Introduction to Scenario Sessions

Lars Strupeit

Malé Declaration: Emission inventory preparation / scenarios / atmospheric transport modelling and soil acidification workshop

UNEP RRCAP, Bangkok, Thailand. 28 January to 1 February 2008

the international institute for industrial environmental economics
Lund University, Sweden
iiiee

Outline

- What have we done in previous workshops?
  - July 2006
  - February 2007

- What will we do in the scenario sessions in this workshop?
  - January 2008

July 2006 workshop

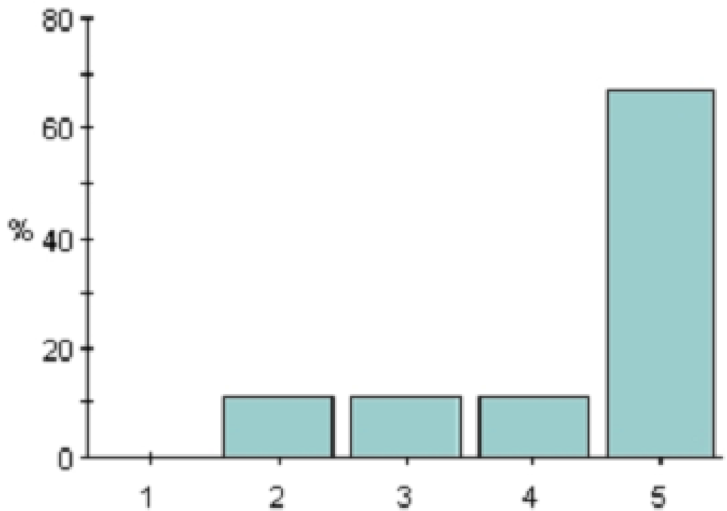
- What are scenarios and what is their purpose?
  - Scenario types and characteristics e.g.
    - quantitative vs qualitative
    - forecasting vs backcasting
  - What are emission scenarios?
  - Examples of scenarios work done

- Backcasting exercise
  - "Imagine a South Asian city in 2026."
  - example for a qualitative scenario

Feedback obtained after the July 2006 workshop

- About which topics would you like to learn more to support your professional work?

How to conduct an Emission Scenario

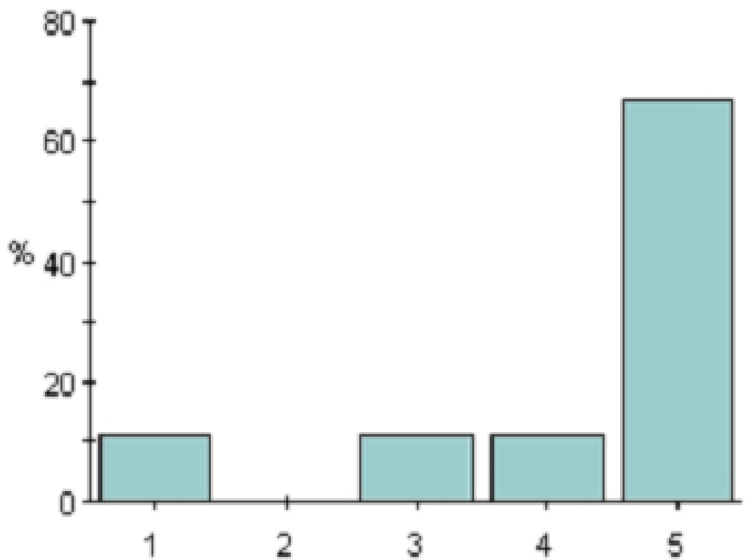


	%	#
1	0%	0
2	11.1%	1
3	11.1%	1
4	11.1%	1
5	66.7%	6
Total	100%	9
Mean		4.3

Feedback obtained after the July 2006 workshop

- About which topics would you like to learn more to support your professional work?

Tools and modeling approaches for emission scenarios



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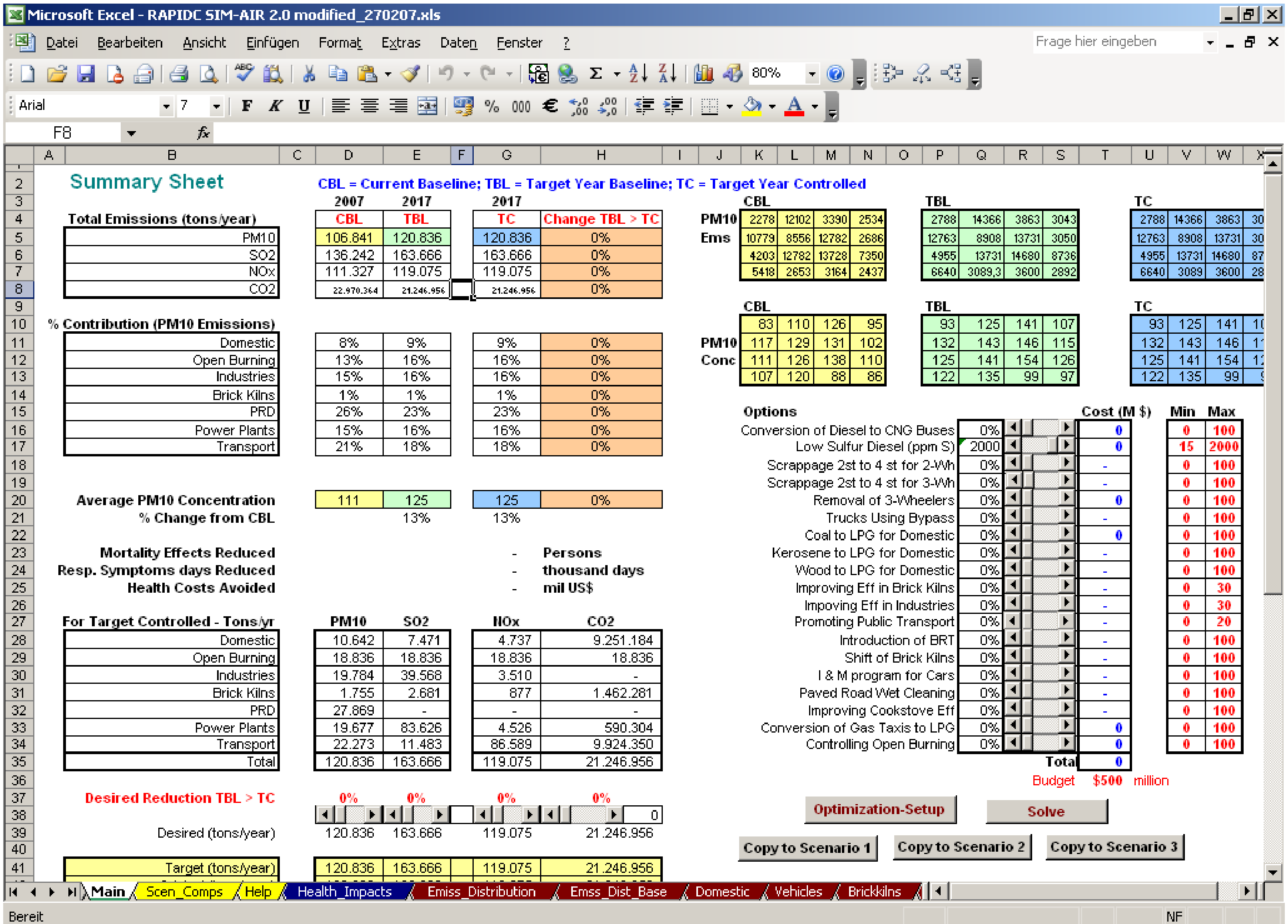
1	11.1%	1
2	0%	0
3	11.1%	1
4	11.1%	1
5	66.7%	6
Total	100%	9
Mean		4.2

February 2007 workshop

- What are emission scenarios?
- Exercise: Building scenarios and Integrated Assessment with SIM-AIR tool
  - SIM-AIR: tool to conduct Integrated Assessment and building scenarios on a city level
  - Baseline and Alternative Policy Scenarios
  - Evaluation and optimization of policy options for air pollution prevention and control

SIM-AIR model



Microsoft Excel - RAPIDC SIM-AIR 2.0 modified_270207.xls

Datei Bearbeiten Ansicht Einfügen Format Extras Daten Fenster ?

Summary Sheet

CBL = Current Baseline; TBL = Target Year Baseline; TC = Target Year Controlled

Total Emissions (tons/year)	2007 CBL	2017 TBL	2017 TC	Change TBL > TC
PM10	106.841	120.836	120.836	0%
SO2	136.242	163.666	163.666	0%
NOx	111.327	119.075	119.075	0%
CO2	22.970.364	21.246.956	21.246.956	0%

% Contribution (PM10 Emissions)	CBL	TBL	TC	Change
Domestic	8%	9%	9%	0%
Open Burning	13%	16%	16%	0%
Industries	15%	16%	16%	0%
Brick Kilns	1%	1%	1%	0%
PRD	26%	23%	23%	0%
Power Plants	15%	16%	16%	0%
Transport	21%	18%	18%	0%

	CBL	TBL	TC	Change
Average PM10 Concentration	111	125	125	0%
% Change from CBL		13%	13%	

Mortality Effects Reduced	-	Persons
Resp. Symptoms days Reduced	-	thousand days
Health Costs Avoided	-	mil US$

For Target Controlled - Tons/yr	PM10	SO2	NOx	CO2
Domestic	10.642	7.471	4.737	9.251.184
Open Burning	18.836	18.836	18.836	18.836
Industries	19.784	39.568	3.510	-
Brick Kilns	1.755	2.681	877	1.462.281
PRD	27.869	-	-	-
Power Plants	19.677	83.626	4.526	590.304
Transport	22.273	11.483	86.589	9.924.350
Total	120.836	163.666	119.075	21.246.956

	PM10	SO2	NOx	CO2
Desired Reduction TBL > TC	0%	0%	0%	0%
Desired (tons/year)	120.836	163.666	119.075	21.246.956
Target (tons/year)	120.836	163.666	119.075	21.246.956

PM10 Ems

CBL				TBL				TC			
2278	12102	3390	2534	2788	14366	3863	3043	2788	14366	3863	30
10779	8556	12782	2686	12763	8908	13731	3050	12763	8908	13731	30
4203	12782	13728	7350	4955	13731	14680	8736	4955	13731	14680	87
5418	2653	3164	2437	6640	3089,3	3600	2892	6640	3089	3600	28

PM10 Conc

CBL				TBL				TC			
83	110	126	95	93	125	141	107	93	125	141	1(
117	129	131	102	132	143	146	115	132	143	146	1
111	126	138	110	125	141	154	126	125	141	154	1
107	120	88	86	122	135	99	97	122	135	99	

Options		Cost (M $)	Min	Max
Conversion of Diesel to CNG Buses	0%	0	0	100
Low Sulfur Diesel (ppm S)	2000	0	15	2000
Scrappage 2st to 4 st for 2-Wh	0%	-	0	100
Scrappage 2st to 4 st for 3-Wh	0%	-	0	100
Removal of 3-Wheelers	0%	0	0	100
Trucks Using Bypass	0%	-	0	100
Coal to LPG for Domestic	0%	0	0	100
Kerosene to LPG for Domestic	0%	-	0	100
Wood to LPG for Domestic	0%	-	0	100
Improving Eff in Brick Kilns	0%	-	0	30
Impoving Eff in Industries	0%	-	0	30
Promoting Public Transport	0%	-	0	20
Introduction of BRT	0%	-	0	100
Shift of Brick Kilns	0%	-	0	100
I & M program for Cars	0%	-	0	100
Paved Road Wet Cleaning	0%	-	0	100
Improving Cookstove Eff	0%	-	0	100
Conversion of Gas Taxis to LPG	0%	0	0	100
Controlling Open Burning	0%	0	0	100
Total		0		

Budget $500 million

Optimization-Setup | Solve

Copy to Scenario 1 | Copy to Scenario 2 | Copy to Scenario 3

Main / Scen_Comps / Help / Health_Impacts / Emiss_Distribution / Emss_Dist_Base / Domestic / Vehicles / Brickkilns

