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The transportation sector includes air, maritime, rail and road transport. Expanding motorization across the globe has caused a steady increase in CO₂ emissions in the transport sector, which accounted for about 23% of total worldwide CO₂ emissions in 2005, of which roughly 73% was generated by road transport.

**World CO₂ Emissions by Sector**

![Pie chart showing CO₂ emissions by sector](image)

**CO₂ Emissions in the Global Transport Sector**

![Graph showing CO₂ emissions](image)

Notes: 1. The above emission volumes represent fuel combustion-generated CO₂ emissions only; they do not include electricity and heat end-use emissions.
2. ‘Other’ includes CO₂ emissions from vehicles for off-road use, such as construction and ore transport equipment, and from oil gas pipeline transport.

**Promoting Sustainability in the Road Transport Sector**

It is the responsibility of the road transport sector to respond to environmental concerns by promoting sustainable initiatives aimed at improving air quality, addressing climate change by countering global warming, and conserving energy. This document focuses on CO₂ reduction to counter global warming.

1. **Improving Air Quality**
   - Through a significant reduction of tailpipe-emitted pollutants

2. **Countering Global Warming**
   - Through a significant reduction of CO₂ emissions

3. **Conserving Energy**
   - Through new energy policies for the oil-dependent transport sector (e.g., the development and supply of alternative fuels)

The challenges in these three areas require balanced, sustainable solutions.
CO₂ Reduction Measures to Promote Energy Conservation

With today’s continuous surge in crude oil prices, energy conservation measures are all the more urgently needed in order to promote energy security. Reducing automotive fuel consumption results in reduced road transport CO₂ emissions and promotes energy conservation.

World Demand for Automotive Fuels

![Graph showing world demand for automotive fuels from 1990 to 2005.]

Historic & Projected Trends in Average Crude Oil Import Prices (IEA Reference and High Growth Scenarios)

![Graph showing historical and projected trends in average crude oil import prices from 1970 to 2030.]

Source: Adapted from World Energy Outlook 2007, International Energy Agency

The objective of the Japan Automobile Manufacturers Association (JAMA) in producing this pamphlet is to recommend policies and measures for the reduction of CO₂ emissions in the road transport sector worldwide.

<table>
<thead>
<tr>
<th>Region 1</th>
<th>Region 2</th>
<th>Region 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road transport sector</td>
<td>Road transport sector</td>
<td>Road transport sector</td>
</tr>
<tr>
<td>Residential/Service sector</td>
<td>Residential/Service sector</td>
<td>Residential/Service sector</td>
</tr>
<tr>
<td>Industrial sector</td>
<td>Industrial sector</td>
<td>Industrial sector</td>
</tr>
</tbody>
</table>

JAMA advocates the sectoral approach as the most effective way to achieve bottom-up CO₂ emissions cuts in the global road transport sector, without undermining the economic development of individual countries and with the cooperation of the automotive industries and government.
1. Promoting Sustainability in the Road Transport Sector

Calculating CO₂ Emission Volumes

As a rule, the volume of CO₂ emissions generated by human activity can be calculated by multiplying emissions intensity by activity volume.

The Kaya Equation (for calculating CO₂ emissions generation):

\[
\text{CO₂ Emissions} = \frac{\text{CO₂ Emissions}}{\text{Energy Consumption}} \times \frac{\text{Energy Consumption}}{\text{GDP}^*} \times \text{GDP}
\]

*Gross domestic product

CO₂ Emissions = Emissions Intensity \times Activity Volume

Calculating CO₂ Emission Volumes in the Road Transport Sector

In the case of the road transport sector, “emissions intensity” represents fuel efficiency performance and “activity volume” represents the total distance travelled. More specifically, emissions intensity in the road transport sector represents a combination of factors, including on-road and certified fuel efficiency.

\[
\text{CO₂ emissions} = \text{Emissions intensity} \times \text{Activity volume}
\]

\[
= \text{On-road fuel efficiency} \times \text{CO₂ emissions coefficient} \times \text{Total distance travelled}
\]

\[
= \text{Certified fuel efficiency (km/ℓ)}^{-1} \times \text{Travelling coefficient} \times \text{CO₂ emissions coefficient (g CO₂/ℓ)} \times \text{Total distance travelled (v-km)}
\]

To be increased by automobile manufacturers
To be reduced through congestion mitigation and eco-driving
Lower coefficient in the case of biofuels
To be reduced through modal shifts

