

**Future Policy for
Motor Vehicle Emission Reduction**

(Ninth Report)

January 29, 2008

Central Environment Council

Chukanshin No. 451

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To: His Excellency Ichiro Kamoshita
Minister of the Environment

From: Motoyuki Suzuki
Chairperson
Central Environment Council

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

In response to an inquiry concerning “Future Policy for Motor Vehicle Emission Reduction” (Inquiry No. 31, dated May 21, 1996), the Central Environment Council (Chukanshin) hereby submits recommendations as detailed in the attached report based on the conclusion of its deliberations on the issue.

Future Policy for Motor Vehicle Emission Reduction

In response to an inquiry concerning “Future Policy for Motor Vehicle Emission Reduction” (Inquiry No. 31, dated May 21, 1996), the Central Environment Council has already submitted a series of reports. The Interim Report (October 1996), the Second Report (November 1997), the Third Report (December 1998), the Fourth Report (November 2000), and the Fifth Report (April 2002) resulted in the establishment of two sets of maximum permissible emission limits – the “New Short-Term Target” and the “New Long-Term Target” – for motor vehicles fueled by gasoline or liquefied petroleum gas (LPG) (hereinafter collectively referred to as “gasoline/LPG-powered motor vehicles”) and diesel-fueled motor vehicles (hereinafter referred to as “diesel motor vehicles”). These were followed by: the Sixth Report (June 2003) that called for setting new emission reduction targets for special motor vehicles, expanding the scope of regulated vehicles, and introducing new targets for two-wheeled vehicles; the Seventh Report (July 2003) that provided new fuel quality targets for sulfur content, etc. as part of efforts to reduce motor vehicle emissions; and the Eighth Report (April 2005) that set forth another set of permissible emission limits referred to as the “2009 Target.” The 2009 Target would reduce particulate matter (PM) and nitrogen oxide (NO_x) emissions from diesel motor vehicles by 53% to 63% and 40% to 65% respectively. The reduction targets set for PM emissions, representing levels below the quantitative limit of the measurement method applied as of the time of submission of the report, are the most stringent in the world.

Based on these developments, the Expert Committee on Motor Vehicle Emissions embarked on a renewed examination of overall measures for reducing motor vehicle emissions and its findings have been compiled into the Ninth Report attached hereto.

The Air Environment Committee, to which the Ninth Report was submitted, deliberated on the report and concluded that in order to properly promote motor vehicle emission control measures in the future, it is appropriate to adopt the report and recommend that new permissible emission limits be set for special motor vehicles fueled by diesel (hereinafter referred to as “diesel-powered special motor vehicles”) and in-use diesel motor vehicles, while continuing to study further measures to reduce motor vehicle emissions.

Accordingly, the Central Environment Council submits the following recommendations.

1. Stricter Emission Control for Diesel-Powered Special Motor Vehicles

1.1 Necessity of stricter emission control for diesel-powered special motor vehicles

Diesel-powered special motor vehicles intended for use on public roadways have been subject to emission control regulations since October 2003. In October 2006, the government tightened emission control requirements for certain types of these vehicles and introduced emission control regulations for those not intended for use on public roadways. However, the percentage contribution of diesel-powered special motor vehicles to total PM and NO_x emissions from motor vehicles is bound to increase, but it is expected that after-treatment devices for PM and NO_x emission control will become available for such vehicles in the future. Given these prospects, it is considered necessary to strengthen measures to control emissions from diesel-powered special motor vehicles.

1.2 Emission test methods

In order to enable the implementation of substantially stricter emission control requirements for diesel-powered special motor vehicles, the introduction of exhaust gas after-treatment devices such as diesel particulate filters (DPF) and NO_x after-treatment devices would be necessary. The exhaust gas purification rate of after-treatment devices varies according to exhaust gas temperature. However, the current test mode (C1 8-mode), being a steady-state test cycle, is incapable of reproducing actual changes in exhaust gas temperature and may not be able to properly assess the effectiveness of exhaust gas after-treatment devices. Therefore, it would be desirable and appropriate to adopt a transient cycle as a test mode under the next regulatory regime.

