set in March 2013, targeting a 19.6% improvement compared to the 2015 standard. As a result, automakers will need to maintain a continued focus on fuel economy.

However, as fuel-efficient vehicles become more widespread, the divergence between real-world and advertised fuel economy has become an issue, particularly because this divergence increases in the case of vehicles with better environmental performance. Real-world fuel economy is affected by various factors, including the usage environment, driving style, and operational status of electrical equipment. Measures will be required in the future to help resolve this issue.

3. 2. 2. Popularization of next-generation vehicles

The strategy for promoting environmentally friendly vehicles drawn up by the Japanese Ministry of the Environment (MOE) and the Next Generation Vehicle Strategy 2010 from the Ministry of Economy, Trade and Industry (METI) call for the development and market introduction of next-generation vehicle technology (i.e., for hybrid, electric, clean diesel, fuel cell, and natural gas vehicles) to help counter global warming, as well as from the standpoint of strengthening the international competitiveness of the automotive industry. Since the full-scale introduction of the preferential tax scheme and incentives for environmentally friendly vehicles in 2009, sales

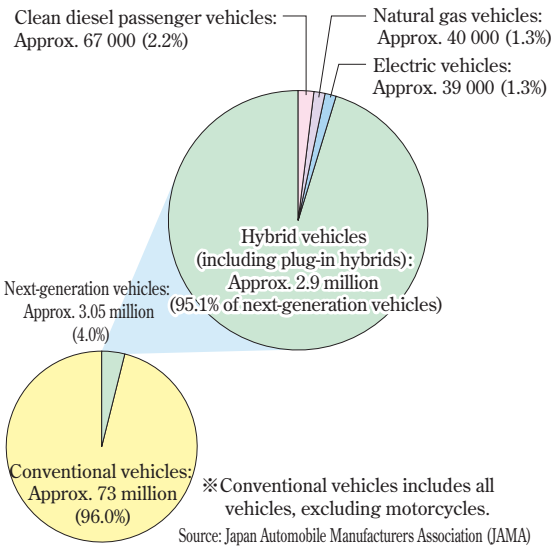


Fig. 5 Breakdown of vehicle ownership and next-generation vehicles (estimated figures for 2012).

of next-generation passenger vehicles have increased substantially, reaching roughly 3.05 million in 2012. Approximately 95% of these vehicles are hybrids. However, only about 4% of all vehicles on the roads in Japan are classified as next-generation vehicles and further popularization efforts will be needed (Fig. 5).

3. 3. Traffic environment measures

3. 3. 1. Promotion of intelligent transport systems (ITS)

Various ITS-based services have become widespread across Japan, including the non-stop Electronic Toll Collection (ETC) system and Vehicle Information and Communication System (VICS). In December 2013, the ETC usage rate reached 89.3% and the number of vehicles equipped with onboard VICS units exceeded 40 million. These systems help to improve fuel economy and reduce emissions by facilitating traffic streams (Fig. 6). In addition, ITS spot services began operating in roughly 1,600 locations around Japan in 2011. These use the same communication technology as ETC to provide various information-based services. One example of an ITS spot service is dynamic route guidance, which provides real-time road traffic information for urban expressways encompassing expressways and other feasible routes in a wide area across different prefectures. The vehicle navigation system can then search and select the fastest route based on the latest regularly updated information, allowing more efficient travel (Fig. 7).

The 20th ITS World Congress was held in Tokyo from October 14 to 18, 2013, attracting 20,000 participants

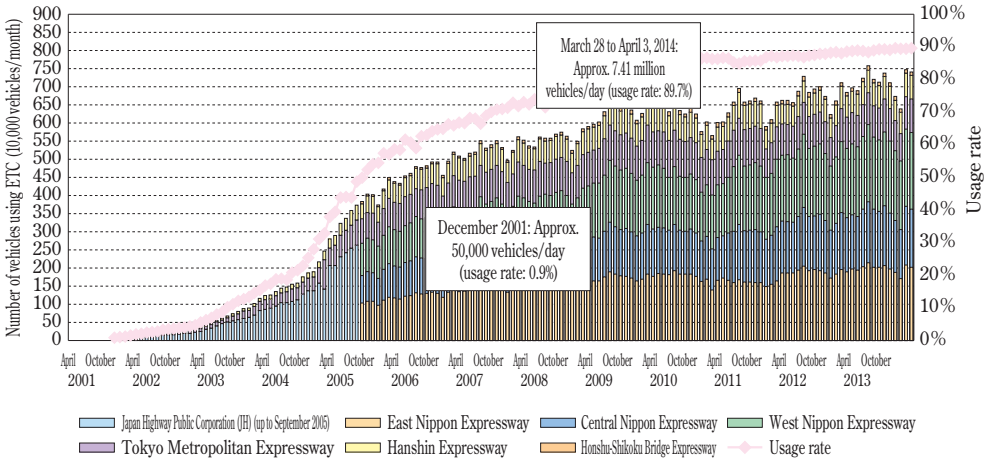


Fig. 6 ETC usage rate.

