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Air Quality Management Planning for Urban Areas Around The World

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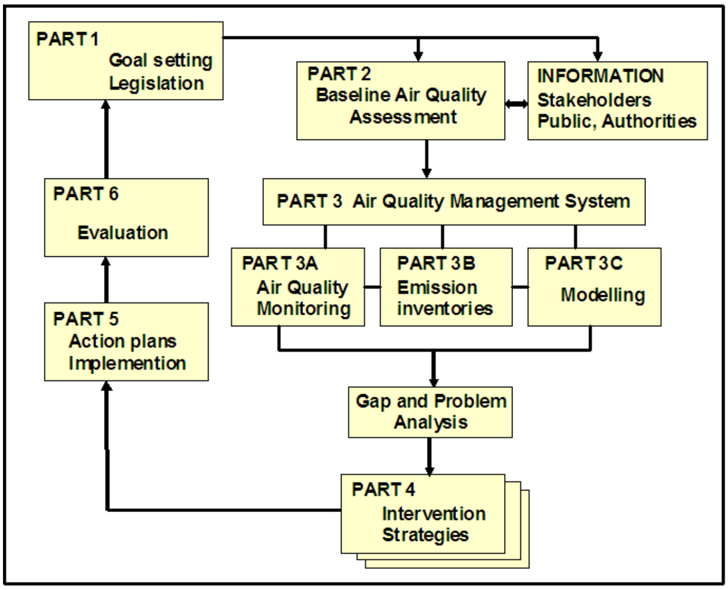

AIR QUALITY MANAGEMENT PLANNING FOR URBAN AREAS AROUND THE WORLD

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Abstract

A main objective of the modern Air Quality Management System (AQMS) is to enable direct data and information transfer, provide information on how much pollution the population is exposed to, establish a basis for strategies to reduce pollution and estimate air pollution impacts from present and future developments. The Norwegian Institute for Air Research (NILU) has been developing a system to handle air quality management planning and during the last few years NILU has applied the system in several urban areas in Asia, Africa, The Middle East and Europe.

The first application was in the URBAIR project undertaken by NILU for the World Bank. The AQMS consisted of two main components, which were assessment and control. In parallel with the AQMS development, and to facilitate checking the effectiveness of the air pollution control actions, a third component, the surveillance phase, will have to be developed and established.

The basic concept for an Air Quality Management Strategy contains the following main components:

- Air Quality Assessment
- Environmental Damage Assessment
- Abatement Options Assessment
- Cost Benefit Analysis or Cost Effectiveness Analysis
- Abatement Measures
- Optimum Control Strategy

A complete air quality management system has been indicated as the basis for air quality management planning in South Africa. Examples will be given concerning the content of such procedures as well as results from studies performed in cities around the world.

Keywords: Air Quality Management, modelling, strategy planning.

1 Introduction

Air Quality Management Planning (AQMP) include the basis for strategies to reduce pollution and estimate air pollution impacts from present and future developments. The Norwegian Institute for Air Research (NILU) has been developing an Air Quality Management System (AQMS); AirQUIS, to handle the air quality management planning process (Sivertsen 1997, Slørdal et.al 2008). During the last few years NILU has applied the system in several urban areas in Asia, Africa, The Middle East and Europe (Sivertsen & Bøhler, 2004).

The first application was in the URBAIR project undertaken by NILU for the World Bank (Larssen et.al, 1995). This project ended in a Guidebook for air quality management strategies in Asia (Shah et. al 1997).The AQMS consisted of two main components, which were assessment and control. In parallel with the AQMS development, and to facilitate checking the effectiveness of the air pollution control actions, a third component, the surveillance and control phase have to be developed and established.

2 Air quality management planning

An AQMP describes the current state of air quality in an area, how it has been changing over recent years, and what could be done to ensure clean air quality in a region. The development and implementation of an AQMP is a dynamic process involving several steps such as:

- Goal setting
- Baseline air quality assessment
- The air quality management system (AQMS)
- Intervention strategies
- Action plans implementation
- Evaluation and follow up

The linkages between these steps are indicated in Figure 1 below.

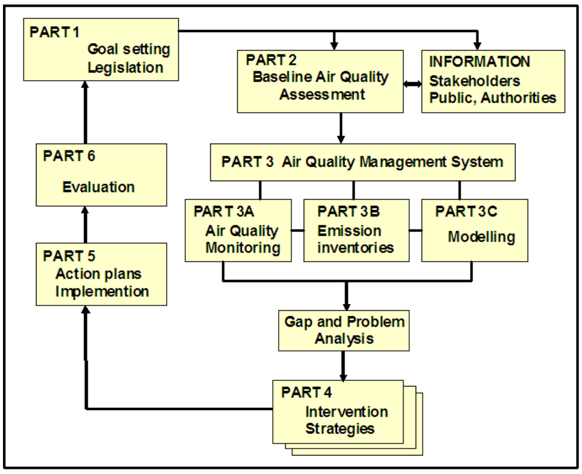

Figure 1: Steps in the AQMP process.

This process has also been the basis for the goals and aims stated in the recently updated EU Directives (European Commission, 2008), which includes:

- Defining and establishing objectives for ambient air quality designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole;
- Assessing the ambient air quality on the basis of common methods and criteria;
- Obtaining information on ambient air quality in order to help combat air pollution and nuisance and to monitor long-term trends and improvements resulting from identified measures;
- Ensuring that information on ambient air quality is made available to the public;
- Maintaining air quality where it is good and improving it in other cases;

The process has also been presented as input to the National Framework for Air Quality Management in the Republic of South Africa (DEAT, 2007). The first air quality management plan was presented for Johannesburg already in 2003 (Annegarn et.al, 2003).

3 The Air Quality Management System (AQMS)

The main elements of an AQMS include:

- Monitoring
- Emission inventories
- Atmospheric Dispersion Modelling
- Exposure assessment

3.1 Monitoring

Air quality monitoring includes the collection of data to provide necessary information to make adequate decisions on improving air quality. Monitoring normally includes the measurements of important indicators (criteria pollutants) as well as meteorological parameters. The level of sophistication of the monitoring system will depend on the results of baseline studies and on the complexity of the air pollution situation. Air monitoring programme design has to follow well established guidelines (Sivertsen, 2006).

