Faster Freight – Cleaner Air 2004

Next Generation Natural Gas Vehicle (NGNGV) Engine & Vehicle Projects

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NREL is operated by Midwest Research Institute • Battelle
NGNGV Activity

- Initiated in 2000
- Focused on medium and heavy-duty trucks
- Supported by DOE, SCAQMD, and CEC
- Program development workshops attended by stakeholders:
  - Engine and vehicle OEMs
  - Fleet operators
  - Industry and trade associations
  - Funding partners
  - Utilities and fuel distributors
  - Equipment suppliers
  - National labs
  - Consultants and universities
NGNGV Activity

Workshop Results

• Need engine R&D to meet *proposed* 2007/2010 standards (0.5 g/bhp-hr NO\textsubscript{x}, 0.01 g/bhp-hr PM)

• Current plans
  – 2007: 1.2 g/bhp-hr NO\textsubscript{x}, 0.01 g/bhp-hr PM
  – 2010: 0.2 g/bhp-hr NO\textsubscript{x}, 0.01 g/bhp-hr PM

• Technologies
  – Lean-burn combustion
  – Stoichiometric combustion (EGR)
  – Exhaust after-treatment

• Market research: identify & define best application

• Customer demand for near-term engines/vehicles
NGNGV Integrated R&D Strategy

- Engine Laboratory
- Long-Term Engine/Vehicle
- Vehicle Demonstration
- Proof of Concept

Commercialization
Next Generation Natural Gas Vehicle Projects
Completed NGNGV Projects

Engine Proof of Concept

1. 6L GM (286 hp/317 ft-lb)
   - SI stoichiometric w/TWC
   - 0.08 NOx, 0.002 PM

2. 12L Cat C12 (410 hp/1250 ft-lb)
   - Dual-Fuel w/EGR & CDPF
   - 0.54 NOx, 0.004 PM

3. 5.9L CWI B+ (230 hp/500 ft-lb)
   - SI lean burn w/LNA
   - 0.15 NOx, 0.01 PM

4. 15L CWI ISX (450 hp/1650 ft-lb)
   - HPDI w/EGR & oxidation catalyst
   - 0.6 NOx, 0.03 PM
Ongoing NGNGV Projects

Vehicle Integration

8.1L JDPS 6081
(280 hp/900 ft-lb)
- SI lean burn, oxy cat
- Transit bus

8.9L CWI L+
(320 hp/1000 ft-lb)
- SI lean burn, oxy cat
- Refuse truck

12L Mack E7G
(325 hp/1250 ft-lb)
- SI stoich, EGR, TWC
- Refuse truck
Ongoing NGNGV Projects

Engine Development

8.3L CWI C+ (310 hp/950 ft-lb)
- SI stoichiometric w/EGR & TWC
- Targeting 0.2 NOx, 0.01 PM

11L Mack (325 hp/1250 ft-lb)
- SI stoichiometric w/VVT, EGR, & TWC
- Targeting 0.2 NOx, 0.01 PM
Upcoming Projects

15L CWI ISX (450 hp/1650 ft-lb)
- HPDI w/EGR & oxidation catalyst
- Targeting 1.2 NOx, 0.01 PM in Class 8 truck

8.9L CWI L+ (320 hp/1000 ft-lb)
- SI stoichiometric w/EGR & TWC
- Targeting 0.2 NOx, 0.01 PM
NGNGV Progress

- Spark-ignited NG engine development
  - Near-term commercial engines certified to 2007 emission levels (1.2 g NO\textsubscript{x}, 0.01 g PM) available MY2005
  - SI, EGR, TWC products aiming at 2010 (0.2 g NO\textsubscript{x}) emission standards by 2007
- Direct-injection, diesel pilot, NG product (Westport Innovations/Cummins ISX, 15L) has been laboratory demonstrated with limited field testing
  - NREL and SCAQMD are conducting 1.2 g NO\textsubscript{x} product demonstration with Westport
  - More R&D required for 2010 capability
- NG engines provide fuel diversity, lower emissions, and meet the needs of clean air non-attainment areas