BEST AVAILABLE TECHNIQUES FOR COMBUSTION INSTALLATIONS AND STATIONARY ENGINES

The Centre for Best Available Techniques (BAT) is founded by the Flemish Government, and is hosted by Vito. The BAT centre collects, evaluates and distributes information on environment friendly techniques. Moreover, it advises the Flemish authorities on how to translate this information into its environmental policy. Central in this translation is the concept "BAT" (Best Available Techniques). BAT corresponds to the techniques with the best environmental performance that can be introduced at a reasonable cost.

The objective of this study is to trace techniques that minimise the environmental pollution caused by combustion installations and stationary engines at a reasonable cost. Judging on the selected BAT, recommendations concerning environmental permit legislation and promotion through investment support are presented to the Flemish Government.

Combustion installations and stationary engines are used for the transformation of chemical energy into thermal energy. This thermal energy (heat) is either used directly or is transformed into mechanical energy and further into electrical energy. The operation of fossil fuel-fired combustion installations to generate electrical energy and/or heat is a very important cornerstone of our modern society.
In this document we focus on industrial furnaces with a capacity of 100 kW_{th} and more. Stationary engines includes gas engines, diesel engines and gas turbines with a miminum nominal output of 10 kW.

This BAT report focusses mainly on the techniques to reduce NO_x and SO_2 emissions. Nineteen environmental techniques for the reduction of NO_x and SO_2 for combustion installations and seven measures for stationary engines are discussed. Emissions to water, soil, waste, noise nuisance and energy efficiency are also considered.

Cost-efficiency and feasibility of the environmental techniques are essential in BAT assessment and are evaluated by means of the estimation of investment and operation costs and reduction efficiencies. To consider whether a technique is too expensive or not, two evaluations were made; one were the total cost of techniques to reduce NO_x and SO_2 did not exceed ± 0,005 euro/kWh_e and the other were the total cost of techniques did not exceed ± 0,002 euro/kWh_e. Further research should re-evaluate this limit on sector level (electricity production, refineries, …). In the assessment of cost-efficiency costs of 5000 euro/ton NO_x removed and 2500 euro/ton SO_2 removed were used as reference points.

Without taking into account sector-specific economic feasiblity, the BAT conclusions for existing combustion installations are:

- use of SNCR technology for medium and large installations with a thermal capacity < 100 MW (NO_x);
- use of either primary measures (e.g. low NO_x burners, flue gas recirculation and/or overfire air) together with SNCR or SCR for installations with a capacity of > 100 MW_{th} (NO_x);
- flue gas treatment with wet scrubbers (SO_2);
- Use of fuels with low sulphur content in installations that operate less than 2000 hours a year (SO_2).

New installations make use of the most recent burner technology and boiler design to achieve low NO_x emissions (< 200 mg/Nm^3). BAT for the reduction of SO_2 are flue gas purification or the use of fuels with very low sulphur content (e.g. 0,1 % S).

BAT for gas engines is lean burn with an oxidation catalyst, which minimises NO_x, CO and VOS emissions. For diesel engines, with a capacity of ≥ 3 MW_{th} and operate more than 360 hours a year, SCR was selected as BAT. BAT for gas turbines on natural gas is dry low NO_x. On gasturbines using liquid fuels, the injection of water/steam is selected as BAT.

On the basis of these BAT, Vito proposes the Flemish authorities to consider new emission limit values for nitrogen and sulphur oxides. An outline of this BAT proposal for emission limit values for combustion installations and stationary engines is given in the following charts. Further research should analyse the feasibility of this proposal per sector.

The BAT proposal for combustion installations:

a) Existing installations

Nominal thermal capacity (MW)	Emission limit values (mg/Nm³)					
	Coal (6 % O_2)		Liquid fuel (3 % O_2)		Natural gas (3 % O_2)	
	NO_x	SO_2	NO_x	SO_2	NO_x	SO_2
30 – 50	500-800	<1050	300-350	<850	300	35
50 – 100	500	200-1050	300-350	200-850	300	35
100 – 300	500	200-1050	300-350	200-850	250	35
300 – 600	350-500	200-1050	150-350	200-850	150-300	35
> 600	200-600	200-1050	150-350	200-850	150-300	35

b) New combustion installations

Nominal thermal capacity (MW)	Emission limit values (mg/Nm³)					
	Coal (6 % O_2)		Liquid fuel (3 % O_2)		Natural gas (3 % O_2)	
	NO_x	SO_2	NO_x	SO_2	NO_x	SO_2
0,1 – 2	500	1050	150	350	150	35
30 – 50	400	350	150	200	150	35
50 – 100	150	200	150	200	100	35
100 – 300	150	200	150	200	100	35
300 – 600	150	200	150	200	100	35
> 600	150	200	150	200	100	35

The BAT proposal for stationary engines:

a) Gas and diesel engines:

Para-meter	Emission limit values (mg/Nm³) at 5 % O_2			
	gas engines		diesel engines	
	excisting	new	excisting	new
NO_x	1.300 × η/30	500 × η/30	-	$<3MW_{th}$ 4.000 $\geq 3MW_{th}$ 500 - 2.000
SO_2	-	-	max. 0,2 %	max. 0,2 %
CO	650	650	650 - 1.500	650
VOS	150	150	150	150

b) Gas turbines:

Para-meter	Emission limit values (mg/Nm³) at 15 % O_2					
	existing gas turbines			new gas turbines		
	gaseous fuel	gasoil	liquid fuel	gaseous fuel	gasoil	liquid fuel
NO_x	> 50 MW_{th} 100	<50 MW_{th} 600 ≥50 MW_{th} 450	<50 MW_{th} 600 ≥50 MW_{th} 450	< 50 MW_{th} 100 ≥ 50 MW_{th} 50	<50 MW_{th} 200 ≥50 MW_{th} 150	<50 MW_{th} 600 ≥50 MW_{th} 450
SO_2	-	max. 0,2 %	max. 0,2 %	-	max. 0,2 %	max. 0,2 %
CO	100 - 250	100 - 250	100 - 250	100	100	100

If the BAT are implemented in Flanders, the SO_2 emissions caused by combustion of fossil fuels in large combustion installations can be reduced from 43.000 ton/year (2000) to ± 10.000 ton/year. The emission of NO_x could also be minimised from 34.000 ton/year (2000) to 15.000 ton/year.
Stationary engines are already conform BAT and emit about 5.000 ton NO_x/year.

This study also includes an overview of techniques that can be considered for investment support, e.g. SCR and SNCR technology, $SCONO_x^{TM}$ and catalytic combustion.

BAT selection was brought about on the basis of, among other things, cost calculations, foreign BAT reports, plant visits and discussions with industry experts, representatives of the federation, suppliers and specialists from (semi) public institutes. The formal consultation was organised by means of an advisory committee of which the composition is given in Annex 1.

Full Dutch version available **here** (14,8 Mb)

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