

Motor Vehicle Inspection and Maintenance: The Worldwide Experience



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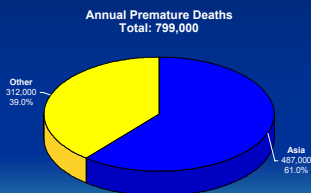
Summary

- Air Pollution Causes Serious Health and Environmental Problems
- A Comprehensive Strategy is Needed
- I/M Plays A Critical Role
- The Keys To Successful I/M
- Conclusions

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The Global Health Impact of Urban Air Pollution

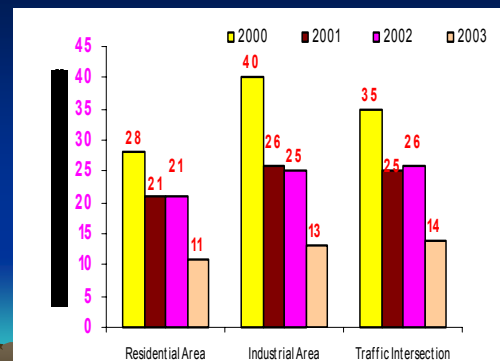


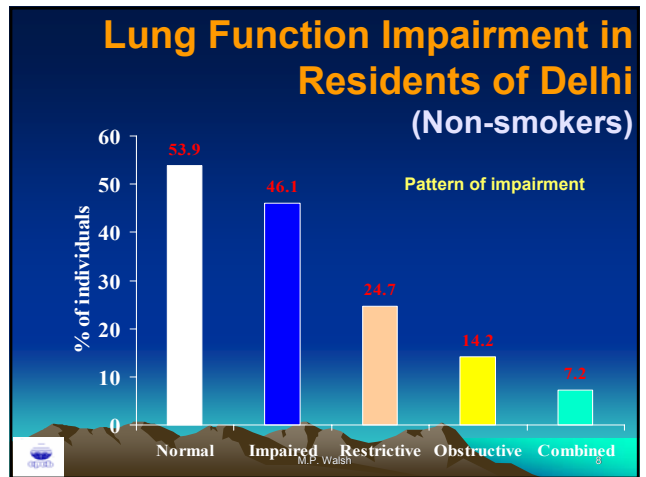
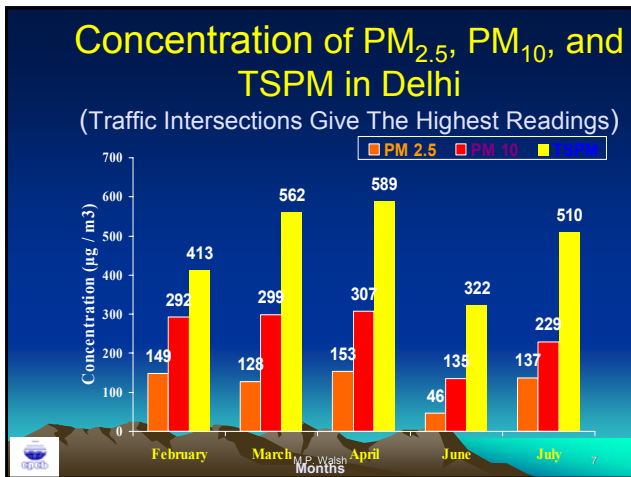
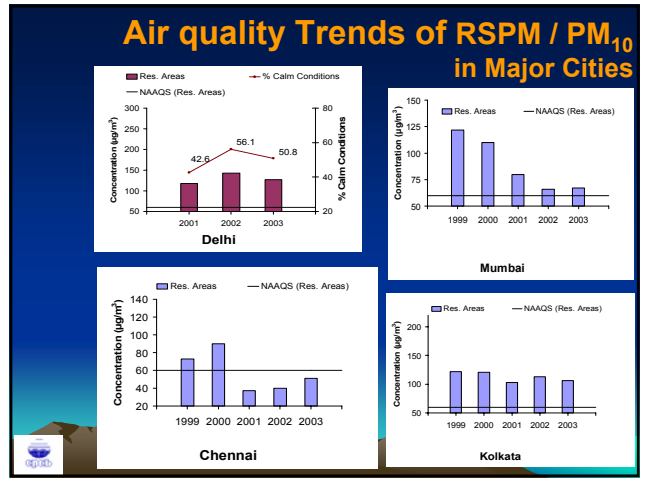
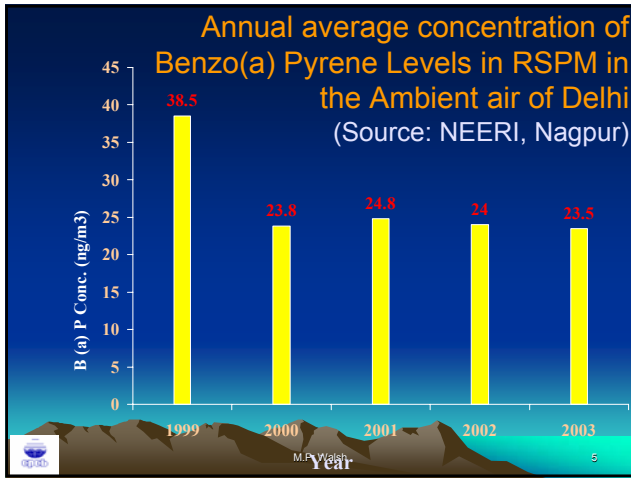
Source: WHO
The World Health Report 2006

