

Alternate Fuels: Impact on Emissions for Tractor Application

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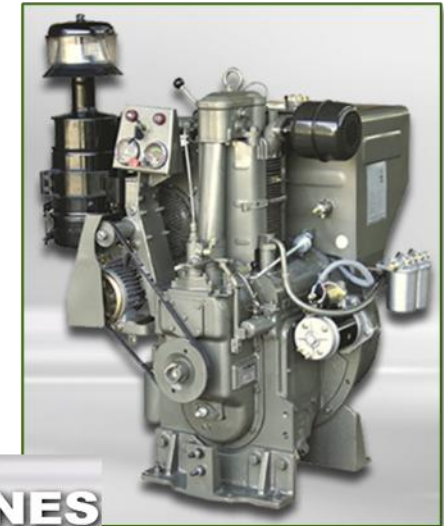
Agro Engines



Tractors



Power Generators



**INDUSTRIAL
ENGINES**

Industrial Engines



De-Watering Pump



Air Compressor
Application for India Army



Gensets for Defense Application



Customised genset for COVID VACCINATION BUS

- **Air Cooled Engine Series :**
 - Mech FIE & EGR
 - ✓ 7.5 kVA
 - ✓ 10 kVA
 - ✓ 15 kVA
 - CRDI, EGR & DOC
 - ✓ 25 kVA
 - ✓ 30 kVA
 - ✓ 35 kVA
 - **Water Cooled Engine Series :**
 - CRDI, EGR & DOC
 - ✓ 40 kVA
 - ✓ 45 kVA
 - ✓ 60 kVA
 - CRDI, EGR, DOC & SCR
 - ✓ 82.5 kVA
 - ✓ 100 kVA
 - ✓ 125 kVA
-
- ✓ Power ratings : 12
 - ✓ Base engine variants : 06

Air Cooled Engine with CRDI



Patent Applied

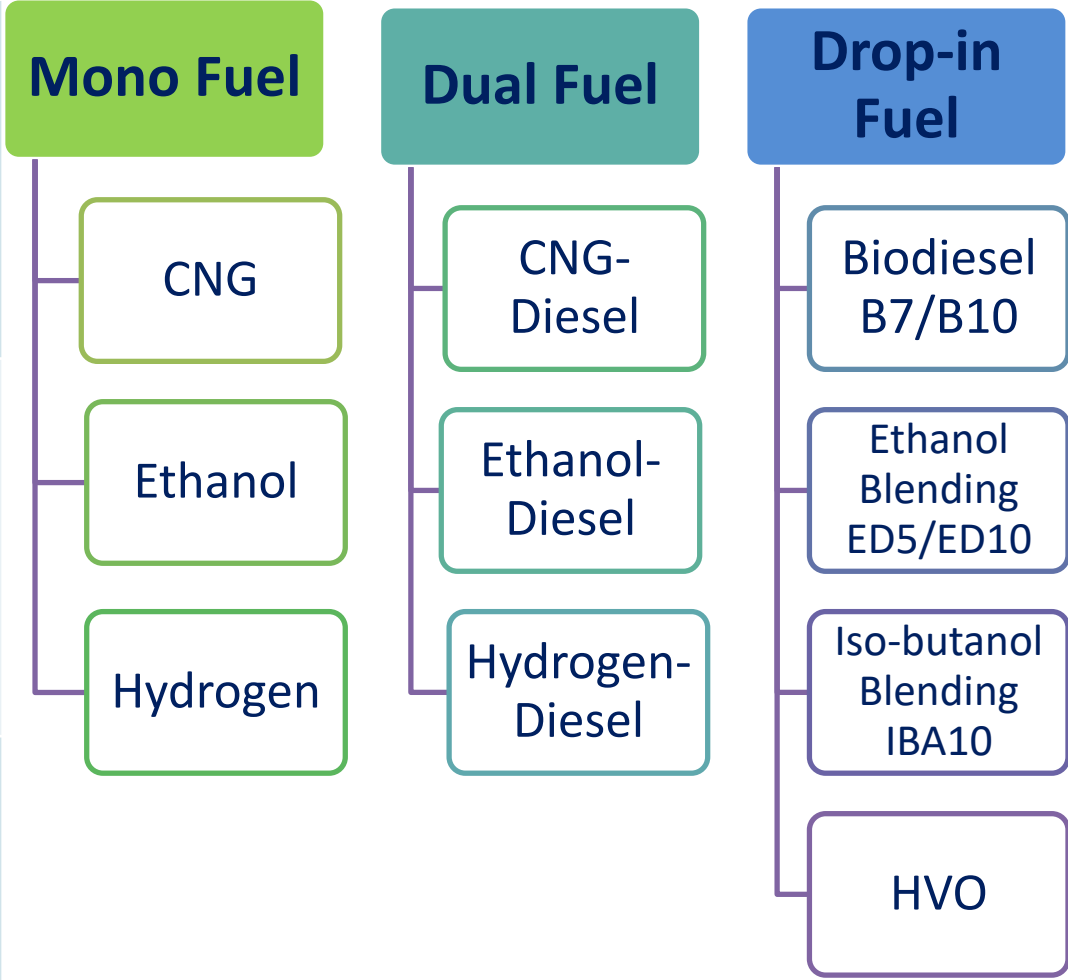
Smart Mechatronic Air Cooled Engine



Patent Applied

Alternate Fuels Classification in Terms of Application

	Mono Fuel	Dual Fuel	Drop-in Fuel
What is it?	- Use of High Octane fuel, - Combustion is Stoichiometric	Combination of higher octane fuel along with diesel	- Direct replacement of diesel, - Combustion is Compression Ignition
What are the Pros?	- Use of lower carbon fuels, - Reduction of emission footprint	- Use of lower carbon fuels, - Reduction of emission footprint, - Retro-fit on field tractor possible	- Easy to implement - Minor to no changes in the existing engine (except DME)
What are the Cons?	- Lot of changes in the existing tractor engine - Solution suitable for long term	Not complete green solution	Not complete green solution



