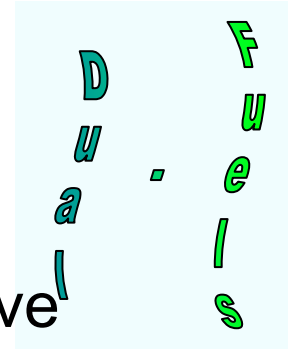


# Consequences of the GFV meeting Limits

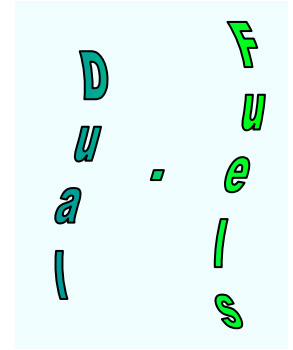
HDDF Task force meeting N°3  
Brussels 21 December 2010

# Characterisation of the type of HDDDF engines



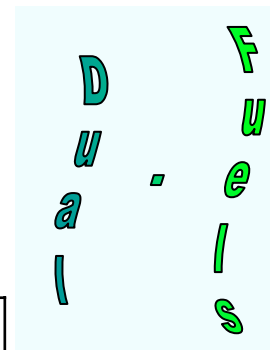
- A Type 1 HDDDF engine will be regarded as a positive ignition engine because the Diesel fuel is essentially used for providing the ignition of the gas instead of e.g. a spark plug, a laser beam, or any other external ignition mean. ( $90\% \leq GR$ )
- A Type 2 HDDDF engine will be regarded as an intermediate between a positive ignition and a compression ignition engine because the Diesel fuel is also used in a typical manner for the normal motion of the vehicle ( $10\% < GR < 90\%$ )
- A Type 3 HDDDF engine will be assimilated to a Diesel mono-fuel engine ( $GR \leq 10\%$ )

# Applicable limits for EURO VI HDDF



- Agreed in GFV
  - T1: NMHC and CH4 - WHTC / ETC only
  - T2: THC, NMHC and CH4 – WHTC / ETC and WHSC / ESC
  - T3: THC – WHTC and WHSC / ESC and NMHC (or THC at the same level) - ETC
- Agreed in HDDF-TF meeting 2
  - HDDF-T2 should be submitted to the WHSC / ETC test-cycle (because of particulates)
  - Regarding HC, only NMHC should be considered during a WHSC / ETC test
- Proposal:
  - HDDF agreement on the WHSC / ETC test was not discussed in GFV
  - HDDF will continue working nevertheless in conformity with its opinion
  - HDDF will present its complete proposal to GFV in January 2011

Type 1 – EURO V + EEV + EURO VI – applicable limits  
 WHTC or ETC test cycles (as appropriate)



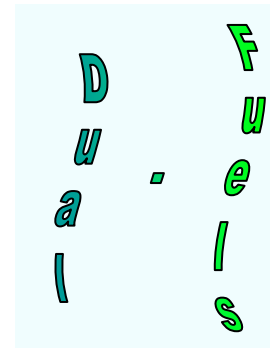
	EURO V (g/kWh)	EEV (g/kWh)	EURO VI (mg/kWh)
NMHC	0.55	0.40	160
CH4	1.1	0.65	500
NOx	2	2	460
CO	4	3	4000
PM		0.02	10
PN			tbd

