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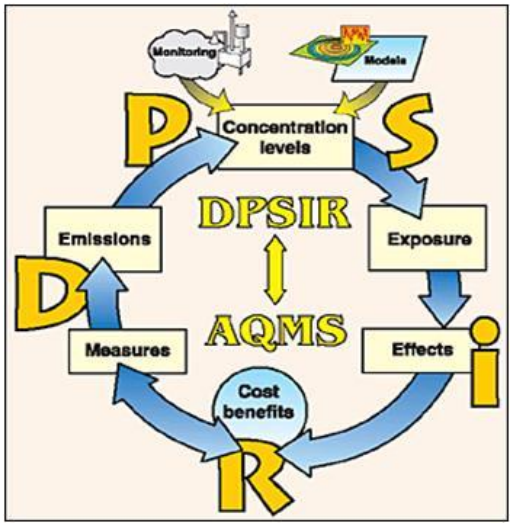
Air Quality Management Planning

Draft Implementation Manual

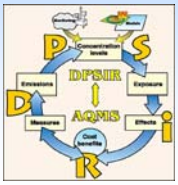
Bjarne Sivertsen

Presented for South African delegation at NILU on 8 April 2008



Air Quality Management Planning

AQMP Draft Implementation Manual



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AQMP – Draft Implementation Manual

Based on AQMP report for DEAT 2007

- Introduction
- Roles and responsibilities
- The process – this report
- P1: Goal setting
- P2: Baseline data
- P3: AQM System; Monitoring, Emission inventory, Modelling
- P4: Intervention strategies
- P5: Action plans and Implementation
- P6: Follow-up and Evaluation
- Capacity building, training and institutional building
- Information and public awareness

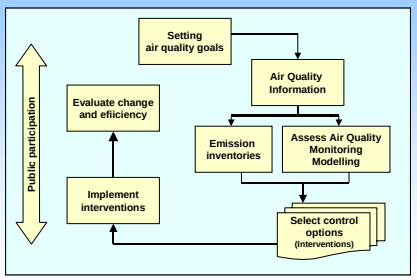
Introduction

The main purpose of the AQMP development process is to establish an effective and sound basis for planning and management of air quality

AQMP should take into account:

- ✓ Air Quality Management System (AQMS) requirements
- ✓ Operational and functional structure requirements
- ✓ Source identification through emission inventories
- ✓ Source reduction alternatives, which may be implemented
- ✓ Mechanisms for facilitating interdepartmental cooperation in order to assure that actions are being taken
- ✓ Institutional building and training requirements

AQMP – a dynamic process



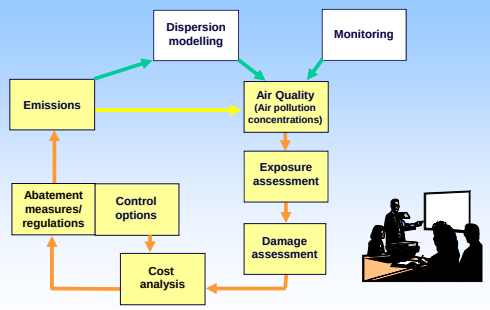
The Air Quality Management Plan (AQMP)

Take into account :

- Existing Air Quality status, identify the problems
- Operational and functional structure requirements
- Source identification through emission inventories
- Implementable source reduction alternatives
- Mechanisms for facilitating interdepartmental cooperation
- Institutional building and training requirements

AQM System

AQ Management Model Concept



Development of Air Quality Management Strategy Plan

Assessment
- Sources
- Monitor
- Exposure
- Source - exposure
- Contributions to exposure
- Damage

AQMS

Control
- Control options
- Cost - benefit
- Control strategy
- Investment plan

Masterplan

Surveillance
- Develop institutions
- AQ Information System

Roles and responsibilities

- National level
- Provincial level
- Municipalities
- Priority Area AQM plans
- Industrial AQM plans

National government (DEAT)

Establish legislative framework

Provincial and Local Governments develop their own standards:

More strict !