Bereit

Current Baseline (CBL) = emission inventory

Vehicle Data

Return to Main

Sheet Contains
Current and Target Year Baseline and Controlled

Vehicle Characteristics - Current Year = 2007

			Emission Factors (gm/km)				Total Emissions (tons/yr)			
Vehicle Type	## Vehicles	VKT (km/day)	PM10	SOx	NOx	CO2	PM10	SOx	NOx	CO2
2 Wheeler - 2st	500.000	20	0,10	0,08	0,30	70,0	365	292	1.095	255.500
2 Wheeler - 4st	600.000	20	0,02	0,02	0,10	50,0	88	88	438	219.000
3-Wheeler - 2st	100.000	40	0,10	0,08	0,30	70,0	146	117	438	102.200
3-Wheeler - 4st	20.000	40	0,02	0,02	0,10	50,0	6	6	29	14.600
Car/Jeep/Van-Gasoline	1.000.000	30	0,40	0,08	1,00	150,0	4.380	876	10.950	1.642.500
Car/Jeep/Van-Diesel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.643	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18	[illegible]	[illegible]
Taxi-CNG	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]
Taxi-LPG	500	100	0,10	0,10	0,80	100,0	2	2	15	1.825
Medium Bus - Diesel	40.000	100	1,60	0,80	17,00	1.000,0	2.336	1.168	24.820	1.460.000
Medium Bus - CNG	2.000	100	0,70	0,40	12,00	500,0	51	29	876	36.500
Large Bus - Diesel	40.000	130	1,60	0,80	17,00	1.000,0	3.037	1.518	32.266	1.898.000
Large Bus - CNG	2.000	130	0,70	0,40	12,00	500,0	66	38	1.139	47.450
LD Truck - Diesel	80.000	50	2,50	2,20	2,20	1.000,0	3.650	3.212	3.212	1.460.000
HD Truck - Diesel	10.000	300	2,50	2,20	2,20	1.200,0	2.738	2.409	2.409	1.314.000
						Total	22.273	11.483	86.589	9.924.350

Vehicle Characteristics - Target Year = 2017

			Emission Factors (gm/km)				Total Emissions (tons/yr)				
Vehicle Type	## Vehicles	VKT (km/day)	PM10	SOx	NOx	CO2	PM10	SOx	NOx	CO2	% Annual Growth Rates
2 Wheeler - 2st	740.122	20	0,10	0,08	0,30	70,0	540	432	1.621	378.202	4,0%

Summary | Help | Health_Impacts | Emiss_Distribution | Domestic | Vehicles | Brickkilns | OpenBurn | PRD | Industries

Bereit NF

Vehicle numbers

Average activity rate per vehicle

Average emission factors

Total emissions in 2007

Building baseline scenario by assuming a higher transport volume

Vehicle Characteristics - Target Year = 2017

Vehicle Type	## Vehicles	VKT (km/day)	Emission Factors (gm/km) PM10	SOx	NOx	CO2	Total Emissions (tons/yr) PM10	SOx	NOx	CO2	% Annual Growth Rates
2 Wheeler - 2st	740.122	20	0,10	0,08	0,30	70,0	[illegible]	[illegible]	1.621	378.202	4,0%
2 Wheeler - 4st	977.337	20	0,02	0,02	0,10	50,0	[illegible]	[illegible]	713	356.728	5,0%
3-Wheeler - 2st	179.085	40	0,10	0,08	0,30	70,0	[illegible]	[illegible]	784	1[illegible]3.025	6,0%
3-Wheeler - 4st	35.817	40	0,02	0,02	0,10	50,0	[illegible]	[illegible]	[illegible]	[illegible]146	6,0%
Car/Jeep/Van-Gasoline	1.343.916	30	0,40	0,08	1,00	150,0	[illegible]	[illegible]	4.7[illegible]	2.2[illegible].383	3,0%
Car/Jeep/Van-Diesel	814.447	30	0,95	0,30	1,50	250,0	[illegible]	[illegible]	3.377	2.229.550	5,0%
Car/Jeep/Van-CNG	35.265	30	0,20	0,08	0,80	100,0	[illegible]	[illegible]	309	38.615	3,5%
Car/Jeep/Van-LPG	35.265	30	0,20	0,08	0,80	100,0	[illegible]	[illegible]	309	38.615	3,5%
Taxi-Gasoline	10.305	100	0,35	0,12	1,00	200,0	[illegible]	[illegible]	376	75.228	7,5%
Taxi-Diesel	1.708	100	0,90	0,50	1,50	300,0	56	31	94	18.704	5,5%
Taxi-CNG	640	100	0,10	0,10	0,80	100,0	2	2	19	2.336	2,5%
Taxi-LPG	1.031	100	0,10	0,10	0,80	100,0	4	4	30	3.761	7,5%
Medium Bus - Diesel	67.041	100	1,60	0,80	17,00	1.000,0	3.915	1.958	41.599	2.447.015	5,3%
Medium Bus - CNG	5.187	100	0,70	0,40	12,00	500,0	133	76	2.272	94.672	10,0%
Large Bus - Diesel	51.203	130	1,60	0,80	17,00	1.000,0	3.887	1.944	41.303	2.429.600	2,5%
Large Bus - CNG	3.258	130	0,70	0,40	12,00	500,0	108	62	1.855	77.291	5,0%
LD Truck - Diesel	107.513	50	2,50	2,20	2,20	1.000,0	4.905	4.317	4.317	1.962.118	[illegible],0%
HD Truck - Diesel	13.439	300	2,50	2,20	2,20	1.200,0	3.679	3.237	3.237	1.765.906	3,0%
						Total	32.289	16.384	126.984	14.334.895	
						% Chang	45,0%	42,7%	46,7%	44,4%	

Annual growth rates of vehicle numbers

Baseline scenario

Vehicle Characteristics - Target Year = 2017

Vehicle Type	## Vehicles	VKT (km/day)	Emission Factors (gm/km) PM10	SOx	NOx	CO2	[illegible] PM10	SOx	NOx	CO2	% Annual Growth Rates
2 Wheeler - 2st	740.122	20	0,10	0,08	0,30	70,0	[illegible]	[illegible]	[illegible]	378.202	4,0%
2 Wheeler - 4st	977.337	20	0,02	0,02	0,10	50,0	[illegible]	[illegible]	[illegible]	356.728	5,0%
3-Wheeler - 2st	179.085	40	0,10	0,08	0,30	70,0	[illegible]	[illegible]	[illegible]	183.025	6,0%
3-Wheeler - 4st	35.817	40	0,02	0,02	0,10	50,0	10	10	52	26.146	6,0%
Car/Jeep/Van-Gasoline	1.343.916	30	0,40	0,08	1,00	150,0	5.886	1.177	14.716	2.207.383	3,0%
Car/Jeep/Van-Diesel	814.447	30	0,95	0,30	1,50	250,0	8.472	2.675	13.377	2.229.550	5,0%
Car/Jeep/Van-CNG	35.265	30	0,20	0,08	0,80	100,0	77	31	300	38.615	2,5%
Car/Jeep/Van-LPG	35.265	30	0,20	0,08	0,80	100,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Taxi-Gasoline	10.305	100	0,35	0,12	1,00	200,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Taxi-Diesel	1.708	100	0,90	0,50	1,50	300,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Taxi-CNG	640	100	0,10	0,10	0,80	100,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Taxi-LPG	1.031	100	0,10	0,10	0,80	100,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Medium Bus - Diesel	67.041	100	1,60	0,80	17,00	1.000,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Medium Bus - CNG	5.187	100	0,70	0,40	12,00	500,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Large Bus - Diesel	51.203	130	1,60	0,80	17,00	1.000,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Large Bus - CNG	3.258	130	0,70	0,40	12,00	500,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LD Truck - Diesel	107.513	50	2,50	2,20	2,20	1.000,0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HD Truck - Diesel	13.439	300	2,50	2,20	2,20	1.200,0	3.679	3.237	3.237	1.765.906	3,0%
						Total	32.289	16.384	126.984	14.334.895	
						% Chang	45,0%	42,7%	46,7%	44,4%	

Average emission factors in target year

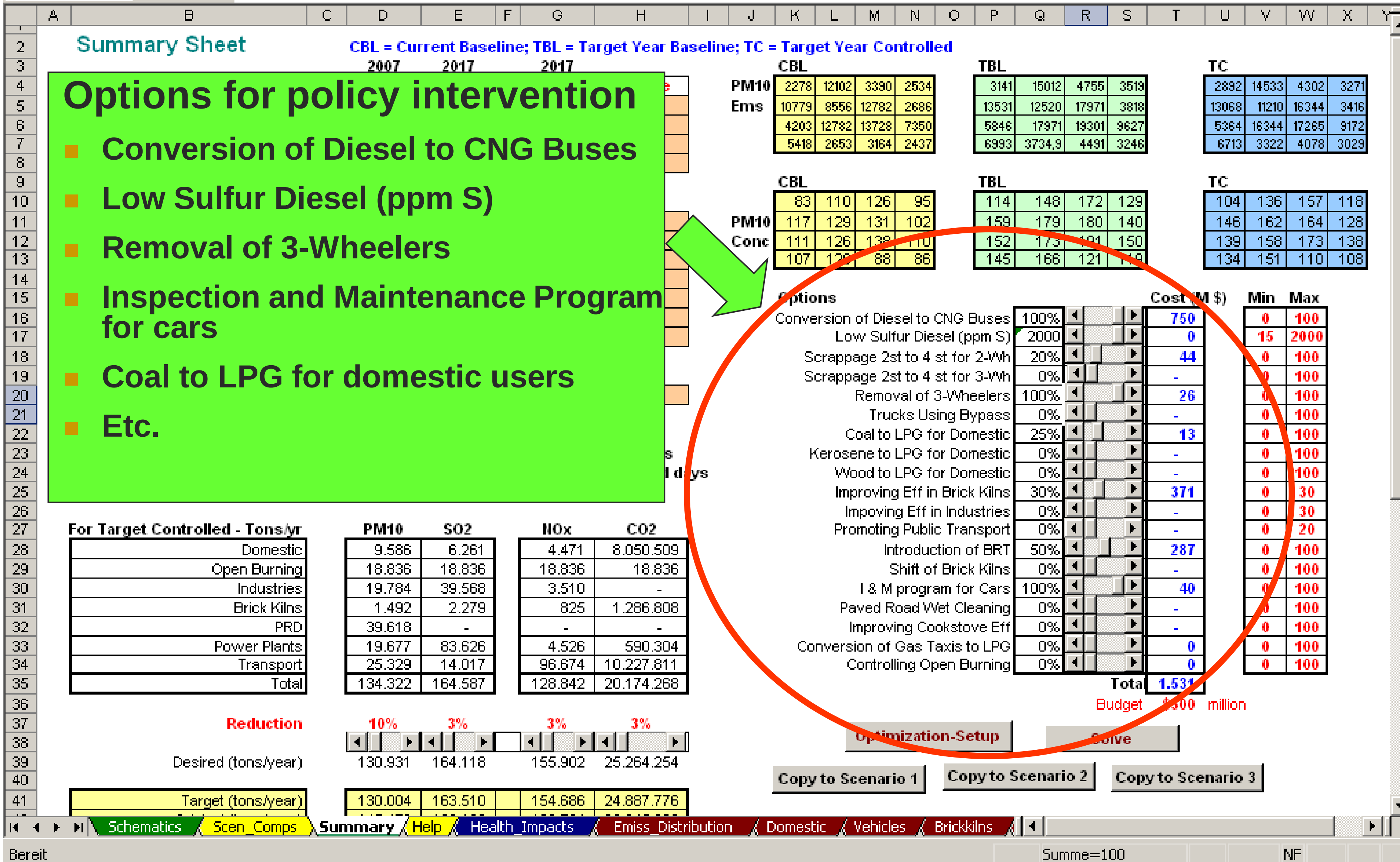
Even without policy intervention, these figures are likely to change in the future due to regular renewal of the vehicle fleet

Note: SIM-AIR 2.0 does not model these changes

Building alternative policy scenarios

Options for policy intervention

- Conversion of Diesel to CNG Buses
- Low Sulfur Diesel (ppm S)
- Removal of 3-Wheelers
- Inspection and Maintenance Program for cars
- Coal to LPG for domestic users
- Etc.



