Reducing CO2 Emissions in Road Transport Sector

Submitted by: Japan Automobile Manufacturers Association (JAMA)
Reducing CO$_2$ Emissions in Road Transport Sector

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1. Introduction

◆ Transport sector

- Steady increase to **29 billion tons** in CO2 emissions
- **23%** of total worldwide CO2 emissions in 2007
- **73%** was generated by road transport.

CO2 Emissions in the Global Transport Sector

![Graph showing CO2 emissions by sector]

- International air transport
- International maritime transport
- Other
- Domestic air transport
- Domestic maritime transport
- Rail transport
- Road transport

**Road transport sector 73% in 2007**

**World CO2 Emissions by Sector**

- **Power generation 46%**
- **Transportation 23%**
- **Industry 20%**
- **Residential Service & Other 11%**

◆ Promoting Sustainability in the Road Transport Sector

◆ Improving Air Quality
Through a significant reduction of tailpipe-emitted pollutants

◆ Countering Global Warming
Through a significant reduction of CO2 emissions

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

The challenges for sustainable solutions in these three areas

◆ Integrated Approach Promotion
Driving Sustainability through an Integrated Approach
2. Cause and Countermeasure of CO2

◆ Calculating CO2 Emission Volumes in the Road Transport Sector

Emissions intensity : Fuel efficiency performance  
Activity volume : Total distance travelled

\[
\text{CO}_2 \text{ emissions} = \frac{\text{Emissions intensity}}{\times} \frac{\text{Activity volume}}{\times}
\]

\[
= \frac{\text{On-road fuel efficiency}}{\times} \frac{\text{CO}_2 \text{ emissions coefficient}}{\times} \frac{\text{Total distance travelled}}{\times}
\]

\[
= \frac{\text{Certified fuel efficiency (km/ℓ)}^{-1}}{\times} \frac{\text{Travelling coefficient}}{\times} \frac{\text{CO}_2 \text{ emissions coefficient (gCO}_2/ℓ)}{\times} \frac{\text{Total distance travelled (v-km)}}{\times}
\]

Improved by Automotive Technologies  
Improved by Congestion Mitigation & Eco-Driving  
Improved by Bio-Fuels  
Improved by Modal Shifts

Notes:  
1. km/ℓ: Kilometer/liter 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.
**Improving Vehicle Fuel Efficiency**

- **24.1%** increased compared by 2009 in 2020 includes Next-Generation Vehicles.
- The effect of tax reductions and purchasing subsidies applied to eco-friendly vehicles.
- The actual fuel efficiency improvement achieved to **16.3km/l** in 2009 in Japan.

![Graph showing changes in average fuel efficiency for gasoline-engine passenger cars and FY2015 targets](image-url)
Adopted Technologies

- Fuel efficiency improvement is achieved through step-by-step advances in technology.

**Improved Engine Efficiency**

- **Gasoline Engine**
  - Variable valve timing
  - Direct injection
  - 4-valve DOHC
  - Low friction
  - EFI

- **Diesel Engine**
  - Piezo injector
  - Common rail (180MPa)
  - Common rail (135MPa)
  - DPNR

**Improved Aerodynamics**

- Improved body configuration

**Reduced Vehicle Weight**

- Expanded use of lightweight materials
- Improved body structure

**Improved Drive System**

- Integrated vehicle control
- 8AT
- CVT
- 6AT
- Flex lockup
- Flex start

**Other**

- Electric power steering
- Idling prevention
- Hybridization

**Reduced Rolling Resistance**

- Low rolling-resistance tires
◆ Current & Next-Generation Alternative-Energy Vehicles

- Next generation vehicles are expanded to 26/571 models in 2009.
◆ The Travelling Coefficient

\[ \text{CO}_2 = \text{Fuel efficiency} \times \text{Travelling coefficient} \times \text{CO}_2 \text{ emissions coefficient} \times \text{Total distance travelled} \]

\[ \text{Travelling coefficient} = \frac{\text{On-road CO}_2 \text{ emissions}}{\text{Certified CO}_2 \text{ emissions}} \]

- Use of air conditioner
- Driving behavior
- Road congestion
- Engine warm-up
3. Success Case in reducing CO2 in Japan

◆ Upgrading Road Infrastructure

- Improved road traffic flow increases vehicle travelling speed,
- Upgrading road networks and infrastructure to reduced road transport CO2 emissions.