# Type 2 – EURO V + EEV + EURO VI – applicable limits transient test cycles (WHTC / ETC)

D  
u  
a  
l  
-  
F  
u  
e  
l  
s

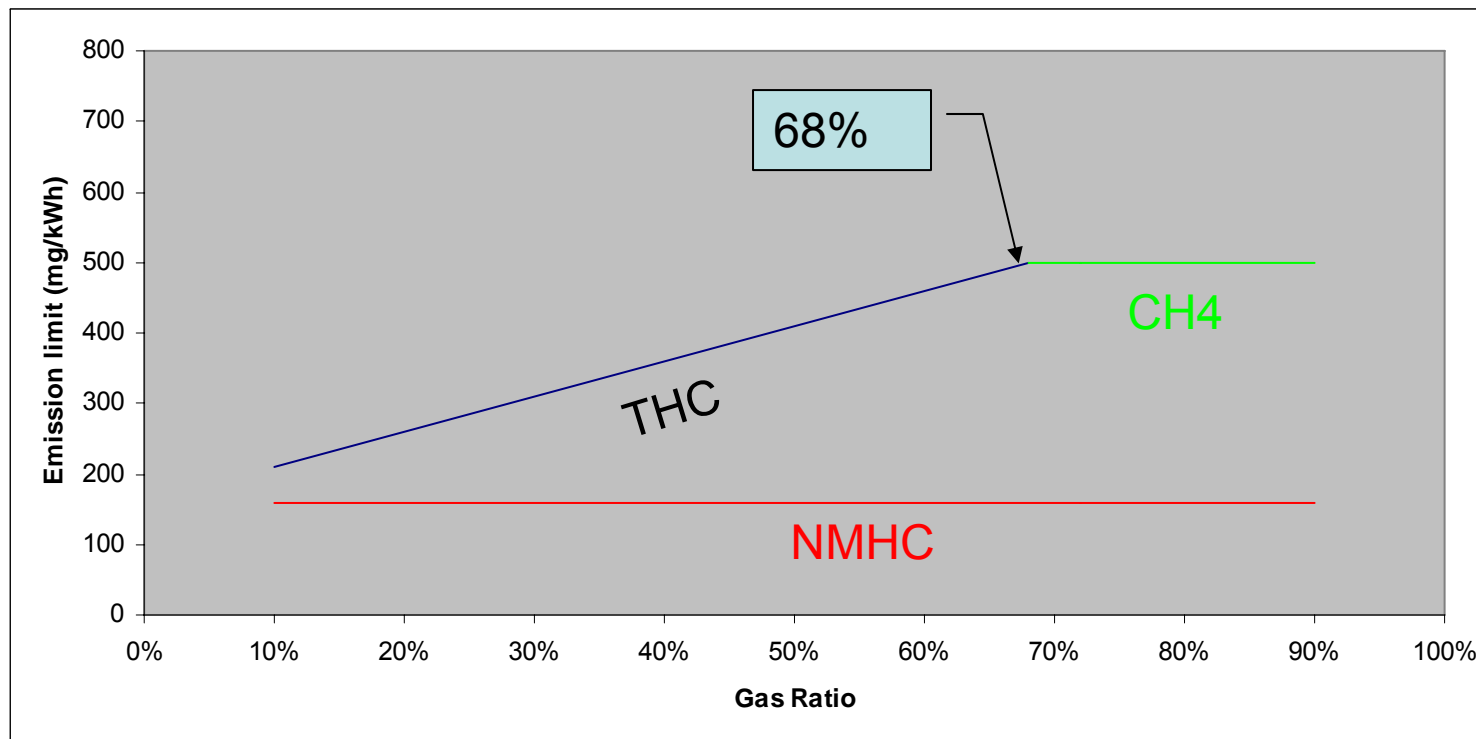
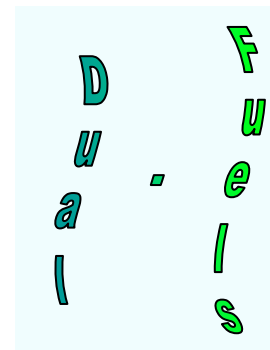
Transient cycle	EURO V (g/kWh)	EEV (g/kWh)	EURO VI (mg/kWh)
NMHC	0.55	0.40	160
THC	See sheet 8	See sheet 9	See sheet 7
CH4	See sheet 8	See sheet 9	See sheet 7
NOx	2	2	460
CO	4	3	4000
PM	0.03	0.02	10
PN			See sheet 10

# Type 2 – EURO V + EEV + EURO VI – applicable limits transient test cycles (WHSC / ESC)



Steady State cycle	EURO V (g/kWh)	EEV (g/kWh)	EURO VI (mg/kWh)
NMHC	0.46	0.25	130
NOx	2	2	400
CO	1.5	1.5	1500
PM	0.02	0.02	10
PN			See sheet 10

