UNECE Convention on Long-range Transboundary Air Pollution

Impact of the EGTEI proposed ELVs on Emission Scenarios

Modelling analysis performed by the GAINS_Europe Model

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  (Test Case Italy)

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Introduction

In the frame of the UN-ECE Convention on Long Range Transboundary Air Pollution (LRTAP), the Expert Group on Techno-Economic Issues (EGTEI), technical body of the Convention, has been mandated to revised the ELVs in the Annexes IV, V, VI, VIII, to the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) and elaborate a new Annex on dust and a new Annex on solvent content in products.

The work started in April 2008 and was concluded in June 2009.

The ELVs have mandatory nature, (in the current GP) as part of an International Treaty, to be ratified by the Parties.

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Introduction

Three options, corresponding to different ambition levels, were proposed by EGTEI, in the new Annexes, leaving the final choice to the negotiation process.

Option 1: ELV1, demanding but technically feasible option with the objective of achieving a high level of reduction. ELV1 is based upon a value ranging between the lower and upper BAT AEL (where available),

Option 2: ELV2, while technically demanding, pays greater attention to the costs of the measures for achieving reduction. ELV2 is based on the upper value of BAT AEL (where available),

Option 3: ELV 3, represents current practices based on the current legislation in a number of Parties to the Convention.

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Objective of the analysis

1. Establish a link between the work of EGTEI on ELVs and the Emission Scenarios developed by CIAM
2. Estimate the effects of the New Suggested ELVs, in terms of Emission Reductions and Additional Costs
3. Ultimately, provide the Delegation Experts in Geneva with additional technical info to facilitate a choice on the EGTEI suggested Options (ambition levels).

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Methodology

Starting from the detailed output emissions, by technological option, in GAINS_Europe, (for each country, SOx, NOx, TSP) a proper Excel Macro has been developed to perform the following steps:

1. ***Compare the average EF (mg/m3), output of GAINS with the ELVs in the EGTEI Tables, for each source category, (in Power Plant and Industrial Boilers Sectors).***
2. ***Identify which source categories are NOT in compliance with the ELVs, respectively, for the 3 options (ELVs stricter than current average value: average > ELV).***
3. ***Introduce changes in the Control Strategy in GAINS, such as the average EF is consistent with the 3 options.***
4. ***Re-calculate, by the new 3 Control Strategies the resulting emissions (and costs) from GAINS, at the target year (2020).***

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Example of GAINS output

Sector-Activity-Technology	Abbr.	Sectoral activity [Units]	Unabated emission factor kt NOx/Unit	Removal efficiency %	Abated emission factor kt NOx/Unit	Coversion coefficient mg/m3/g/GJ	Abated emission factor mg/m3	Capacities controlled %	Emissions kt NOx
non-IGGC new power plants-Natural gas (incl. other gases)-No control-[10^15 Joules]	PP_NEW-GAS-NOC-[PJ]	1727.347	0.070	0.000	0.070	1.060	74.200	100.000	120.914
non-IGGC new power plants-Gasoline and other light fractions of oil (includes kerosene)-No control-[10^15 Joules]	PP_NEW-GSL-NOC-[PJ]	0.384	0.070	0.000	0.070	3.170	221.900	100.000	0.027
non-IGGC new power plants-Hard coal, grade 1-Selective catalytic reduction on new hard coal power plants-[10^15 Joules]	PP_NEW-HC1-PHCSCR-[PJ]	471.725	0.150	80.000	0.030	2.860	85.800	100.000	14.152
non-IGGC new power plants-Heavy fuel oil-Selective catalytic reduction on new oil and gas power plants-[10^15 Joules]	PP_NEW-HF-POGSCR-[PJ]	71.177	0.100	80.000	0.020	3.170	63.400	100.000	1.424
non-IGGC new power plants-Medium distillates (diesel, light fuel oil)-No control-[10^15 Joules]	PP_NEW-MD-NOC-[PJ]	0.384	0.050	0.000	0.050	3.170	158.500	100.000	0.019
non-IGGC new power plants-Biomass fuels-No control-[10^15 Joules]	PP_NEW-OS1-NOC-[PJ]	123.867	0.065	0.000	0.065	2.860	185.900	100.000	8.051
non-IGGC new power plants-Other biomass and waste fuels-Selective catalytic reduction on new hard coal power plants-[10^15 Joules]	PP_NEW-OS2-PHCSCR-[PJ]	66.373	0.065	80.000	0.013	2.860	37.180	100.000	0.863