National level Departments

Department of Transport
Department of Trade and Industry
Department of Mineral and Energy
Department of Land Affairs
Department of Agriculture
Department of Housing
Department of Defence
Department of Water Affairs and Forestry

Initial assessment

The municipalities have been rated as either:

Acceptable –
generally good air quality

Potentially Poor
air quality may be poor at times or deteriorating

Poor
ambient air quality standards regularly exceeded

The role of the Municipalities

State level
DEAT
Departments
Guidelines and standards

Provinces
Identify needs
Coordinate input
Province report

Municipalities
Detailed AQMP
Use AQM system
Action plans

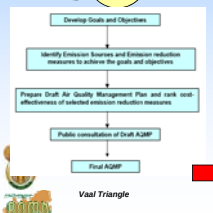
Priority Areas

Industries

AQM Systems
Emission inventory
Monitoring
Modelling
Cost/benefit
Action plans

Priority Area AQM Plans

When problems cross the Municipality or Province boundaries, the AQ Act provides for establishment of a Priority Area



Vaal Triangle

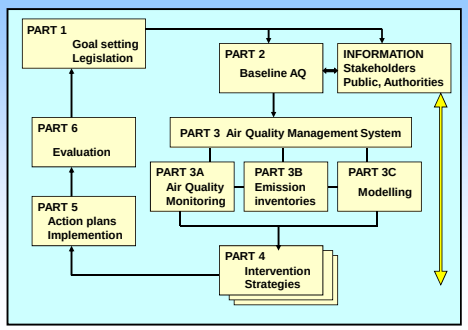
- ✓Definition of a Priority Area
- ✓Process for declaration of a Priority Area
- ✓Defining the boundaries of the Priority Area air-shed
- ✓Roles and Responsibilities
- ✓Framework for the establishment of a Priority Area, which includes Air Quality Management Planning, and
- ✓Priority Area management time lines

Implementation Manual for Air Quality Management in Priority Areas is available

Complete integrated AQMS for Priority Area

- Identify main sources and non-attainment zones
- Establish baseline assessment
- Identify interventions and actions
- Develop action plan
- Manage the process and include stakeholders
- Communicate with public, information dissemination

AQMP The process – This report



PART 1 Goal setting

Laws and Regulation Development

- Clean Air Act
- Setting emission standards
- Adopting air quality standards
- Outlining air quality reporting procedures
- Ensuring compliance and enforcement

Re-assessment of standards

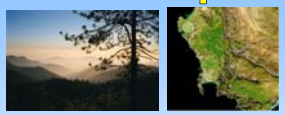
- Review and update
- Evaluate guidelines and standards
- Include recent developments
- Improve processes
- Assess manuals and guidelines
- Follow-up action plans

Reporting

PART 2 Baseline data

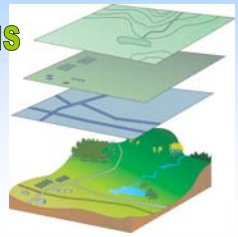
- ✓ Area description and geography
- ✓ Meteorology and climate
- ✓ Population statistics
- ✓ Air quality information based on available data
- ✓ Pollutants of concern
- ✓ Priority air quality issues
- ✓ Current management and tools

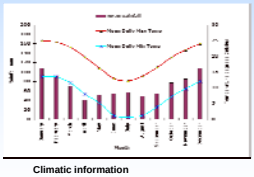
Area description



- ✓ Location
- ✓ Topography
- ✓ Climate
- ✓ Meteorology
- ✓ Population

GIS





Climatic information

Area description and geography

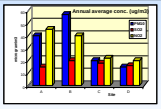
The boundaries of the area should be clearly specified

- ✓Administrative boundaries
- ✓Region or municipality
- ✓Priority area definition
- ✓Urban populated extension
- ✓Conglomeration
- ✓Kilometre square modelling area

