The Environment and the Automobile Industry

Michio Shinohara[1)]

1) Honda Motor

1 Introduction

In 2011, the production of the Japanese automotive industry fell abruptly due to a series of natural disasters such as the Great East Japan Earthquake and flooding in Thailand. In 2012, this was offset by a gradual recovery in the U.S. and the steady expansion of markets in Asia, which more than made up for the decline in sales in China due to the effects of the dispute over the Senkaku Islands. Sales in the overall Japanese market exceeded five million for the first time in four years and a large proportion of vehicles sold were either environmentally friendly cars taxed under preferential rates or extremely fuel-efficient mini-vehicles. As a result, the average fuel economy of new vehicles sold in Japan improved dramatically.

However, despite the efforts of each automaker to develop innovative production technologies to help combat global warming, the shutting down of Japan's nuclear power plants had a major effect and necessitated an increase in the basic units of energy consumption. Consequently, since steps toward restarting nuclear power plants must be taken with great prudence, and because of the time required to switch to renewable energy sources, even greater innovation in vehicle production will be required to counter global warming. Another major recent topic is the issue of particulate matter smaller than 2.5 micrometers (PM 2.5), which is thought to be caused by delays in adopting environmentally friendly policies in China and other emerging markets. Emerging markets that are prioritizing economic growth are behind the curve in legislating to help conserve the environment. The effects of this approach on the global environment are becoming increasingly difficult to ignore.

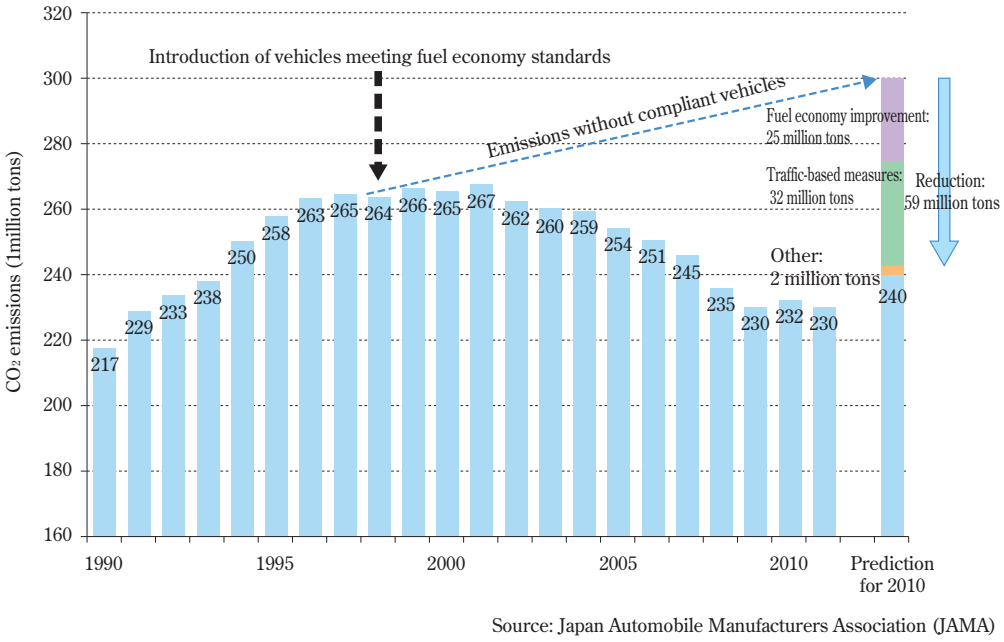
The issue of climate change was addressed by the United Nations Framework Convention on Climate Change (COP 18) held in Doha. Countries are promoting activities to help reduce greenhouse gas (GHG) emissions toward fixed targets. Japan did not take on new targets in the second commitment period of the Kyoto Protocol and is covered by targets based on the Cancun Agreements. However, as an environmentally friendly developed nation, Japan must cooperate even more closely with environmental policies that affect the production and sale of vehicles in emerging markets.