## Type 2 – EURO VI hydrocarbon limits (WHTC test cycle)



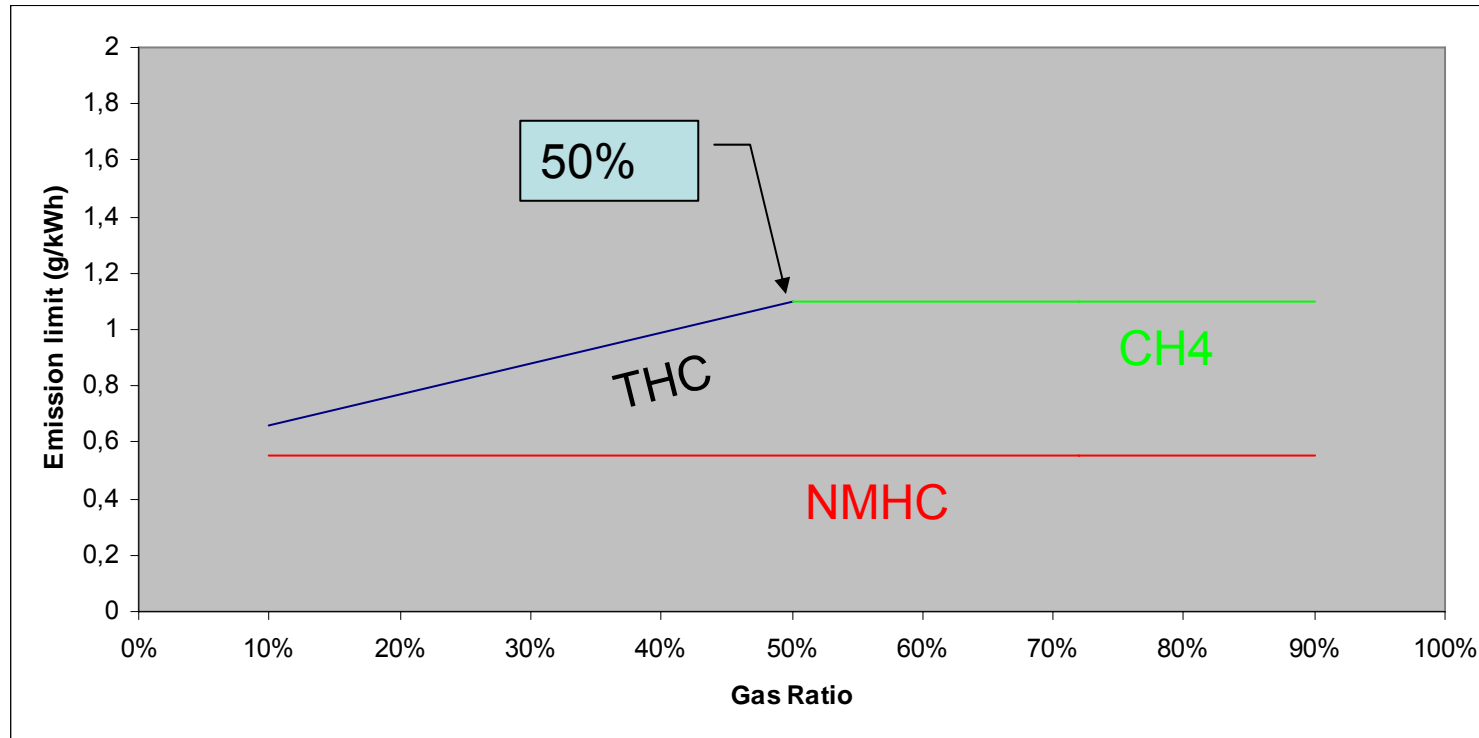
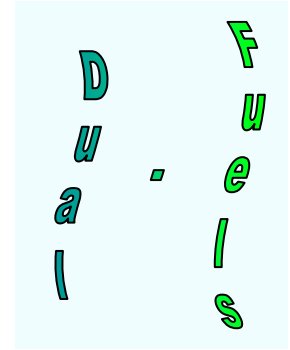
### Formula - THC

- If  $\text{THC} \leq 500 \text{ mg/kWh}$ , then
  - o  $\text{THC} = 160 + (500 * \text{GR}) - \text{mg} / \text{kWh}$
- Otherwise
  - o No applicable THC limit

### Formula – CH4

- If no THC limit is applicable, then
  - o  $\text{CH4} = 500 \text{ mg/kWh}$
- Otherwise
  - o No applicable CH4 limit

