Future Policy for
Motor Vehicle Emission Reduction

(Seventh Report)

July 29, 2003

Central Environment Council

Chukanshin No. 142
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To: His Excellency Shunichi Suzuki
Minister of the Environment

From: Akio Morishima
Chairperson
Central Environment Council

Subject: "Future Policy for Motor Vehicle Emission Reduction (Seventh Report)"

In response to an inquiry concerning "Future Policies for Motor Vehicle Emission Reduction" (Inquiry No. 31, dated May 21, 1996), the Central Environment Council (Chukanshin), having studied and deliberated the issues, submits the following recommendations based on its conclusions.

Future Policy for Motor Vehicle Emission Reduction
(Seventh Report)

In response to an inquiry concerning "Future Policy for Motor Vehicle Emission Reduction" (Inquiry No. 31, dated May 21, 1996), six reports have been compiled and submitted to date: The Interim Report submitted in October 1996 was followed by the Second Report (November 1997), Third Report (December 1998), Fourth Report (November 2000), Fifth Report (April 2002), and Sixth Report (June 2003). The recommendations in these reports led to the establishment of target levels representing two phases of emissions reductions—the "new short-term targets" and the "new long-term targets"—for motor vehicles powered by gasoline or liquefied petroleum gas (hereinafter referred to as gasoline/LPG motor vehicles) as well as for those using diesel fuel (hereinafter referred to as diesel motor vehicles). The long-term targets for diesel motor vehicles are among the world's most rigorous, calling for a 75% to 85% reduction in emissions of particulate matter (PM) and a 41% to 50% reduction in nitrogen oxides (NOx) from the corresponding short-term targets by 2005. To achieve the new long-term targets, moreover, the recommendations call for lowering the permissible limit target level for sulfur content in gasoline and diesel fuel to 50 ppm by 2004. In addition, emissions regulations for two-wheeled motor vehicles (including motor-driven cycles) were adopted in 1998 and are to be tightened in 2006. With respect to special motor vehicles, regulations governing those using diesel fuel (hereinafter referred to as "special diesel motor vehicles") were introduced in 2003 and will be tightened in 2006, while regulations governing special motor vehicles using gasoline or LPG (hereinafter referred to as "special gasoline/LPG motor vehicles") are to be instituted in 2007.

The attached Seventh Report of the Experts Committee on Motor Vehicle Emissions was compiled by said committee on the basis of a comprehensive study of policies for reducing motor vehicle emissions. After receiving said Seventh Report and deliberating its content, the Air Environment Committee concluded that the effective promotion of motor vehicle emissions reduction would be best served by adopting the report and, in keeping with its content, recommending further reductions in the sulfur content of diesel fuel, additional studies carried out at the earliest possible time regarding further steps for reducing emissions from diesel motor vehicles after the new long-term targets are met, the establishment of permissible limits for new regulatory items concerning

fuel quality, and continued study of overall measures for motor vehicle emission reduction.

Accordingly, the Central Environment Council submits the following recommendations.

1. Measures to Reduce Emissions from Diesel Motor Vehicles

1.1. Fuel-Quality Measures

In addition to striving for the earliest possible development and adoption of the kind of after-treatment device needed to achieve a major reduction in diesel exhaust emissions, diesel fuel with lower sulfur content should be introduced as soon as possible in order to reduce exhaust emissions from vehicles in use.

For this purpose, beginning in 2007, the permissible limit target level for sulfur content in diesel fuel should be reduced to 10 ppm by designing and modifying refining facilities with efficiency in mind. In addition, since there are several oil refineries capable of supplying low-sulfur diesel fuel earlier, fuel producers should be encouraged to begin supplying it voluntarily, as part of their total output, in early 2005.

1.2. Measures to Reduce Emissions Beyond the New Long-Term Targets

Regarding the establishment of new target levels beyond the new long-term targets and a timetable for meeting them, in addition to encouraging technological development by motor vehicle manufacturers through the reduction of diesel fuel sulfur content to 10 ppm or less, the council should study the issue further on the basis of technical assessments as well as an evaluation of the new long-term targets, the regulations by vehicle category instituted under the Automobile NOx/PM Law, and traffic control measures in terms of their efficacy in improving air quality, with the aim of reaching a conclusion as soon as possible.

In addition, motor vehicle manufacturers should remain focused on technological development and begin phasing in vehicles designed for the low-sulfur diesel fuel expected to appear on the market in 2005. This should include the trial introduction of low-emission vehicles equipped with such after-treatment devices as NOx reduction catalysts.

In the United States, new regulations premised on the introduction of diesel fuel with sulfur content of no more than 15 ppm are expected to be phased in between 2007 to 2010 to reduce NOx emissions by 95% and PM emissions by 90% from current levels, and studies are currently under way to determine the technical feasibility of such targets. These developments should be watched closely and their outcomes incorporated into the technical assessments recommended above.

2. Revision of Permissible Limits Relating to Fuel Quality

2.1. Study Background

In order to prevent deterioration of air quality due to motor vehicle emissions, it is necessary to build a more comprehensive system for the regulation of fuel quality. This means adding to the regulatory framework by establishing permissible limits for currently unregulated items that have an impact on air quality. Determinations regarding the addition of regulatory items and appropriate permissible limits for these items should be made with the current status of fuel quality in mind, since the emissions control systems of vehicles in use and those now under development are designed on the basis of the gasoline and diesel fuel currently on the market.

Among the regulatory items that should be added are those relating to oxygenated compounds. Included among these compounds are biomass fuels derived from organic matter, which have gained attention in recent years as replacements or additives for gasoline and diesel fuel because of their potential to aid in the fight against global warming. Among these fuels, special attention has been focused on ethanol produced from biomass (hereinafter referred to as "bioethanol") for gasoline and fatty acid methyl ester (hereinafter referred to as "FAME") for diesel fuel. Permissible limits for these oxygenated compounds should be established after their effect on emissions from vehicles in use is determined.

In addition to biomass fuels, which were examined for the purposes of the current report, such alternatives as gas-to-liquid fuels (GTL), dimethyl ether (DME), and ethyl tertiary-butyl ether (ETBE) are also being eyed as replacements and additives for gasoline and diesel fuel should be studied henceforth on the assumption that they will eventually come into use. The council should consider the regulation of these new fuels and fuel additives, taking into account such considerations as market trends, energy diversification, and the compatibility between measures to reduce carbon dioxide and other exhaust emissions.

2.2. Gasoline

The council deliberated which items pertaining to gasoline quality should be regulated in the interests of preventing the deterioration of air quality due to motor vehicle emissions, taking into account the fuel quality of gasoline currently on the market. On the basis of these deliberations, it has added octane number, distillation characteristics,

vapor pressure, and oxygen content and established the permissible limit target levels displayed in Appendix 1.

The council will revisit the possibility of raising the permissible limit target level for oxygen content to allow for such higher-ethanol blends as E10, taking into account the supply situation and the state of the corresponding automotive technology.

Finally, gasoline sulfur content should be reduced to no more than 10 ppm as soon as possible, since lower sulfur content makes it possible to reduce carbon dioxide while maintaining the efficiency of emissions-control technology, as by limiting the sulfur poisoning of NOx reduction catalysts in such lean-burn engines as the gasoline direct-injection engine and extending their lean-burn driving range.

2.3. Diesel Fuel

The council deliberated which aspects of diesel fuel content should be regulated in the interests of preventing the deterioration of air quality due to motor vehicle emissions, taking into account the quality of diesel fuel currently on the market. On the basis of these deliberations, it has added density and carbon residue and established the permissible limit target levels displayed in Appendix 2.

The establishment of a permissible limit for FAME, a diesel additive now being eyed for its potential in the fight against global warming, remains difficult at this stage. Such issues as its impact on diesel motor vehicle emissions should be studied in greater depth with the aim of reaching a conclusion as quickly as possible.

3. Future Measures to Reduce Emissions from Motor Vehicles

3.1. Future Issues to Be Studied

The following issues, including those mentioned in Sections 1 and 2 above, were deemed to merit further study by the council.

(1) With regard to diesel motor vehicles, in addition to promoting the development of new emissions-control technology, the council will examine the target levels beyond the new long-term targets and a timetable for meeting them on the basis of technical assessments as well as an evaluation of the current new long-term targets, the regulations by vehicle category under the Automobile NOx/PM Law, and traffic control measures in terms of their efficacy in improving air quality, with the aim of reaching a conclusion as soon as possible. Regarding lubricants for diesel motor vehicles, there are currently no regulations governing quality, but in view of concerns that the ash and sulfur content of such lubricants can affect the performance and life of diesel particulate filters and other exhaust after-treatment devices, some response is called for. This should include a study of lubricant specifications undertaken as soon as possible in cooperation with motor vehicle manufacturers, fuel producers, and others.

