Integrated assessment modelling activities in Belarus

Sergey Kakareka, Anna Malchykhina, Olga Krukovskaja

Institute for Nature Management
Minsk, Belarus

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Introduction

Activities in integrated assessment started recently in Belarus. They are conducted in the framework of the state scientific programs under the task of the Ministry of Natural Resources and Environment Protection of Belarus. Now they are supported also by Swedish EPA.

Starting points

Integrated assessment is necessary/useful for:

- abatement costs saving and optimization;
-account of interrelations of abatement of different pollutants;
-searching possibilities to meet ambient air quality criteria and emission limit values;
-health and ecosystems risks assessment in air protection;
-raising of scientific level of abatement strategies etc.

Included into presentation from current IAM activities in Belarus:

1 – abatement costs statistics analysis;

2 – databases (input data) for GAINS;

3 – IAM parameterization;

4 – scenarios analysis: PM emission, costs and benefits, projections;

5 – ammonia sources integrated assessment;

6 – conclusions, further actions and proposals.

1. Emission abatement costs statistics analysis

Purpose: to set background for verification of IAM air protection costs assessment and projection results

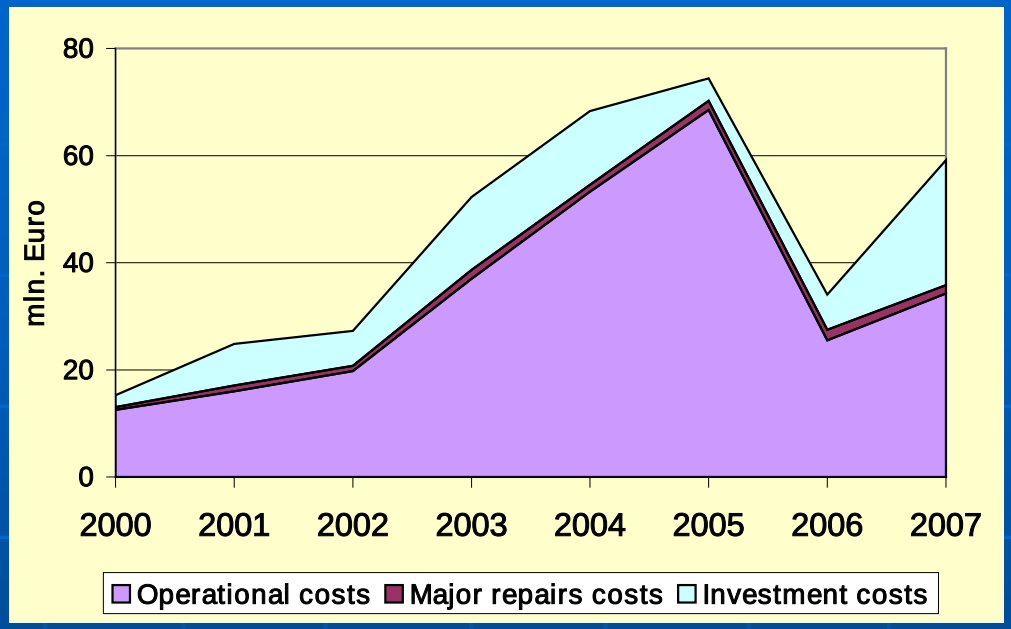
Total abatement costs

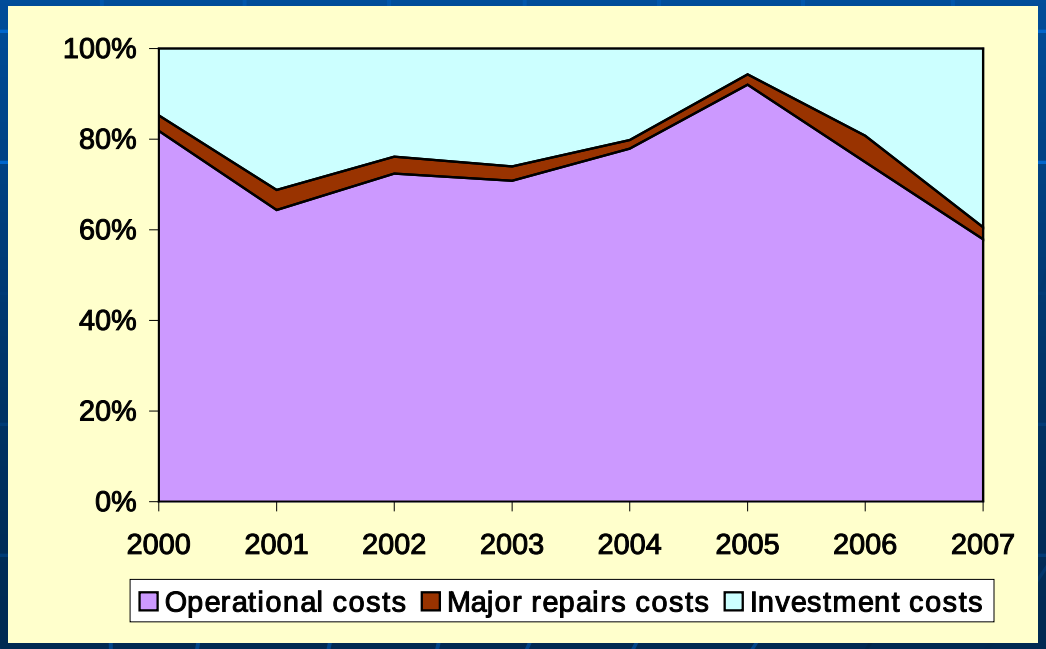
Total air and climate protection costs in Belarus amounted (in recalculation from national currency) 59.2 mln. Euro (as of 2007); operational costs comprised 58%, major repair costs - 2,6%, investment costs - 39,4%.

Share of operational costs in the costs structure is the greatest and vary last years from 58 to 91%.

Investment costs share vary from 9% to 53%.