For the protection of human health sampling points should be located in areas where the highest concentrations occur and the population is likely to be exposed. The measurements should normally not be dominated by one single source; some sampling points should be representative for all sources and thus named as “urban background stations”. (Sivertsen, 2007b)

While a sophisticated continuous monitoring network may be required for poor air quality areas, the use of simple passive samplers may suffice for acceptable air quality areas.

3.2 Emission inventories

The emission inventory list all sources of air pollution within the area from a range of stationary and mobile sources. These include smokestacks, vents and surface areas of commercial or industrial facilities; residential sources; motor vehicles and other transport related sources.

The sources of air pollution are divided in three categories.

Point sources; single activities like industries, energy production etc., that are linked to single stacks, are treated as point sources.

Line sources; moveable sources like road traffic, air flights and shipping are treated as line sources in the emission database.

Area sources; home heating/cooling, public and private services, open burning, windblown dust etc., are treated as area sources.

The emission module calculates all combinations of emissions in an area, such as total emissions of a component in selected areas or divided into source categories in a selected time period.

3.3 Modelling

The air quality models combines knowledge of pollutant sources with meteorological data to estimate concentrations at receptor points. Models allow for the assessment of exposure and risk, impact areas and forecasting. The framework, as it is built into the AirQUIS platform, enables calculation of concentrations in any point within the modelling area, whether representative for the average concentration in each of the grid elements of the model area (typically 1x1km^2 , or whether it is specific, freely selected points close to specific sources (e.g. stacks, roads), representing "hot-spots", areas of high concentrations (Slørdal et.al 2003).

The set of models typically include:

- Wind field models
- Urban air shed dispersion models (NILU EPISODE for AirQUIS)
- Industrial / point source models:
- Road and road network (line source) dispersion models:

3.4 Exposure assessment

Calculation of the population exposure to air pollution provides the real basis for assessing an important part of the costs of the damage caused by air pollution, and further the basis for optimising the control scenarios based upon cost analysis.

Other parts of the damage of air pollution concerns materials (in buildings and monuments) and ecosystems. AirQUIS also includes a module for assessing damage to materials.

In the population exposure module, the population exposure is calculated by combining the air concentration fields with the population distribution fields. Various schemes are used for these calculations.

4 Implementation of intervention strategies

The implementation of intervention strategies involves a close cooperation with stakeholders from industries, traffic authorities and the public. The identification of these intervention strategies may lead to the development of action plans.
The objective is to:

- Implement the control strategies,
- Include possible financing of the control measures and setting a time frame
- Identify how to implement intervention strategies/ action plans
- Enforce the policies and regulations needed to implement the strategies

In Europe (European Commission, 2008) the Directives specifies that if the levels of pollutants in ambient air exceed any limit value or target value, plus any relevant margin of tolerance in given zones or agglomerations the Member States shall ensure that air quality plans are established for those zones and agglomerations in order to achieve the related limit value or target value specified.

5 Review process

Once all the steps have been implemented and the checklists have been completed, the draft AQMP should be distributed to all key stakeholders. This review process was described for South Africa in preparation of the AQMP for DEAT. Once comments have been received the document should be updated and the final document should be included as part of the Integrated Development Plan and the Environmental Implementation Plan. Distribution of the AQMP to all key stakeholders for review/comments includes:

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

The AQMP should be updated and revised at pre-defined intervals (e.g. every 5 year). This to ensure that the plans are in accordance with updated national and international goals and requirements.

It will also be important that the process ensures follow-up and feedback concerning the compliance with the designed action plans, and that the air quality goals are actually met.

6 Information to authorities and to the public

Information produced by the air quality monitoring and management system should be disseminated to decision makers, stakeholders to support decisions and to the public in order to increase awareness of air pollution in general.

To simplify the daily on-line information reported to the public an air quality index (AQI) is often produced. The measured results for the potential harmful species NO_2, CO, SO_2, O_3 and PM_{10} are included for determination of the AQI. Further both hourly and daily averages are included to take into account that the health deterioration may be initiated both of short time exposure to high concentrations and long time exposure to lower levels. This fact is also reflected in the Air Quality Standards.

Pages are also prepared with information on air quality made easily available to the media. The web solution for air quality is a dynamic one and the main goal is to ensure that the pages can easily be used by media and the public.

7 Examples

Urban air pollution is a serious problem worldwide. It is especially serious in the many mega-cities of Asia and Africa. The gravity of the urban air pollution problem is largely attributed to the complex and multi-sectoral nature of everyday air polluting activities as well as the inadequate actions of governments. The lack of actions by governments is further due to poor information and weak understanding of the air pollution problems and, in addition, lack of institutional capacity and coordination among government agencies

A number of studies have been undertaken by NILU based on the air quality management concept presented above (Sivertsen, 2007). A few examples are presented in the following.

7.1 Guangzhou, China

The main objective for the project in Guangzhou, China was to develop an air quality action plan as part of a city Environmental Master plan to reduce the air pollution in Guangzhou. This priority list of actions should be part of the Government Agenda 21 for the Environment (Larssen, 2000).

The NILU developed AirQUIS system was used as the platform for identifying target goals. A draft Action Plan was developed, listing a number of viable abatement measures for various source categories, looking at the pollutants SO_2, NOx and particles. The measures were prioritised according to their potential for reducing the air pollution exposure of the population.

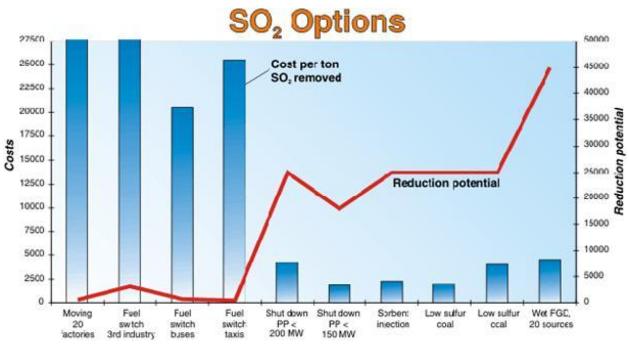

Figure 2: Air pollution reduction potential and estimated costs for ten alternative actions identified in order to reduce the SO2 impact in Guangzhou (Larssen, 2000)

The target for annual average for SO_2 would be met quite easily at low total annual costs. The least cost package consisted of cogeneration in 8 industrial facilities, shut down of a group of small power plants and sorbent injection in all 55-60 large point sources. The net annual costs will be less than RMB 70 mill. Some of the SO_2 options are presented in the Figure 2 above.

