Dual-Fuel Technology Development for Heavy-Duty Long Haul Applications in 2014 and Beyond

Marc Vanderslice – Principal Investigator
Jim Kerekes – Program Manager – Presenter

Clean Air Power / Vayon Gas Technologies

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Project ID FT041

Project Overview

Timeline

- Project start Oct 2014
- Project end date Aug. 2018
- Percent complete 35%

Budget

- Total project funding $4.7M
  - DOE share $1.7M
  - Vayon/CAP share $3.0M
- Funding received FY 2015 $247K

Barriers

- Barriers addressed
  - Development of heavy-duty on-board diagnostics (HD OBD) for compliant and compatible Dual-Fuel engine

Partners

- None

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Project Objectives

- Demonstrate a natural gas (CNG or LNG) Class 8 heavy duty Dual Fuel 13-liter compression ignition engine that utilizes an average of 60-75 percent natural gas ignited by a pilot of 25-40 percent diesel for use in heavy-duty commercial on-road applications;
- Work with a wide cross-section of fleets to demonstrate the Dual-Fuel 13-liter engine, collecting performance and operational data to help refine and more effectively commercialize an alternative fuel engine product that fills an existing gap in the marketplace;
- Refine the ultra-low NOx emission engine that secures initial EPA and CARB emission certification at 0.2 g/bhp-hr NOx;
- Develop HD OBD Compliant and Compatible Dual-Fuel engines;
- Provide a low incremental cost option for fleets interested in Class 8 heavy duty natural gas operations, allowing fleets to recognize long-term fuel cost savings with a shorter payback timeframe on upfront vehicle costs;

Milestones

Budget Period	Start/End Date	Milestone	Type	Description
1	10/01/2014 – 02/28/2017	OBD Demonstration	Phase I Go/No-Go	Demonstration of System Compatibility with OEM OBD
2	03/01/2017 - 08/31/2018	2018 Vehicle Market Readiness	Technical	Demonstration of Technical and Commercial Viability for 2018 vehicle

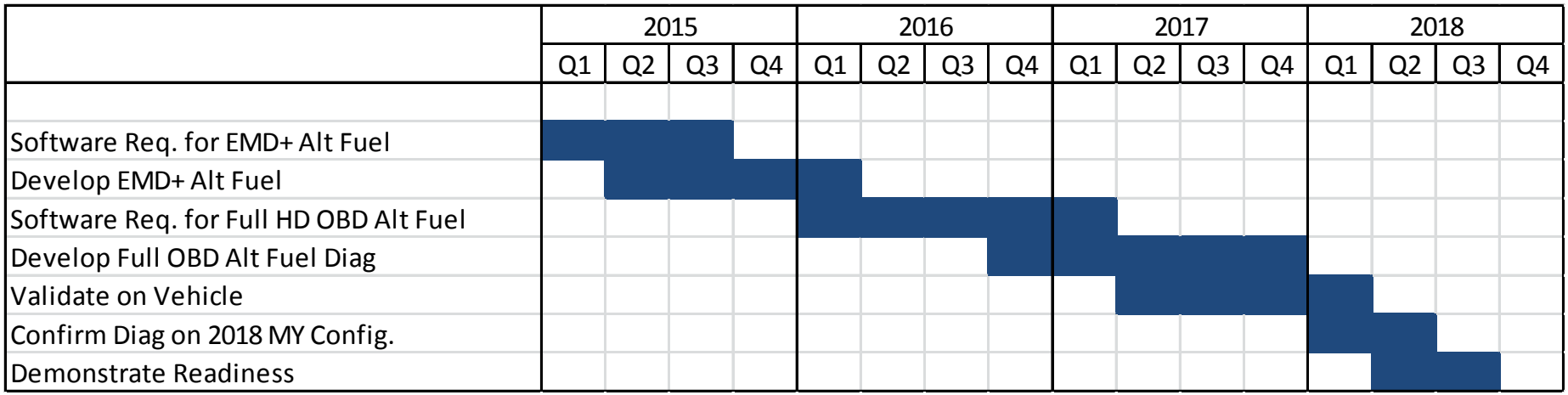
Approach

HD OBD Requirements Roll out by Model Year

HD Diesel Engine	EMD +		FULL HD OBD						
Alt Fuel Engines	EXEMPT		EMD +					FULL HD OBD	
	2011	2012	2013	2014	2015	2016	2017	2018	2019
	MODEL YEAR								

- On-Board Diagnostic requirements for Alternative Fuel engines followed a similar roll-out to HD Diesel OBD requirements with a delayed implementation until the 2018 Model year