2 Environmental Trends

2. 1. Japan

2. 1. 1. Reduction of GHG emissions

At the 64th session of the UN General Assembly in September 2009, then Prime Minister Hatoyama announced a conditional 25% reduction in Japan's GHG emissions by 2020 [(1)(2)]. However, since the Fukushima Daiichi nuclear disaster caused by the Great East Japan Earthquake in March 2011, Japan's energy policy is in need of a fundamental overhaul. Subsequently, after Prime Minister Abe came to power in December 2012, the government announced its intention to review the policy before the opening of COP 19 in November 2013, including making changes to the current GHG reduction targets. In 2011, Japan's GHG emissions totaled 1.38 billion tons after conversion to CO_2, a 4.0% increase compared to 2010. This increase is due to a rise in emissions from the industrial sector, reflecting the uptick in manufacturing due to the economic recovery after the global financial crisis, as well as greater consumption of fossil fuels by thermal power stations to replace the offline nuclear power plants. The CO_2 emissions of the transport sector (including automobiles) were 0.23 billion tons, a 1.0% decrease from the previous year (equivalent to a reduction of 2.3 million tons of CO_2). Although the CO_2 emissions of the transport sector increased between 1990 and 2001, this decreasing trend is likely to continue in the future (Fig. 1) [(1)].



Source: Japan Automobile Manufacturers Association (JAMA)

Fig. 1 CO_2 emissions of the transport sector and reduction targets.

2. 1. 2. Changes to Japan's preferential tax scheme for environmentally friendly vehicles, green tax plan, and motor vehicle weight tax

To encourage the spread of environmentally friendly vehicles, Japan introduced a preferential tax scheme (motor vehicle weight tax and vehicle acquisition tax) as well as special provisions for environmental measures in the vehicle tax system. This policy was extended from April 2012 and vehicles that fulfill the conditions qualify either for a tax reduction (for three years) or are tax-exempt. Under the revision of the tax system in 2012, a new motor vehicle weight tax was introduced in May that changed the amounts of tax payable on both vehicles that are eligible and non eligible for the preferential tax scheme for environmentally friendly vehicles. In addition, the so-called temporary tax rate for the motor vehicle weight tax was scrapped for environmentally friendly and other vehicles and lowered for older cars (less than 13 years).

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

Japan introduced this system to revitalize the Japanese vehicle market, encourage the purchase of environmentally friendly vehicles, and help to meet the goals of its environmental policies. The system was included in the 4th supplemental budget in 2011 and provided a set level of incentives for purchasing vehicles that fulfilled the conditions of the legislation. The duration of the incentives was limited to between December 20, 2011 and January 31, 2013 (or until the allocated budget was used up). Applications ceased to be accepted on September 21, 2012, as the budget began to run out.

2. 2. Outside Japan

In the U.S., the Department of Transportation, Environmental Protection Agency, and California Air Resource Board (CARB) agreed to a joint proposal for fuel economy standards covering passenger vehicles and light trucks between 2017 and 2025. This agreement paves the way for a unified national approach to fuel economy standards rather than one in which California sets standards ahead of the rest of the country. In November 2011, a proposal was issued to set the average industry fuel economy of 2025 model year passenger vehicles at 54.5 miles per gallon. The final regulation was announced in August 2012. In addition, California adopted new comprehensive emissions rules under the Advanced Clean Car program covering passenger vehicles and light trucks between 2017 and 2025 [4]. These rules mandate a certain minimum level of sales of zero-emission vehicles (ZEVs) such as battery powered electric vehicles (BEVs) and fuel cell electric vehicles (FCVs). By 2025, this legislation is targeting sales of ZEVs accounting for 15.4% of new vehicle sales (Fig. 2).

Europe has decided to phase in CO_2 regulations for

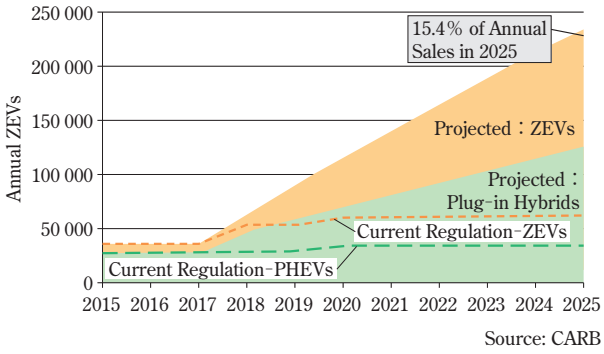
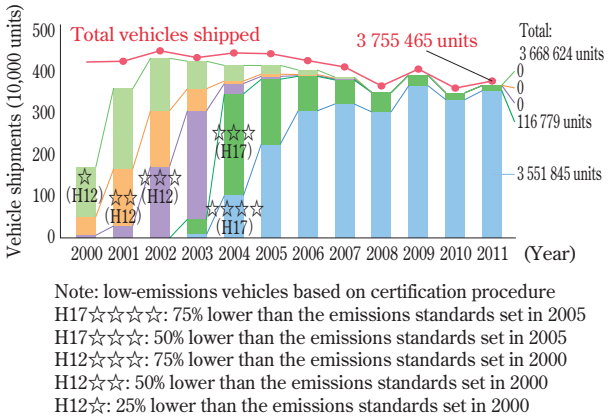