Impact of Vehicle Speed on CO2 Emissions

Source: Japan Automobile Research Institute

Travelling Coefficient Values in Congested Traffic (Japan Case Study)

Source: “e-nenpi” car owner survey, IRI Commerce & Technology Inc.
◆ Improved traffic flow

- JAMA calculated CO2 reduction by new bypass road as **20kt-CO2** per year with our transportation static data.
◆ Onboard Equipment for Eco-driving

- Wide variety of eco-driving support tools are being installed.
◆ Customers

- Wider use of low-carbon vehicles
- Eco-driving

Ten tips for eco-driving being promoted in Japan

1. Accelerate gently
2. Maintain a steady speed
3. Slow down by releasing the accelerator
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
**Benefits of Eco-driving**

- On-road CO2 emissions are estimated to decrease by roughly **10%** through the adoption of fuel-conserving eco-driving practices.

### Impacts on Vehicle Fuel Efficiency of Selected International Eco-driving Program 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 - Eco-driving contests</td>
<td>Up 12%</td>
<td>Up 5-10%</td>
</tr>
<tr>
<td>Germany</td>
<td>- National (new drivers) - Professional fleet drivers - Passenger-car driver training courses</td>
<td>Up 6-10%</td>
<td>Up 6-8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Up 10-25%</td>
<td>Up 10-15%</td>
</tr>
<tr>
<td>UK</td>
<td>Fleet operators/drivers</td>
<td>Up 10%</td>
<td></td>
</tr>
</tbody>
</table>

The Total Distance Travelled by Automobiles Worldwide

- Over **13 trillion vehicle-km**
- The ratio of passenger transport and freight transport was roughly 8 to 2.

Proposal for Integrated Approach

◆ Integrated Approach Promotion

Driving Sustainability through an Integrated Approach

- Government
  - Low carbon policy
  - Subsidies
  - Incentives
  - Infrastructure

- Automakers
  - High fuel efficiency
  - Next gen. vehicles

- Consumers
  - Eco-driving
  - Wider use of low-carbon vehicles

- Suppliers
  - Diversified fuel/energy

www.drivingsustainability.com
Factors in CO2 Emission Reduction in Japan’s Transport Sector

- Increased vehicle fuel efficiency
- Improved traffic flow; Eco-driving; Use of alternative fuels
- Reduced travel Distances (modal shifts, etc.)
- Reduced volume of traffic besides vehicles

BAU: If no CO2 countermeasures taken

Source: JAMA
◆ Government - Policy, Subsidy, Incentives, Infrastructures

- Fuel Efficiency Standards
  - Adoption of fuel efficiency standards in all countries
- Fuel-Efficient Vehicles Promotion
  - TAX incentives
  - Purchase subsidy
- Acceleration of Replacement with New-Model Vehicles
  - Replacement incentives
- Traffic flow Improvement
  - Intelligent transportation systems (i.e. route guidance, signal control)
  - Traffic flow design initiative for new cities
- Infrastructures for next generation vehicles
  - Battery charge stations
  - Smart grid
  - Hydrogen supply stations

◆ Fuel / Energy Suppliers - Diversified fuel/energy

- High Quality of Conventional Fuels
- Low Carbon Fuels and Energies
  - Bio-fuels, Cellulosic bio-ethanol fuels and Biomass to liquid fuels
  - Electric power with renewable energy
Assumption of Integrated Approach Effectiveness

- Peaked out Global CO₂ from road transportation sector with the integrated approach implementation.

Global CO₂ Emissions from Road Transport Sector

- Current IA plan
- IA Full Opportunity

Without any countermeasures

Fuel efficiency improvement

Bio-fuel use

Traffic flow improvement

Adoption of Eco-driving

Accelerated replacement with new models
Thank you