Dual Fuel Tractors

TMTL CNG Diesel Dual Fuel Tractors

✓ 485 Dual Fuel Air Cooled Tractor (45 HP)

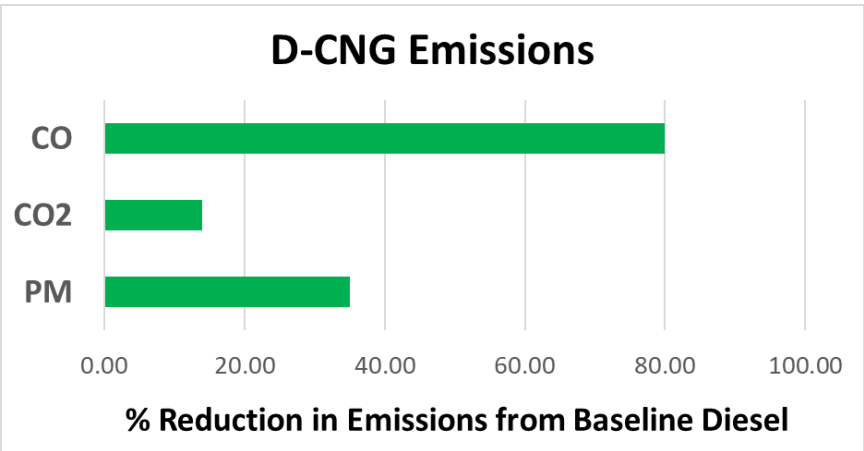


✓ 551 Dual Fuel Water Cooled Tractor (50 HP)

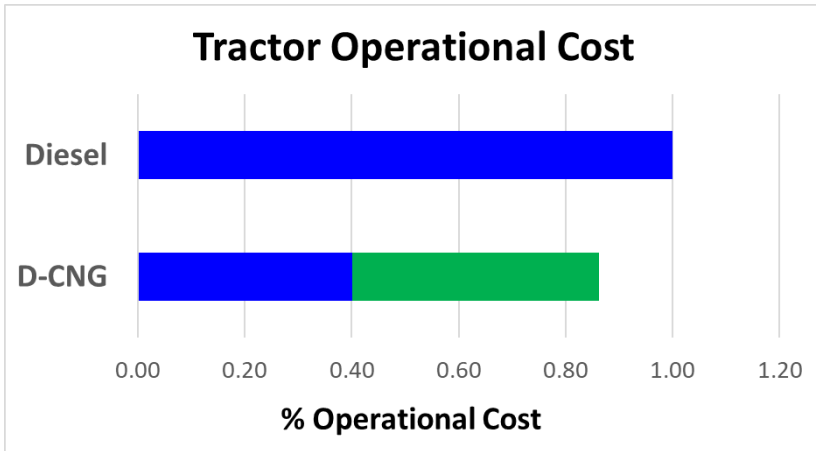


CNG-Diesel Dual Fuel Tractor (Eicher D-CNG, 45 and 50 HP)

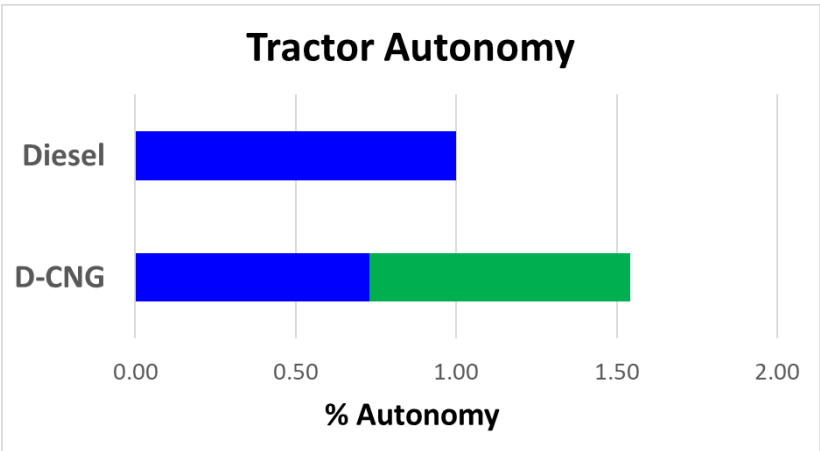
✓ Environmental Benefit



✓ Economical Benefit

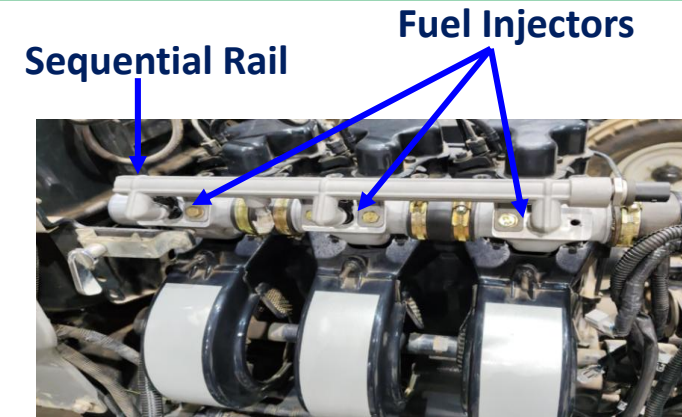
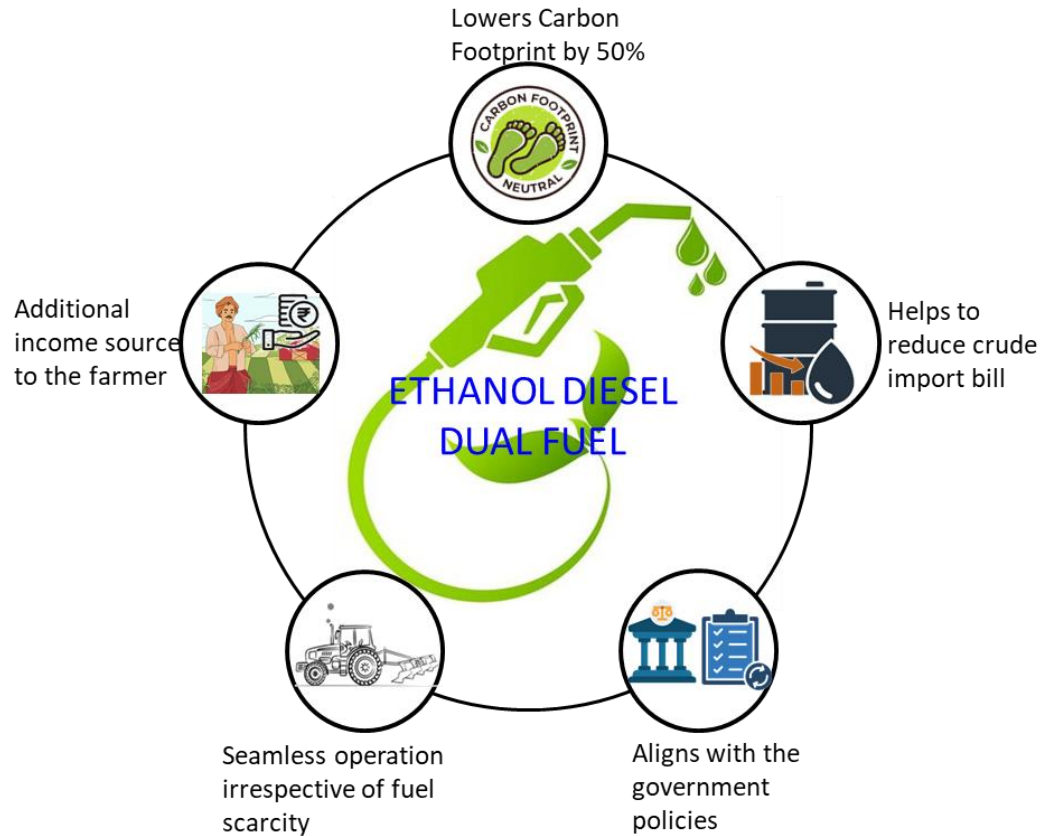


✓ Other Benefit



- Challenges
- CNG Infrastructure
 - Customer Awareness

45 HP Ethanol-Diesel Dual Fuel Tractor

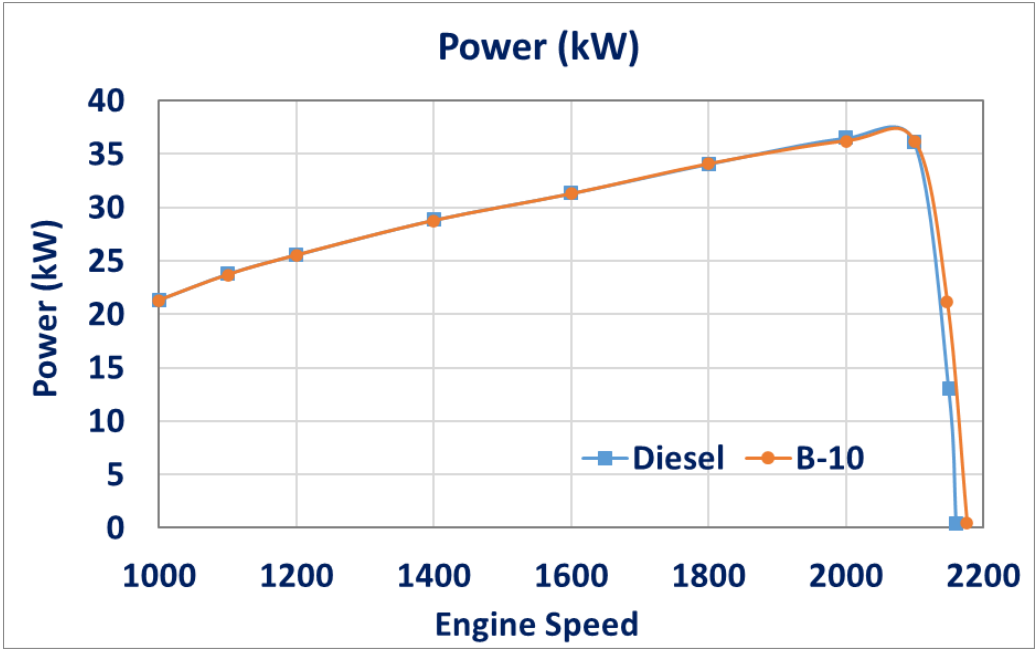


- Sequential Port injection of Methanol is preferred over manifold injection
- Engine Testing & Calibration is Underway