Structure and trends of air protection costs in Belarus



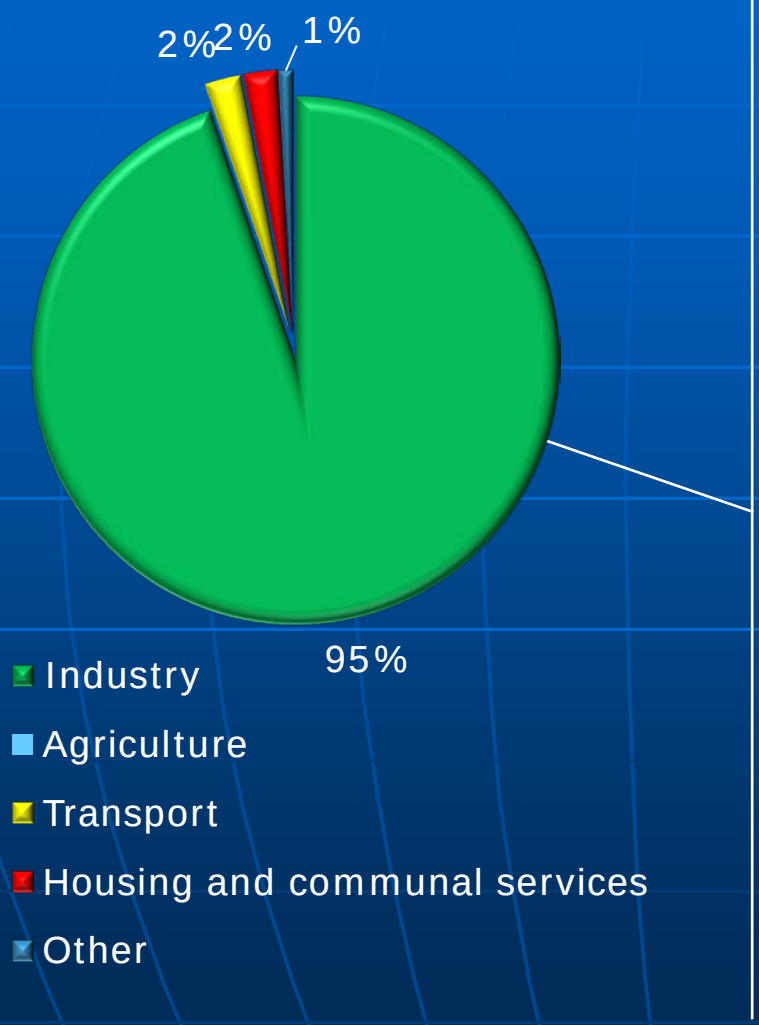


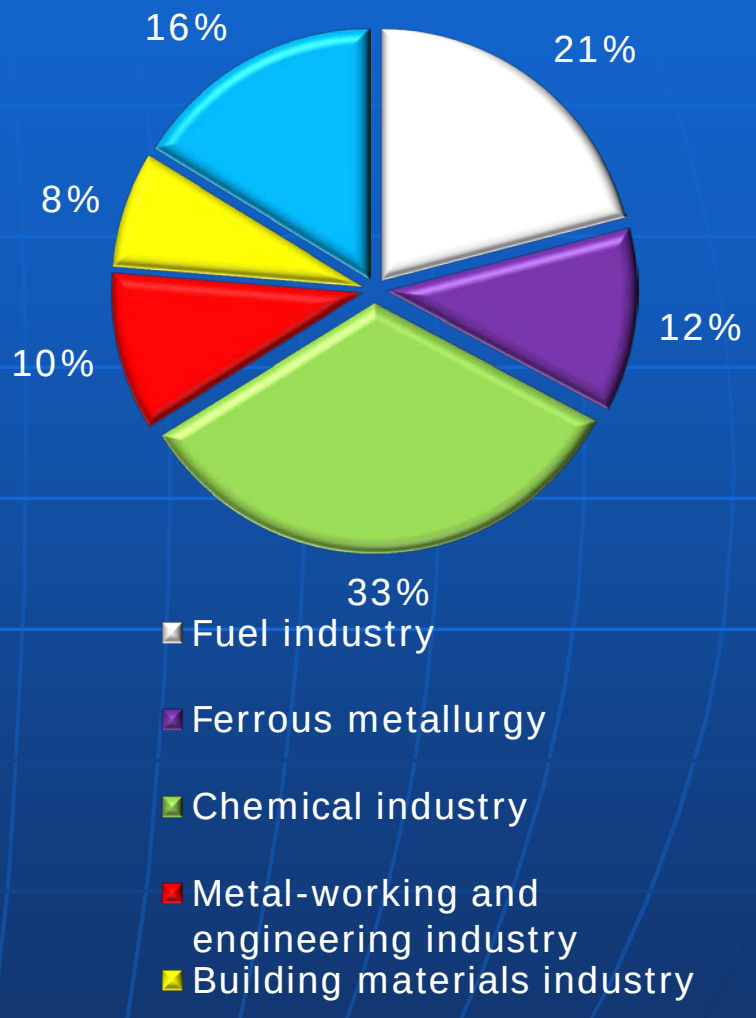
Abatement costs by sector

95% of total costs on air protection are spent in industry. Share of transport and residential-communal sectors were about 2% each; costs in agriculture by statistics were lower than 0.1% of total air protection costs.

In industry greatest operational costs were in chemical and petrochemical industries (10.8 mln. Euro) - 34% of total costs, in fuel industry - 21% of total costs. In cement industry costs amounted 0.87 mln Euro, in ferrous industry – 3.9 mln. Euro, in machine building – 2.9 mln Euro.

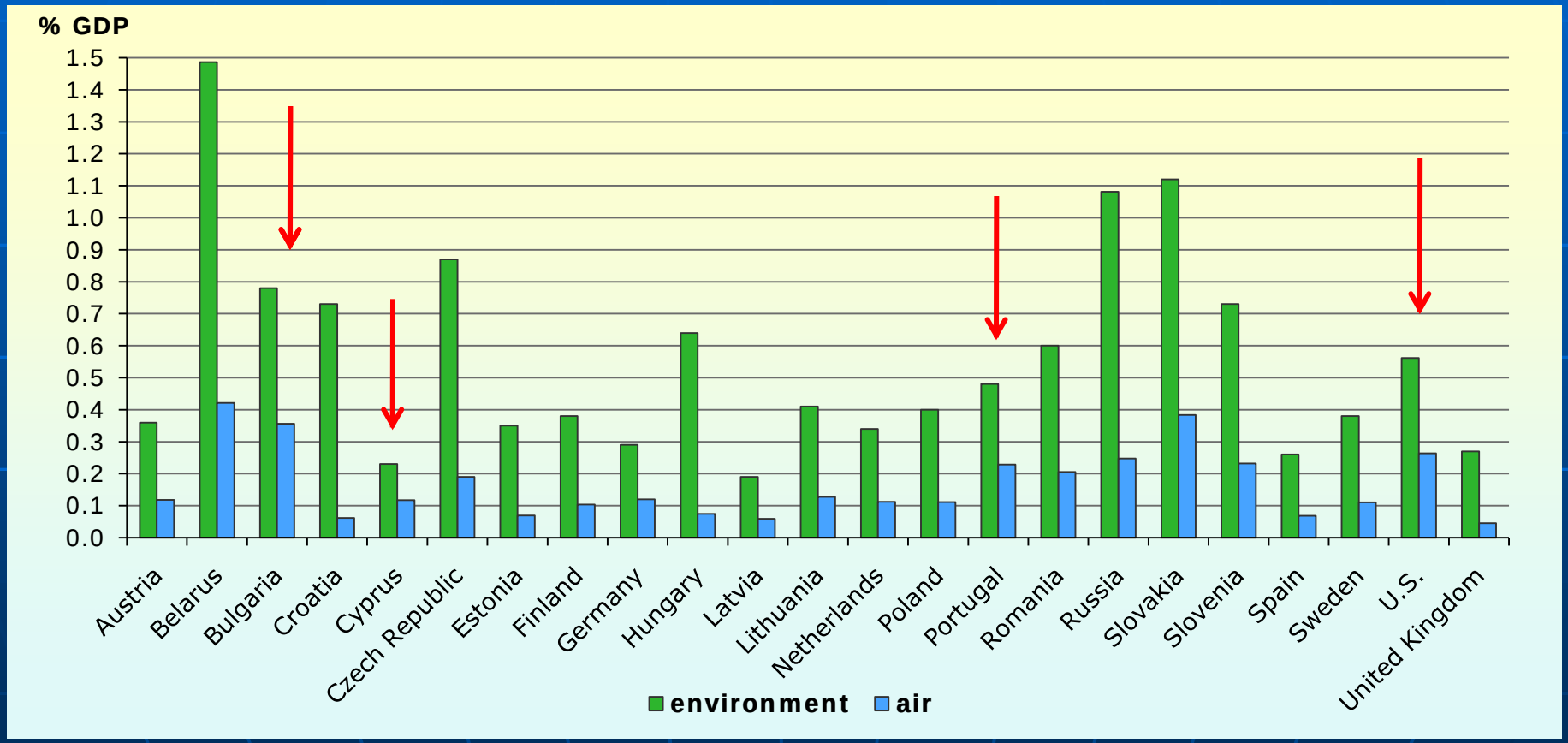
Emission abatement costs by sector (statistical data)





