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Update of cost data for LCP, Stationary Engines, Glass, Refineries, Cement and Iron & Steel Sectors

Costs provided for the 48th WGSR
SO_2, NO_x, PM and NMVOC abatement techniques

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LCP

PM REDUCTION TECHNIQUES

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Achievable dust emission limits for various types of dedusting equipment

Technique	# fields	Stand alone	With wet FGD
Type	No.	mg/Nm^3	mg/Nm^3
FF	-	<10	<5
ESP	2	~50	~30
ESP	3	~30	<20
ESP	4	~10	<5
ESP	6	~5-6	<5

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Achievability of ELV options - plants > 300 MW_{th}

Table 2.1	Options – New Plants			Table 2.2	Options – Existing Plants		
Technique	1	2	3	Technique	1	2	3
ELV	10	10[1]	30	ELV	10	20	50
FF	Y	Y	Y	FF	Y	Y	Y
2-ESP	N	N	FGD?	2-ESP	N	N	FGD req.?
3-ESP	N	N	Y	3-ESP	N	Y	Y
4-ESP	FGD req.?	FGD req.?	Y	4-ESP	FGD req.?	Y	Y
6-ESP	Y	Y	Y	6-ESP	Y	Y	Y

[1] For biomass and peat; Opt.2: 20 mg/Nm^3

FGD? = selected technique + FGD may not reach ELV option
FGD req? = ELV may not be reached without FGD

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Achievability of ELV options - plants 100 - 300 MW_{th}

Table 3.1	Options – New Plants			Table 3.2	Options – Existing Plants		
Technique	1	2	3	Technique	1	2	3
ELV	10	20	30	ELV	15[1]	25[2]	50
FF	Y	Y	Y	FF	Y	Y	Y
2-ESP	N	N	FGD?	2-ESP	N	N	FGD req.?
3-ESP	N	FGD req.	FGD?	3-ESP	N	FGD req.	Y
4-ESP	FGD req.?	Y	Y	4-ESP	Y	Y	Y
6-ESP	Y	Y	Y	6-ESP	Y	Y	Y

[1] For biomass and peat Opt.1: 10 mg/Nm^3
[2] For biomass and peat Opt.2: 20 mg/Nm^3

FGD? = selected technique + FGD may not reach ELV option
FGD req? = ELV may not be reached without FGD

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Achievability of ELV options – plants 50 - 100 MW_{th}

Table 4.1	Options – New Plants			Table 4.2	Options – Existing Plants		
Technique	1	2	3	Technique	1	2	3
ELV	10	20	50	ELV	15	30	50
FF	Y	Y	Y	FF	Y	Y	Y
2-ESP	N	N	FGD req.?	2-ESP	N	FGD?	FGD req.?
3-ESP	N	FGD req.	Y	3-ESP	N	FGD req.?	Y
4-ESP	FGD req.?	Y	Y	4-ESP	Y	Y	Y
6-ESP	Y	Y	Y	6-ESP	Y	Y	Y

FGD? = selected technique + FGD may not reach ELV option
FGD req? = ELV may not be reached without FGD

Data on investment for ESP and FF for HC plants

Electrostatic Precipitators (ESP)				
ESP	Design, 800 MW_{el}	25.90 €/kW_{el} [2008]	< 30 mg/Nm³, 3-field ESP, equipment and steelworks	Riepe
ESP	Design, 800 MW_{el}	29.40 €/kW_{el} [2008]	< 20 mg/Nm³, 4-field ESP, equipment and steelworks	Riepe
ESP	Design, 800 MW_{el}	36.30 €/kW_{el} [2008]	< 6 mg/Nm³, 5 or 6-field ESP, equipment and steelworks	Riepe
ESP	Design, 1,100 MW_{el}	32.70 €/kW_{el} [2008]	< 10 mg/Nm³, 4 or 5-field ESP, equipment and steelworks	Riepe
ESP	Design, 1,100 MW_{el}	41.80 €/kW_{el} [2008]	< 5 mg/Nm³, 5 or 6-field ESP, equipment and steelworks	Riepe
Pulse Jet Fabric Filters (PJFF)				
PJFF	Design, 750 MW_{el}	19.70 €/kW_{el} [2008]	< 5 mg/Nm³, equipment and steelworks, PAN filter bags	Riepe
PJFF	Design, 750 MW_{el}	21.00 €/kW_{el} [2008]	< 5 mg/Nm³, equipment and steelworks, PPS filter bags	Riepe

Thomas Riepe: „Elektrofilter und Gewebefilter für kohlegefeuerte Kraftwerke im Vergleich", held at: 4. Conference on „Grundlagen, Betriebserfahrungen, Optimierungsmaßnahmen und Sonderverfahren für Rauchgasreinigungsanlagen", Essen (Germany), 2008.