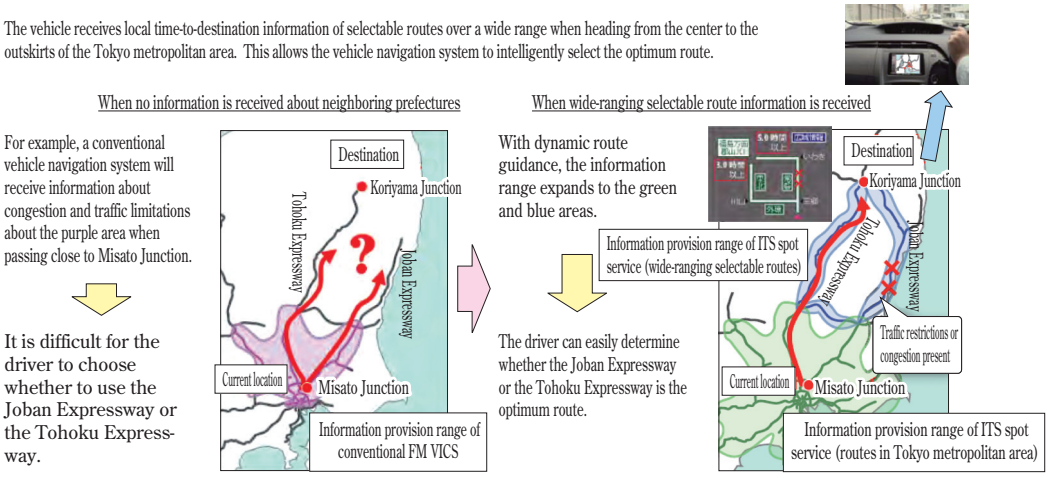


Fig. 7 Dynamic route guidance.

from 65 countries, and providing an opportunity to showcase technical development, policies, and market trends related to ITS. Discussions and information exchanges were held from wide-ranging standpoints.

3. 3. 2. Popularization of environmentally friendly driving techniques

The Eco-Drive Promotion Liaison Committee, a joint organization of the National Police Agency (NPA), METI, MLIT, and MOE, designated November as the official national environmentally friendly driving month (official name: Eco-Drive Promotion Month) since this is a popular month for leisure trips and people have more opportunities to drive. The Committee also promotes cooperation for the holding of symposiums and events around the country to popularize and promote environmentally friendly driving. This Committee also created ten recommendations for environmentally friendly driving in 2003, which was then partially amended in 2006 and 2012.

3. 3. 3. More efficient logistics and encouraging use of public transport

In April 2012, after approval of the Fourth Basic Environment Plan by the Cabinet, MLIT formulated its Environmental Action Plan for the seven year period from 2014 to 2020. One of the aims of this Action Plan is to counteract and alleviate global warming toward the achievement of a low carbon society. It includes measures to encourage the use of public transport by increasing the user friendliness of railways and buses and by promoting mobility management, as well as measures to increase the efficiency of logistics by promoting a modal shift from transportation by truck to transportation by trains or boats, and by boosting the efficiency of international freight transportation.

3. 4. Measures for used vehicles

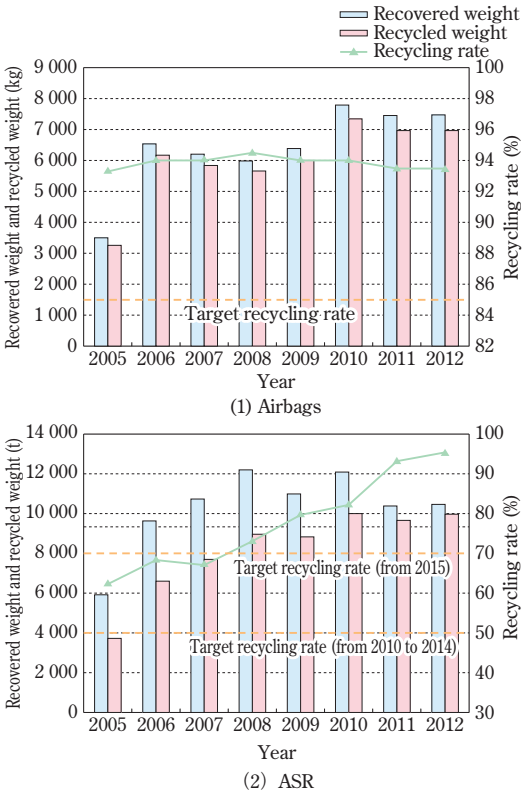


Fig. 8 Recycled weights and recycling rates.

The End-of-Life Vehicle (ELV) Recycling Law introduced in January 2005 obligated the smooth recycling and treatment of chlorofluorocarbons, airbags, and automotive shredder residue (ASR) by each automaker. In 2012, the weight of recovered airbags was 7,500 kg and the recycling rate was 93.5%. Although this was 0.1% lower than the 93.6% achieved in 2011, it was still greatly above the target rate of 85%. In the same year, 10,500 t of ASR was recovered, and a recycling rate of 95.5% was achieved. This was up 2.2% from the 93.3% achieved in 2011. The ASR recycling rate has exceeded the 2015 target of 70% since 2008 (Fig. 8).