In general in Belarus air protection costs are comparatively high: by the share of GDP spent onto air protection Belarus is in the first ranks in Europe.

Total environment and air protection costs in different countries, % of GDP



Belarus also is the third in a list of countries by environmental costs share spend onto the air protection.

2. Input data for GAINS

Economic pathways

Statistical datasets for 1990-2005 were developed in format compatible with RAINS/GAINS model which includes data on fuel consumption, the production of basic industrial products, activities in the agricultural sector information.

This datasets are harmonized with the system of emission assessment and reporting.

Control strategies

Compilation/quantification of control strategies is an important stage of IAM using GAINS but not so much attention to them compared to pathways.

Control strategies are usually very uncertain, especially on a national level where emission reduction policy is based mainly on limit or reduction values. What is used in IAM as a control strategy is a technological scenario based on certain very common assumption/suggestions. A broad set of control strategies can be produced with the same level of relevance; this result in increase of uncertainty of IAM projections.

Fragment of control strategy

Файл Правка Вид Вставка Формат Записи Сервис Окно Справка

FUEL_ABB	SEC_ABB	TECH_ABB	1990	1995	2000	2005	2010	2015	2020	2025	2030
BC1	CON_COMB3	IN_ESP1	0	0	0	0	0	0	10	20	30
BC1	CON_COMB3	IN_ESP2	0	0	0	0	0	0	0	0	0
BC1	DOM_STOVE	COAL1	0	0	0	5	10	10	10	10	10
BC1	IN_OC3	IN_ESP1	0	0	0	0	0	0	0	0	0
BC1	IN_OC3	IN_ESP2	0	0	0	0	0	0	0	0	0
BC1	PP_EX_OTH3	ESP1	0	0	0	0	0	0	0	0	0
BC1	PP_EX_OTH3	ESP2	0	0	0	0	0	0	0	0	0
BC1	PP_NEW1	CYC	50	50	50	30	30	30	20	20	10
BC1	PP_NEW1	ESP1	40	40	40	50	50	50	50	50	50
BC1	PP_NEW1	ESP2	10	10	10	20	20	20	30	30	40
BC1	PP_NEW3	ESP1	90	90	90	80	80	80	70	70	60
BC1	PP_NEW3	ESP2	10	10	10	20	20	20	30	30	40
BC2	CON_COMB1	IN_CYC	40	40	40	50	50	60	60	60	50
BC2	CON_COMB1	IN_ESP1	5	5	5	10	10	10	20	20	30
BC2	CON_COMB1	IN_ESP2	0	0	0	0	5	5	10	10	20
BC2	CON_COMB3	IN_ESP1	45	45	45	60	60	70	80	80	80
BC2	CON_COMB3	IN_ESP2	0	0	0	0	5	5	10	10	20
BC2	DOM_STOVE	COAL1	0	0	0	5	10	10	10	10	10
BC2	IN_BO1	IN_CYC	40	40	40	50	50	60	60	60	50
BC2	IN_BO1	IN_ESP1	5	5	5	10	10	10	20	20	30
BC2	IN_BO1	IN_ESP2	0	0	0	0	5	5	10	10	20
BC2	IN_BO3	IN_ESP1	45	45	45	60	60	70	80	80	80
BC2	IN_BO3	IN_ESP2	0	0	0	0	5	5	10	10	20

A set of control strategies in our practice is usually includes Basic, CLE and MT(F)R ones.

3. IAM parametrisation

Purpose: to increase accuracy of IAM estimates.

Current GAINS do not allow user parametrisation. So activities in this sphere are aimed at application in future with GAINS or with other models.

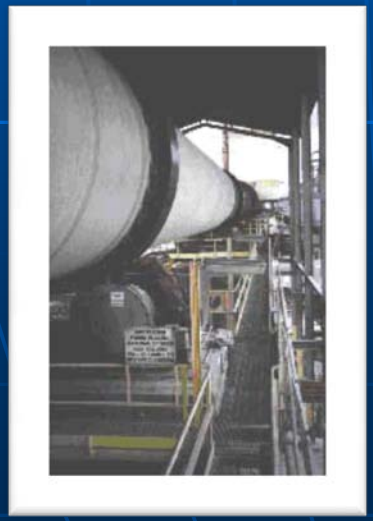
Parametrisation includes update of:

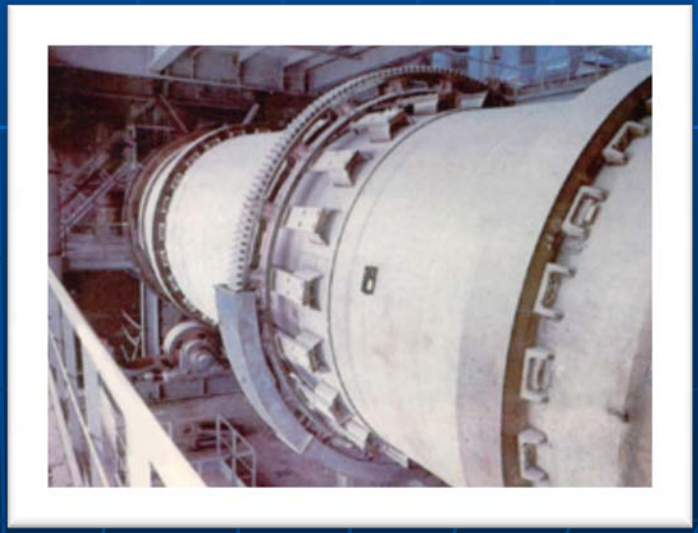
- emission rates and emission factors (by source/technology);
- abatement efficiency (by control technology);
- abatement costs parametrisation (by technology/sector).

