Status of the HDDF retrofit regulation

GFV Jun 8th 2015

Geneva

Overview

A new regulation will include the requirements for the type approval of **retrofit systems** intended to be fitted on a heavy duty diesel vehicle to enable its operation either in diesel mode or in dual-fuel mode.

Only Euro IV, Euro V and EEV vehicles will be included in the first release of the regulation.

The principles of the new regulation are still under discussion.

Issues to be considered

- Regulation for type approval of **systems** for retrofitting diesel vehicles to dual fuel operation, but it references to R49: type approval of **engines**
- Tension between retrofit conversion effort/costs and environmental impact/benefit
- Level playing field for both retrofit system manufacturers and engine/vehicle manufacturers
- Euro IV, V and EEV diesel engines have limited diagnostic functionality and no NO_X closed loop control (difference with R115 for LDV's)

Complete and engine retrofit systems (1)

From a business stand-point, there is a certain interest in having the possibility to type approve the part of the retrofit system to be fitted on the engine separately from the other system components.

Companies designing and manufacturing an engine retrofit system may not always be able to design and manufacture the complete retrofit system for each vehicle and each vehicle market.

Other companies may wish to complete an approved engine retrofit system by adding additional components specific for a vehicle or market.

Complete and engine retrofit systems (2)

From a legal standpoint it is important that a single manufacturer assumes responsibility for the emissions performance of the complete retrofit system.

To address this issue the introduction of a concept of engine and complete retrofit systems has been investigated.

Interface requirements and tests are being established.

Principles

- Type Approval process
- Emission Tests: Engine test and simplified test
- Methane emissions
- Safety

Type Approval process

- UNECE
  - Engine Retrofit System
  - Complete system
  - Extensions and actual applications

- National
  - Vehicle inspection after retrofit

Retrofit system family

“retrofit system family” means a manufacturer’s grouping of retrofit systems which through their design, as defined in this Regulation, have similar retrofitting characteristics

The approval will be considered valid for all the members of the retrofit system family.

Identification of the criteria defining the retrofit system family is under development.

Application range

"application range" means a grouping of engines to which the retrofit system is approved to be applied.

During the initial type approval, the manufacturer submits to tests one retrofit system (parent retrofit system) installed on a demonstration engine and a demonstration vehicle equipped with the same engine and retrofit system.

The initial application range of the retrofit system is the "R49" engine family of the demonstration engine.

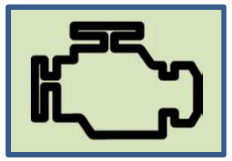
The application range may be extended to include other engines (or other engine families) by means of a formal extension of the initial type approval.

Actual applications

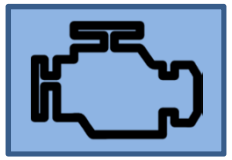
"Actual applications" means type approved or notified retrofit systems (fulfilling all emission and other requirements)

- During the application of a retrofit system, the manufacturer applies the retrofit system to a vehicle.
- Calibration is the task of the retrofit system manufacturer.
- The retrofit system manufacturer shall inform the Type Approval Authority that a specific system is marketed for a certain Application Range member.
- An installation manual comprising a list of components including calibration-id and a declaration of compliance should then be submitted to the Type Approval Authority.
- For changes not defining the system the Approval Authority will be notified. Other changes → new TA (or extension t.b.d.)

