

# **SMALL HANDHELD 4-STROKE ENGINES**

## **SYNOPSIS SHEET**

Prepared in the framework of EGTEI

## 1. Activity description and EGTEI contribution – summary

4-stroke engines considered in [1] are common in off-road applications such as trimmers, blowers or chainsaws.

In a 4-stroke engine, a piston makes four passes or strokes in the cylinder to complete an entire cycle. The strokes are intake, compression, power and exhaust. Two of the strokes are downward (intake and power) and two are upward (compression and exhaust).

4-stroke engines have considerably lower VOC emissions than 2-stroke engines, due to the fact that 4-stroke do not experience short circuiting of raw fuel. CO emissions are very similar for both technologies since these emissions are the result of inefficient combustion of the air-fuel mixture within the cylinder. Since the fuel combustion within the cylinder of a 4-stroke engine is more efficient than in a 2-stroke engine, combustion temperatures are higher which results in higher NO<sub>x</sub> emission levels.

SO<sub>2</sub> emission levels are proportional to the sulphur content of the fuel used. The only way to reduce SO<sub>2</sub> emissions is to reduce the gasoline sulphur content. TSP emissions are not a big issue for these types of engines. They are not considered in this document as no data has been found.

In RAINS [2], off-road 4-stroke engines are considered either separately or with on-road engines when no country specific data are available. NO<sub>x</sub> emissions at a EU25 level (according to the RAINS model: version CP\_CLE\_Aug04(Nov04)) are about 2.9 kt representing only 0.04% of total transport emissions. VOC emissions are only 2.3 kt being about 0.05% of total transport emissions. These figures do not take into account emissions from all countries as some of them are considered with on-road emissions.

These engines are addressed by the European Directive 2002/88/EC [3]. Only engines rated below 18kW are considered in the Directive because they emit 80% of VOC emissions from small off-road engines (according to an inventory from the European Commission). Gasoline is also regulated by the Directives 98/70/EC [4] and 2003/17/EC [5]. In order to be able to better represent the impact of these Directives in terms of emission reductions and costs, this sector has been considered as an individual activity by EGTEI [1].

The representative unit used is the amount of fuel consumed annually (PJ/year). **As VOC and NO<sub>x</sub> emissions for these engines are already lower than those defined in the new regulation, no technical improvement is necessary to comply with the emission limit values defined as stages I and II.**

As all data are already defined in the EGTEI background document [1], they have not been reproduced in this synopsis sheet.

Only the level of activity (amount of fuel consumed annually) for these types of engines can be provided by national experts. This is a very useful information as it defines the shares of emissions which will not be reduced between 2000 and 2020. This information can be introduced in RAINS as it is possible to consider off-road 4-stroke engines separately in the model.

## 2. Bibliography

- [1] EGTEI background document.  
[http://citepa.org/forums/egtei/small\\_SI\\_handheld\\_engines\\_4\\_stroke\\_300603.pdf](http://citepa.org/forums/egtei/small_SI_handheld_engines_4_stroke_300603.pdf)
- [2] Review of data used in RAINS model  
<http://www.iiasa.ac.at/web-apps/tap/RainsWeb/>
- [3] Directive 2002/88/EC of the European Parliament and of the Council of 9 December 2002 amending Directive 97/68/EC on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery.
- [4] Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC [Official Journal L 350. 28.12.1998].
- [5] Directive 2003/17/EC of the European Parliament and of the Council of 3 March 2003 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels.