

# IAM activities in Belarus

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## IAM framework in Belarus:

- NAS projects
- IVL project

Ideology: step by step (by pollutants, by task etc)

Base model: GAINS

### **Goals:**

- IAM basis in Belarus strengthening for air legislation improvement and new air abatement programs elaboration
- scientific provision of negotiations on Gothenburg and HM Protocols
- support to EGTEI etc.

### **Actual tasks:**

- 1.Input data for IAM preparation: data collection, gaps identification, gaps filling
- 2.Abatement technology analysis
- 3.Costs effectiveness analysis
4. Impacts assessment.

## Included into presentation:

1. Input data (scenarios, pathways, abatement strategies etc.) improvement
2. Analysis of CIAM emission scenarios vs. national
3. Analysis and review of the GAINS parametrisation
4. Technical document to EGTEI (outline)
5. Ways forward: new scenarios for 2015-2030

# 1. Scenarios and pathways

## 1.1 Identification and discussion on data gaps and inconsistencies in economic scenarios (pathways)

All Processes		Upload:	NO UP	Units:	Mt					
Upload nan WE009_REF		Owner	schoepp	Region	BELA	WHOL	2010	2015	2020	2025
3	Activity Sector	Unit	1990	1995	2000	2005	2010	2015	2020	2025
4	NOF CONSTRUCT	M m2	2,859	2,859	2,859	2,859	2,859	2,859	2,859	2,859
5	NOF MINE_BC	Mt	0	0	0	0	0	0	0	0
6	NOF MINE_HC	Mt	0,027	0,027	0,027	0,027	0,027	0,027	0,027	0,027
7	NOF MINE_OTH	Mt	0	0	0	0	0	0	0	0
8	NOF OTHER_CO2	Mt	-12,4444	-12,4444	-12,4444	-5,262	-5,262	-5,262	-5,262	-5,262
9	NOF OTHER_NOX	kt	5,3	4,8	5,1	5,15	5,2	5,25	5,3	5,3
10	NOF OTHER_PM	kt	0	0	0	0	0	0	0	0
11	NOF OTHER_SO2	kt	0	0	0	0	0	0	0	0
12	NOF OTHER_CH4	kt	40,69	40,69	40,69	40,69	40,69	40,69	40,69	40,69
13	NOF OTHER_N2O	kt	-13,0227	-13,0227	-13,0227	-13,0227	-13,0227	-13,0227	-13,0227	-13,0227
14	NOF PR_ALPRIM	Mt	0	0	0	0	0	0	0	0
15	NOF PR_ALSEC	Mt	0	0	0	0	0	0	0	0

All Processes		Upload:	NO UP	Units:	Mt					
Upload nan For_report		Owner	AnnaMal	Region	BELA	WHOL	2010	2015	2020	2025
3	Activity Sector	Unit	1990	1995	2000	2005	2010	2015	2020	2025
4	NOF CONSTRUCT	M m2	2,859	1,9488	3,6285	3,7855	3,7855	3,7855	3,7855	0
5	NOF MINE_BC	Mt	0	0	0	0	0	0	0	0
6	NOF MINE_HC	Mt	0	0	0	0	0	0	0	0
7	NOF MINE_OTH	Mt	0	0	0	0	0	0	0	0
8	NOF OTHER_CO2	Mt	0	0	0	0	0	0	0	0
9	NOF OTHER_NOX	kt	0	0	0	0	0	0	0	0
10	NOF OTHER_PM	kt	0	0	0	0	0	0	0	0
11	NOF OTHER_SO2	kt	0	0	0	0	0	0	0	0
12	NOF OTHER_CH4	kt	0	0	0	0	0	0	0	0
13	NOF OTHER_N2O	kt	0	0	0	0	0	0	0	0
14	NOF PR_ALPRIM	Mt	0	0	0	0	0	0	0	0
15	NOF PR_ALSEC	Mt	0	0	0	0	0	0	0	0