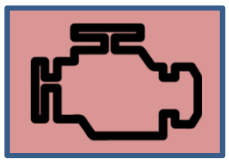
Explanation of the symbols



Engine OEM 1



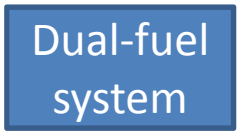
Engine OEM 2



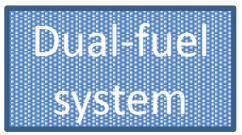
Engine OEM 3

SCR engine/vehicle

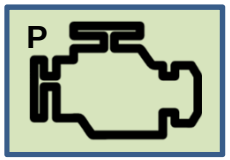
EGR engine/vehicle



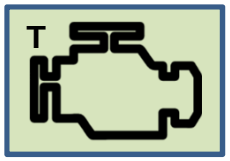
Parent retrofit system



Retrofit system family member



Parent engine



Test engine

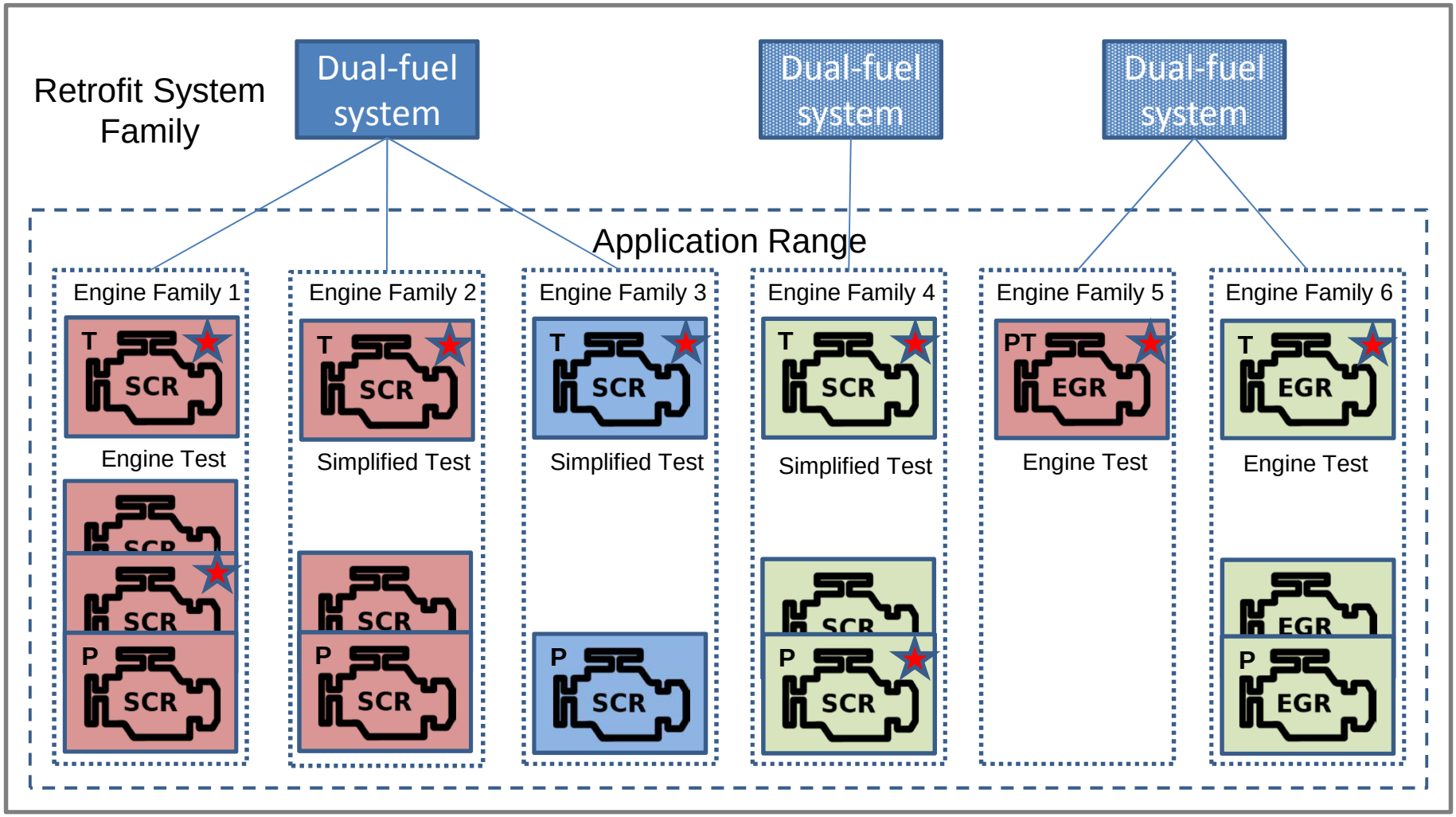
OEM engine family

Application Range