For NOx the control options covered in the study was not sufficient to meet the stated targets. There are two important reasons for this: background levels represented high shares of target concentration levels and the control options for traffic are not very effective.

As for TSP we concluded that three options, cogeneration, shut down of small power plants and high effective ESP on 11 sources, will reduce total emissions of combustion particles by 40,000-50,000 tons, or 35-40% from 1995 level. The total costs will be small, and all three options should be feasible.

7.2 Hochiminh City, Vietnam

As a basis for evaluating alternative actions in order to reduce the air pollution exposure in HoChiMinh city the AQMS models have been used to estimate relative the relative importance of different sources to the population exposure (VoThanh Dam and Sivertsen, 2008). The estimates have been based on person-weighted average concentrations (PW) calculated by the following formula:

$C\ (PW) = \{ \Sigma\ (N(x,y)*C(x,y,i)\ )\}/N(tot)$

where N represents the total number of persons in the area (x,y).

C(x,y,i) represents the average concentration of compound i in area (x,y).

The NOx concentrations calculated as annual average concentrations in each square kilometre of HCMC are taken as input to these estimates. The results are presented in Figure 3.

These estimates show that about 32% of the contribution to the NOx exposure is due to emissions for motorbikes in HCMC. Another 33% of the contributions are from light trucks and 20 % is from heavy trucks. Emissions from buses represent 20% of the exposure, while cars and point sources (industries) only represented less than 2 % each inside the city.

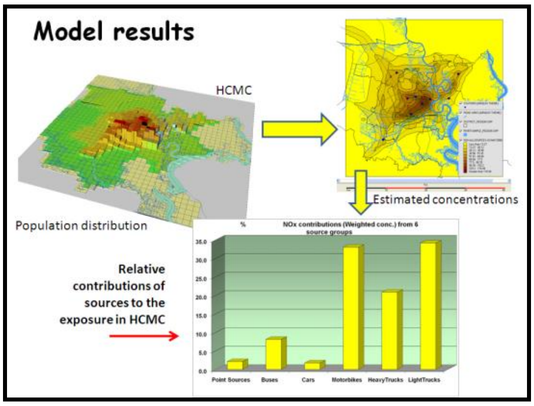

Figure 3: Population distribution and NOx concentration distributions from model estimates represented the input for estimating the relative contributions of sources to the exposure of NOx in HCMC.

7.3 Shanxi, China

The project objective was to find ways of improving air quality in urban areas of the Shanxi province in order to satisfy official Chinese air quality standards no later than 2015.

Using NILU´s AirQUIS system as the basic tool, a total of 2350 polluting sources were investigated in the three cities; Taiyuan, Datong and Yangquan City. There are 6919 industrial enterprises only in Taiyuan City among which 383 enterprises are of large scale production (Larssen, 2007).

After a thorough study of measurements, sources, emissions, dispersion and human exposure, the project partners were, via air pollution modelling results, able to present a complete cost benefit analysis to the Shanxi Provincial Government.

Emission scenarios and cost-benefit analysis show that action plans should be based on:

1) Centralized heating
2) Natural gas utilization
3) Clean coal technologies
4) Implementation of productivity policies,
5) Dust control
6) Improved desulfurisation in power plants

Another part of the project was the training of local experts in the use of AirQUIS. The system will be the corner stone of future environmental impact assessments and air quality planning in the Shanxi region. Emission reduction potential, concentration reductions and cost-benefit ratios are presented in Figure 4 for SO_2 emissions in Taiyuan (ECON, 2005).

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

	Emission Reduction (t)	Concentration reduction (μg/m^3)	Cost-benefit ratio	Rank
Natural gas utilization	20400	19.79	-52	2
Desulfuration in power plants	18460	6.47	115	4
Centralized heating	30000	51.89	-424	1
Implementation of productivity policies	9280	5.75	2000	5
Clean coal technology	36600	6.24	-23	3

Figure 4: Cost-benefit ratios estimated for five control options for SO_2 in Taiyuan, Shanxi.

The centralized heating alternative was the most cost effective action. The negative cost-benefit ratio indicates that the price for the emission reductions in this alternative was less than the value of the air pollution impact reductions. This was also the case for the use of natural gas. The ranking of alternative actions may be used by decision makers to put priorities in the Master Plan against Air Pollution in Shanxi Province.

7.4 AirQUIS applied in Africa

An Air Pollution Monitoring and Surveillance Program (BAQMAP) has been developed, installed and tested for **Botswana** (Bekkestad, 1997). The project is funded partly by NORAD and partly by the Botswana Government.

NILU provided assistance in establishment the air pollution monitoring network, laboratories and QA/QC systems, emission data bases, and atmospheric dispersion model estimates for air quality planning and impact assessment analysis.

The complete and modern monitoring system for Botswana also includes the larger city areas and will also cover emissions from industries, waste burning, energy sources and traffic. The programme has been used as a planning tool for environmental improvement, including consequence analysis and impact assessment capabilities.

The first results from the monitoring programme also support that episodic high concentrations of SO2 have been observed at a site located about 15 km north-west of the Selebe Phikwe copper smelters.

The AirQUIS system has been applied in **Durban, South Africa** in order to perform planning and abatement studies (Chetty, 2007). The programme integrates emission inventories, ambient air quality measurements, a quality assurance (QA/QC) programme, data acquisition, data storage as well as modelling and impact assessment procedures utilizing all data and systems that are already operating in the region. The development includes a capacity building programme.

The eThekwini Health Unit has made great strides in improving air quality since the creation of the Multi-Point Plan in 2000. Modern technology such the AirQUIS system has provided the opportunity to track air quality in real time and provide data to the public, industry, local, provincial and national government and other stakeholders and institutions. The air quality in the eThekwini area has showed a significant improvement in 2007 as compared to 2003 due to continuous government and stakeholder engagement and participation.

NILU has designed a programme to facilitate the support for development and operations of an air quality monitoring and management programme for **Dakar, Senegal** (Guerreiro et. al 2007, Sivertsen et.al 2007). The programme includes screening studies, network design; a GIS based database system, emission inventories and modelling. A major task will also include the establishment of institutions and laboratories. Training seminars, workshops and on-the job training will represent some of the input to obtain sustainability in the establishment.