Summary Sheet

CBL = Current Baseline; TBL = Target Year Baseline; TC = Target Year Controlled

PM10 Ems

CBL				TBL				TC			
2278	12102	3390	2534	3141	15012	4755	3519	2892	14533	4302	3271
10779	8556	12782	2686	13531	12520	17971	3818	13068	11210	16344	3416
4203	12782	13728	7350	5846	17971	19301	9627	5364	16344	17265	9172
5418	2653	3164	2437	6993	3734,9	4491	3246	6713	3322	4078	3029

PM10 Conc

CBL				TBL				TC			
83	110	126	95	114	148	172	129	104	136	157	118
117	129	131	102	159	179	180	140	146	162	164	128
111	126	[illegible]	[illegible]	152	[illegible]	[illegible]	150	139	158	173	138
107	[illegible]	88	86	145	166	121	[illegible]	134	151	110	108

Options		Cost (M $)	Min	Max
Conversion of Diesel to CNG Buses	100%	750	0	100
Low Sulfur Diesel (ppm S)	2000	0	15	2000
Scrappage 2st to 4 st for 2-Wh	20%	44	0	100
Scrappage 2st to 4 st for 3-Wh	0%	-	0	100
Removal of 3-Wheelers	100%	26	0	100
Trucks Using Bypass	0%	-	0	100
Coal to LPG for Domestic	25%	13	0	100
Kerosene to LPG for Domestic	0%	-	0	100
Wood to LPG for Domestic	0%	-	0	100
Improving Eff in Brick Kilns	30%	371	0	30
Impoving Eff in Industries	0%	-	0	30
Promoting Public Transport	0%	-	0	20
Introduction of BRT	50%	287	0	100
Shift of Brick Kilns	0%	-	0	100
I & M program for Cars	100%	40	0	100
Paved Road Wet Cleaning	0%	-	0	100
Improving Cookstove Eff	0%	-	0	100
Conversion of Gas Taxis to LPG	0%	0	0	100
Controlling Open Burning	0%	0	0	100
Total		1.531		

Budget [illegible] million

Optimization-Setup | Solve

Copy to Scenario 1 | Copy to Scenario 2 | Copy to Scenario 3

For Target Controlled - Tons/yr	PM10	SO2	NOx	CO2
Domestic	9.586	6.261	4.471	8.050.509
Open Burning	18.836	18.836	18.836	18.836
Industries	19.784	39.568	3.510	-
Brick Kilns	1.492	2.279	825	1.286.808
PRD	39.618	-	-	-
Power Plants	19.677	83.626	4.526	590.304
Transport	25.329	14.017	96.674	10.227.811
Total	134.322	164.587	128.842	20.174.268
Reduction	10%	3%	3%	3%
Desired (tons/year)	130.931	164.118	155.902	25.264.254
Target (tons/year)	130.004	163.510	154.686	24.887.776

Schematics | Scen_Comps | Summary | Help | Health_Impacts | Emiss_Distribution | Domestic | Vehicles | Brickkilns

Bereit Summe=100 NF

This workshop (January 2008)

- Case study: IEA Energy Scenarios for India for 2030
- Methodologies for the building of emission scenarios
  - Economic development and energy demand
  - Energy demand, energy prices and fuel mix
  - Energy demand versus electricity demand
  - Technology change
  - Policy intervention

This workshop (January 2008)

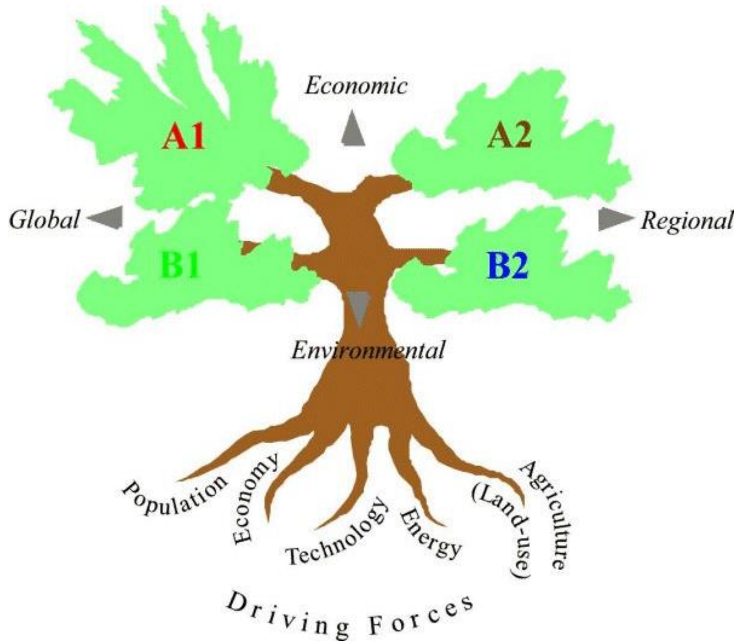
- Exercise: Building emission scenarios for India for 2030
- Two stages
  1. Building energy scenarios and change of emission factors
  2. Feed this data into scenario sheets of the Emission Inventory Workbook to calculate emission scenarios for your countries for 2030
- Presentation of results / discussion of further needs

ADDITIONAL SLIDES

- What are emission scenarios?
- What are emission scenarios used for?

What are emission scenarios?

- *A plausible quantitative description of how emissions in the future may develop, based on a coherent and internally consistent set of assumptions ("scenario logic") about key relationships and driving forces.*
- *Emission scenarios are neither predictions nor forecasts.*

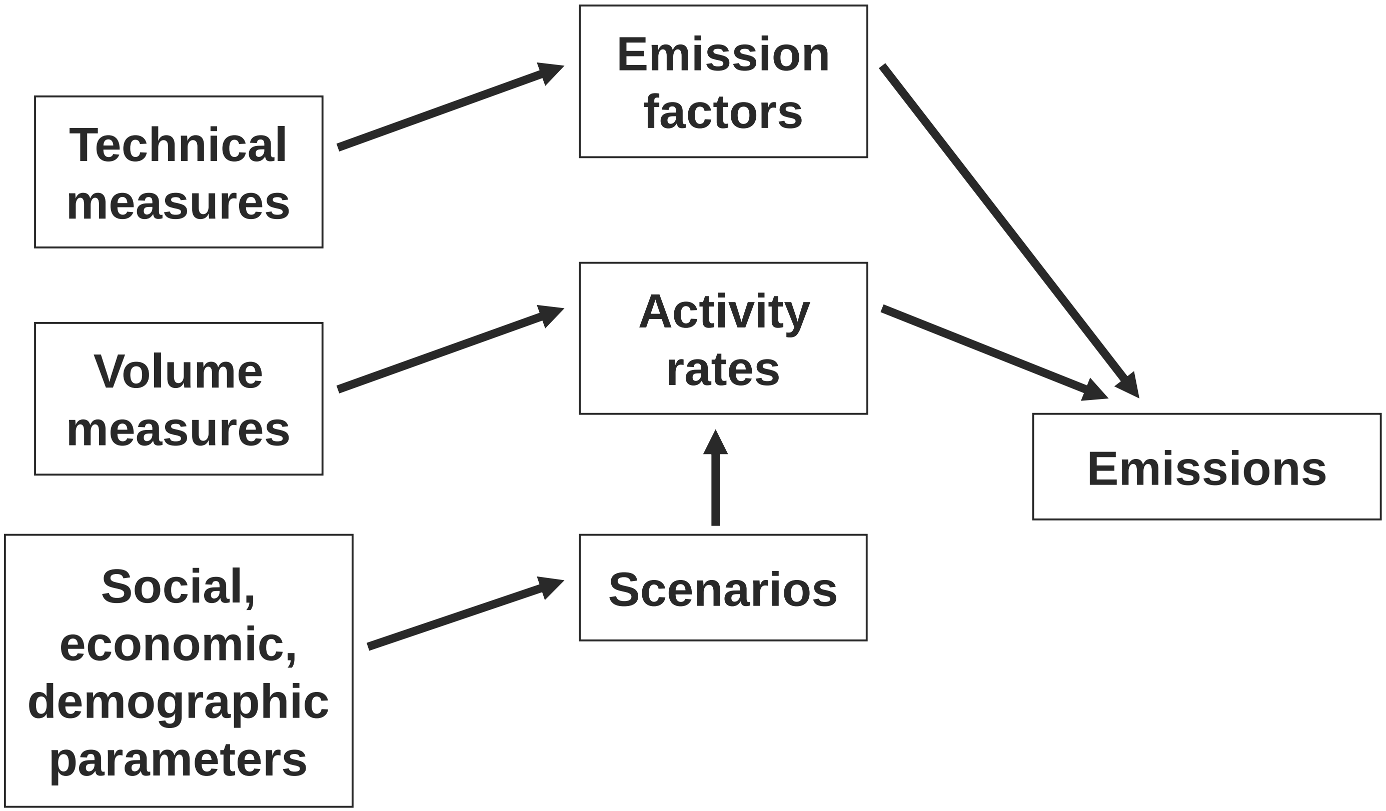


(adapted from IPCC)

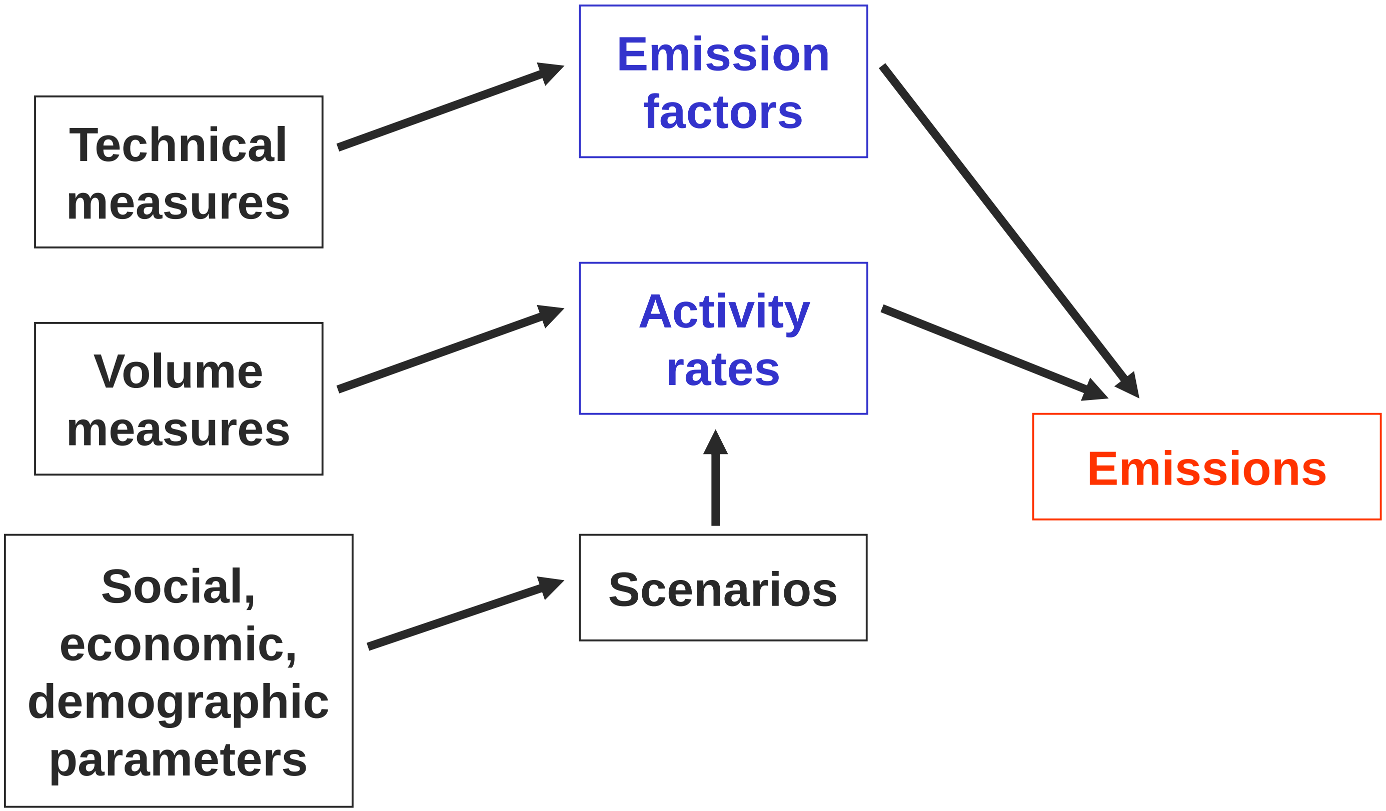
General approaches for emission scenarios

- **socio-economic**
  - correlate emissions with socio-economic time series, such as GDP development, without accounting in detail for technological change
  - top-down approach
- **technology based**
  - considers explicitly technological change
  - emission factor approach is widely used, mainly due to the fact that technological change became a prevailing parameter
  - bottom-up approach, can be rather detailed and resource-intensive

Technology-based, bottom-up approach



Technology-based, bottom-up approach



The fundamental formula

$$E = A \times \sum_{k=1}^{n} (F_k \times P_k)$$

E: emissions

A: activity rate

F: process level emission factors

P: activity share or penetration rate of a technology within a sector

k: technology type

Source: EEA

Activity rate, e.g.

- electricity consumption (kWh)
- transport volume (Pkm / tkm)
- steel production (tons)

Process level emission factor, e.g.

- g_{SO2} / kWh_{el}
- g_{NOx} / tkm
- g_{SO2} / ton_{steel}

Activity shares or **penetration rates** of a technology (k) within a sector

- eventually determined by the behaviour of people
- legislative requirements
- technology acceptance
- etc.

$$E = A \times \sum_{k=1}^{n} (F_k \times P_k)$$

Sectoral emission factor

The fundamental formula

Data sources for emission inventories (PAST)

- A: national statistics
- F: measurements
- P: - national statistics, - expert judgements

$$E = A \times \sum_{k=1}^{n} (F_k \times P_k)$$

E: emissions

A: activity rate

F: process level emission factors

P: activity share or penetration rate of a technology within a sector

k: technology type

The fundamental formula

Data sources for emission inventories (PAST)

- national statistics → A
- measurements → F_k
- - national statistics
  - expert judgements

  → P_k

$$E = A \times \sum_{k=1}^{n} (F_k \times P_k)$$

- economic scenarios → A
- technological investigation → F_k
- - technological investigation
  - financial economic basic assumptions
  - behaviour projections

  → P_k

Data sources for emission projections / scenarios (FUTURE)

E: emissions

A: activity rate

F: process level emission factors

P: activity share or penetration rate of a technology within a sector

k: technology type

The link between inventories and projections / scenarios

- Each emission projection must be based on an existing emission inventory as a starting point.

Data sources for emission inventories (PAST)

- A: national statistics
- F_k: measurements
- P_k: - national statistics - expert judgements

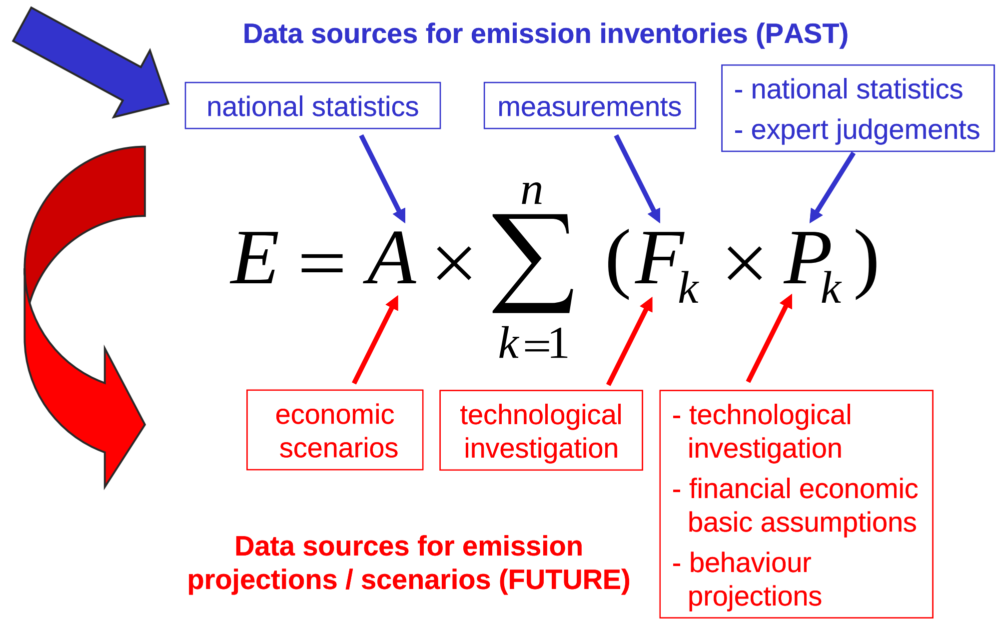
$$E = A \times \sum_{k=1}^{n} (F_k \times P_k)$$

- A: economic scenarios
- F_k: technological investigation
- P_k: - technological investigation - financial economic basic assumptions - behaviour projections

Data sources for emission projections / scenarios (FUTURE)

The link between inventories and projections / scenarios

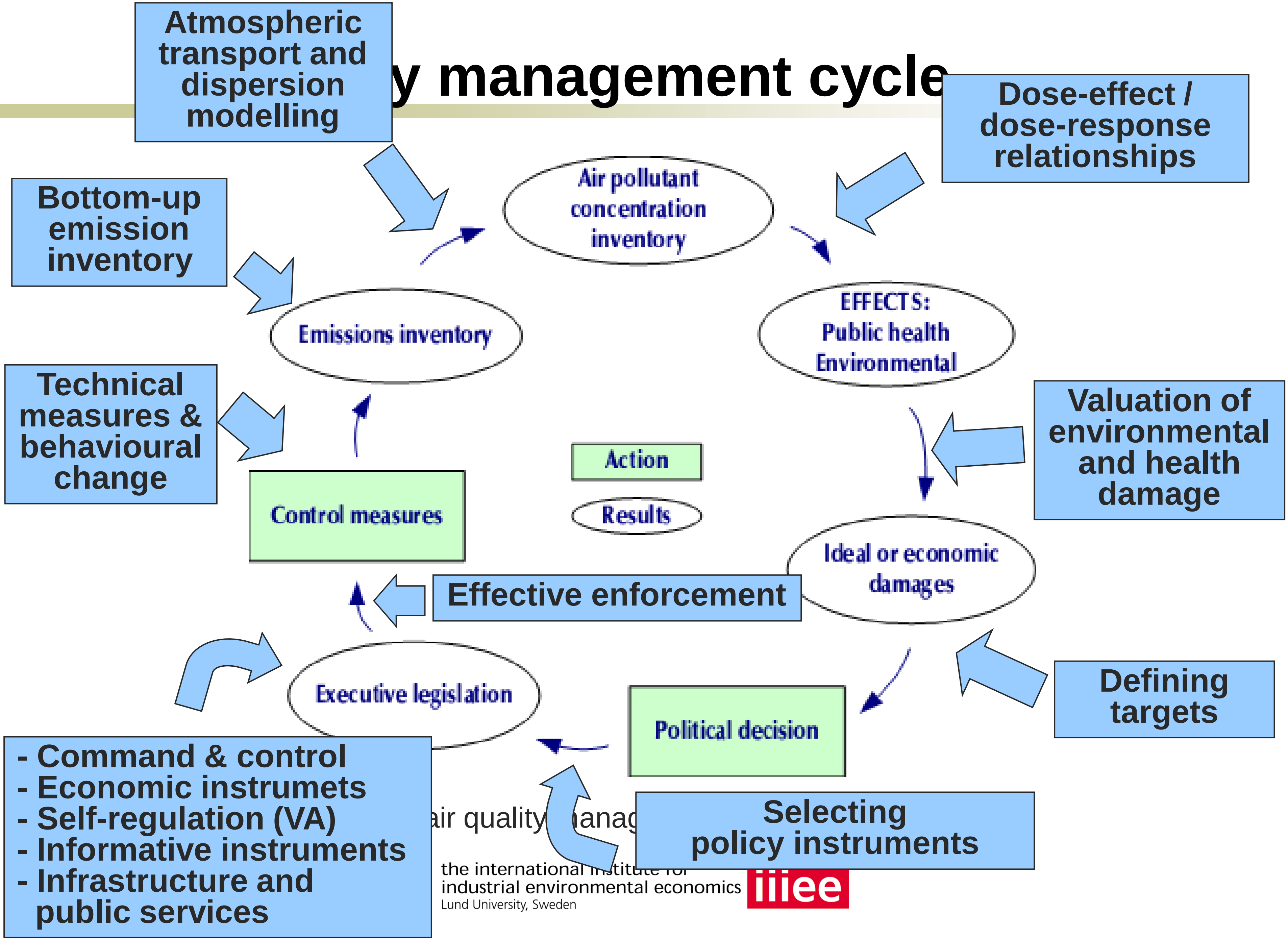
- Each emission projection must be based on an existing emission inventory as a starting point.
- The main difference between an emission inventory and an emission projection / scenario is the <u>time reference</u>.



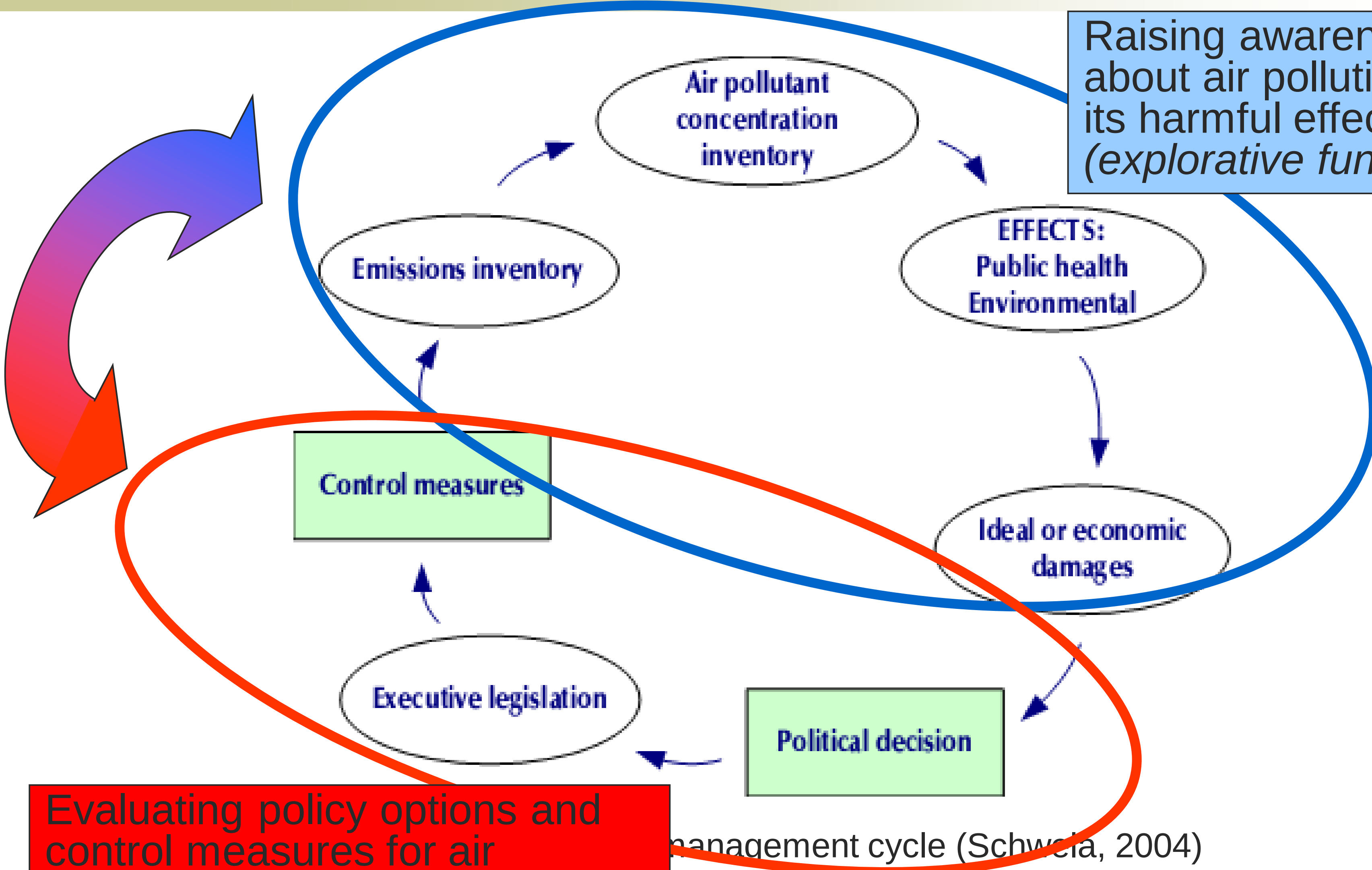
$$E = A \times \sum_{k=1}^{n} (F_k \times P_k)$$

What do we use emission scenarios for?