LCP

NO_x REDUCTION TECHNIQUES

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Achievability of ELV options (solid fuels – large plants)

Fuel : Technique	2nd/3rd Gen. LNB	Achiev. Conc. (mg/Nm³)	Fullfilled Options
HC-PC : SCR	-	<200	New: 3 / Ex.: 2, 3
HC-PC : SCR	Y	<100	New: 1,2,3 / Ex.: 1,2,3
Lignite : LNB	Y	<200	New: 3 / Ex.: 2, 3
Lignite : SCR	-	<100	New: 1,2,3 / Ex.: 1,2,3

ELV 100 => new LNB + SCR for pulv. coal and pulv. lignite
ELV 150 => old LNB + SCR for pulv. coal, for pulv. lignite new LNB+SNCR?
ELV 200 => LNB for pulv. lignite, SCR for pulv. coal

FBC: Coal / Lignite + Biomass: in certain cases only SNCR required for < 200 mg/Nm³. Usually combustion modification and biomass co-firing is used to lower emissions. SNCR might be required for low ELVs.

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Achievability of ELV options (liquid and gaseous fuels)

Liquid fuels

BAT and Emission factors for HFO similar to HC firing

ELVs of 200 mg/Nm³ and lower: modern LNB + SCR
ELVs above 200 mg/Nm³: new LNB (+SNCR?)

Gaseous fuels

ELVs of 80 mg/Nm³ for NG: Combustion Modifications (SNCR or SCR only in special cases)

„other gaseous fuels“: Strongly depending on fuel. Usually ELVs require combustion modifications only and fuel mixing

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Data on investment for SCR for HC plants

Selective Catalytic Reduction (SCR)				
SCR	Studstrup, DK, 2x360 Mw_{el}	24.30 €/kW_{el} [ref. year unknown]	Site with high complexity, start of operation 2006 and 2007	IEA CCC
SCR	Esbjerg, DK, 380 MW_{el}	31.86 €/kW_{el} [ref. year unknown]	Incl. air heater modifications, plant site was "SCR-ready", start of operation 2005	IEA CCC
SCR	Fynsvaerket, DK, 400 MW_{el}	40.42 €/kW_{el} [ref. year unknown]	Incl. economiser splitting, start of operation 2007	IEA CCC
SCR	Israel Power Co., 4x575 MW_{el}	43.48 €/kW_{el} [2011]	Process equipment incl. catalyst, steelwork, ductwork and control equipment	Bilfinger Berger
SCR	Sines, PT, 320 MW_{el}	68.75 €/kW_{el} [ref. year unknown]	Seawater & Corrosion resistant	EGTEI Expert
SCR	Le Havre IV, FR, 580 MW_{el}	86.21 €/kW_{el} [ref. year unknown]	Seawater & Corrosion resistant, cost basis probably 2005	IEA CCC

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LCP

SO_2 REDUCTION TECHNIQUES

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Achievability of ELV options

Emission factors are determined by sulphur content of fuel!

Solid fuels:	Low sulphur fuels (imported hard coals, etc. with <
1% S)	may not necessarily need wet FGD systems but may
use	dry or semi-dry sorption principles.
	High sulphur fuels (>> 1% S) need techniques with
high	abatement efficiencies such as wet FGD systems.
Liquid fuels:	Similar to solid fuels. High sulphur fuels (e. g. HFO)
	usually need wet FGD systems, low sulphur fuels
(LFO, H-	EL) not necessarily.
Gaseous fuels:	NG is pre-desulphurised. For industrial fuels („other gaseous fuels“) it is highly site-specific.