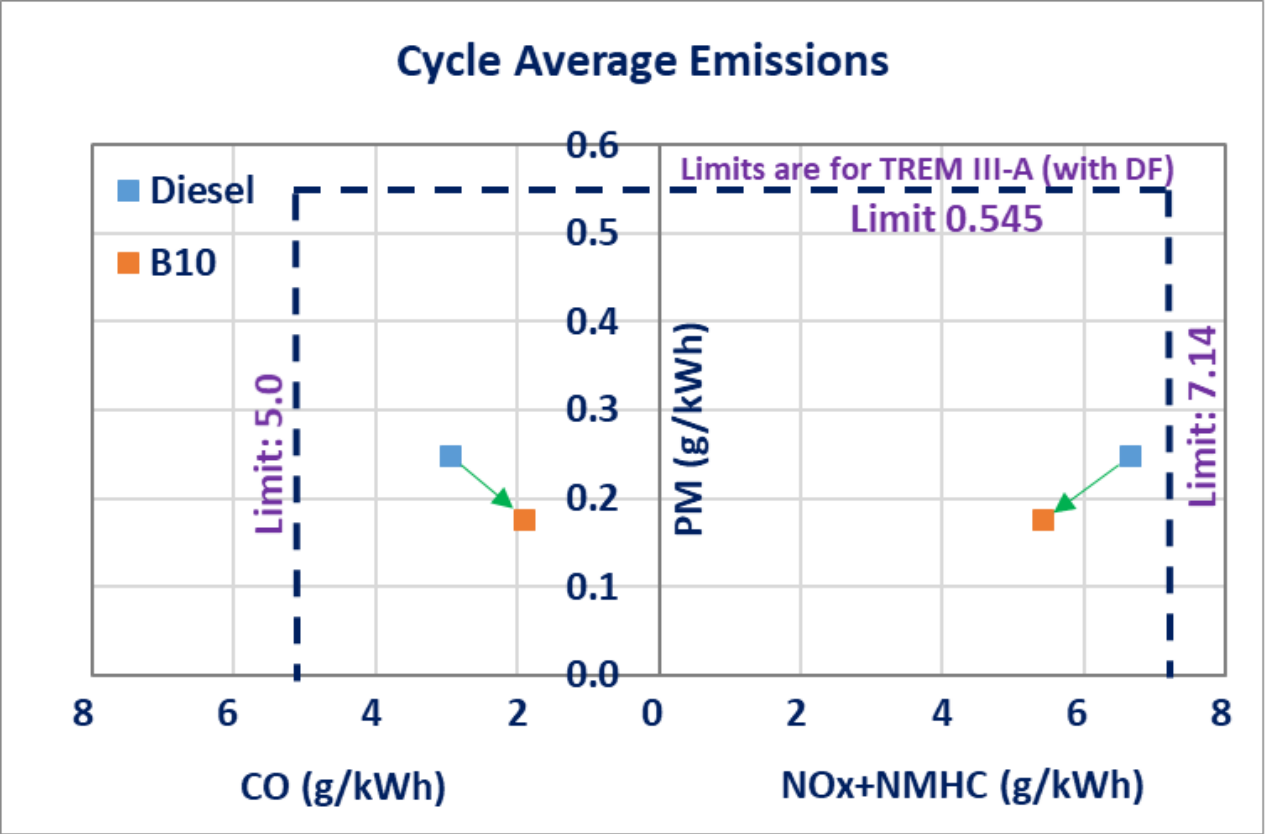
Drop in Fuels

B10 Fuel in 50HP Naturally Aspirated Water Cooled Tractor

Parameter	Influence with B10 with respect to Diesel
Power/Torque Characteristics	Same as diesel
Thermal efficiency	2% improved
Cycle Average PM	29% reduced
Cycle Average CO	35% reduced
Cycle Average (HC+NOx)	18% reduced



