

# **Test Results on Effects of Fuel Specification**

**Presentation Japan for 26th WHDC Meeting**

# Test Condition

- Location
  - Test cell @NTSEL Proving ground
- Fuel
  - EU and US fuels
- Test mode
  - WHTC
  - (Cold + 5 minutes soak + 5 minutes soak )\*2
  - (Cold + 10 minutes soak + 10 minutes soak )\*2
  - (Cold + 20 minutes soak w/cal.+ 20 minutes soak w/o cal.)\*3
- Emissions
  - NO<sub>x</sub>, PM, NMHC, CO, CO<sub>2</sub>

# Test Engine

## WHTC Bench Test Results of New Type of Engine meeting JPN '05 regulation (Low emission version\*)

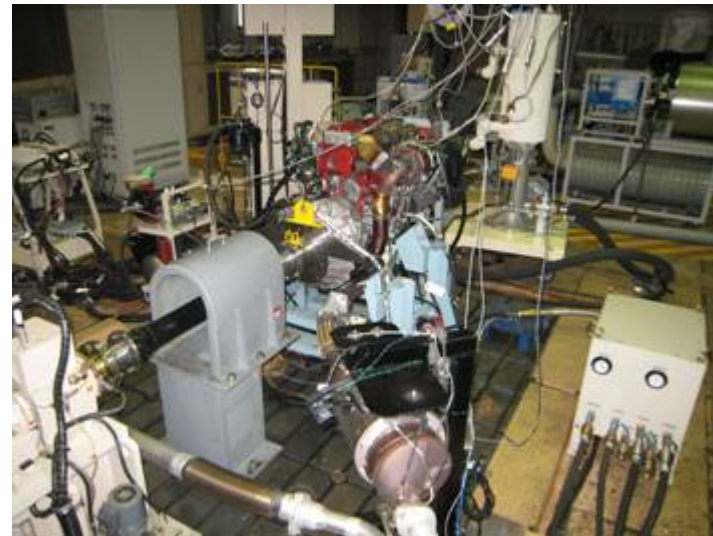
### Engine Specifications

|                          |  |
|--------------------------|--|
| Type                     | 4-cylinder Intercooler-turbo diesel engine |
| Injection system         | Common-rail                                |
| Emission control devices | Cooled EGR<br>DPF + NSR Catalyst           |
| Bore*stroke (mm)         | 104*118                                    |
| Displacement (L)         | 4,009                                      |
| Compression ratio        | 18.0                                       |
| Max. power               | 110kW (150PS)<br>/ 3,000rpm                |
| Max. torque              | 392N·m (40.0kg·m)<br>/ 1,600rpm            |

### JPN '05 regulation

| Components      | Level (g/kWh) |
|-----------------|---------------|
| CO              | 2.22          |
| NMHC            | 0.17          |
| NO <sub>x</sub> | 2.0           |
| PM              | 0.027         |

