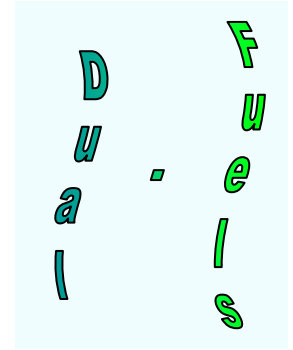


UNECE HDDDF-TF status report

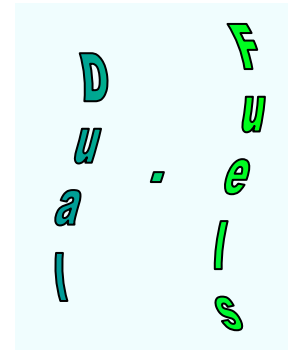
GFV meeting 08 November 2010

Priorities (based on Commission desires)

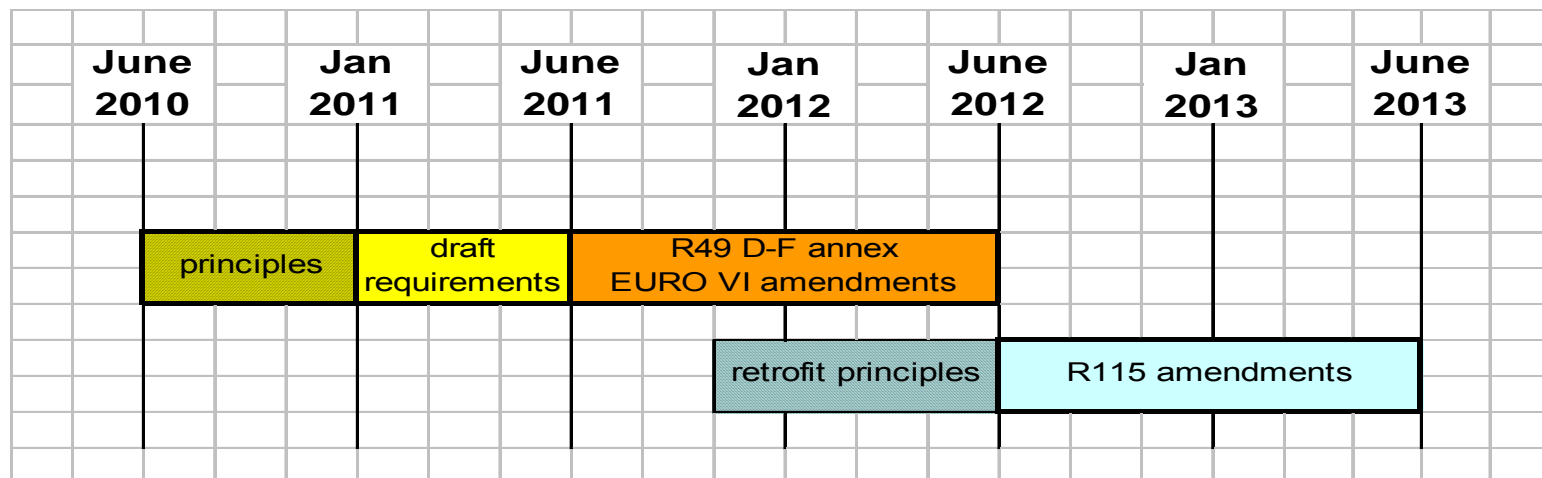


- *The main focus for the TF is new vehicles*
 - *Highest priority is to adapt the Euro VI legislation and procedures to enable type approval of dual fuelled engines.*
 - *Second highest priority is to adapt the Euro V and EEV legislations and procedures. The TF should try to do that work simultaneously with the adaptation of the EURO VI legislation.*
- *The adaptation or the R115 (retrofit) legislation shall be done in a later stage and be based on the requirements for new vehicles.*

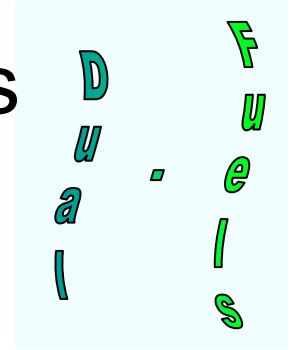
Draft time-plan



- HDDF-TF Aug 2010: principles (1) - done
- HDDF-TF Oct 2010: principles (2) - done
- GFV Nov 2010: validation of the principles
- HDDF-TF Dec 2010: editorial meeting on the basis of the elements validated by GFV
- GFV Jan 2011: review of the draft HDDF-TF text
- GRPE Jan 2011: status report + informal document
- GRPE June 2011: status report + informal document
- GRPE Jan 2012: amendments proposals to UNECE-R49.
- GRPE June 2012: approval of the amendments to UNECE-R49
- WP29 Nov 2012: approval of the amendments to UNECE-R49

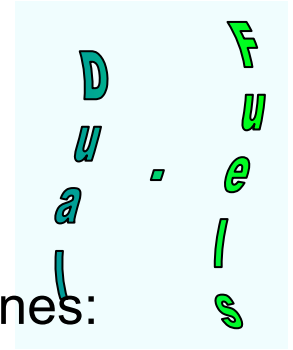


Definition of Dual-fuel engines and vehicles



- Preliminary proposal :
A Dual-Fuel engine means an engine that uses simultaneously 2 different types of fuels supplied from separate on-board storage systems and where the consumed amount of one of the fuels versus the other one may vary depending on the operation.
- Rationale:
 - A DF is neither a bi-fuel nor a flex-fuel
- Further steps to consider in setting the final definition:
 - Allow somewhere in the text that it may be possible for a DF engine to work as mono-fuel engine in some operations (e.g. LPG-DF engines in alpine operation)

Characterisation of HDDDF-types 1 to 3 split between the categories

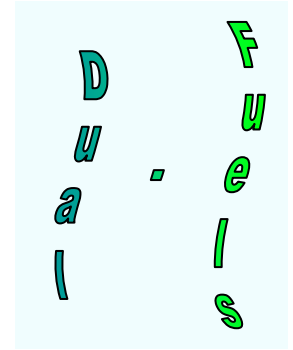


- GRPE agreed to consider the following 3 types of HDDDF engines:
 - HDDDF Type 1 engines: Diesel / gas Dual-fuel engines with a very high level of gas usage, for example the CAL "HD pilot ignition engines"
 - HDDDF Type 2 engines: Diesel / gas Dual-fuel engines with a balanced usage of Diesel fuel
 - HDDDF Type 3 engines: Diesel / gas Dual-fuel engines with a very low level of gas usage
- HDDDF introduced far separating the types and for describing the applicable requirements the Gas Ratio concept, that is

the Ratio of the energy content of the gas fuel over the energy content of the total fuel (Diesel+gas) *

* the energy content concept is used in the CAL rules to define T1 HDDDF

Characterisation of type 1 HDDDF engines



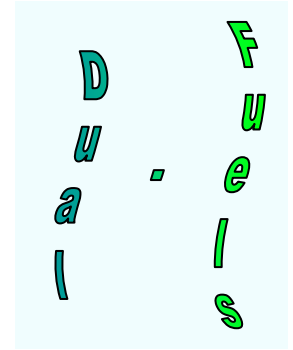
- Proposal:
A Type 1 HDDDF engine shall be regarded as a positive ignition engine

Rationale:

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.

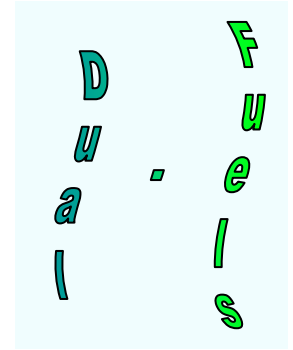
- Consequence:
The limit of Diesel content shall be limited to 10% in energy content after averaging over the WHTC or ETC test-cycle (consistency with the Californian approach)

Characterisation of types 2 & 3 HDDF engines



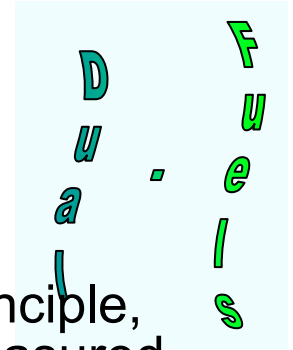
- Proposal for Type 2:
A Type 2 HDDF engine shall be regarded as an intermediate between a positive ignition and a compression ignition engine because the Diesel fuel is also used in a typical manner for the normal motion of the vehicle
- Proposal for Type 3:
A Type 3 HDDF engine shall be assimilated to a Diesel mono-fuel engine, provided the energy content of gas is not exceeding 10%

Limits applicable to HDDDF



- EURO VI HDDDF limits
 - T1: NMHC and CH4 (WHTC only)
 - T2: THC, NMHC and CH4 (WHTC and WHSC)
 - T3: THC (WHTC and WHSC)
- EURO V and EEV limits
 - T1: NMHC and CH4 (ETC only) – No ELR
 - T2: THC, NMHC and CH4 (ETC and ESC) – No ELR
 - T3: NMHC or THC at the same level (ETC), and THC (ESC) – smoke (ELR)

Remarks concerning the limits for T2 engines need for GFV's arbitration



- Proportionality principle

For T2 engines, HDDF suggests to apply a proportionality principle, that would be based on the actual GR of the engine, once measured on a test cycle or test route.

- This proportionality principle may be applied to both THC and CH4
- This proportionality principle may be applied to THC only. The CH4 limit would then be that defined for positive ignition engines (Maximum CH4 allowed emissions)

→ GFV arbitration is required

- Consistency with co-decision acts

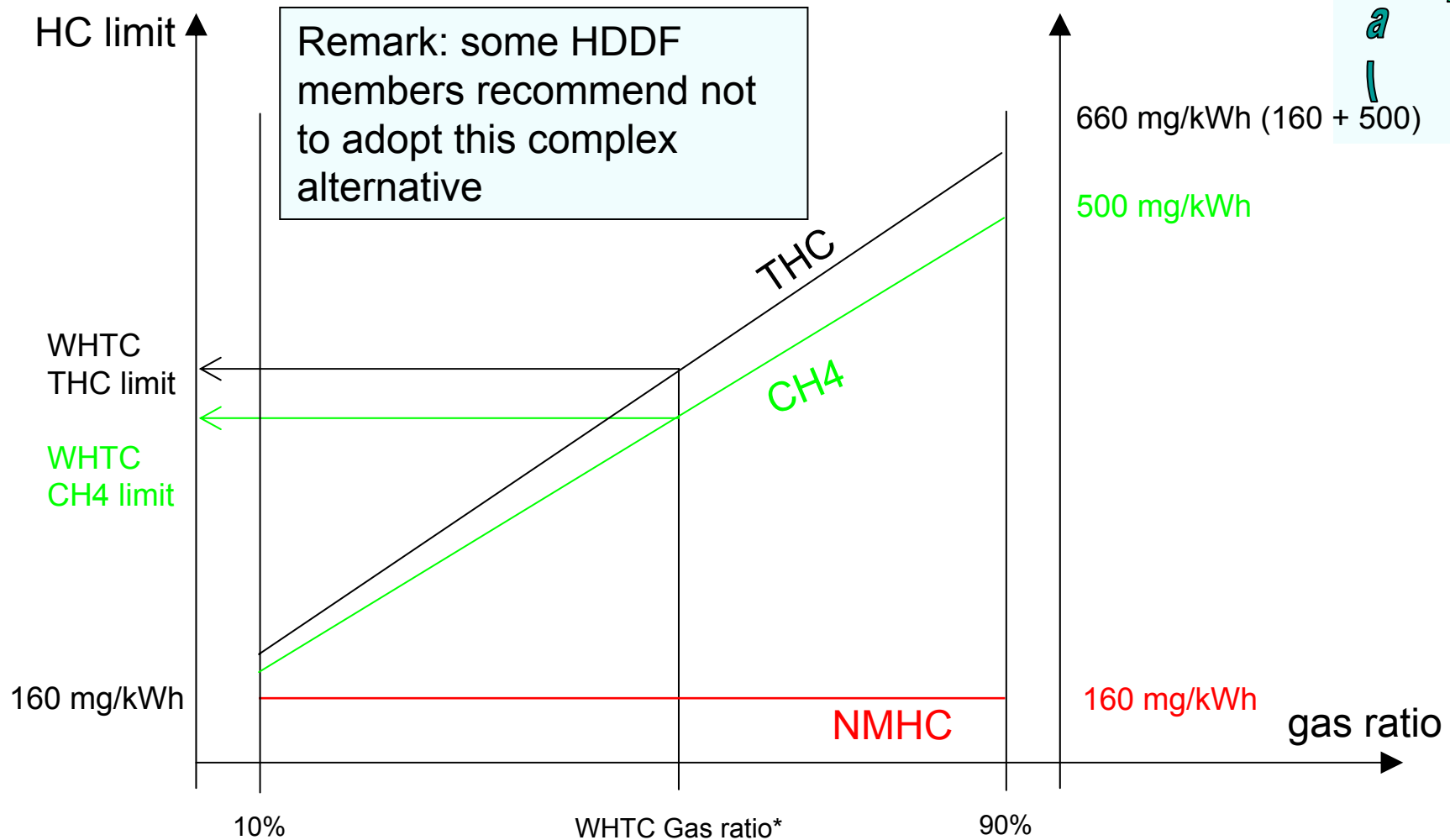
There may be an issue in expressing the limits for a pure Diesel or for a pure Gas, because it interferes with co-decision acts (e.g. no PM limit for gas engines in EURO V ESC, while such a limit is needed for T2) .

- HDDF suggests the limits be expressed by formulas build according to the proportionality principle and limited to respectively 10% and 90% Diesel fuel (energy content).

→GFV validation is required

Type 2 – 1st alternative for proportionality

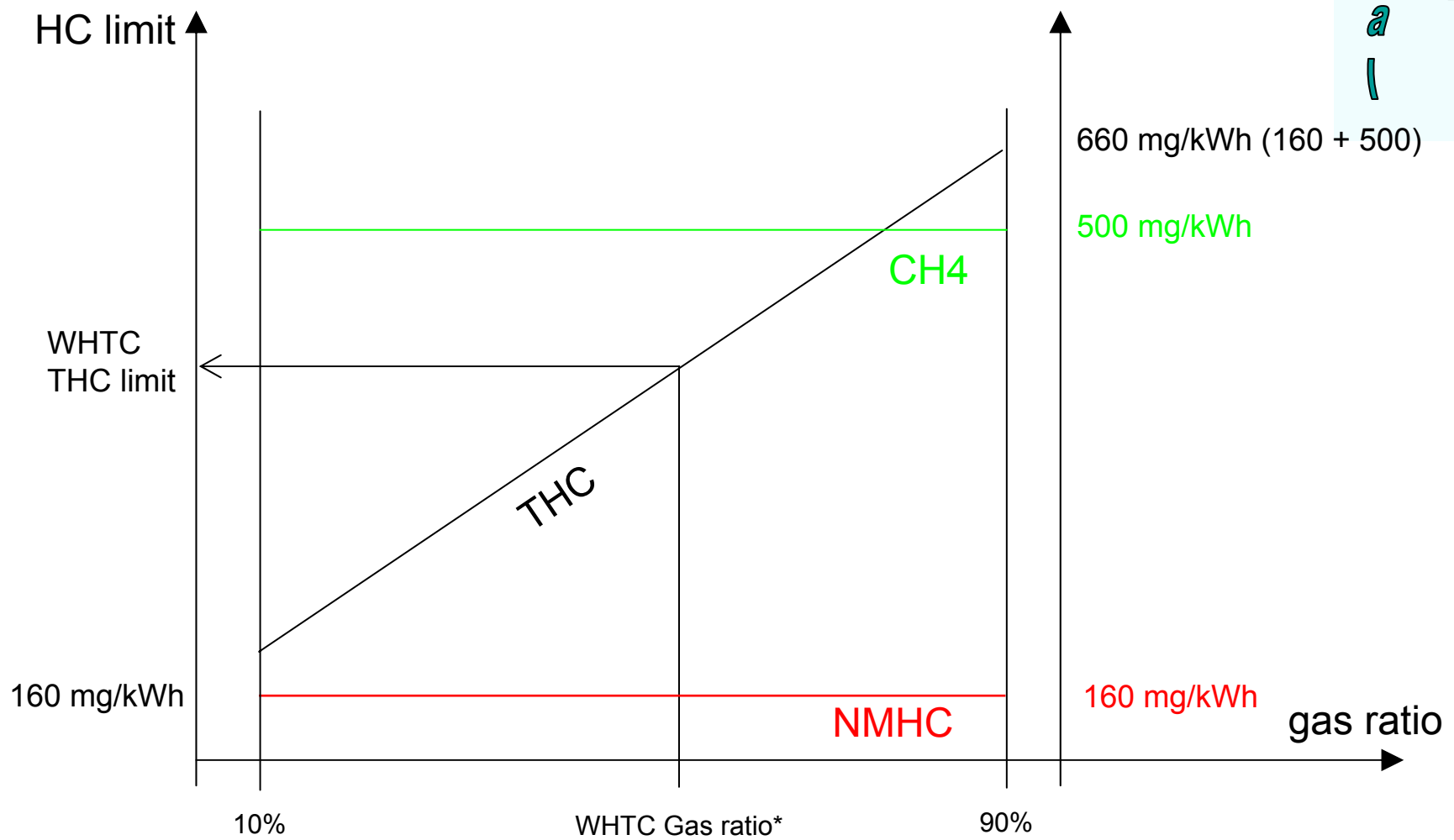
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* This value is calculated on an energy equivalent basis over the complete test cycle

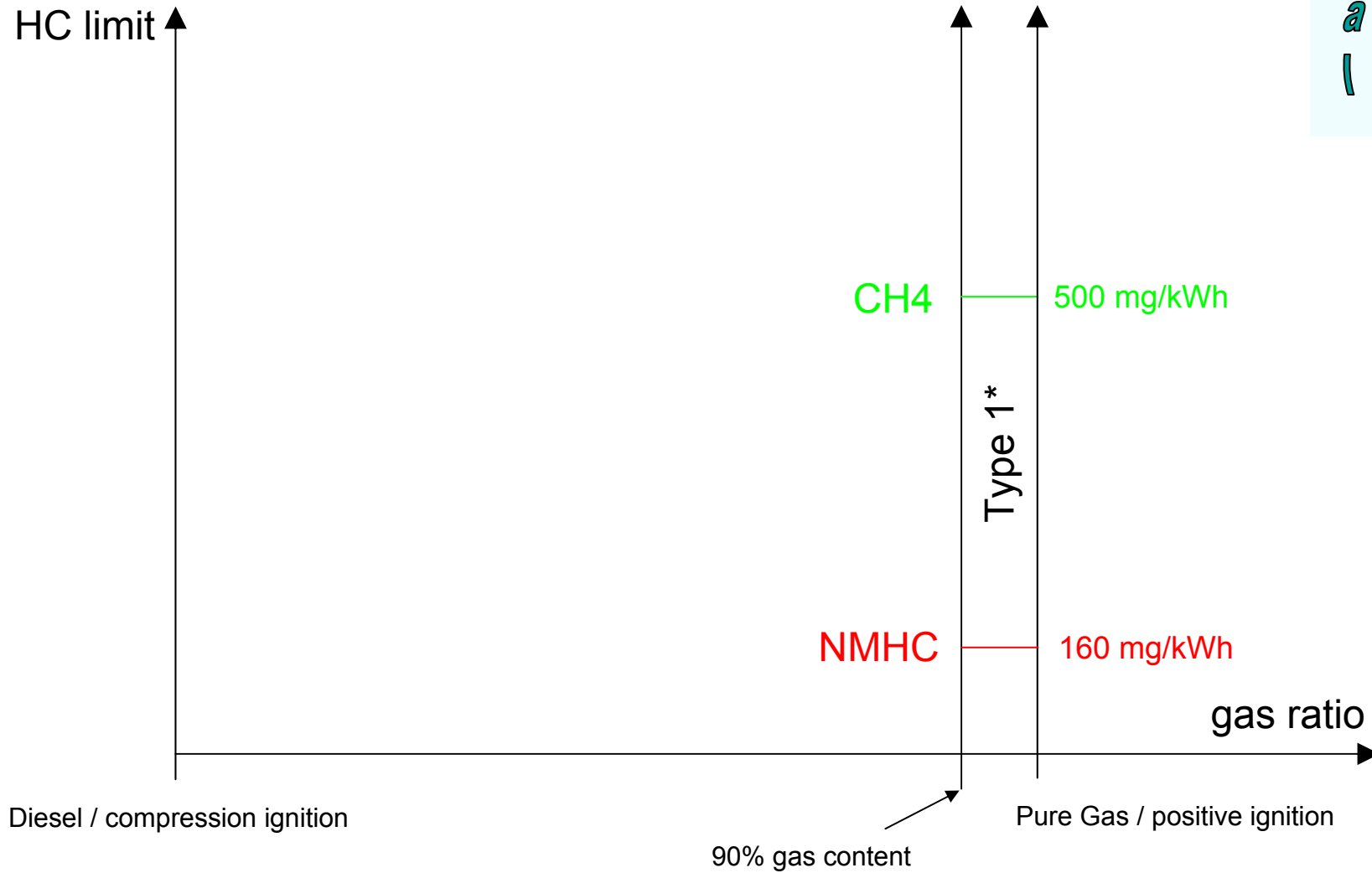
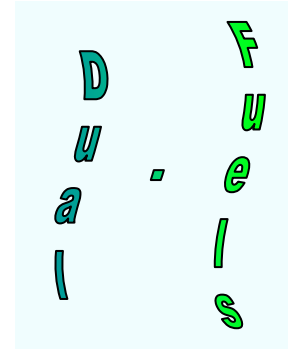
Type 2 – 2nd alternative for proportionality