8 PM10 abatement in Norway

NILU has performed dispersion and exposure calculations to evaluate the extent of abatement measures needed in order to fulfil the goals defined in the "Norwegian Air Quality Target for PM_{10}" (Slørdal et.al 2006). The air quality management system AirQUIS (AirQUIS, 2006) was applied in two cities; Oslo and Trondheim. Based on projected emissions, a Reference 2010 simulation has been performed. Exposure were performed in order to indicate the exceedance levels to be expected if no abatement measures were invoked. Then a set of abatement measures was defined. By incorporating the effect of these measures on the Reference 2010 emission inventory, a series of Scenario simulations were performed.

Ambient air concentrations and population exposure have been calculated both in the positions of buildings located close to the main road network and within a domain-covering, two-dimensional grid with a quadratic 1 km^2 grid.

The total number of inhabitants exposed beyond the "National Target" for PM_{10} for the two reference simulations and the various scenario simulations are presented in Figure 5 for the cases in Oslo.

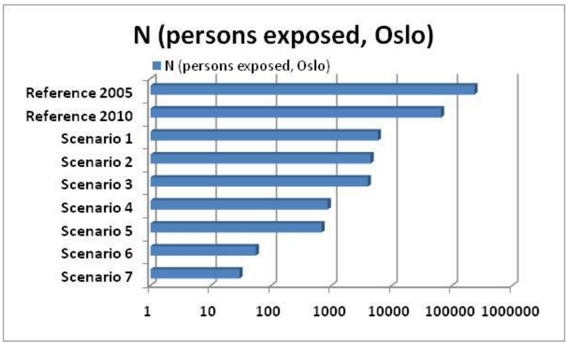

Figure 5: Total number of people exposed beyond the Norwegian Target values for PM_{10} for reference cases and 7 Scenarios.

These findings indicate that strong traffic-oriented measures are needed in order to reach the goal. Furthermore, tests performed in this study clearly demonstrated that all local sources apart from road traffic and domestic wood burning are of marginal importance, and the emphasize is therefore put on measures reducing the contribution from these two sources.

9 Summary and conclusions

The air quality management planning process should not be considered a once-off process to address air quality issues, which ends after implementation. It should rather be a process that focuses on the long term goal of improving air quality and maintaining a healthy environment. This requires tracking progress of the plan on a routine basis (e.g. annually) to establish if intervention strategies have been effective. It will also define the areas of responsibility of different levels of government, industry and relevant stakeholders

The benefits of developing an AQMP include the following:

- Development of long term strategies for dealing with air quality issues
- Provides a mechanism for presenting the public with a comprehensive picture of what is happening with the air quality in their area
- Facilitate the potential affected sources to plan installation of controls and/or process changes
- Co-ordination of Local government, initiation of partnerships between stakeholders and public to work together on improving ambient air quality

The successful implementation of an AQMP is dependant on the involvement of all stakeholders and the adoption of an AQMP will yield many benefits for all.

The "Clean development Mechanism" (CDM) provides financing opportunity for urban authorities to realize the environmental control. Because the improvement of the air quality in most of the area will certainly reduce the CO_2, as well as other greenhouse gases emission. This will thus attract countries or companies to invest in order to reach the standard through the reduction of the emissions.

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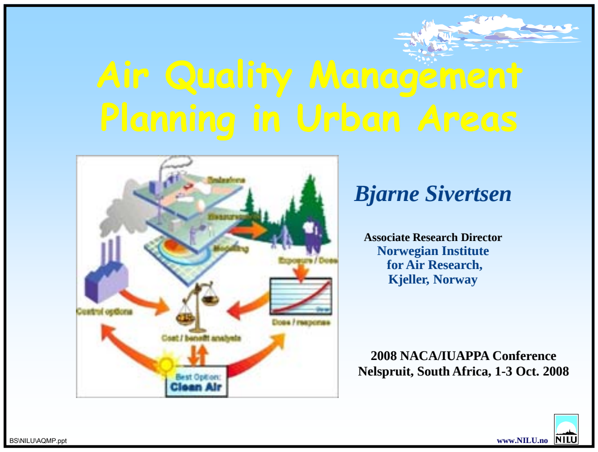
Air Quality Management
Planning in Urban Areas
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Measurements
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Exposure / Dose
Control options
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Cost / benefit analysis
Best Option:
Clean Air
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Norwegian Institute
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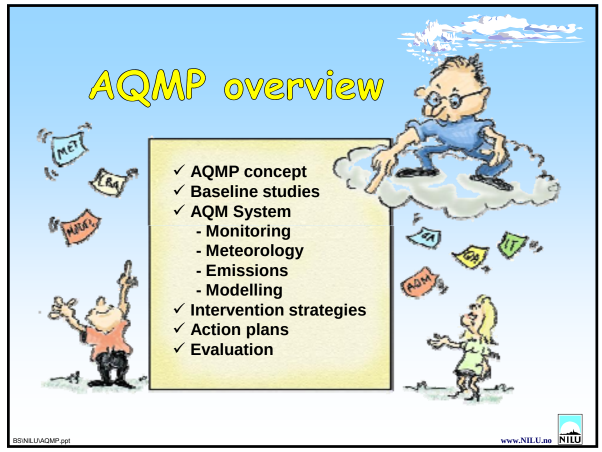
AQMP overview
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✓ Baseline studies
✓ AQM System
- Monitoring
- Meteorology
- Emissions
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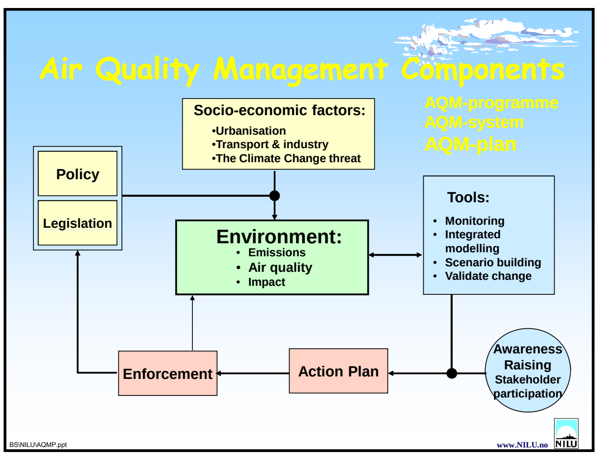
Air Quality Management Components
Socio-economic factors:
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•Transport & industry
•The Climate Change threat
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AQM-system
AQM-plan
Policy
Legislation
Environment:
• Emissions
• Air quality
• Impact
Tools:
• Monitoring
• Integrated modelling
• Scenario building
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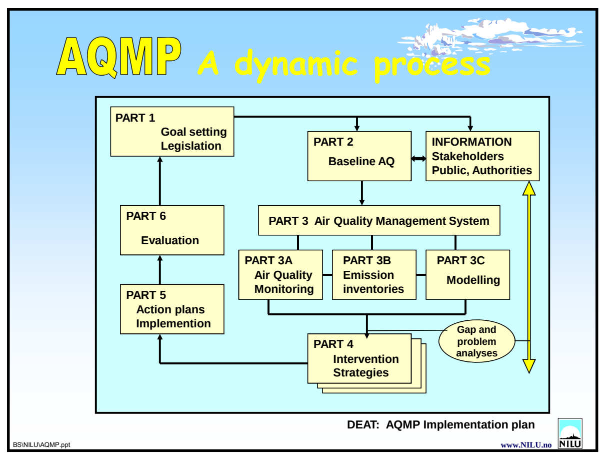
AQMP A dynamic process
PART 1
Goal setting
Legislation
PART 2
Baseline AQ
INFORMATION
Stakeholders
Public, Authorities
PART 6
Evaluation
PART 3 Air Quality Management System
PART 3A
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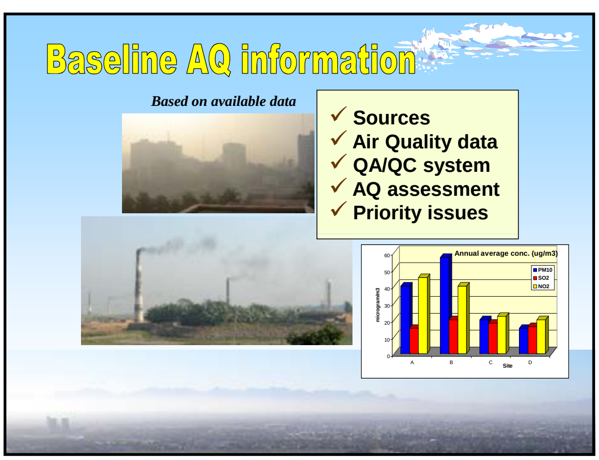
Baseline AQ information
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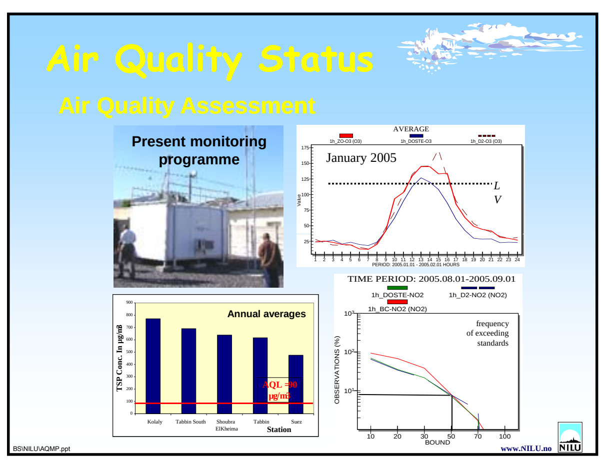
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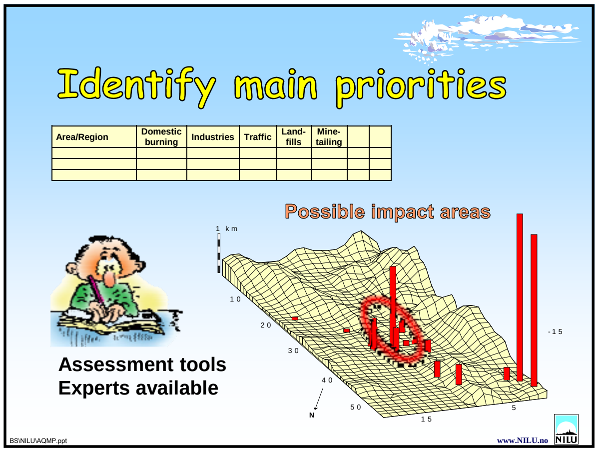
Identify main priorities
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Domestic burning
Industries
Traffic
Land-fills
Mine-tailing
Possible impact areas
Assessment tools
Experts available
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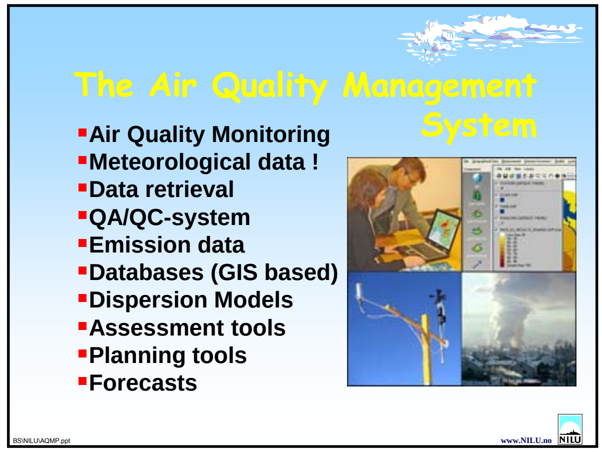
The Air Quality Management System
Air Quality Monitoring
Meteorological data !
Data retrieval
QA/QC-system
Emission data
Databases (GIS based)
Dispersion Models
Assessment tools
Planning tools
Forecasts
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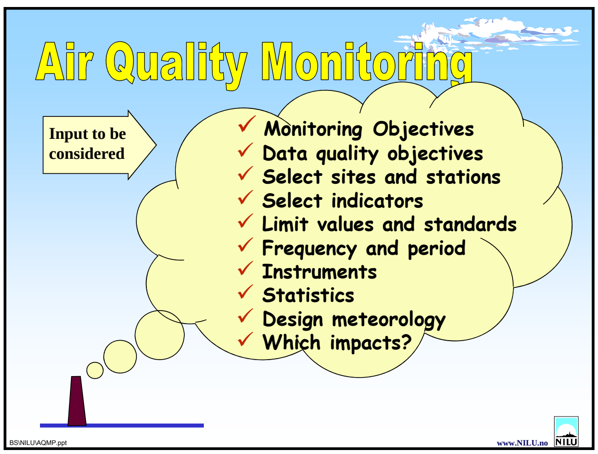
Air Quality Monitoring
Input to be considered
Monitoring Objectives
Data quality objectives
Select sites and stations
Select indicators
Limit values and standards
Frequency and period
Instruments
Statistics
Design meteorology
Which impacts?
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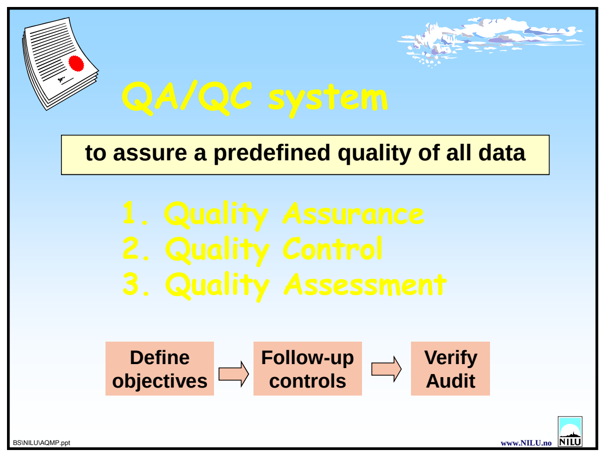