Notes:
1. km/ℓ, Karatameter are the units of measurement used in Japan.
2. “Travelling coefficient” represents the ratio of on-road fuel efficiency and certified fuel efficiency, based on averages of all-in-use vehicles.
3. v-km: Vehicle-kilometers

Vehicle fuel efficiency can be converted to a CO₂ equivalent value (in g CO₂/km), referred to simply as “CO₂ emissions,” as follows:

For certified fuel efficiency conversion:

\[
\text{Certified CO₂ emissions (g CO₂/km)} = \text{Certified fuel efficiency (km/ℓ)}^{-1} \times \text{CO₂ emissions coefficient (g CO₂/ℓ)}
\]

For on-road fuel efficiency conversion:

\[
\text{On-road CO₂ emissions (g CO₂/km)} = \text{On-road fuel-efficiency (km/ℓ)}^{-1} \times \text{CO₂ emissions coefficient (g CO₂/ℓ)}
\]
1.1 Certified Fuel Efficiency

Increasing the Certified Fuel Efficiency of Passenger Cars

European, U.S., Japanese and other automobile manufacturers have been steadily increasing the average fuel efficiency of their new passenger cars in compliance with relevant fuel efficiency standards.

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Fuel Efficiency Evaluation Basis</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.A.</td>
<td>Corporate average (CAFE)</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Europe</td>
<td>Industry average (ACEA, JAMA, KAMA)</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Canada</td>
<td>Corporate average (CAFC)</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Australia</td>
<td>Industry average (FCAI)</td>
<td>Voluntary</td>
</tr>
<tr>
<td>South Korea</td>
<td>Corporate average, by engine size</td>
<td>Mandatory</td>
</tr>
<tr>
<td>China</td>
<td>Individual models</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Taiwan</td>
<td>Individual models</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Japan</td>
<td>Corporate average, by vehicle weight</td>
<td>Mandatory</td>
</tr>
</tbody>
</table>

CAFE: Corporate average fuel efficiency; CAFC: Corporate average fuel consumption; FCAI: Federal Chamber of Automotive Industries; ACEA: Association des Constructeurs Européens d'Automobiles; JAMA: Japan Automobile Manufacturers Association; KAMA: Korea Automobile Manufacturers Association


Passenger car fuel efficiency standards in selected countries/regions cannot be compared with total accuracy because of differences in test methods and in diesel-engine diffusion rates. When those standards are converted into CO₂ emissions, however, an aggregate average annual rate of decline in CO₂ emissions of 2.3% can be calculated for a ten-year period.

Projected CO₂ Emissions for New Passenger Cars in Selected Countries/Regions


Test values for CO₂ emissions from gasoline passenger cars have not decreased in countries where fuel efficiency standards have not yet been introduced.

CO₂ Emissions of Gasoline Passenger Cars in Countries Without Fuel Efficiency Standards

Source: MoMo database, International Energy Agency
### Increasing the Certified Fuel Efficiency of Trucks

Compared with fuel efficiency standards for new passenger cars, fewer countries to date have introduced fuel efficiency standards for new trucks.

<table>
<thead>
<tr>
<th>Country</th>
<th>Fuel Efficiency Evaluation Basis</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.A.</td>
<td>Corporate average (CAFE)</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Canada</td>
<td>Corporate average (CAFC)</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Australia</td>
<td>Industry average (FCAI)</td>
<td>Voluntary</td>
</tr>
<tr>
<td>South Korea</td>
<td>Corporate average, by engine size</td>
<td>Mandatory</td>
</tr>
<tr>
<td>China</td>
<td>Individual models</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Taiwan</td>
<td>Individual models</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Japan</td>
<td>Corporate average, by vehicle weight*</td>
<td>Mandatory</td>
</tr>
</tbody>
</table>

CAFE: Corporate average fuel efficiency; CAFC: Corporate average fuel consumption; FCAI: Federal Chamber of Automotive Industries

*Fuel efficiency standards for heavy-duty vehicles (GVW>3.5 tons) have been introduced only in Japan.*
Leading Vehicle Fuel Efficiency Technologies

Greater fuel efficiency is achieved through step-by-step advances in technology.