(2) With regard to gasoline/LPG motor vehicles, the council will monitor the effect of regulation under the new long-term targets for gasoline motor vehicles, the possibilities for further technological development, and the efficacy of various existing measures and consider new reduction targets as needed. In regard to fuel and lubricant quality, the council will carry out studies in cooperation with the government, motor vehicle manufacturers, and fuel producers to ascertain the emissions-control efficacy of new automotive technologies and reformulated fuel in various combinations and will use this information to deliberate measures for improving fuel and lubricant quality.

(3) Regarding special diesel motor vehicles with rated engine outputs ranging from 19 kW up to but not including 560 kW, the council will determine the feasibility of adapting the after-treatment devices used in ordinary diesel motor vehicles under regulations based on the new long-term targets and study the matter of further reduction targets designed to be met by around 2010. At the same time, the council will study the introduction of a new emissions testing method.

(4) Regarding special gasoline/LPG motor vehicles with rated engine outputs ranging from 19 kW up to but not including 560 kW, the council will monitor the effect of regulation instituted on the basis of the Sixth Report, the possibilities for further technological development, and the efficacy of various existing measures and consider new reduction targets as necessary.

(5) There are currently no emissions reduction targets for special motor vehicles with rated engine outputs below 19 kW or those of 560 kW or more, or for general-purpose engines other than special motor vehicles. The council will study the introduction of emissions regulations for these categories as needed while monitoring such developments as pollution levels, changes in these engines' contribution to total emissions, and the state of emissions-control technology.

(6) Regarding two-wheeled motor vehicles, the council will monitor the response to regulation based on the reduction targets recommended in the Sixth Report, the possibilities for further technological development, and the effect of various existing measures and consider new reduction targets as needed. At the same time, the council will study the adoption of new regulations for evaporative emissions.

(7) Regarding the problem of ultrafine particles emitted by diesel engines, studies will be carried out to ascertain the current emissions situation, including the quantity of such particles, their impact on health, and the establishment of a reliable method of measurement. The council will then determine the need for regulation in the light of this information.

Because motor vehicles are products that are distributed internationally, in studying or implementing measures related to the issues cited above, it is important to enhance international harmonization of standards wherever possible to the extent that this can be done without compromising Japan's own environmental protection efforts. Accordingly, Japan should contribute actively to efforts at international harmonization by doing its best to align its standards with international norms with regard to such matters as emissions testing methods for large-sized motor vehicles, two-wheeled motor vehicles, and special motor vehicles, including general-purpose engines; onboard diagnostic systems (OBD); and measures for controlling off-cycle emissions.

International harmonization will bring the following advantages:

Promotion of more efficient research and development among motor vehicle manufacturers

leading to improved technological development and an increase in the use of common parts leading to lower development and production costs.

Lower costs for purchasers of motor vehicles.

3.2. Related Measures

The following related measures should be carried out henceforth to supplement the basic recommendations of this report.

(Pursuing Comprehensive Emission Measures)

In addition to going forward with the implementation of regulations by vehicle category under the Automobile NOx/PM Law promulgated on June 27, 2001, it will be necessary to (1) enhance measures to control emissions from motor vehicles used for business purposes and (2) implement comprehensive measures to promote the dissemination of low-pollution vehicles while assessing the effectiveness of those measures. In addition to those measures undertaken under the Automobile NOx/PM Law, it will be necessary to study effective policies for reducing traffic volume.

(Promoting the Dissemination of Low-Pollution Vehicles, Etc.)

In accordance with the Action Plan for Developing and Disseminating Low-Pollution Vehicles adopted on July 11, 2001, all concerned ministries and agencies should work together to further disseminate low-pollution vehicles.

(Measures to Promote "Idling Stop")

Cutting down on idling time by turning off the engine when the vehicle is stationary offers the double benefit of reducing both fuel consumption and motor vehicle emissions. For this reason it is recommended that measures be taken to promote "idling stop," including the diffusion of motor vehicles equipped with an idling-stop function.

(Measures to Reduce Emissions from Vehicles in Use)

As noted in the Sixth Report and elsewhere, it is important to continue efforts to maintain good emission-control performance in all gasoline, LPG, and diesel motor vehicles currently in use by encouraging regular maintenance and inspection by users

and by checking the functioning of emission control systems during the vehicle inspections mandated by the Road Vehicles Act, as well as roadside inspections.

With regard to diesel motor vehicles in use, it will also be necessary to promote the dissemination of DPF and similar devices.

In addition, it would be advisable to undertake a study to ascertain whether the adoption of emission standards and surveillance would be helpful in maintaining the performance level of emission control systems during normal vehicle use, and whether such measures are needed.

(Cost Burden, Etc.)
Implementation of the emission reduction measures recommended in this report can be expected to have an impact on cost by raising vehicle and fuel prices, the cost of ensuring engine durability, fuel consumption, and maintenance costs. Vehicle manufacturers and users will have to bear these costs on the principle of internalizing the environmental costs associated with motor vehicle use.

It will also be necessary to put in place financial and tax incentives to ensure that both improvement of fuel guality and the replacement of old vehicles by new ones in compliance with the latest regulations proceed smoothly.

(Status Surveys and Measures for Unregulated Emission Sources)
As noted in the Sixth Report and elsewhere, it will be necessary to continue conducting surveys on the status of those emission sources that are currently unregulated and review the information to determine whether regulatory measures are required, as well as to study systems for implementing such measures. There is a particularly urgent need to conduct a systematic study of emissions from boats and ships—an important source that has hardly been took measures in Japan—with an eye on international trends past and present.

(Measures against Air Toxics)
As noted in the Sixth Report and elsewhere, there is a need to develop new and more accurate monitoring methods to establish a basis for ascertaining the quantity of air toxics emitted from motor vehicles and formulate the necessary policies on the basis of the information thus obtained. Also needed are efforts to better understand how the

quantity of such emissions is affected by such factors as engine combustion technology, exhaust after-treatment such as catalysts, and fuel and lubricant quality.

(Making Measurements of Emissions from Vehicles More Precise)

As noted in the Sixth Report and elsewhere, as regulations affecting both gasoline/LPG and diesel motor vehicles are tightened substantially and emission levels are reduced, it will be vital to gain an accurate assessment of the reliability of gauges and quality control procedures used during the production process. To this end, there is a need for research aimed at improving measurement precision.

(Enhancing the Ability to Predict and Measure Effects)

As noted in the Sixth Report, as vehicle and comprehensive measures of reducing motor vehicle emissions evolve, it becomes increasingly important, in terms of planning and implementing further measures, both to predict their effect and to measure it through accurate monitoring. To this end, it is necessary to compile an inventory of particulate matter, hydrocarbons, and other emissions from mobile sources such as motor vehicles, stationary sources such as factories and other work sites, and various natural sources, and to gain an understanding of their role in the formation of such secondary pollutants as suspended particulate matter and photochemical oxidants. For this reason, it is desirable to develop improved methods for predicting and measuring the effects of different policies to improve air quality, and to establish systems that will help us to determine the on-site impact at roadside and other locations.

Appendix 1

New Regulatory Items and Permissible Limit Target Levels for Gasoline Fuel Quality

New Regulatory Item		Permissible Limit Target Level
Octane number		≥ 89
Distillation characteristics	10% point (T_{10})	≤ 70ºC
	50% point (T_{50})	75ºC–110ºC
	90% point (T_{90})	≤ 180ºC
	End point	≤ 220ºC
	Residual oil	≤ 2.0% of volume
Vapor pressure		Summer: 44 kPa–72kPa (65 kPa max. beginning 2005) Winter: 44 kPa–93 kPa
Oxygen content		≤ 1.3% by mass

Appendix 2

New Regulatory Items and Permissible Limit Target Levels for Diesel Fuel Quality

New Regulatory Item	Permissible Limit Target Level
Density	≤ 0.86 g/cm^3
Carbon residue on 10% distillation residue	≤ 0.1% by mass

Future Policy for
Motor Vehicle Emission Reduction

(Seventh Report)

June 30, 2003

Experts Committee on Motor Vehicle Emissions
Air Environment Committee
Central Environment Council

Future Policy for Motor Vehicle Emission Reduction (Seventh Report)

(Contents)

1. Introduction

1.1. Background to Motor Vehicle Emission Control in Japan

Motor vehicle emission control in Japan began in 1966 with the adoption of regulations limiting the concentration of carbon monoxide (CO) in exhaust emissions from ordinary-sized and small-sized motor vehicles using gasoline for fuel. Subsequently, regulations were added for mini-sized motor vehicles and vehicles using liquefied petroleum gas (hereinafter referred to as "LPG") for fuel, as well as motor vehicles fueled by diesel oil (hereinafter referred to as "diesel motor vehicles"). The list of regulated substances was also gradually expanded as follows: For motor vehicles that run on gasoline or LPG (hereinafter called "gasoline/LPG motor vehicles"), excluding two-wheeled motor vehicles, regulations were instituted for CO, hydrocarbons (HC), and nitrogen oxides (NOx); for diesel motor vehicles, in addition to these substances, particulate matter (PM) in general and black smoke emissions in particular were regulated.