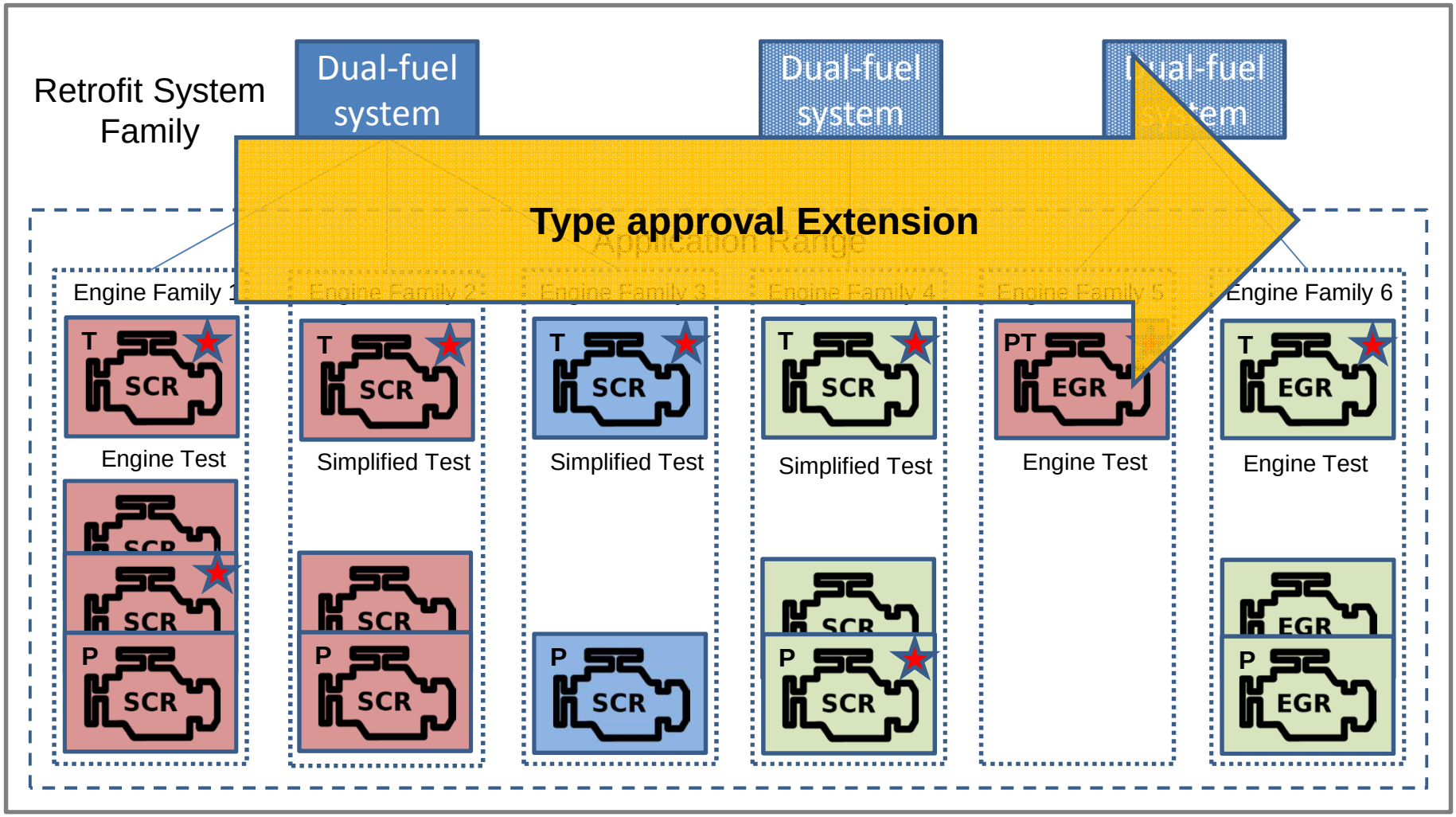
Type Approval

Actual Application

System Family, AR and Actual Applications



System Family, AR and Actual Applications



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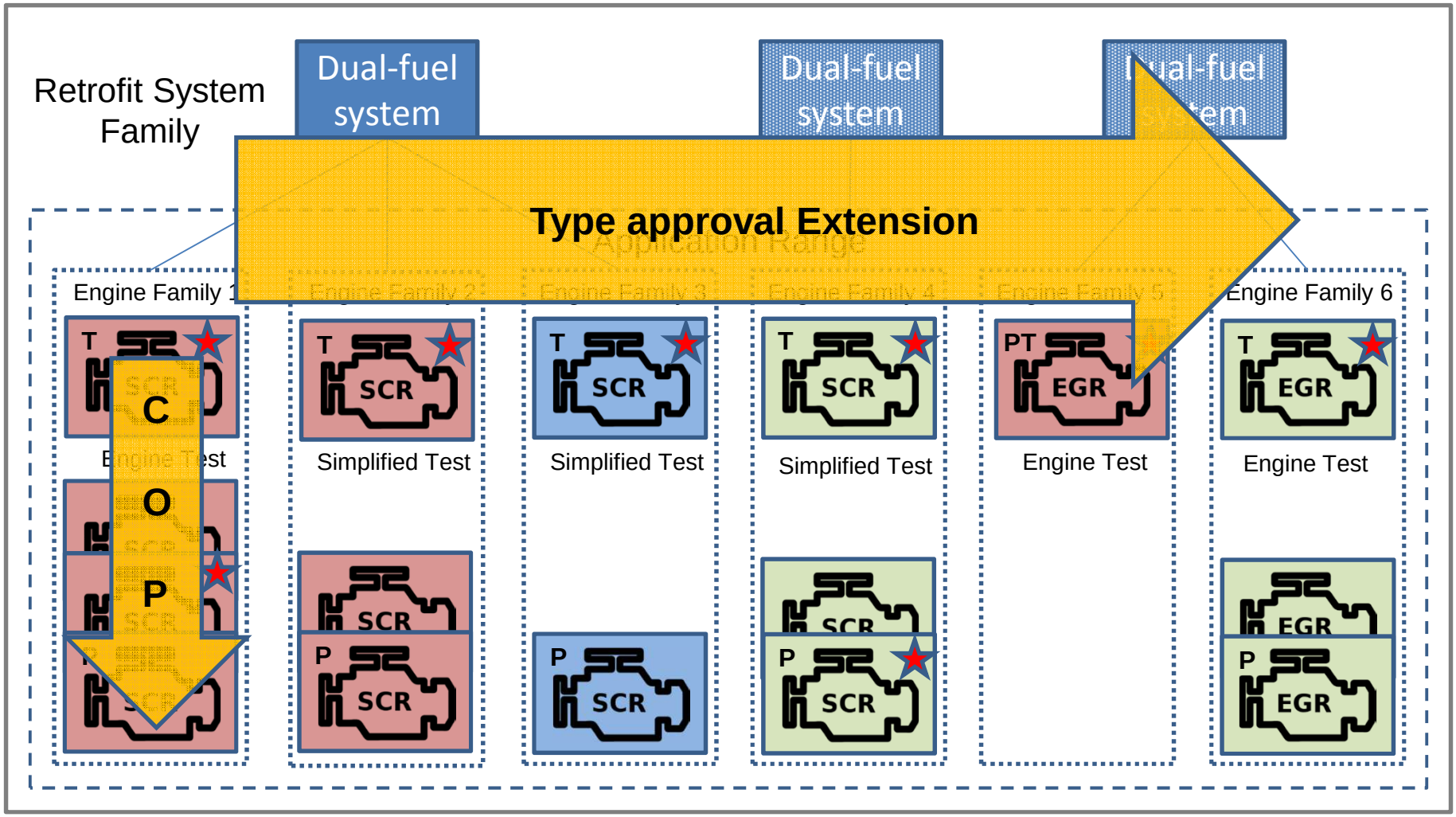