For Reference

Automotive fuel consumption is generally measured with a test car running on a chassis dynamometer, as shown above. However, test methods, including test cycles (i.e., vehicle running patterns) vary among countries and regions.
Next-Generation Vehicles

Various types of alternative-energy vehicles are currently under development, as are next-generation clean-diesel vehicles, so called because they generate clean exhaust emissions. Hybrid vehicles (HVs) are increasingly in use, and plug-in hybrid vehicles (PHVs) will be marketed in the near future. Electric vehicles (EVs), fuel-cell vehicles (FCVs) and hydrogen vehicles are projected to be in widespread use in the long term.

Hybrid Vehicle → Plug-In Hybrid Vehicle

Electric Vehicle

Natural Gas Vehicle

Clean-Diesel Vehicle

Fuel-Cell Vehicle

Flex-Fuel Vehicle (gasoline/ethanol)

Hydrogen Vehicle

Present

Future
1.2 Reducing CO₂ Emissions through Increased On-Road Fuel Efficiency

On-road CO₂ emissions are usually higher than certified CO₂ emissions for any given vehicle model. In real-world running conditions, CO₂ emissions increase as a result of a number of factors, including road congestion and driver behavior (e.g., abrupt acceleration and sudden heavy braking).

The Travelling Coefficient

The travelling coefficient is the ratio of on-road CO₂ emissions and certified CO₂ emissions.

\[ \text{Travelling coefficient} = \frac{\text{On-road CO₂ emissions}}{\text{Certified CO₂ emissions}} \]

The travelling coefficient increases in numerical value the greater the discrepancy between on-road CO₂ emissions and certified CO₂ emissions.

Upgrading Road Infrastructure

Improved road traffic flow increases vehicle travelling speed, which in turn increases fuel efficiency and thereby decreases CO₂ emissions.

By improving traffic flow, the upgrading of roads and road infrastructure, including signal control systems, contributes very significantly to reduced road transport CO₂ emissions.

Travelling Coefficient Values in Congested Traffic (Japan Case Study)

Impact of Vehicle Speed on CO₂ Emissions

Source: “e-nergy” car owner survey, IRI Commerce & Technology Inc.

Source: Japan Automobile Research Institute
Benefits of Ecodriving

Fuel-conserving ecodriving has been shown to increase on-road vehicle fuel efficiency by about 10% (in other words, on-road CO₂ emissions are estimated to decrease by about 10% through the adoption of ecodriving).

**Impacts on On-Road Fuel Efficiency of International Ecodriving Initiatives**

<table>
<thead>
<tr>
<th>Country</th>
<th>Scope of Initiative</th>
<th>Impact (Short-Term)</th>
<th>Impact (Mid-Term)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>National</td>
<td>Up 10-20%</td>
<td>Up 5-10%</td>
</tr>
<tr>
<td>Austria</td>
<td>National</td>
<td>Up 10-15%</td>
<td>Up 5-10%</td>
</tr>
<tr>
<td>Japan</td>
<td>Driver training courses&lt;br&gt;Ecodriving contests</td>
<td>Up 10-25%</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>National (new drivers)&lt;br&gt;Professional fleet drivers&lt;br&gt;Passenger-car driver training courses</td>
<td>Up 6-10%&lt;br&gt;Up 10-25%</td>
<td>Up 6-10%&lt;br&gt;Up 6-8%&lt;br&gt;Up 10-15%</td>
</tr>
<tr>
<td>UK</td>
<td>Fleet operators/drivers</td>
<td>Up 10%</td>
<td></td>
</tr>
</tbody>
</table>

1.3 The CO₂ Emissions Coefficient

Automotive Fuels Have Different CO₂ Emissions Coefficients

Vehicle CO₂ emission volumes differ on a per-litter basis depending on the fossil fuel used. Biofuels are essentially carbon neutral.

![CO₂ Emissions Coefficients by Fuel Type](chart)

1.4 Automotive Activity Volume

The Total Distance Travelled by Automobiles Worldwide

In 2005 the total distance travelled by automobiles in use worldwide amounted to over 13 trillion vehicle-kilometers, 73% of which was travelled by vehicles in OECD member countries. The ratio of passenger transport and freight transport was roughly 8 to 2.

![OECD and Non-OECD Countries, 2005](chart)

Impact of Economic Growth and Transport Demand

Growth in national demand for transportation typically parallels growth in gross domestic product.