QA/QC system
to assure a predefined quality of all data
1. Quality Assurance
2. Quality Control
3. Quality Assessment
Define objectives
Follow-up controls
Verify Audit
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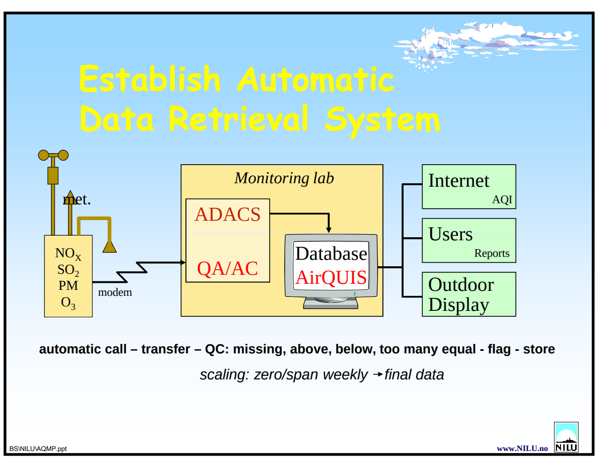
Establish Automatic Data Retrieval System
met.
NOX
SO2
PM
O3
modem
Monitoring lab
ADACS
QA/AC
Database
AirQUIS
Internet
AQI
Users
Reports
Outdoor Display
automatic call – transfer – QC: missing, above, below, too many equal - flag - store
scaling: zero/span weekly → final data
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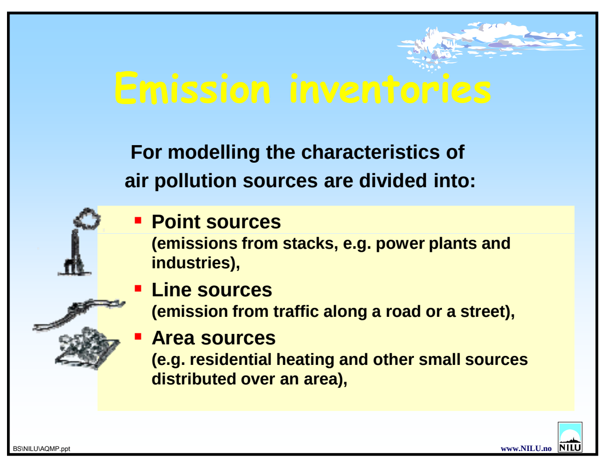
Emission inventories
For modelling the characteristics of air pollution sources are divided into:
Point sources
(emissions from stacks, e.g. power plants and industries),
Line sources
(emission from traffic along a road or a street),
Area sources
(e.g. residential heating and other small sources distributed over an area),
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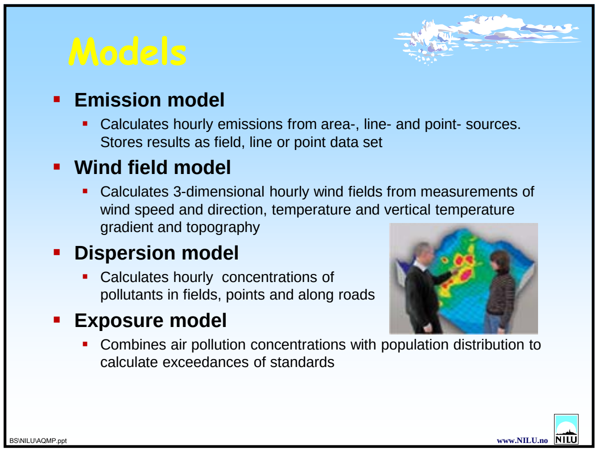
Models
Emission model
Calculates hourly emissions from area-, line- and point- sources. Stores results as field, line or point data set
Wind field model
Calculates 3-dimensional hourly wind fields from measurements of wind speed and direction, temperature and vertical temperature gradient and topography
Dispersion model
Calculates hourly concentrations of pollutants in fields, points and along roads
Exposure model
Combines air pollution concentrations with population distribution to calculate exceedances of standards
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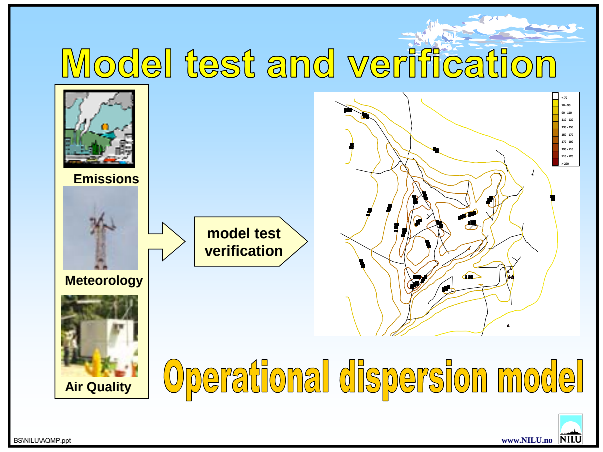
Model test and verification
Emissions
Meteorology
Air Quality
model test verification
Operational dispersion model
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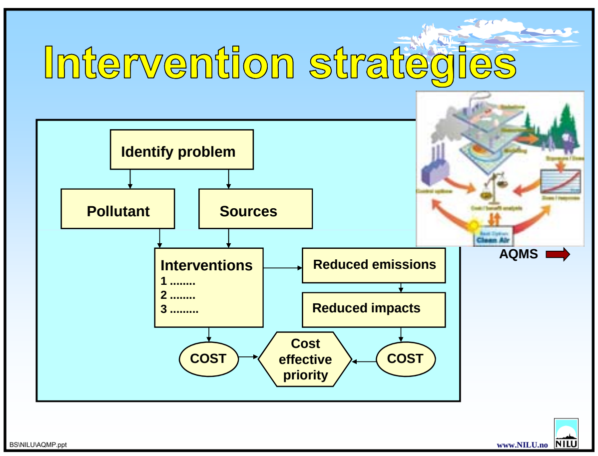
Intervention strategies
Identify problem
Pollutant
Sources
Interventions
1 ....
2 ....
3 ....
Reduced emissions
Reduced impacts
COST
Cost effective priority
COST
AQMS
BS\NILU\AQMP.ppt
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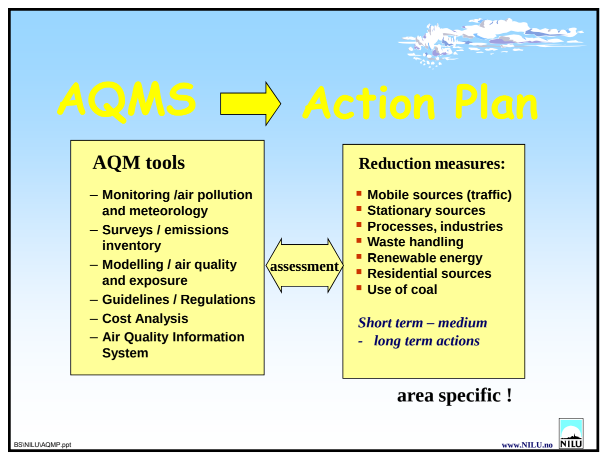
AQMS
Action Plan
AQM tools
– Monitoring /air pollution and meteorology
– Surveys / emissions inventory
– Modelling / air quality and exposure
– Guidelines / Regulations
– Cost Analysis
– Air Quality Information System
assessment
Reduction measures:
Mobile sources (traffic)
Stationary sources
Processes, industries
Waste handling
Renewable energy
Residential sources
Use of coal
Short term – medium
- long term actions
area specific !
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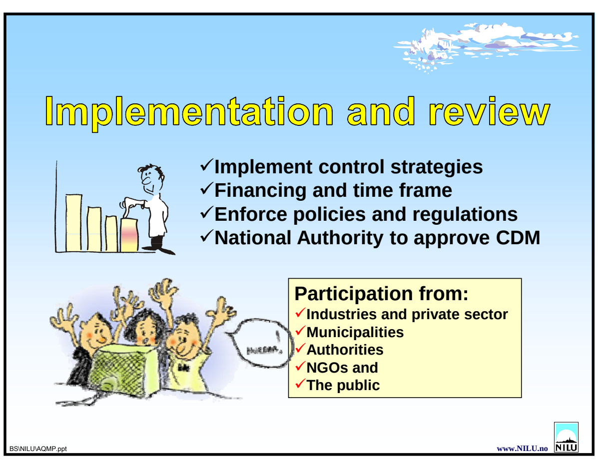
