

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

**AKTION PLANS FOR REDUCING VEHICLE EMISSIONS
- STRENGTHENING INSPECTION AND MAINTENANCE**

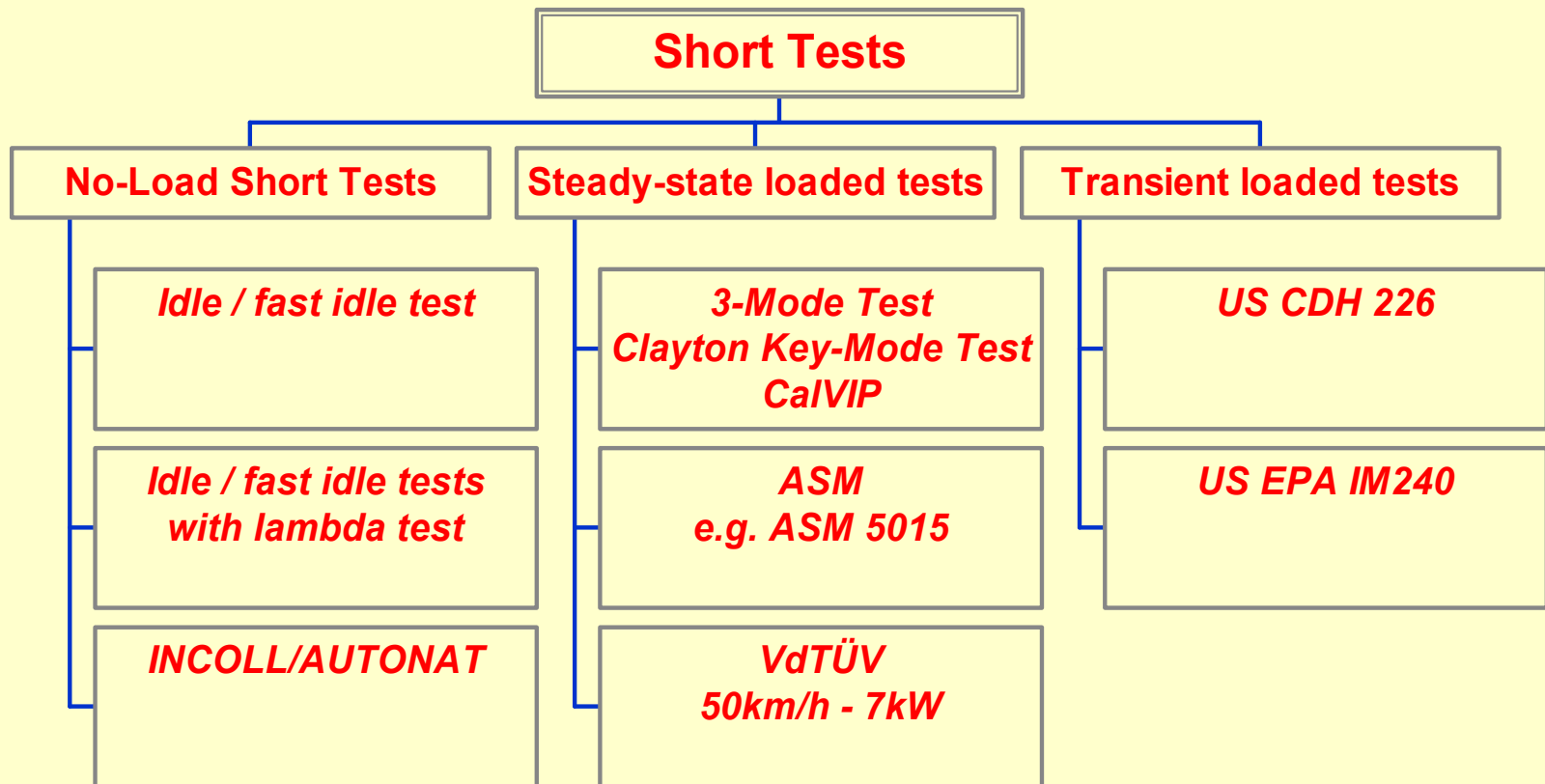
**Experiences outside Asia
in using I&M programs
to control vehicle emissions**

H. Waldeyer, D. Hassel, F.-J. Weber

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Available Short Tests



Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE



LAT / AUTH



The Inspection of In-Use Cars in Order to Attain Minimum Emissions of Pollutants and Optimum Energy Efficiency