Sources of data:

- facilities reporting and inventory data analysis;
- abatement equipment market proposals;
- abatement equipment survey etc.

Main sectors: iron and steel production, cement, lime.



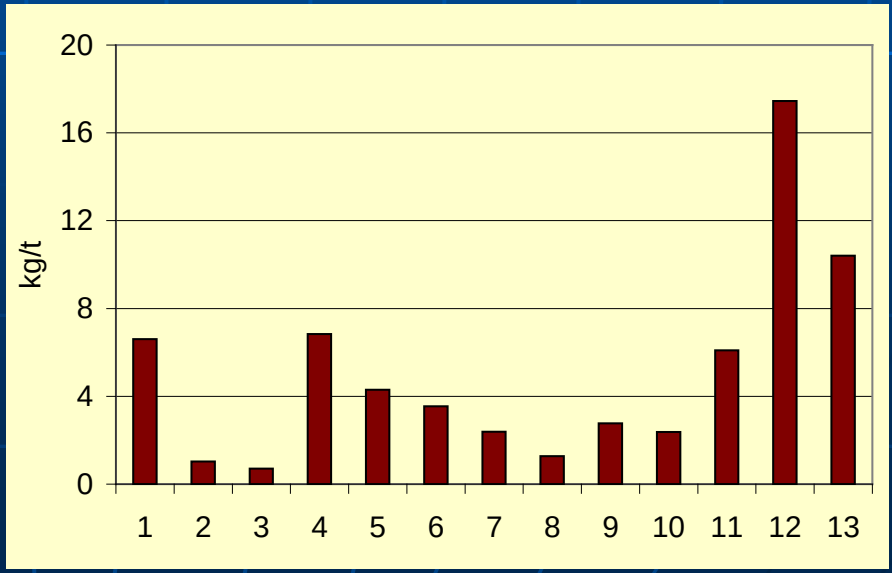


TSP emission factors (unabated), kg/t

draft

Sector	Basic value	Estimated Value		
		Average	Minimum	Maximum
Cement production	130	120,6	17,3	321,3
Lime production	100	45,5	-	-
Iron and Steel foundries	15,05	2,92	0,06	20,2
Electric Arc Furnace	17,55	12,7	0,5	60,9
Glass production	3,25	0,34	0,08	1,4

Variability of TSP emission factors from cast iron production by facilities



Comparative cost of control equipment

Equipment	Unit investment costs, $/1000 m³/year	
	produced in the EECCA	produced in the U.S.
Cyclone	26,4	15,7
Wet scrubber	30,8	15,1
Fabric filter	82,8	49,3
ESP	89,6	91,7

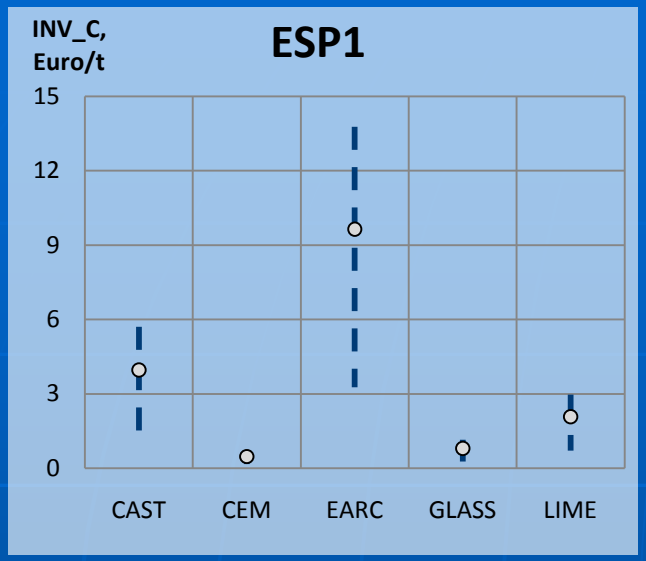
Output from control equipment study for IAM: *draft*

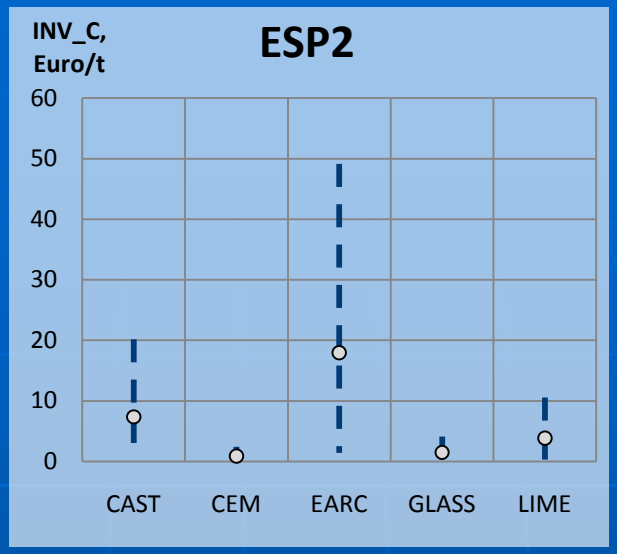
Investment cost function coefficient ci^f for iron and steel foundries

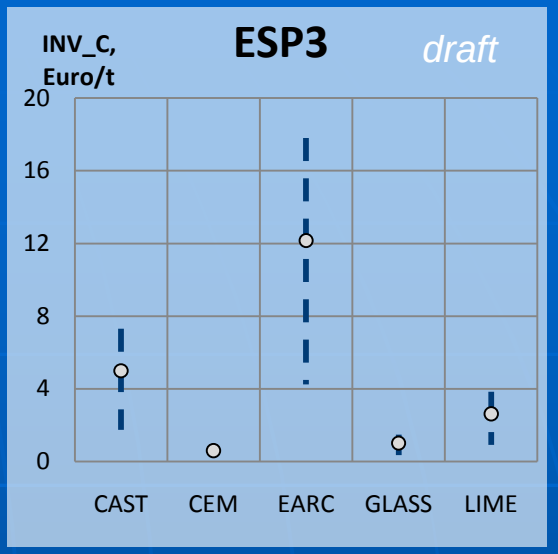
RAINS/GAINS Sector	Abatement technology	Investment function coefficient ci^f			
		Average	Minimum	Maximum	Basic
Iron and Steel Foundries	Cyclone	2.14	0.1	11.3	11.07
	ESP1	3.96	1.34	5.7	27.46
	ESP2	7.36	0.57	20.2	34.19
	ESP3 / High efficiency deduster	4.99	1.74	7.3	40.16
	Fabric filter	3.95	0.22	19.5	-
	Wet scrubber	4.91	0.49	19.9	-

