

NL Dual-Fuel Test Program

Information and Update

3 December 2013

Dual Fuel Test Program Test setup

Experience with three test setups:

- Engine test stand
- Simulation of ETC and ESC cycles on a vehicle/powertrain test stand
- Road data with PEMS

All three setups were used in the Dutch Dual Fuel Test Program

Fuel

- Market fuel or reference fuel?

Both types are allowed for the Dutch DF program

- Fuel consumption measurement of the two fuels is required.

Difficult for PEMS and LNG systems.

In the program these aren't measured because of several reasons (practical, availability, influence on the gas supply system)

Emission Sampling

Issue is the fluctuating fuel composition

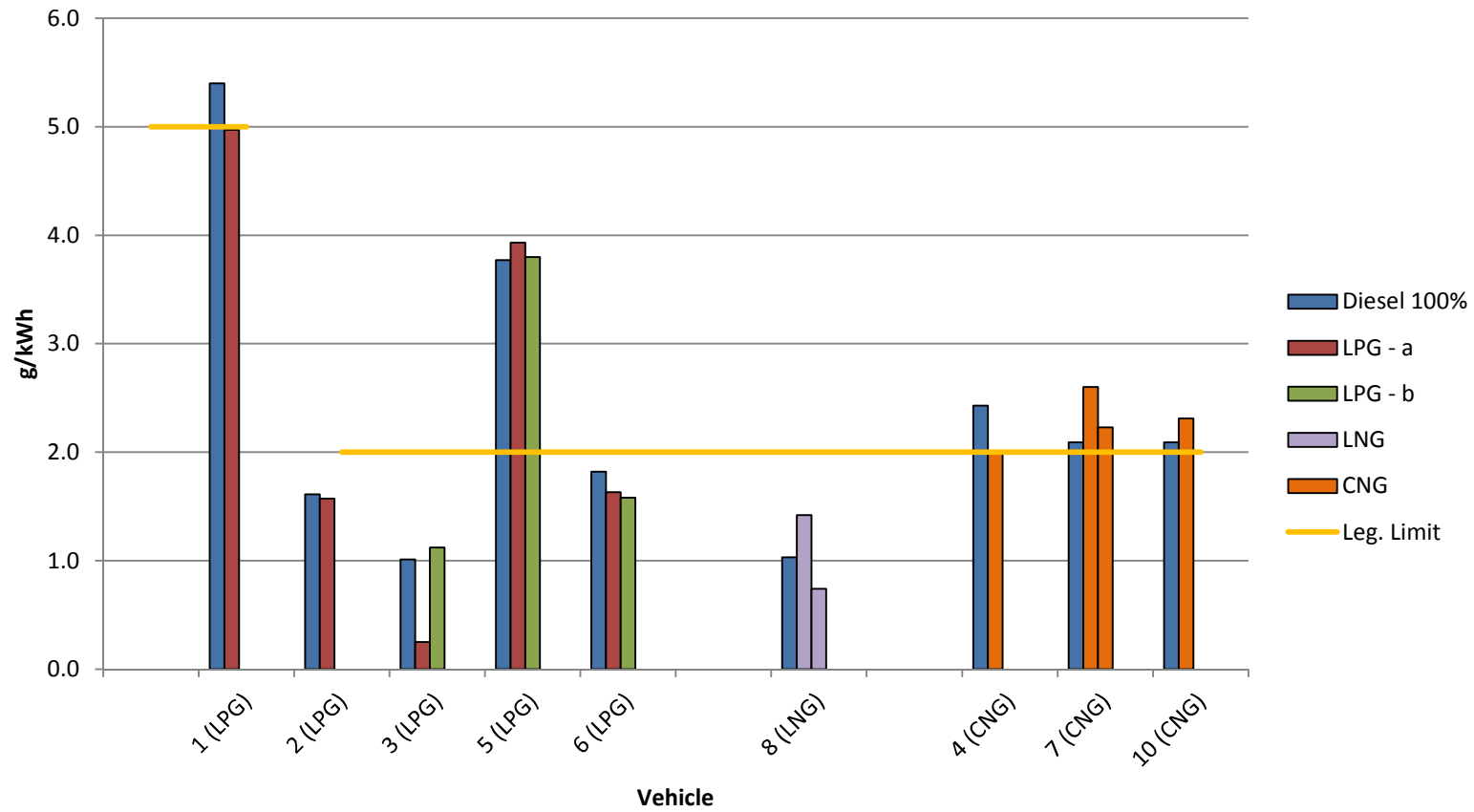
Matters to take in account:

