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Technical and economic aspects of the pollutant emission reduction in Belarus

A Contribution to EGTEI

S.Kakareka, O.Krukowskaya, T.Kukharchyk

Institute for Nature Management
National Academy of Sciences
Minsk, Belarus

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Background

- air legislation improvement and new air abatement programs elaboration;
- scientific provision of negotiations on LRTAP Protocols accession, inc. Goteborg Protocol

Framework

- Projects financed by National Academy of Sciences and supported by Ministry of Natural Resources and Environmental Protection
- Swedish-Belarus project 'Validation of Belarus Air Pollution Data within the Convention on Long Range Transboundary Air Pollution – CLRTAP (IP 1001, BIP 19/4/2), Phase III', financed by the Swedish international development cooperation agency (SIDA) and IVL

Goals:

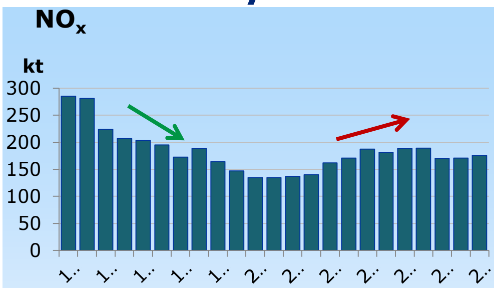
Assessment of the emission abatement potential in Belarus towards emission targets in 2020 as announced in the revised Gothenburg protocol

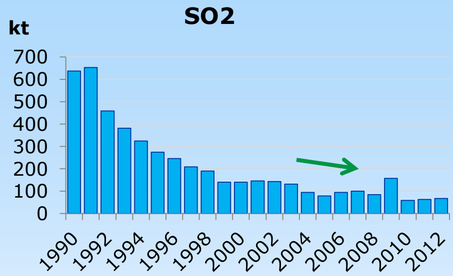
Pollutants: NO_x, SO_2, PM, and NH_3

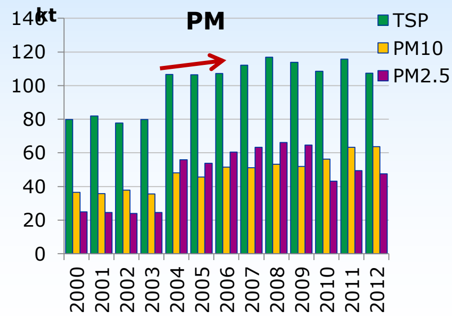
Tasks

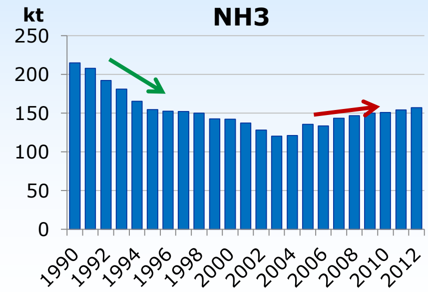
1. Analysis of current emission trends for Belarus;
2. Comparison of emission trends and projections;
3. Analysis of discrepancies between the modeled and the reported sector-specific emissions for 2010;
4. Quantification of gaps between the emission scenarios and emission targets for 2020;
5. Assessment of the emission abatement potential in Belarus towards emission targets in 2020
6. Assessment of costs for NO_x, NH_3 and PM emissions reduction

1. Analysis of emission trends in Belarus









Trend analysis is a supplementary tool to integrated assessment of emission reduction potential: it allows to do emission projection verification, abatement strategies verification.

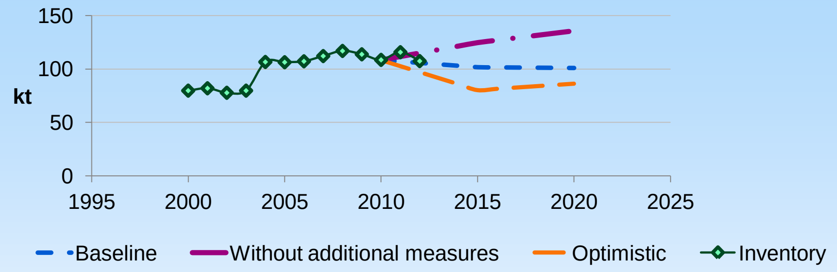
Overall accuracy of emission inventory is average.
It can be placed into the row as: SO_2>NO_x>PM>NH_3.

Uncertainties in emission inventory lead to limited accuracy of emission modeling.