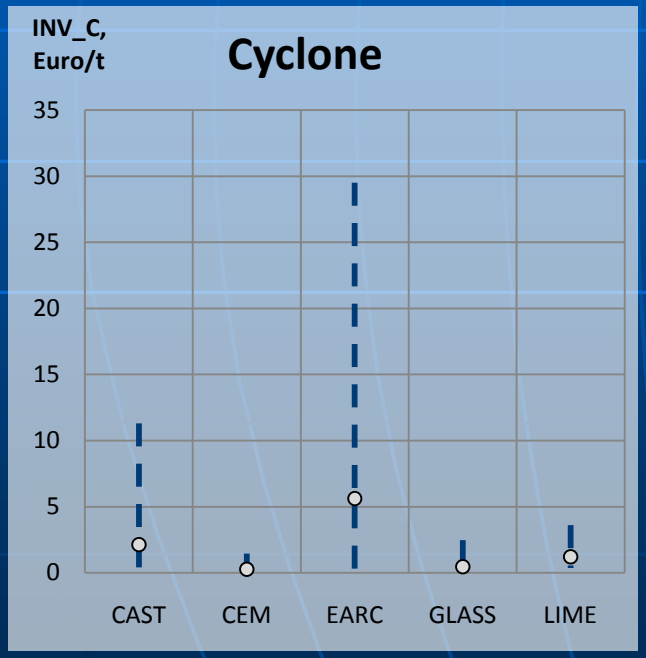
Comparative means of the investment cost function constant coefficient ci^f, Euro / t

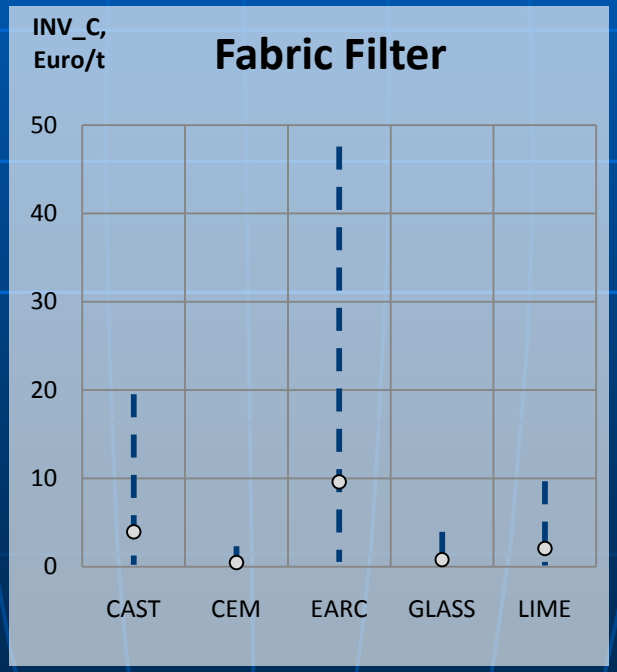
	Cast	Cement	EARC	Glass	Lime
CYC	2 / 11.1	0.3 / 1.5	5.6 / 0.6	0.5 / 1.3	1 / 5.5
ESP1	4 / 27.5	0.5 / 3.8	10	0.8 / 2.2	2 / 13.2
ESP2	7 / 34.2	0.9 / 4.7	18	1.5 / 4.3	4 / 14.6
HED	4-5 / 40.2	0.5-0.7 / 5.5	10-12 / 2.3	0.9-1 / 4.7	2-2.5 / 17.0