- Fuel flow measurement of the two fuels is required
- Wet/dry correction of the emissions

Solved in R49r06

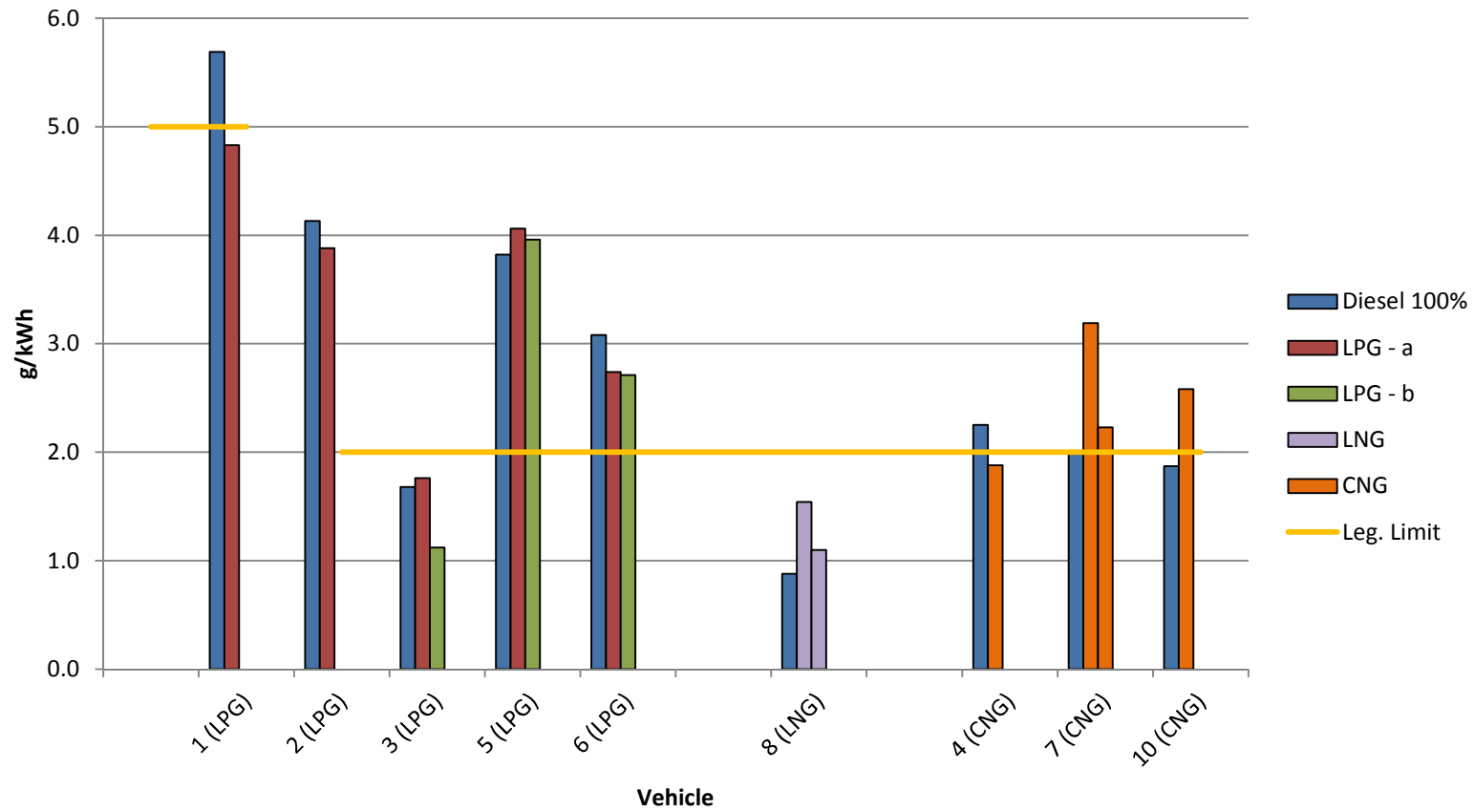
Test bench Results

NOx - ETC cycle



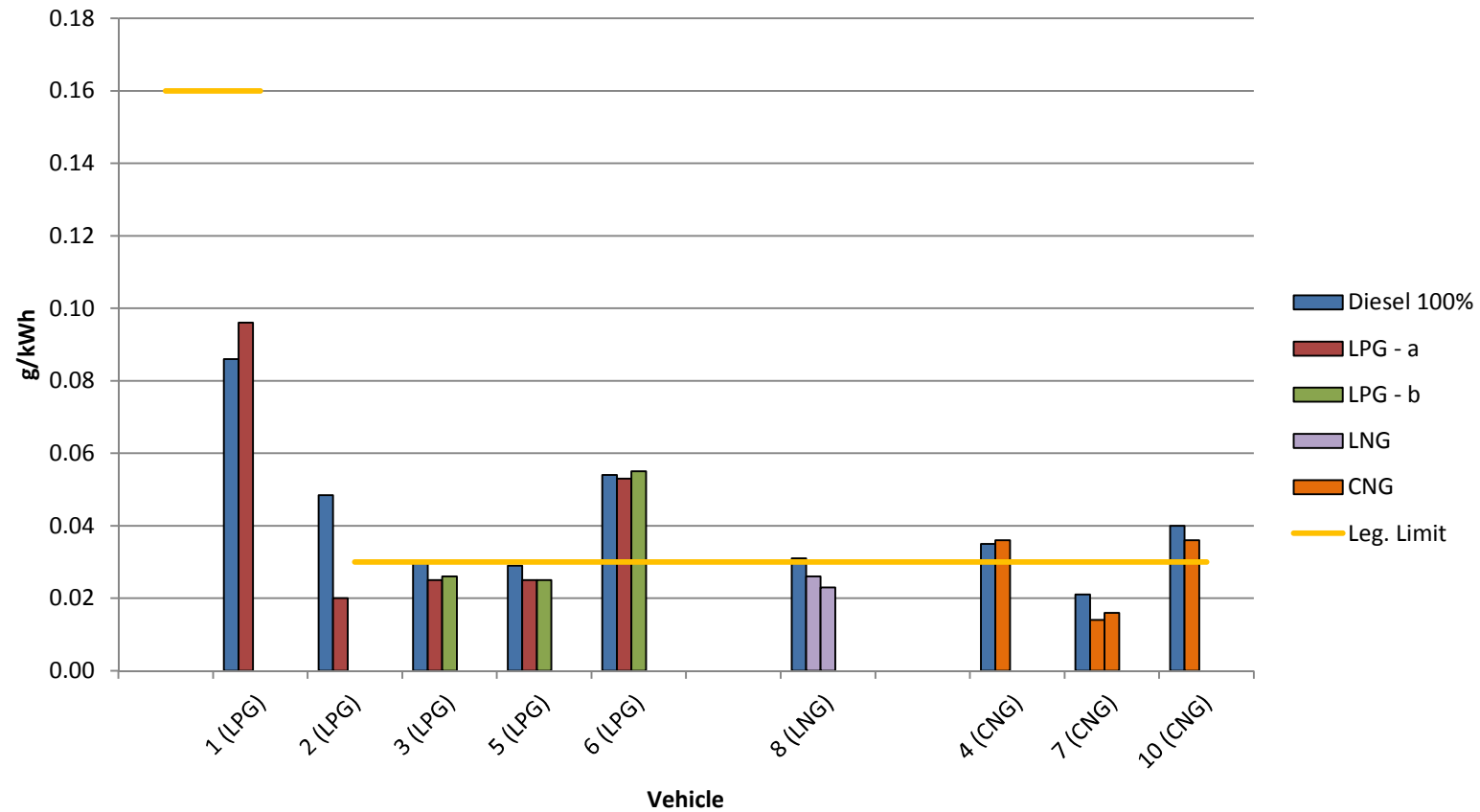
Test bench Results

NOx - ESC cycle



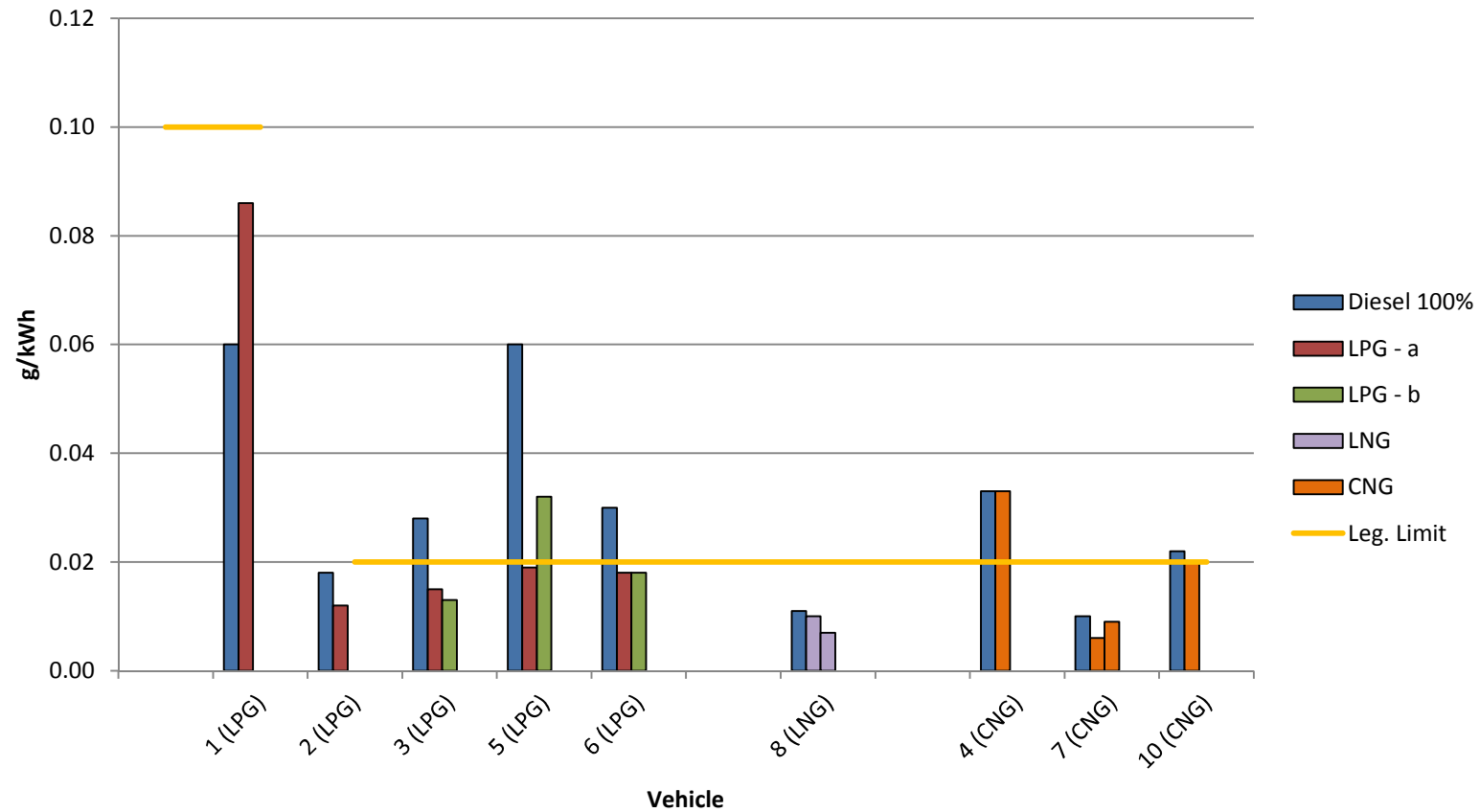
Test bench Results

PM - ETC cycle



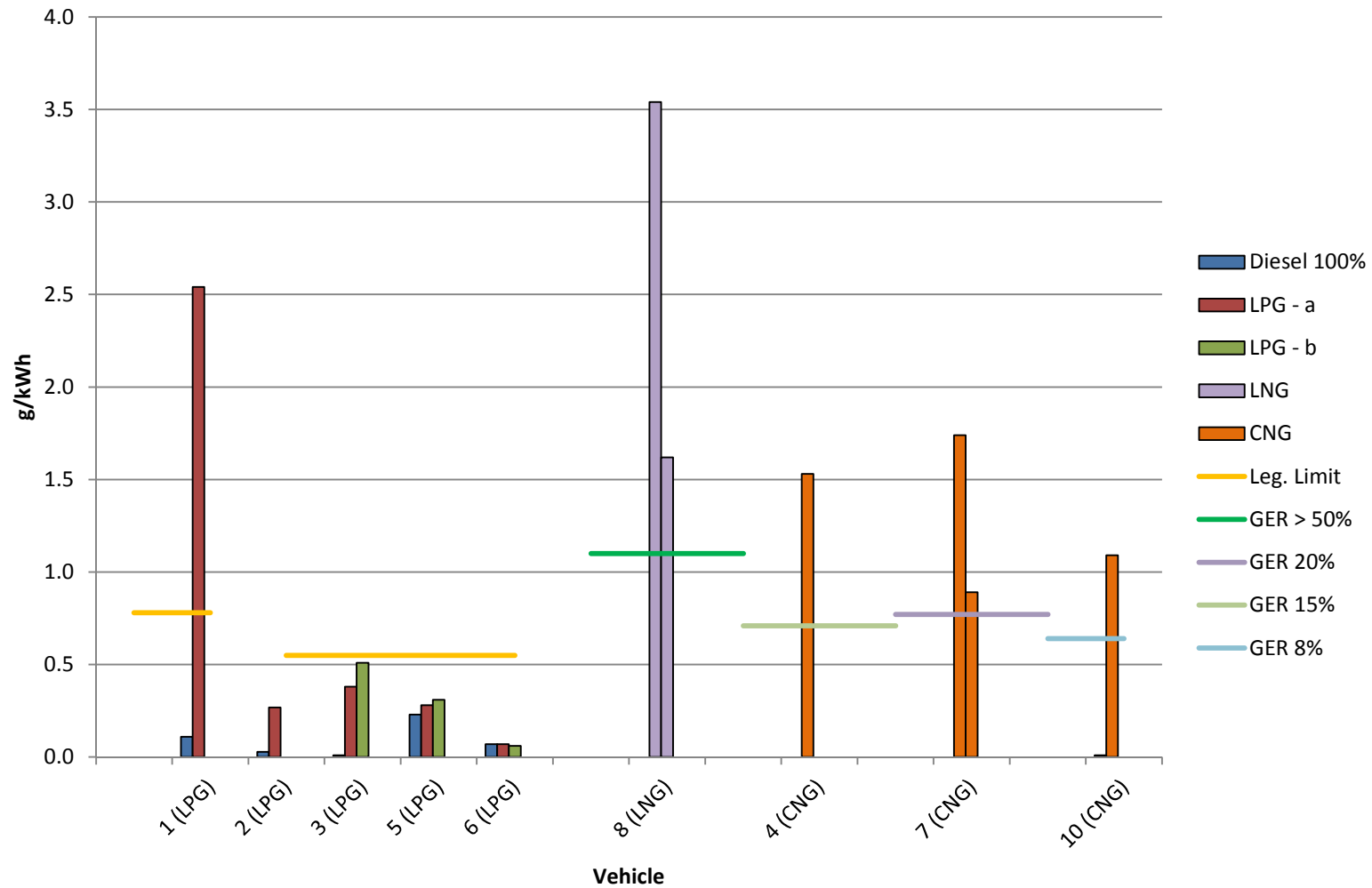
Test bench Results

PM - ESC cycle



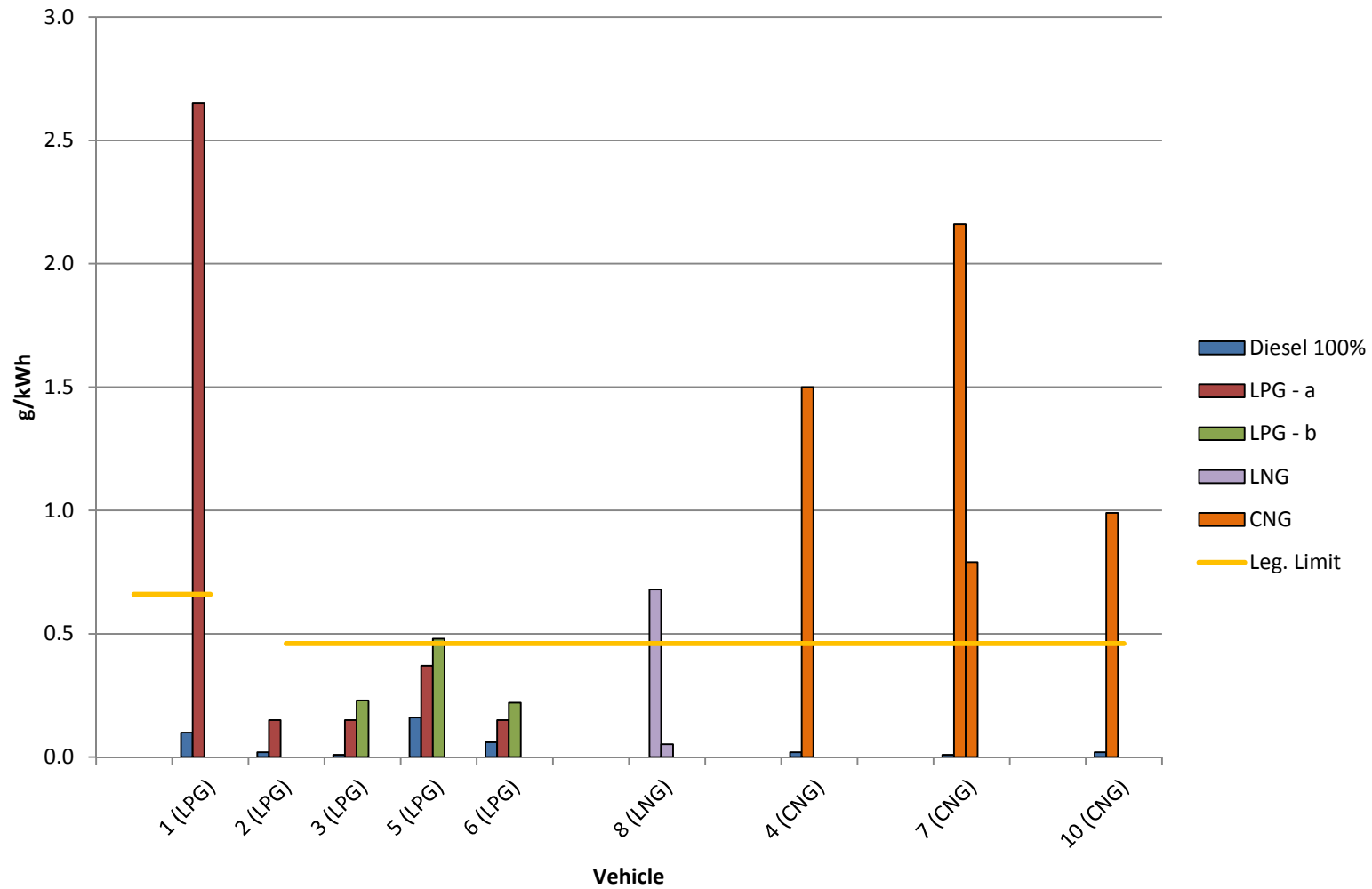