Project Funded by
the European Commission
DG VII, DG XI & DGXVII

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Partners

- **LAT**, Aristotle University of Thessaloniki, Greece
- **INRETS**, France
- **TNO**, The Netherlands
- **TÜV** Rheinland, Germany
- **TRL**, United Kingdom

In collaboration with:

- **IVL & MTC**, Sweden
- **VKM-Thd**, Graz University of Technology, Austria

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Project Objectives (1/2)

- To review the short tests for passenger cars in the international literature or proposed by the study team.
- To study the performance of short tests vs the European standardised and representative driving cycles.
- To study the performance of one remote sensing technique coupled to short tests

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

**AKTION PLANS FOR REDUCING VEHICLE EMISSIONS
- STRENGTHENING INSPECTION AND MAINTENANCE**

Project Objectives (2/2)

- To quantify the impact of maintenance on car emissions and the ability of short tests to verify the effectiveness of maintenance.
- To study the technical and financial conditions of each test
- To propose a set of short tests for the European legislation, chosen to be technically feasible and environmentally effective.

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

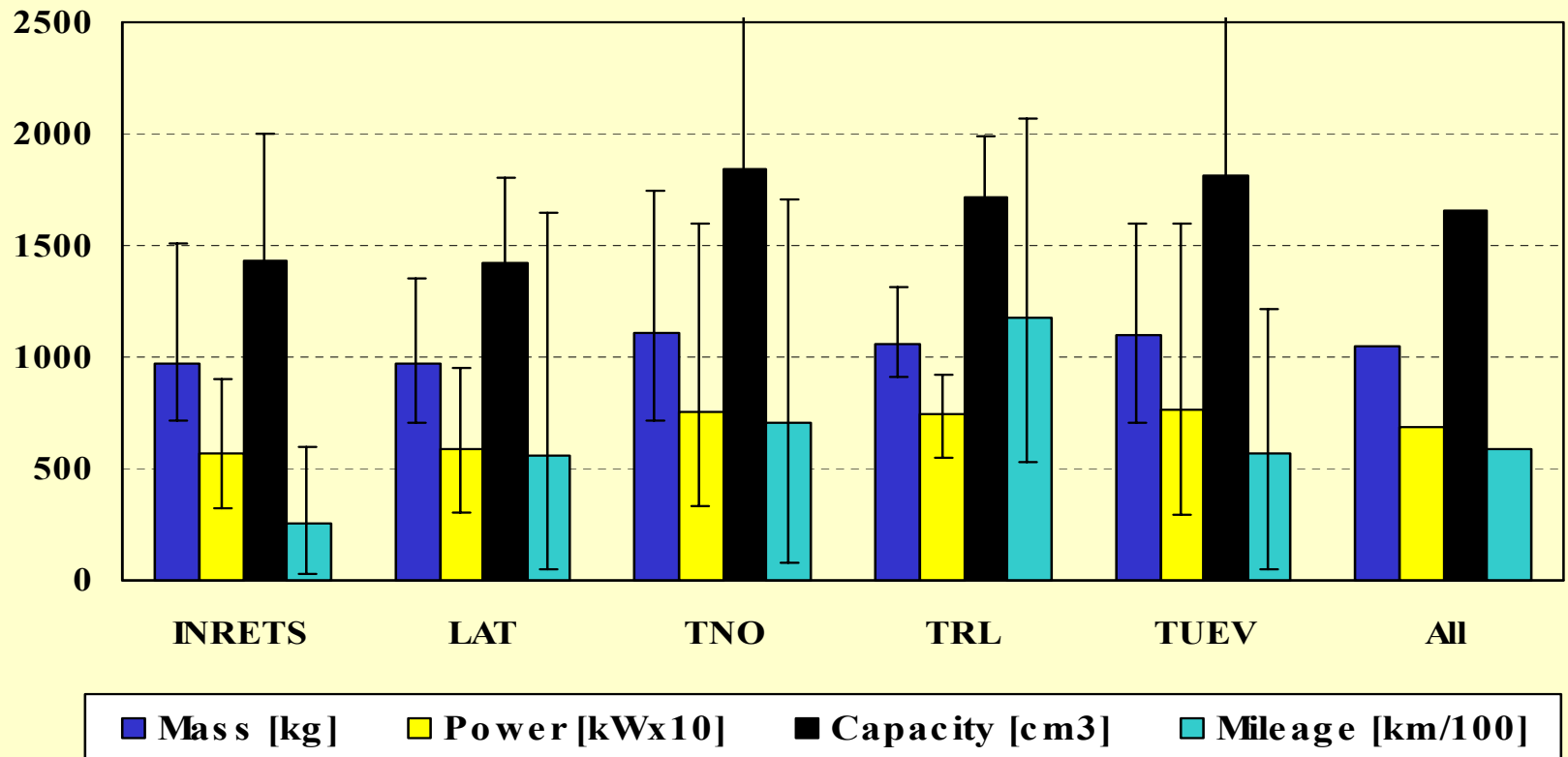
Vehicles Tested with Respect to Technology & Type of Choice