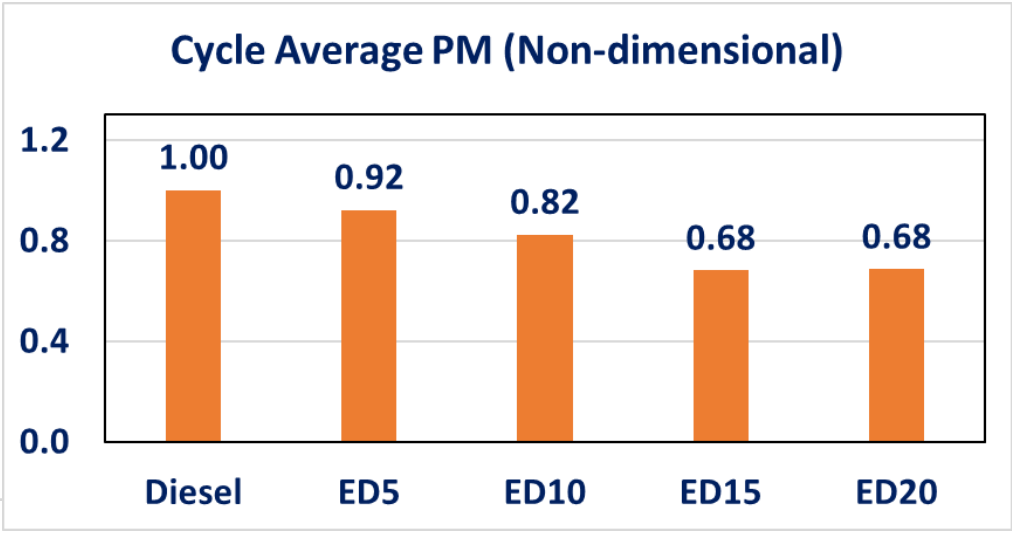
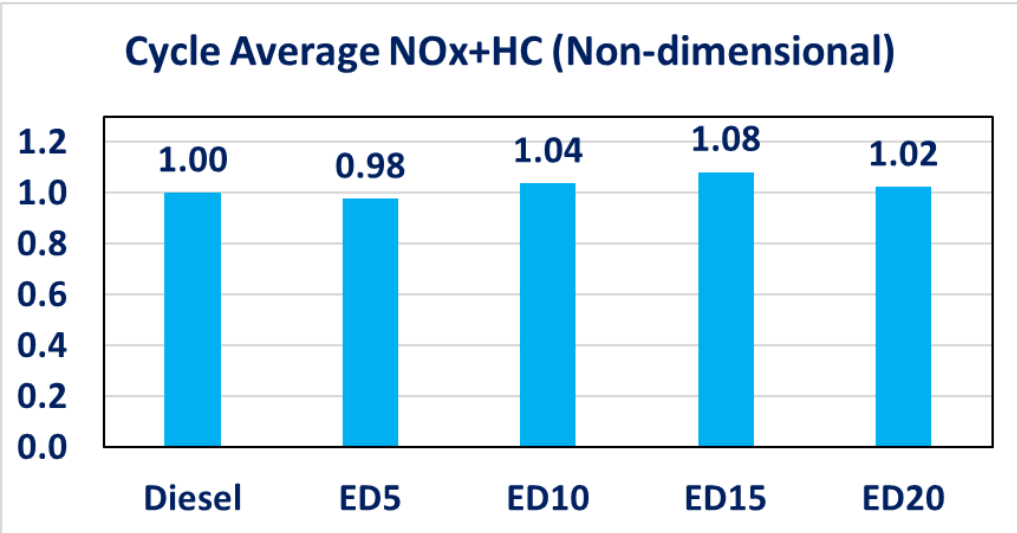
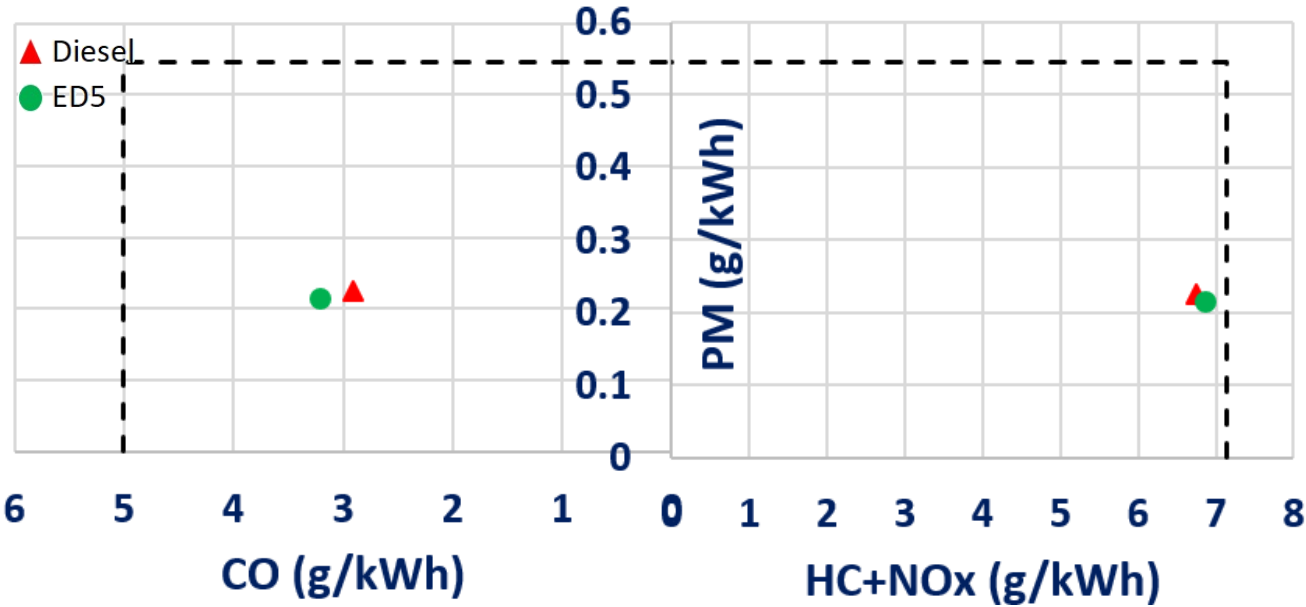
B10: 10% (v/v) Blending of Biodiesel in Diesel