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Data on investment for Wet FGD for HC plants

Wet Limestone Flue Gas Desulphurisation Plants (Wet FGD)				
Wet FGD	Unknown UK, 4x500 MW_{el}	73.38 [2000]	-	IEA CCC
Wet FGD	Unknown UK, 4x500 MW_{el}	80.84 [2000]	Design S-Content of Coal: 1,7%	IEA CCC

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Glass

PM & SO_2 REDUCTION TECHNIQUES

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Achievability of ELV options

PM and SO_2 are abated in combination!
Dry sorbent injection + dedusting equipment

The PM-ELV determines the required filter type for installation

ELVs < 15 mg/Nm³: 4-field ESP or FF
ELVs ~ 30 mg/Nm³: 3-field ESP or FF

FFs are only selected in certain cases and are only installed in certain small furnaces across Europe.

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Data on investment for different combinations of filters and scrubbers (Berkeens, 2007)

Type of glass	Production(Tons melt per day)	ESP & dry scrubber ($Ca(OH)_2$) Filter dust recycle [€/t]	ESP & dry scrubber ($Ca(OH)_2$) Filter dust disposal [€/t]	ESP & dry scrubber ($NaHC0_3$) Filter dust recycle [€/t]	ESP & dry scrubber ($NaHC0_3$) Filter dust disposal [€/t]	Bag filter & dry scrubber Filter dust recycle [€/t]	Bag filter & dry scrubber Filter dust disposal [€/t]	Bag filter & semi dry scrubber Filter dust recycle [€/t]	Bag filter & semi dry scrubber Filter dust disposal [€/t]	Wet scrubber [€/t]
Float	500	4.8	6.51				6	7-7.35	9.6 (gas)-13 (oil)	
Float	700	4.27	5.87	4.39	7.75	6.98				
Float	900	3.88	5.44					5.82	8.33	
Container	100-150	11	14							
Container	200		6.7			4.63-5.9	4.8-7			
Container (oil)	200					6.4	9.25			
Container (oil)	300-350	4.52-6	6.31-7.5		7.38-8.33	3.86-5	4.11-7.3	5.3	6.54	
Container	450	3.96-5.2	4.77-6.5			2.9	3.6			
Container (oil)	600	3.58	5.1			2.7	3.37			

Note: „ESP“ = 3-field ESP

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Data on investment for different combinations of filters and scrubbers (cont'd, Berkeens, 2007)

Type of glass	Production(Tons melt per day)	ESP & dry scrubber ($Ca(OH)_2$) Filter dust recycle [€/t]	ESP & dry scrubber ($Ca(OH)_2$) Filter dust disposal [€/t]	ESP & dry scrubber ($NaHC0_3$) Filter dust recycle [€/t]	ESP & dry scrubber ($NaHC0_3$) Filter dust disposal [€/t]	Bag filter & dry scrubber Filter dust recycle [€/t]	Bag filter & dry scrubber Filter dust disposal [€/t]	Bag filter & semi dry scrubber Filter dust recycle [€/t]	Bag filter & semi dry scrubber Filter dust disposal [€/t]	Wet scrubber [€/t]
Container (gas)	740	4	5.1							
Container (gas)	1,240	3.4	4.6							
Container (oil)	1,240	3.7	6.2							
Tableware	30-35	15.65	16.7			12.85	13.84			
Tableware	180-200		7.66			3.75-4.35				
E-glass oxy	100-120						11			14.4-21.5*
E-glass air	100-120									15.7-20.5*

* higher value for filter dust disposal 400 Euro/ton

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Iron & Steel

PM REDUCTION TECHNIQUES

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Achievability of ELV options

PROCESS	OPTIONS	ELVS	ASSOCIATED TECHNIQUES FOLLOWING I&S BREF 2001
Sinter plant (>150 t/day)	OPTION 1	**15 mg/Nm**	ESP+FF **Note:** Generally use of dry ESP with 3 fields completed by a new bag filter ; in case of a new plant, it is however not sure that a new 3-fields ESP would be installed upstream the bag filter; it could be also advanced cyclones or advanced 2-fields ESP or any other alternative solution economically and technically applicable and feasible.
	OPTION 2	**50 mg/Nm3**	Advanced ESP or prededusting (ESP or cyclones) + high pressure wet scrubbing Note: Advanced ESP generally means a dry ESP with 3 fields but revamped, in case of existing, or equipped, in case of new ESP, with new generation of equipments such as micro-pulses, cleaner or rapper of the electrodes and the plates, new regulators/transformers to minimize the corona effect and to maximize the voltage; in some cases, MEEP (moving electrodes) or a 4th field could be installed as an alternative solution depending on local conditions.
	OPTION 3	**50 mg/Nm3**	
Pelletization plant (>150 t/day)	OPTION 1	**5 mg/Nm3**	1/
	OPTION 2	**10 mg/Nm3**	1/
	OPTION 3	**25 mg/Nm3**	Scrubbing or Semi-dry desulphurisation and subsequent de-dusting (e.g. gas suspension absorber (GSA)) or any other device with the same efficiency

1/ No technique out of the BAT techniques referred to in the BAT Reference Document of 2001 can be associated with this option

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Achievability of ELV options (cont'd)

PROCESS	OPTIONS	ELVS	ASSOCIATED TECHNIQUES FOLLOWING I&S BREF 2001
Blast furnace: Hot stoves (>2.5 t/hour)	OPTION 1	**5 mg/Nm3**	1/
	OPTION 2	**10 mg/Nm3**	Significantly depends on fuel composition and dedusting
	OPTION 3	**50 mg/Nm3**	
Basic oxygen steelmaking and casting (>2.5 t/hour)	OPTION 1	**10 mg/Nm3**	FF
	OPTION 2	**30 mg/Nm3**	Advanced ESP (3 field plus steam injection(optional))
	OPTION 3	**50 mg/Nm3**	ESP (2 or 3 fields)
Electric steelmaking and casting (>2.5 t/hour)	OPTION 1	**10 mg/Nm3** (existing), **5 mg/Nm3** (new)	For new plants: Advanced FF For existing plants: 1/
	OPTION 2	**15 mg/Nm3** (existing), **5 mg/Nm3** (new)	Advanced FF
	OPTION 3	**20 mg/Nm3**	FF

1/ No technique out of the BAT techniques referred to in the BAT Reference Document of 2001 can be associated with this option

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Stationary engines

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Achievability of ELV options

ENGINE TYPE, POWER, FUEL SPECIFICATION	ELV 1	ELV 2	ELV 3
GAS ENGINES > 1 MW$_{th}$ Spark ignited (=Otto) engines all gaseous fuels	35 (SCR high efficiency)	95 (advanced lean burn)	190 (lean burn)
DUAL FUAL ENGINES > 1 MW$_{th}$ In gas mode (all gaseous fuels) In liquid mode (all liquid fuels) 1-20 MW >20 MW	35 (SCR high efficiency) 225 (SCR high efficiency) 225 (SCR high efficiency)	190 (lean burn) 750 (SCR moderate eff.) 450 (SCR moderate eff.)	380 (lean burn) [1850] [2000] (Primary measures) [1850] [2000] (Primary measures)

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ELV options – EU provisional position

ENGINE TYPE, POWER, FUEL SPECIFICATION	ELV 1	ELV 2	ELV 3
GAS ENGINES > 1 MW$_{th}$ Spark ignited (=Otto) engines all gaseous fuels	~~35~~ (SCR high efficiency)	**95** (advanced lean burn)	**190** (standard lean burn)
DUAL FUAL ENGINES > 1 MW$_{th}$ In gas mode (all gaseous fuels) In liquid mode (all liquid fuels) 1-20 MW >20 MW	~~35~~ (SCR high efficiency) **225** (SCR high efficiency) **225** (SCR high efficiency)	**190** (lean burn) ~~750~~ (SCR moderate eff.) ~~450~~ (SCR moderate eff.)	~~380~~ (lean burn) ~~[1850] [2000]~~ (Primary measures) ~~[1850] [2000]~~ (Primary measures)

In bold EU provisional position – Annex V amended ver 5 (post WS) clean.doc

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Achievability of ELV options