	Maintenance	Random	German AU (TUEV)	High emitters (TNO)	Remote sensing	Total
Conventional gasoline	<i>before</i>	14	-	-	27	41
	<i>after</i>	7	-	-	15	22
TWC gasoline	<i>before</i>	135	16	12	29	192
	<i>after</i>	23	17	7	9	56
Diesel	<i>before</i>	20	8	-	-	28
	<i>after</i>	-	3	-	-	3
Total	<i>before</i>	169	24	12	56	261
	<i>after</i>	30	20	7	24	81

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

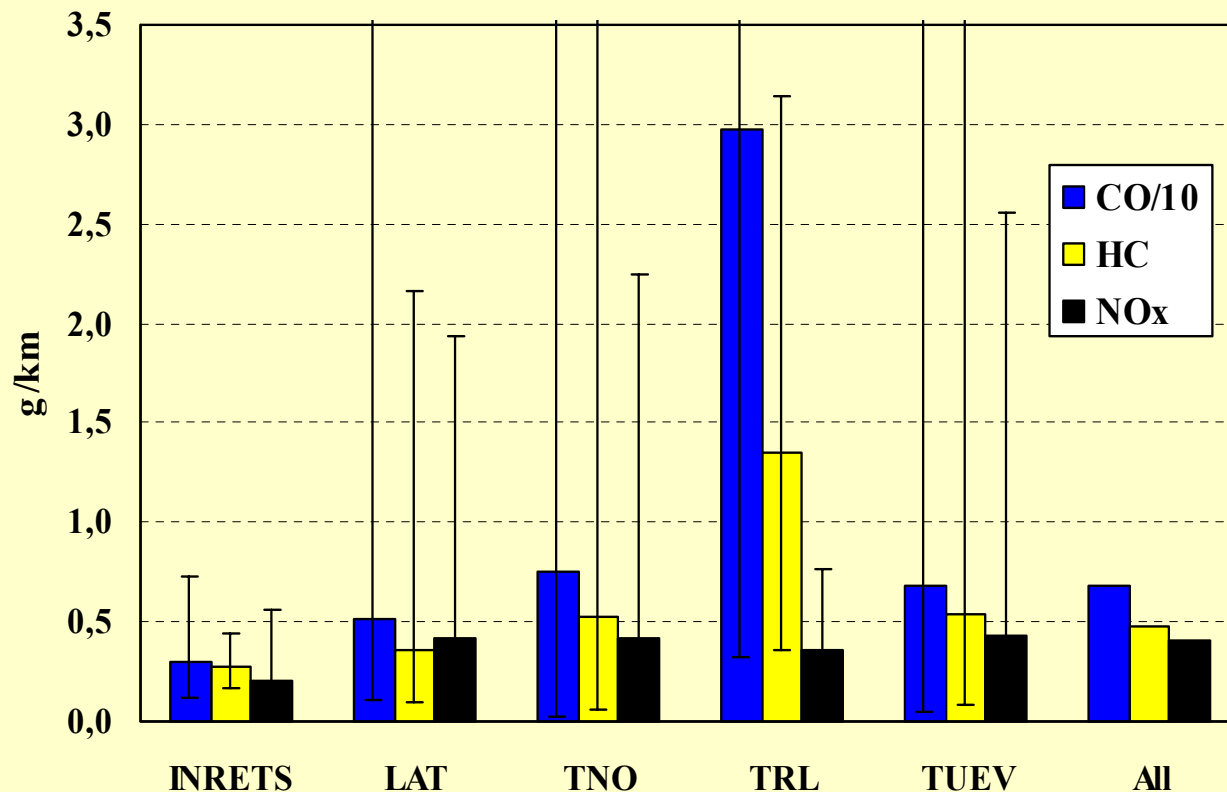
Main Characteristics of TWC Total Vehicle Sample