## Type 2 – EURO V hydrocarbon limits (ETC test cycle)



### Formula - THC

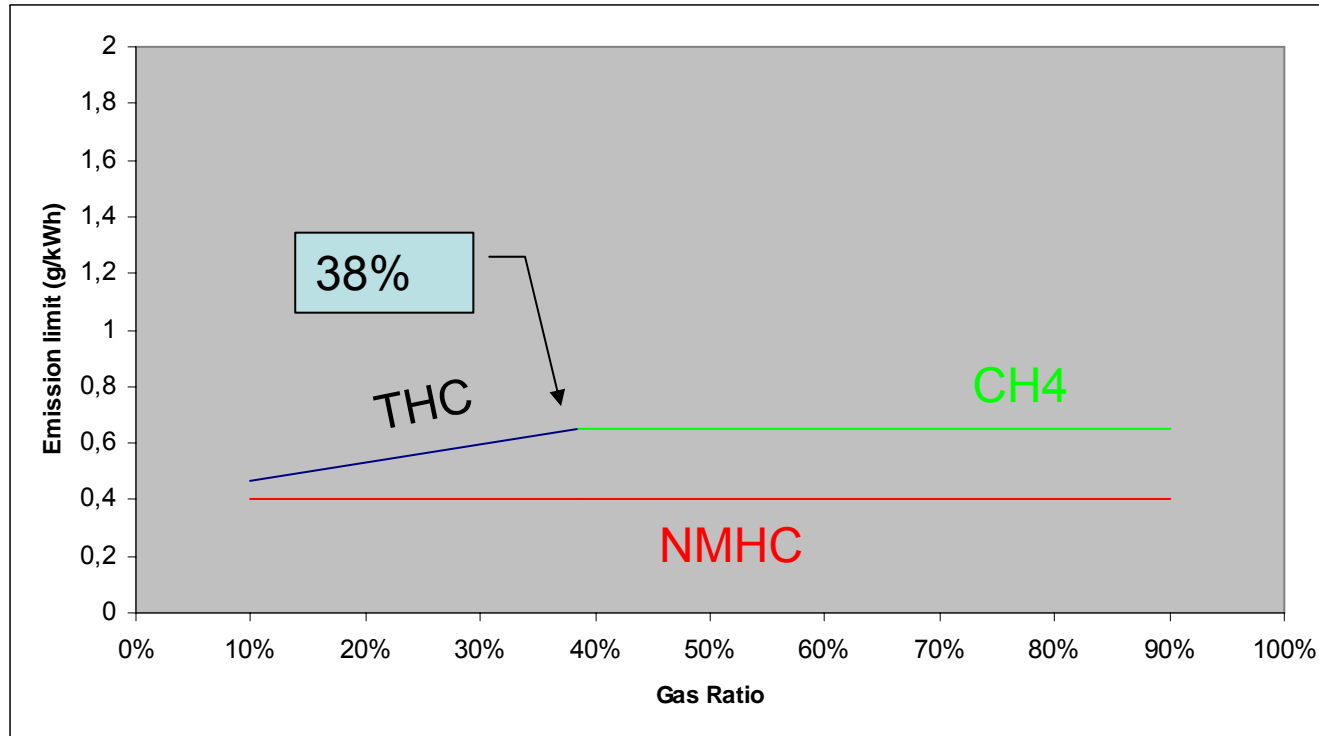
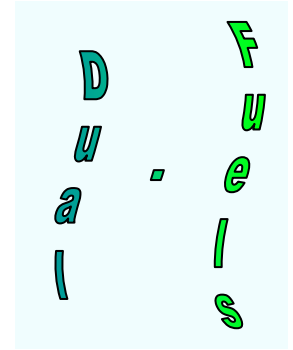
- If  $\text{THC} \leq 1.1 \text{ g/kWh}$ , then
  - o  $\text{THC} = 0.55 + (1.1 * \text{GR}) - \text{g / kWh}$
- Otherwise
  - o No applicable THC limit

### Formula – CH4

- If no THC limit is applicable, then
  - o  $\text{CH4} = 1.1 \text{ g/kWh}$
- Otherwise
  - o No applicable CH4 limit