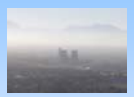
Baseline AQ information

Based on available data

- ✓ Sources
- ✓ Air Quality data
- ✓ AQ assessment
- ✓ Priority issues



Air pollution sources in South Africa



- Energy and power generation
- Process Industry
- Traffic and road transport
- Extraction of fuels
- Waste disposal and burning
- Agricultural activities
- Residential heating/cooking
- Natural sources

Priority Air Quality issues

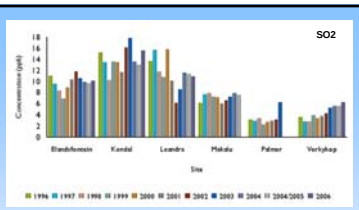
Identify impact areas sources and problems

Area/Region	Domestic burning	Industries	Traffic	Land-fills	Mine-tailing		

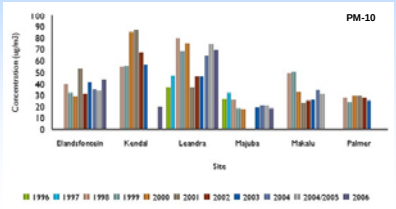
Air Quality Status

Present monitoring programme

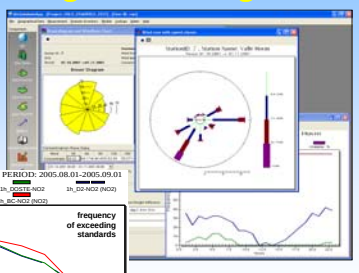
Long term air quality trends



Eskom annual report 2006



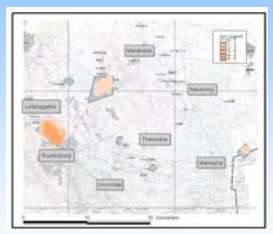
Management software available using monitoring data



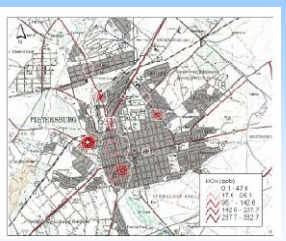
AirQUIS

Model estimates

Predicted concentration distribution from individual source groups



Maximum daily predicted SO_2 concentrations from domestic fuel burning in Rustenberg settlements



Maximum daily Nox concentrations (ppb) due to vehicle activity in Polokwane

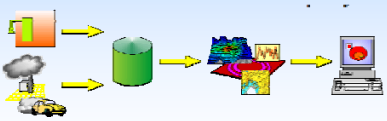
PART 3 The Air Quality Management System

- Air Quality Monitoring
- Meteorological data !
- Data retrieval
- QA/QC-system
- Emission data
- Databases (GIS based)
- Dispersion Models
- Assessment tools
- Planning tools
- Forecasts (Met+AQ)

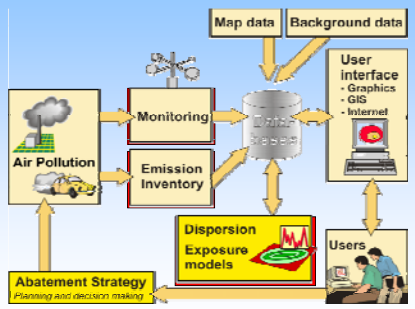
The AQM System

Identify sources Emission inventory
Meteorological data Dispersion and turbulence
Dispersion modelling SO2, NOx, PM +
Concentrations, Exposure
Exposure/response functions
Effect / cost data

- ✓ Monitoring programme development
- ✓ Emission inventories
- ✓ Dispersion models
- ✓ Exposure and impact assessment
- ✓ Cost/benefit analyses