Passenger Travel and GDP by Region, 1950-1997

![Graph showing passenger-km per capita vs GDP per capita (US$) for regions like North America, Western Europe, India, Pacific OECD (Japan, Australia), and China.](source: Mobility 2001, World Business Council for Sustainable Development)

Projected Increases in the Total Number of In-Use Motor Vehicles

Accordingly, the number of automobiles in use worldwide is expected to increase with the growth in GDP of non-OECD countries.

Ownership of Light-Duty Vehicles per 1,000 Persons

![Graph showing ownership of light-duty vehicles per 1,000 persons for regions like North America, OECD Pacific, OECD Europe, Eastern Europe, Former Soviet Union, Latin America, Non-OECD Countries, India, China, Other Asia, Middle East, and Africa.](source: Mobility 2030 (full report), World Business Council for Sustainable Development)
2. Projected CO₂ Emissions in the Global Road Transport Sector

Projected Reductions in CO₂ Emissions

Assuming current rates of achievement in vehicle CO₂ emissions reduction and other areas, CO₂ emissions (in gCO₂/km) in the global road transport sector are projected to decrease by 15% from the current level by 2030.

Factors in Projected Global Road Transport CO₂ Reduction, 2010-2030

<table>
<thead>
<tr>
<th></th>
<th>OECD Countries</th>
<th>Non-OECD Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater fuel efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(new vehicles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger cars</td>
<td>Average (including China) annual rate of decrease in CO₂ emissions: 2.3%(^{(1)})</td>
<td>Average annual rate of decrease in CO₂ emissions: 0% to 1%(^{(2)})</td>
</tr>
<tr>
<td>Commercial vehicles</td>
<td>Average (excluding China) annual rate of decrease in CO₂ emissions: 0% to 1%</td>
<td>No change</td>
</tr>
<tr>
<td>Increased use of biofuels</td>
<td>Average global rate of use: 1% to 4% (bioethanol + biodiesel)(^{(3)})</td>
<td></td>
</tr>
<tr>
<td>Improved traffic flow</td>
<td>Average gain in on-road vehicle speed: 2km/h (1km/h every 10 years)</td>
<td>No gain in on-road vehicle speed(^{(4)})</td>
</tr>
<tr>
<td>Ecodriving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger cars</td>
<td>Potential average rate (approximate) of decrease in CO₂ emissions: 10%</td>
<td>Ecodrivers as % of world driving population: 0%</td>
</tr>
<tr>
<td>Commercial vehicles</td>
<td>Potential average rate (approximate) of decrease in CO₂ emissions: 10%</td>
<td>Ecodrivers as % of world driving population: 0% to 50%</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Assuming that current rates of decrease in response to regulatory trends are maintained. \(^{(2)}\) Assuming the promotion of greater vehicle fuel efficiency. \(^{(3)}\) Source: Reference Scenario, World Energy Outlook 2007, International Energy Agency. \(^{(4)}\) Assuming that the positive impact on vehicle speed of road-related measures will be offset by increased numbers of vehicles in use. Note: Unless otherwise acknowledged, achievement rates are based on JAMA’s own analysis.

Projected Growth in Vehicle-Kilometers Travelled Globally

With the growing number of automobiles in use worldwide, the total distance travelled by them is projected to increase by some 90% over the current level by 2030.

Projected Increases in the Total Distance Travelled by Automobiles Worldwide

<table>
<thead>
<tr>
<th>Year</th>
<th>OECD Countries</th>
<th>Non-OECD Countries</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>9,566</td>
<td>3,581</td>
<td>13,147</td>
</tr>
<tr>
<td>2020</td>
<td>11,605 (21%)</td>
<td>8,393 (134%)</td>
<td>19,998</td>
</tr>
<tr>
<td></td>
<td>(Increase over 2005)</td>
<td>(Increase over 2005)</td>
<td>(Increase over 2005)</td>
</tr>
<tr>
<td>2030</td>
<td>13,063 (37%)</td>
<td>12,214 (241%)</td>
<td>25,277</td>
</tr>
</tbody>
</table>

\(\times 1\) billion vehicle-km
Projected Overall Increase in CO₂ Emissions

Assuming current growth rates, and notwithstanding the projected reductions explained above, CO₂ emissions in the road transport sector worldwide are projected to increase by roughly 60% over the present level by 2030. Rapid growth in the number of motor vehicles in use in non-OECD countries is the major factor behind the actual and projected rise in CO₂ emissions worldwide. Put another way, increases in the number of vehicle-kilometers travelled globally offset the decreases in emissions intensity.