Test bench Results

HC - ETC cycle



Test bench Results

HC - ESC cycle



Results

- Only type 2B engines/vehicles tested
- NO_x emissions on diesel often (too) high
- CNG HC emissions above the limit
- LPG HC emissions within limits
- No CO₂ (GHG) benefit observed
- Difference between measured and claimed diesel replacement

Findings and issues

- Most data from engines with SCR technology.
- Poor results from several EGR engines.
- GER of retrofit systems was usually much lower than specified.
- With DF technology it is possible to meet EURO V emission levels in the type approval cycles.
Real life emissions are unknown.
CH₄ problematic.

Findings and issues

- GHG benefit was negligible for both NG as well as LPG.
- So far no OBD failures found while using dual-fuel.
- Lifetime effects unknown. Durability?
- In use emission data is unknown. Also the effect of different ambient conditions (humidity, temperature, altitude).

Findings and issues

- Used vehicles have sometimes high mileage (400.000 kilometers). The diesel emission may be above the emission limit. How to handle in that case the dual fuel emission result?
- It may be advantageous to require an additional test (WHTC for Emissions and GER). This is already a requirement in China (Beijing) for Euro V TA.
- Family concept and choice of parent engine. What will be the effect on emissions at different power ratings in the same engine family?

Findings and issues

- How to ensure that the software and calibration delivered are the ones used at approval?
- Retrofit approval possibilities:
 - system - probably not possible:
not closed-loop
 - family - software and calibration issues
 - individual - SEMS?
- Combination of those?

Findings and issues

- ISC or IUC for retrofit?
- Real Driving Emissions?
- R67 and R110 tank mounting requirements for HD use needs attention