The elements of an AQMS



PART 3 A

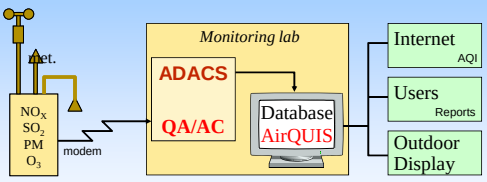
Develop AQ Monitoring Programme

Input to be considered

- ✓ Monitoring Objectives
- ✓ Data quality objectives
- ✓ Select sites and stations
- ✓ Select indicators
- ✓ Limit values and standards
- ✓ Frequency and period
- ✓ Instruments
- ✓ Statistics
- ✓ Design meteorology
- ✓ Which impacts?

on-line data:

Establish Automatic Data Retrieval System



automatic call – transfer – QC: missing, above, below, too many equal - flag - store

scaling: zero/span weekly → final data

Quality Assurance

All planned and systematic activities which are needed to assure and demonstrate the predefined quality of data

1) Monitoring Objectives
Determine use of data, e.g. monitoring of trends

2) Data Quality Objectives
Determine necessary data quality to fulfil the Monitoring Objectives

3) Equipment selection
Results must fulfil the DQO. Select best measuring practice

4) Site selection
Must be representative for the Monitoring Objectives

PART 3 B
Emission Data Base

Geographical Information System (GIS)

Calculation of Emission → Modeling

Point Sources	Line Sources	Area sources
• Industry • Stacks • Consumption • Emission • Production • Emission factors • Time variation	• Static road data (Geography, road classification) • Dynamic traffic data • Emission factors • Time variation	• Consumption • Emission • Production • Source sector • Fuel /Raw material • Emission factors • Time variation

Input data requirements

Location
Amount of emission
Variation of the emissions with time (hour of the day, day of the week and year).

- ✓ **Fuel consumption:** - various types and qualities of fuel various processes (transport, domestic, industrial)
- ✓ **Traffic activity:** - various vehicle classes and traffic data on major roads
- ✓ **Industrial sources:** - type, location, production, emissions, emission conditions (stack height, temperature, etc.)
- ✓ **Other sources:** - refuse burning, harbour activities etc.
- ✓ **Population data:** - geographic distribution within the area
- ✓ **Emission factors:** - amount emitted - per unit of production per input unit (raw material) per kilometre driven per fuel unit

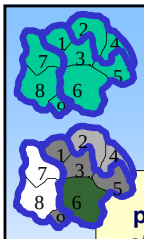
Line sources - traffic

Counting traffic on main roads
3 teams each 6 persons

Vehicles in 5 groups

- ❑ Heavy trucks (carry over 3 tons) or Coaches over 25 seats
- ❑ Light trucks (carry less than 3 tons) or Van from 9-25 seats
- ❑ Cars 4-9 seats
- ❑ Buses
- ❑ Motorbikes

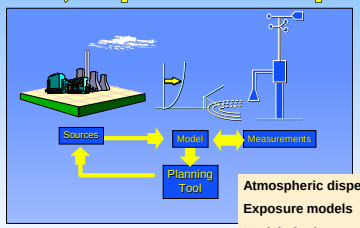
Using camera to capture traffic flow



Area Sources

Smaller or more diffuse sources of pollution (home heating, public services etc.) are provided on an area basis either for administrative areas, such as counties, municipality etc, or for regular grids.

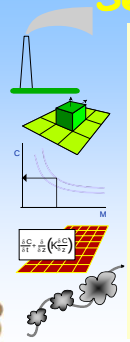
PART 3 C
Models, exposure & impacts



Models link:
sources – emissions – concentrations - exposure

- Atmospheric dispersion models
- Exposure models
- Models for impact assessment
- Dose/response evaluation
- Cost-benefit analyses

Several types of models



- **Gaussian models**
  - most used models for estimates of dispersion from stacks.
  - available for area sources and urban areas.
- **Box models**
  - based upon budgets analysis
  - used in simple urban air pollution modelling.
- **Statistical models**
  - based upon established relationships.
  - can not be used for planning purposes.
- **Numerical models**
  - based upon numerical solutions of the continuity equations.
  - Several models have been developed and applied.
- **Trajectory / puff models**
  - based upon knowledge of the wind field and the variations of winds
  - suited for dispersion from single sources at larger distances or in cases with space and time variations in meteorology

Different type of models

treat the elements of modelling differently

- ❖source characteristics,
- ❖transport of pollutants,
- ❖diffusion,
- ❖plume buoyancy,
- ❖deposition,
- ❖chemical reactions etc.