Approach



- Develop requirements and software for EMD+ Alt. Fuel
- Expand learnings from EMD+ to Full HD OBD Alternative Fuel requirements
- Develop and validate on current MY OEM product with Dual-Fuel system installed
- Demonstrate readiness with Field trial vehicles

Accomplishments to Date

- A MY 2015 vehicle with a Volvo/Mack 13L engine was procured during the 1st quarter of 2015, the installation of the Dual-Fuel system was completed and the vehicle was commissioned to operate on natural gas.
- An assessment was made of the EMD+ Requirements during the 1st quarter time period. This assessment was used in the 2nd quarter time period to form the basis of the SWRS.
- The SWRS to update the existing software to ensure compliance with new EMD+ requirements for system monitoring was completed.
- Concept-level countermeasures to avoid activation of the OEM HD OBD system while operating in Dual-Fuel mode were developed.
- A list of support (information, hardware, etc.) that will be requested from an OEM partner was produced.

Responses to Previous Year Reviewers' Comments

- This Project was not reviewed in 2015

Collaborators

- **California Air Resources Board**
  - Engaged with discussions on Alternative Fuel HD On-Board Diagnostics

- **Volvo Powertrain**
  - Supportive of Project Objectives
  - Preliminary discussions concerning contributing necessary equipment

- **United Parcel Service**
  - Interest in Field trial vehicle deployment

Remaining Challenges and Barriers

- The work to date has focused on the HD EMD+ On-Board diagnostic requirements, the remaining challenge will be to expand that base work to include the Full HD OBD requirements including:
  - Requires capturing faults based on drive cycle
  - More comprehensive fuel system monitor (including fuel pressure, injection quantity, injection time)
  - Monitor tailpipe emission levels
  - Additional features to be monitored (example: misfire detection and boost system monitoring)

Proposed Future Work

- Establish Software Requirements for Full HD OBD Alternative Fuel
- Procure a MY 2017 Volvo/Mack D13/MP8 engine and vehicle. Install the CAP Dual-Fuel system on the engine and vehicle. Investigate any differences between the MY 2017 configuration and previous MY engines and implement required revisions to the CAP Dual-Fuel system
- Complete the development and the calibration of the new HD OBD software using the MY 2017 engine and vehicle
- Confirm the HD OBD with Dual-Fuel on a 2018 MY engine and vehicle
- Conduct market readiness demonstration of the HD OBD compliant Dual-Fuel system

Summary

- Completion of the EMD+ SWRS document and the successful demonstration of a Dual-Fuel system adapted to a fully HD OBD compliant vehicle without activation of OEM fault codes were major steps in the overall Project
- Remaining work to expand the adaption to include the Full HD OBD Alternative Fuel requirements will be more challenging but possible based on the EMD+ demonstration

PRESENTER CONTACT DETAILS

Jim Kerekes
E-Mail: jkerekes@cleanairpower.com

THANK YOU !

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Technical Back-Up Slides

Business Background

- Vayon Group is a first-tier supply to niche producers and OEMs for niche products. The group operates in 3 main sectors – energy storage, vehicle technologies and gas technologies
- Vayon Gas Technologies (VGT) is a global leader in the development and sale of Dual-Fuel Combustion Technology for heavy-duty diesel engines.
- We design, develop and sell Natural Gas Engine Fuel systems for leading brands of commercial transport vehicles; offering a full range of retrofit installation support and Aftermarket Services.
- VGT has established partnerships with Tier 1 vehicle manufacturers such as Volvo and Mercedes-Benz, and strong customer relationships in the logistics and retail sectors.
- 2015 saw the acquisition and merger of two Natural Gas Low Carbon brands – Hardstaff and Clean Air Power; both of which have been pioneering alternative fuel systems since 1991
- We have over 2,700 Dual-Fuel installations worldwide
- The US Division of VGT is based in Poway, near San Diego, CA