Vehicle certification / Vehicle approval after the retrofit conversion

The (re-)certification of a retrofitted vehicle including all the quality requirements should be handled in national and/or CP legislation

- The check that the Vehicle Retrofit System is approved for the engine/vehicle combination and is installed in line with the installation manual
- Safety check of the conversion in line with R67 and R110 (including check of the used components)
- Specific attention for the installation of the cylinders and the safety devices.

Principles

- ✓ Type Approval process
- Emission Tests: Engine test and simplified test
- Methane emissions
- Safety

Emission Tests

- Emission Tests:
  - Initial Type Approval: Engine test
  - Type Approval extension: Simplified test

Emission tests
Type-approval extension

For a type approval extension, the emissions may be measured with a (retrofit specific) test procedure using a Portable Emission Measurement System mounted on a vehicle equipped with the retrofit system.

Back-to-back comparison between a test in diesel mode and a test in dual-fuel mode.

Details of this simplified test method still to be developed and verified.

Principles

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Emission Tests

CH_4 emissions (1)

CH_4 emission is a real issue for diesel - CNG/LNG dual fuel retrofit systems.

Constraint

Maintain the desired level of environmental performance after retrofit

- No compromise on health affecting pollution
- No compromise on green-house gas emission

Emission Tests

CH_4 emissions (2)

Difficulties

- To keep a balance between feasibility and complexity of the retrofit systems in order to permit the diffusion of the retrofit technology.
  - Example: Forcing the implementation of a CH_4 catalyst is generally considered as not economically viable on used vehicles (conversion of a GHG to another less reactive GHG at high costs and no guarantee on durability).

- Not to create an R49 “bypass” based on different limits.
  - Example: A retrofit-specific CH_4 limit could be detrimental for R49 approved dual fuel engines

- Not to introduce precedents concerning possible GHG limits.

Engine emission tests

Dual-fuel mode requirements (under development)