Regional Workshop, CHONGQING, PRC, 7-9 November 2001

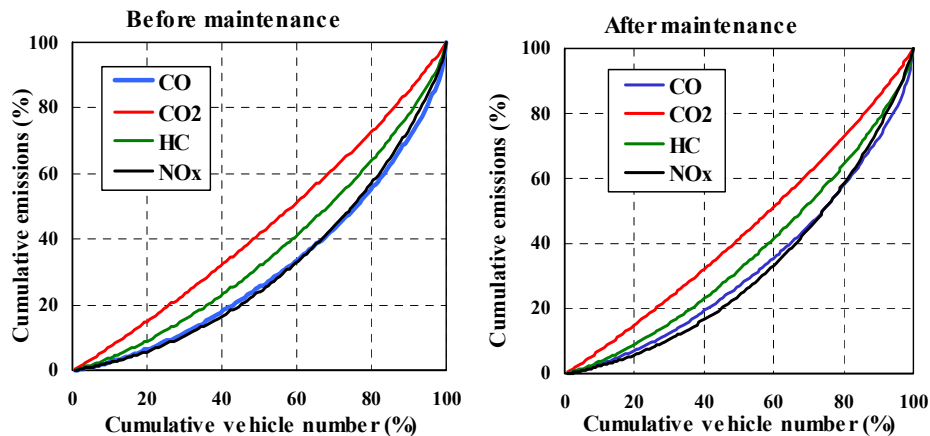
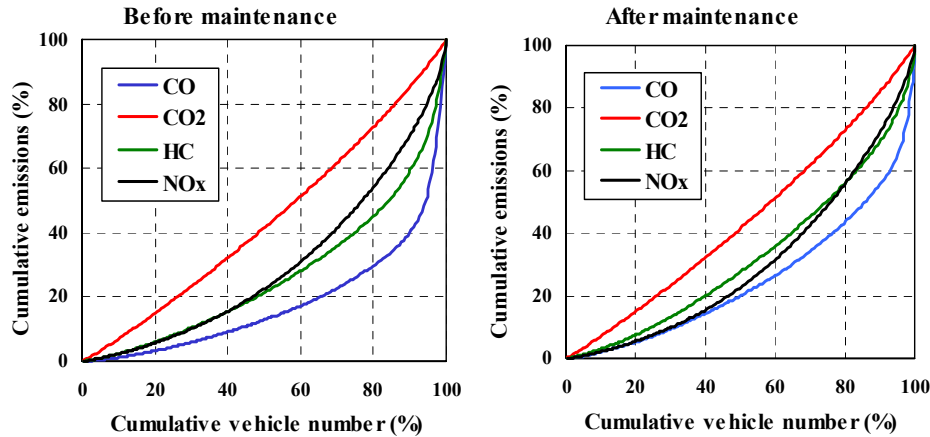
AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Emissions over NEDC of TWC Total Vehicle Sample



Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE



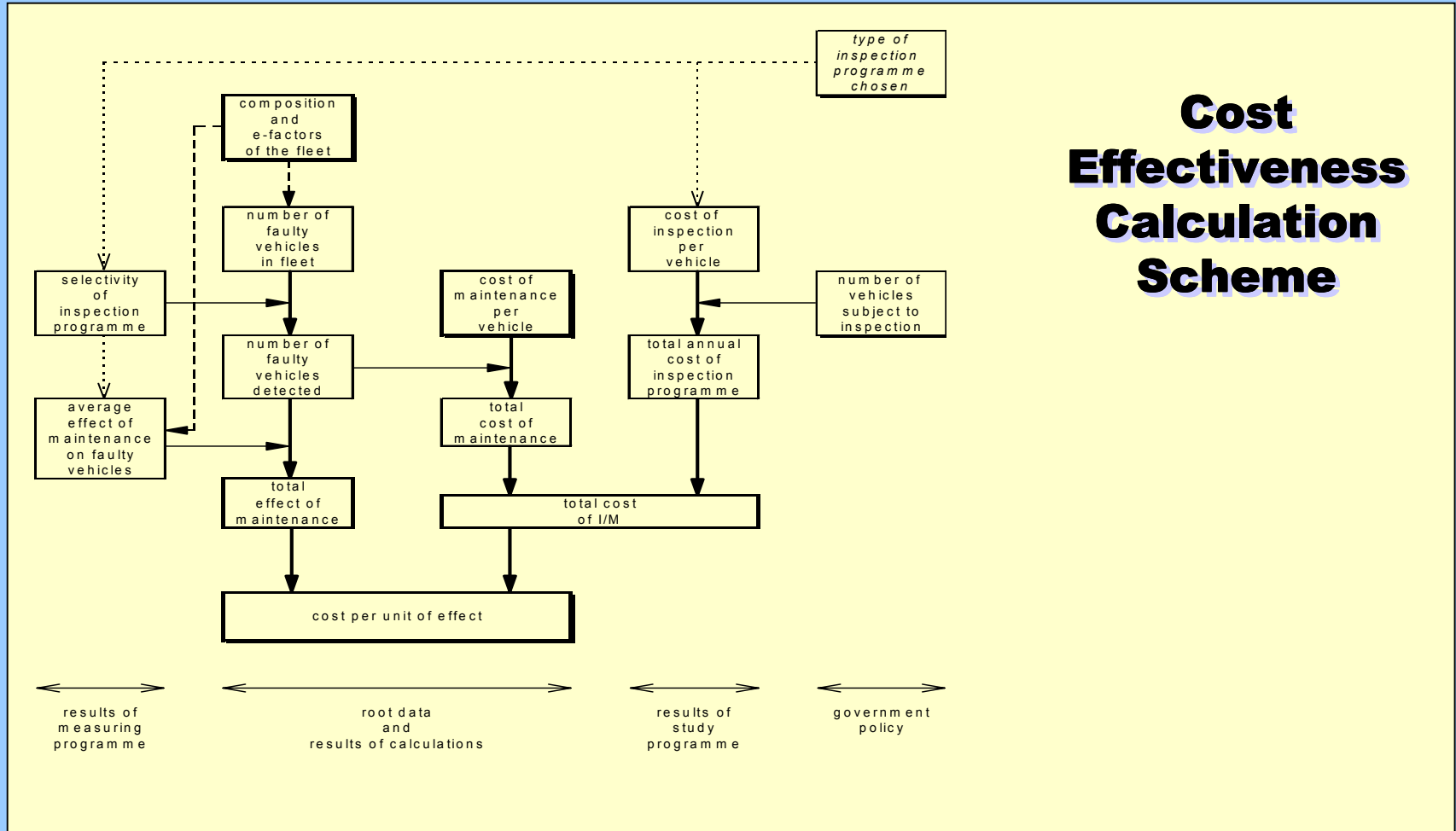
Cumulative Distribution of Emissions for TWC Vehicles

Total Sample

Random Sample

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

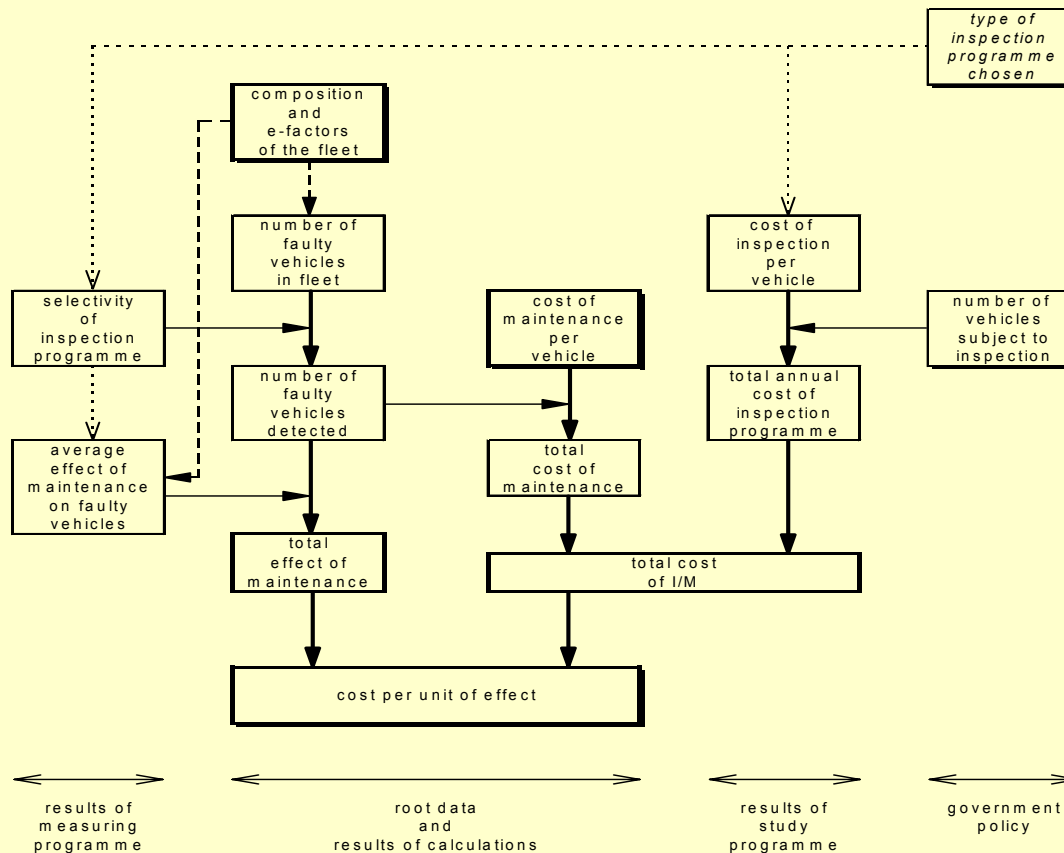
AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE



Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Cost Effectiveness Calculation Scheme



Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Conclusions - TWC Cars (1/2)

- **20 % of fleet responsible for 45% of total emissions for all pollutants**
- **No high polluters found only in HC**
 - **CO guide pollutant**
 - **NOx measurement mainly for NOx emission reduction**
- **Directive 92/55/EEC**
 - **completely ineffective for clean fleets**
 - 4 **identification of 15% of gross polluters**
 - 4 **ERRP = 4 % for all pollutants**
 - **lambda test adds errors of commission**
 - **no improvement if HC measurement is added**

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Conclusions - TWC Cars (2/2)

- **Transient tests by far more effective**
 - Identification of all gross polluters
 - ERRP = 15 - 20 % for all pollutants
- **The two transient cycles used:**
 - were found of equal performance
 - can be performed either with a CVS or with continuous measurement of the raw exhaust gas concentrations.
 - can be conducted with a simplified inertia system
 - need a preconditioning of the vehicle
- **No effect of maintenance on FC & CO₂ (2%)**

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

**AKTION PLANS FOR REDUCING VEHICLE EMISSIONS
- STRENGTHENING INSPECTION AND MAINTENANCE**

Conclusions - Conventional Gas. Cars

- **Directive 92/55/EEC very effective without adding high idle test if**
 - **CO cutpoint is reduced from 3.5 to 1.5%**
 - **HC measurement is introduced with cut-point 3000 ppmC1**
- **NOx emissions may increase after maintenance**
- **Reduction in FC of the order of 5% has been observed**

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Conclusions - Diesel Cars

- **High polluters only in PM emissions**
- **FAS test not reliable**
 - **it may identify many gross polluters but it is associated with many errors of commission**
 - **no correlation with NEDC**
 - **strong influence of preconditioning**
- **Continuous opacity measurement over short transient cycle found to be promising when smoke is visible**
- **Intermediate solutions are feasible**
- **The future emission standards require more advanced approaches**

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Cost Effectiveness (1/3)

For 1995 the current procedure of 92/55/EEC was found very cost-effective. This is valid during the coming years, for countries with a continuing high share of non-catalyst cars.

If there is a high share of TWC cars, dynamic testing turns out to be more cost-effective, provided that it is centrally organised.

For diesel cars, FAS is associated with a high number of errors of commission therefore less cost-effective. Dynamic testing is more cost effective, provided that the same lanes are also used for dynamic testing of otto engined cars.

**AKTION PLANS FOR REDUCING VEHICLE EMISSIONS
- STRENGTHENING INSPECTION AND MAINTENANCE**

Cost Effectiveness (2/3)

- **OBD is not likely to constitute a cost-effective alternative on the short or middle term:**
 - **OBD will not be common for otto cars before 2005 and not universal before 2010, with diesels trailing 5 years behind.**
 - **OBD only monitors exceeding of the OBD thresholds, which may be considerably higher than the certification limits.**
 - **OBD thresholds may start to slip after 80,000 km.**
 - **OBD may be temporarily disabled under various circumstances.**

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Cost Effectiveness (3/3)

Remote sensing with a high cut-point and vehicle selection is done on the basis of multiple detection , the effectiveness per vehicle detected can be high.

Using a low cut-point, in order to detect all high polluters, may lead to lower cost-effectiveness by a factor of three.

Detailed calculations of the cost-effectiveness are not yet possible, but a rough calculation seems to indicate that the cost-effectiveness may be of the same order of magnitude as that of a regular periodical inspection.