ED5 Fuel in 45 HP Naturally Aspirated Air Cooled Tractor

ED5: 5% (v/v) Blending of Ethanol in Diesel

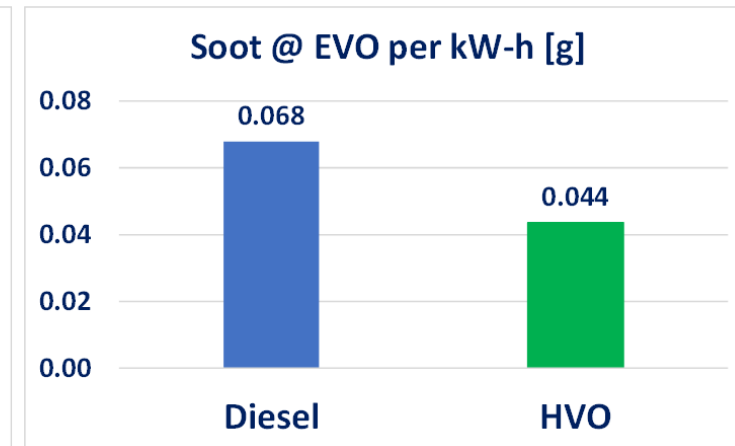
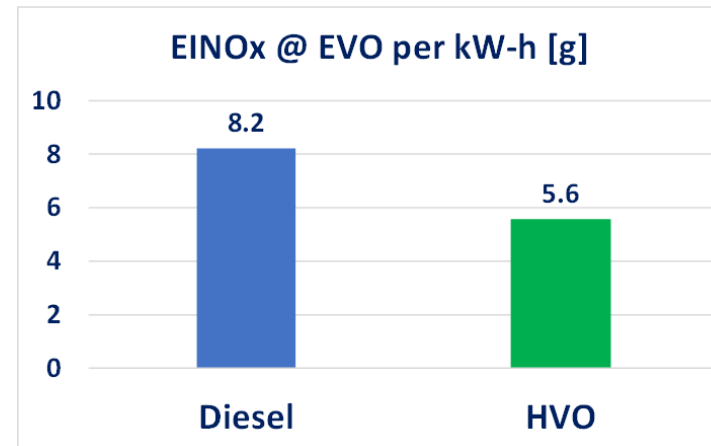
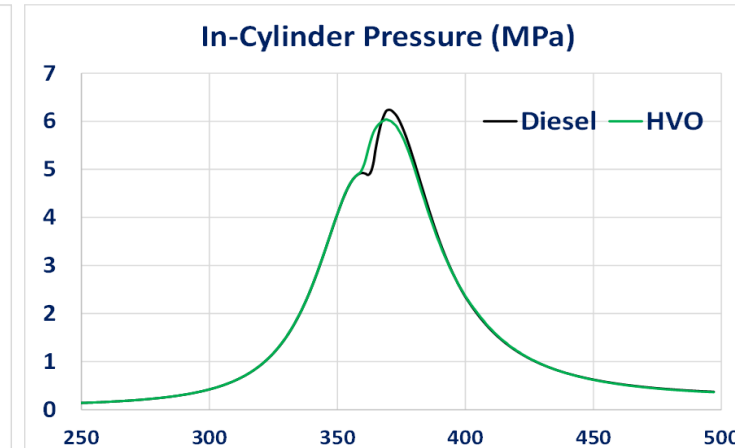
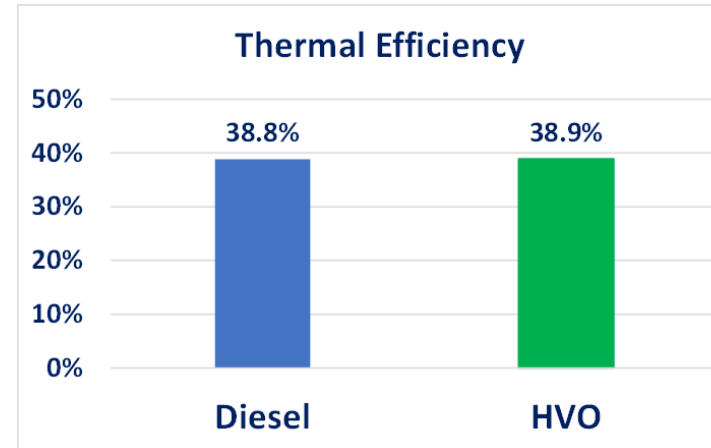
Parameter	Influence with ED5 with respect to Diesel
Power/Torque Characteristics	Same as diesel
Thermal efficiency	Same in full load, slightly reduced at part load
Cycle Average PM	8% reduced
Cycle Average CO	10% increased
Cycle Average (HC+NOx)	Same as diesel



50 HP Hydrotreated Vegetable Oil (HVO) Engine

Properties	Diesel	HVO
Density at 15 °C (kg/m ³)	835	775-785
Cetane Number (CN)	53	80-99
Lower Heating Value (MJ/kg)	42.7	44
Viscosity at 40 °C (mm ² /s)	3.5	2.5-3.5

- HVO is the blend of Higher alkanes (i.e. C₁₅H₃₂, C₁₆H₃₄ and C₁₇H₃₆)
- The benefits of HVO fuel include
 - ✓ excellent cold temperature performance,
 - ✓ extended storage,
 - ✓ high cetane number,
 - ✓ a lower emission profile and
 - ✓ up to 90% reduction in life cycle greenhouse gas emissions

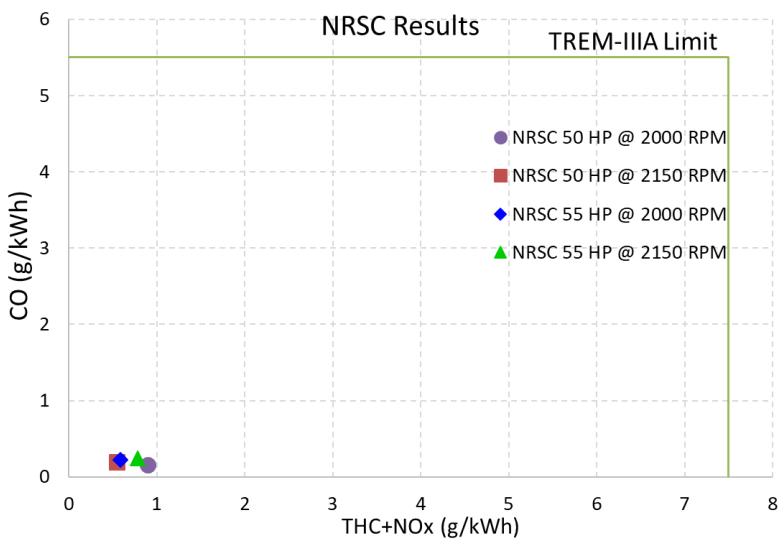


- Thermal efficiency and in-cylinder pressure was comparable for HVO and Diesel
- Both NOx and Soot emissions are lower for HVO as compared to diesel.