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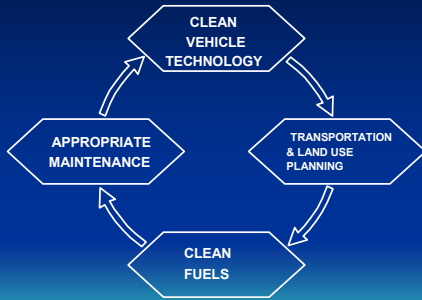
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Benzene Concentration in Ambient Air of Delhi





ELEMENTS OF A COMPREHENSIVE VEHICLE POLLUTION CONTROL STRATEGY



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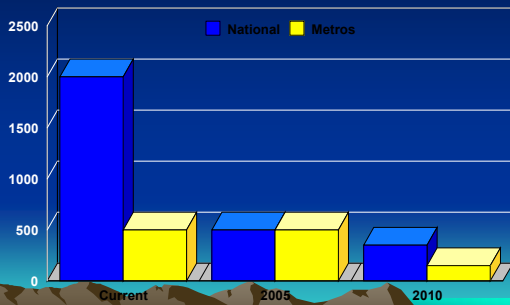
New Vehicle Standards in India

- Entire Country
 - Euro 2 – April 2005
 - Euro 3 – April 2010
- Major Cities
 - Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad & Ahmedabad, Pune Surat, Kanpur & Agra Already Euro 2
 - Tighter emission norms for all private vehicles, city public service vehicles and city commercial vehicles
 - Euro 3 From April 2005
 - Euro 4 From April 2010

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India Diesel Fuels Road Map



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Delhi: Air Quality Improvement Plan (AQIP)

Chronology of Recent Actions

2001: Transport, Industry & Urban

- Replacement of all post-1990 3-wheelers and taxis with new vehicles on clean fuels
- Sulphur content in diesel reduced to 0.05% in select outlets
- Number of CNG vehicles increases: 14000 3-w; 2200 taxis; 400 buses; 250 RTVs; 9500 private (26350 total)
- Piped NG by March to 2821 domestic, 15 small and 5 large commercial establishments
- Hazardous Industry closure continues: total of 3538 closed



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Delhi: Air Quality Improvement Plan (AQIP)

Chronology of Actions

2002: Transport & Urban

- 94 CNG stations setup up by March
- All diesel buses phased-out / converted to CNG.
- Number of CNG vehicles increases further: 35678 3-w; 4816 taxis; 4231 buses; 2165 RTVs; 10350 private (57240 total)
- Piped NG by March to 4111 domestic, 37 small, and 5 large commercial establishments
- 16340 non-destined good vehicles turned away from entering Delhi between July and November