NOx Emissions by Control Option

Example of EGTEI table

Fuel type	Thermal input [MWth]	Suggested ELV for NO_x [mg/Nm³][b]							
		Option 1[c]		Option 2[c]			Option 3[c]		
		Lower BAT AEL	Techniques	Upper BAT AEL	Techniques		Legislation		
	>300	New plants: 100 (coal, lignite); 100 (biomass, peat)	Coal (PC): 90 Lignite (PC): 50 Coal, lignite (FBC): 50 Biomass, peat (PC): 50 Biomass, peat (FBC): 50 Combination of Pm (air and fuel-staging, low NOx burner, reburning, etc.) in combustion with SCR or combined techniques Combination of Pm (such as air and fuel-staging, low NOx burner, reburning, etc) Combination of Pm (such as air and fuel-staging) Combination of Pm (air and fuel staging, low NOX burner), if necessary SNCR and or SCR Combination of Pm (air distribution or by flue-gas recirculation), if necessary SNCR and/or SCR	New plants: 150 (coal, lignite); 150 (biomass, peat)	Coal (PC): 150 Lignite (PC): 200 Coal, lignite (FBC): 150 Biomass, peat (PC): 150 Biomass, peat (FBC): 150	Same as for option 1	New plants: 200 (coal, lignite); 200 (biomass, peat)	EU-LCPD (licence before 2002, <500MW): 600 EU-LCPD (licence before 2002, >500MW): until 2016: 500; after 2016: 200 EU-LCPD (licence after 2002): 200 UNECE-GP: 200 EU-IED (permit before 2014): 200 EU-IED (permit after 2014): 150 Lignite (PC): 200

EGTEI Table in Annex V, page 10

Assumptions and Actions

Main Assumption: The *average* EF (mg/m3) in GAINS, derived from emission at the target year, for each source category, is ***comparable*** with the ELVs in the EGTEI Tables.

The *average* EF (mg/m3) is calculated, from GAINS output, as weighted average, taking the Tech implementation rates as weight factors. Average EF is calculated as :

$$\Sigma_i A_i * EF\_Tech_i \quad i = 1, n \in N, \Sigma_i A_i = 1$$

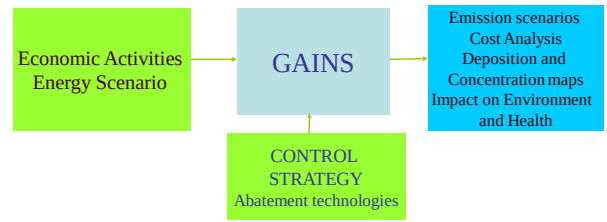
IF the current *average* EF is higher than the ELVs, the Excel Macro searches for new implementation rates which deliver the equivalence ***average EF = ELV value*** (*minimum achievement*)

$$\Sigma_i A_i * EF\_Tech_i = ELV1,2,3(EGTEI) \quad i = 1, n \in N, \Sigma_i A_i = 1$$

Among 2 or more available technologies, the least cost technologies are privileged, while upgrading the Control Startegy.

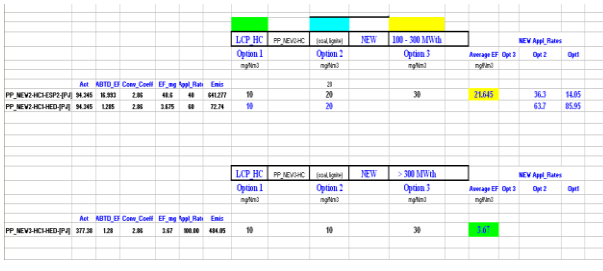
A fraction of NO Control is allowed by the legislation and not considered in the analysis.