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

**AKTION PLANS FOR REDUCING VEHICLE EMISSIONS
- STRENGTHENING INSPECTION AND MAINTENANCE**



Research project 85.008 / 1999

Exhaust gas testing: Checking efficacy / Part 2

**Petrol engine vehicles fitted with closed-loop catalytic
converter**

- Abbreviated report-

May 2000

Client:

Bundesanstalt für Straßenwesen
Postfach 10 01 50
51401 Bergisch-Gladbach

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

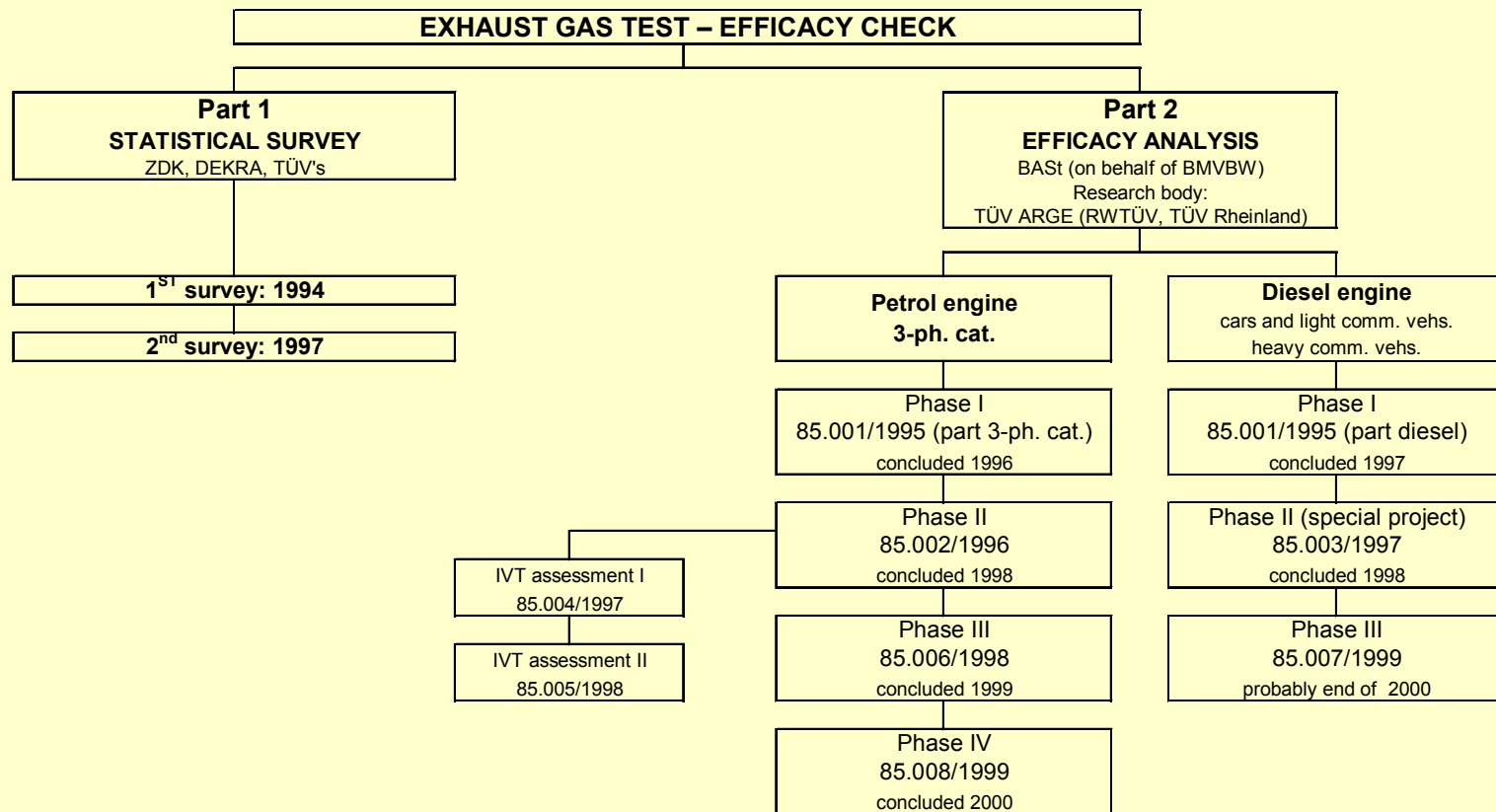
Compilation of defects of vehicles failed in the I/M test