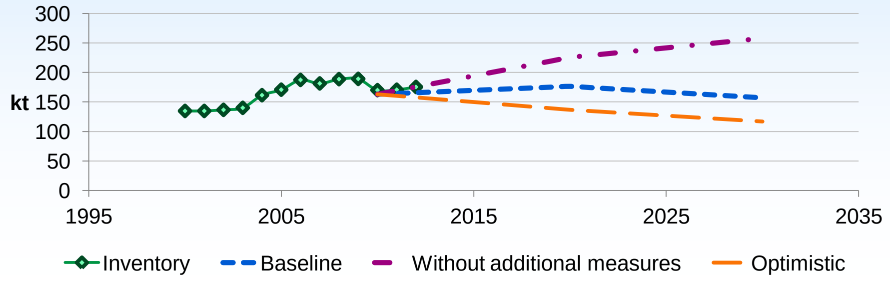
Additional efforts for emission inventory uncertainty reduction are necessary.

2. Emission trends vs emission projection

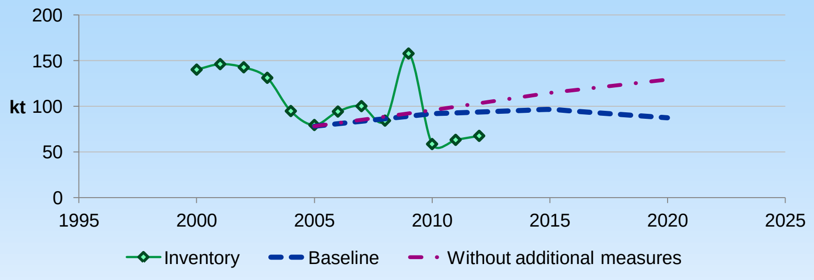
PM (TSP) emission projections (2011)



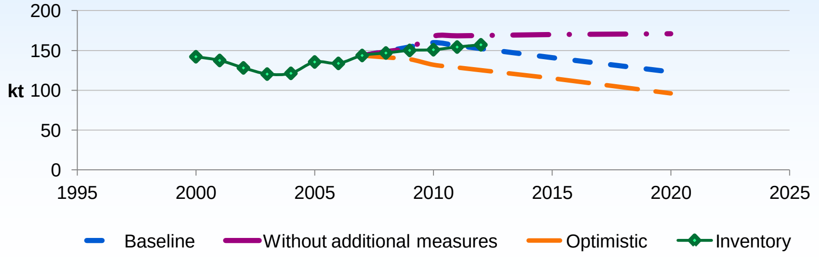
NO_x emission projections (2013)



SO_2 emission projections (2009)



NH_3 emission projections (2008)



3.Differences between the modeled and the reported sector-specific emissions for 2010

Scenarios for analysis:

PRIMES 2013 REF-CLE (ID: TSAP_Sept2013_P13_REFv3) as IIASA Baseline

p4_c_tr (ID: p4_c_tr) as National baseline

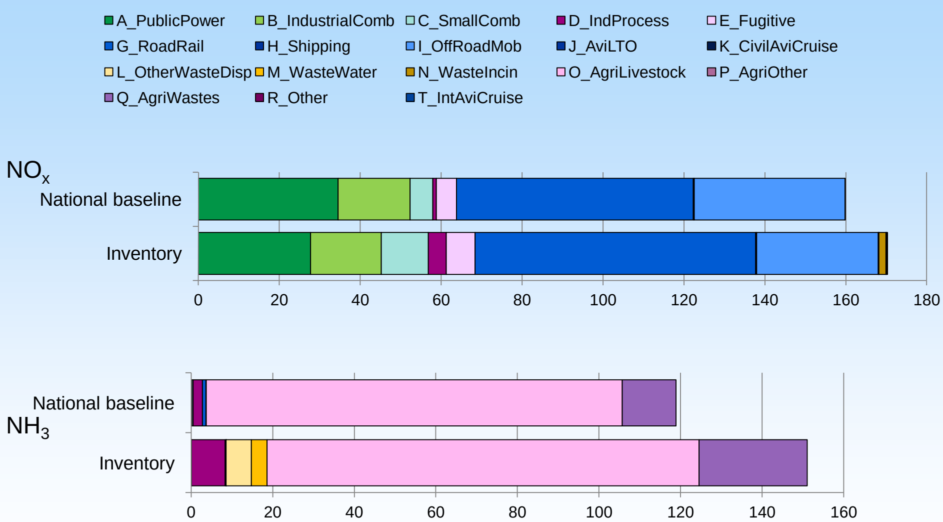
(with natural fleet modernization for road transport)