Fig. 2 ZEV regulation trends in California.



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-emissions vehicles in new vehicle sales.

light commercial vehicles from 2014 (two years after the regulations for small passenger vehicles). The target for the average CO_2 emissions of new vehicles sold within the EU has been lowered from 175 g/km to 147 g/km in 2020. It is also examining even more stringent regulations for 2050. In addition, the EU is also studying the addition of particle number (PN) rules for gasoline vehicles and the revision of threshold values for on-board diagnostics (OBD) in the Euro 6 emissions regulations.

There is a clear trend for more stringent regulations related to fuel economy and CO_2 around the world. China is examining the introduction of the Beijing 5 emissions regulations (equivalent to Euro 5) in addition to its third-stage fuel economy regulations. These regulations were due to be applied to the whole country in 2012 but this has been postponed. South Korea has introduced fuel economy and CO_2 regulations that gradually become stricter, and CO_2 regulations are also being considered in countries such as Taiwan and Brazil. In contrast to these individual trends, international harmonization of regulations by the United Nations (UN) is also picking up speed. Tighter regulatory levels is having the effect of narrowing differences in traffic-based emissions between regions, which has triggered efforts to develop unified global test cycles and testing methods. The Worldwide Harmonized Motorcycle Emissions Certification/Test Procedure (WMTC) for motorcycles and Worldwide Harmonized Heavy-Duty Certification Procedure (WHDC) for heavy-duty vehicles have already been completed and countries are now working toward formulating a Worldwide Harmonized Light Vehicles Test Procedure (WLTP).

3 Automotive Environmentally Friendly Measures

3. 1. Urban environmental issues

3. 1. 1. Gasoline vehicles

Automakers are actively launching low-emissions vehicles as part of efforts to help improve the urban environment. In 2011, 98% of new gasoline vehicles (3.67 million units) were classified as low-emissions vehicles. Of these, approximately 97% achieve emissions 75% lower than the standards set in 2005 (i.e., vehicles awarded four stars (☆☆☆☆) under these regulations) (Fig. 3) [(1)].

3. 1. 2. Diesel vehicles

Diesel vehicles emit less CO_2 than gasoline vehicles and have a potentially large GHG reduction effect. Consequently, several automakers are developing and releasing passenger vehicles that comply with the new post long-term regulations. These emissions regulations came into force in October 2009 and are the most stringent in the world. Compliance requires the use of electronically controlled high-pressure multi-stage fuel injection, combustion control using exhaust gas recirculation (EGR), and aftertreatment systems such as diesel particulate filters (DPFs), lean NOx catalysts, selective catalyst reduction (SCR catalyst systems that use urea as a reductant (urea SCR systems), or the like. This category of clean diesels has expanded to include five models from three Japanese automakers and seven models from two automakers outside Japan. Each automaker uses a different approach to decreasing NOx levels such as lean NOx catalysts, urea SCR systems, and the like.

