UNECE Convention on Long-range Transboundary Air Pollution

Proposal how to analyze technical annexes by GAINS

Work in progress in cooperation with IIASA

Presented by T. PIGNATELLI
ENEA, Italy

Prologue

EGTEI revised the Annexes IV, V, VI, VIII, elaborated a new Annex on dust (VII) and a new Annex on solvent content in products [XI], to the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol), on mandate by WGS&R.

The work started in April 2008 from the existing Annexes and the original structure was maintained. The work was carried out in cooperation with experts from the Expert Group on PM and the Task Force on Heavy Metals. Concluded in June 2009. Guidance Documents also revised. (see docs WGS&R_45)

Three options, corresponding to different ambition levels, were proposed by EGTEI, in the new Annexes.

Prologue

Later on, in the discussion, the following issue was raised:
"How to compare the new ELVs suggested in the Annexes with the IAM scenario Analysis ?".

At the last TFIAM meeting (October 2009) the development of ad hoc scenarios calibrated on the 3 options suggested by EGTEI, resulted infeasible, due to too much time and human resources needed.

At its last meeting, EGTEI (November 2009) decided NOT to be involved in scenario analysis, because out of its expertise

The original question remains, therefore, unanswered !

Prologue

On the other hand, in Italy there is interest in knowing which is the “relative position” with respect the new suggested ELVs, in IAM analysis.

Moreover, there should be an added value for the upcoming negotiation, in the Gothenburg Protocol process.

During an informal conversation with Zig Klimont (IIASA) a new chance appeared.

The Proposal

Conversion of GAINS emissions in concentrations by appro priate conversion factors retrieved by IIASA and now implemented in GAINS.

Development of an algorithm able to search for comparable “homogeneous elements“ in GAINS output list and EGTEI Tables

Application of the algorithm (by an Excel Macro) to Italy’s scenarios, as a test

Generalization of the application to other countries.

The Proposal –more details

Conversion factors allow to switch from specific emission (g/GJ) to concentrations (mg/m^3)

Algorithm can be developed by the Visual Basic Editor, in Excel

The suitable GAINS output list in NOT the same for all countries, depending upon the structure of the control technologies implemented, and the energy structure. The EGTEI tables have their own structure (bubble concept, plant size, etc)

…… making the task more difficult

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

TFIAM 38 – Dublin, 17th – 19th of May, 2010

Example of EGTEI table

Fuel type	Thermal input [MWth]	Suggested ELV for NO_x [mg/Nm³][b/]							
		Option 1[1/]			Option 2[1/]			Option 3[1/]	
			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 combination 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

Results for LCP - NOx

Sector/Fuel/Tech	GAINS Calculated			EGTEI TABLES				
				LCP_HC	PP_NEW-HC	(coal)	NEW	> 300 MWth
	Associated Concentation Value			Option 1		Option 2		Option 3
	mg/Nm3			mg/Nm3		mg/Nm3		mg/Nm3
PP_NEW-HC1-PHCSCR-[PJ]	85.8			100		150		200
				LCP_OS	PP_NEW-OS	Biomass/peat	NEW	> 300 MWth
	Associated Concentation Value			Option 1		Option 2		Option 3
	mg/Nm3			mg/Nm3		mg/Nm3		mg/Nm3
PP_NEW-OS1-NOC-[PJ]	185.9			100		150		200
PP_NEW-OS2-PHCSCR-[PJ]	37.18							
	Associated Concentation Value			LCP_HC	PP_EX_OTH-HC	(coal)	EX	> 300 MWth
	mg/Nm3			Option 1		Option 2		Option 3
				mg/Nm3		mg/Nm3		mg/Nm3
PP_EX_OTH-HC2-PHCCSC-[PJ]	188.76			100		200		200

Results for LCP - SOx

Sector/Fuel/Tech	GAINS Calculated		EGTEI TABLES				
			LCP_HC	PP_NEW-HC	(coal, lignite)	NEW	> 300 MWth
			LCP_OS	PP_EX_OTH-OS	Biomass/peat	EX	> 300 MWth
	Associated Concentation Value		Option 1		Option 2		Option 3
	mg/Nm3		mg/Nm3		mg/Nm3		mg/Nm3
PP_EX_OTH-OS1-NOC-[PJ]		107.3	100		150		200
PP_EX_OTH-OS2-PWFGD-[PJ]		17.9					
	Associated Concentation Value		LCP_LIQ	PP_NEW-LIQ	Liquid fuels	NEW	> 300 MWth
	mg/Nm3		Option 1		Option 2		Option 3
PP_NEW-GSL-NOC-[PJ]		13.8	100		150		200
PP_NEW-HF-PWFGD-[PJ]		317.0					
PP_NEW-HF-RFGD-[PJ]		126.8					
PP_NEW-MD-LSMD1-[PJ]		298.4					
PP_NEW-MD-LSMD2-[PJ]		67.1					

Results for LCP – PM10

Sector/Fuel/Tech	GAINS Calculated	EGTEI TABLES				
		LCP_HC	PP_NEW-HC	(coal, lignite)	NEW	> 300 MWth
	Associated Concentation Value	Option 1		Option 2		Option 3
	mg/Nm3	mg/Nm3		mg/Nm3		mg/Nm3
PP_NEW2-HC1-ESP2-[PJ]	41.2	10		10		30
PP_NEW2-HC1-HED-[PJ]	2.9					
PP_NEW3-HC1-HED-[PJ]	3.0					
		LCP_HC	PP_EX-HC	(coal, lignite)	EX	> 300 MWth
	Associated Concentation Value	Option 1		Option 2		Option 3
	mg/Nm3	mg/Nm3		mg/Nm3		mg/Nm3
PP_EX_OTH1-HC2-ESP2-[PJ]	35.3	5		20		50
PP_EX_OTH1-HC2-HED-[PJ]	3.3					
PP_EX_OTH2-HC2-ESP2-[PJ]	41.2					
PP_EX_OTH2-HC2-HED-[PJ]	2.9					
PP_EX_OTH3-HC2-ESP2-[PJ]	36.6					
PP_EX_OTH3-HC2-HED-[PJ]	3.0					
PP_EX_OTH3-HC2-NOC-[PJ]	2052.9					

Conclusions

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

The proposed comparative method allow to identify, as first approximation, which combinations Sect/Fuel/Tech allow to achieve concentration values (mg/m3) consistent with the EGTEI suggested ELVs

The method, currently applied to Power Plant (LCPs) can be extended to other Industrial Combustion Installations (IN_BO, IN_OC) and, within the limit of the bubble concept, to refineries

The analysis is limited to SOx, NOx and PM