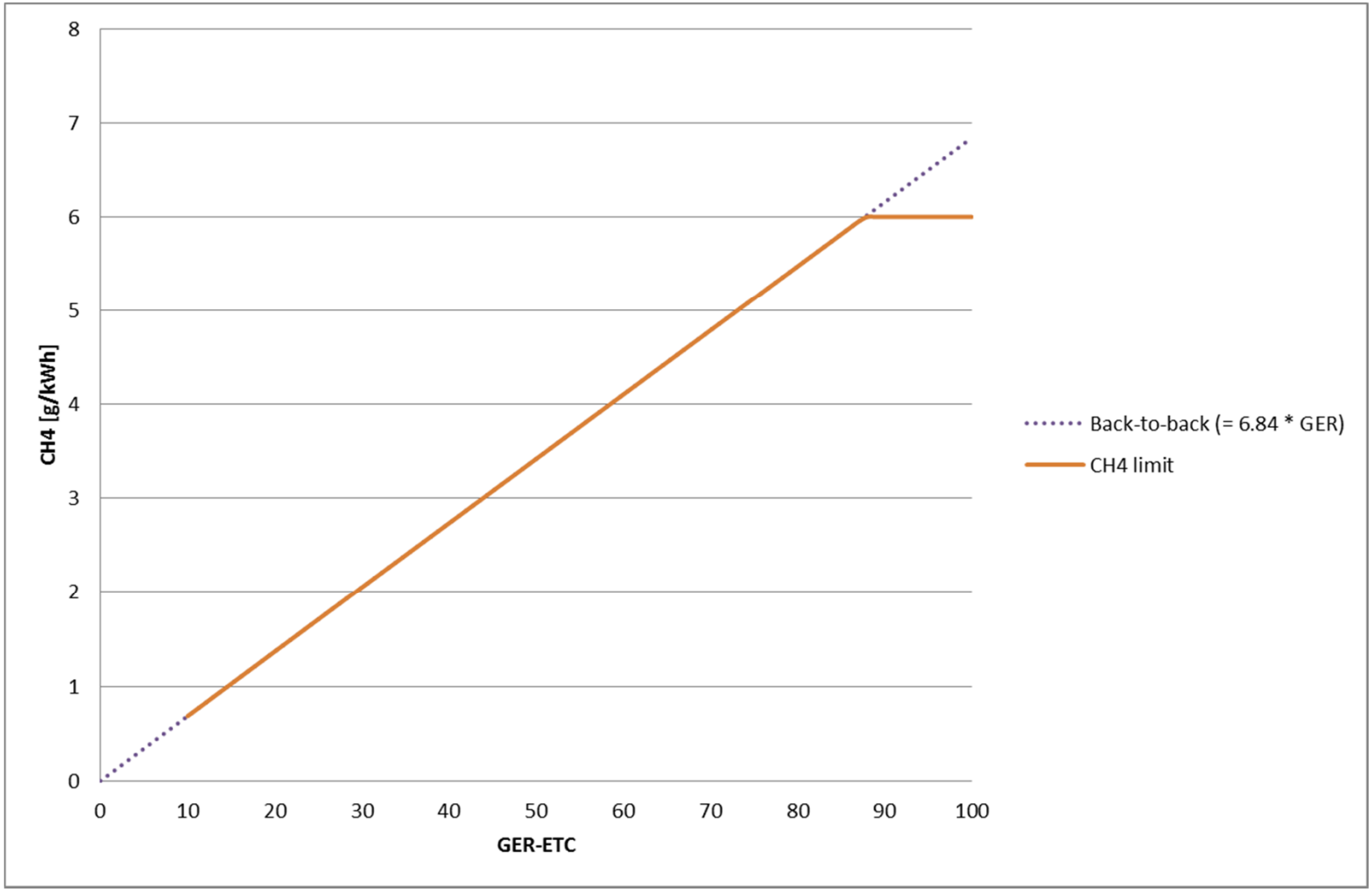
The manufacturer of the retrofit system could choose between two options:

- OPTION 1 *(Possibility to claim CO_2 reduction)*
  - All emission limits for dual-fuel mode as specified in the applicable R49 series of amendments apply

- OPTION 2
  - The NO_X, NMHC, PM and CO emission limits for dual-fuel mode as specified in the applicable R49 series of amendments apply;
  - The CH_4 emissions shall not exceed the following GER dependent CH_4 limit:

$$CH_4 \leq 6.84 * GER/100 \quad \text{AND} \quad CH_4 \leq 6 \qquad \text{[g/kWh]}$$

Methane emission limit vs. GER



R49 Dual-fuel mode requirements

It is proposed to amend the 05 series of amendments to R49 to align the CH_4 emission requirements for OEMs and Retrofit System Manufacturers when the retrofit dual-fuel regulation will be submitted to GRPE

Reconsider?

Principles

- ✓ Type Approval process
- ✓ Emission Tests: Engine test and simplified test
- ✓ Methane emissions
- Safety

Safety

- OEM concerns regarding possible torque differences between diesel and dual-fuel operation (physical and/or CAN parameters)
- Possible solution (torque test) in development

Next steps and time schedule

Many topics still need more investigation and discussion. Drafting has already started and will be continued.

Monthly f2f- and weekly web-meetings are scheduled.

GFV have the following targets in order to complete the task:

- An informal document enabling type approval of **Engine** Retrofit Systems will be submitted to the next GRPE (January 2016)
- An informal document enabling type approval of **Complete** Retrofit Systems will be submitted to the June 2016 GRPE
- A formal document for the complete regulation will be submitted for the January 2017 GRPE

Retrofit Heavy Duty Dual Fuel

Thank You