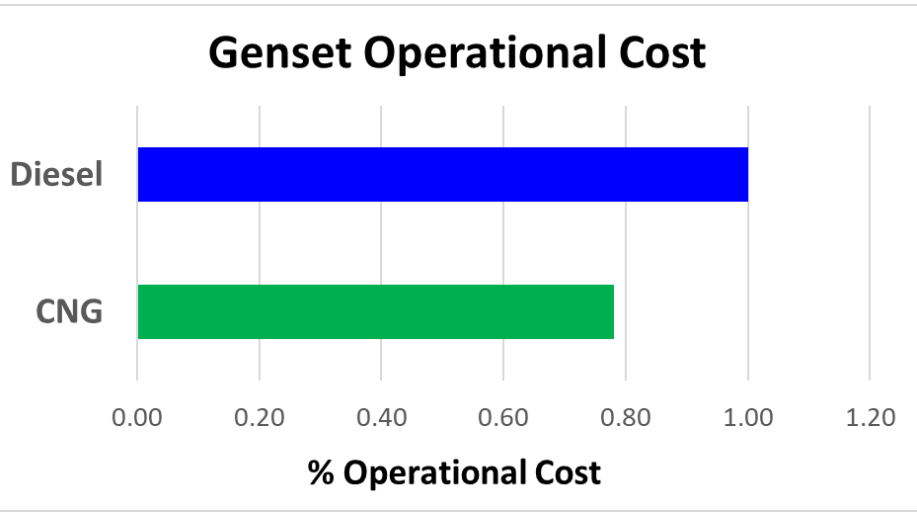
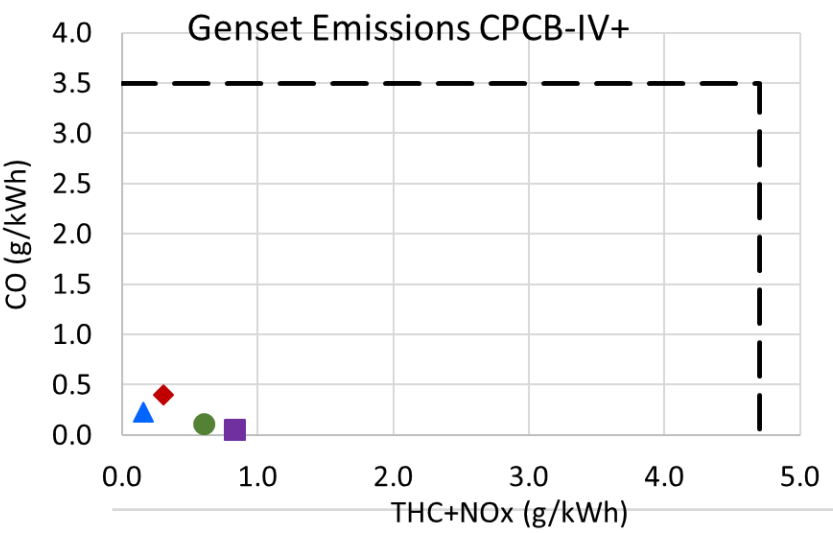
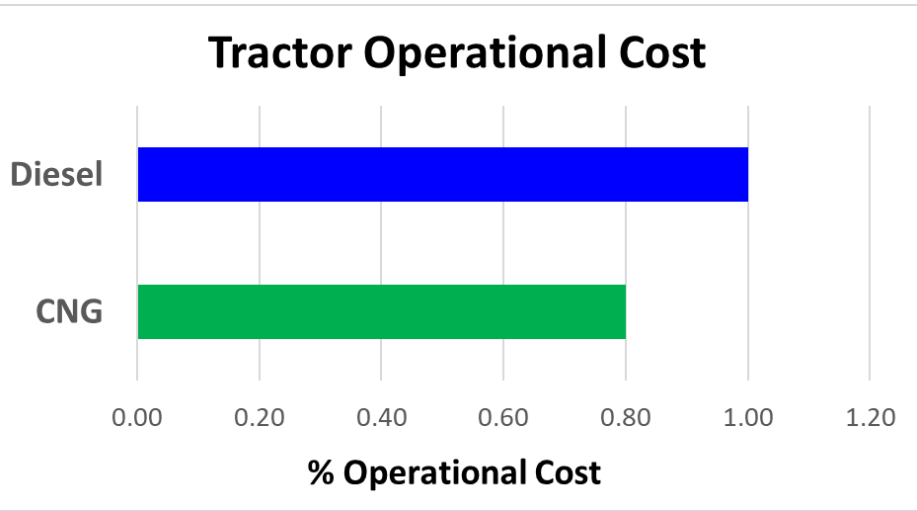
Mono Fuel Tractors