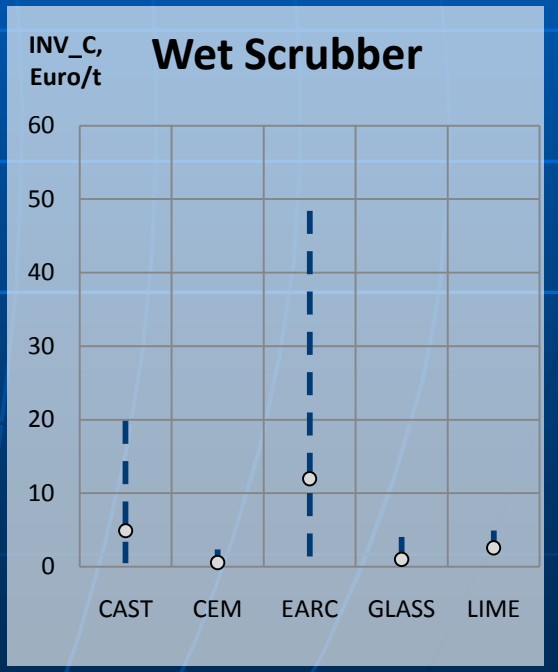








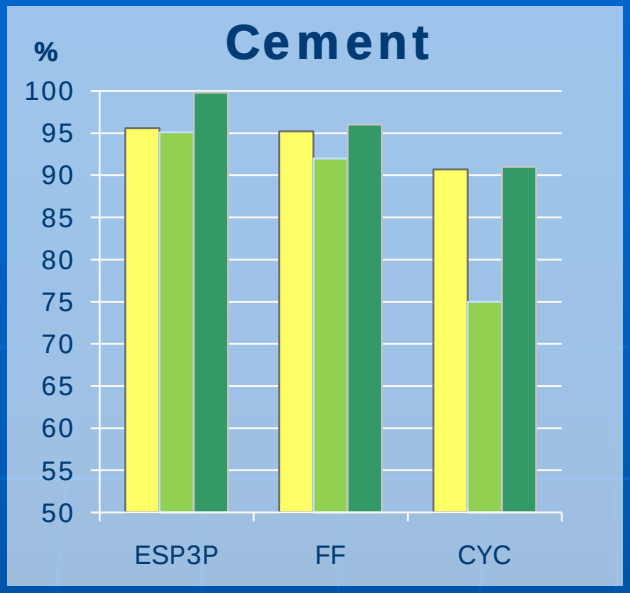


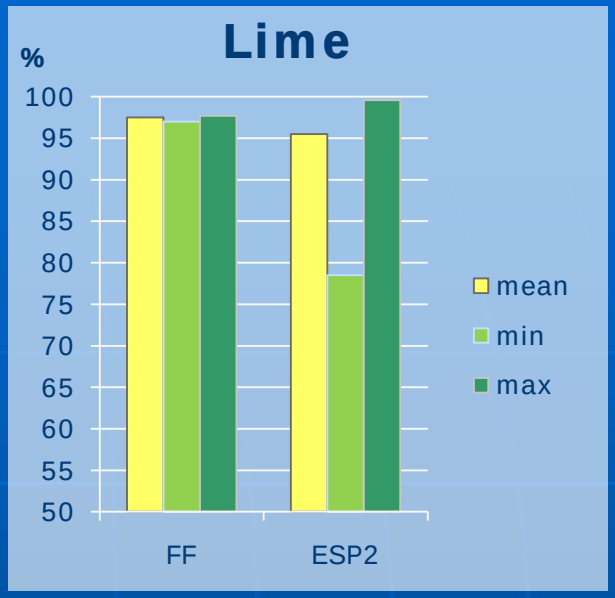


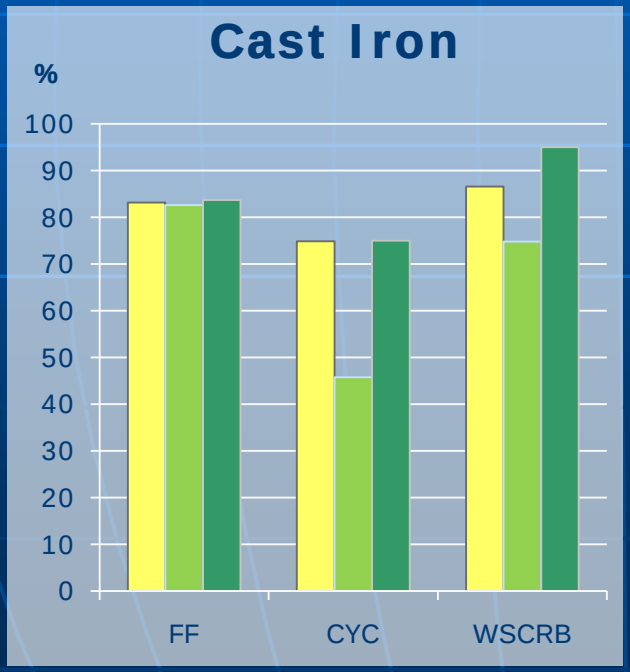
Investment cost function coefficient ci^f variability by type of control equipment

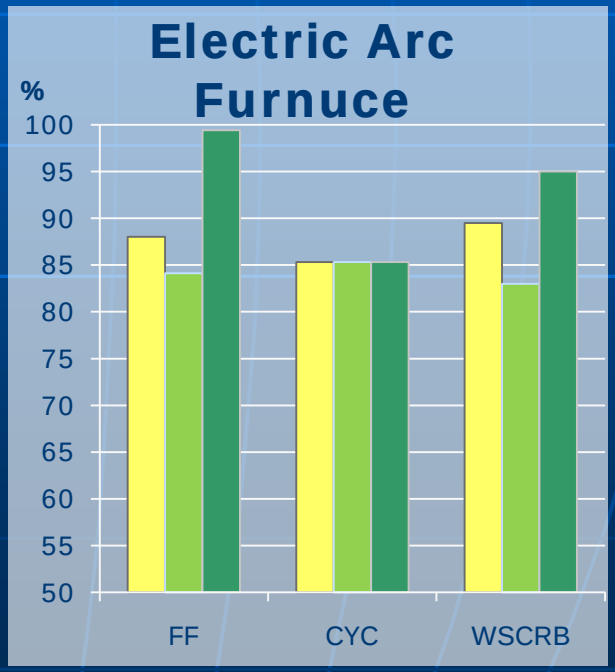
Comparative PM removal efficiency by sector, %

Abatement technology	Sector			
	Cement production	Lime production	Iron and Steel foundries	Electric Arc Furnace
ESP2	91.9 / 97.1			
ESP3	95.6 / 99.5	97.5 / 99.8		
Fabric filters	95.2 / 99.5	95.5 / 99.8	83.2 / 99.1	96.1 / 94.6
Cyclone	90.7 / 54.6		74.9 / 38.5	
Wet scrubber			86.6 / 80.0	









Abatement efficiency variability by type of control equipment

4. PM emission, abatement costs and health impacts in Belarus by 2020: scenarios analysis

Using GAINS 3 scenarios of PM emission abatement were analysed. Main purposes: testing of the model sensitivity to economic and abatement strategies changes. For every scenario PM emission, abatement costs and health impacts (years of expected life losses) were estimated.

Scenarios are differ by control strategy.

1. BAU scenario (without additional measures).
2. CLE scenario; adopted programs in air protection are considered.
3. MTR scenario; suggested, that best available in GAINS control technologies will be implemented.

In addition GAINS IEA WEO 2009RS scenario as a zero was used.

TSP emission by 2020, kt/year

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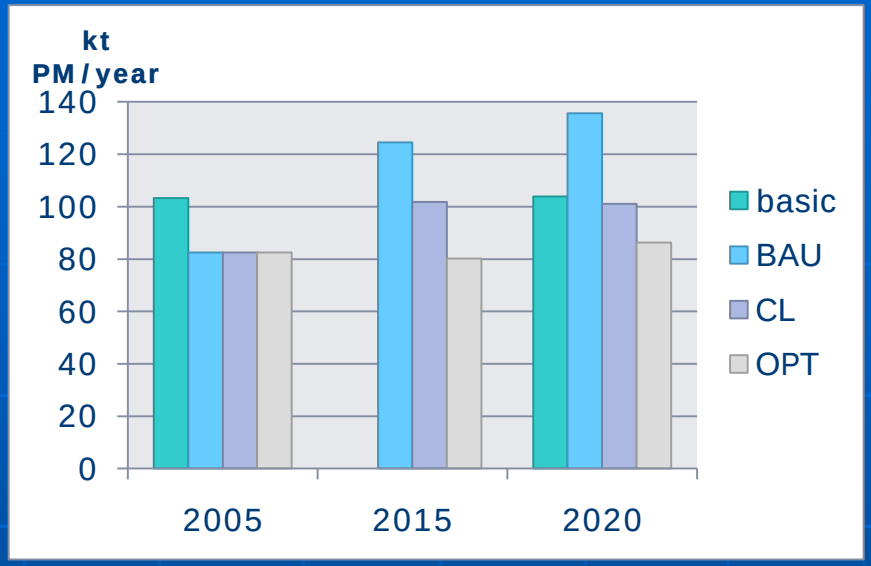
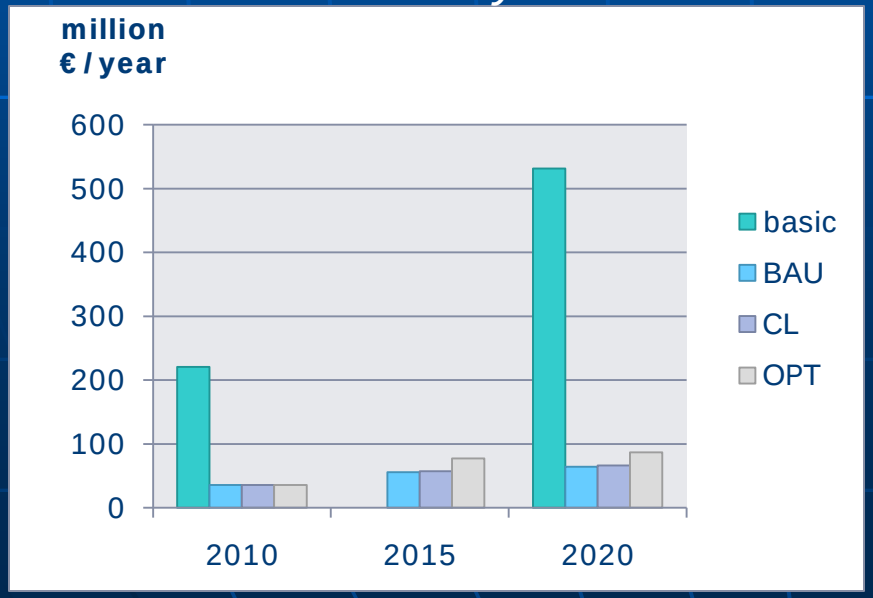
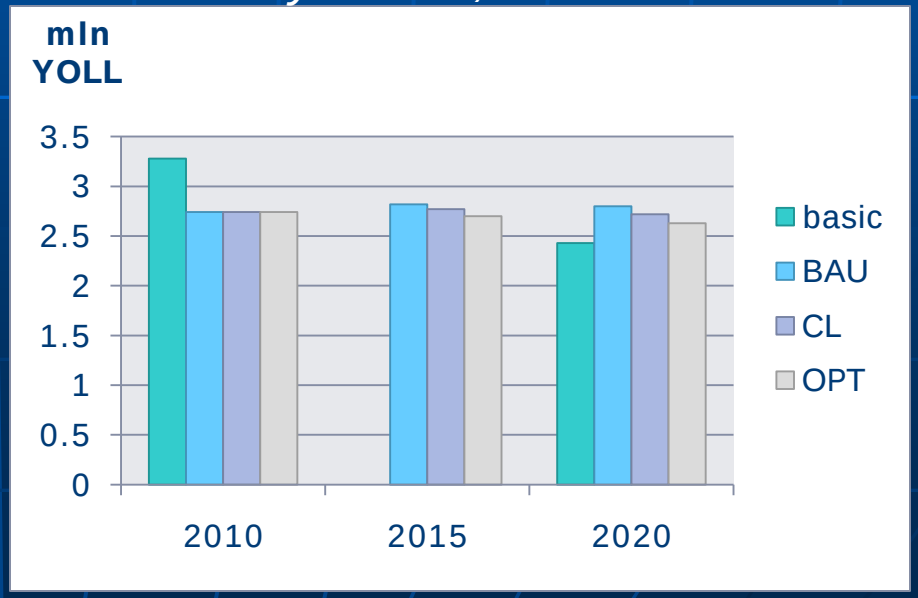


Abatement costs by 2020, mln. Euro/year



Health impacts from PM emission by 2020 , mln. YOLL



- by all scenario except zero growth of PM emission is expected; greatest – by BAU scenario.

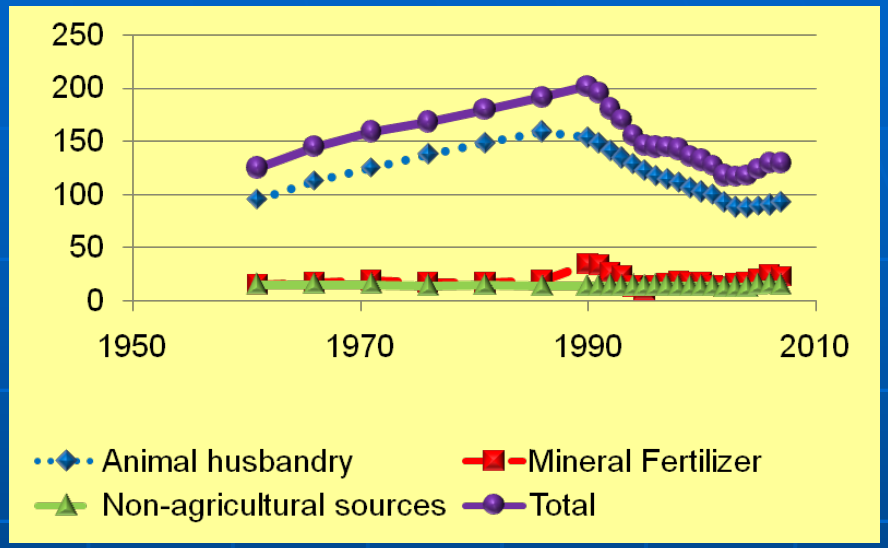
- for all scenarios abatement costs will grow. Zero scenario shows exceptional levels of costs and their grows which can hardly been explained.

- health impacts (years of life losses) will grow by BAU and CLE scenario, and reduce – by MTR and zero scenarios. Differences in life losses and not high; their statistical relevance should be tested.

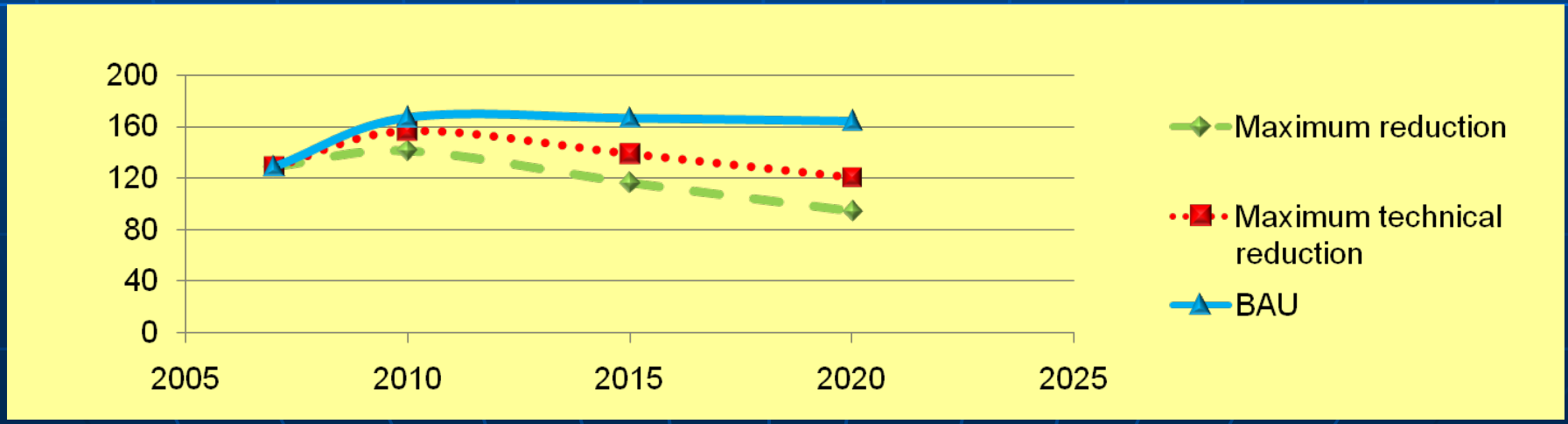
- for further increase of accuracy of emission, costs and health impacts estimates model parametrisation is necessary.

