MITIGATING THE ENVIRONMENTAL AND HEALTH EFFECTS OF MOTOR VEHICLES & FUELS IN RUSSIA AND THE CIS

Presentation by
Michael P. WALSH
International Consultant
Arlington, Va. (USA)
Mitigating The Environmental and Health Effects of Motor Vehicles & Fuels in Russia and the CIS

Implementing Sustainable Urban Travel Policies in Russia and CIS
September 30, 2004
Moscow, Russia
Global Trends in Motor Vehicle Production (Cars, Trucks & Buses)

R-square = 0.951  # pts = 53
y = -1.8e+009 + 9.28e+005x
World Motor Vehicle Population

- Motorcycles
- Commercial Vehicles
- Cars

Millions

Global Trends in the Total Vehicle Population (Excluding Motorcycles)

Number (000)

- Oceania
- Other Asia
- Japan
- S & E Asia
- Africa
- C & S America
- N America
- C & E Europe
- W Europe
Products of Combustion

- Lead
- Hydrocarbons
- Carbon Monoxide
- Oxides of Nitrogen
- Carbon Dioxide
- Particulates
- Other pollutants
- Water Vapor

Ambient Air

Real Fuel

Engine/Emission Technology
Other Emissions From Vehicles

- Refueling Losses
  - displaced vapors

- Evaporative Emissions
  - diurnal, running losses, hot soak

- Other Emissions
  - brake linings, tire wear, fluid leaks

- Crankcase Losses
  - due to "blow-by"
What pollutants are of concern?

- Carbon monoxide (CO)
- Ozone (ROG + NOx)
- Haze
- Particles (PM10/PM2.5) (NOx, SOx, ROG, ammonia)
- Toxics - Diesel particles - Benzene - Chromium - Asbestos
- Greenhouse Gases - CO2, methane
Health Impacts of Air Pollution

- Premature Deaths
- Cancer
- Developmental Effects
- Hospitalization
- Asthma Attacks and Bronchitis
Adverse Health Effects From Emissions Beyond Dispute

- WHO Concludes ~ 800,000 Premature Deaths Each Year From Urban PM; Diesels One Major Source
- Numerous Studies in Europe & US Consistently Link PM With Premature Deaths, Hospital Admissions, Asthma Attacks, Etc.
- No Evidence of a Threshold
- Ozone Also A Serious Health Concern
Integrated Air Quality Management Framework

- Establish objectives, identify data gaps, studies and pilots
- Identify, analyze and select management options
- Develop strategies & implement action plan
- Institute monitoring and enforcement

Issues
- Technical
- Economic
- Institutional
- Legal
- Policy
- Social
- Stakeholder Involvement

Options
- Fuels & Vehicle Technology
- Traffic Management
- Standards
- Economic Incentives and Disincentives
ELEMENTS OF A COMPREHENSIVE VEHICLE POLLUTION CONTROL STRATEGY

- Clean Vehicle Technology
- Appropriate Maintenance
- Clean Fuels
- Transportation & Land Use Planning
EU Emissions Standards For Petrol Fueled Cars

% reduction

CO
NOx
HC+NOx

Euro I
Euro II
Euro III
Euro IV


HC+NOx
NOx
CO

% reduction
Emissions From Diesel Cars In Europe

% reduction

PM
HC+NOx

Euro I
Euro II
Euro III
Euro IV

EU Emissions Standards For Heavy-duty Vehicles on ETC
European Fuel Sulfur Levels (PPM)

- For Gasoline:
  - Euro 2: 500
  - Euro 3: 150
  - Euro 4: 50
  - Euro 5: 10

- For Diesel:
  - Euro 2: 500
  - Euro 3: 350
  - Euro 4: 50
  - Euro 5: 10

Widely Available
- In 2005: 100%
- In 2009:

- Euro 2: Widely Available
- Euro 3: Widely Available
- Euro 4: Widely Available
- Euro 5: Widely Available
Sulfur Effects

Zeolite or refractory oxide support

Precious Metal

$SO_2$

$SO_3$

$O_2$

$H_2SO_4$

Sulfate make

Sulfate Poisoning

Sulfur inhibition

Transition Metal

Sulfur Effects
European Tax Incentives Schemes To Encourage Low Sulfur Fuels

Source: IFQC
California Civic 600 cpsi catalyst - 49,000 miles

Canadian Civic 600 cpsi catalyst - 49,000 miles
What To Do About Existing Vehicles?
Swedish Retrofit Program
All Trucks Above 3.5 Tons

Very Low Sulfur Fuel Dominates The Market
Diesel Oxidation Catalyst

Flow through monolith with catalytic coating:
- CO + 1/2 O₂ → CO₂
- HC + O₂ → CO₂ + H₂O
- PAH + O₂ → CO₂ + H₂O
- Aldehydes + O₂ → CO₂ + H₂O

Soot
Metals

C₂H₂n₊₂
PAH
SO₂+H₂O

CO
Aldehydes
HC
PAH
SO₂
NOx

CO₂
H₂O
SO₂/SO₃
NOx

SO₂+H₂O

Soot
Metals
Diesel Particulate Filter
Inspection/Maintenance Considerations

- Program Type
- Effectiveness
  - Enforcement
  - Test types
  - Network design
  - Frequency
  - Quality of repairs
- Cost
  - Economies of scale
  - Sophistication
  - Capital
  - Operations
- Economic Impact
  - Ability to pay for repairs
  - Waivers
  - Scrappage
  - Alternatives
- Institutional Support
  - Audits
  - Oversight
  - Training
The Current Situation In Russia

- High Vehicle Population Growth, especially in Cities
- Poor Vehicle Maintenance
- Insufficient Development of Road Network
- Poor Road Conditions
- Ineffective Traffic Engineering
Emissions Technology Structure of Russian Motor Vehicle Fleet

Source: Donchenko
Strategy For Progress in Russia

- Institutional Arrangements
  - Responsibility
  - Resources
  - Authority

- Action Plan
  - Well Defined Goals
  - Short, Longer Term Measures
  - Input From All Stakeholders
  - Task Assignments
Strategy For Progress in Russia (Cont’d)

- Enforcement
  - Realistic Penalties
  - Sufficient Resources
- Variety of Policy Instruments
  - Command & Control Regulations
  - Economic Instruments
  - Other Incentives
- Public Awareness
  - Multiple Voices
  - Highlight Benefits