ENGINE TYPE, POWER, FUEL SPECIFICATION	ELV 1	ELV 2	ELV 3
DIESEL ENGINES > 5 MW_{th} Slow (< 300 rpm)/ Medium (300-1200 rpm)/ speed			
5-20 MW			
HFO and bio-oils	225 (SCR high efficiency)	450] [750] (SCR moderate eff.)	[1300] [1600] (primary meausres)
LFO and NG	150 (SCR high efficiency)	190 (SCR high efficiency)	[1300] [1600] primary meausres)
>20 MW			
HFO and bio-oils	190 (SCR high efficiency)	[225] [450] (SCR high - mod. eff.)	[750] [1850] (SCR mod.eff. – prim. Meas.)
LFO and NG	150 (SCR high efficiency)	190 (SCR high efficiency)	[750] [1850] (SCR mod.eff. – prim. Meas.)
High speed (>1200 rpm)	[130] [150] (SCR high efficiency)	190 (SCR high efficiency)	[750] - [900] (SCR mod.eff. – prim. Meas.)

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ELV options – EU provisional position

ENGINE TYPE, POWER, FUEL SPECIFICATION	ELV 1	ELV 2	ELV 3
DIESEL ENGINES > 5 MW_{th} Slow (< 300 rpm)/ Medium (300-1200 rpm)/ speed			
5-20 MW			
HFO and bio-oils	**225** (SCR high efficiency)	~~450] [750]~~ (SCR moderate eff.)	~~[1300] [1600]~~ (primary meausres)
LFO and NG	~~150~~ (SCR high efficiency)	**190** (SCR high efficiency)	~~[1300] [1600]~~ primary meausres)
>20 MW			
HFO and bio-oils	**190** (SCR high efficiency)	~~[225] [450]~~ (SCR high - mod. eff.)	~~[750] [1850]~~ (SCR mod.eff. – prim. Meas.)
LFO and NG	~~150~~ (SCR high efficiency)	**190** (SCR high efficiency)	~~[750] [1850]~~ (SCR mod.eff. – prim. Meas.)
High speed (>1200 rpm)	~~[130] [150]~~ (SCR high efficiency)	**190** (SCR high efficiency)	~~[750] - [900]~~ (SCR mod.eff. – prim. Meas.)

In bold EU provisional position – Annex V amended ver 5 (post WS) clean.doc

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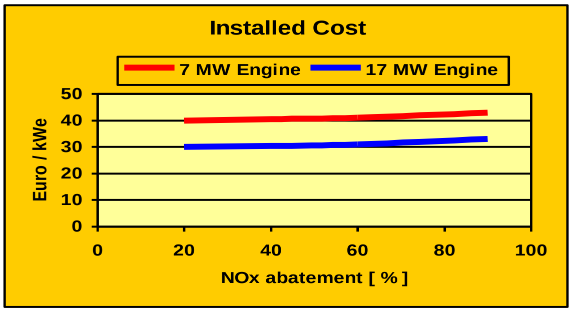
Investments

Diesel engines **(**source background document)



Gas engines

Costs provided by EUROMOT

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Operating costs

Work with EUROMOT (meeting on the 21 February)
Operating costs include :
✓Urea water 40 wt-% solution consumption (Urea water 40 wt-% solution
✓ Electricity consumption
✓ Wages

Costs estimated for the following cases :
✓ Diesel engine (low speed, heavy fuel oil) located in main land with an urea cost of 300 Euros/t - 4000 operating hours
✓ Diesel engine (low speed, heavy fuel oil) located in main land with an urea cost of 300 Euros/t - 2500 operating hours
✓ Diesel engine (low speed, heavy fuel oil) located in remote area with an urea cost of 750 Euros/t - 4000 operating hours
✓Gas engine located in main land with an urea cost of 300 Euros/t - 4000 operating hours
Costs still to be estimated for high speed diesel engines (using light distillates)

Costs of a SCR for diesel engines in main lands (urea cost 300 Euros/t). Case 4000 h/year