TMTL CNG Tractor & Genset

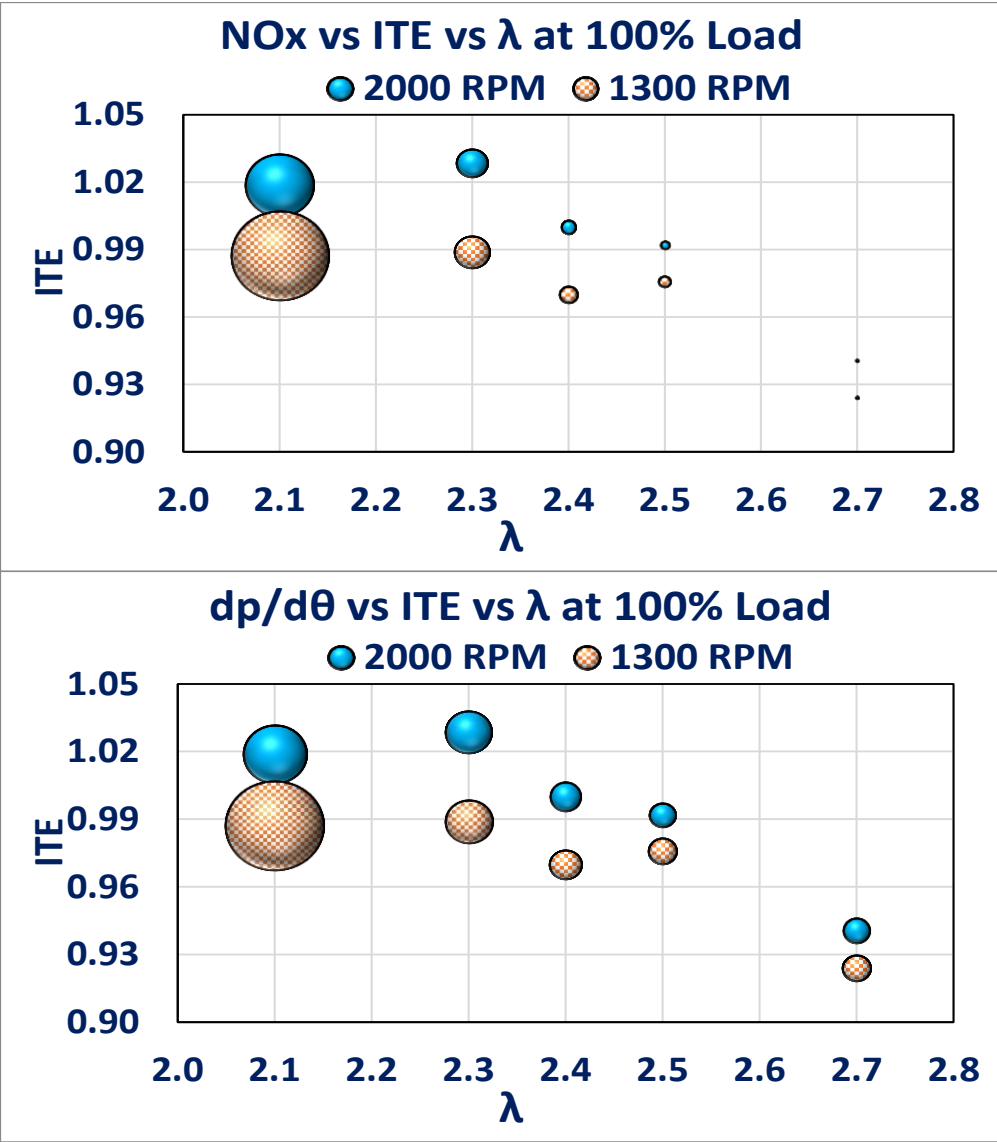
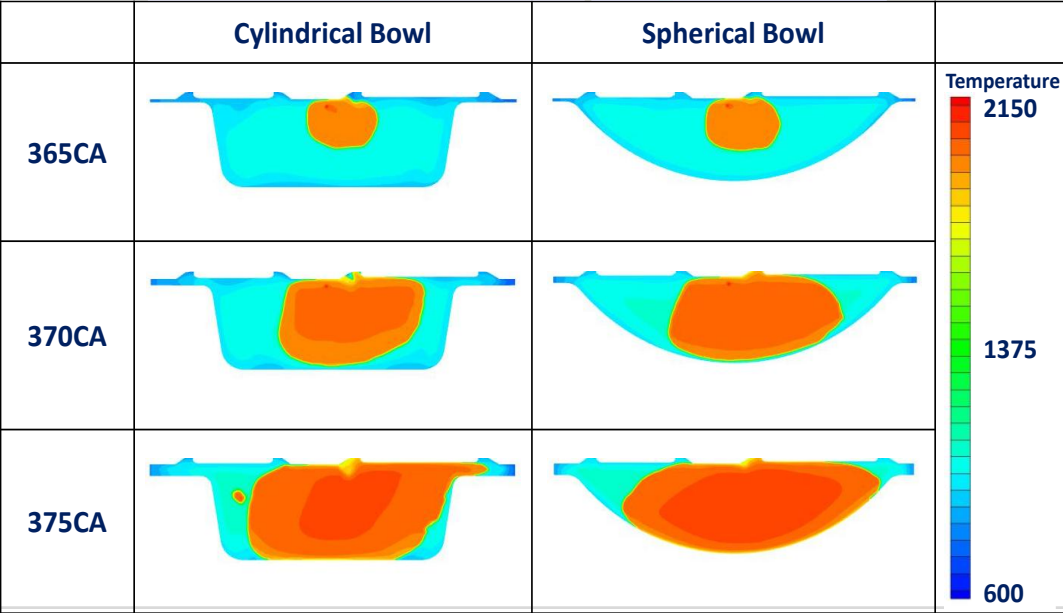
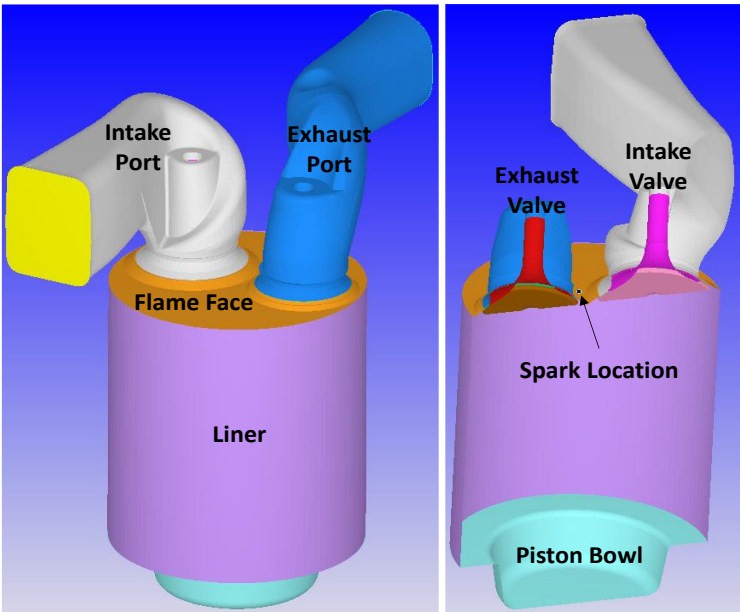
✓ Environmental Benefit



✓ Economical Benefit



Mono-fuel Hydrogen Tractor (Proto Development is Planned)



Data is Presented in Normalized form₁₆

Thanks !