In 1997, gasoline-fueled two-wheeled motor vehicles (including motor-driven cycles) were added to the list of regulated vehicles through revisions to the relevant Prime Minister's Office Ordinances and other regulations. As a result, regulations were adopted for first-class motor-driven cycles and mini-sized two-wheeled motor vehicles in 1998, and for second-class motor-driven cycles and small-sized two-wheeled motor vehicles in 1999. In 2003, regulations were adopted to cover large-sized and small-sized special motor vehicles that use diesel oil for fuel (hereinafter referred to as "special diesel motor vehicles") and have rated engine outputs ranging from 19 kW up to but not including 560 kW.

In addition, the Air Pollution Control Law was partially revised in 1995 to establish permissible limits relating to the quality of gasoline and diesel fuel. On the basis of this legal change, regulation of motor vehicle fuel quality was initiated in 1996.

1.2. Background to Discussions Held by the Central Environment Council

Recent measures for reducing motor vehicle emissions have been implemented in keeping with the targets recommended in a report issued in December 1989 by the Central Council for Environmental Pollution Control (Chukoshin), entitled "Future Policy for Motor Vehicle Emission Reduction" (Chukoshin No. 266, December 22, 1989; hereinafter referred to as the "1989 Report"). By 1999, the government had adopted all

measures recommended in the report, which included regulations designed to accomplish the following:

- Achieve major reductions in NOx, PM, and other emissions from diesel motor vehicles, etc., in two stages through short- and long-term targets
- Reduce the sulfur content in diesel oil to one-tenth of current levels in two stages through short- and long-term targets (from 0.5 mass % to 0.2 mass % and finally to 0.05 mass %).

In May 1996, with the nation on track to achieve all the targets indicated in the 1989 Report, the Director-General of the Environment Agency sent a request to the Central Environment Council to formulate recommendations for "Future Policy for Motor Vehicle Emission Reduction" (Inquiry No. 31, May 21, 1996). In response, deliberations were begun within the Air Quality Committee of the Central Environment Council, as well as this Experts Committee on Motor Vehicle Emissions (hereinafter referred to as "this Committee"), newly established under the Air Quality Committee.

In response to the agency's request, six reports have been compiled and submitted to date: The Interim Report submitted in October 1996 was followed by the Second Report (November 1997), Third Report (December 1998), Fourth Report (November 2000), Fifth Report (April 2002), and Sixth Report (June 2003).

The recommendations contained in these reports led to the establishment of target levels for emissions reductions in two stages—the "new short-term targets" and "new long-term targets"—for gasoline/LPG motor vehicles, as well as for diesel motor vehicles.

The new short-term targets for gasoline motor vehicles call for a reduction in NOx and HC emissions of about 70% (50% in the case of mini-sized trucks) compared with the old long-term target levels, to be achieved between 2000 and 2002, depending on the vehicle category. The new short-term targets for diesel motor vehicles call for a reduction in PM and NOx emissions of about 30% compared with the old long-term targets, to be achieved between 2002 and 2004, depending on the vehicle category.

The new long-term targets for gasoline motor vehicles were determined with a view to tightening restrictions on NOx, etc., with due consideration for the need to reduce

carbon dioxide emissions as well. They call for reducing NOx emissions from gasoline motor vehicles by 50% to 70% compared with the new short-term targets by 2005 (2007 for mini-sized trucks). The new long-term targets for diesel motor vehicles place priority on slashing PM emissions while continuing to reduce NOx, etc. These last targets are among the most rigorous in the world, entailing a 75% to 85% reduction in PM emissions and a 41% to 50% reduction in NOx emissions from diesel motor vehicles compared with the new short-term target levels by 2005. Further, to achieve the new long-term targets, the permissible limit target level for sulfur content in gasoline and diesel fuel has been set at 50 ppm or less, to be achieved by the end of 2004. In addition, the test modes used will be changed between 2005 and 2011 to ensure accurate assessment of motor vehicles' emission performance. The necessary provisions are being put in place, including revision of the notification titled Permissible Limits for Motor Vehicle Emissions (hereinafter referred to as the "permissible limits") based on the Air Pollution Control Law, and some have already been implemented.

With regard to two-wheeled motor vehicles, emission regulations were introduced between 1998 and 1999 (depending on the vehicle category) in accordance with the recommendations of the Interim Report. In addition, the Sixth Report has proposed implementing new regulations between 2006 and 2007 to reduce HC emissions by 75% to 85%, NOx by 50%, and CO by 85% compared with current limits.

Regarding special diesel motor vehicles, the permissible limits have been revised and other necessary measures taken to begin regulation in 2003, in keeping with the recommendations of the Second and Fourth Reports. In addition, the Sixth Report recommends further tightening regulations for special diesel motor vehicles between 2006 and 2008 to reduce NOx and PM emissions an additional 20% to 50% and adopting regulations for special vehicles using gasoline or liquefied petroleum gas (hereinafter referred to as "special gasoline/LPG motor vehicles").

(Study Background and Summary of this Report)

In accordance with the guidelines for future study recommended in the Fifth and Sixth Reports, this Committee met for deliberation on seven occasions, including hearings attended by industry groups and deliberations by the working committee established within this Committee. The conclusions it reached concerning measures for reducing motor vehicle emissions are detailed in this report.

In the following, Section 2 explains this Committee's views on measures for reducing emissions from diesel motor vehicles; Section 3 addresses the revision of permissible limits pertaining to fuel quality; Section 4.1 concerns topics for future study; and Section 4.2 deals with related policies.

2. Measures to Reduce Emissions from Diesel Motor Vehicles

2.1. The Necessity for Stronger Measures

Japan has adopted a wide array of measures for curbing air pollution, including tighter regulations on motor vehicle emissions. Nonetheless, pollution from suspended particulate matter (SPM) and nitrogen dioxide (NO_2) remains a serious problem, particularly in urban areas. Since emissions of PM and NOx from diesel motor vehicles play a major role in SPM and NO_2 pollution, particularly in roadside areas, controlling the former emissions is an urgent necessity.

As discussed in the previous section, earlier reports have established future emission reduction targets for diesel motor vehicles, gasoline/LPG motor vehicles, two-wheeled motor vehicles, and special motor vehicles. In addition, beginning in October 2002, new vehicle-category regulations were put in place under the Law concerning Special Measures for Total Emission Reduction of Nitrogen Oxides and Particulate Matter from Automobiles in Specified Areas (hereinafter referred to as the "Automobile NOx/PM Law"), to address emissions from vehicles already in use. The goal is to largely attain environmental quality standards by FY 2010 through these measures.

This Committee carries out its work on reduction of motor vehicle emissions with the following understanding in mind: to reduce motor vehicle emissions, it is necessary above all to further strengthen measures for PM and NOx reduction, while at the same time working for a reduction in HC emissions. This is indicated by the following facts concerning the relationship between atmospheric pollutants and motor vehicle emissions:

(The Relationship between Atmospheric Pollutants and Motor Vehicle Emissions)

- Reducing PM emissions from motor vehicles contributes to a reduction in the atmospheric concentration of SPM and a reduction in emissions of air toxics; it is therefore a critical aspect of emission control.
- Reducing NOx emissions from motor vehicles contributes to reductions in atmospheric concentrations of NO_2, SPM, and photochemical oxidants, and it also helps control acid rain. In view of these benefits, especially the effect on NO_2 concentrations, reduction of NOx emissions is a critical aspect of emission control.

- The reduction of HC emissions from motor vehicles contributes to reductions in atmospheric concentrations of NO_2, SPM, and photochemical oxidants, and it also helps control acid rain; it is therefore a critical aspect of emission control.

The new long-term targets for diesel motor vehicles to be adopted in 2005 emphasize regulation of PM emissions over that of NOx. For this reason, it is estimated that in 2010, while the volume of PM emissions from diesel motor vehicles will have decreased by two-thirds from the 2000 level, NOx emissions will have decreased by no more than about 30%. This means that the contribution rate of diesel motor vehicles to total NOx emissions will remain high. Keeping these circumstances in mind, in order to ensure that environmental quality standards are largely attained by the aforementioned target year of FY 2010 as previously stated, the appropriate course of action is to study additional measures for motor vehicle emission control beyond the new long-term targets while evaluating the effect of the new long-term targets, the vehicle-category regulations implemented under the Automobile NOx/PM Law, and traffic control measures to assess their efficacy in improving air quality.

This Committee carried out studies to determine the necessary emission control measures with the above in mind and with an awareness of the necessity of pursuing still stronger measures for controlling emissions from diesel motor vehicles.