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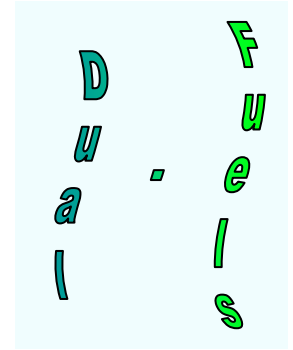


* This value is calculated on an energy equivalent basis over the complete test cycle

Type 1 – EURO VI hydrocarbon limits (WHTC)

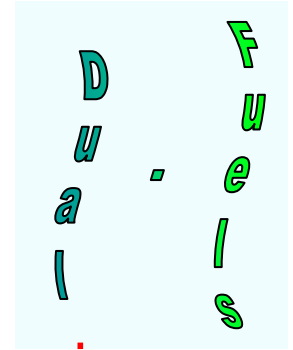


OCE – EURO VI WNTE laboratory-test



- HDDF-Type2 engines:
 - T2 engines shall be subject to the WNTE laboratory test because the OCE test is an integral part of the EURO VI certification procedure for Diesel engines.
- HDDF-type1 engines:
 - T1 engine shall not be subject to the WNTE laboratory test because that test is not mandatory for mono-fuel gas engines (No WHSC limit).

T2 – Certification tests GFV arbitration needed



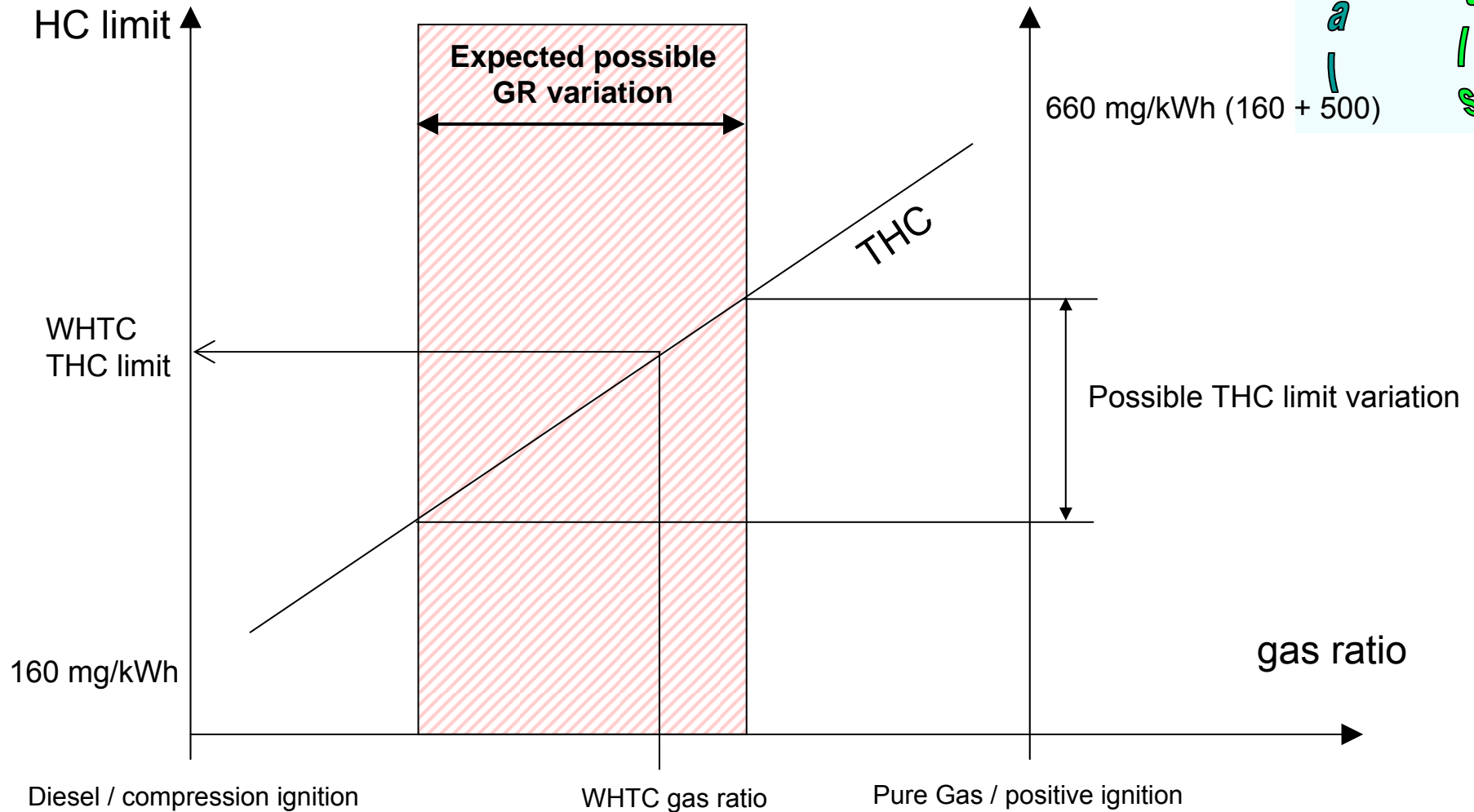
Due to the possibility for HDDF-type2 to present a continuously changing gas ratio in real road operation, is the WHTC test-cycle sufficient to secure the design conformity, having in mind there will be specific ISC rules ?