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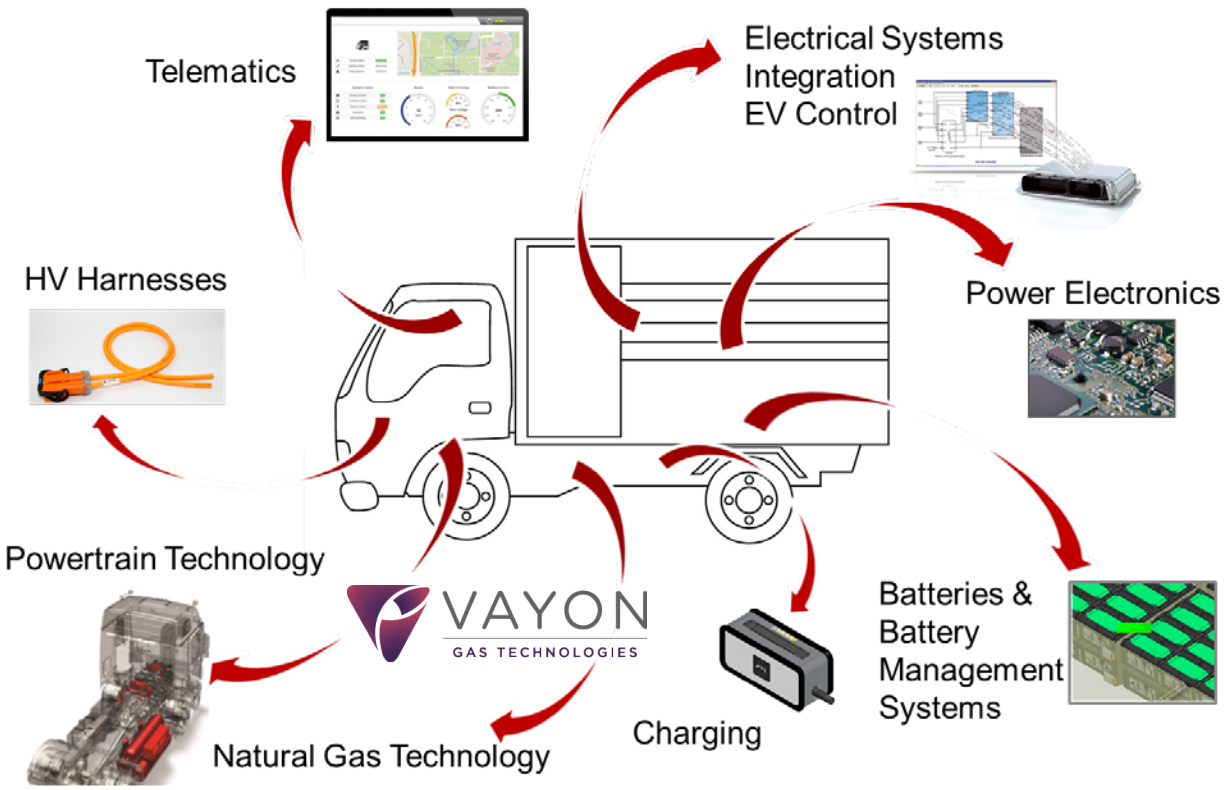
Commercial Background

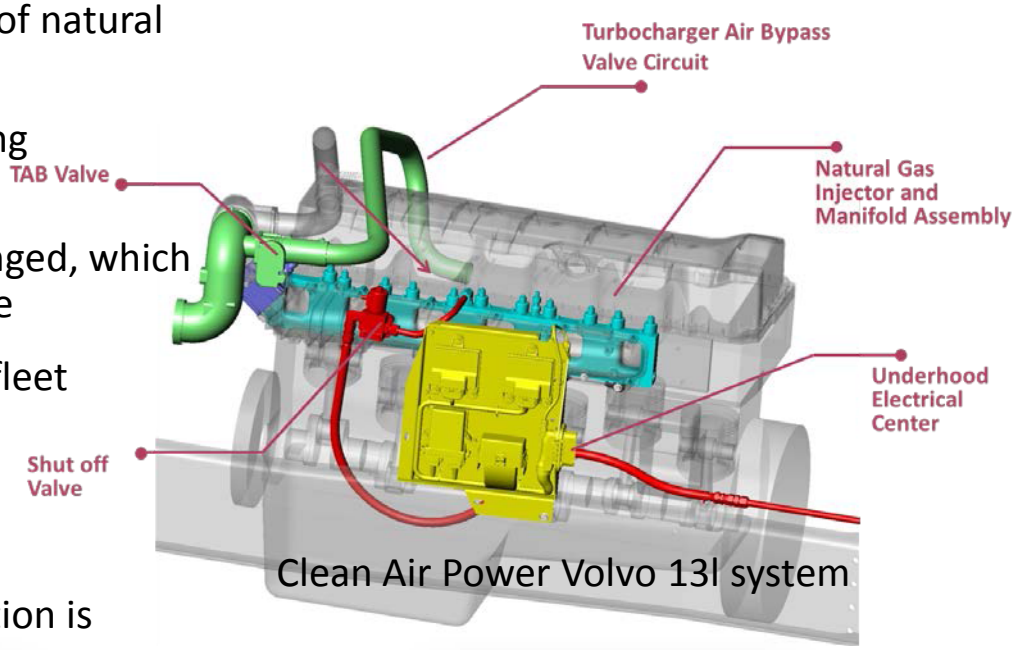
- Vayon Group acquired Clean Air Power in 2015
- Vayon Group focus on low-carbon commercial vehicle technologies
- Vayon Gas Technology focus on natural gas combustion & powertrain technology
- Commercial “Dual-Fuel” technology on heavy trucks with Volvo and Mercedes