Gaps classification  
Analysis of gaps closure possibilities

Gaps impact (on modeling results) analysis

23	NOF PR_EARC	Mt	0,744	0,744	0,744	0,744	0,744	0,744	0,744	0,744
24	NOF PR_GLASS	Mt	0,0392	0,0392	0,0392	0,0392	0,0392	0,0392	0,0392	0,0392
25	NOF PR_HEARTH	Mt	0	0	0	0	0	0	0	0
26	NOF PR_NIAC	Mt	0,93	0,558	0,651	0,696	0,744	0,792	0,836	0,88
27	NOF PR_OTHER	Mt	0,0455	0,0273	0,0319	0,0342	0,0364	0,0387	0,0409	0,0431
28	NOF PR_OT_NFME	Mt	0	0	0	0	0	0	0	0
29	NOF PR_PELL	Mt	0	0	0	0	0	0	0	0
30	NOF PR_PIGI	Mt	0	0	0	0	0	0	0	0
31	NOF PR_PIGI_F	Mt	0	0	0	0	0	0	0	0
32	NOF PR_PULP	Mt	0	0	0	0	0	0	0	0
33	NOF PR_REF	Mt	39,2	19,693	21,063	24,978	26,479	27,98	29,481	30,98
34	NOF PR_SINT	Mt	0	0	0	0	0	0	0	0
35	NOF PR_SINT_F	Mt	0	0	0	0	0	0	0	0
36	NOF PR_SUAC	Mt	1,17	0,702	0,819	0,878	0,936	0,994	1,052	1,11
37	CRU PROD	PJ crude oil	0	0	0	0	0	0	0	0
38	GAS PROD	PJ gas	9,25	9,25	8,92	10,48727	12,05455	12,43059	12,80651	13,6994
39	NOF STH_AGR	Mt	12,1848	12,1848	12,1848	12,1848	12,1848	12,1848	12,1848	12,1848
40	NOF STH_COAL	Mt	24,4028	24,4028	24,4028	24,4028	24,4028	24,4028	24,4028	24,4028
41	NOF STH_FEORE	Mt	0	0	0	0	0	0	0	0
42	NOF STH_NPK	Mt	6,2938	6,2938	6,2938	6,2938	6,2938	6,2938	6,2938	6,2938
43	NOF STH_OTH_IN	Mt	9,4251	9,4251	9,4251	9,4251	9,4251	9,4251	9,4251	9,4251
44	GAS TRANS	PJ gas transported	459,16	466,48	577,88	687,82	761,9102	842,8986	914,1194	914,1194
45	NOF WASTE_FLR	PJ	1,09	1,09	1,09	1,09	1,09	1,09	1,09	1,09
46	NOF WASTE_RES	Mt	0,085192	0,070578923	0,08	0,12	0,203269	0,219615	0,237892	0,25789
47	NOF MSW_TOT	Mt	4,433523	3,668445279	4,162727	6,236099	10,5722	11,42191	12,36316	13,4002
48	10YR_BP MSW_TOT	Mt	3,744336	4,097493793	4,433523	3,668445	4,162727	6,236099	10,5722	11,42191
49	20YR_BP MSW_TOT	Mt	3,050818	3,401843156	3,744336	4,097494	4,433523	3,668445	4,162727	6,236099
50	NOF INW_TOT	Mt	15,06157	9,49914688	7,96544	10,49419	12,73906	15,75333	17,08306	18,84004
51	10YR_BP INW_TOT	Mt	15,06157	15,0615736	15,06157	9,499147	7,96544	10,49419	12,73906	15,75333
52	20YR_BP INW_TOT	Mt	15,06157	15,0615736	15,06157	15,06157	15,06157	9,499147	7,96544	10,49419
53	NOF IND_PAP	M m3 wastewater	30,6432	26,7792	24,32	26,752	28,2112	29,19	29,670	30,6432
54	NOF IND_FOOD	M m3 wastewater	110,7277	70,54206	60,032	77,96096	92,18048	121,23	132,368	146,588
55	NOF IND_OCH	M m3 wastewater	52,75827	50,74944	50,2208	51,17235	51,80672	52,22963	52,22963	52,75827
56	NOF PR_ADIP	Mt	0	0	0	0	0	0	0	0
57	POP ANY	M Persons	10,28	10,194	9,99	9,756	9,522171	9,333056	9,145644	8,93344

23	NOF PR_EARC	Mt	1,112	0,744	1,623	2,076	2,5	3,5	3,5	3,5
24	NOF PR_GLASS	Mt	0,006	0,031	0,058	0,109	0,109	0,109	0,109	0,109
25	NOF PR_HEARTH	Mt	0	0	0	0	0	0	0	0
26	NOF PR_NIAC	Mt	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001
27	NOF PR_OTHER	Mt	0,162	0,028	0,05	0,056	0,056	0,056	0,056	0,056
28	NOF PR_OT_NFME	Mt	0	0	0	0	0	0	0	0
29	NOF PR_PELL	Mt	0	0	0	0	0	0	0	0
30	NOF PR_PIGI	Mt	0	0	0	0	0	0	0	0
31	NOF PR_PIGI_F	Mt	0	0	0	0	0	0	0	0
32	NOF PR_PULP	Mt	0,0368	0,0349	0,0559	0,0613	0,1075	0,255	0,268	0,268
33	NOF PR_REF	Mt	39,442	13,118	13,528	19,802	19,802	19,802	19,802	19,802
34	NOF PR_SINT	Mt	0	0	0	0	0	0	0	0
35	NOF PR_SINT_F	Mt	0	0	0	0	0	0	0	0
36	NOF PR_SUAC	Mt	1,177	0,437	0,584	0,737	0,128	0,144	0,145	0,145
37	CRU PROD	PJ crude oil	0,088	0,082	0,079	0,076	0,076	0,076	0,076	0,076
38	GAS PROD	PJ gas	10,01	9,97	8,66	7,69	7,69	7,69	7,69	7,69
39	NOF STH_AGR	Mt	7,035	5,802	4,856	6,421	7,77	7,86	8,3	8,3
40	NOF STH_COAL	Mt	57,4	23,65	11,5	4	16,8	33,7	53	53
41	NOF STH_FEORE	Mt	0	0	0	0	0	0	0	0
42	NOF STH_NPK	Mt	5,99	3,349	4,056	5,669	6,759	6,759	6,759	6,759
43	NOF STH_OTH_IN	Mt	2,458	1,335	1,947	3,231	6,2	10	12	12
44	GAS TRANS	PJ gas transported	422,72	403,96	534,67	644,63	703,44	762,8	806,025	806,025
45	NOF WASTE_FLR	PJ	1,09	1,09	1,09	1,09	1,09	1,09	1,09	1,09
46	NOF WASTE_RES	Mt	0,085192	0,070578923	0,08	0,12	0,203269	0,219615	0,237892	0,25789
47	NOF MSW_TOT	Mt	0,736	1,465	1,696	3,182	3,182	3,182	3,182	3,182
48	10YR_BP MSW_TOT	Mt	0	0	0,736	1,465	1,696	3,182	3,182	3,182
49	20YR_BP MSW_TOT	Mt	0	0	0,736	1,465	1,696	3,182	3,182	3,182
50	NOF INW_TOT	Mt	15,0616	9,49914688	7,96544	10,4942	12,73906	15,75333	17,08306	18,84004
51	10YR_BP INW_TOT	Mt	15,0616	15,0616	9,49915	7,96544	10,4942	12,73906	15,75333	17,08306
52	20YR_BP INW_TOT	Mt	15,0616	15,0616	15,0616	15,0616	9,49915	7,96544	10,4942	12,73906
53	NOF IND_PAP	M m3 wastewater	0	4	3	3	3	3	3	3
54	NOF IND_FOOD	M m3 wastewater	0	11	7	7	7	7	7	7
55	NOF IND_OCH	M m3 wastewater	0	136	71	71	71	71	71	71
56	NOF PR_ADIP	Mt	0	0	0	0	0	0	0	0
57	POP ANY	M Persons	9,049	10,117	9,99	9,761	9,549	9,288	9,027	8,766