## Type 2 – EEV hydrocarbon limits (ETC test cycle)



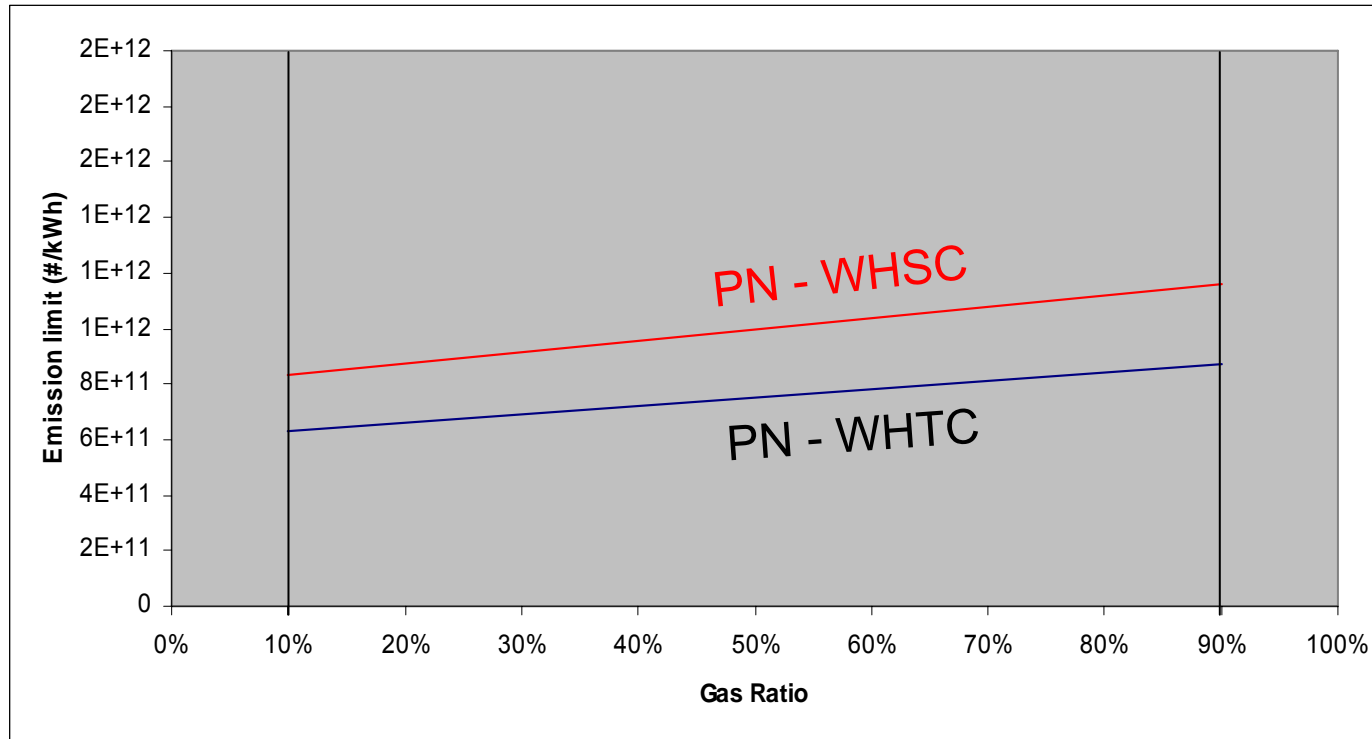
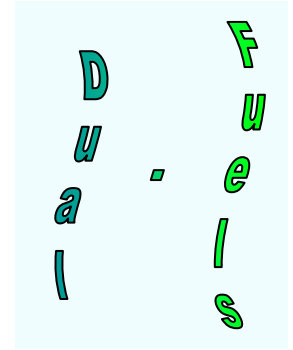
### Formula - THC

- If  $\text{THC} \leq 0.65 \text{ g/kWh}$ , then
  - o  $\text{THC} = 0.40 + (0.65 * \text{GR})$  – in g / kWh
- Otherwise
  - o No applicable THC limit

### Formula – CH4

- If no THC limit is applicable, then
  - o  $\text{CH4} = 0.65 \text{ g/kWh}$
- Otherwise
  - o No applicable CH4 limit

## Type 2 – EURO VI PN limits (WHTC & WHSC test cycles)

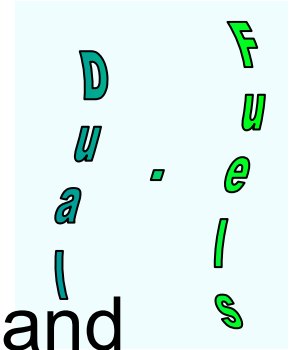


### Formulas

- $PN (WHTC) = 6 \cdot 10^{11} + (xx \cdot 10^{11} \cdot GR)$  – in # / kWh
- $PN (WHSC) = 8 \cdot 10^{11} + (yy \cdot 10^{11} \cdot GR)$  – in # / kWh

xx and yy values are the PN emission limits for positive ignited engines.  
These values are to be defined in EURO VI Comitology.

# Type 3 – Tests & limits



- HDDF-T3 shall be submitted to all the tests and limits of a mono-fuel Diesel engine
  - Including the WNTE lab-test

As agreed in HDDF-01