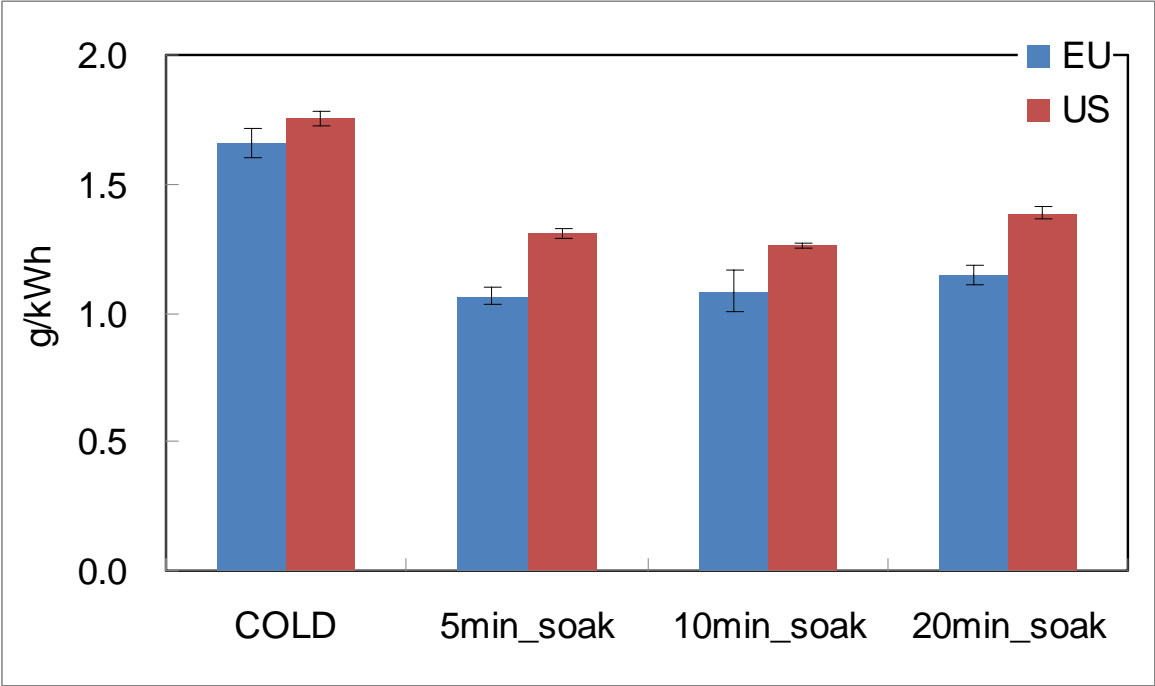
(\*Low emission version: NO<sub>x</sub>=1.8, PM=0.024)