For Reference

CO₂ reduction in the road transport sector is by no means an easy task. In the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, for instance, estimated economic mitigation potentials in 2030 for CO₂ reduction by measures costing under US$100 per ton of CO₂ equivalent were lower for the transport sector than for most other sectors.

Economic Mitigation Potentials by Sector in 2030 (estimated from bottom-up studies)

Note: Only global totals are shown for the transport sector because international aviation is included.
Source: Climate Change 2007: Synthesis Report, Intergovernmental Panel on Climate Change (WGIII, 72)
3. Japan’s Experience in Reducing Road Transport CO₂ Emissions

CO₂ emissions in Japan’s transport sector peaked in 2001 and have been on a downward trend ever since, as projected.

CO₂ Emissions in Japan’s Transport Sector

This positive trend is attributable to efforts made in Japan’s road transport sector to:

- Increase vehicle fuel efficiency
- Upgrade roads and road infrastructure
- Implement other traffic flow-related measures (e.g., transport demand management)
- Use motor vehicles more efficiently, through ecodriving among other measures
For Reference: Japan’s Early Compliance with Fuel Efficiency Targets

In 2005, considerably ahead of schedule, almost all of Japan’s automobile manufacturers achieved compliance with Japan’s 2010 passenger-car fuel efficiency target. Real-world vehicle CO₂ emission volumes are the result of the fuel efficiency performance of vehicles in use. Accordingly, early compliance with the 2010 target has made a very significant contribution to the reduction of CO₂ emissions in Japan’s transport sector.

Trends in Average Fuel Efficiency of Gasoline Passenger Cars in Japan (including imported cars)
CO₂ reduction in road transport requires initiatives in the following four areas and the cooperative efforts of automobile manufacturers, government, fuel suppliers and vehicle users in implementing those initiatives.

As previously stated here, the Japan Automobile Manufacturers Association advocates the sectoral approach as the most effective way to achieve bottom-up CO₂ emissions cuts in the global road transport sector. JAMA also recommends the adoption of the following specific measures in the four areas concerned.
CO₂ Reduction in Global Road Transport: Recommended Measures in Four Areas

Area 1-Greater Fuel Efficiency

Increasing Vehicle Fuel Efficiency

Increasing Passenger Car Fuel Efficiency

The criteria applied in the regulation of passenger car fuel efficiency vary depending on the country or region of implementation. For example:
- The United States regulates passenger car fuel efficiency based on corporate average performance only (as per its CAFE standards).
- Japan regulates passenger car fuel efficiency based on corporate averages by vehicle weight.
- The European Union is planning to regulate passenger car fuel efficiency based on corporate averages by vehicle weight in the near future.

Individual countries/regions should adopt passenger car fuel efficiency regulatory criteria on the basis of their suitability to national/regional circumstances.

<table>
<thead>
<tr>
<th>Merits/Demerits of CAFE-Type Fuel Efficiency Regulation</th>
<th>Merits/Demerits of Vehicle Weight-Based Fuel Efficiency Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+) Encourages greater fuel efficiency overall, regardless of vehicle weight.</td>
<td></td>
</tr>
<tr>
<td>(−) Poses far greater compliance challenges for large-car manufacturers than for small-car manufacturers.</td>
<td></td>
</tr>
<tr>
<td>(−) Encourages the development of technologies for greater fuel efficiency.</td>
<td></td>
</tr>
<tr>
<td>(+) Encourages product diversification.</td>
<td></td>
</tr>
<tr>
<td>(−) With increased vehicle weight, increased fuel efficiency is less likely to be achieved.</td>
<td></td>
</tr>
</tbody>
</table>

Adopting Passenger Car Fuel Efficiency Standards Worldwide

Assuming that a given country/region introduces fuel efficiency standards for passenger cars in 2010 aimed at achieving an annual rate of decline in CO₂ emissions of 2.3% by 2030, certified passenger car fuel efficiency will increase by 1.3% per year.

All countries/regions should adopt passenger car fuel efficiency standards.

Adopting Truck Fuel Efficiency Standards Worldwide

The extent of regulation of truck fuel efficiency varies depending on the country or region of implementation. For example:
- The United States applies its CAFE standards to a single truck category, namely light-duty trucks (LDTs).
- Japan has already introduced fuel efficiency standards for trucks of all weight categories.