- It was suggested by some HDDF experts to perform 2 additional "PEMS tests" at certification.
- It was suggested by some other HDDF experts not to perform such tests,
 - in order to avoid unnecessary burden at certification.
 - because of the real difficulty to find appropriate routes to perform the tests
- It may be suggested to perform one single "standard" HDDF PEMS test

* TOR test would mean (Type-approval On-Road) test

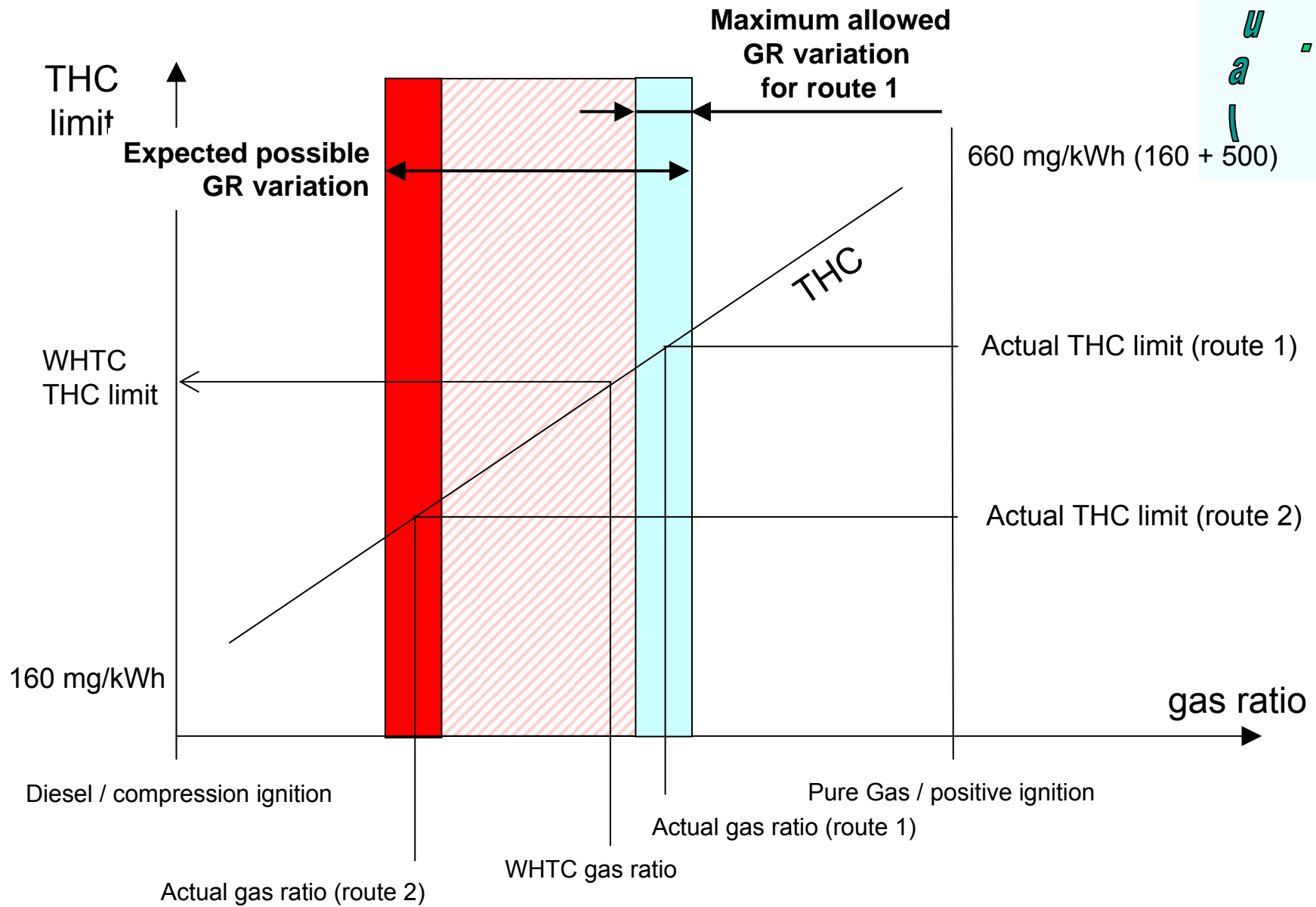
Type 2 – Possible GR variations on the road