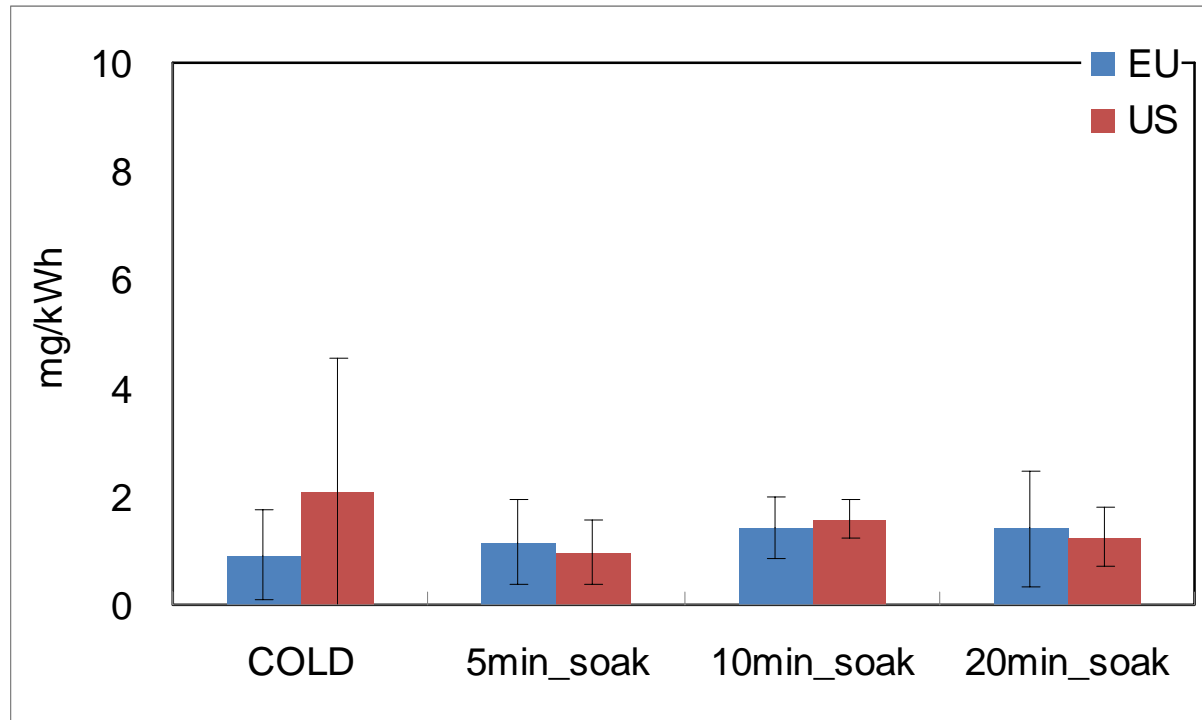
# Fuel Specification

|                       |                    | EU     |             |               | US     |             |             |
|-----------------------|--------------------|--------|-------------|---------------|--------|-------------|-------------|
| Cetane Number         |                    | 52.9   | 52-54       | ISO 5165      | 47.8   | 45-50       | ASTM D613   |
| Cetane Index          |                    | ---    |             |               | 49.3   | 40-50       | ASTM D976   |
| Density (15deg.C)     | kg/m <sup>3</sup>  | 833.6  | 833-837     | ISO 3675      | 847.2  | 839.8-864.6 | ASTM D4052  |
| Viscosity (40deg.C)   | mm <sup>2</sup> /s | 2.930  | 2.300-3.300 | ISO 3104      | 2.659  | 2.000-3.200 | ASTM D445   |
| Distillation<br>deg.C | IBP                | 204.0  |             | ISO 3405      | 195.4  | 171.1-204.4 | ASTM D86    |
|                       | 10%                | 233.7  |             |               | 228.9  | 204.4-237.8 |             |
|                       | 50%                | 275.3  | 245-        |               | 272.3  | 243.3-282.2 |             |
|                       | 90%                | 322.3  |             |               | 310.7  | 293.9-332.2 |             |
|                       | 95%                | 348.4  | 345-350     |               | ---    |             |             |
|                       | FEP                | 357.7  | -370        |               | 333.3  | 321.1-365.6 |             |
| Flash Point           | °C                 | 88     | 55-         | ISO 2719      | 83     | 54-         | ISO 2719    |
| Sulfur                | massppm            | 1.6    | -10         | ASTM D5453    | 10.3   | 7.0-15.0    | ISO 20846   |
| Total Aromatics       | vol%               | 23.4   |             | IP 391        | 31.3   | 27.0-       | EN 12916    |
| CH                    | C                  | 86.35  |             | ASTM D3343    | 86.82  |             | ASTM D3343  |
|                       | mass% H            | 13.65  |             |               | 13.18  |             |             |
| H:C Ratio             | (C=1)              | 0.158  |             |               | 0.152  |             |             |
| Net Heating Value     | MJ/kg              | 43.199 |             | ASTM D3338    | 42.930 |             | ASTM D3338  |
| HFRR (WS1.4)          | µm                 | 207    | -400        | CEC-F-06-A-96 | 551    |             | ISO 12156-1 |