Semplified schema of GAINS



Results for Italy LCP - TSP

Official Gothenburg Scenario (Nat. Proj.Feb.2010_CP)TSP **Italy 2020**



Power heat plants: New, fluidized bed-Hard coal, grade 1-Electrostatic precipitator: 2 fields - power plants- [PJ] — PP_NEW2-HC1-ESP2

Power heat plants: New, fluidized bed-Hard coal, grade 1-High efficiency de-duster - power plants-[PJ] — PP_NEW2-HC1-HED

Power heat plants: New, pulverized-Hard coal, grade 1-High efficiency de-duster - power plants-[PJ] — PP_NEW3-HC1-HED

Example for Italy

Goth Scenario TSP Italy 2020 - Consistency with option 2

Upgraded Control Strategy

Activity	Sector	Technology	1990	1995	2000	2005	2010	2015	2020	2025	2030
HC1	PP_NEW2	ESP1			0	0	0	0	0		
HC1	PP_NEW2	ESP2			40	40	40	40	36.3		
HC1	PP_NEW2	HED			60	60	60	60	63.7		

Consistency with option 1

Activity	Sector	Technology	1990	1995	2000	2005	2010	2015	2020	2025	2030
HC1	PP_NEW2	ESP1			0	0	0	0	0		
HC1	PP_NEW2	ESP2			40	40	40	40	14.1		
HC1	PP_NEW2	HED			60	60	60	60	84.9		

The application rates for ESP2 and HED are upgraded to achieve the desired Average EF = ELV (1,2)

Example for Italy

Results: emissions and technology costs

	Baseline	OPT 3	OPT 2	OPT 1
Exist PP Emissions (kt_ TSP)	0.632	0.632	0.628	0.514
New PP emissions (kt_TSP)	1.708	1.708	1.653	1.217
Total PP emissions (kt_TSP)	2.340	2.340	2.281	1.731
Difference in emissions vs Base (kt_TSP)	0	0	-0.059 -2,52%	-0.609 -26.0%
Additional tech costs vs Base (M_Euro)	0	0	0.0745	1.2393
Total TSP Emissions 2020 (kt)	317.30	317.30	317.25	316.70

Test for France

Results: emissions and technology costs

	Baseline	OPT 3	OPT 2	OPT 1
Exist PP Emissions (kt_ TSP)	0.013	0.013	0.013	0.013
New PP emissions (kt_TSP)	0.259	0.259	0.248	0.243
Total PP emissions (kt_TSP)	0.272	0.272	0.261	0.256
Difference in emissions vs Base (kt_TSP)	0	0	-0.011 -4%	-0.017 -6.0%
Additional tech costs vs Base (M_Euro)				
Total TSP Emissions 2020 (kt)	549	549	548.9	548.9

Test for Belarus

Results: emissions and technology costs

	Baseline	OPT 3	OPT 2	OPT 1
Exist PP Emissions (kt_ TSP)	0.795	0.795	0.795	0.795
New PP emissions (kt_TSP)	1.640	1.572	1.557	1.195
Total PP emissions (kt_TSP)	2.435	2.367	2.352	1.990
Difference in emissions vs Base (kt_TSP)	0	-0.067 (-2.7%)	-0.083 (-3%)	-0.445 (-18%)
Additional tech costs vs Base (M_Euro)				
Total TSP Emissions 2020 (kt)	102.7	102.6	102.6	102.2

Conclusions

Taking in due account all the caveats concerning the comparability of GAINS output with EGTEI suggested ELVs (defined or derived in different ways)…

The methodology developed allows to identify, as first approximation, the combinations of Techs which achieve the concentration values (mg/m3), consistent with the EGTEI suggested ELVs.

The Excel macros developed modify the existing Control Strategy, upgrading to more efficient technologies (GAINS list) to be consistent with the 3 EGTEI options, respectively, ONLY where needed. Emissions and technology costs are then re-calculated, by GAINS

The analysis is limited to the SOx, NOx and TSP pollutants and Power Plant and Industrial Boilers sectors.

Conclusions

For each Party to the Convention, the methodology developed allows to estimate the (minimum) effort to achieve the 3 levels of ambition, suggested by EGTEI, in the revised Annexes .

The effort is expressed in terms of (additional) emission reductions, technology upgrade and related costs, for each EGTEI Option.

Such supplemental information should facilitate the task of the negotiators, at the next WGS&R meeting (April 2011)

The final technical report will be submitted as EGTEI informal document, at the 48th session of WGS&R, in April 2011, in Geneva. Thank you for your attention !