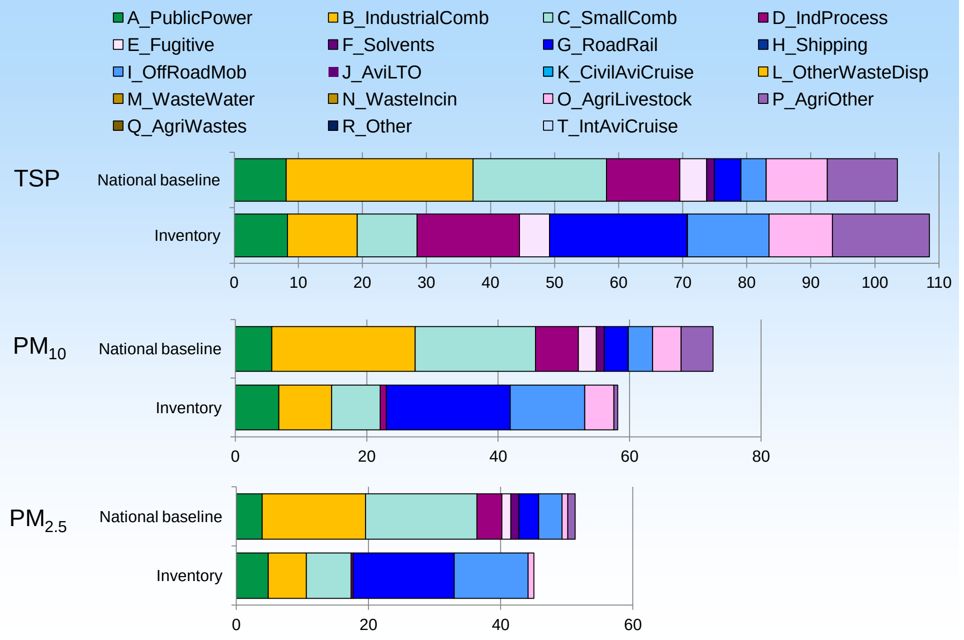
Scenario	Emissions, kt				
	NO_x	TSP	PM_{10}	$PM_{2.5}$	NH_3
Inventory	170.08	108.53	58.19	45.04	151.05
Baseline	160.14	103.64	72.73	51.26	120.96
Diff, %*	*-6%*	*-5%*	*25%*	*14%*	*-20%*
ΔE	9.94	4.89	-14.54	-6.22	30.09
PRIMES	159.81	97.95	68.45	50.8	152.96
Diff, %*	*-6%*	*-10%*	*18%*	*13%*	*1%*

* Relatively to emission inventory

Sources of inconsistency:

- Activity data
- Control strategy
- Emission factors





Differences between Baseline scenario and PRIMES 2013 REF-CLE scenario

Control strategies

Sector (activity)	Technology	National Baseline		PRIMES 2013	
		2010	2020	2010	2020
TRA_RD_HDT (MD)	NSC_TRA	25	10	0	0
TRA_RD_HDT (MD)	HDEUI	23	14	40	3
TRA_RD_HDT (MD)	HDEUII	21	16	10	80
TRA_RD_HDT (MD)	HDEUIII	23	23	0	0
TRA_RD_HDT (MD)	HDEUIV	8	17	0	0
TRA_RD_HDT (MD)	HDEUV	0	15	0	0
TRA_RD_HDT (MD)	HDEUVI	0	5	0	0
TRA_RD_HDT (MD)	HDEUVII	0	0	0	0

Sector (activity)	Technology	National Baseline		PRIMES 2013	
		2010	2020	2010	2020
PR_CEM (NOF)	NSC_PM	0	0	0	0
PR_CEM (NOF)	PR_CYC	5	5	0	0
PR_CEM (NOF)	PR_WSCRB	0	0	0	0
PR_CEM (NOF)	PR_ESP1	0	0	0	0
PR_CEM (NOF)	PR_ESP2	95	95	100	100
PR_CEM (NOF)	PR_HED	0	0	0	0

4. Gaps between baseline emissions and emission targets in 2020

Emission in 2020
by PRIMES 2013 REF-CLE and National baseline scenarios
in comparison with targets

Scenario	Emissions, kt				
	NO_x	TSP	PM_{10}	$PM_{2.5}$	NH_3
Target	**135.1**			**41.1**	**126.5**
Baseline	165.96	112.49	81.27	61.7	127.35
Diff, kt	*-30.86*			*-20.6*	*-0.85*
*Diff, %**	*23%*			*49.8%*	*1%*
PRIMES	165.45	101.49	70.88	52.2	157.2
*Diff, %**	*22%*			*27%*	*24%*

* Relatively to targets

Gaps (relative) between baseline and target emissions in 2020 decrease in line from $PM_{2.5}$ to NO_x and NH_3. In the same order additional measures are required, and resources for reduction increase.

