Stakeholder Dialogue on Improving Environmentally Sustainable Transport in Sri Lanka
Organized by
Ministry of Environment & Renewable Energy
Air Resource Management Center
Clean Air Sri Lanka
Centre for Science and Environment

CLEANER FUELS AND VEHICLES

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OVERVIEW

- The Context
- Fuel Economy
- Cleaner Vehicles
- Cleaner Fuels
THE CONTEXT

- **Growing Concerns**
  - Energy Security
  - Environment Sustainability
  - Economic Development

- **Interventions in Transport**
  - Energy Efficient & Environmentally Sustainable Transport System (E³ST)

FUEL ECONOMY

- Average fuel economy and new vehicles registrations, 2005 and 2008
Fuel Economy Testing in a Chassis Dynamometer
Fuel Economy Testing in a Chassis Dynamometer

United States

City cycle

Highway cycle

Japan

JC08 mode

Europe

New European driving cycle (NEDC)
Comparison of LDV CO\textsubscript{2} Emission Rates
CLEANER VEHICLES

- Roadmap of Advanced Power-train Technologies

Technology Diversification

Conventional Combustion Engines

Advanced Combustion Engines / Aerodynamics / Light Weight Designs

Mild Hybrid Propulsion (ICE + small electric drive)

Hybrid Propulsion

Fuel Cell Propulsion

TODAY

TOMMOROW
CLEANER VEHICLES

- Advanced / Emerging Technologies for New Vehicles: Propulsion System Improvements
  - Direct Fuel Injection
  - Secondary Air Injection
  - Pre-chamber / Swirl Chamber
  - Cylinder Deactivation
  - Variable Valve Timing
  - Controlled Auto-ignition
  - Advanced turbochargers
  - Friction Reduction
  - Smart Cooling
  - Variable Compression Ratio
  - High Pressure Fuel Injection
  - Camless Valve Trains

**Medium Term (5 – 10 yrs)**
Up to 10 % Improvements in Fuel Economy

**Long Term (10 – 30 yrs)**
Up to 35 % Improvements in Fuel Economy
CLEANER VEHICLES

Advanced / Emerging Technologies for New Vehicles: Non-propulsion System Improvements
- Vehicle Aerodynamics
- Tire Rolling Resistance
- Vehicle Weight Reduction

3 – 8 % Improvements in Fuel Economy

Alternative Fuels / Technologies
- Electric
- Hybrid
- Bio-fuels (Ethanol, Biodiesel, Biogas)
- Hydrogen IC / Hydrogen Fuel Cell

Fuel Economy Benefits of Hybrid
- Weak Hybrid: Up to 20%
- Mild Hybrid: Up to 50%
- Full Hybrid: Up to 80%

Electric
- EV: 5 km / kWh ($\eta = 60\%$)
- Limited range per full charge

Hydrogen
- Production of 1 kg of $H_2$ needs 55 kWh of electricity ($\eta=70\%$)
- IC Engine: 25 km / kg $H_2$ ($\eta=6\%$)
- Fuel Cell: 80 km / kg $H_2$ ($\eta=20\%$)
CLEANER FUELS

- Road Map for Cleaner Fuels:
CLEANER FUELS

- Global Fuel Quality Developments:

- Lead Removal
- Volatility Controls & Oxygenate Introduction; Catalytic Converters
- Initial Benzene & Sulfur Reduction
- Olefin & Aromatic Content Limits
- Sulfur Elimination & Additional Composition Controls; Advanced Emission Control Systems
- Introduction of Renewable Fuels (Biofuels)
- Low Carbon Fuel Standards

Objective
Control Emissions of Air Pollutants

Objective
Energy Security & CO₂ Reduction
### CLEANER FUELS

- **Conventional and advanced biofuel conversion technologies**

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- **Bioethanol**
  - Cellulosic Ethanol
  - Ethanol from sugar and starch crops

- **Diesel-type biofuels**
  - Microalgae – Biodiesel
  - Sugar-based HCs
  - Biomass to Biodiesel (from gasification)
  - Hydro-treated vegetable oil
  - Biodiesel (by transesterification)

- **Other fuels & additives**
  - Novel Fuels (e.g. furanics)
  - Biobutanol, Dimethylether
  - Pyrolysis-based fuels
  - Methanol

- **Biomethane**
  - Bio-synthetic gas
  - Biogas (AD)

- **Hydrogen**
  - All other
  - Gasification
  - Biogas
  - Novel routes
  - with reforming
  - reforming
**CLEANER FUELS**

- **Demand for Biofuels – IEA BLUE Map Scenario**

  ✓ 760 million tonne of oil equivalent (Mtoe)
  ✓ 27% of Transport Energy

![Graph showing demand for biofuels from 2010 to 2050](image)
Thank You