

## 1. INTRODUCTION

The necessity for cleaner technologies that reduce anthropogenic greenhouse gas emissions in the atmosphere by improving fuel economy, has made researchers and vehicle manufactures focus their attention on more advanced engine concepts. This is the case of **Gasoline Direct Injection (GDI)** engines which can achieve a 20% **reduction** in both **fuel consumption and carbon dioxide** depletion. In the near future the majority of light petrol vehicles will be GDI.

## 2. PARTICULATE MATTER

However, **GDI** engines are **linked with** higher levels of **PM** emitted, a toxic pollutant considered as **carcinogenic** by the International Agency of Research in Cancer. The effect of PM is size dependent, small particulates are emitted in larger numbers and can penetrate deeper in the human body. The European legislation, **Euro6c** which comes into force in September 2017, include a limit in **PM number:  $6 \times 10^{11}$  particulates/km.**

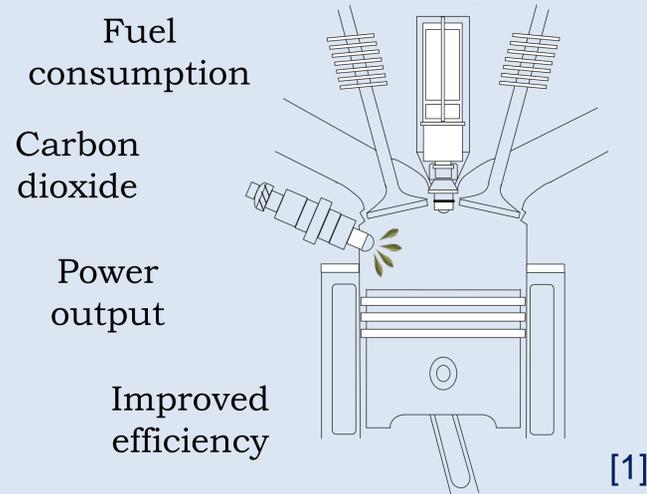
## 3. PM CONTROL

There are several ways to reduce/control PM. The optimisation of **engine parameters** such as the injection pressure or spark timing. Moreover, **filters** have been an effective ways to reduce PM in diesel cars. The same concept is now applied to petrol vehicles. Lastly, the use of **alternative and renewable fuels**, such as bioethanol, can palliate PM formation in the combustion chamber.

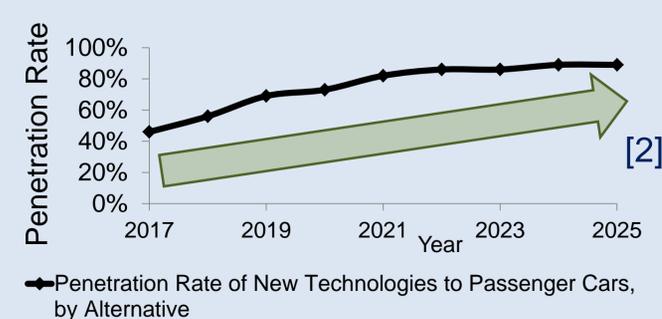
## 4. BHAM'S RESEARCH

**Hydrogen** combustion has been proven to reduce PM significantly. The physical properties of PM (**morphology and microstructure**) as well as **soot oxidation patterns** have been researched. Filter and lung deposition are strongly linked with those parameters. In addition, different gasoline particulate filters have been analysed.

### 1.1. GDI advantages



### 1.2. GDI in the near future



High concentration of **particulate matter** and  $\text{NO}_2$  are linked to plethora of **respiratory health problems**

**Air pollution:** How strong is the link to **cancer?**

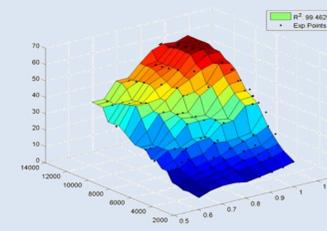
Tiny **particles** make air pollution the fourth leading cause of **death** worldwide [3]



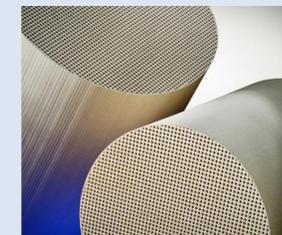
**MORE AIR POLLUTION MEANS MORE STROKES**

**Air pollution** linked to 40,000 **early death**, UK doctors warn

### 3.1. Optimising engine calibration



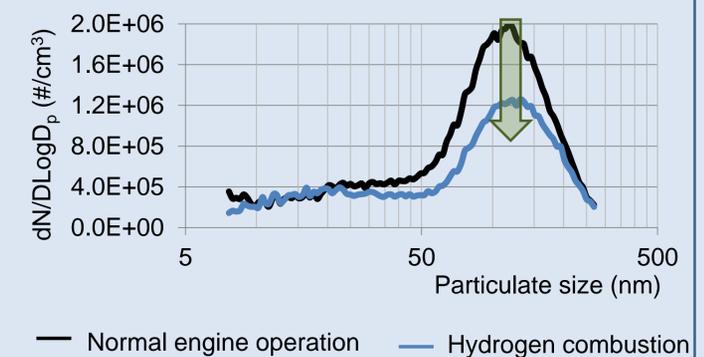
### 3.2. Aftertreatment systems



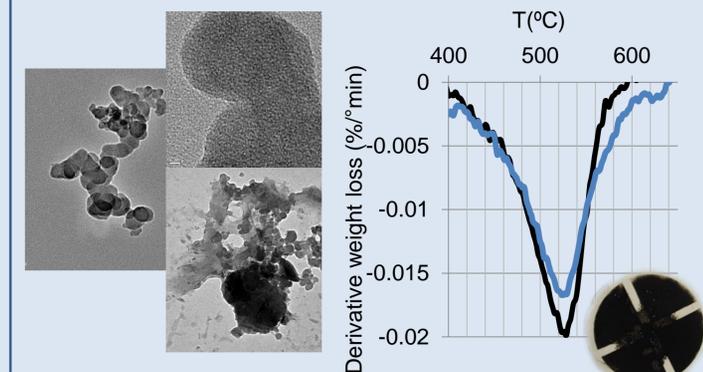
### 3.3. Alternative fuels



### 4.1. Hydrogen combustion



### 4.2. PM characterisation



## REFERENCES

- [1] F. Zhao et al. PECS (1999) 437–562. [3] BBC/Sky/The Times News. Accessed 24 March 2016  
 [2] CAFE for MY 2012-MY 2016 Passenger Cars and Light Trucks. [4] <http://www.chinadaily.com.cn/> Accessed 24 April 2016

## ACKNOWLEDGEMENTS