All countries/regions should adopt fuel efficiency standards for trucks.
Reducing Vehicle Weight

Even with the progressive enhancement of their safety features, the weight of passenger cars in Japan’s domestic market has not increased over the past decade. In contrast, a rise in vehicle weight was seen over the same period in both the United States and EU markets.

Countermeasures to increased vehicle weight should be adopted regardless of the market.

International Comparisons in Passenger Car Weight
Vehicle Fuel Efficiency and Mass (1990 = 1)

Promoting Next-Generation Automobiles

The limited distance that natural gas and electric vehicles can travel before refuelling remains the most difficult challenge in terms of their development. Also, introducing electric vehicles and plug-in hybrid vehicles to the market requires technological breakthroughs in regard to secondary battery performance and cost reduction.

For fuel-cell vehicles, high-performance fuel-cell stacks are needed in addition to measures enabling cost reduction.

While the more widespread use of hybrid vehicles, including plug-in types, should be promoted, innovations in fuel-cell and electric-vehicle technologies should be accelerated.

These technological breakthroughs should be achieved as soon as possible through cooperative efforts among industry, government and academia.

To promote the greater use of alternative-energy vehicles including electric and hydrogen vehicles, the necessary fuel/energy supply infrastructures must be established.

The fuel efficiency performance of automobiles that run on conventional fuels cannot be endlessly improved. Sustainable fuel efficiency for the mid- to long term must therefore be ensured by replacing conventional automobiles with next-generation vehicles.
Promoting the Widespread Use of Fuel-Efficient Vehicles

Auto manufacturers in Japan made all-out efforts to achieve early compliance with 2010 fuel efficiency targets in response to consumer demand. Also, the central government introduced tax incentives for the purchase of low-emission and fuel-efficient vehicles, which are designated as such by means of an environmental performance certification system.

Japan’s Green Tax Scheme:

Reductions on the Automobile Tax
(introduced in 2001)

Reductions on the Automobile Tax are applied to low-emission and fuel-efficient vehicles.
(Note: 10% surcharges on the tax are mandated for diesel vehicles on the road 11 years or longer, and for gasoline vehicles on the road 13 years or longer, since first registration.)

Reductions on the Acquisition Tax
(introduced in 1999)

Financial incentives are applied to the Acquisition Tax for purchasers of low-emission and fuel-efficient vehicles.

Tax Incentives for Low-Emission & Fuel-Efficient Vehicles

<table>
<thead>
<tr>
<th>Emissions Performance</th>
<th>Fuel Efficiency</th>
<th>Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>Compliant</td>
<td>50% reduction</td>
</tr>
<tr>
<td></td>
<td>+25% compared to 2010 standards</td>
<td>Amount deducted ¥300,000</td>
</tr>
<tr>
<td>Emissions down by 75% from 2005 standards</td>
<td>Compliant +15% compared to 2010 standards</td>
<td>25% reduction</td>
</tr>
<tr>
<td></td>
<td>Amount deducted ¥150,000</td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>Compliant with 2009 standards</td>
<td>2% reduction</td>
</tr>
<tr>
<td></td>
<td>Compliant with 2015 standards</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: Eligible vehicles are those newly registered in 2008 and 2009.
Source: Ministry of Land, Infrastructure, Transport and Tourism (Japan)

Promoting Accelerated Replacement with New-Model Vehicles

Old-model vehicles with low fuel efficiency are still on the road worldwide, to a greater or lesser extent depending on the country. Governments are therefore urged to encourage consumers to replace their older models with fuel-efficient new models to improve air quality and reduce CO₂ emissions.

Trends in In-Use Passenger Car Age in Japan

Average Fuel Efficiency of Passenger Cars (IW1250 class)

1994 models

185g/km

Down by 50gCO₂/km

2006 models

135g/km

Replacement of a 1994 model with a 2006 model reduces CO₂ emissions by an average of 50g/km.

Source: Motor Vehicles in Use by Year of First Registration, Automobile Inspection & Registration Information Association
Ensuring the Supply of High-Quality Fuels and Alternative Fuels

Optimizing the performance of fuel-efficient gasoline and diesel engines requires improvements in the quality of conventional fuels. Higher-quality fuels contribute very significantly to greater fuel efficiency and thus to emissions reduction.

The widespread use of low-carbon fuels and sources of energy, such as biofuels and electric power generated by renewable energy, should be promoted as well.