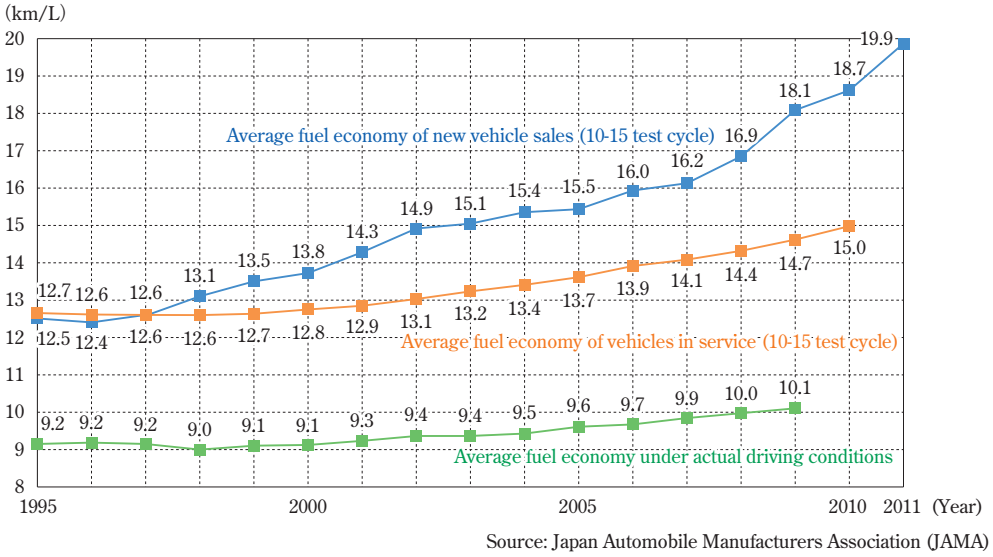


Fig. 4 Average fuel economy trends of gasoline passenger vehicles.

3. 2. Global environmental issues

3. 2. 1. Improving fuel economy

Climate change is a critical issue throughout the world. Japan is making efforts to reduce CO_2 emissions by improving vehicle fuel economy and is working to meet fuel economy standards as early as possible. As a result, more than 97% of gasoline vehicles sold in Japan in 2011 complied with the 2010 fuel economy standards. Average fuel economy improved to 19.9 km/L (under Japan's 10-15 test cycle). This figure is much higher than the 2010 fuel economy equivalent level (Fig. 4) [(1)]. The 2015 fuel economy regulations for heavy-duty vehicles (trucks and buses) were adopted in April 2006 and for passenger vehicles and small trucks and buses in July 2007. Some passenger vehicles, mini-vehicles, and heavy-duty vehicles that meet these standards are already being launched. The industry is continuing to make a supreme effort toward meeting the 2020 fuel economy standards.

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

The Japanese government's Next Generation Vehicle Strategy [(3)] and Mid- and Long-Term Roadmap [(4)] require the popularization of next-generation vehicles (hybrid electric vehicles (HEVs), BEVs, FCVs, and natural gas vehicles). The proportion of next-generation passenger vehicles in new vehicle sales has grown drastically since 2009, when the Japanese government introduced incentives and a preferential tax system. In 2011, the number of next-generation vehicles in Japan reached approximately 2.11 million, 96% of which are HEVs (Fig. 5) [(1)]. Automakers are continuing to actively launch next-generation vehicles and plan to start selling FCVs in around 2015 [(5)].

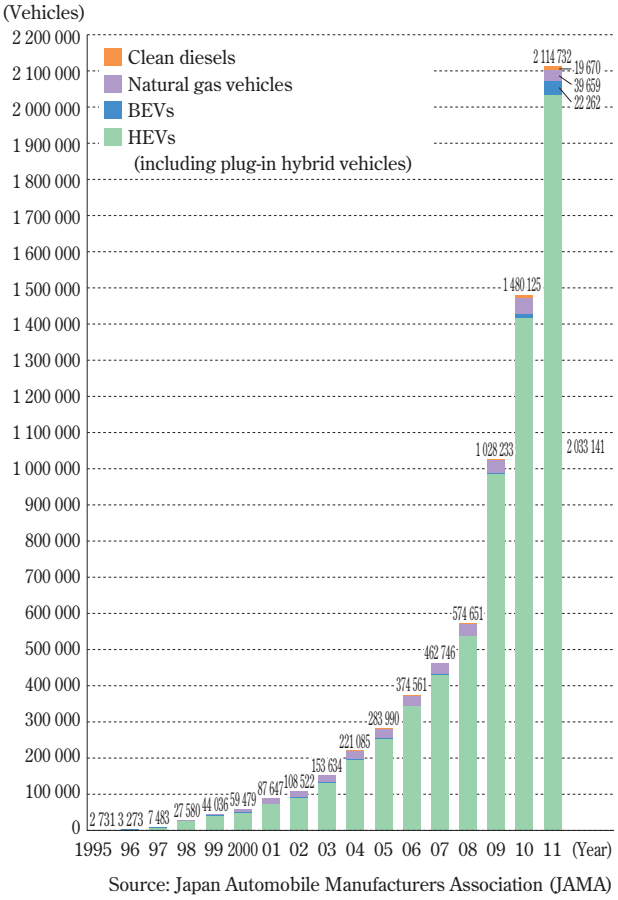


Fig. 5 Trends for number of next-generation vehicles in Japanese market.

3. 3. Measures for used vehicles

Recycling companies and automakers achieved a ve-

hicle recycling rate of approximately 80% in 2004 under the 3R approach (reduce, re-use, recycle). The End-of-Life Vehicle (ELV) Recycling Law introduced in 2005 obligated the smooth recycling and treatment of chlorofluorocarbons, airbags, and automotive shredder residue (ASR). In 2011, the recycling rate for ASR was more than 92%, greatly above the 2015 target of 70% (Table 1). As a result, a vehicle recycling rate in excess of approximately 95% has been achieved. Automakers are also carrying out voluntary reductions of substances of concern (SOCs) to the same levels of the European ELV Directive. The targets for new vehicles (lead: 1/10 of 1996 level, mercury and hexavalent chromium: use prohibited) have been met since 2008 [1].

3. 4. Environmental management

Automakers are building up a management system throughout the whole supplier chain to promote environmental conservation. ISO 14001 (an international standard that sets out the criteria for an environmental management system) is being adopted by a growing number of production sites, non-production sites, and related companies both inside and outside Japan. There are also increasing demands for greater transparency, reliability, and verification of industrial environmental management, including calls for the disclosure of the total GHG emissions in the corporate activities of manufacturers. One example of this is the GHG Protocol initiative, which is being used to identify and disclose GHG emissions levels of whole supply chains.

Table 1 Current recycling status of three controlled items.

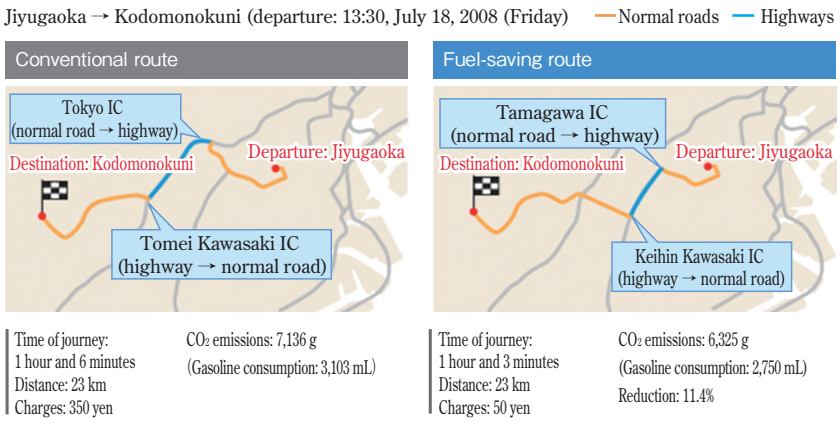
	2011
Recovery and breaking down of chlorofluorocarbons (10 ,000 vehicles)	237.5
Airbags (10,000 vehicles)	164.6
Recycling rate of airbags (%)	92～100
ASR (10,000 vehicles) *	282.9
Recycling rate of ASR (%)	92～94

＊ : Number of vehicles including whole certified recycling agents
Source: Japan Automobile Manufaturers Association (JAMA)