2.2. New Long-Term Regulations and Further Emission Control Measures

2.2.1. Study Background

The main emission control technologies currently available to enable compliance with the new long-term diesel motor vehicle regulations are as follows: for PM reduction, high-pressure fuel injection, optimization of the configuration of the combustion chamber, and diesel particulate filters; for NOx reduction, electronic fuel injection control for more precise control and cooling and increasing the volume of gas recirculated in exhaust gas recirculation systems (EGR).

Since improvements in engine combustion control can only achieve so much in reducing NOx emissions of diesel motor vehicles, the adoption of NOx reduction after-treatment devices is crucial to achieving a wholesale decrease in such emissions. For such devices, the use of either NOx adsorber catalysts or urea selective catalytic reduction (SCR) is regarded as promising, and motor vehicle manufacturers are currently at work

developing such devices. It has been determined, however, that used in conjunction with diesel fuel with a sulfur content as high as 50 ppm, these technologies function poorly because of catalyst poisoning and other factors. For this reason, it will be necessary to further reduce sulfur content in diesel oil.

NOx adsorber catalysts, a technology already applied to gasoline motor vehicles, are easily poisoned by sulfur and raise issues concerning long-term purification performance and life of the catalyst, as well as increased fuel consumption caused by the post-injections used to desulfurize the NOx catalyst. To avoid these problems, sulfur content in diesel fuel needs to be reduced to the lowest level possible. Reducing sulfur content increases the long-term purification performance and minimizes the decrease in fuel economy by reducing the number of post-injections required for desulfurization.

SCR, a technology currently applied to large-scale combustion apparatuses and stationary diesel engines, requires the addition of urea as a reducing agent. Since an oxidation catalyst is generally placed before and after the NOx reduction catalyst to heighten its reactivity and to eliminate emissions of unreacted ammonia, the sulfur content of the diesel oil needs to be kept to a minimum to heighten the reactivity of the oxidation catalyst as well as to prevent the formation of sulfates. In addition to such technical challenges as extending the life and perfecting the mechanism for controlling the quantity of urea added, the application of SCR for automotive use will also require infrastructure for the supply of urea and a means of guaranteeing a steady supply. The advantage of this technology is that it has little impact on fuel consumption.

In consideration of the above, this Committee has concluded that the appropriate steps are as follows:

- Further reduce sulfur content in diesel fuel as soon as possible
- In addition to promoting development of emissions control technology, study the appropriate levels and timetables for further targets beyond the new long-term regulations with the aid of technical assessments and evaluations with a view to reaching a conclusion as soon as possible, while at the same time evaluating the effect of the new long-term targets, the vehicle-category regulations implemented under the Automobile NOx/PM Law, and traffic control measures to assess their efficacy in improving air quality.

Specific measures relating to fuel quality are discussed in 2.2.2 below, while further measures for reducing emissions, beyond the new long-term targets, are discussed in 2.2.3.

2.2.2. Fuel-Quality Measures

The adoption of after-treatment devices is essential to achieve a major reduction in exhaust emissions from diesel motor vehicles. In addition to oxidation catalysts, which have already been developed for practical use in diesel motor vehicles, and the continuously regenerating DPF, which is in the final phases of development, two important diesel exhaust after-treatment devices are NOx adsorber catalysts and urea-injection SCR systems, currently being developed for automotive application some time in the future. As indicated in the previous section, it is known that these technologies function poorly in combination with high-sulfur diesel fuel because the catalysts used are easily poisoned by sulfur compounds. For this reason, it is necessary to reduce the sulfur content of diesel fuel to a minimum. In the Fourth Report, issued in November 2000, the permissible limit target level for diesel fuel sulfur content was set at 50 ppm in consideration of the limits of the fuel desulfurization technology available at that time, and the long-term targets for diesel emissions were set with these fuel-quality constraints in mind.

However, the use of NOx adsorber catalysts and SCR systems will be necessary to achieve major reductions in NOx emissions from diesel motor vehicles beyond the new long-term targets, and further reduction of sulfur content in diesel oil is a precondition for the use of those technologies. Furthermore, early introduction of diesel fuel with lower sulfur content can be expected to add impetus to the development and diffusion of NOx reduction catalysts.

Lower sulfur content in diesel fuel also inhibits poisoning of the oxidation catalyst to extend its life, limits the formation of sulfates, and reduces PM emissions. For this reason, it will result in immediate reduction in exhaust emissions from the following motor vehicles: (1) motor vehicles fitted with oxidation catalysts to comply with the new short-term regulations, (2) motor vehicles fitted with continuously regenerating DPFs supplemented with oxidation catalysts to comply with the new long-term regulations, and (3) motor vehicles in use that are fitted with these after-treatment devices. In vehicles in use prior to the new short-term regulations that are not fitted

with these devices, it will limit the formation of sulfates, thereby reducing PM emissions.

Accordingly, it is desirable to introduce the use of diesel fuel with lower sulfur content as soon as possible, not only from the standpoint of aiming for early development and adoption of after-treatment devices to achieve major reductions in NOx emissions in the future but also in order to reduce exhaust emissions from motor vehicles in use.

Furthermore, in terms of fuel production, there has been significant progress in ultra-deep desulfurization technology since the Fourth Report, with the result that even in Japan, which relies on the high-sulfur crude oil from the Middle East, the reduction of diesel fuel sulfur content to no more than 10 ppm has become feasible.

It should also be noted that Europe and the United States have plans to reduce the sulfur content of diesel fuel in the interests of controlling diesel exhaust emissions, with the European Union calling for a maximum of 10 ppm by 2009 and the United States for 15 ppm or less by 2006.

In view of the foregoing, it would be appropriate to reduce the permissible limit target level for diesel fuel sulfur content to 10 ppm beginning in 2007 by means of the efficient design and modification of refinery equipment. In addition, since there are several oil refineries capable of supplying low-sulfur diesel fuel earlier, fuel producers should be encouraged to begin supplying it voluntarily, as part of their total output, as early as 2005.

Measures for fuel quality issues other than diesel fuel sulfur content are discussed in Section 3.

2.2.3. Measures for Reducing Emissions

As mentioned in the previous section, reducing the sulfur content of diesel fuel to 10 ppm or less can be expected not only to further improve the performance of continuously regenerating DPFs but also to facilitate the adoption of NOx exhaust after-treatment devices. For this reason, decisions as to the appropriate level and timetable for targets beyond the new long-term regulations must be premised on the adoption of these technologies. However, because such after-treatment devices as NOx

reduction catalysts are still under development, it is not possible to anticipate the situation with any specificity at this time.

Therefore, in addition to encouraging technological development by motor vehicle manufacturers through the reduction of diesel fuel sulfur content to 10 ppm or less, the Council should continue to study the appropriate levels and timetables for further targets beyond the new long-term regulations on the basis of technical assessments, as well as an evaluation of the new long-term targets, the vehicle-category regulations instituted under the Automobile NOx/PM Law, and traffic control measures in terms of their efficacy in improving air quality, with the aim of reaching a conclusion as soon as possible. In addition, motor vehicle manufacturers should remain focused on technological development and begin phasing in vehicles designed for the low-sulfur diesel fuel that some producers will begin supplying voluntarily in 2005. This should include the trial introduction of low-emission vehicles equipped with such after-treatment devices as NOx reduction catalysts.

In the United States, new regulations premised on the introduction of diesel fuel with sulfur content of no more than 15 ppm are expected to be phased in between 2007 and 2010 to reduce NOx emissions from heavy-duty diesel motor vehicles by 95% and PM emissions by 90% from current levels, and studies are currently under way to determine the technical feasibility of such targets. These developments should be watched closely and their outcomes incorporated into the technical assessments recommended above.

3. Revision of Permissible Limits Relating to Fuel Quality

3.1. Study Background

In Section 2 we stressed the importance of further limiting the sulfur content of diesel fuel in order to reduce diesel emissions below the levels of the new long-term regulations. This is one example of the increasingly important role fuel quality plays in motor vehicle emissions control as regulations are progressively tightened. Meanwhile, an increasing variety of fuels, including alcohol-based substances, have come on the market in recent years. There also have been cases in which unapproved diesel fuels blended with substances, such as heavy oil A and kerosene, are used. These developments have heightened concerns that air quality will deteriorate due to motor vehicle emissions.

In order to prevent this, it is necessary to build a more comprehensive system for the regulation of fuel quality by establishing permissible limits for currently unregulated substances if they have an impact on air quality. Determinations regarding the addition of regulatory items and appropriate permissible limits for these items should be made with the current status of fuel quality in mind, since vehicles in use and those now under development are designed to meet current standards on the basis of the gasoline and diesel fuel currently on the market.

Among the regulatory items that should be added are those relating to oxygenated compounds. Included among these compounds are biomass fuels derived from organic matter, which are being eyed as replacements or additives for gasoline and diesel fuel because of their potential as aids in the fight against global warming. Among these fuels, special attention has been focused on ethanol refined from organic matter for use with gasoline (hereinafter referred to as "bioethanol"), and fatty acid methyl ester (hereinafter referred to as "FAME"), produced from biomass as an additive for diesel fuel. Permissible limits pertaining to oxygenated compounds should be established after determining the effect these additives have on emissions from vehicles in use.