Year of first registration	Before 1988	1988 - 1990			ab 1991			Total
		< 1,4	1,4-2,0	>2,0	<1,4	1,4-2,0	>2,0	
Lambda probe	3	3	13	6	11	17	8	61
Catalytic converter	1	5	6	4	4	17	3	40
Ignition system	8	5	11	2	6	8	5	45
Mixture preparation	3	7	10	3	11	13	3	50
Exhaust system	1	-	4	-	6	6	1	18
Intake system	3	3	6	-	3	3	1	19

Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

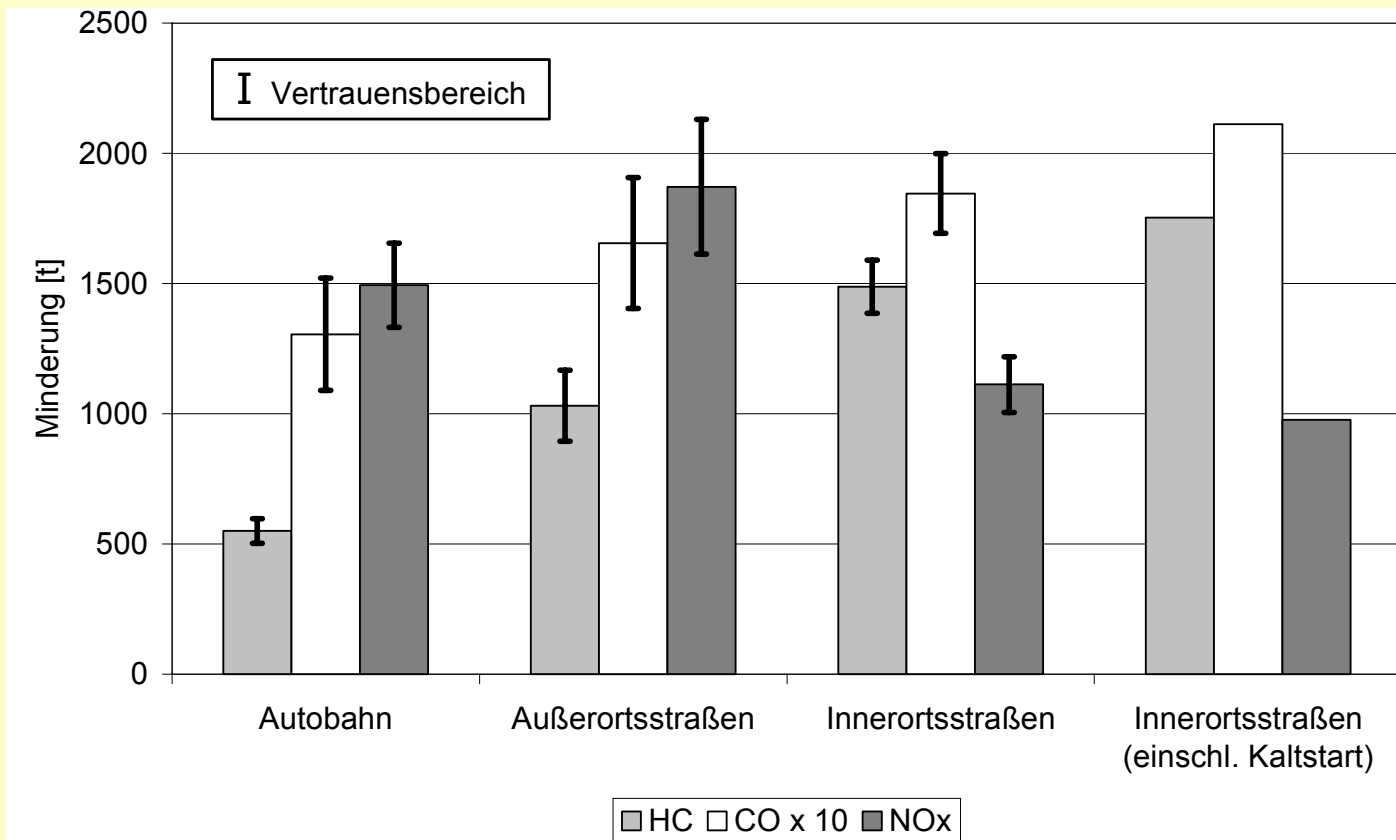
Structure of the "Exhaust gas testing: Checking efficacy"



Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Emission reduction for different road categories in the ref. year 1997



Regional Workshop, CHONGQING, PRC, 7-9 November 2001

AKTION PLANS FOR REDUCING VEHICLE EMISSIONS - STRENGTHENING INSPECTION AND MAINTENANCE

Effectiveness of the I/M Programme for different road categories