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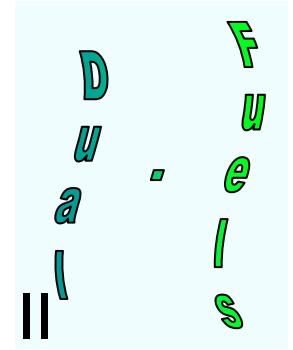


Type 2 – Certif step2 (selection of 2 additional test routes)

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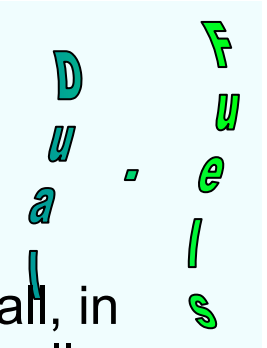


Type2: draft ISC testing



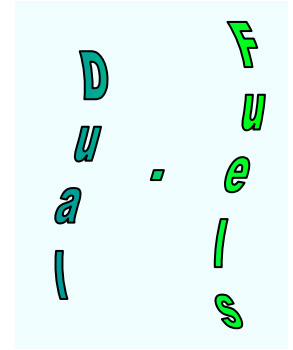
- Route and vehicle are selected according to Annex II
- The actual gas ratio on that route is calculated
 - The CF is calculated (CF_{act}) from the actual HC limit for that route (resulting from the proportionality principle)
- Pass if
 - $CF_{act} \leq 1.5$, and
 - The actual gas ratio is within the declared possible gas ratios for that engine
- ISC Statistics as defined for Diesel

The cases where the engine may also operate as mono-fuelled engine (e.g. as a diesel engine)



- GRPE agreed on the principle that those engines / vehicles shall, in addition to the new DF specific requirements be compliant with all the requirements applicable to the Diesel engines / vehicles when operating in a pure Diesel mode
 - Type 1+ or type 2+ HDDF engines shall be defined as respectively Type 1 and Type 2 HDDF engines having in addition a certified pure Diesel mode
- Limp-home strategies – operability restrictions (e.g. vehicle speed) GRPE also agreed that the limp-homes strategies may constitute an exception to the above rule, provided a mobility restriction is then applied.
 - A 2-step mobility restriction is introduced at respectively 70 and 20 km/h
 - The 20km/h restriction is introduced after 8hrs at 70km/h
 - Rules of Annex XIII shall be adapted
 - Warning shall be introduced as well as MI illumination and OBD fault recording

Concerned fuels – priorities



- The "universal fuel type-approval" issue
- The complex "gas fuel type-approval issue"
- Bio-diesel (with a high FAME content) / gas DF engines and DF engines using gaseous fuel with a high level of inert gases could be considered dependent of the developments in Euro VI.

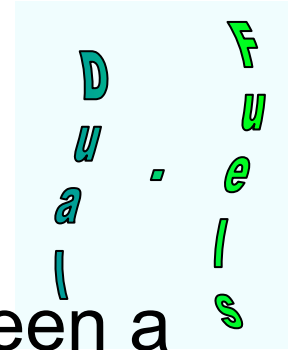
Concerned fuels (priorities)



	CH4 (G ₂₀)	L Range	H Range	HL Range	Manuf. Range	LPG A	LPG B	LPG A+B
Regular Diesel	1	2	2	3	3	1	1	2
Extended Bio- diesel	2	3	3	3	3	2	2	3

1= low hanging fruit
 2= normal priority
 3= lower priority

Fuels – work to be done (proposal)



- Take into account that for LPG, there has been a change between EURO V and EURO VI
- CH₄ (and/or bio-methane, to be confirmed)
 - G20 should be introduced into the reference fuels list in accordance with the LDV Regulation (EC) 692/2008
 - There is a need to introduce for HDDF engines the possibility of having methane (and/or bio-methane, to be confirmed) as "single" gas-fuel in case of e.g. LNG in addition to the current ranges of gases (H, L, or HL ranges)