In addition to biomass fuels, which were examined for the purposes of the current report, such alternatives as gas-to-liquids fuels (GTL), dimethyl ether (DME), and ethyl tertiary-butyl ether (ETBE) are also being eyed as replacements and additives for gasoline and diesel fuel. This Committee intends to study appropriate regulations for these new fuels and fuel additives, taking into account such considerations as market

trends, energy diversification, and the need for measures to reduce atmospheric carbon dioxide as well as other emissions.

3.2. Gasoline

In recent years, both in Japan and abroad, we have seen major advances in emissions control technology for vehicles fueled by gasoline (hereinafter referred to as "gasoline motor vehicles"), particularly passenger vehicles. These advances have centered on extending the performance and life of catalysts and using computer technology to improve the precision of various control mechanisms. If these technologies are to function effectively, it is important to ensure proper fuel quality.

After deliberating the addition of regulatory items pertaining to gasoline quality with the above in mind, this Committee concluded that it would be appropriate to add octane number, distillation characteristics, vapor pressure, and oxygen content and to establish the permissible limit target levels displayed in Appendix 1. The necessity for each of these additional items is discussed in the following.

(Octane Number)

Octane number is a measure of a gasoline's anti-knock properties. When knock and other abnormal combustion phenomena occur, they cause an increase in NOx emissions, leading to a deterioration in air quality. For this reason it is necessary to establish permissible limit target levels for octane.

(Distillation Characteristics and Vapor Pressure)

For optimal combustion, the vaporization of gasoline in the combustion chamber must proceed smoothly. However, when gasoline is too easily vaporized, it results in an increase in evaporation of gasoline from the gas tank and gas pump when air or engine temperatures rise. These evaporative emissions contribute to such atmospheric pollution as SPM and photochemical oxidants.

For this reason, from the standpoint of controlling emissions, it is necessary to establish permissible limit target levels for distillation characteristics and vapor pressure, which play an important role in the vaporization of gasoline.

Distillation characteristics are a measure of volatility. They are generally expressed in terms of the maximum temperatures at which 10%, 50%, and 90% of the fuel will be

evaporated, together with the maximum end point temperature and the amount of residual oil. When the distillation characteristics do not fall within the proper range, the air/fuel ratio fluctuates, affecting the ability of the three-way catalyst to purify the exhaust.

Vapor pressure, used to measure how easily a gasoline evaporates, is most often expressed in terms of Reid Vapor Pressure, or RVP; the higher the RVP, the more easily a gasoline evaporates. Since gasoline is less apt to generate evaporative gas in winter when temperatures are low, gasoline shipped in winter generally has a higher RVP than that used in summer, to ensure that vaporization occurs and engines start easily.

At gas stations where turnover of stored gasoline is low, it may take considerable time to switch over from wintertime to summertime gasoline, and this is something that needs to be taken into consideration when setting different vapor pressure standards for summertime and wintertime gasoline.

(Oxygenated Fuels)

One of the oxygenated fuels to be considered is bioethanol. Bioethanol is already in use in some countries, such as the United States and Brazil, and its adoption is being studied in Japan because of its potential as an aid in the fight against global warming. However, there are concerns that the use of ethanol as an additive in motor vehicles already designed and manufactured to run on regular gasoline could increase the emission of pollutants. Accordingly, if the goal is improving air quality, then permissible limits pertaining to bioethanol must be established with an understanding of the impact various levels of ethanol in a gasoline blend will have on emissions from vehicle in use, taking into account the characteristics of current emissions control technologies. Safety issues could also arise if gasoline with a high level of ethanol is used in vehicles already in use.

When emissions tests were conducted using gasoline with relatively low ethanol content in vehicles with three-way catalysts and oxygen sensors for controlling air/fuel ratio (hereinafter referred to as “oxygen-sensor control”), almost no effect on exhaust emissions was evident. On the other hand, with vehicles lacking oxygen-sensor control and two-wheeled vehicles, while CO emissions were reduced, NOx emissions tended to increase. The reasons for these outcomes are thought to be as follows.

Because ethanol is an oxygenated compound, adding ethanol increases a fuel's oxygen content, which causes the air/fuel ratio to shift in the direction of excess oxygen. Engines with oxygen-sensor control sense the change and readjust the air/fuel ratio to enable optimum performance by the three-way catalyst. This is most likely why the use of gasoline mixed with small amounts of ethanol had almost no impact on exhaust emissions in such vehicles. On the other hand, in gasoline motor vehicles lacking oxygen-sensor control and two-wheeled motor vehicles, there is no readjustment mechanism, and so the oxygen excess is not corrected. This appears to result in a reduction in CO emissions but an increase in NOx emissions.

With regard to two-wheeled motor vehicles, there are concerns not only about increased NOx emissions but also about the impact on driving performance. Many two-wheeled motor vehicles use rich combustion, in which fuel is burned in excess in order to achieve optimum driving performance with minimum displacement, and there are concerns that with even a low level of ethanol, such vehicles will be unable to sustain rich combustion, resulting in a drop in engine responsiveness or power, or other adverse effects on driving performance.

These observations lead to the conclusion that the impact of ethanol on exhaust emissions is due primarily to the ethanol's oxygen content. This being the case, the best way to regulate such oxygenated compounds as ethanol is to set permissible limits for oxygen content. The permissible limit for MTBE (methyl tertiary-butyl ether), an oxygenated compound regulated under current fuel-quality rules, is 7% by volume, which corresponds to an oxygen content of 1.3% by mass. Accordingly, it seems appropriate to limit all oxygenated compounds by setting the permissible limit target level for oxygen at 1.3% by mass. For ethanol, this translates into 3.5% by volume. Therefore, setting an upper limit of 1.3% by mass for oxygen content means limiting the amount of ethanol additive to 3.5% by volume.

The addition of ethanol also increases fuel vapor pressure owing to the phenomenon of azeotropy. For this reason, compliance with the new permissible limit target levels for gasoline vapor pressure will be necessary to prevent an increase in evaporative emissions due to the addition of ethanol.

In the United States, some motor vehicles on the market have been designed or converted to accommodate a blend that is 10% ethanol, known as E10. However, while such vehicles have been modified to ensure the durability of fuel-system parts, etc., no measures have been taken to control additional emissions. Moreover, since emissions tests in the United States are still carried out with conventional gasoline, the impact of ethanol blends on emissions has still not been assessed.

In Japan, more study is needed regarding the possible use of E10 or other blends in which the ethanol exceeds the proposed permissible limits, taking into consideration the supply situation and progress that has been made toward developing vehicles adapted to such fuels (hereinafter referred to as "ethanol-friendly vehicles"). However, given the status of emissions reduction efforts to date, this Committee believes that motor vehicles in Japan must be made to comply with the regulatory levels for emissions established with conventional gasoline in mind, even if they use ethanol blends. It is possible that this will require more technically sophisticated modifications than those applied to ethanol-friendly vehicles sold in other countries (including vehicles made in Japan). This should be kept in mind when conducting further study of the ethanol issue.

Sulfur in gasoline poisons the NOx reduction catalysts installed in vehicles with such lean-burn engines as the gasoline direct injection engine, one of the technologies developed in recent years to reduce CO_2 emissions. To maintain catalyst performance, therefore, the engine switches out of the lean-burning mode in certain operating conditions and burns on the typical air-to-fuel ratio of conventional engines. The more often this occurs, however, the more the reduction of CO_2 emissions is compromised. Lower gasoline sulfur content should inhibit sulfur poisoning of the catalyst and thereby expand the driving range of the lean-burn mode, thus improving fuel consumption in vehicles with this type of engine.

In the Fifth Report, released in April 2002, the permissible limit target level for gasoline sulfur content was set at 50 ppm in consideration of the technical limits of gasoline desulfurization at that time. Since then, however, gasoline desulfurization technology has progressed, and reducing sulfur content to 10 ppm or lower has become a realistic goal. For this reason, the Advisory Committee for Natural Resources and Energy of the Agency for Natural Resources and Energy is currently studying the possibility of lowering gasoline sulfur content to 10 ppm or lower.

In order to lower gasoline sulfur content to 10 ppm, oil refineries would have to increase their CO_2 emissions, and there are concerns that over the short term, this increase would overshadow the decrease in motor vehicle emissions, yielding a net increase in CO_2 emissions. However, even if this turned out to be the case, with the diffusion of lean-burn engines, the overall emissions-reducing effect would increase, so that in the future the result would be a net decrease in emissions.

Moreover, since a reduction in gasoline sulfur content to 10 ppm would alleviate the problem of sulfur poisoning in the three-way catalysts widely used in gasoline motor vehicles, it would contribute further to a reduction in exhaust emissions by extending the life and improving the performance of the catalysts.