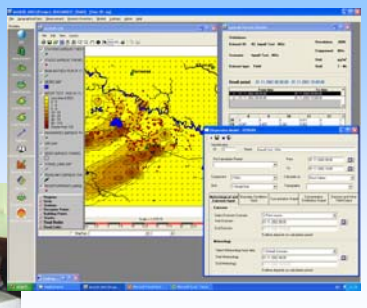
Model input

- source characteristics / emission data
- area characteristics
- measurement data air quality
- meteorological data
- dispersion coefficients
- dry & wet removal
- receptor point locations / grid

Numerical Dispersion Model

GIS

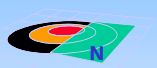
Part of the AirQUIS system



Training required !

Exposure estimates

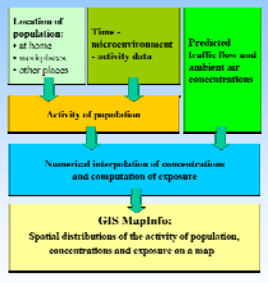
1



Integrated number of people within areas

2

Individual exposure estimates in micro environments

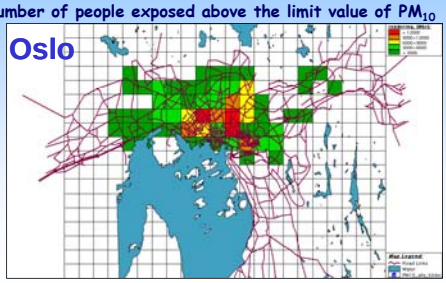


Block diagram of the exposure model

Exposure assessment

Links population data to concentration fields

Number of people exposed above the limit value of PM_{10}



Dose response functions

10 µg/m³ increase in PM concentration

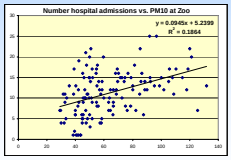
Table 26. Summary of relative risk estimates for effects of long-term exposure to particulate matter on the morbidity and mortality associated with a 10 µg/m³ increase in the concentration of $PM_{2.5}$ or PM_{10}

Endpoint	Relative risk for $PM_{2.5}$ (95% confidence interval)	Relative risk for PM_{10} (95% confidence interval)
Death (2)	1.14 (1.04–1.24)	1.10 (1.03–1.18)
Death (3)	1.07 (1.04–1.11)	
Bronchitis (4)	1.34 (0.94–1.99)	1.29 (0.96–1.83)
Percentage change in FEV_1, children (5)*	−1.9% (−3.1% to −0.6%)	−1.2% (−2.3% to −0.1%)
Percentage change in FEV_1, adults (6)		−1.0% (not available)

WHO Guideline update 2005, includes no risk functions

WHO Air Quality Guidelines for Europe

Hospital admissions vs. PM10



WHO 1995:
Hospital Admission
RD = 0.20 % / µg/m³ PM_{10}

Preliminary estimate HCMC
1 case per 1 µg/m³ of PM_{10}

PART 4

Intervention strategies

Aims and targets
- Improve air quality
- Reduce negative impact on human health
- Achieve acceptable air quality
- Reduce negative impact on the environment

Tasks:
1. Assess control options, their feasibility (technical, economic, political) and their costs.
2. Calculate cost-benefit ratios for options, find best control strategies.
3. Implement control strategies,
4. Enforce policies and regulations needed to implement strategies.