Implementation and review
✓Implement control strategies
✓Financing and time frame
✓Enforce policies and regulations
✓National Authority to approve CDM
Participation from:
✓Industries and private sector
✓Municipalities
✓Authorities
✓NGOs and
✓The public
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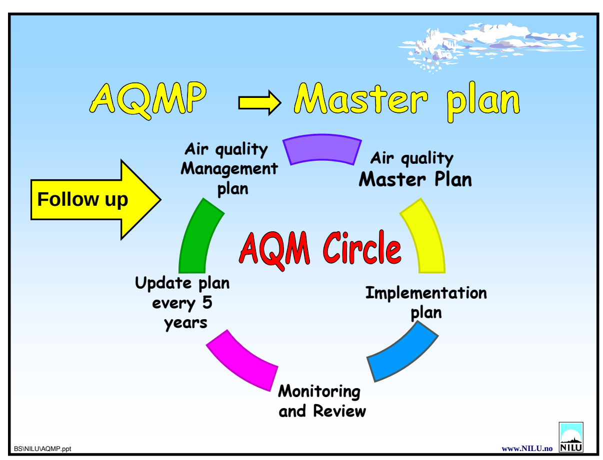
AQMP
Master plan
Follow up
Air quality Management plan
Air quality Master Plan
AQM Circle
Update plan every 5 years
Implementation plan
Monitoring and Review
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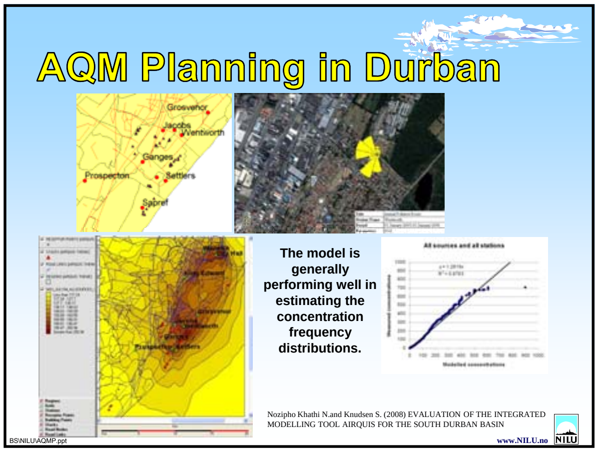
AQM Planning in Durban
Grosvenor
Jacobs
Wentworth
Ganges
Prospecton
Settlers
Sabref
The model is generally performing well in estimating the concentration frequency distributions.
All sources and all stations
Nozipho Khathi N.and Knudsen S. (2008) EVALUATION OF THE INTEGRATED MODELLING TOOL AIRQUIS FOR THE SOUTH DURBAN BASIN
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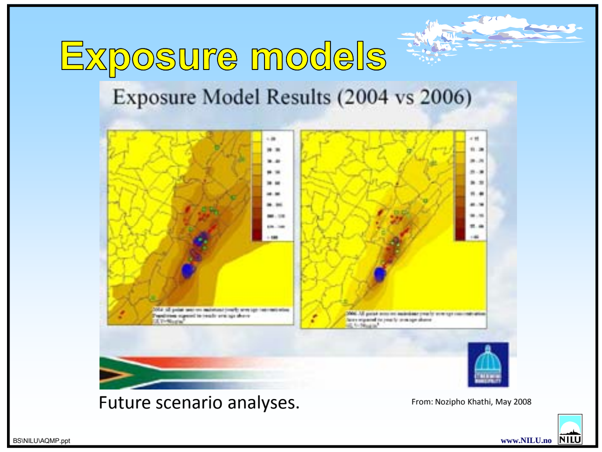
Exposure models
Exposure Model Results (2004 vs 2006)
Future scenario analyses.
From: Nozipho Khathi, May 2008
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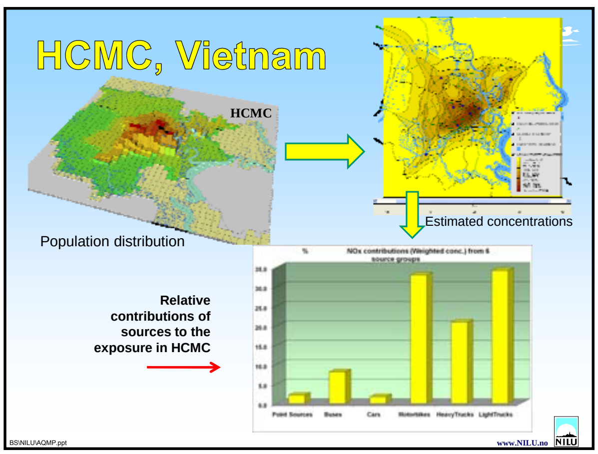
HCMC, Vietnam
HCMC
Population distribution
Estimated concentrations
Relative contributions of sources to the exposure in HCMC
NOx contributions (Weighted conc.) from 6 source groups
Point Sources
Buses
Cars
Motorbikes
HeavyTrucks
LightTrucks
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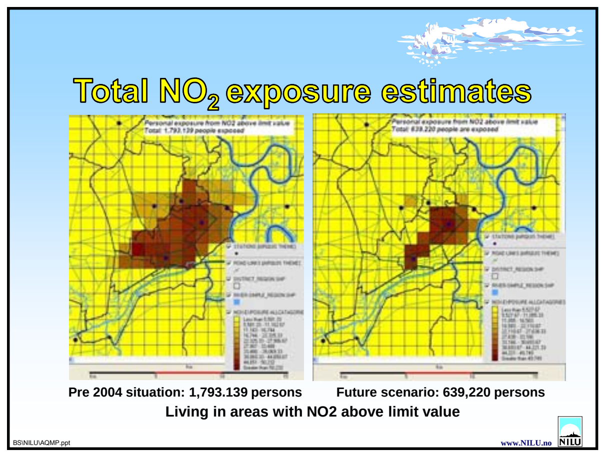
Total NO_2 exposure estimates
Pre 2004 situation: 1,793.139 persons
Future scenario: 639,220 persons
Living in areas with NO2 above limit value
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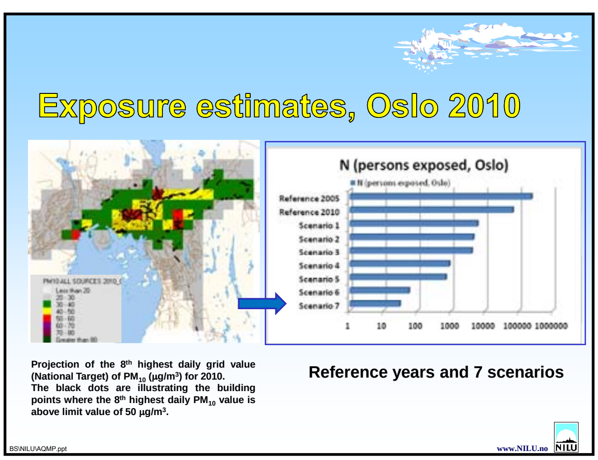
Exposure estimates, Oslo 2010
N (persons exposed, Oslo)
Reference 2005
Reference 2010
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5
Scenario 6
Scenario 7
1 10 100 1000 10000 100000 1000000
Projection of the 8th highest daily grid value (National Target) of PM_{10} (μg/m³) for 2010. The black dots are illustrating the building points where the 8th highest daily PM_{10} value is above limit value of 50 μg/m³.
Reference years and 7 scenarios
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Ex: Cost-effective actions
A.Q. Assessment
Health impacts
Abatement options
Cost analyses
Optimal abatement strategy
Guangzhou, China
SO_2 Options
Cost effective SO_2 options
Cost per ton SO_2 removed
Reduction potential
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费用效益分析
Cost benefit analysis