Accordingly, the sulfur content of gasoline should be reduced to 10 ppm or lower as soon as possible because such a limit would make it possible to reduce CO_2 emissions while maintaining the performance of other emissions control technologies.

3.3. Diesel Fuel

As indicated in 2.2.1 above, with the advance of motor vehicle emissions control technology in recent years, fuel quality has become extremely important from the standpoint of maintaining the performance of such devices as diesel particulate filters to ensure that emissions control technology functions effectively.

After studying the regulation of diesel fuel quality from this perspective, this Committee concluded that it would be appropriate to add density and residual carbon to the regulatory items and to establish the permissible limit target levels indicated in Appendix 2. The necessity for these new regulatory items is explained in the following.

(Density)

A higher ratio of denser matter in diesel fuel means a larger proportion of aromatic hydrocarbons and similar compounds. This in turn means a larger carbon number, which raises concerns of increased particulate emissions. Accordingly, it is necessary to establish permissible limit target levels for diesel fuel density in order to curb PM emissions.

(Residual Carbon)

When residual carbon increases, carbon builds up on the combustion chamber and the injection mechanism, making it difficult to maintain proper injection and combustion.

Further, because residual carbon is found in greater quantity in heavy oil than in diesel fuel, regulating residual carbon will also have the effect of discouraging the admixture of such unapproved fuels as heavy oil A.

Accordingly, both to ensure proper combustion and to prevent an increase in NOx and PM emissions by maintaining effective functioning of after-treatment devices and other emissions control mechanisms, it is necessary to establish permissible limit target levels for residual carbon.

With regard to the use of FAME, an oxygenated fuel now being eyed for its potential as an aid in the fight against global warming, as a diesel fuel additive, it is necessary first to determine its effect on emissions in motor vehicles manufactured with conventional diesel fuel in mind, including vehicles in use and those currently being developed in compliance with the new long-term regulations. In making this determination, it will be necessary to consider a wide range of chemical and physical properties that distinguish FAME as a result of differences in raw material and manufacturing process.

Although the data is limited, in emissions tests to date FAME showed a tendency to produce slightly more NOx emissions and in some conditions increased the soluble organic fraction component of PM (organic compounds formed from unburnt fuel and lubricant). For this reason it will be necessary henceforth to carry out more detailed studies to better understand the effect on these emissions.

In addition, it will be necessary to carry out an assessment of FAME in conjunction with the different emissions control systems of various vehicles in use and new vehicles compliant with the new long-term regulations, and to study the effect of FAME's properties on emissions.

Since it would be difficult to set permissible limits for FAME at this time, the appropriate course of action is to conduct more detailed studies henceforth regarding its effect on diesel motor vehicle gas emissions with a view to arriving at a conclusion as soon as possible.

It should be noted that a 5% (by volume) FAME blend is widely used in Europe and elsewhere, and standards for FAME are now being deliberated within the European Union. It will be necessary to keep an eye on trends in the standardization of fuel quality overseas and on studies carried out in other countries regarding the impact of FAME additive on emissions.

4. Future Measures to Reduce Emissions from Motor Vehicles

4.1. Future Issues to Be Studied

The following issues, including those mentioned in Sections 2 and 3 above, were deemed to merit further study by the Committee.

(1) With regard to diesel motor vehicles, in addition to promoting the development of new emissions-control technology, this Committee will deliberate target levels beyond the new long-term targets and a timetable for meeting them on the basis of technical assessments as well as an evaluation of the current new long-term targets, the regulations by vehicle category under the Automobile NOx/PM Law, and traffic control measures in terms of their efficacy in improving air quality, with the aim of reaching a conclusion as soon as possible. Regarding lubricants for diesel motor vehicles, there are currently no regulations governing quality, but in view of concerns that the ash and sulfur content of such lubricants can affect the performance and life of diesel particulate filters and other exhaust after-treatment devices, some response is called for. This should include a study of lubricant standards undertaken as soon as possible in cooperation with motor vehicle manufacturers, fuel producers, and others.

(2) With regard to gasoline/LPG motor vehicles, this Committee will monitor the response to regulation under the new long-term targets for gasoline motor vehicles, the potential for further technological development, and the efficacy of various types of measures and consider new reduction targets as needed. In regard to fuel and lubricant quality, it will carry out studies in cooperation with the government, motor vehicle manufacturers, and fuel producers to ascertain the emissions-control efficacy of new automotive technologies and reformulated fuel in various combinations and will use the outcome of these studies to deliberate measures for improving fuel and lubricant quality.

(3) Regarding special diesel motor vehicles with rated engine outputs ranging from 19kW up to but not including 560 kW, this Committee will determine the feasibility of adapting the after-treatment devices used by conventional diesel motor vehicles under the new long-term regulations and study the matter of further reduction targets designed to be met by around 2010. At the same time, it will study the introduction of new emissions testing methods.

(4) Regarding special gasoline/LPG motor vehicles with rated engine outputs ranging from 19kW up to but not including 560 kW, this Committee will monitor the effect of regulation instituted on the basis of the Sixth Report, the potential for further technological development, and the efficacy of various types of measures and consider new reduction targets as necessary.

(5) There are currently no emissions reduction targets for special motor vehicles with rated engine outputs below 19 kW or those of 560 kW or more, or for general-purpose engines other than special motor vehicles. This Committee will study the introduction of emissions regulations for these categories as needed while monitoring such developments as pollution levels, these engines' contribution to total emissions, and the progress of emissions-control technology.

(6) Regarding two-wheeled motor vehicles, this Committee will monitor the response to regulation based on the reduction targets recommended in the Sixth Report, the potential for further technological development, and the efficacy of various types of measures and consider new reduction targets as needed. At the same time, it will study the adoption of new regulations for evaporative emissions.

(7) Regulations pertaining to PM emissions from diesel motor vehicles are currently based on weight. However, there is rising concern both within Japan and overseas that the health effects of PM are closely related not merely to weight but also to the quality of the particulate emissions (including the composition of the particles and the number of ultrafine particles). However, because reliable methods for measuring the quality of diesel particulate emissions have yet to be established, the nature of these emissions remains unclear. A related issue that is yet to be resolved is the quantity and quality of extremely fine particulate emissions said to be contained in exhaust from vehicles with direct-injection gasoline engines, which have become increasingly popular because of their superior fuel consumption. With this in mind, this Committee will carry out studies regarding the current PM emissions situation and the development of reliable measurement methods and will then deliberate the need for regulation in the light of this information.

Because motor vehicles are products that are distributed internationally, in studying or implementing measures related to the issues cited above, it is important to strive for

international compatibility in the institution of standards and seek the greatest possible agreement between domestic and international emissions control measures to the extent that this can be done without compromising Japan's own environmental protection efforts. Accordingly, Japan should contribute actively to efforts at international harmonization by doing its best to align its standards with international norms with regard to such matters as emissions testing methods for large-sized motor vehicles, two-wheeled motor vehicles, and special motor vehicles, including general-purpose engines; onboard diagnostic systems (OBD); and measures for controlling off-cycle emissions.

International harmonization will bring the following advantages:

- Promotion of more efficient R&D among motor vehicle manufacturers leading to improved technological development and an increase in the use of common parts leading to lower development and production costs.
- Lower costs for purchasers of motor vehicles.

4.2. Related Measures

The comprehensive emissions policies and other related measures should be carried out henceforth to complement the basic recommendations of this report.

(Pursuing Comprehensive Emission Measures)

In addition to going forward with the implementation of regulations by vehicle category under the Automobile NOx/PM Law promulgated on June 27, 2001, it will be necessary to (1) enhance measures to control emissions from motor vehicles used for business purposes and (2) implement comprehensive measures to promote the dissemination of low-pollution vehicles, etc., and assess the effectiveness of those measures. In addition to those measures undertaken under the Automobile NOx/PM Law, it will be necessary to study effective policies for reducing traffic volume.

(Promoting the Dissemination of Low-Pollution Vehicles, Etc.)

In accordance with the Action Plan for Developing and Disseminating Low-Pollution Vehicles adopted on July 11, 2001, all concerned ministries and agencies should work together to further disseminate low-pollution vehicles.

(Measures to Promote "Idle Stop")

Cutting down on idling time by turning off the engine when the vehicle is stationary offers the double benefit of reducing both fuel consumption and motor vehicle emissions. For this reason it is recommended that measures be taken to promote "idle stop," including the diffusion of motor vehicles equipped with an idle-stop feature.

(Measures to Reduce Emissions from Vehicles in Use)

As noted in the Sixth Report and elsewhere, it is important to continue efforts to maintain good emissions-control performance in all gasoline, LPG, and diesel motor vehicles currently in use by encouraging regular maintenance and inspection by users and by checking the functioning of emission control systems during the vehicle inspections mandated by the Road Vehicles Act, as well as roadside inspections.