3. 5. Traffic environment measures

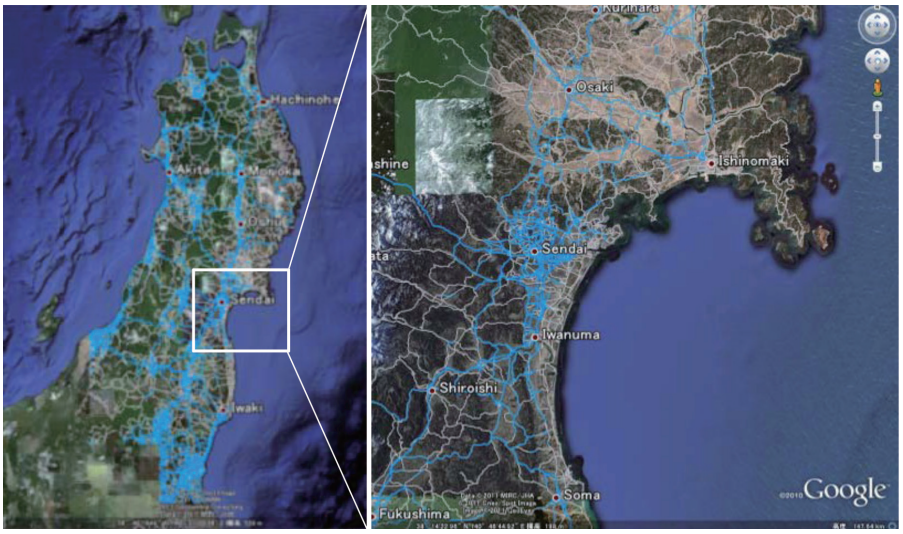
3. 5. 1. Promotion of intelligent transport systems (ITS)

In addition to helping to conserve the global environment by reducing emissions such as CO_2 and the like through improved fuel efficiency, the improvement of traffic streams is also a promising measure to revitalize economies, and to ameliorate social conditions through improved safety and disaster prevention. ITS systems aim to use information communication technology to dramatically improve safety, transport efficiency, and comfort by building integrated traffic systems of people, infrastructure, and vehicles. Current examples of ITS services in widespread use include non-stop automatic electronic toll collection (ETC) systems, sophisticated navigation-based systems, vehicle safety systems, and so on. Before the introduction of ETC in Japan, approximately 30% of all highway congestion occurred at toll booths. This has now been reduced to just 2%. As of September 20, 2012, roughly 7.1 million vehicles a day used Japan's ETC network, a usage rate of 87.8%. The accumulated number of onboard ETC units (set-up units) reached 50.96 million by the end of September. One example of a sophisticated navigation-based system is the Vehicle Information and Communication System (VICS). By the end of June 2012, 34.67 million vehicles in Japan were equipped with onboard VICS units [1].



Source: Honda Motor Corporation

Fig. 6 Fuel-saving route displayed on navigation system.



Source: Honda Motor Corporation

Fig. 7 Maps showing actual traffic volumes based on floating car data.

Due to the integration of road information, navigation system options now include the provision of fuel-saving routes with a high CO_2 emissions reduction potential (Fig. 6). Advances in ITS technology have also enabled the creation of maps showing actual traffic volumes based on driving information (floating car data). Immediately after the Great East Japan Earthquake in March 2011, these maps were created from floating car data provided by each automaker and released for public use. These maps were a useful information tool for rescues activities in the aftermath of the earthquake (Fig. 7) [6].

3. 5. 2. Popularization of environmentally friendly driving techniques

Each automaker is actively adopting devices to support driver self-awareness of eco-driving to realize more environmentally friendly driving techniques. These include fuel economy readouts, eco-indicators, the installation of eco driving modes, and so on. Automakers are also helping to reduce CO_2 emissions through educational activities, such as by offering environmentally friendly driving classes, posting advice on websites, and so on.

3. 5. 3. More efficient logistics and encouraging use of public transport

The government is encouraging activities such as the so-called modal shift to reduce CO_2 emissions by increasing overall efficiency. This involves switching the transportation of vehicles and goods from trucks to boats or trains. The government is also promoting traffic-based measures through ITS and measures to improve the efficiency of logistics. Other activities include inducing people to switch from cars to public transport by building new railway lines, promoting environmentally friendly commuting, and encouraging more effective vehicle use in cities through car sharing programs and the like. In the future, it will be important to build systems capable of accurately measuring and evaluating the energy consumption and CO_2 reduction effect of implementing these measures.

References

(1) Japan Automotive Manufacturers Association, Report on Environmental Protection Efforts 2012
(2) California Air Resources Board (CARB), Advanced Clean Cars (ACC) Regulation
(3) Ministry of Economy, Trade and Industry, Next-Generation Vehicle Strategy 2010
(4) Ministry of the Environment, Mid-and Long-term Roadmap for Global Warming Measures
(5) Ministry of Economy, Trade and Industry, Joint statement by private companies concerning the introduction of fuel cell vehicles onto the domestic market and the development of hydrogen supply infrastructure
(6) Honda Motor Website