The commercialization of cellulosic bioethanol and BTL (biomass-to-liquid) fuels, which have no adverse impacts on food supply and soil quality, is the key to expanding biofuel supply. Here too, coordinated efforts involving the industrial, public and academic sectors are required to advance technological development.

While supplies of crop-based bioethanol are reaching their limits, the potential for cellulosic bioethanol is promising. The development of cellulosic bioethanol for mass production should therefore be promoted.

Alleviating Road Congestion

To mitigate road congestion, individual countries should adopt road traffic-related measures that represent the most effective responses to local conditions.

Improving traffic flow through road construction and road infrastructure development is an especially urgent priority in major developing countries, where motorization is expanding at a rapid pace.

The following ITS (Intelligent Transport Systems)-related technologies are useful tools in improving road traffic flow:

- Advanced navigation systems (such as Japan’s VICS, or Vehicle and Information Communication System), providing real-time road traffic information and route guidance;
- Electronic toll collection, enabling road-toll payment without stopping at tollgates;
- Advanced signal control systems, controlling road traffic signals in real time.

Integrating Traffic Flow Control Measures for Low-Carbon City Planning

In efforts to make cities low-carbon areas, and especially in urban areas where significant population influxes are projected, effective road congestion-mitigation measures, including road network development and ITS applications, should be integrated into city planning initiatives from their earliest stage.
CO₂ Reduction in Global Road Transport: Recommended Measures in Four Areas

Area 4—More Efficient Use of Vehicles

Practicing Ecodriving

In addition to reducing CO₂ emissions, ecodriving practices by truck fleet operators and their drivers also help reduce operating costs. The adoption of ecodriving by passenger car drivers must now be vigorously promoted. Good use of support tools (digital tachographs for trucks, fuel-efficiency gauges for passenger cars) is effective.

Digital tachograph (Fleet management)  Fuel-efficiency gauge

Ten Tips for Fuel-Conserving Ecodriving (as promoted in Japan)

1) Accelerate gently.
2) Keep your speed constant.
3) Slow down by decelerating.
4) Limit the use of your air conditioner.
5) Don’t idle your engine.
6) Don’t warm up your engine before starting off.
7) Know your itinerary.
8) Check your tire pressure regularly.
9) Reduce your load.
10) Respect parking regulations.
5. Anticipated Impacts of the Recommended Measures

JAMA carried out a hypothetical study to estimate the potential for CO₂ reduction in the global road transport sector assuming the implementation of the measures recommended here.

As shown in the graph that follows below, global road transport CO₂ emissions would level off on the basis of greater fuel efficiency (reducing by one-half the volume of CO₂ emissions projected if no countermeasures are taken) and of the combined implementation of the other CO₂ reduction measures (diversified fuel supply, improved traffic flow, ecodriving and accelerated replacement with new models—thereby reducing by the remaining half the volume of CO₂ emissions otherwise projected).

Therefore, in contrast with the projected decrease of 15% by 2030 assuming current rates of achievement (as previously cited here), global road transport CO₂ emissions (in gCO₂/km) would decrease by about 31% from the current level by 2030. Meanwhile, such emissions would have peaked in about 2025 to then proceed on a steady decline. There is thus a high potential for a significant reduction of CO₂ emissions in the global road transport sector if integrated measures are implemented worldwide.