- Fuel cost & carbon savings



Dual Fuel Technology Summary

- Our Natural Gas technology allows heavy duty diesel powered engines to run on a high percentage of natural gas, which substitutes diesel use.
- The diesel works like a liquid spark plug, igniting the compressed natural gas.
- The diesel engine itself remains largely unchanged, which means no loss of its inherent high performance
- The product has proven reliability, with many fleet operators.
- We control ALL combustion parameters to maximise emissions benefit
- 100% instantaneous diesel contingency operation is available



Clean Air Power Volvo 13l system

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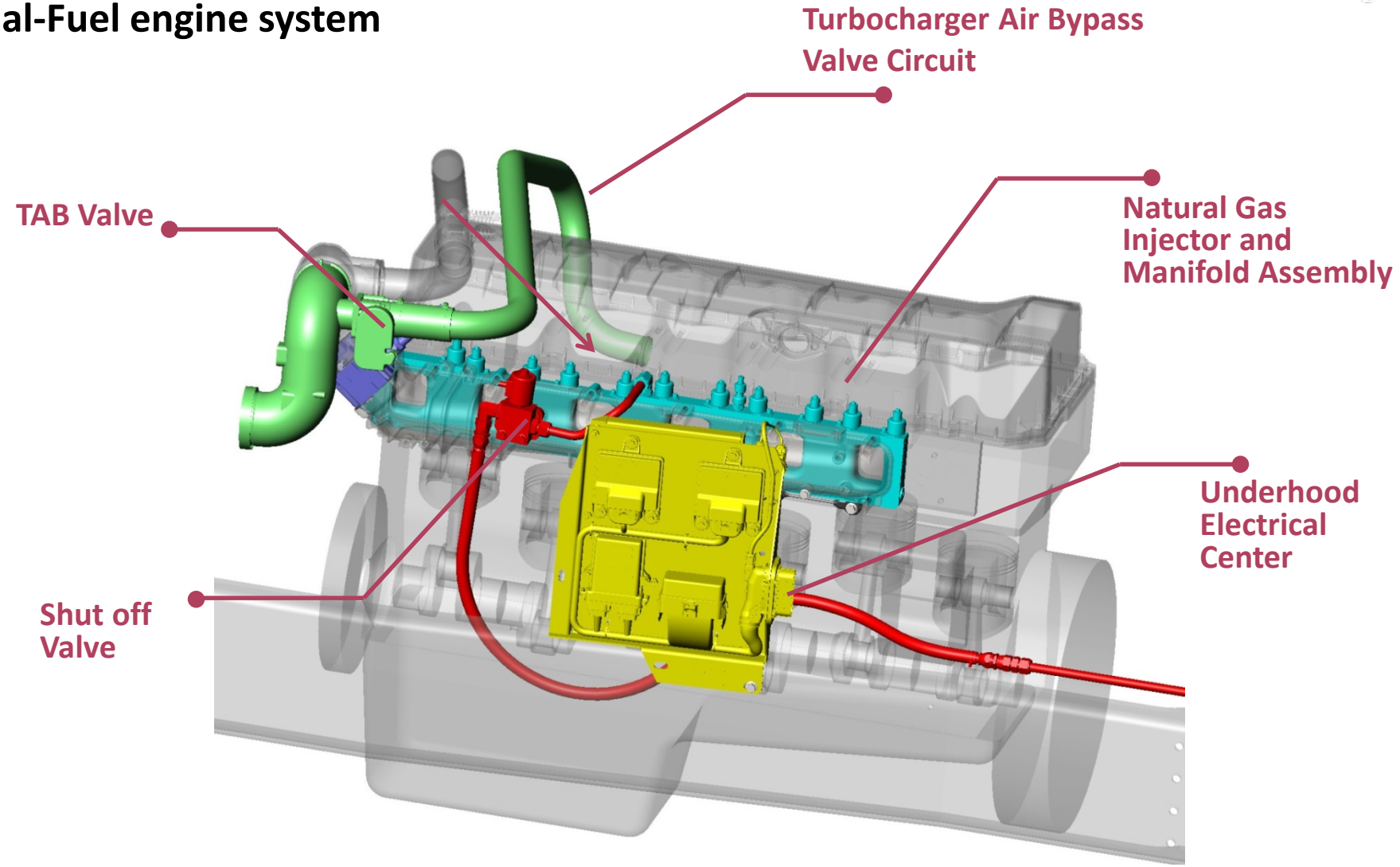
Dual-Fuel engine system



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