Shanxi, China

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	18450	6.47	115	4
Centralized heating	30000	51.89	-424	1
Implementation of productivity policies	9280	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	-0.489	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

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IPCC:

Climate Change: Our largest threat !

Urban AQ analyses + Green house gas estimates

Urban emission inventories	CO_2 GHG emissions	Reduced CO_2 emissions	Co-benefit
National inventory	SO_2, NOx PM, VOC toxics	Actions for improved local Air quality	Improve local Air Quality + Reduce green house gas emissions

Energy production, fuel consumtion industrial emissions, traffic, waste burning

State – Provinces - Municipalities

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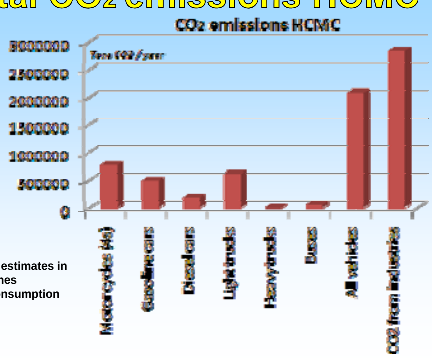
Total CO2 emissions HCMC



Industrial CO2
Based on SO2 estimates in 9 industrial zones and total oil consumption in HCMC 2002

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Summary and conclusions

AQMP :
- Assessing the AQ situation
- Develop long term strategies
- Tool for information and decisions
- Identify cost-effective measures
- Improving the air quality together:
- politicians, stakeholders, NGOs and public

Clean Development Mechanism (CDM) provide financing and may be part of the AQMP process.

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