- The role of emission scenarios in the Air Quality Management Cycle


y management cycle
Atmospheric transport and dispersion modelling
Dose-effect / dose-response relationships
Bottom-up emission inventory
Air pollutant concentration inventory
Emissions inventory
EFFECTS: Public health Environmental
Technical measures & behavioural change
Valuation of environmental and health damage
Action
Results
Control measures
Ideal or economic damages
Effective enforcement
Executive legislation
Political decision
Defining targets
- Command & control
- Economic instrumets
- Self-regulation (VA)
- Informative instruments
- Infrastructure and public services
Selecting policy instruments
air quality
the international
industrial environmental economics
Lund University, Sweden
iiiee

Linking the air pollution scientific community with policy makers



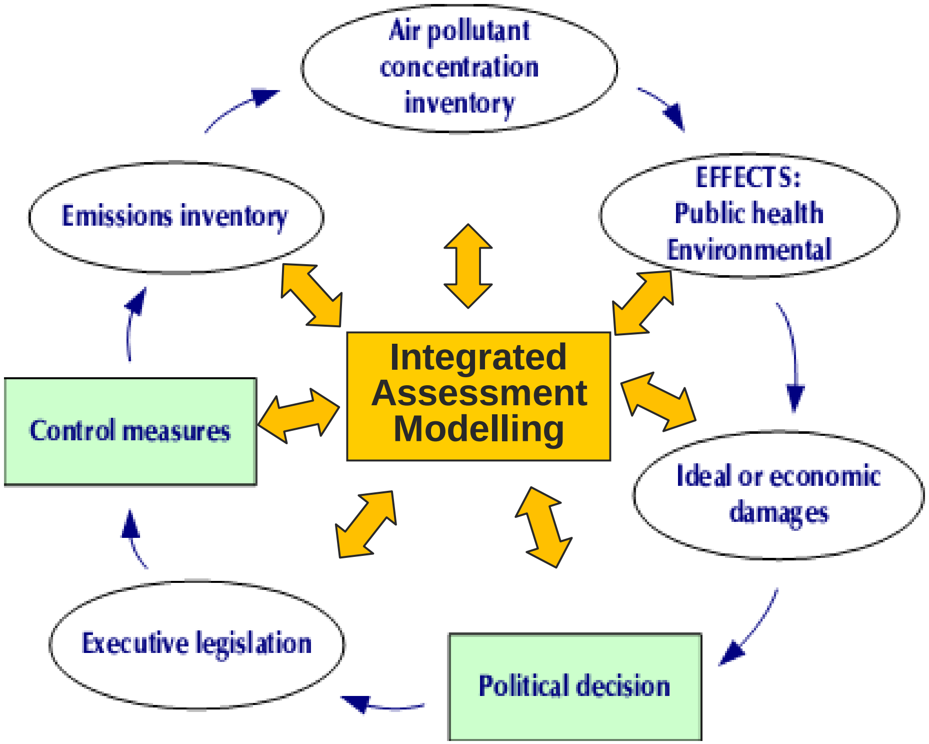
Raising awareness about air pollution and its harmful effects *(explorative function)*

Evaluating policy options and control measures for air pollution prevention and control *(decision support)*

anagement cycle (Schw la, 2004)

Integrated Assessment Modelling (IAM)

- IAM models the air quality management cycle numerically.
- IAM collects and connects data from different sources to obtain a comprehensive picture of reality.
- Emission scenarios are typically one component of Integrated Assessment Models for air quality management.
- Scenarios are used as a tool to explore how reality may evolve under a set of different assumptions



Scenarios in IAM

What happens if…?

”Vehicle numbers grow by annually 10%.”

”A new coal-fired power plant is built at location X.”

”Strict emission standards are imposed on large-point sources.”

”New / higher taxation on the sulphur content of fossil fuels.”

”No (new) policies for air pollution prevention and control are implemented.”

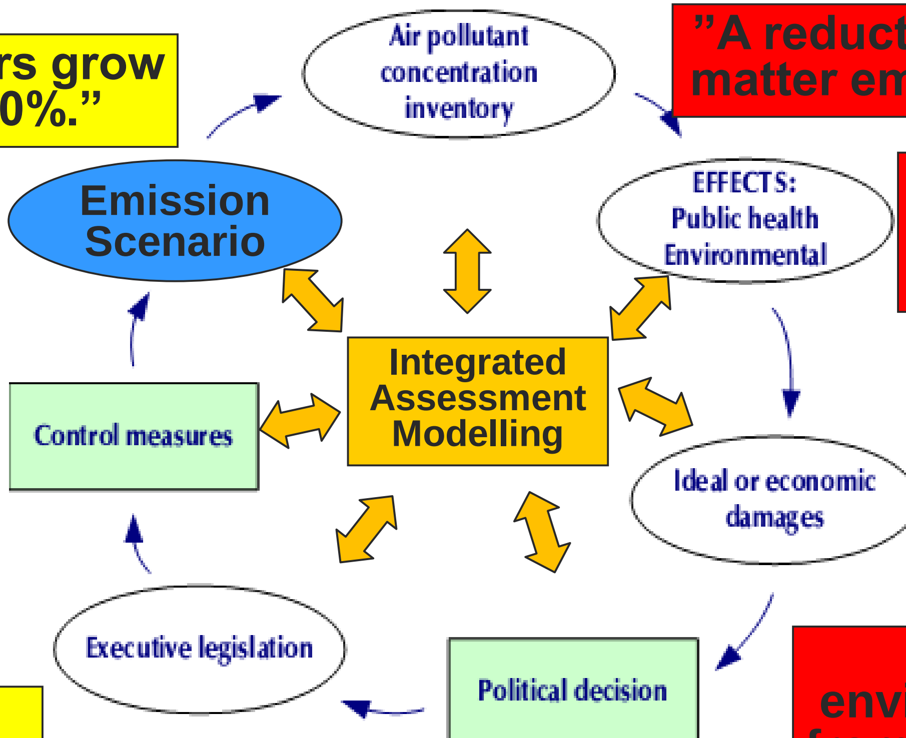
How to attain…?

”A reduction of particulate matter emissions by 70%.”

”Air quality standards according to WHO guidelines.”

”Health and environmental targets in the most *cost-effective* way.”

”Health and environmental targets from the perspective of *economic efficiency*.”



Business-as-ususal scenario

What emission load can we expect in the year 2030 under a Business-as-usual (BAU) scenario?

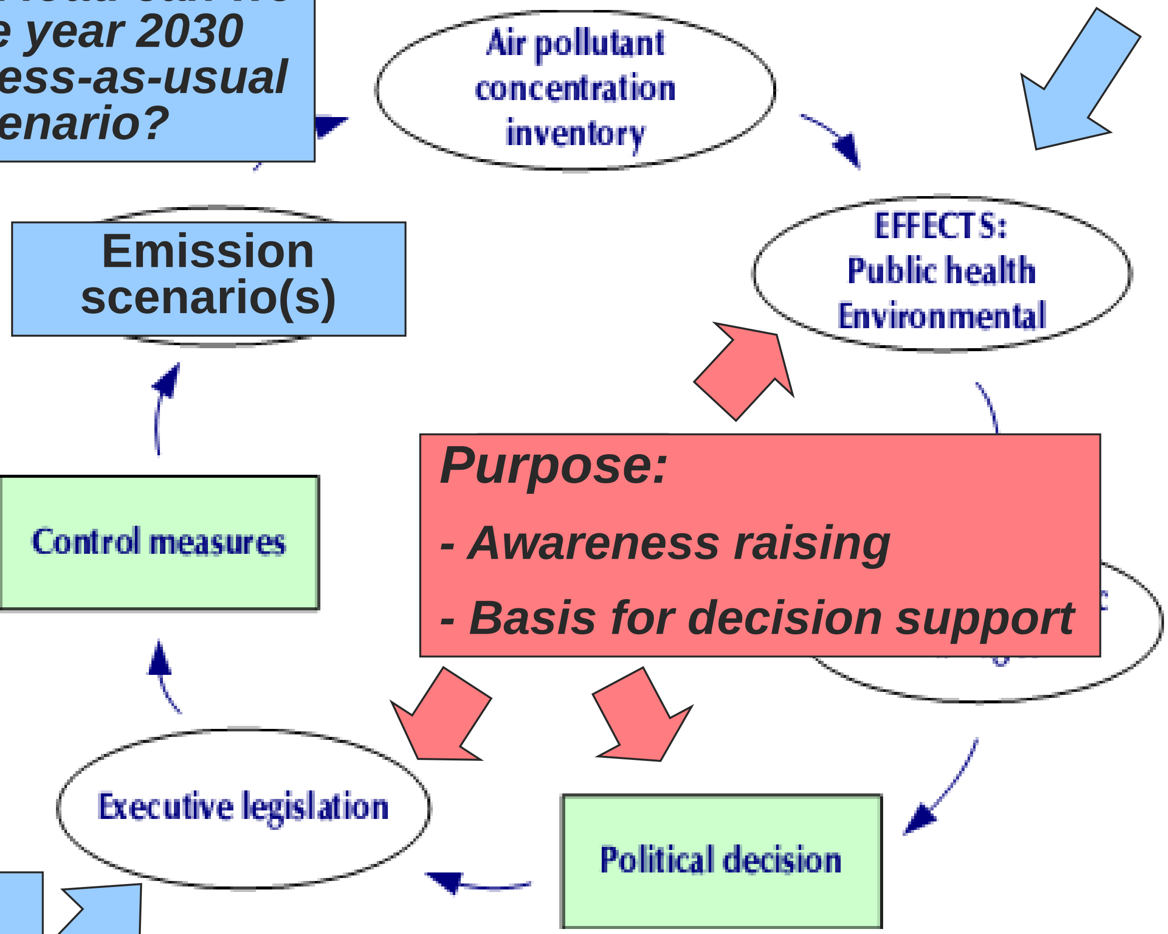
What damage can we expect under a BAU scenario?

Health

Crops

Materials

Ecosystems



Purpose:

- ***Awareness raising***
- ***Basis for decision support***

Under a BAU scenario, no additional policies are implemented.