The United States and Europe are set to adopt the non-road transient cycle (NRTC) as a test mode when they shift into the next regime of emission control regulations. The use of the NRTC as an emission test mode in Japan will likely result in substantial improvements in air quality, and the move is also conducive to ongoing international efforts to harmonize emission test methods. Therefore, it would be desirable and appropriate to adopt the NRTC (see Appendix 3) as a transient test mode under the next regulatory regime for controlling emissions from special motor vehicles.

Meanwhile, in order to ensure the proper assessment of emission control performance (i.e., the performance of exhaust gas after-treatment devices) at the time of engine startup, etc., it is necessary to test engines not only while warm, but also while cold. It would therefore be desirable and appropriate to assess emission control performance in such a way as to incorporate the influence of cold engine performance, whereby the volume of exhaust gas emissions from special motor vehicles tested over the NRTC should be calculated as follows:

$$\begin{aligned} &\text{Exhaust gas emissions from special motor vehicles (g/kWh)} \\ &= \text{Cold-engine emissions (g/kWh)} \times 0.1 + \text{Warm-engine emissions (g/kWh)} \times 0.9 \end{aligned}$$

It would also be desirable and appropriate to maintain the C1 cycle, which is the current emission test mode in Japan for the time being, thereby testing emissions for special motor vehicles by two methods (NRTC and C1) under the next regulatory regime. The necessity of these tentative measures will be reviewed again based on the status of emissions and international regulatory trends in the future. The values of emission reduction targets based on measurements using the C1 cycle should be same as those based on measurements using the NRTC.

1.3 Emission reduction targets

With respect to diesel-powered special motor vehicles, it would be desirable and appropriate to promote the reduction of PM, NO_x, non-methane hydrocarbon (NMHC), and carbon monoxide (CO) emissions in accordance with the permissible emission limits set forth in Appendices 1 and 2.

With an eye to future progress of technological development, the two sets of permissible emission limits specified in Appendices 1 and 2 should be achieved within the timeframes set forth below:

- 2011 Target

Special motor vehicles having engines with a rated power output equal to or greater than 130kW but less than 560kW should achieve their designated emission limits by the end of 2011, those with a rated output equal to or greater than 56kW but less than 75kW and those with a rated power output equal to or greater than 75kW but less than 130kW by the end of 2012, and those with a rated power output equal to or greater than 19kW but less than 37kW and those with a rated power output equal to or greater than 37kW but less than 56kW by the end of 2013.

- 2014 Target

Special motor vehicles having engines with a rated power output equal to or greater than 130kW but less than 560kW should achieve their designated emission limits by the end of 2014, those with a rated power output equal to or greater than 56kW but less than 75kW and those with a rate power output equal to or greater than 75kW but less than 130kW by the end of 2015.

Because special motor vehicles are typically produced in a wide variety in low volumes, vehicle types and models targeted by emission control regulations are very diverse. It is also often the case that the manufacturer of these special motor vehicles is not the manufacturer of engines installed in the vehicles; in such cases the vehicle manufacturer begins work on designing and developing a new vehicle only after it has received the new engine from the engine manufacturer. Therefore, substantial lead time needs to be allowed for the development of new vehicles in compliance with new regulations. In particular, in implementing emission control regulations for special motor vehicles with a rated power output equal to or greater than 19kW but less than 37kW, special care needs to be taken to facilitate adaptation to such new requirements because the levels of engine

power output for these vehicles are lower than the lowest of the output range for engines installed in ordinary diesel motor vehicles and it takes time to develop completely new emission control technologies.

1.4 Use of proper fuel in in-use special motor vehicles

In order to achieve the emission reduction targets set forth in this Report, it would be necessary to have engines equipped with a common rail fuel injection system and fitted with PM and NOx after-treatment devices. Failure to properly control the sulfur content and viscosity of fuel may cause degradation, malfunction, or other damage to these after-treatment devices and common rail fuel injection systems.