Source reductions - Action plans

- ✓ Actions defined
- ✓ Cost of actions
- ✓ Reduced emissions
- ✓ Reduced exposure

Possible actions:
- Introduction of scrubbers;
- Shifting to renewable energy (or low sulphur fuel);
- Introduction of cleaner technology;
- Implementation of process equipment changes and process changes;
- Improvement of operating practice;
- Ensuring regular maintenance; and
- Ensuring maximum energy conservation

COSTS → Emissions reduced

Prioritise

Cost of Actions

Input from Stakeholders and Industries

Sources – Strategies - Technologies

- ✓ Update emission data
- ✓ Validate cost with recent installations
- ✓ Expand with additional technology
- ✓ Policy options - compliance date
- ✓ Dynamic analyses

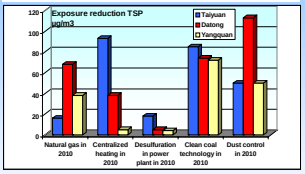
Estimated costs (US$) per ton reduced in a specific area					
	NOx	SOx	PM_{10}	CO	HC
Low	5	1000	400	5	200
High	175000	167000	389000	38000	27000
Average	43900	52400	92500	26300	6300

Cost and benefits

Six steps in the process

1. Identify the population and stock/assets at risk due to pollution
2. Determine the number of people and objects that are exposed to ambient pollution that exceeds standards or guidelines.
3. Identify relevant dose-response functions
4. Calculate marginal physical impact
5. Determine monetary values per unit of physical impact
6. Calculate the monetary value of benefits/damage

Population weighted exposure reduction of TSP for 5 control scenarios (µg/m³)



Model estimated exposure reductions in 3 cities

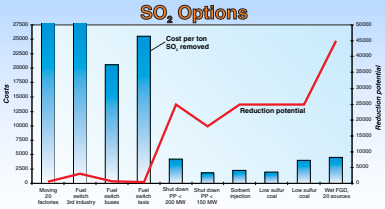
Larssen et.al.

Cost effective SO2 options

- A.Q. Assessment
- Health impacts
- Abatement options
- Cost/benefit analyses
- Optimal abatement strategy

SO_2 Options

Cost vs. reduction potential



Results of Cost Benefit analysis

A comparison of cost-benefit of various control options for SO_2 and TSP in Taiyuan

Cost benefit analysis:

A comparison of cost-benefit of various control options for SO_2 and TSP in Taiyuan

A comparison of cost-benefits of various control options for SO2 in Taiyuan

	Emission Reduction (t)	Concentration reduction (μg/m³)	Cost-benefit ratio	Rank
Natural gas utilization	20400	19.79	-52	2
Desulfuration in power plants	16450	6.47	115	4
Centralized heating	30000	51.89	-424	1
Implementation of productivity policies	9200	5.75	2000	5
Clean coal technology	36600	6.24	-23	3

A comparison of cost-benefits of various control options for TSP in Taiyuan

	Emission Reduction (t)	Concentration reduction (μg/m³)	Cost-benefit ratio	Rank
Natural gas utilization	31900	16.7	-0.459	2
Centralized heating	69400	90.29	-1.601	1
Implementation of productivity policies	17000	18.57	3.711	5
Clean coal technology	47100	93.13	-0.008	3
Dust control		50	1.813	4

BS\NILU\AQMPlanning Manual, summary Apr2008

PART 5
Action plan implementation

Priority setting

- Temporal approaches
- Geographical approaches
- Problem intensity approach
- Sectoral approach

Problem zones
Hot spot areas
Sensitive areas
Population claims

Impacts
Health problems
Accidents
Alert

Coal burning
Mine tailings
Waste burning
Traffic problems
Energy alternatives

BS\NILU\AQMPlanning Manual, summary Apr2008

Air quality master plan for Durban Metro

Air quality master plan for Durban Metro

Waste and sanitation
NGO's
Durban metro health
Department of housing
Roads and transport
Industry
Legal depart ment
City planners

BS\NILU\AQMPlanning Manual, summary Apr2008

Approval and review process

AQMP submitted to Authorities and DEAT

Distributed

- All major industries,
- Local and District Municipalities,
- Provincial Authorities,
- Relevant NGOs,
- Public