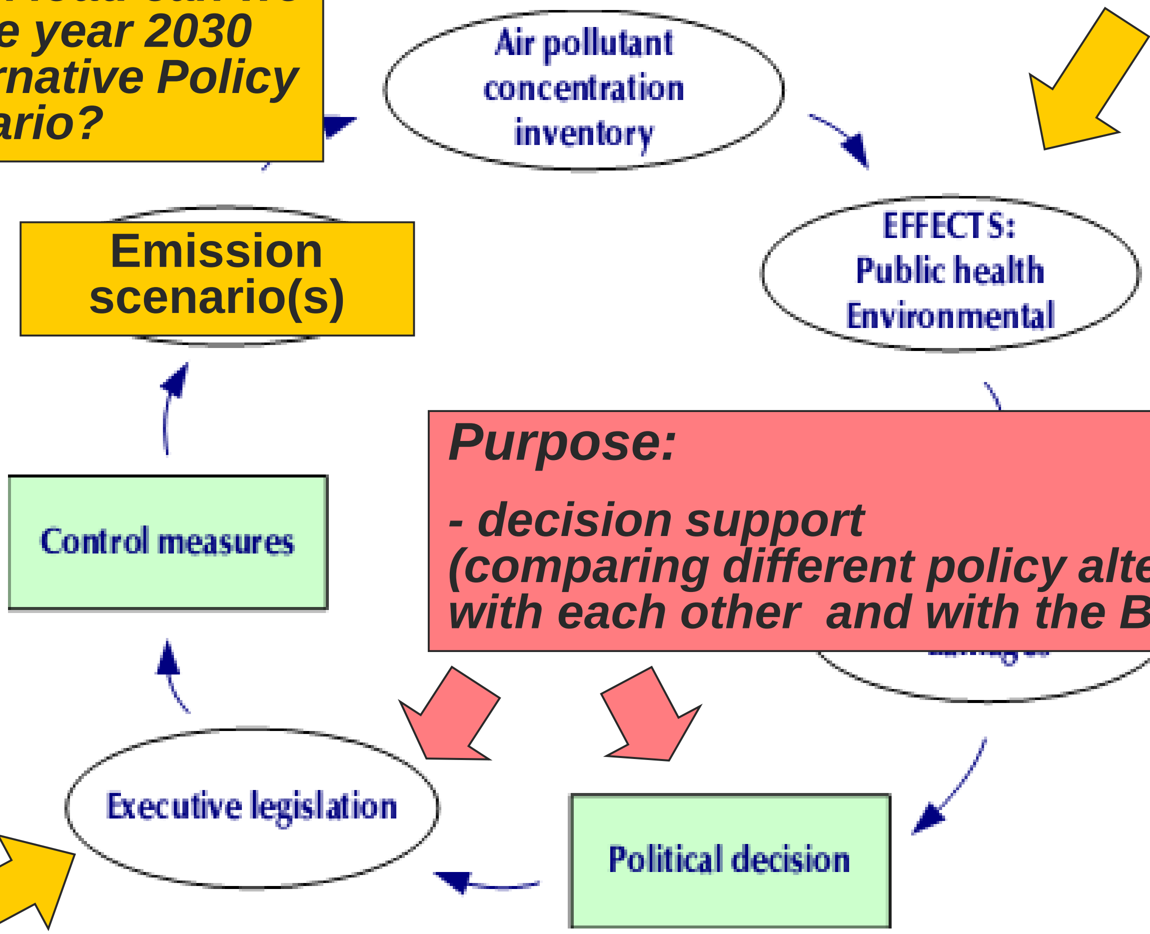
Simplified air quality management cycle (Schwela, 2004)

Alternative Policy scenario

What damage can we expect under an Alternative Policy scenario?

- Health
- Crops
- Materials
- Ecosystems

What emission load can we expect in the year 2030 under an Alternative Policy scenario?



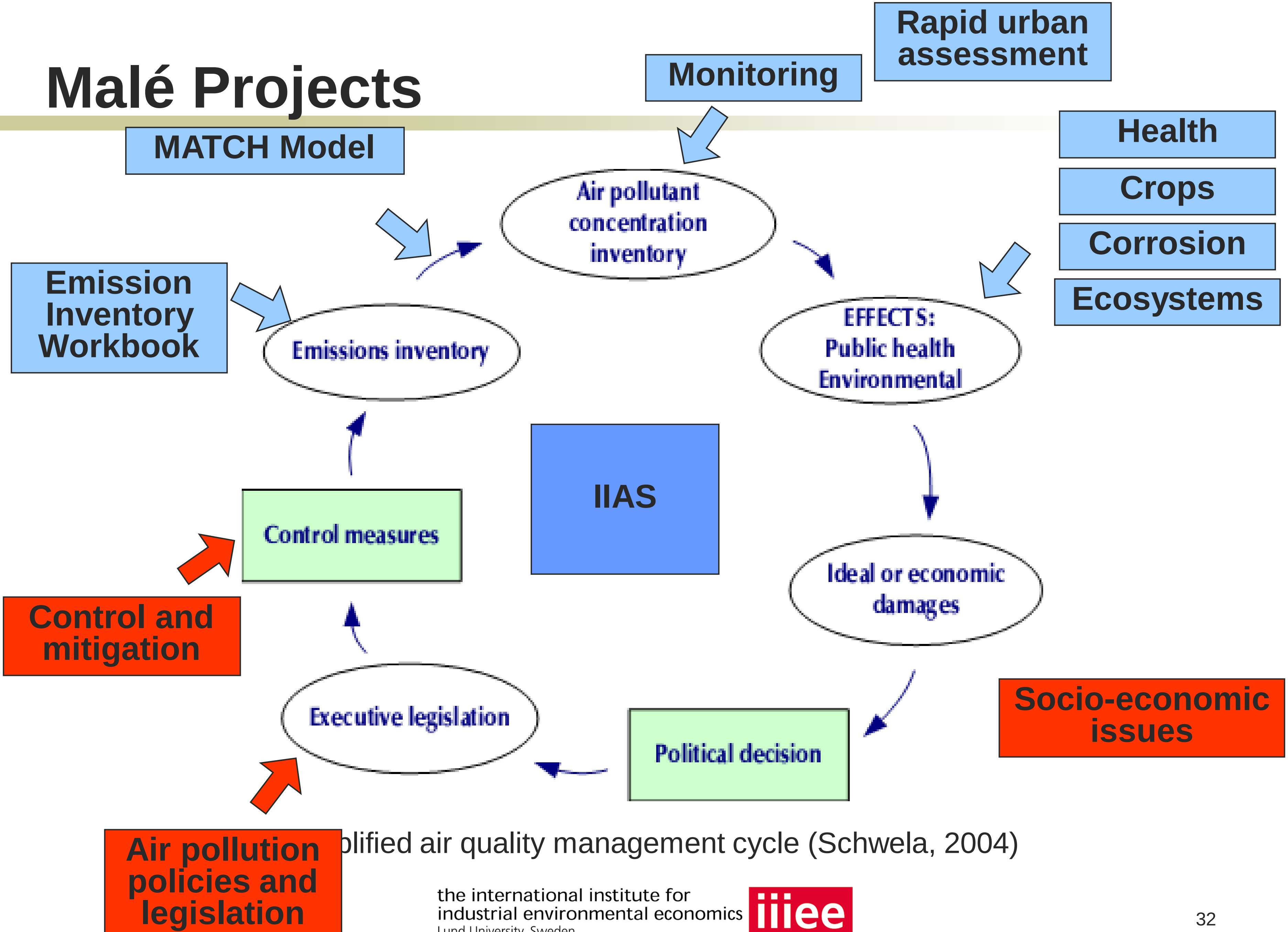
Purpose:

- decision support (comparing different policy alternatives with each other and with the BAU scenario)

Under an Alternative Policy scenario, additional policies are implemented.

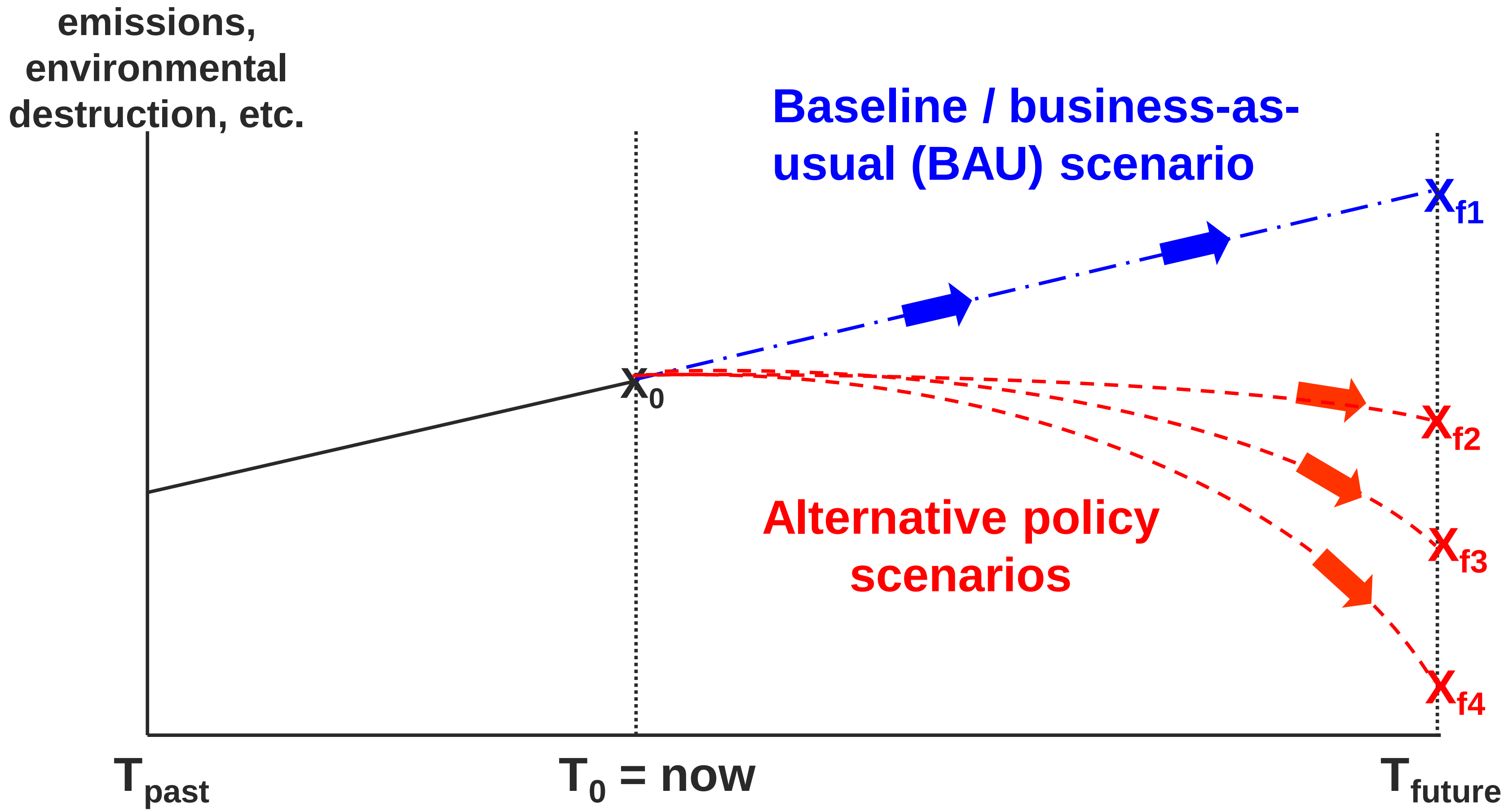
lified air quality management cycle (Schwela, 2004)

Malé Projects



plified air quality management cycle (Schwela, 2004)

Emission scenario variants



Emission scenarios…

- …are an important tool to design and assess emission reduction strategies, which aim at achieving given emission reduction targets in the future
- …help to evaluate alternative abatement options to achieve these targets within given scenarios of societal trends
- …help to allocate emission abatement measures in a temporal and spatial frame and to assess the future efficiency of a large variety of measures

Outline

1. Integrated Assessment Modelling (IAM) in the Air Quality Management process
2. Emission scenarios
3. Example: the *Clean Air for Europe (CAFÉ)* scenarios

The CAFE programme of the EU

- Clean Air for Europe (CAFE) is an EU programme of technical analysis and policy development to support EU strategies with regard to air pollution
- CAFE aims to develop a long-term, strategic and integrated policy advice for *"achieving levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment"*; including "*no exceedance of critical loads and levels for acidification or eutrophication*".

