

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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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.

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.

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).

Methodology

Starting from the detailed output emissions, by technological option, in GAINS_Europe, (for each country, SO_x, NO_x, 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).*

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	Conversion 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

39th TFIAM Meeting Stockholm, February 23-25, 2011

Example of EGTEI table

Fuel type	Thermal input [MWt h]	Suggested ELV for NO _x [mg/Nm ³] ^{b/}						
		Option 1 ^{1/}		Option 2 ^{1/}			Option 3 ^{1/}	
			Lower BAT AEL	Techniques		Upper BAT AEL	Techniques	
>300		Coal (PC): 90	Combination of Pm (air and fuel-staging, low NO _x burner, reburning, etc.), in combination with SCR or combined techniques		Coal (PC): 150	Same as for option 1		EU-LCPD:(licence before 2002, <500MW): 600
		Lignite (PC): 50	Combination of Pm (such as air and fuel-staging, low NO _x burner, reburning, etc)		Lignite (PC): 200			EU-LCPD:(licence before 2002, >500MW): until 2016: 500; after 2016: 200
	New plants: 100 (coal, lignite)	Coal, lignite (FBC): 50	Combination of Pm (such as air and fuel-staging)	New plants: 150 (coal, lignite) 150 (biomass, peat)	Coal, lignite (FBC): 150		New plants: 200 (coal, lignite) 200 (biomass, peat)	EU-LCPD:(licence after 2002): 200
	100 (biomass, peat)	Biomass, peat (PC): 50	Combination of Pm (air and fuel staging, low NO _x burner), if necessary SNCR and/or SCR		Biomass, peat (PC): 150			UNECE-GP: 200
		Biomass, peat (FBC): 50	Combination of Pm (air distribution or by flue-gas recirculation), if necessary SNCR and/or SCR		Biomass, peat (FBC): 150			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 :

$$\sum_i A_i * EF_Tech_i \quad i = 1, n \in N, \sum_i A_i = 1$$

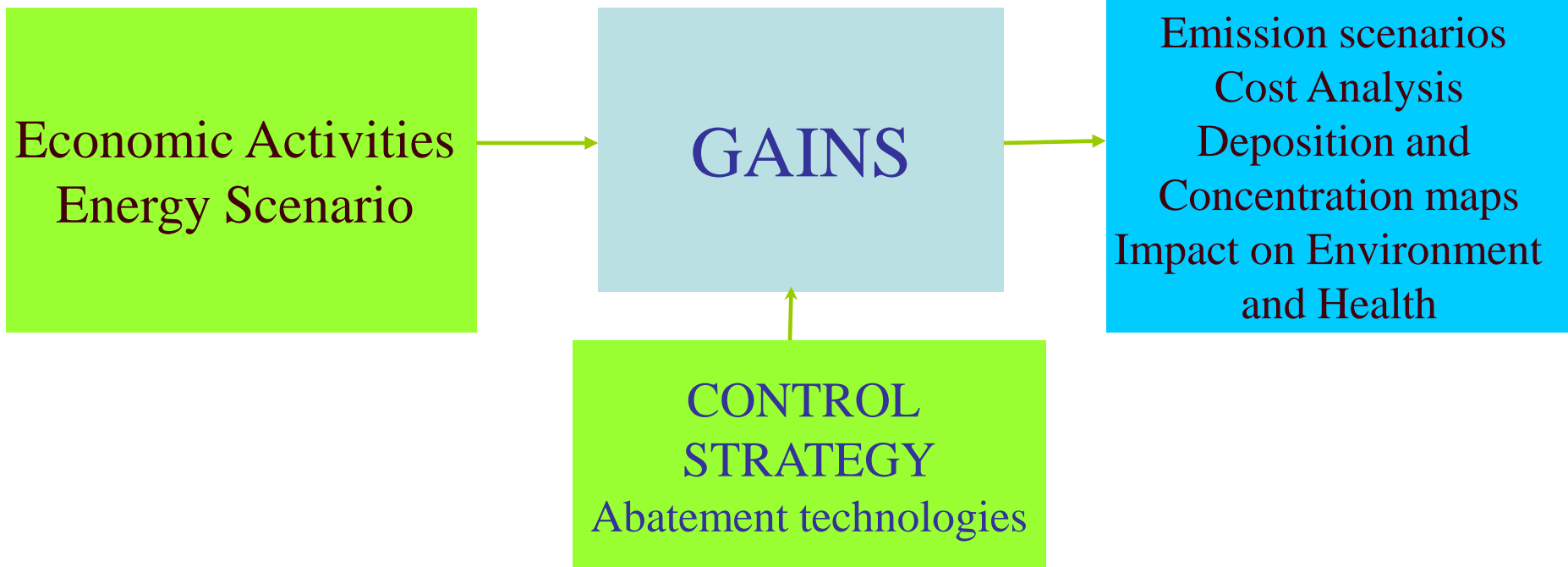
IF the current *average* EF is higher than the ELVs, the Excel Macro searches for new implementation rates which deliver the equivalence ***average EF = ELV value*** (*minimum achievement*)

$$\sum_i A_i * EF_Tech_i = ELV_{1,2,3}(EGTEI) \quad i = 1, n \in N, \sum_i A_i = 1$$

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

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

Simplified schema of GAINS



Results for Italy LCP - TSP

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

							LCP_HC	PP_NEW2-HC	(coal, lignite)	NEW	100 - 300 MWth	NEW Appl_Rates			
							Option 1		Option 2		Option 3	Average EF	Opt 3	Opt 2	Opt1
							mg/Nm3		mg/Nm3		mg/Nm3	mg/Nm3			
	Act	ABTD_EF	Conv_Coeff	EF_mg	Appl_Rate	Emis									
PP_NEW2-HC1-ESP2-[PJ]	94.345	16.993	2.86	48.6	40	641.277	10		20		30	21.645		36.3	14.05
PP_NEW2-HC1-HED-[PJ]	94.345	1.285	2.86	3.675	60	72.74	10		20					63.7	85.95
							LCP_HC	PP_NEW3-HC	(coal, lignite)	NEW	> 300 MWth	NEW Appl_Rates			
							Option 1		Option 2		Option 3	Average EF	Opt 3	Opt 2	Opt1
							mg/Nm3		mg/Nm3		mg/Nm3	mg/Nm3			
	Act	ABTD_EF	Conv_Coeff	EF_mg	Appl_Rate	Emis									
PP_NEW3-HC1-HED-[PJ]	377.38	1.28	2.86	3.67	100.00	484.05	10		10		30	3.67			

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

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 SO_x, NO_x 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 !**