<table>
<thead>
<tr>
<th>Assumed Current Rates of Achievement</th>
<th>OECD Countries</th>
<th>Non-OECD Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through greater fuel efficiency (new vehicles)</td>
<td>Passenger cars: Average (including China) annual rate of decrease in CO₂ emissions: 2.3%</td>
<td>Average annual rate of decrease in CO₂ emissions: 0% to 1%</td>
</tr>
<tr>
<td></td>
<td>Commercial vehicles: Average (excluding China) annual rate of decrease in CO₂ emissions: 0% to 1%</td>
<td>No change</td>
</tr>
<tr>
<td>Through increased use of biofuels</td>
<td>Average global rate of use: 1% to 4% (IEA WEO 2006 Reference Scenario)</td>
<td>No gain in on-road vehicle speed</td>
</tr>
<tr>
<td>Through improved traffic flow</td>
<td>Average gain in on-road vehicle speed: 2km/h (1km/h every 10 years)</td>
<td>No gain in on-road vehicle speed</td>
</tr>
<tr>
<td>Through ecodriving</td>
<td>Passenger cars: Potential average rate (approximate) of decrease in CO₂ emissions: 10% Ecodrivers as % of world driving population: 0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commercial vehicles: Potential average rate (approximate) of decrease in CO₂ emissions: 10% Ecodrivers as % of world driving population: 0% to 50%</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Assuming Implementation of Recommended Measures</th>
<th>OECD Countries</th>
<th>Non-OECD Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through greater fuel efficiency (new vehicles)</td>
<td>Passenger cars: Average (including China) annual rate of decrease in CO₂ emissions: 2.3%</td>
<td>Average annual rate of decrease in CO₂ emissions: 1.3%</td>
</tr>
<tr>
<td></td>
<td>Commercial vehicles: Average (excluding China) annual rate of decrease in CO₂ emissions: 0% to 1%</td>
<td>Average annual rate of decrease in CO₂ emissions: 0% to 1%</td>
</tr>
<tr>
<td>Through increased use of biofuels</td>
<td>Average global rate of use: 1% to 7% (IEA WEO 2006 Alternative Policy Scenario)</td>
<td></td>
</tr>
<tr>
<td>Through improved traffic flow</td>
<td>Average gain in on-road vehicle speed: 10km/h (5km/h every 10 years)</td>
<td>Average gain in on-road vehicle speed: 2km/h (1km/h every 10 years)</td>
</tr>
<tr>
<td>Through ecodriving</td>
<td>Passenger cars: Potential average rate (approximate) of decrease in CO₂ emissions: 10% Ecodrivers as % of world driving population: 0% to 30%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commercial vehicles: Potential average rate (approximate) of decrease in CO₂ emissions: 10% Ecodrivers as % of world driving population: 0% to 70%</td>
<td></td>
</tr>
<tr>
<td>Through replacement with new models</td>
<td>In and after 2010, all vehicles in use for 12 years or longer to be replaced with new models.</td>
<td></td>
</tr>
</tbody>
</table>

Note: Unless otherwise acknowledged, achievement rates are based on JAMA’s own analysis.
For Reference: CO₂ Emissions Reduction in the Global Road Transport Sector (assuming current rates of achievement)

Greater reduction of CO₂ emissions

CO₂ Emissions Reduction in the Global Road Transport Sector (assuming the implementation of recommended measures)
6. Conclusions

For significant CO₂ emissions reductions in the global road transport sector, a sectoral approach should be adopted and implemented, comprising initiatives in the four areas identified here.

![Diagram showing four areas: Greater Fuel Efficiency, More Efficient Use of Vehicles, Improved Traffic Flow, Diversified Automotive Fuel Supply]

Individual countries/regions should implement CO₂ reduction measures taking into account national/regional circumstances and conditions in order to ensure effective reductions in road transport CO₂ emissions.
7. Related Issues

1) A Global Framework for Implementing Sectoral Measures for Road Transport CO₂ Reduction

To ensure effective reductions in road transport CO₂ emissions, a global framework must be established enabling the industries and governments of individual countries/regions to share information on best practices and promote the measures required on a basis of mutual cooperation.

2) Data Compilation and Global Data Sharing

For policy-making targeting efficient investment, quantitative evaluations of the impact of CO₂ reduction measures will be necessary. To that end, the compilation and global sharing of all relevant road transport data should be carried out.

3) A Scheme for Environmental Technology Transfers

To facilitate the application of the environmental technologies required, it will be necessary to establish a scheme enabling the efficient transfer of such technologies.

4) Financial Mechanisms

Very significant costs are involved for the implementation of the CO₂ reduction initiatives required, including related technological development, road traffic measures, biofuel development and the establishment of an electricity/hydrogen supply infrastructure. Well-planned financing will be crucial to the successful implementation of these initiatives, making it imperative to establish effective financial mechanisms for the long term.

5) CO₂ Reduction throughout the Life Cycle of Automobiles

Tailpipe CO₂ emissions reduction alone will not ensure sustainable mobility. Optimal efforts should be made to reduce CO₂ emissions throughout the life cycle of automobiles, from the design stage through manufacture and use to final disposal. Particularly for next-generation vehicles that use new types of materials and fuels, cooperation with materials and fuel/energy (including electricity) suppliers will be vital.

CO₂ Emissions per Liter in Manufacturing and Combustion Processes by Fuel Type (CO₂ emissions from gasoline = 1.0)

Sources: For manufacturing process, Michuho Information & Research Institute, Toyota Motor Corporation; for combustion process, IHRG Combined Efficiency Study Committee