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CNG Situation in Delhi

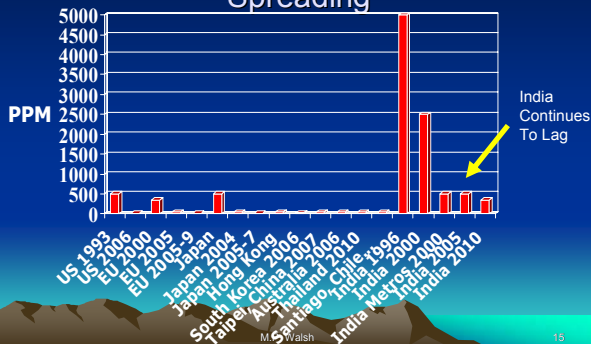
January 1, 2005

- Buses 10,352
- Minibuses 4,999
- Taxis 5.69
- Three Wheelers <60,000
- Pvt. Cars 10,895
- CNG Stations 126

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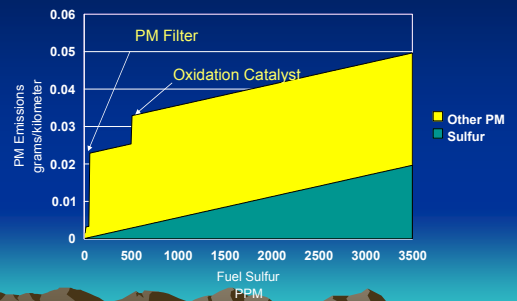
International Best Practice Ultra Low Sulfur Diesel Fuel Is Spreading



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Linkage Between Fuel Sulfur and PM Emissions



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One of the Weakest Aspects of the India Program Has Been the PUC I/M Program

- Test procedures and norms did not adjust to changing vehicle characteristics such as catalysts
- PUC Center operators are not trained
- Equipment not maintained / calibrated
- Proper test procedure not followed
- No well defined criteria for authorizing /registering PUC Center
- No auditing of PUC Center
- Lack of centralised agency for co-ordination
- The number of vehicles undergoing PUC test is very small and absence of control mechanism to identify vehicles escaping PUC
- No analysis of the data collected
- Existing system is prone to tampering



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I/M Plays A Critical Role

- Improved Vehicle Maintenance
- Deterrent To Tampering
- Deterrent To Misfueling
- Primary Enforcement Mechanism For Other Strategies
 - ▶ Alternative Fuel Retrofit
 - ▶ Other Retrofit

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Vehicle Inspection and Maintenance (I/M) Program

- Purpose:
 - To Assure that vehicle is properly maintained and used
 - Identify Dirtiest Vehicles & Get Them Repaired
 - Identify Unsafe vehicles & Get them Repaired
- General Attributes:
 - Relatively short
 - Relatively simple
- Test Types
 - Idle
 - 2-Stage Idle
 - Steady Speed Loaded
 - Transient Loaded
- Variety of Safety Tests

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Lessons From Mexico City I/M Program

- Test and Repair
 - Very convenient for vehicle owners
 - Very Difficult to Control
 - Often Degenerates into a visibly flawed program with no Public Support
- Test Only-Centralized
 - Good Technical and Administrative Control
 - Design program for profitability
 - Legal framework to favor sanctions
 - Minimize impact of technician on Results

Source: John Rogers

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Lessons From Mexico Gasoline Vehicle Testing Protocols

- Easy to generate False Pass on Static (Idle) Tests
- Dynamometers and NOx testing are essential to minimize False Passes
- Short, loaded-mode, constant-speed test (ASM) easy to operate at reasonable investment and cost
- Dynamic tests technically better but more difficult for low-skill technicians

Source: John Rogers

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Lessons From Mexico Harness Public Opinion

- Program success depends on public support
- Program benefits must be seen to outweigh social costs
- Must be seen to be effective, totally objective, transparent and focused on the gross polluters
- Well enforced, supervised and audited
- False Passes critically damage public opinion
- Design the Program to minimize False Passes from Day One

