New work to update costs for LCP and refineries

SO_2, NO_x and PM abatement techniques

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Work plan of EGTEI

(d) Progress on the update of the methodology on LCP, proposed by the Expert Group;
(e) Continue to cooperate with the European Integrated Pollution Prevention and Control Bureau, including the updating of cost data in BAT reference documents for some industry sectors, such as steel and LCP;

Report_of_EGTEI_18th_meeting_Lyon_Nov.2010.pdf Informal doc for the 48th session of WGSR

LCP and refineries

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Current Methodology

Set of representative power plants

Standard cost functions f (size, technique)

- Investment
- Annualised capital cost
- Fixed operating cost
- Variable operating cost

Current Methodology

Cost assessment of abatement techniques

- specific investment amount (€/kW$_{th}$)
- specific operating cost (€/kW$_{th}$/y)
- cost effectiveness (€/ton pollutant abated)
- cost of moving from option $_{(i)}$ to $_{(i+1)}$

Set of representative power plants

Existing plants	Capacity (MW$_{th}$)	Operating Hours	Energy input (PJ/a)
HC1 (24 GJ/t)[1]	According to the cases : more than 500 MWth	According to the cases	According to the cases
HC2 (24.9 GJ/t)			
HC3 (24.9 GJ/t)			
BC (24.9 GJ/t)			
HF (39.2 GJ/t)			
GAS (39 GJ/t)			

New plants	Capacity (MW$_{th}$)	Operating Hours	Energy input (PJ/a)
HC3	According to the cases : more than 500 MWth	According to the cases	According to the cases
HF			
GAS			

(1) Lower heating value used for France.

Investment function

$$INV_{tot}[€] = \sum_i \left[\left(INV_{C,i} * BS + INV_{V,i} \right) * \vartheta * \left(1 + \frac{Retro - \%_i}{100} \right) * 1{,}000 \right]$$

i = installed technique
BS = Boiler size in MW_{th}
$INV_{C,i}$ = variable cost component of technique i
$INV_{V,i}$ = fixed cost component of technique i
Retro-$\%_i$ = Cost factor for retrofit difficulty
ϑ = relative flue gas volume (hard coal = 1)

Investment function

example: wet FGD retrofit to a HC3 unit

$$INV_{tot}[€] = \sum_i \left[\left(INV_{C,i} * BS + INV_{V,i} \right) * \vartheta * \left(1 + \frac{Retro - \%_i}{100} \right) * 1{,}000 \right]$$

i = 1 BS = 1,622 MW_{th}
$INV_{C,i}$ = 33.65 €/kW_{th} $INV_{V,i}$ = 0 €
Retro-$\%_i$ = 30% ϑ = 1

$$INV_{tot}[€] = \left(33{,}65 \frac{€}{kW_{th}} * 1{,}622 MW_{th} + 0€ \right) * \left(1 + \frac{30}{100} \right) * 1{,}000 \frac{kW_{th}}{MW_{th}} = 70{,}9 * 10^6 €$$

Annualised capital cost

Annualised capital cost = f (investment, lifetime, interest rate)

$$ACC \quad [€] = INV_{tot} * \frac{\left(1+\frac{i}{100}\right)^{t}}{\left(1+\frac{i}{100}\right)^{t}-1} * \frac{i}{100}$$

Currently used:
Lifetime t = 20 years (technical lifetime)
Interest rate i = 4% p.a.

Fixed operating cost

Fixed operating cost = f (investment)

Currently used:
4% p.a. of total investment (INV_{tot})

Variable operating cost

Technique and pollutant specific

Parameters:
- labour demand,
- electricity consumption,
- chemicals demand,
- byproduct cost/ profit,
- …

Fields of improvement

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General Assumption

Annualised capital cost

Annualised capital cost = f (lifetime, interest rate)

$$ACC \quad [€] = INV_{tot} * \frac{\left(1+\frac{i}{100}\right)^{t}}{\left(1+\frac{i}{100}\right)^{t}-1} * \frac{i}{100}$$

Lifetime t = 25-30? years (technical lifetime)
Interest rate i = 4% p.a.? (social planners)

Set of representative power plants

Existing plants	Capacity (MW_{th})	Operating Hours	Energy input (PJ/a)
HC1 (24 GJ/t)[1]	?	?	?
HC2 (24.9 GJ/t)	?	?	?
HC3 (24.9 GJ/t)	?	?	?
BC (24.9 GJ/t)	?	?	?
HF (39.2 GJ/t)	?	?	?
GAS (39 GJ/t)	?	?	?

New plants	Capacity (MW_{th})	Operating Hours	Energy input (PJ/a)
HC3	?	?	?
HF	?	?	?
GAS	?	?	?

(1) Lower heating value. National input, here France.

Unabated emission factors

Fuel	TSP-EF (t TSP/PJ)	Fraction PM10 (%)	Fraction PM2.5 (%)	Sulphur content (%)	SO_2-EF (t SO_2/PJ)	NO_X-EF (t NO_X/PJ)	
HC1	3,500[1]	23	12	0.9	735	260	150
HC2	4,337	23	12	0.8	627	333	200
HC3	4,337	23	12	1.2	941	315	190
BC	4,337	23	12	1.0	941	315	190
HF	15.5	85	60	2.79	1,423	238	120
GAS	0.1	100	100	0.01	50	80	50

(1) 3,500 and 4,500 t TSP/PJ both have been stated as emission factors.

Fields of improvement

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Extension of the range of installations covered
> 50 MWth instead of > 500 MWth

Fields of improvement

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Reduction techniques

Selection of techniques

- PM:
  - Now: Cyclone, l.e. ESP, ESP, FF
  - Future: replace current ESPs by 2-, 3-, 4-field ESP?
- SO_2:
  - Now: Wet FGD, HE-Wet-FGD
  - Future: ?
- NO_x:
  - Now: PM, SCR
  - Future: add SNCR? Differentiate PM?

Individual techniques

- Selected abatement efficiency appropriate?
- Consider maximum achievable emission limit? (~BAT-AEL?)
- Consumption figures (electricity, reagent) up to date?
- Wet FGD: include saleable byproducts (gypsum)?

Fields of improvement

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Cost functions

Questions about cost data

- Is modeling with a single investment function appropriate?
  - splitting investment function into a partially continuous function (acc. to size range)?
  - defining variable and fix part of function acc. to characteristics
  - defining range of possible scaling
- Thermal input or volume flow as basis?
- Retrofit cost factors appropriate?
- How to include inflation? CEPCI?

Defining the cost of moving from one option to another

- Uprading by investment + retrofit factor?
- Building a completely new unit?
- Starting point: zero or a BAT for this option?

Proposed work programme

- Target : one year to complete the work (May 2012)
- Development of cost functions on the basis of collected information for installation larger than 500 MWth
- Extend to 50 to 500 MW installations
- Undertake the update of operating costs when necessary
- Hold a first meeting in the beginning of October to discuss the first results and define the following steps (representation of the sector for estimation of total costs for one activity)
- Inform the secretariat before end of June 2011 for experts to be involved in the work (LCP and refineries)