Therefore, to secure emission control performance, it is imperative to ensure that proper fuel quality be maintained. At the same time, to ensure the effectiveness of emission control measures, diesel fuel with a sulfur content of 0.001 mass % or lower (10ppm diesel) would have to be used in diesel-powered special motor vehicles.

In the case of off-road special motor vehicles, it has been said that non-diesel fuels are often used even though diesel is the fuel designated by the vehicle manufacturer. It is thus important to conduct an in-depth survey on the use of such non-diesel fuels and to implement measures to promote the use of proper fuel. It is hoped that parties concerned will enhance collaboration and step up efforts to promote the use of proper fuel in special motor vehicles through such measures as vigorous public relations campaigns, training programs, and the development of devices for detecting fuel quality. If it is concluded that these measures would not sufficiently reduce emissions from special motor vehicles, the introduction of additional necessary measures should be considered.

1.5 Measures for maintaining good emission control performance of in-use vehicles

In order to prevent possible deterioration in the emission control performance of in-use vehicles, it is necessary to designate the number of operating hours for which emission control devices are required to maintain good performance. Specifically, it would be desirable and appropriate to retain the current requirement that diesel-powered special motor vehicles with a rated power output equal to or greater than 19kW but less than 37kW maintain good emission control performance for a minimum of 5,000 hours and those with a rated power output equal to or greater than 37kW but less than 560kW for a minimum of 8,000 hours. In the meantime, motor vehicle manufacturers and other interested parties are required to make efforts, in the course of their respective production processes, to deliver greater sustainability of emission control performance that goes beyond the designated endurance time.

In order to ensure the proper functioning of emission control devices in in-use special motor vehicles, it is important that users take proper care of their vehicles by strictly observing inspection and

maintenance requirements. At the same time, in order to eliminate vehicles with improperly maintained or modified emission control devices and to promote the use of proper fuel, it is necessary to ensure that appropriate checks are carried out at the time of mandatory motor vehicle inspections (*shaken*) under the Road Trucking Vehicle Act (statutory vehicle inspection), compliance checking and enforcement at the roadside (roadside inspection), and on-site inspections prescribed by the Act on Regulations, etc. of Emissions from Non-Road Special Motor Vehicles.

2. Review of Black Smoke Control

2.1 Shift to measurement with opacimeter (light transmission type smoke meter)

The gradual tightening of regulatory control resulted in remarkable reductions in PM emissions from diesel motor vehicles. However, if a defect occurs in a DPF or any other emission control device, the volume of emissions may increase greatly. Thus, it is all the more important to check and ensure that the emission control performance of in-use vehicles is properly maintained. Until now, PM emissions from in-use vehicles have been checked in terms of the density of black smoke. However, it is expected that the use of an opacimeter in statutory vehicle inspections and other occasions will result in greater efficiency in testing for black smoke. Therefore, it would be desirable and appropriate to change the inspection method for in-use vehicles from the conventional measurement of black smoke density to the one using an opacimeter. By doing so, comprehensive assessment of emissions – including soluble organic fractions (SOF) that cannot be measured by the conventional method based on the measurement of black smoke density – will be possible.

2.2 Emission reduction targets for in-use vehicles

Emission reduction targets based on measurement with opacimeters should be applied only to vehicles subject to the Diesel 2009 Target (post-New Long-Term Emission Control Regulations) set forth in the Eighth Report, as vehicles subject to the New Long-term Emission Control Regulations or earlier regulations have already been sold. Due to the principle of the measurement method, the volume of emissions measured with an opacimeter may be affected by water vapor when measured under cold engine conditions and is subject to interference by NO₂. Based on these observations, and taking into account the effect of emission control measures, the number of working hours required for the statutory vehicle inspection, etc., it is considered appropriate to set the target at 0.5m-1.