Stakeholder involvement

Comments

Approval → IDP

Integrated Development Plan

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The AQMP approval process

eThekwini :

- Creating the framework of AQMP
- Involve stakeholders and define problems and potential problems
- Meeting to inform stakeholders on the activity
- Workshop on problems with stakeholder participation
- Problems will be described and analysed
- At what level do we have information concerning problems
- Fill in the necessary gaps
- Abatement strategies/Workshop(s)
- Action plan/workshop(s)
- Master plan (seminar)

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AQMP – update for sustainability

Air quality Management plan

Air quality master plan

AQM Circle

Update plan every 5 years

Implementation plan

Monitoring and Review

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Information dissemination

To:
Stakeholders
Authorities
Decision makers

in order to:
Increase awareness
Better participation
NGO support
Understanding

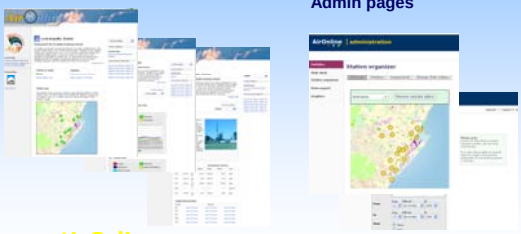
Disseminating air quality information

- Newspaper articles
- Booklets/Pamphlets /brochures/leaflets
- Posters on air pollution in central places such as schools and hospitals
- Radio, national and local
- TV
- Public meetings
- Bill boards

Web solutions for dissemination of ambient air quality

Public pages

Admin pages



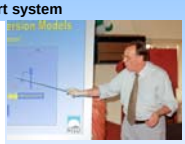
AirOnline

PART 7

Capacity building and training

AQMS – an expert system

- Need institutional building and training
- Understanding the issues, local and global
- Tools and equipment
- Assure sustainability!



Future needs and priorities

Tools – Policy – Actions – Follow-up

Raising public awareness

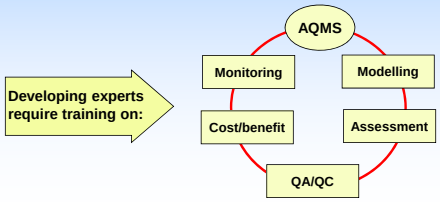
- Media campaigns in the press, on radio, television, bill boards;
- Public seminars and workshops;
- Distribution of leaflets;
- Effective education programmes developed for primary and secondary schools taking into account the local context;
- The organisation of clean air events to coincide with recognised events such as World Environment Day; and
- Maintenance of an informative and up-to-date website.

Training needs assessment

Topics identified for one training programme:

- Introduction to Air Quality Management planning;
- Presentation of the Implementation Manual;
- Discussion session on the Implementation Manual;
- Presentation of the Air Quality management regulations in S.A.
- Discuss Air Quality management regulations;

Developing experts require training on:




Thank you !
Questions ???
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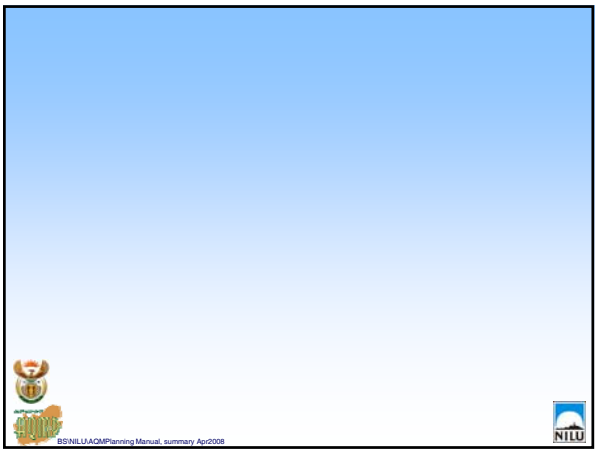
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