ABSTRACT

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 environmentally 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. In this study, the BAT are selected for new, small and medium combustion installations, stationary combustion engines and gas turbines that burn fossil fuels.

First of all, this study aims to gather available information with regard to the environmental impact of burning fossil fuels in small and medium combustion installations, stationary combustion engines and gas turbines. Next, measures for emission prevention and/or reduction are presented. These techniques are mostly focused on emissions of NO_x, SO_2 and particulates. The measures and techniques described make up the basis for the evaluation of the BAT and give a first insight into the achievable emission levels.
This BAT study focuses specifically on *new* installations, which means installations that are not yet installed nor authorized with a permit, with a thermal output power between 300 kW_{th} and 50 MW_{th}.

Combustion installations, engines and gas turbines transform the chemical energy of different fuels into thermal energy (heat). This heat can either be used as such or be transformed further into mechanical energy and even further into electricity. Small and medium combustion installations can be found in a wide range of applications: horticulture, hospitals, chemical companies and other industrial sectors. Different types of fossil fuels can be burned: solid fuels e.g. coal, liquid fuels e.g. fuel oil and gaseous fuels e.g. natural gas.

The BAT selection in this study is based on plant visits, a literature survey, a technical and socio-economic study, cost calculations, and discussions with industry experts and authorities. The formal consultation was organised by means of an advisory committee, with members from the Government as well as sector representatives.
An evaluation of the technical feasibility and the environmental aspects is performed for a broad range of measures. An estimation of the economic feasibility is made by calculating the cost effectiveness of the measures as well as the affordability (relative increase of costs). To calculate the cost effectiveness (cost per ton emissions reduced) information on investment and operational costs of the environmental measures on the one hand and emission reduction efficiencies (i.e. the achievable emission levels) on the other is required.

Since this study only focuses on new installations, the availability of measured data of operational installations is rather limited: most data come from producers and are therefore mostly relevant in laboratory conditions. The level of reduction achievable with the different prevention and reduction techniques as well as the cost of these techniques are estimated based on the available literature. Actual data of installations with end-of-pipe techniques in operation are not that readily available. The legislation in Flanders as it is now does not yet oblige companies to implement most of these techniques.

To evaluate whether an emission reduction technique is cost effective or not, a reference value is needed. In this study, an indicative range is used. Affordability of

a technique is much harder to evaluate, as it is a very sector-specific issue and therefore hard to evaluate in this type of horizontal BAT study.
When evaluating the economic feasibility of the measures, the number of operational hours, the output power and the investment costs are important parameters. Uncertainties in cost data are taken into account by calculating different price scenarios as well as sensitivity analysis.

Based on the assumptions described above, BAT conclusions are formulated. In the conclusions, first the BAT are pointed out. Then the BAT achievable emission levels are identified. To get a complete overview of the assumptions and conclusions, we refer to chapter 5 and 6 of this study, as well as the tables in annex 3 (calculation of the cost effectiveness).

Summary of the BAT conclusions

New, small and medium *combustion installations on solid fossil fuel*s seem to be used mostly in horticulture. Generally, SNCR or SCR (depending on the cost scenario of SCR) is BAT in all circumstances (power, operational hours) to reduce NOx, except for the smallest installations below 1 MWth. To reduce emissions of particulates, a cyclone (1-<5 MW_{th} and > 4000 h, 5-<20 MW_{th} and <4000 h), wet scrubber (5-<20 MW_{th} and >4000 h, 20-<50 MW_{th} and <4000 h) and fabric filter or ESP (20-<50 MW_{th} and >4000 h) are BAT. To reduce particulate emissions of installations < 1 MW_{th} and 1-5 MW_{th} and <4000 hours, none of the end-of-pipe techniques was selected as BAT.

For new, small and medium *combustion installations on liquid fossil fuels* the BAT analysis is specifically done per fuel type, making a distinction between heavy fuel oil (1% S) and light fuel oil (0,1% S). In addition to the end-of-pipe techniques also fuel switch from heavy to light fuel oil is analysed.
For the reduction of NO_x when burning heavy fuel oil, SNCR or SCR is BAT depending on the cost scenario for SCR. Only for installations below 1 MWth and less than 4000 operational hours a year, a low-NO_x burner is BAT.
For light fuel oil, a low-NO_x burner is BAT for all installations burning this fuel up to 5 MW_{th} and SNCR or SCR is BAT for larger installations (depending on cost scenario for SCR).
SO_2 emissions depend on the sulphur content of the fuel. Although some end-of-pipe techniques are BAT, policy can also focus on the quality of the fuel and the sulphur content to reduce these emissions.
The BAT conclusions for liquid fossil fuels are difficult to compare with the current legislation in the VLAREM II because in current legislation, no distinction is made between the fuel types.

For new, small and medium *combustion installations on natural gas* the BAT for reduction of NO_x-emissions is a new, low-NO_x burner combined with optimal design. For installations above 5 MWth and more than 4000 operation hours a year, SNCR or SCR is BAT (depending on the cost scenario for SCR).

The current legislation for new, small and medium *stationary combustion engines* (>360 hours) can be made more stringent for all emission limit values. For gas engines, the emission of NO_x is the most relevant environmental parameter, for which SCR is BAT. Diesel engines are again analysed for each type of fuel. This makes a comparison with the current emission limit values rather difficult since this distinction is not made in VLAREM II.

For *gas turbines* no new recommendations were formulated.

When translating the BAT conclusions and recommendations into legislation, other policy issues can play an important role as well, such as European Directives on national emission ceilings or environmental quality objectives. Since all these aspects should be taken into account when translating BAT conclusions and associated emission levels into legislation, the conclusions in chapter 6 should be critically evaluated.