The CAFE programme of the EU

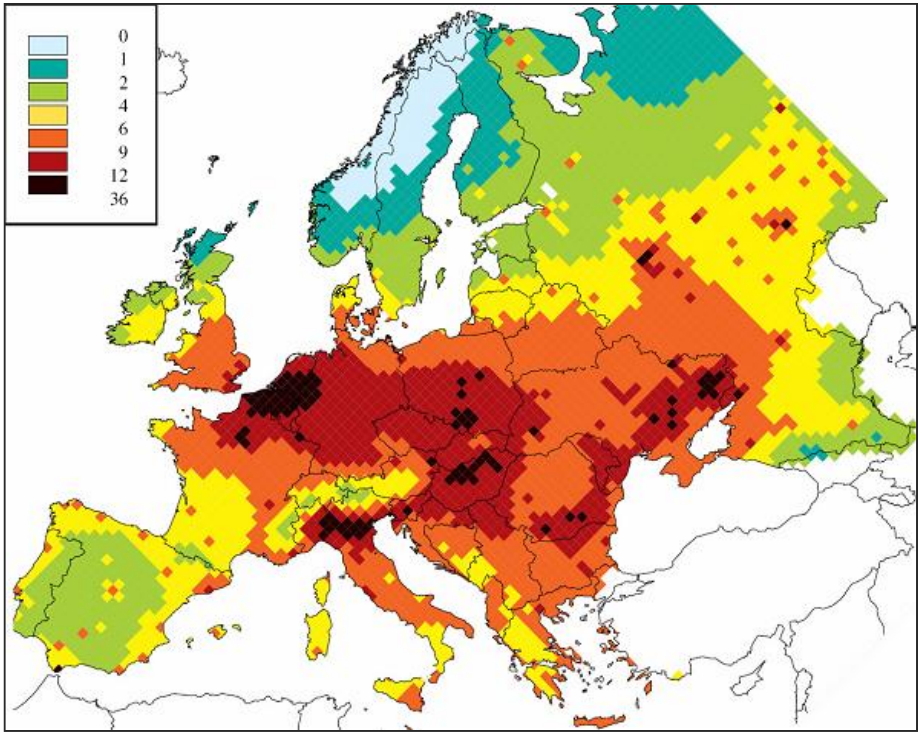
- CAFE uses IAM and scenarios
  - to project how air quality in Europe is likely to evolve until 2020 on the basis of current policies and measures
  - to provide a benchmark against which other policy scenarios can be compared.
  - to assist the cost-effectiveness analysis of policy proposals for revised air quality legislation
- The scenarios address four environmental impacts of air pollution:
  - Particulate matter (PM)
  - Ground-level ozone (O_3)
  - Acidification
  - Eutrophication

CAFE Scenarios

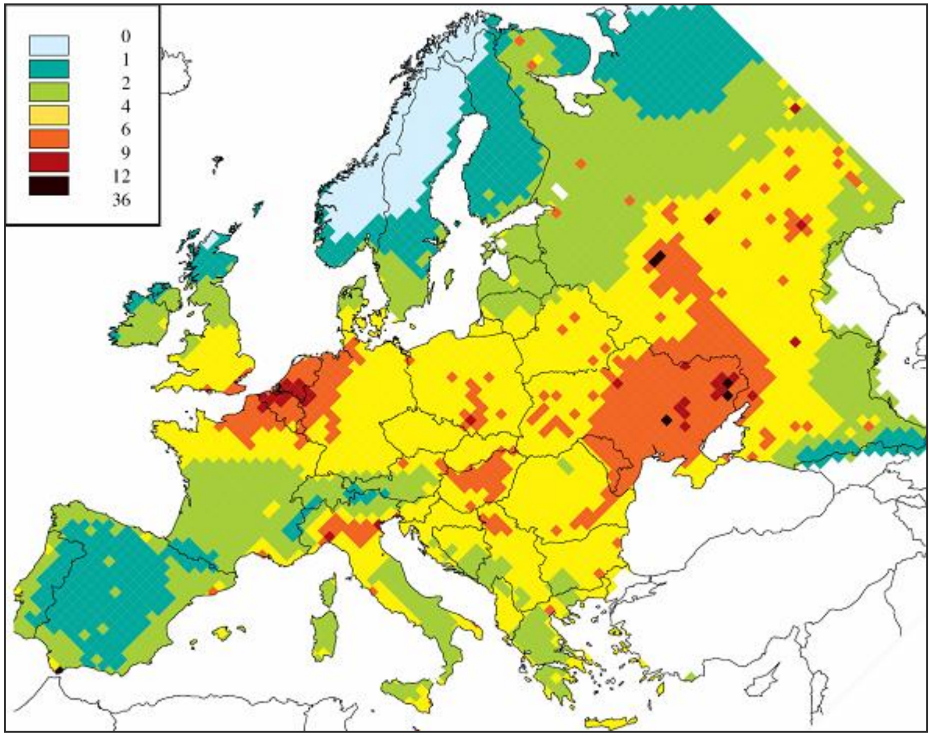
- Five scenarios for the year 2020
  - baseline scenario based on current legislation projection (CLE)
  - maximum technically feasible emission reductions (MTFR)
  - three joint optimizations (A, B, C) that combine with each other the lowest, medium and highest ambition levels of all four environmental endpoints (PM, O_3, acidification, eutrophication)

Loss in life expectancy attributable to exposure to fine particulate matter ($PM_{2.5}$)

2000



Baseline scenario for 2020

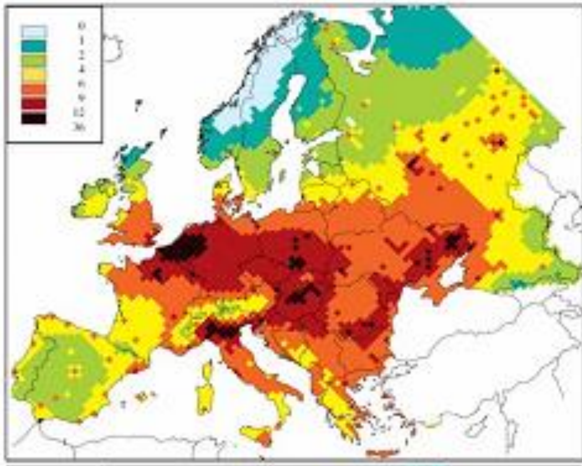


Statistical loss in life expectancy in months

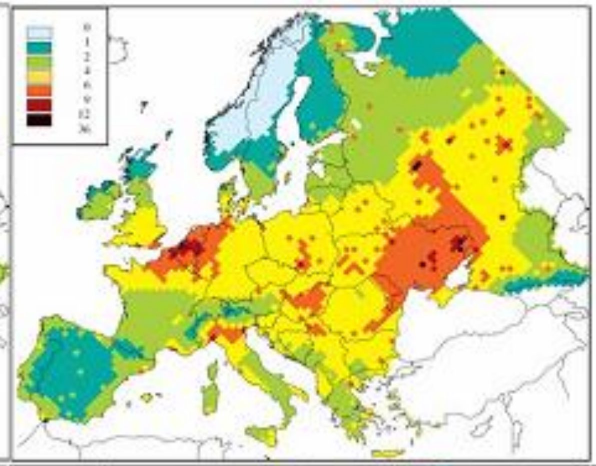
Source: IIASA

Loss in life expectancy attributable to exposure to fine particulate matter ($PM_{2.5}$)

2000

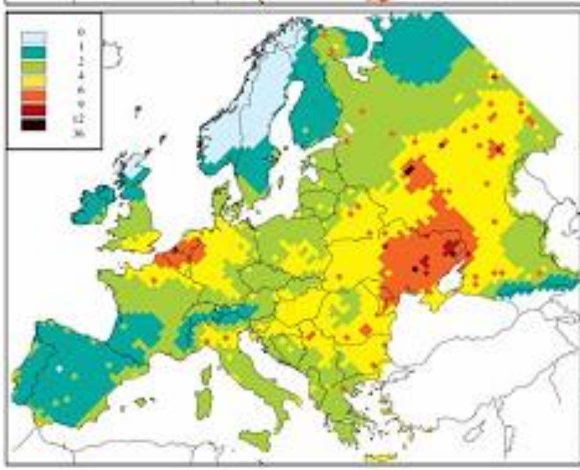


Baseline CLE (2020)

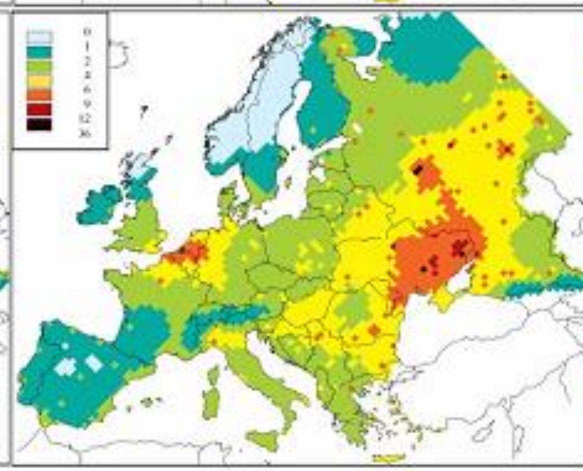


Loss in statistical life expectancy in months due to $PM_{2.5}$ in

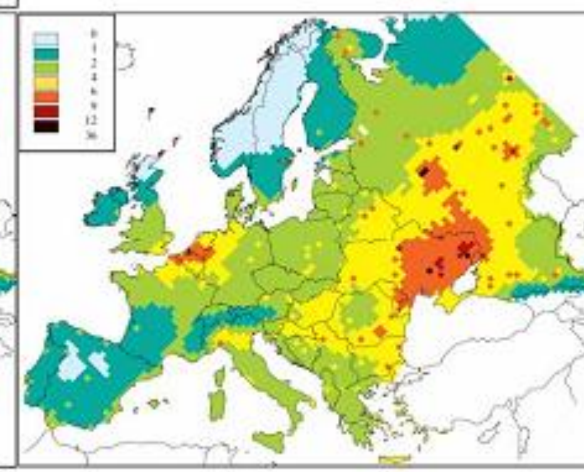
- 2000
- 2020 with current legislation
- 2020 with alternative polices A, B, and C



Alternative A (2020)



Alternative B (2020)

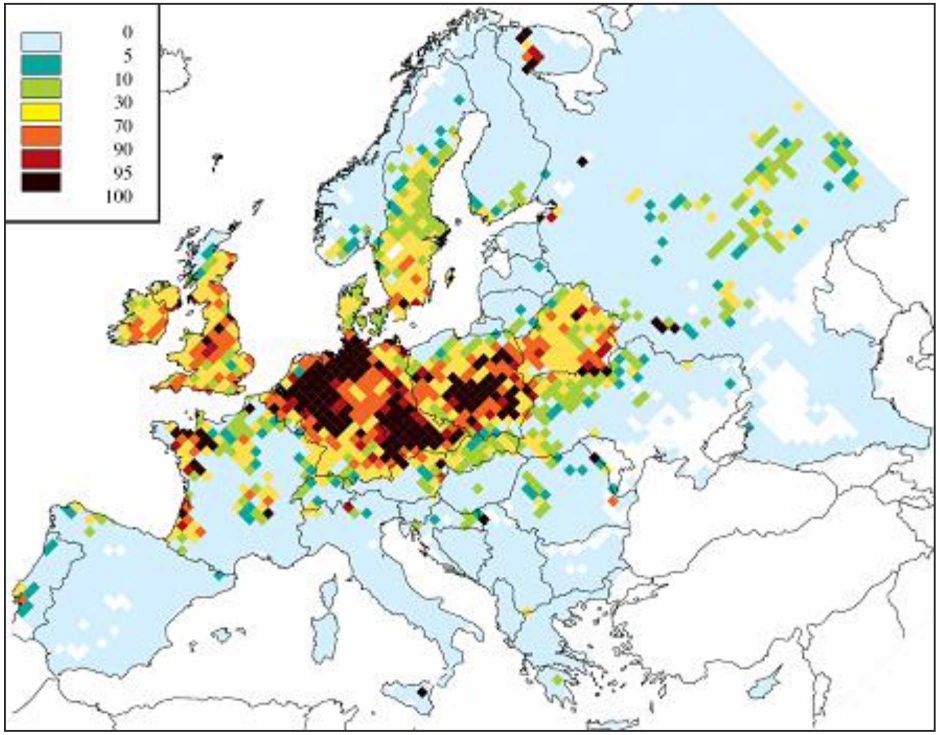


Alternative C (2020)