Diesel engines		OPTION 3		OPTION 2		OPTION 1
From 5 to 20 MWth						
	mg NOx/Nm³ at 15 %	1600		750	450	**225**
Based on an engine of 16 MWth (7 MWe) heavy fuel oil						
SCR efficiency required				53%	72%	86%
Investment	k€			286	293	307
Total annual cost	k€/year			162	191	214
Cost of removed NOx	**€/t NOx abated**			**1 014**	**884**	**827**
Additional cost of electricity produced	**€/MWhe**			**5.8**	**6.8**	**7.6**
Additional cost of electricity produced	**%**			**8.28%**	**9.76%**	**10.9%**
From 20 to 50 MWth						
	mg NOx/Nm³ à 15 %	1850	750	450	225	**190**
Based on an engine of 38 MWth (17 MWe) heavy fuel oil						
SCR efficiency required			59%	76%	88%	90%
Investment	k€		527	544	577	594
Total annual cost	k€/year		404	480	538	549
Cost of removed NOx	**€/t NOx abated**		**751**	**700**	**677**	**676**
Additional cost of electricity produced	**€/MWhe**		**6.0**	**7.1**	**7.9**	**8.1**
Additional cost of electricity produced	**%**		**8.5%**	**10.1%**	**11.3%**	**11.5%**

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Costs of a SCR for diesel engines in main lands (urea cost 300 Euros/t). Case 2500 h/year

Diesel engines		OPTION 3		OPTION 2		OPTION 1
From 5 to 20 MWth						
	mg NOx/Nm³ at 15 %	1600		750	450	**225**
Based on an engine of 16 MWth (7 MWe) heavy fuel oil						
SCR efficiency required				53%	72%	86%
Investment	k€			286	293	307
Total annual cost	k€/year			128	146	161
Cost of removed NOx	**€/t NOx abated**			**1 284**	**1 086**	**1 000**
Additional cost of electricity produced	**€/MWhe**			**7.3**	**8.4**	**9.2**
Additional cost of electricity produced	**%**			**10.5%**	**12.0%**	**13.2%**
From 20 to 50 MWth						
	mg NOx/Nm³ à 15 %	**1850**	750	450	225	**190**
Based on an engine of 38 MWth (17 MWe) heavy fuel oil						
SCR efficiency required			59%	76%	88%	90%
Investment	k€		527	544	577	594
Total annual cost	k€/year		296	344	383	370
Cost of removed NOx	**€/t NOx abated**		**882**	**805**	**770**	**730**
Additional cost of electricity produced	**€/MWhe**		**7.0**	**8.1**	**9.0**	**8.7**
Additional cost of electricity produced	**%**		**10.0%**	**11.6%**	**12.9%**	**12.5%**

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Costs of a SCR for diesel engines in remote area (urea cost 750 Euros/t). Case 4000 h/year

Diesel engines		**OPTION 3**		**OPTION 2**		**OPTION 1**
		From 5 to 20 MWth				
	mg NOx/Nm^3 at 15 %	**1600**		**750**	**450**	**225**
Based on an engine of 16 MWth (7 MWe) heavy fuel oil						
SCR efficiency required				53%	72%	86%
Investment	k€			343	352	368
Total annual cost	k€/year			292	363	418
Cost of removed NOx	**€/t NOx abated**			**1826**	**1680**	**1617**
Additional cost of electricity produced	**€/MWhe**			**10.4**	**13.0**	**14.9**
Additional cost of electricity produced	**%**			**14.9%**	**18.5%**	**21.3%**
		From 20 to 50 MWth				
	mg NOx/Nm^3 à 15 %	**1850**	**750**	**450**	**225**	**190**
Based on an engine of 38 MWth (17 MWe) heavy fuel oil						
SCR efficiency required			59%	76%	88%	90%
Investment	k€		632	653	692	713
Total annual cost	k€/year		553	1 014	1 156	1 180
Cost of removed NOx	**€/t NOx abated**		**1 539**	**1 480**	**1 454**	**1 452**
Additional cost of electricity produced	**€/MWhe**		**12.2**	**14.9**	**17.0**	**17.4**
Additional cost of electricity produced	**%**		**17.4%**	**21.3%**	**24.3%**	**24.8%**

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Costs for GAS ENGINES (urea cost 300 Euros/t). Case 4000 h/year