2.3 Discontinuation of black smoke test using 4-mode test cycle

Data obtained from black smoke tests using the 4-mode test cycle for diesel motor vehicles in compliance with the New Long-Term Emission Control Regulations show that the measured value of black smoke from those equipped with DPFs has been reduced to near zero. Under the 2009 Target, it is expected that almost all diesel motor vehicles will be equipped with DPFs. Thus, from the viewpoint of streamlining regulations, it would be desirable and appropriate to discontinue the black smoke test using the 4-mode test cycle.

3. Reduction of Motor Vehicle Emissions: Future Measure and Issues

3.1 Issues to be studied

- Under the Challenge Target for heavy-duty diesel vehicles referred to in the Eighth Report, relevant technological development and the achievability of the target should be assessed in or around 2008 and, if necessary, permissible emission limits and a timetable for their achievement should be finalized by taking into account the degree of improvement of air quality obtained by that time, particularly in major urban areas, the potential for further improvement of the overall environment through localized air pollution abatement measures, etc., and the relationship with measures for reducing carbon dioxide (CO₂) emissions, while at the same time monitoring improvements in the quality of fuel and lubricants. As part of that process, permissible emission limits in terms of the size and quality of particles – including the necessity of setting such limits – should be examined.
- In recent years, there has been growing concern both in Japan and overseas that not only the weight, but also the size and quality of particles – i.e., the number and composition of particles with a diameter of 2.5 microns or less (hereinafter referred to as “fine particles”) as well as of those with a nanometer-sized diameter (hereinafter referred to as “ultra-fine particles”) – may have a significant association with their impacts on human health.

However, there is no established method for measuring the size and quality of particles emitted by diesel motor vehicles and there exists no sufficient knowledge in Japan or elsewhere in the world about the status of particle emissions and how the health impacts of such particles differ depending on their size and quality.

For these reasons, it is difficult at this stage to set specific permissible emission limits focusing on the size and quality of particles. Yet, from a precautionary perspective, it is necessary as an interim measure to make efforts to achieve maximum possible reductions in PM emissions. At the same time, the government, the private sector, and academia must join forces to promote research and studies with a view to developing methods and apparatus that enable the accurate measurement and assessment of the status of particle emissions and their impacts on human health in a way that properly reflects differences in the size and quality of particles, for instance, how impacts differ between fine and ultra-fine particles. Based on findings from such research and studies, the necessity of setting permissible emission limits should then be considered.

- For gasoline/LPG-powered special motor vehicles with a rated power output equal to or greater than 19kW but less than 560kW, new emission reduction targets should be considered, if deemed necessary, following the assessment of the potential for further technological development and

the efficacy of various types of measures.

- With respect to special motor vehicles that are currently not subject to any emission limits in Japan, i.e., those with a rated power output of less than 19kW and those with a rated power output of 560kW or more, it is hoped that voluntary emission control initiatives in accordance with the relevant regulations in the United States and Europe will continue to be implemented and followed. The imposition of emission control requirements for these vehicles should be considered, if deemed necessary, following the assessment of a range of factors which include: the status of air pollution; the vehicles' contribution to total emissions; the effect of the type designation system for emission-controlled construction machinery, under which the Ministry of Land, Infrastructure, Transport and Tourism designates specific types of machinery approved for use in national government projects; the progress of voluntary emission control initiatives implemented by the Japan Land Engine Manufacturers Association for general-purpose engines with a rated power output of less than 19kW; and the development of emission control technologies.
- For diesel-powered special motor vehicles with a rated power output equal to or greater than 19kW but less than 560kW, the introduction of emission control requirements based on measurement with an opacimeter, as a means to check PM emissions from in-use vehicles, should be considered, if deemed necessary, following the assessment of the status of development of PM emission control technologies as well as of PM emissions in the future.
- For gasoline/LPG-powered motor vehicles, the setting of new permissible emission limits should be considered, if deemed necessary, following assessment of the potential for further technological development and the degree of improvement of air quality, while at the same time giving maximum consideration to the balance between fuel efficiency technology and emission reduction technology.

The introduction of measures for controlling evaporative emissions from vehicles during refueling should be considered, if deemed necessary, following the assessment of the contribution of such vehicle evaporative emissions to overall hydrocarbon (HC) emissions and the progress of the control of HC emissions from sources other than motor vehicles.

- For two-wheeled motor vehicles, the setting of new permissible emission limits should be considered, if deemed necessary, following the assessment of responses to the limits set forth in the Sixth Report, the potential for further technological development, and the efficacy of various control measures.
- With respect to the usability of E10 (ethanol-blended gasoline fuel containing up to approximately 10% bioethanol by volume), a type of biomass fuel which is counted on as a

potential greener energy in terms of mitigating global warming, the research undertaken so far has found no major problems concerning exhaust gas emissions as far as such fuel is used in motor vehicles equipped with E10-compatible technologies (including highly sophisticated technologies for satisfying the emission control requirements that have been applied on the premise that the vehicles operate on gasoline). However, further testing of exhaust gas emissions needs to be conducted to determine the impact of the use of E10 as a motor vehicle fuel. The introduction of such blended fuel should be considered, if deemed necessary in the future, with due regard to progress in the development of E10 compatible motor vehicle technologies and the establishment of E10 fuel supply systems. Meanwhile, the introduction of other types of new fuel – such as biodiesel fuel, gas-to-liquid (GTL), dimethyl ether (DME), and ethyl tertiary butyl ether (ETBE) – should be considered, if deemed necessary, based on market trends and other factors.

- In the spirit of the Agreement on Technical Barriers to Trade, which came into force on January 1, 1995 and is intended to ensure that standard certification procedures do not create unnecessary obstacles to international trade, it is desirable that Japan tries, wherever possible, to adopt regulations that are harmonized with international standards so long as they do not hinder Japan's environmental preservation efforts.

Therefore, Japan should promote international harmonization as much as possible, actively contributing to the ongoing efforts undertaken by the World Forum for Harmonization of Vehicle Regulations of the United Nations Economic Commission for Europe (UN-ECE/WP29) to internationally harmonize motor vehicle emission regulations including emission test methods.

3.2 Toward achievement of 2009 Target

In addition to responding to requirements already in place, such as those under the New Long-Term Emission Control Regulations and fuel efficiency standards for heavy-duty vehicles, motor vehicle manufacturers have also been working on the development of technologies toward achieving the 2009 Target. A survey has found that motor vehicle manufacturers, etc. have almost completed the research and development (R&D) of element technologies and are now at the stage of developing actual vehicles.

At the moment, motor vehicle manufacturers, etc. are undertaking rigorous R&D efforts toward achieving the 2009 Target and it is hoped that motor vehicles satisfying all requirements for achieving the target will be developed and introduced at an early date so as to contribute to the improvement of air quality.

3.3 Future issues concerning related measures

As complementary measures to those set forth in this Report, the following related measures should be further promoted in the future:

(1) Comprehensive emission control measures in accordance with Motor Vehicle NOx/PM Act

- a) In addition to promoting measures for reducing emissions per new vehicle sold, the government should work to: ensure the steady implementation of type-specific ownership and use restrictions under the Motor Vehicle NOx/PM Act and measures to promote the use of low-pollution vehicles; enhance emission control measures in accordance with the 2007 amendments to the Motor Vehicle NOx/PM Act that introduced new requirements on certain business users; implement comprehensive motor vehicle emission control measures; and assess the efficacy of all those measures. It is also hoped that the government will proactively consider and implement measures to facilitate traffic flow, control traffic volume, and improve the structure of road and urban systems.
- b) Comprehensive measures for in-use vehicles – such as emission limits and a spot-check system (surveillance) – as well as the necessity of such measures should be examined as soon as possible.
- c) In addition to measures to improve fuel efficiency, measures to promote idle-stop and other forms of eco-driving, i.e., driving behavior that would minimize environmental impact, should be pursued.