5. Integrated assessment of ammonia emissions

Includes:
- **Emission time-series assessment;**
- **Abatement options analysis;**
- **Emission and costs projection;**
- **Scenario analysis**



Ammonia emission projection



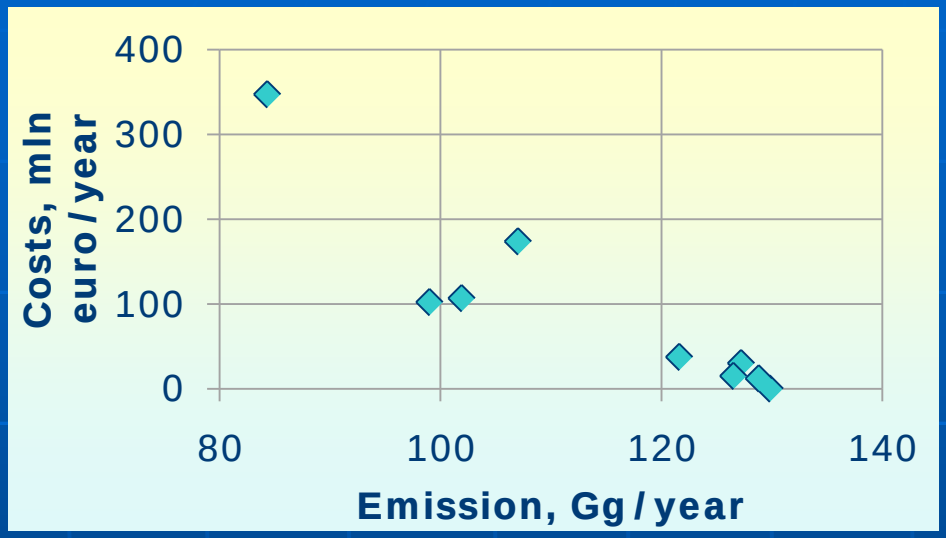
Ammonia emission reduction strategies (scenarios) 1-6

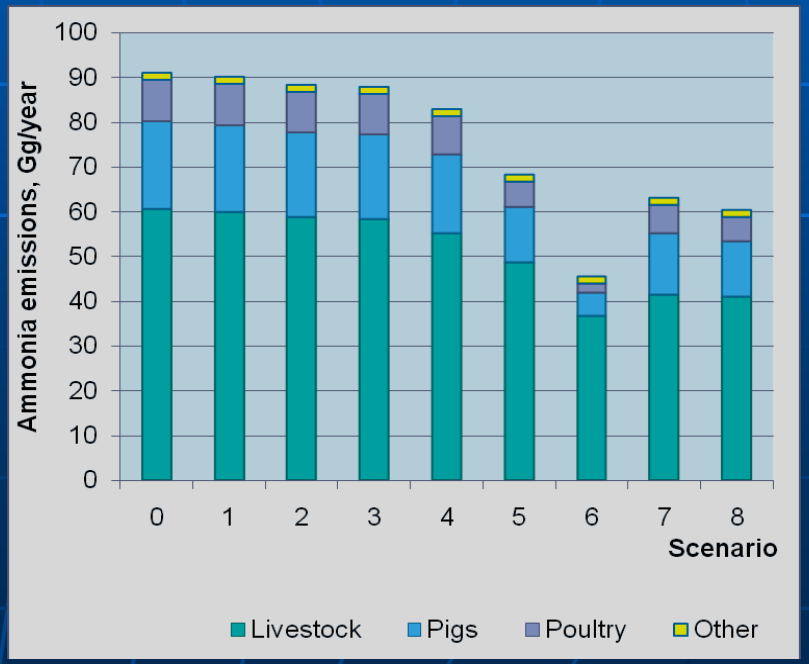
Scenario	Scenario description	
	abatement measures	% of total activity controlled
1	low efficiency abatement measures: manure application (band spreading), manure storage (floating cover)	10
2		25
3	high efficiency abatement measures: manure application (rapid incorporation by plaughing, slurry injection); manure storage (hard cover)	10
4		25
5	high efficiency abatement measures are implemented on all stages: low nitrogen feed, covered outdoor manure storage, low ammonia application, biofiltration	50
6		100

Ammonia emission reduction strategies 7 and 8 description

Sector	Scenario description: abatement measures	% of total activity controlled	
		Sc.7	Sc.8
Livestock; liquid system	Covered outdoor storage of manure; high efficiency	20	-
	Animal house adaptation	20	-
	Low ammonia manure application; high efficiency	60	80
	Covered manure storage, low ammonia manure application		20
Livestock; solid system	Low ammonia manure application; high efficiency	100	100
Poultry	Biofiltration	50	30
	Animal house adaption	20	-
	Low ammonia manure application; high efficiency	10	50
	Covered manure storage, low ammonia manure application, biofiltration	-	20
Pigs; liquid system	Covered outdoor storage of manure; high efficiency	20	-
	Low ammonia manure application; high efficiency	60	80
	Covered manure storage, low ammonia manure application, biofiltration	-	20
Pigs; solid system	Low ammonia manure application; high efficiency	100	100

Ammonia emissions and costs by different scenarios





— maximum achievable ammonia emission reduction is 45.5 Gg. Such reduction is possible in case of abatement measure implementation on all stages of livestock production. The costs will amount 347 mln. Euro/year which is 5-6 times more than all yearly air protection costs in Belarus;

— scenario 7 is characterized by minimal specific costs (3 thousand euro/ton) and will allow to reduce total ammonia emission by 21% which will costs 107 mln. Euro/year;

— so it can be preliminary considered that technically available ammonia emission limit is about 100 thous. tons.

6. Conclusions, further activities and proposals

- potential for wider application of IA/IAM in Belarus and EECCA exists;
- certain basis for IAM application is created;

Planned activities:

- integrated assessment of NOx emission;
- more attention onto health and ecosystem impacts;
- scenarios and control strategies preparation/improvement;
- assessment of uncertainties in emission/costs estimation possible impact onto policy making;
- in-depth analysis of a certain sector using IA approaches (transport).

Possible common actions for EECCA:

- further technological parametrisation of IAM/GAINS;

- in-depth analysis of certain sectors/technologies across a region or few countries;
- guidelines on IAM application, scenarios, strategies;
- experience exchange;
- case studies;
- datasets etc.

Thank you for your attention!