Gas engines		**OPTION 3**	**OPTION 2**	**OPTION 1**
Natural gas	mg NOx/Nm^3 at 15 %	190	95	**35**
Based on an engine of 20 MWth (8.7 MWe)				
SCR efficiency required				82%
Investment	k€			356
Total annual cost	k€/year			84
Cost of removed NOx	**€/t NOx abated**			**2 395**
Additional cost of electricity produced	**€/MWhe**			**2.42**
Additional cost of electricity produced	**%**			**3.45%**

Costs of option 2 is due to additional fuel consumption (+ 3%)

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Cement production

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Achievability of ELV options

	Suggested ELV for NO_x [mg/Nm³]		
	Option 1	**Option 2**	**Option 3**
New installations			
- preheater kilns	300	400	500
	Combination of : primary measures and SNCR, with an efficiency permitting to achieve these levels		
- other kilns	400	800	800
	Combination of : primary measures and SNCR, with an efficiency permitting to achieve these levels		
Existing installations	400	800	1200
	Combination of : primary measures and SNCR, with an efficiency permitting to achieve these levels		

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ELV options – Provisional EU position

	Suggested ELV for NO_x [mg/Nm³]		
	Option 1[1/]	**Option 2**[1/]	**Option 3**[1/]
~~New installations~~			
- ~~preheater kilns~~ **General (existing and new installations)**	~~300~~	~~400~~	**500**
	Combination of: primary measures and SNCR, with an efficiency permitting to achieve these levels		
~~- other kilns~~ **Existing Lepol and long rotary kilns in which no waste are incinerated**	400	800	~~800~~
	Combination of: primary measures and SNCR, with an efficiency permitting to achieve these levels		
~~Existing installations~~	~~400~~	~~800~~	~~1200~~
	Combination of: primary measures and SNCR, with an efficiency permitting to achieve these levels		

In bold EU provisional position – Annex V amended ver 5 (post WS) clean.doc

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Achievability of ELV options

	Suggested ELV for dust [mg/Nm³]		
	Option 1	**Option 2**	**Option 3**
Cement installations	15 Fabric filters or ESP	20 Fabric filters or ESP	50 Fabric filters or ESP

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ELV options – EU position

	Suggested ELV for dust [mg/Nm³]		
	Option 1	**Option 2**	**Option 3**
Cement installations **kilns, mills and clinker cooler**	~~15~~ Fabric filters or ESP	**20** Fabric filters or ESP	~~50~~ Fabric filters or ESP

In bold EU provisional position – Annex VII amended ver 5 (post WS) clean.doc

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Costs

Update of costs provided in the EGTEI background document issued in 2003 with the help of CEMBUREAU and new data of costs from the new BREF document

One reference installation taken into account with a production of 2400 t clinker / day (average size of kilns in Europe (CEMBUREAU))

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Costs for NOx

Cement installation with a capacity of 2,400 t of clinker per day		EXISTING INSTALLATIONS		NEW INSTALLATIONS
		OPTION 3	OPTION 3 TO OPTION 2	OPTION 3 & OPTION2
		Primary technologies	+ SNCR	Primary technologies + SNCR
	mg NO_x/Nm^3 at 10 %	**1,200**	**800**	**400-500**
DeNOx Efficiency required		20 %	33 %	67 – 73%
Investment	k€	450	1530	1980
Operating cost	k€	18.1	62	80.8
Total annual cost	€/year/t of clinker	0.135	0.985	1.410
Cost per ton abated	€/t NOx abated	195	1080	1070 – 985

Reference installation with NOx emissions of 1500 mg/Nm^3

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Costs for dust

Cement installation with a capacity of 2,400 t of clinker per day		OPTION 3[1]		OPTION 3 TO OPTION 2	
		ESP	FF	ESP (addition of a field)	FF (Improved maintenance
	mg TSP/Nm^3 at %	**50**	**50**	**20**	**20**
Investment	k€	3400	3400	1700	0
Operating cost	k€	136.36	136.43	68.13	0.0921
Total annual cost	€/year/t of clinker	0.87	0.90	0.42	0.04
Cost per ton abated	€/t dust abated	6.72	6.94	6044	556

Reference installation with dust emissions of 56 g/Nm^3

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Solvent uses

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Costs

Presented at the 18 th EGTEI meeting
Based on work carried out by EGTEI and used in the BREF STS