(2) Promotion of use of low-pollution vehicles

In order to further improve air quality and mitigate global warming, it is important to promote the use of low-pollution vehicles. Toward this end, the government should expand action plans for promoting the development and use of low-pollution vehicles and implement such measures as tax incentives, subsidies, and loan programs designed to promote the use of low-pollution vehicles.

(3) Accurate assessment of air quality and greater measurement precision

Efforts should be made to establish an effective system to assess the impact of various measures taken for reducing emissions at their source, roadside measures, etc. in terms of their contribution to the improvement of air quality.

(4) Measures for unregulated pollutants

- a) Efforts should be made to develop measurement methods and improve measurement accuracy for unregulated air pollutant emissions from motor vehicles as well as to get a clear picture of how engine combustion technology, catalysts and other exhaust gas after-treatment devices, fuel and lubricant quality, etc. would affect the volume of hazardous air pollutant emissions from motor vehicles.
- b) With respect to unregulated hazardous air pollutant emissions from sources other than motor vehicles, the government should consider institutional arrangements for implementing relevant measures, while continuing to survey the status of emissions and study the necessity of such measures.

(5) Financial and/or tax incentives

In order to promote the improvement of fuel quality and facilitate a shift to motor vehicles in compliance with the latest emission control regulations, it is necessary to provide appropriate financial and/or tax incentives – including adequate support for the development of relevant technology – and appropriate steps should be taken toward introducing these measures.

Appendix 1

2011 Target: Permissible Emission Limits for Diesel-Powered Special Motor Vehicles (To be achieved between 2011 and 2013)

Motor vehicle category		Permissible emission limits (average)				Diesel black smoke
		Nitrogen oxides (NO _x)	Non-methane hydrocarbons (NMHC)	Carbon monoxide (CO)	Particulate matter (PM)	
Diesel-powered special motor vehicles	Rated power output equal to or greater than 19kW but less than 37kW	4.0g/kWh	0.7g/kWh	5.0g/kWh	0.03g/kWh	25%
	Rated power output equal to or greater than 37kW but less than 56kW	4.0g/kWh	0.7g/kWh	5.0g/kWh	0.025g/kWh	25%
	Rated power output equal to or greater than 56kW but less than 75kW	3.3g/kWh	0.19g/kWh	5.0g/kWh	0.02g/kWh	25%
	Rated power output equal to or greater than 75kW but less than 130kW	3.3g/kWh	0.19g/kWh	5.0g/kWh	0.02g/kWh	25%
	Rated power output equal to or greater than 130kW but less than 560kW	2.0g/kWh	0.19g/kWh	3.5g/kWh	0.02g/kWh	25%

Appendix 2

2014 Target: Permissible Emission Limits for Diesel-Powered Special Motor Vehicles (To be achieved between 2014 and 2015)

Motor vehicle category		Permissible emission limits (average)				Diesel black smoke
		Nitrogen oxides (NO _x)	Non-methane hydrocarbons (NMHC)	Carbon monoxide (CO)	Particulate matter (PM)	
Diesel-powered special motor vehicles	Rated power output equal to or greater than 19kW but less than 37kW	4.0g/kWh	0.7g/kWh	5.0g/kWh	0.03g/kWh	25%
	Rated power output equal to or greater than 37kW but less than 56kW	4.0g/kWh	0.7g/kWh	5.0g/kWh	0.025g/kWh	25%
	Rated power output equal to or greater than 56kW but less than 75kW	0.4g/kWh	0.19g/kWh	5.0g/kWh	0.02g/kWh	25%
	Rated power output equal to or greater than 75kW but less than 130kW	0.4g/kWh	0.19g/kWh	5.0g/kWh	0.02g/kWh	25%
	Rated power output equal to or greater than 130kW but less than 560kW	0.4g/kWh	0.19g/kWh	3.5g/kWh	0.02g/kWh	25%

**Additional Transient Test Mode Introduced for Diesel-powered Special Motor Vehicles
(NRTC)**