With regard to diesel motor vehicles in use, it will also be necessary to promote the dissemination of DPF and similar devices.

In addition, it would be advisable to undertake a study to ascertain whether the adoption of emission standards and surveillance would be helpful in maintaining the performance level of emission control systems during normal vehicle use, and whether such measures are needed.

(Cost Burden, Etc.)

Implementation of the emission reduction measures recommended in this report can be expected to have an impact on cost by raising vehicle and fuel prices, the cost of ensuring engine durability, fuel consumption, and maintenance costs. Vehicle manufacturers and users will have to bear these costs on the principle of internalizing the environmental costs associated with motor vehicle use.

It will also be necessary to put in place financial and tax incentives to ensure that both reformulation of fuel and the replacement of old vehicles by new ones in compliance with the latest regulations proceed smoothly.

(Status Surveys and Measures for Unregulated Emission Sources)

As noted in the Sixth Report and elsewhere, it will be necessary to continue conducting surveys on the status of those emission sources that are currently unregulated and review the information to determine whether regulatory measures are required, as well as to study systems for implementing such measures. There is a particularly urgent

need to conduct a systematic study of emissions from boats and ships—an important source that has been all but completely neglected in this country—with an eye on international trends past and present.

(Measures against Air Toxics)

As noted in the Sixth Report and elsewhere, there is a need to develop new and more accurate monitoring methods to establish a basis for ascertaining the quantity of air toxics emitted from motor vehicles and formulate the necessary policies on the basis of the information thus obtained. Also needed are efforts to better understand how the quantity of such emissions is affected by such factors as engine combustion technology, exhaust after-treatment using catalysts and other systems, and fuel and lubricant quality.

(Making Measurements of Emissions from Vehicles More Precise)

As noted in the Sixth Report, as regulations affecting both gasoline/LPG and diesel motor vehicles are tightened substantially and emission levels are reduced, it will be vital to gain an accurate assessment of the reliability of gauges and quality control procedures used during the production process. To this end, there is a need for research aimed at improving measurement precision.

(Enhancing the Ability to Predict and Measure Effects)

As noted in the Sixth Report, as vehicle and comprehensive measures for reducing motor vehicle emissions evolve, it becomes increasingly important, in terms of planning and implementing further measures, both to predict their effect and to measure it through accurate monitoring. To this end, it is necessary to compile an inventory of particulate matter, hydrocarbons, and other emissions from mobile sources such as motor vehicles, stationary sources such as factories and other work sites, and various natural sources, and to gain an understanding of their role in the formation of such secondary pollutants as suspended particulate matter and photochemical oxidants. For this reason, it is desirable to develop improved methods for predicting and measuring the effects of different policies to improve air quality, and to establish systems that will help us to determine the on-site impact at roadside and other locations.

Appendix 1

New Regulatory Items and Permissible Limit Target Levels for Gasoline Fuel Quality

New Regulatory Item		Permissible Limit Target Level
Octane number		≥ 89
Distillation characteristics	10% point (T10)	≤ 70ºC
	50% point (T50)	75ºC–110ºC
	90% point (T90)	≤ 180ºC
	End point	≤ 220ºC
	Residual oil	≤ 2.0% of volume
Vapor pressure		Summer: 44 kPa–72kPa (65 kPa max. beginning 2005) Winter: 44 kPa–93 kPa
Oxygen content		≤ 1.3% by mass

Appendix 2

New Regulatory Items and Permissible Limit Target Levels for Diesel Fuel Quality

New Regulatory Item	Permissible Limit Target Level
Density	≤ 0.86 g/cm3
Carbon residue on 10% distillation residue	≤ 0.1% by mass

Roster of the Experts Committee on Motor Vehicle Emissions and Its Working Committee (Part of the Air Environment Committee of the Central Environment Council)

Member Status	Name	Affiliation	Working Committee
Chairman Special member	Michikata Kono	Dean of the Graduate School of Frontier Sciences, University of Tokyo	○
Special member	Kazuhiko Sakamoto	Dean of the Faculty of Engineering, Saitama University	
Special member	Yasuhiro Daisho	Professor, School of Science and Engineering, Waseda University	○
Expert member	Takashi Ibusuki	Director, Institute for Environmental Management Technology, National Institute of Advanced Industrial Science and Technology (AIST)	
Expert member	Masakazu Iwamoto	Professor, Chemical Resources Laboratory, Tokyo Institute of Technology	
Expert member	Matsuo Odaka	Executive Director, National Traffic Safety and Environment Laboratory	○
Expert member	Takeshi Saito	Director, Traffic Department, National Research Institute of Police Science National Police Agency	
Expert member	Masahiro Shioji	Professor, Graduate School of Energy Science, Kyoto University	○
Expert member	Hiroyasu Nagae	Professor emeritus, Nihon University	
Expert member	Yasuhiro Fukuma	Director, Japan Automobile Research Institute	
Expert member	Hidetsuru Matsushita	Professor emeritus, University of Shizuoka	
Expert member	Makoto Misono	Professor, Department of Environmental Chemical Engineering, Kogakuin University	

Glossary

Air Toxics/Hazardous Air Pollutants

Air pollutants that pose a risk to human health when inhaled continuously. Under the Air Pollution Control Law, emissions of such air toxics as benzene are controlled through monitoring of air quality and businesses' voluntary management plans.

Air/fuel ratio

The ratio of air to fuel, by weight, in the mixture supplied to an engine's cylinders. Precise control of the air/fuel mixture is important, since it affects the performance of catalysts designed to clean exhaust emissions.

Alcohol fuels

Collective term for fuels containing such alcohols as methanol and ethanol.

Biomass fuels

Collective term for fuels, including bioethanol and FAME, produced from plant and other organic matter (biomass) through a variety of processes such as chemical conversion, fermentation, and methyl esterification.

DEP (diesel exhaust particles)

Matter in particle form emitted by diesel motor vehicles. By weight, the bulk of such particles measure between 0.1 and 0.3 microns in diameter, while numerically, the greatest quantity are between 0.005 and 0.05 microns.

DME (dimethyl ether)

An ether produced from natural gas or coal gas, used primarily as a spray propellant. It has recently come under study as a possible substitute for diesel oil.

DPF (diesel particulate filter)

A filter which, when installed in the exhaust system, traps the particulate matter in motor vehicle exhaust and removes it with a heating element or catalyst. Those using catalysts are called "continuously regenerating DPFs."

E10 (ethanol 10%)

A motor vehicle fuel consisting of 90% gasoline and 10% ethanol (bioethanol). Other blends, such as E5 and E15, are likewise named for the percentage of ethanol they contain.

EGR (exhaust gas recirculation)

The mixture of a certain amount of exhaust gas with the intake air to inhibit the formation of nitrogen oxides. The effect is due to a drop in combustion temperature.

Emission gas

Substances, generated by the operation of motor vehicles, that pose a risk to human health or the living environment and are designated as such under the Air Pollution Control Law. Included are carbon monoxide, hydrocarbons, nitrogen oxides, and particulate matter (diesel motor vehicles only). In addition to substances emitted from the exhaust pipes (referred to as exhaust emissions), emissions include evaporative gases and blow-by gases.

ETBE (ethyl tertiary-butyl ether)

An ether produced from ethanol and isobutene. As an oxygenate, it has high octane and is used in France and elsewhere as an additive to raise gasoline octane. Can be manufactured from bioethanol.

FAME (fatty acid methyl esters)

A substance produced by combining adding methanol to vegetable oils, recycled cooking oil, etc. in the presence of a base catalyst to produce an ester, from which glycerol is then removed to lower viscosity.

GRPE (Working Party on Pollution and Energy)

One of the subsidiary bodies of the World Forum for Harmonization of Vehicle Regulations (WP.29) of the United Nations Economic Commission for Europe, responsible for setting unified standards for harmonization of certification procedures regarding motor vehicle emissions, fuel consumption, and so forth.

GTL (gas-to-liquid fuel)

A petroleum-like fuel synthesized from natural gas, coal gas, etc. Containing virtually no sulfur or aromatic hydrocarbons and easier to transport and handle than gas, GTL has come to be regarded as a promising alternative fuel in recent years.

Idle-stop

The practice of or a mechanism for turning off the engine when the vehicle is stopped.

Lean-burn engine

An engine that uses as special technology to maintain steady combustion while using as lean as possible a mixture of gasoline and air. While a high air/fuel ratio normally causes unstable combustion, a lean-burn engine makes use of intake ports that create a swirl of intake air, thus stabilizing combustion.

LPG (liquefied petroleum gas)

A blend of gases, such as propane and butane, liquefied under pressure at ordinary temperatures.

MTBE (methyl tertiary-butyl ether)

An ether made from methanol and isobutene. As an oxygenate, it has high octane and was at one time used in Japan as an additive to raise gasoline octane. However, Japanese oil companies voluntarily abandon the practice after concerns arose in the United States regarding groundwater polluted by fuel leaking from gas tanks.

OBD system (on-board diagnostic system)

A system installed in a motor vehicle for detecting and diagnosing malfunctions or breakdowns.

Octane number

An indicator of the anti-knock properties of a fuel in spark ignition engines. Octane can be expressed in terms of either research octane number (RON), which refers to anti-knock properties at low speeds, or motor octane number (MON), which indicates anti-knock at high speeds. Under Japanese standards, octane is defined as RON.

Oxygenated fuel

Collective term for fuels whose components include substances containing oxygen, including such alcohols as ethanol and methanol and such ethers as MTBE and ETBE,

PM (particulate matter)

PM emissions from motor vehicles are classified as either black smoke, sulfates, or soluble organic fraction (SOF). Sulfates—sulfur compounds formed by the oxidation of sulfur in the fuel—are generated in large quantities when engine load is high or when a powerful oxidation catalyst is used. SOF is formed from unburned diesel fuel and lubricants and consists of organic compounds with a low boiling point that can be removed by solvent extraction.

RVP (Reid vapor pressure)

An indicator of the ease with which a gasoline evaporates. RVP is the vapor pressure of a sample of fuel in pounds per inch, obtained by placing fuel cooled to 0ºC–1ºC in a sealed container and heating it to 37.8ºC (100ºF).

Secondary pollutants

Pollutants, including photochemical oxidants and suspended particulate matter, formed when emissions such as NOx and hydrocarbons react in the atmosphere.

SPM (suspended particulate matter)

Collective term for particles 10 microns or less in diameter that float in the atmosphere; they are subject to environmental quality standards. SPM is divided into primary particles, or those emitted directly from the source, and secondary particles, which are formed by chemical reactions or condensation of gaseous emissions.

Sources: Society of Automotive Engineers of Japan, *Japanese-English Dictionary for Automobiles* (Tokyo, 1997) and others.

“Future Policy for Motor Vehicle Emission Reduction (Seventh Report)” of the Central Environment Council

Press Release

Notice Concerning the "Future Policy for Motor Vehicle Emission Reduction (Seventh Report)" of the Central Environment Council

July 29, 2003 (Tuesday)

Secretariat of the Air Environment Committee
Central Environment Council

Environmental Control Technology Office
Policy and Coordination Division
Environmental Management Bureau
Ministry of the Environment
Director: Keiichi Ando (Extension: 6550)
Deputy Director: Hidenobu Kubota (Extension: 6552)

On July 29, 2003, the Air Environment Committee of the Central Environment Council (chaired by Professor Makoto Ikegami of the Faculty of Engineering, Fukui University of Technology) met and discussed the "Future Policy for Motor Vehicle Emission Reduction (Seventh Report)." On the basis of those discussions, the chairperson of the Central Environment Council submitted a report to the Minister of the Environment that same day.

The content of the report concerns the strengthening of regulations that apply to motor vehicle fuel quality and other matters, as summarized separately.

The Ministry of the Environment will take the necessary steps to strengthen regulations on the basis of the report.

In addition, the Central Environment Council will continue to study measures for reducing emissions from motor vehicles.

Background

1. Discussions Held by the Air Environment Committee (Formerly Air Quality Committee)

1996

May 21 12th meeting of the Air Quality Committee inquiry "Future Policy for Motor Vehicle Emission Reduction"

October 18 15th meeting of the Air Quality Committee/interim report → same day Interim Report of the Central Environment Council

- Introduction of regulations on emissions from two-wheeled motor vehicles
- Reduction of benzene content in gasoline, etc.

1997

November 21 20th meeting of the Air Quality Committee/second report → same day Second Report of the Central Environment Council

- Strengthening of regulations on gasoline motor vehicles
- Introduction of regulations on special motor vehicles, etc.

1998

December 14 22nd meeting of the Air Quality Committee/third report → same day Third Report of the Central Environment Council

- Strengthening of regulations on diesel motor vehicles, etc.

2000

November 1 30th meeting of the Air Quality Committee/fourth report → same day Fourth Report of the Central Environment Council

- Early establishment of new long-term targets for diesel motor vehicles, etc.

2002

April 16 — 4th meeting of the Air Environment Committee/fifth report → same day

Fifth Report of the Central Environment Council

- New long-term target levels for diesel motor vehicles
- Strengthening of regulations on gasoline motor vehicles (new long-term target levels)
- Methods for testing emissions from motor vehicles, etc.

2003

June 30 — 7th meeting of the Air Environment Committee/sixth report → same day

Sixth Report of the Central Environment Council

- Strengthening of regulations for two-wheeled motor vehicles
- Strengthening of regulations for special motor vehicles

June 30 — 7th meeting of the Air Environment Committee
Strengthening of regulations on motor vehicle fuel quality, etc.

July 1 to 22 — Public comments (No changes were made in content as a result of this procedure.)

July 29 — 8th meeting of the Air Environment Committee

Seventh Report of the Central Environment Council

- Measures for reducing emissions from diesel motor vehicles
- Revision of permissible limits relating to fuel quality

2. Discussions Held by the Experts Committee on Motor Vehicle Emissions (Relating to the Seventh Report)

- Experts Committee meetings held a total of 4 times
- Working Committee meetings held a total of 4 times
  (Including hearings with domestic and foreign vehicle manufacturers)
  * The Working Committee is a subcommittee of the Experts Committee.

Overview of "Future Policy for Motor Vehicle Emission Reduction (Seventh Report)" of the Central Environment Council

To date, the Central Environment Council has held a series of meetings to discuss measures for motor vehicle emission reduction focusing on the following two elements: vehicle-related measures and fuel-related measures. As a result of those discussions, the Council plans to submit to the Minister of the Environment the following report regarding permissible limits for motor vehicle fuel based on the Air Pollution Control Law.

I. Measures to Reduce Emissions from Diesel Motor Vehicles

1. Introduction of Ultra-Low-Sulfur Diesel Fuel

Beginning in 2007, the permissible limit for sulfur content in diesel fuel should be reduced to 10 ppm (current limit: 50 ppm). Fuel producers should be encouraged to begin supplying ultra-low-sulfur diesel fuel voluntarily, as part of their total output, in 2005.

2. Measures for Reducing Emissions from Diesel Motor Vehicles beyond the New Long-Term Targets

Based on the premise that diesel fuel sulfur content will be reduced to 10 ppm in accordance with item 1. above, new emission reduction target levels beyond the new long-term targets and a timetable for meeting them should be studied further on the basis of technical assessments, with the aim of reaching a conclusion as soon as possible.

* Diesel motor vehicles only take diesel fuel.
* Japan's new long-term targets for emissions to be achieved by 2005 are among the world's most rigorous.

II. Revision of Permissible Limits for Fuel Quality

In order to prevent deterioration of air quality due to motor vehicle emissions, fuel quality regulations should be strengthened and the following items regarding fuel quality should be added to the regulatory framework on the basis of the quality of gasoline and diesel fuel currently on the market:

1. Gasoline

- Permissible limits for octane number, distillation characteristics, and vapor pressure should be established as in Appendix 1.
- Based on the effect of oxygenated compounds on emissions from vehicles in use, the permissible limit for oxygen content in gasoline should be set at 1.3 mass percent (equivalent to about 3.5 volume percent ethanol/gasoline blends). The council will revisit the possibility of raising the permissible limit for oxygen content to allow for blends with up to 10 percent ethanol by volume (known as E10), taking into account such matters as the state of the corresponding automotive technology.

* The Advisory Committee for Natural Resources and Energy (a committee of the Agency for Natural Resources and Energy) studied the safety issues related to the addition of ethanol to gasoline and has set the permissible limit for the addition of ethanol at a maximum of 3 percent.

2. Diesel Fuel

- Permissible limits for density and carbon residue should be established as in Appendix 2.
- Regarding the diesel additive FAME (fatty acid methyl ester; or biodiesel), an oxygenated compound, such issues as the following should be studied in greater depth:
  - impact on PM and other emission gases, and
  - creation of standards for FAME quality.

Appendix 1

New Regulatory Items and Permissible Limit Target Levels for Gasoline Fuel Quality

New Regulatory Item		Permissible Limit Target Level
Octane number		≥ 89
Distillation characteristics	10% point (T_{10})	≤ 70ºC
	50% point (T_{50})	75ºC–110ºC
	90% point (T_{90})	≤ 180ºC
	End point	≤ 220ºC
	Residual oil	≤ 2.0% of volume
Vapor pressure		Summer: 44 kPa–72kPa (65 kPa max. beginning 2005) Winter: 44 kPa–93 kPa
Oxygen content		≤ 1.3% by mass

Appendix 2

New Regulatory Items and Permissible Limit Target Levels for Diesel Fuel Quality

New Regulatory Item	Permissible Limit Target Level
Density	≤ 0.86 g/cm^3
Carbon residue on 10% distillation residue	≤ 0.1% by mass