WEO 2009

INM 2010

An example of economic pathway table check: in conditions of lack of statistical data a lot of assumptions/extrapolations to be made which increase uncertainty

## 1.2 Control strategies review



### Industry Processes and Combustion

Sector	Technology	CIAM 2011 baseline	INM 2010	BAU 2020
<b>Combustion (Fuel production &amp; conversion, power plants)</b>				
CON_COMB, PP_..., IN_..., PP_NEW	NSC_PM	-	10	
	IN_CYC	-	85	60
	IN_ESP1, ESP1	50	5	20
	ESP2	50	-	10
<b>INDUSTRY PROCESSES</b>				
PR_BRICK	VSBK	40	-	--
	TK_EOF	60	-	-
PR_CAST	PR_WSCRB	-	90	0
	PR_ESP2	100	-	0
PR_COKE	PR_CYC	40	-	40
	PR_ESP1	59	-	59
PR_CEM	PR_ESP2	100	-	3
	PR_HED	-	95	97
PR_EARC	NSC_PM	-	5	
	PR_CYC	50	10	5
	PR_HED	49	90	95
PR_FERT	NSC_PM	-	5	
	PR_CYC	5	15	10
	PR_HED	95	80	90
PR_LIME	PR_ESP1	99	100	10
	PR_HED	-	-	90
PR_GLASS, PR_REF	NSC_PM	1	80	10-40
	PR_CYC	50	20	40-70
	PR_ESP1	49	-	20
PR_SMIND_F	PRF_GP1	60	-	50
	PRF_GP2	-	99	10

## 2. Analysis of emission scenarios

### 2.1 CIAM 2011 scenarios of different levels of ambition for Gothenburg protocol revision in relation to Belarus

#### Methods:

detailed study of the input data and parameterization including :

- economic pathways;
- control strategies and approaches to its development;
- abatement option parameterization

comparison with national scenarios;

expert assessment of key measures impact using variable data

Extra analysis methods:

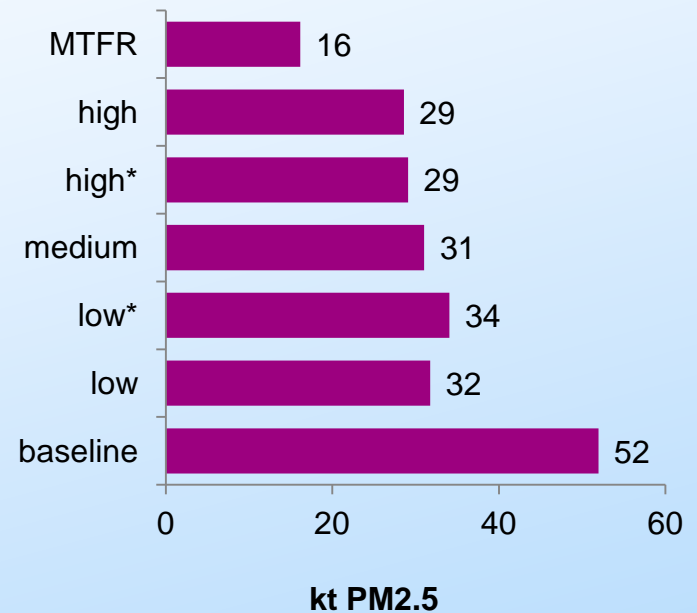
- emissions trends analysis;
- statistic data on costs;
- data and reports from enterprises.

## PM2.5 emission

16–52 kt reduction potential

Emission reduction potential ( Medium scenario), kt	
Waste: Agricultural waste burning	9,97
Ind. Process: Fertilizer production	7,93
Ind. Process: Electric arc furnace	1,61
Ind. Process: Crude oil & other products - input to Petroleum refineries	0,71
Waste: Open burning of residential waste	0,66
Ind. Process: Glass production (flat, blown, container glass)	0,03
<b>Total</b>	<b>20,91</b>

Emission reduction potential (Low* scenario), kt	
Waste: Agricultural waste burning	10,0
Ind. Process: Fertilizer production	7,9
<b>Total</b>	<b>17,9</b>



The greatest costs ( according to scenario) demand to emission reduction from heating stoves and small industrial and business facilities, significant – from fertilizer production, boiler combustion, also from fertilizers and agricultural production handling and storage.

**Realization of scenarios with such parameters is not a trivial task.**

**in 2011 two scientific articles on MTR and key measures scenarios for PM emission sources in Belarus were published.**

Total emission reduction potential in key sectors (industry incl. stationary fuel combustion) was assessed as 14.5 kt TSP and 6.0 kt PM<sub>2.5</sub> (about 17% of total TSP and 23% of PM<sub>2.5</sub> emissions).

PM emission reduction potential of key measures in industry and transport was assessed as 18.4 kt TSP and 7.9 kt PM<sub>2.5</sub> (about 21% of total TSP and 30% of PM<sub>2.5</sub> emission).

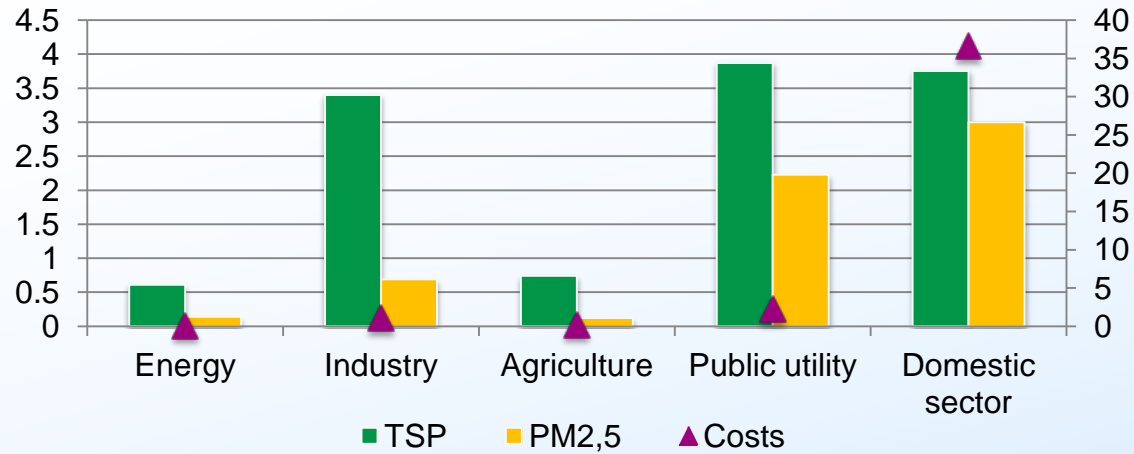
If residential sector to be added total emission potential will comprise 22.2 kt TSP and 10.9 kt PM<sub>2.5</sub> (26% of total TSP and 41% of total PM<sub>2.5</sub>).

Abatement costs were assessed in 27 mln. Euro for realization of key measures in industry, 45.9 mln. Euro for key measures in industry and transport, 82.5 mln. Euro for key measures in industry, transport and residential sector.



**Emission reduction, kt**

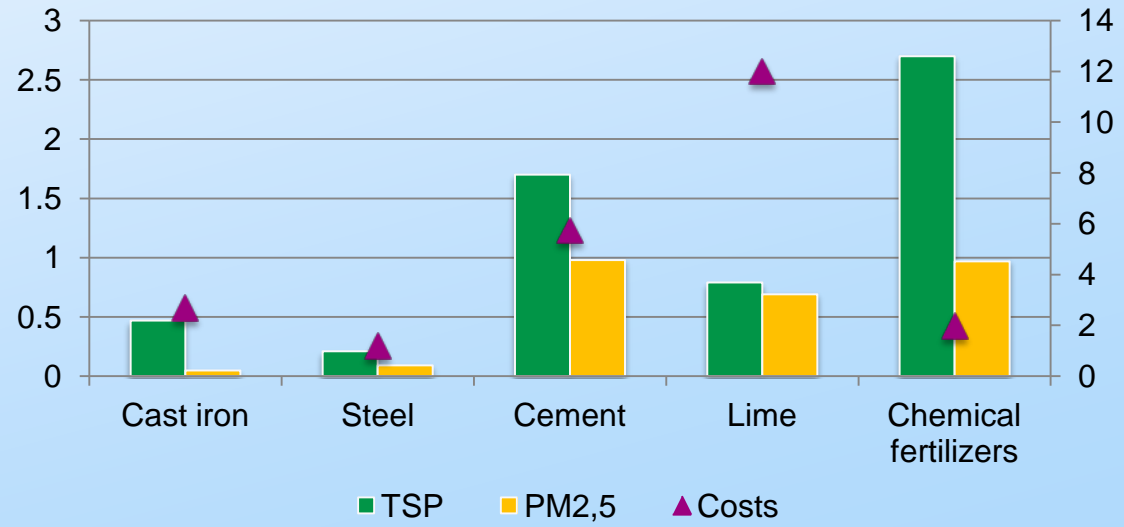
**Costs, MEuro/year**



**Emission reduction potential for stationary fuel combustion**

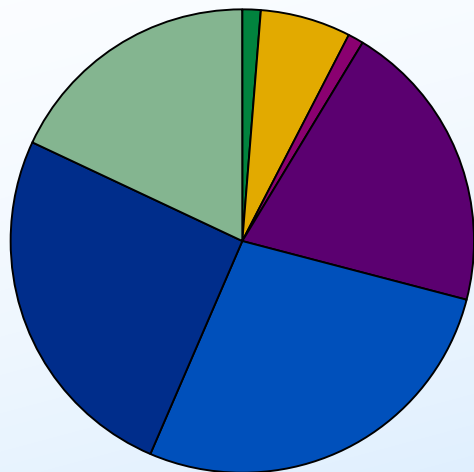
**Emission reduction, kt**

**Costs, MEuro/year**



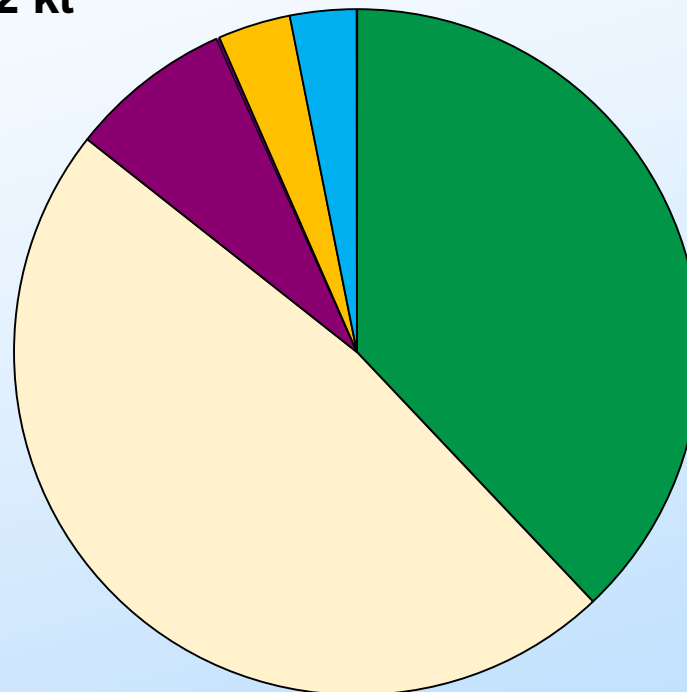
**Emission reduction potential for industry**

**Key sources scenario**  
**10.9 kt**



- Fuel combustion in Energy
- Fuel combustion in Industry
- Fuel combustion in Agriculture
- Fuel combustion in Public utility
- Fuel combustion in Domestic sector
- Industry processes
- Transport

**CIAM 4/2011 medium scenario**  
**22.2 kt**



- Ind. Process: Fertilizer production
- Waste: Agricultural waste burning
- Ind. Process: Electric arc furnace
- Ind. Process: Glass production (flat, blown, container glass)
- Ind. Process: Crude oil & other products - input to Petroleum refineries
- Waste: Open burning of residential waste

National and CIAM scenarios are different in absolute values and structure

## Emissions abatement options

### Comparative PM removal efficiency by sector, %

Abatement technology	Sector			
	Cement production	Lime production	Iron and Steel foundries	Electric Arc Furnace
ESP (2 field)	91.9/97.1			
ESP (3 fields and more)	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	

### Technical paper on emission abatement technologies for PM, applicable in EECCA countries, with special emphasis on Belarus

#### The structure of Technical paper

- Introduction
- Standards for dust abatement equipment
- Classification of abatement equipment
- Abatement equipment manufacturers
- Abatement equipment features
- Abatement equipment by industry sectors
- References

## USSR

GOST 12.2.043-80. Dust equipment.  
Classification

GOST 25199-82. (CMEA Standard 2145-80)  
Dust equipment. Terms and definitions.

### Purposes of use

- Air filter for forced ventilation
- Dust collector for emission

### Types and subtypes

- Dry
  - Gravitational/inertial/filtration/electrostatic
- Wet
  - Gravitational/filtration/electrostatic

Dust abatement efficiency for particles of different size groups (I-V)

## Belarus

Rules of operation for gas treatment facilities

- General types
- Efficiency criteria

## Russia

- FINGO ENGINEERING, CJSC (*all types*)
- «Folter», SPE (*cyclones, filters*)
- IRIMEX, JSC (*all types*)
- «Giprogazoochistka” OJSC (*all types*)
- «Rankom-Energo», EPC (*filters, electrostatic precipitators*)
- STC «Zenith», Ltd. (*cyclones, scrubbers*)
- «SPA «Talnakh», JSC (*cyclones, scrubbers, filters*)
- «Siberian association of energy engineering», Ltd. (*cyclones*)
- «ALYUMATEK», GC (*all types*)

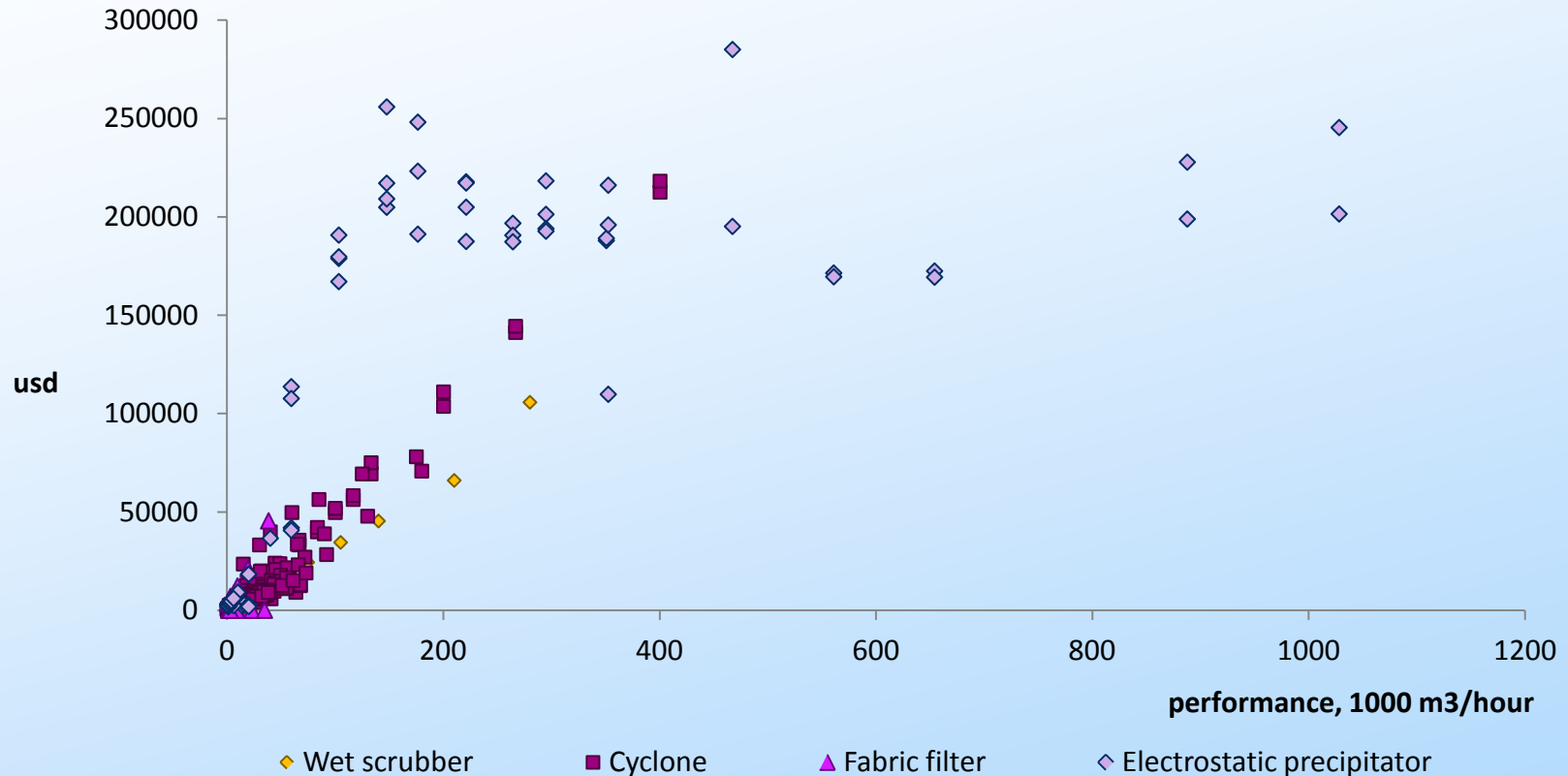
## Belarus

- «BELKOTLOMASH», SPE LLC (*cyclones*)
- «Belenergoremnaladka», JSC (*filters, electrostatic precipitators*)

