

Retrofit Solutions for Haul Trucks

Haulage & Loading Conference
May 19, 2015
Phoenix, AZ



Current Product Line Up



EVO  **MT** tm Systems

EVO  **SP** tm Systems



EVO  **LT** tm Systems

EVO MT™ Product Offerings

EVO MT™ 7770

EVO MT™ 7930

EVO MT™ 8300

EVO MT™ 9300

EVO MT™ System Highlights

- **Natural Gas + Diesel Operation (NG+D™ Technology)**
- **Complete Solution - Engine Conversion and LNG Storage**
- **Maintains OEM Engine and Truck Performance**
- **Maintains 100% Diesel Capability - No Engine De-rate**
- **Solutions for Caterpillar and Komatsu Haul Trucks**

EVO-MT Operational Statistics

- Total running hours to date (since Jun 2012): **170,000**
- Total MT related LTI to date: **0**
- Number of trucks in operation today: **24**
 - *(17 x Cat 793, 2 x Kom 830, 5 x Kom 930)*

EVO-MT History

- **2010** -- 1st Field Test With LNG On Prototype EVO-MT, Cat 777C
- **2012/13** -- 1st Pilot Installation, 4 x Cat 793B/C



EVO-MT History

- **2014** – 1st Commercial Project , 12 x Caterpillar 793C
- **2014** – 1st Electric Drive Haul Truck, 1 x Komatsu 830AC



EVO-MT History

- **2014** -- 1st Electric Drive Pilot Project, 2 x Komatsu 830 DC



- **2014** – 1st Commercial Project , 4 x Komatsu 930E

EVO-MT History

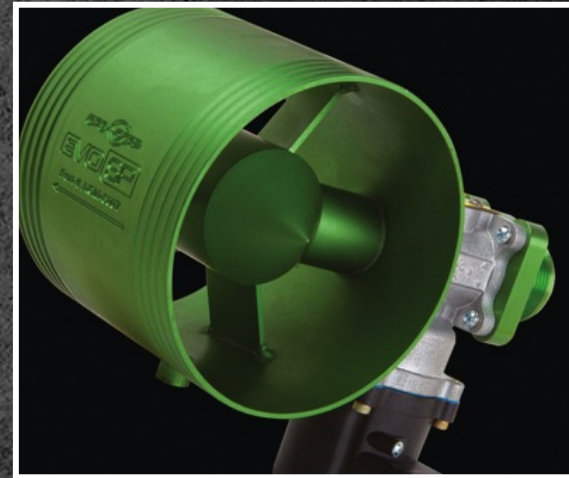
- **2015** – Delivered 10 additional systems for Komatsu 930.



- **2015** – Delivered first system for Cat 793D

Gas Delivery System

- **Integrated Air / Gas Mixer and Electronic Throttle Body Installed Upstream of the Engine Turbo Compressor**
- **Electronic Control Unit**
- **Wiring Harnesses**
- **Engine Sensors**
- **OEM Sensor Interfaces**
- **Safety Sensors**



EVO MT7930[™] Fuel Storage Module

- 360 Net gallon LNG capacity
- Cryogenic solenoid shut off valves
- LNG Vaporizer
- High pressure and low pressure gas regulators
- Gas solenoid shutoff valves
- Sensors, wiring harnesses



EVO-MT8300/9300 Fuel Storage

- **Hydraulic/LNG Combo Tank**
 - 300 Net gallon LNG capacity
 - Optional Diesel/LNG Combo tank for additional 300 net Gallon of LNG & 650 net gal Diesel
- **Cryogenic solenoid shut off valves**
- **LNG Vaporizer**
- **Gas Train Module**



Operator Safety

- **Combustible Gas Detection**
- **Flame Detection**
- **Optional Cab and External E-Stops**
- **Non-flammable Air-Gas Mixture in Engine Intake**
- **Normally Closed, DC Operated Cryogenic Valves**
- **Remote Venting of LNG**
- **Gas Throttle-Body Position Feedback Loop**

Engine Protection

- **Automatic Reversion to 100% Diesel Mode (No Loss of Power)**
- **Exhaust Gas Temperature (4 -16 Channel)**
- **Cylinder Knock (16 channel)**
- **Manifold Air Temperature (2 Channel)**
- **Manifold Air Pressure (2 Channel)**
- **Engine Speed (RPM)**

Refueling Infrastructure



EVO-MT Performance

- **LNG Storage Designed For 12 Hour – 2x Per Day Fueling
Some Applications 1x Per Day**
- **Operating Gas Substitution Depends On Truck Duty Cycle**
- **Typical Substitution Rate 35% ~ 50% Over A Duty Cycle**
- **No Functional Decrease In Truck Capacity**
- **Same Speed / Grade As OEM Specification**

EVO-MT Sustainability

- EVO-MT Decreases Harmful Engine Emissions
- The United Nations Health Organization Has Determined Diesel PM to be ***'Carcinogenic to Humans'***
<http://www.un.org/apps/news/story.asp?NewsID=42204&Cr=cancer&Cr1#.VA8I0-csTy8>
- LNG Will Not Contaminate Soil or Water
- "Well to Wheel" - LNG is Superior Carbon Footprint vs. Distillate Fuels

Conclusions

- **Retrofit Conversions Are Available Today**
- **LNG Supply In USA Is Increasing**
- **Improved Emissions Profiles**

Open for Questions