Source: John Rogers

6/4/2005

Enhanced PUC system Developed By ARAI

- Revision in Idle emission norms based on the year of vehicle manufacture.
- Introduction of idle HC emission standards
- Introduction of idle CO and HC emission norms for CNG / LPG vehicles
- Will have improved test methods for gasoline and diesel vehicles
- Four gas analyzer for better accuracy
- Measurement of Engine oil temperature and engine rpm for repeatable and consistent smoke readings
- Training of PUC center operators by equipment suppliers and institutionalize the complete system
- Calibration of equipment three times per year
- Communication capability with computer for data transfer and storage

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Problems with Idle CO Testing Idle CO check :

- Proper extension pipes especially for 2&3 wheeler vehicles are not used
- Chances of leakages in the system leading to low readings
- Carburetor adjusted to pass the test



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ARAI developed loaded mode test method for 2 Wheeler vehicles

- This test method was reviewed by Dr. R.A. Mashelkar in auto fuel policy report and recommended for dovetailing with the PUC system
- This system represents a significant step forward and should be emulated by other countries
- Can be extended to light duty gasoline and CNG buses



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Diesel Testing: Another Serious Challenge
Current Smoke Testing Very Flawed

Test Methods for Checking Compliance

A. Dynamometer Smoke Test

- ✓ Check rated rpm \pm 5% manufacturer spec
- ✓ Check road power to at least 50% of manufacturer spec
- ✓ Smoke limit 50 HSU



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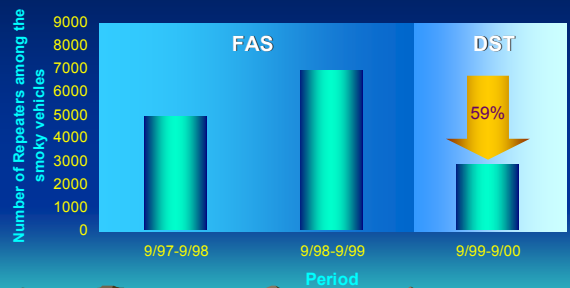
B. Free Acceleration Smoke Test

- ✓ Check rated rpm \pm 5% manufacturer spec
- ✓ Can not check road power
- ✓ Smoke limit:-
Pre- 90 60 HSU
Post 90 50 HSU



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Effectiveness of Advanced Smoke Test on Smoky Light Duty Diesel Vehicles



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Source: Matthew Tsang₂₈

Summarising Test Attributes

Test	Pollutant Measured	Equipment Cost (US\$)	Building, Land Req'd?	Effectiveness (PM)
Free Acceleration	Smoke Opacity	~7,000	No	70%
Lug-Down	Smoke Opacity	~70,000	Yes	70%
Lug-Down	PM	~90,000	Yes	80%
Transient DT80	PM	~100,000	Yes	90%

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Source: Peter Anyon₂₉

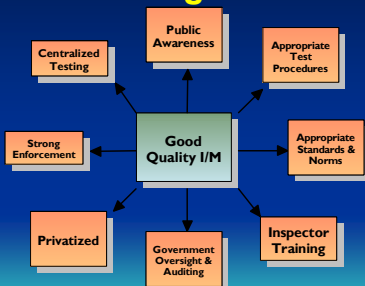
Minimising I/M Program Costs Can Be Deceptive

- Selecting a diesel I/M test presents a dilemma, as low-cost tests are initially financially attractive but may fail to detect many high polluters (and even worse may fail a large number of clean vehicles).
- On the other hand, while equipment and infrastructure capital costs can be quite high for tests that more reliably detect high polluters
 - investment costs can be amortised over many years
 - in fact, test equipment outlays, over 5~10 years of operation are often the smallest budget item.

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Elements of A Successful I/M Program



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Conclusions

- Air Pollution Causes Serious Health and Environmental Problems
- A Comprehensive Strategy is Needed
- India Has Made Significant Strides But
 - Sulfur in Fuel Still Lags
 - I/M Program Very Ineffective
- I/M Plays A Critical Role
- I/M Improvements Are Underway
 - Loaded Testing of MC A Big Step Forward
 - Diesels Remain Significant Challenge
- The Keys To Successful I/M Have Been Reviewed

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