## Ukraine

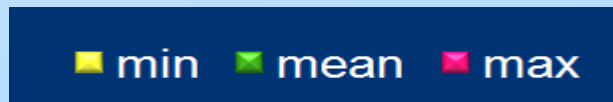
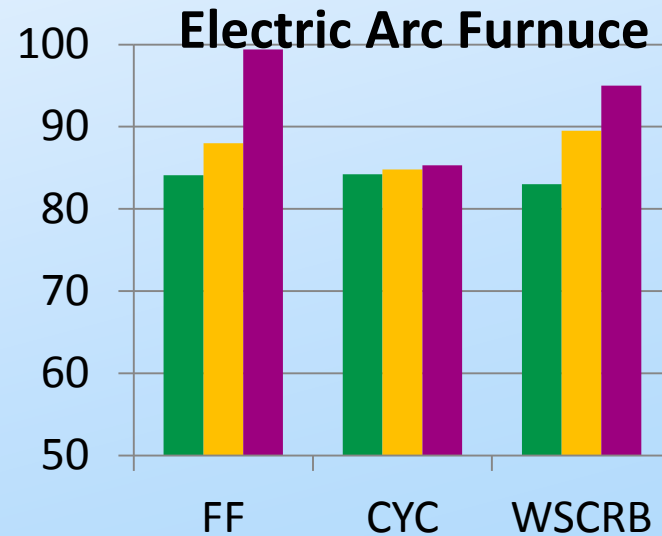
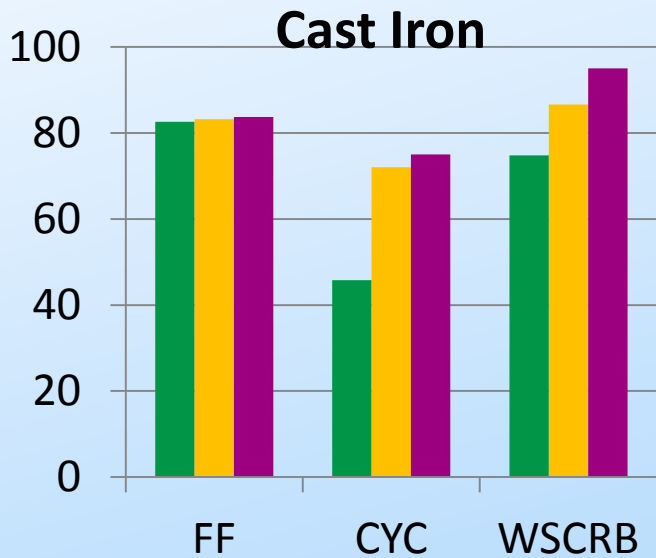
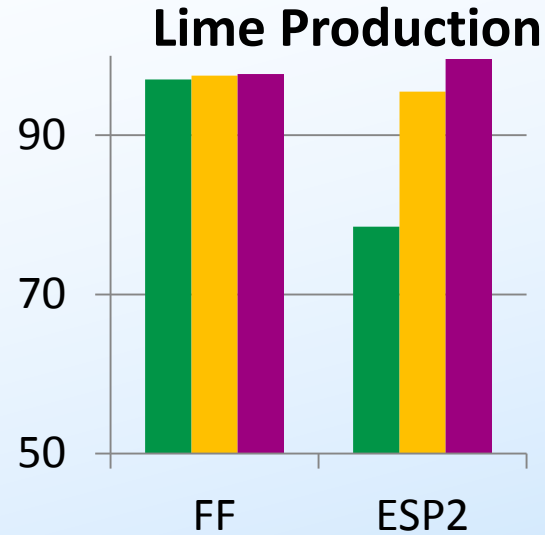
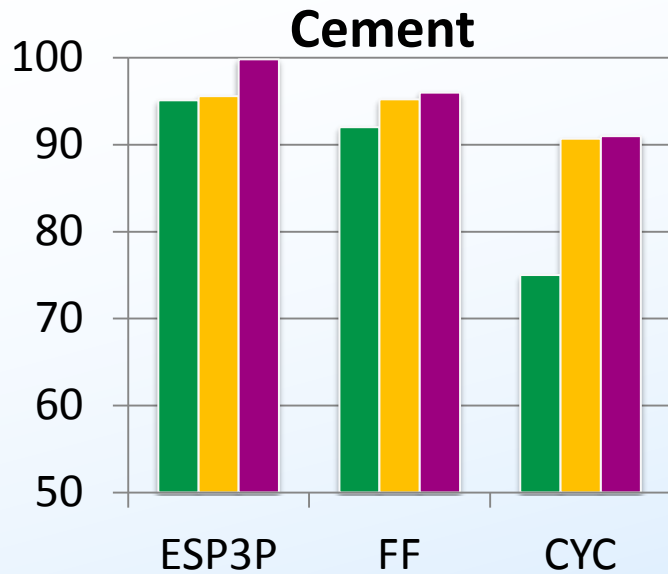
- «Berdichev Machine Building Plant «Progress», TH (*cyclones, filters, electrostatic precipitators*)
- ARTEMOVSKIY MASHINOSTRAITELINYY PLANT «PROMMASH», Ltd. (*cyclones*)
- «Gas Cleaning Equipment Plant» Ltd. (*cyclones, scrubbers, filters*)

# Correlation between capacity and cost of PM abatement equipment by type



Data on more than 700 models of control equipment from EECCA countries were compiled into database. It includes capacity, weight, efficiency, cost parameters etc.

# Abatement efficiency variability by type of control equipment





## 5. Ways forward: new scenarios for 2015-2030

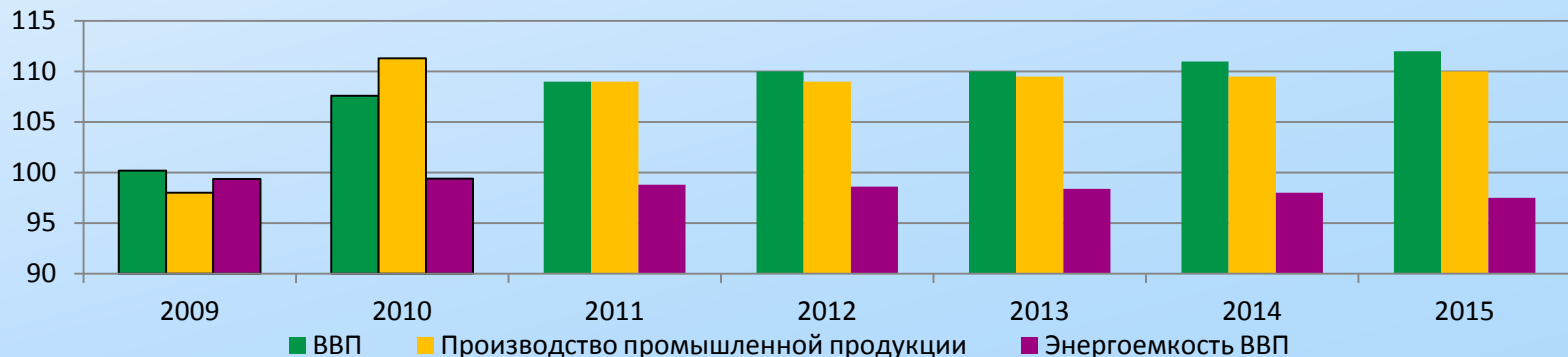
### *Scenarios are based upon plans and programs approved in 2011-2012*