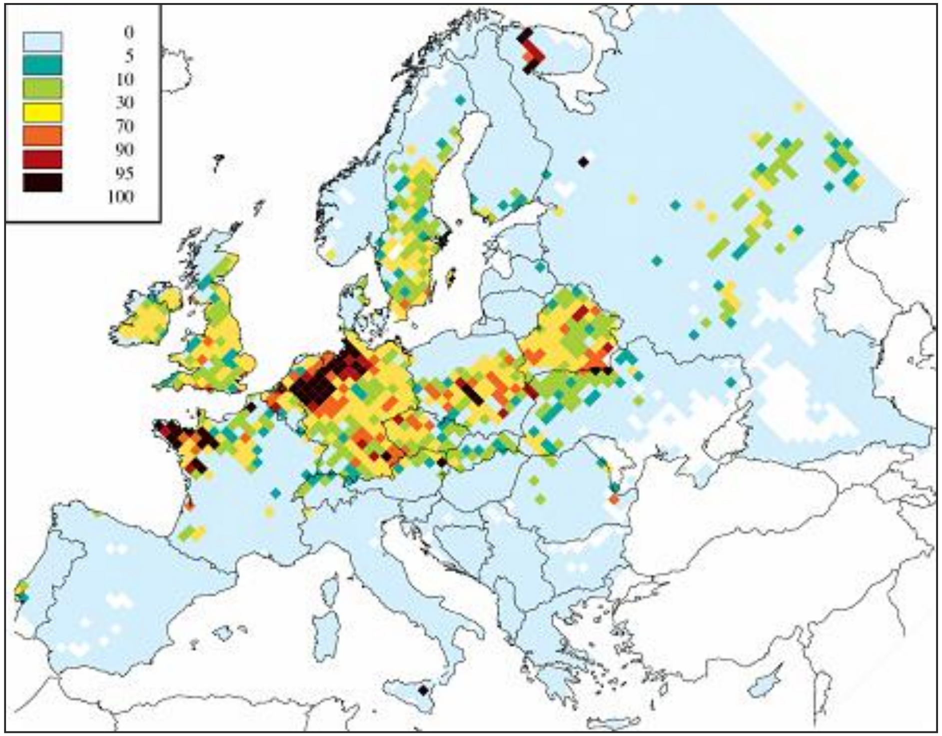
Source: IIASA

Acid deposition to forest ecosystems

2000



Baseline scenario
for 2020



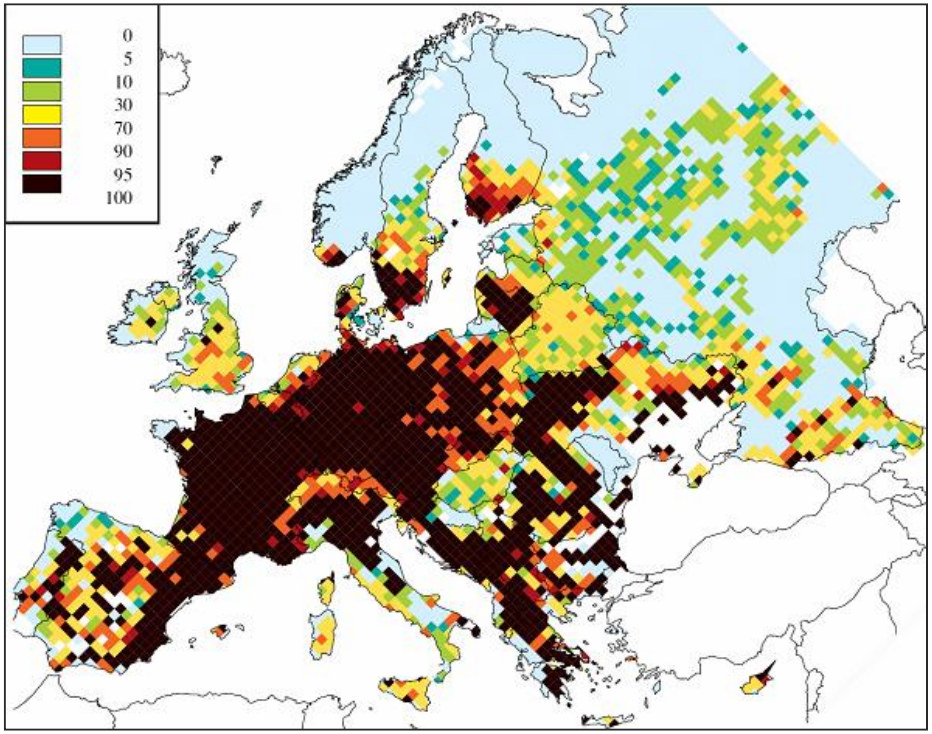
Percentage of forest area receiving acid deposition above the critical loads

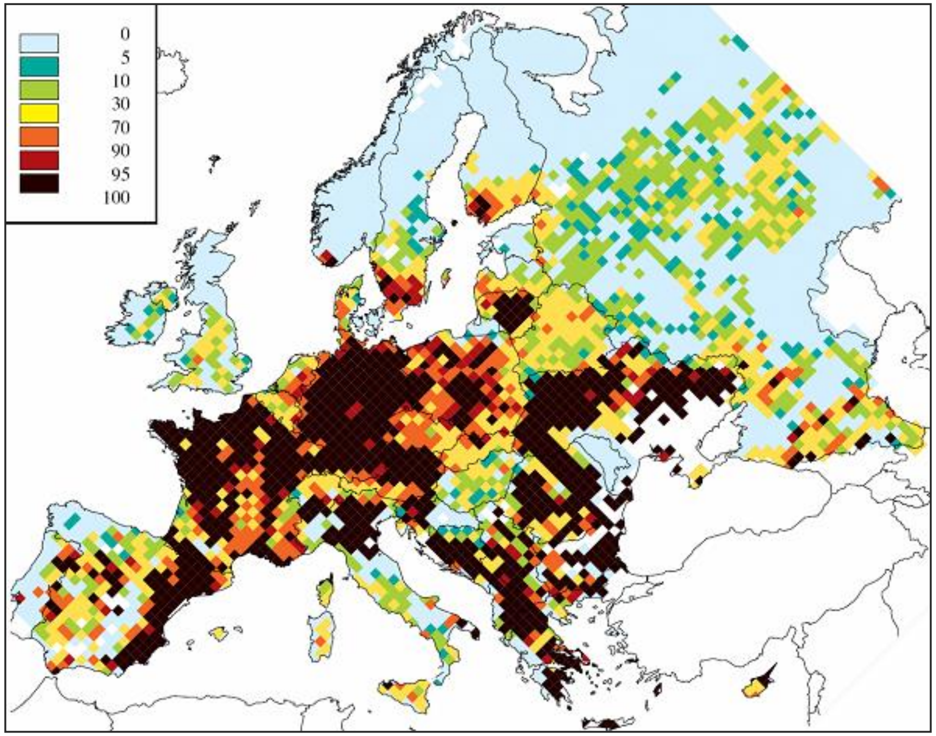
Source: IIASA

Excess nitrogen deposition

2000

Baseline scenario for 2020





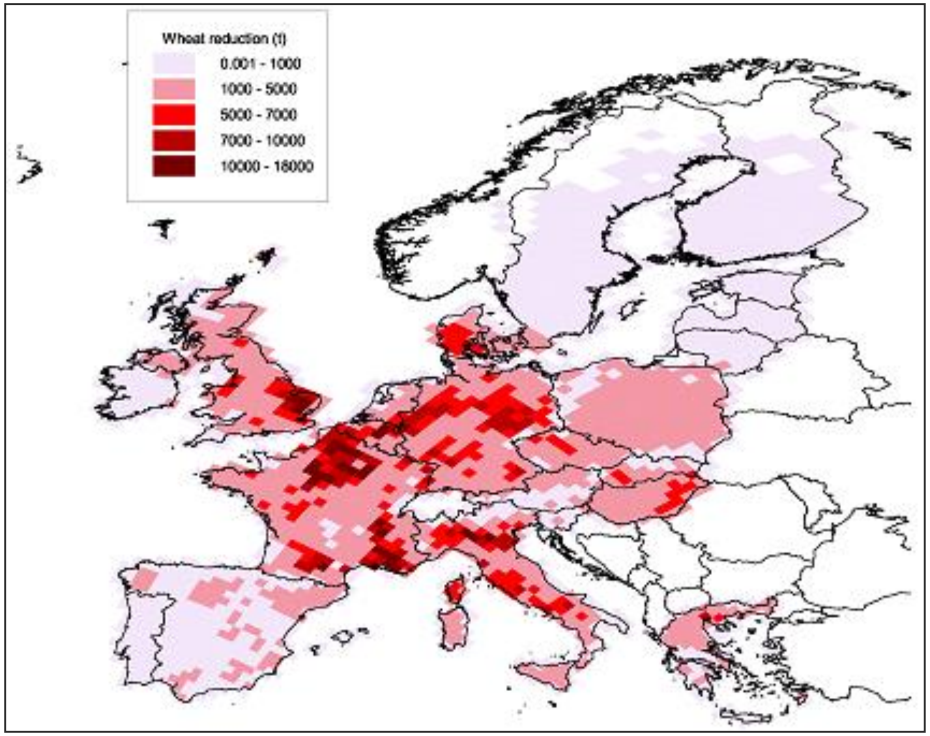
Percentage of total ecosystems area receiving nitrogen deposition above the critical loads for eutrophication

Source: IIASA

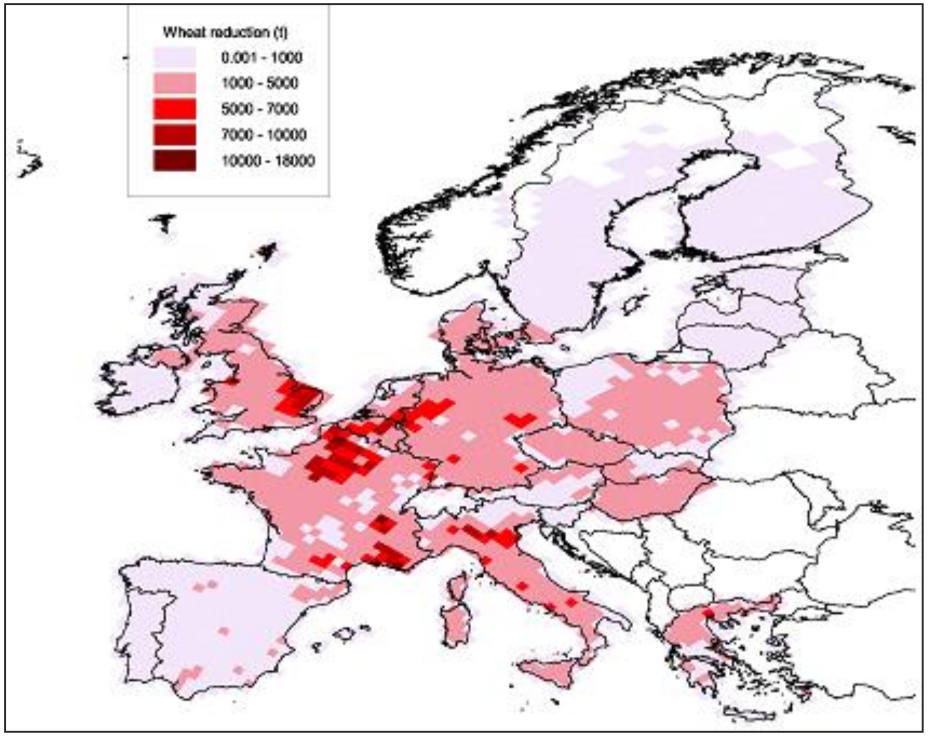
the international institute for industrial environmental economics
Lund University, Sweden

Impacts of ozone on the reduction of wheat yields

Baseline scenario for 2020



Alternative policy scenario C for 2020



Loss of wheat yield in the EU due to ozone (Tons)

Source: IIASA