5. Assessment of the emission abatement potential in Belarus towards emission targets in 2020

Methodology for selection of cost effective measures (by pollutants) includes 4 steps:

1. Assessment of emission reduction potential for each possible measure in addition to baseline scenario (up to 100%)
2. Calculation of cost-effective potential (potential /unit cost)
3. Ranking all measures by cost-effective potential
4. New control strategy with additional measures with the highest rank for each sector (sector-fuel combination) for required reduction

Cost-effective additional measures: resulted NO_x emissions and costs

Sector	Activity	Baseline scenario emission, kt	Scenario with additional measures emission, kt	Reduction, kt	Cost, MEuro/Year
PP_NEW_L	HC1	8.445	1.689	6.756	9.67
PR_REF	NOF	7.500	1.500	6.000	16.46
PR_CEM	NOF	9.170	3.500	5.670	10.97
PP_NEW	GAS	5.515	1.103	4.412	22.94
PP_EX_OTH	GAS	6.761	4.930	1.831	3.40
IN_BO_OTH	GAS	2.021	0.866	1.155	8.86
DOM	GAS	3.514	2.741	0.773	2.65
PP_EX_OTH	OS1	1.333	0.666	0.666	2.59
IN_OC	GAS	2.021	1.444	0.578	1.24
PP_NEW	HF	0.690	0.138	0.552	0.92
PR_LIME	NOF	1.331	0.884	0.447	0.24
IN_BO_OTH	HF	1.104	0.788	0.315	0.45
IN_OC	HF	1.104	0.788	0.315	0.27
PP_MOD	BC2	0.391	0.078	0.313	0.58
PP_NEW	OS1	0.764	0.459	0.306	0.95
IN_BO_OTH_S	BC2	0.411	0.176	0.235	0.62
IN_BO_OTH	OS1	0.726	0.519	0.207	0.43
IN_OC	OS1	0.588	0.420	0.168	0.22
IN_BO_OTH_L	BC2	0.411	0.294	0.118	0.15
PP_EX_S	BC2	0.337	0.246	0.091	0.09
PP_EX_OTH	HF	0.173	0.126	0.047	0.03
Total		***54.31***	***23.355***	***30.955***	***83.72***
Required reduction				***30.86***	

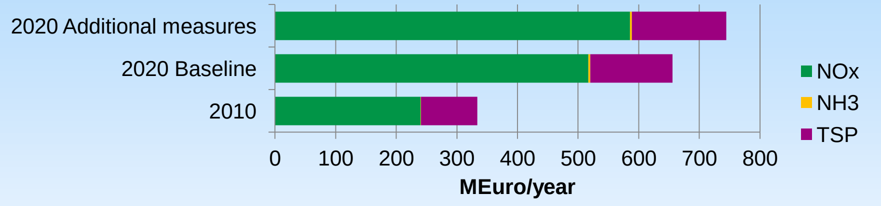
Cost-effective additional measures: resulted $PM_{2.5}$ emissions and costs

Sector	Activity	Baseline scenario emission, kt	Scenario with additional measures emission, kt	Reduction, kt	Cost, MEuro/Year
PR_CEM	NOF	17.082	2.340	14.742	26.12
PR_FERT	NOF	2.172	0.191	1.980	0.43
PP_EX_OTH	GAS	1.708	0.016	1.692	2.27
PP_EX_OTH	HF	1.450	0.168	1.282	0.89
PP_EX_OTH	OS1	1.194	0.012	1.182	1.09
PR_REF	NOF	0.798	0.103	0.695	1.44
Total		**25.089**	**3.448**	**21.573**	**32.23**
Required reduction				***20.6***	

6. Emissions and cost in 2020

Pollutant	Emissions, kt			Cost, MEuro/year		
	Baseline	Additional measures	Emission reduction	Baseline	Additional measures	Cost increase
NOx	165.29	133.2	32.09	516.75	590.67	73.92
PM2.5	61.72	38.16	23.56	135.74	155.56	19.82
NH3	127.33	125.24	2.09	3.14	2.52	-0.62
Total				655.63	748.75	93.12

Costs for NOx, NH3 and TSP emissions reduction



Conclusions

1. Uncertainties in emission trends influence projection verification
2. Emission trends in 2010-2012 correspond rather to scenarios without additional measures with exception for SO_2.
3. Difference between the model and the reported sector-specific emissions for 2010 is quite large (up 25%); such peculiarity of modeling should be kept in mind for interpretation and implementation results of modeling with GAINS;
4. Gaps between national baseline emission scenario and emission targets for 2020 are 30.9 kt for NOx, 20.6 kt for PM2.5 and 0.9 kt for NH3.
5. For indentified gap closure additional measures are required:
   - for NH3 reduction - in 1 sector (on 2.4 kt, up to 125.1 kt)
   - for PM2.5 reduction - in 6 sectors (on 23.7 kt, up to 38.0 kt)
   - for NOx reduction - in 21 sectors (on 30.9, up to 135.1 kt).
6. Costs for realisation of additional measures scenario in 2020 are 14% higher than baseline scenario.

Thank you for your attention!