#### Main State Plans and Programs used for scenarios development

- 1 Программа социально-экономического развития Республики Беларусь на 2011-2015 годы. Утверждена Указом Президента Республики Беларусь 11 апреля 2011 г. № 136;
- 2 Государственная программа инновационного развития Республики Беларусь на 2011-2015 годы. Постановление Совета Министров Республики Беларусь от 26.05.2011 № 669.
- 3 Закон Республики Беларусь от 27 декабря 2010 года «О возобновляемых источниках энергии» (Национальный реестр правовых актов Республики Беларусь, 2011 г., № 2, 2/1756);
- 4 Постановление Совета Министров Республики Беларусь от 23 января 2008 г. № 94 «Об утверждении Государственной программы «Торф» на 2008 – 2010 годы и на период до 2020 года» (Национальный реестр правовых актов Республики Беларусь, 2008 г., № 29, 5/26698);
- 5 Постановление Совета Министров Республики Беларусь от 22 февраля 2010 г. № 248 «О мерах по повышению эффективности использования топливно-энергетических ресурсов на период до 2012 года» (Национальный реестр правовых актов Республики Беларусь, 2010 г., № 53, 5/31328);

#### Key macroeconomic parameters by 2015

% к уровню  
предыдущего года

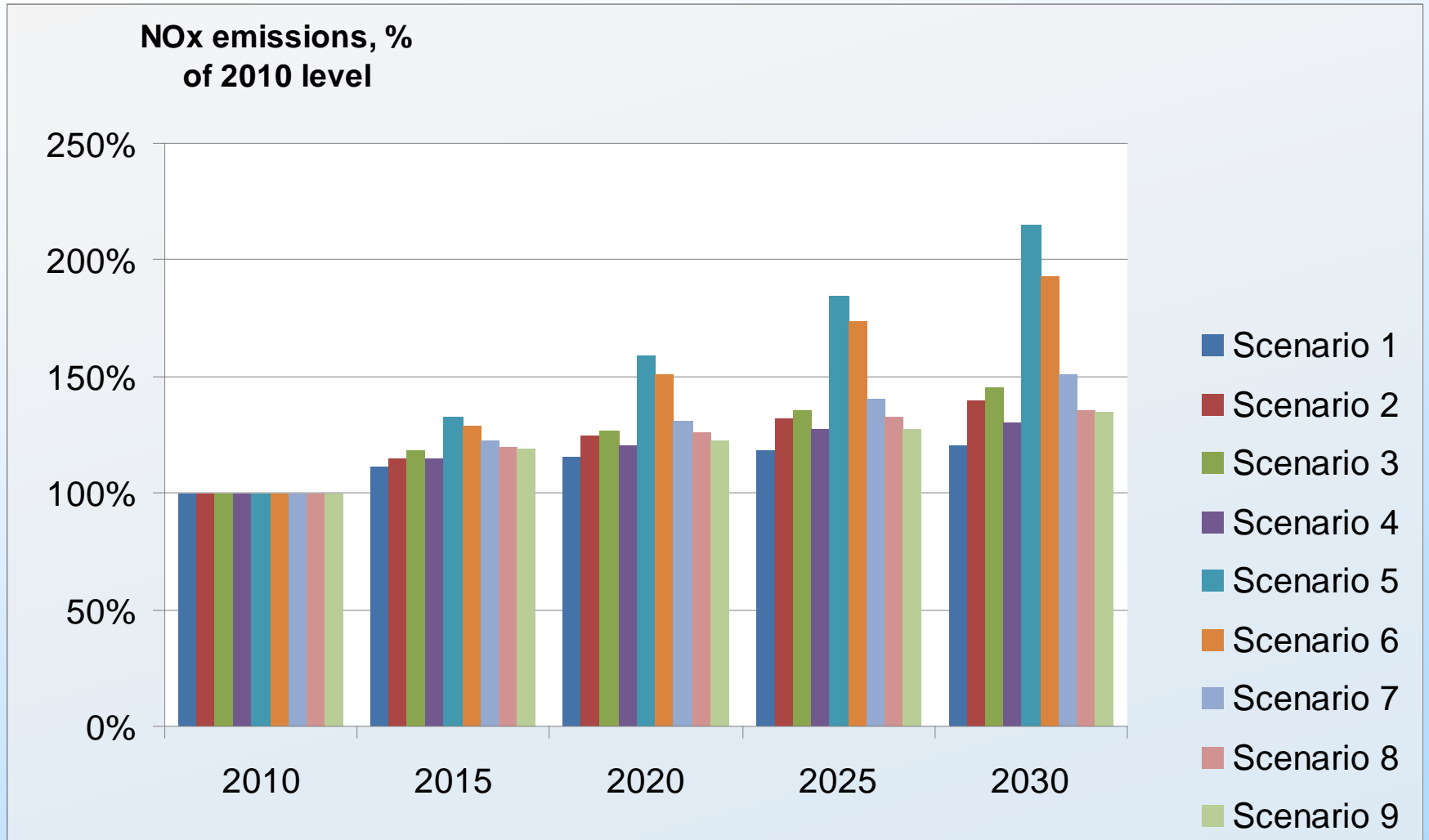




*Scenarios scheme*

Rate of economy growth	Energy structure	Control strategy		
		Basic	Current legislation	Optimistic
Pessimistic	Basic	Scenario 1		
Nominal	Basic		Scenario 2	
Optimistic	Basic		Scenario 5	Scenario 6
	Basic		Scenario 3	Scenario 4
Planned	Local and Renewable energy sources		Scenario 7	Scenario 9
	Local and Renewable energy sources+ Atomic energy		Scenario 8	

## ***NOx emission projection by 2030 vs. 2010 level***



## Further plans:

- More attention to impact assessment
- GAINS + other IAM models
- Application of IAM for certain state plans and programs analysis
- Urban environment air abatement impact analysis
- VOCs and NH<sub>3</sub>

**Thank you for your attention!**