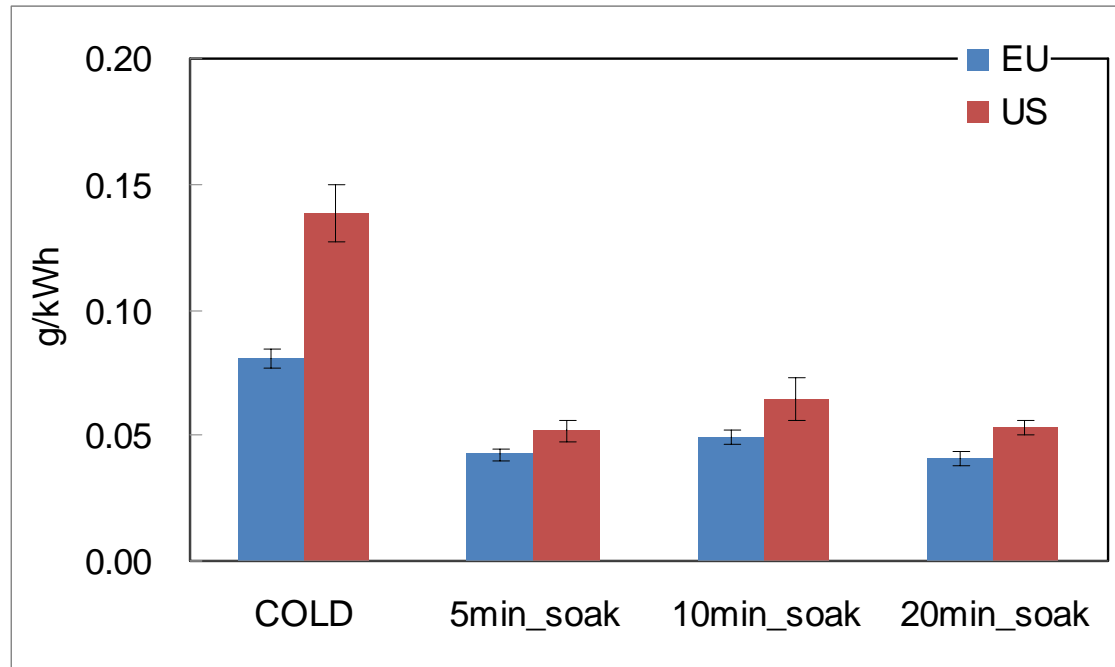
# Effects of Fuel (NOx)



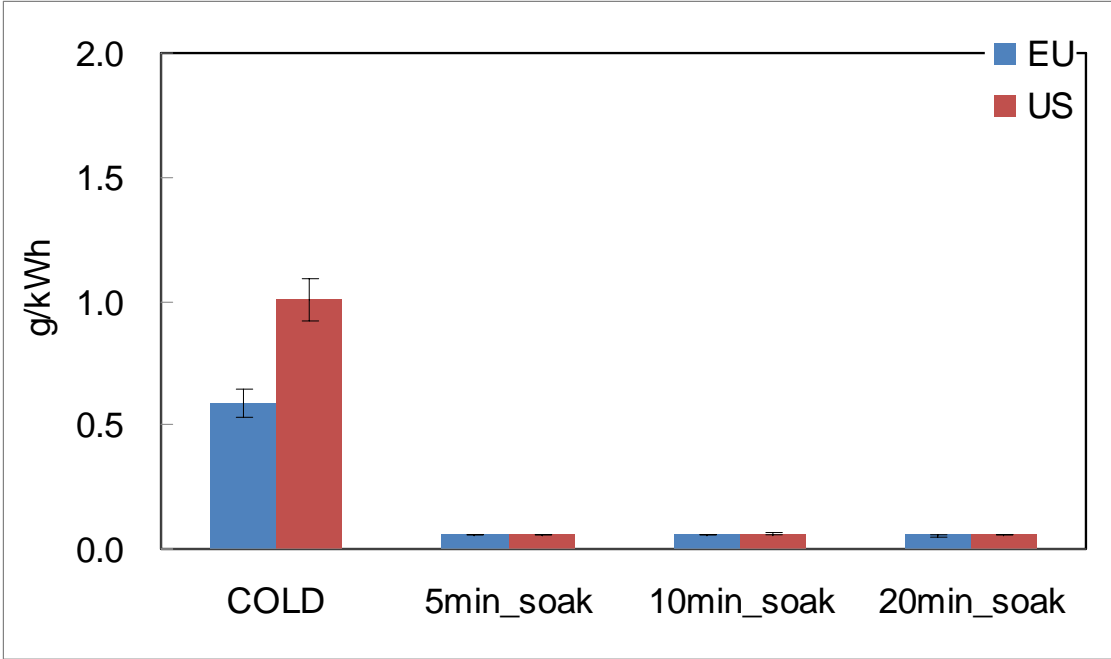
# Effects of Fuel (PM)



# Effects of Fuel (NMHC)



# Effects of Fuel (CO)





# Effects of Fuel (CO<sub>2</sub>)

