Heavy-Duty Engine Development & Market?

Larry Osgood
PERC Engine & Vehicle Development
June 13, 2017
Topics Today

• Traditional Autogas Vehicle Market
• New Opportunities for Propane in Medium & Heavy-Duty Engines
• Why?
• Propane Engine Power Using Direct Injection
• Engine Optimization w Propane
• Discussion of MD & HD Opportunities
• So What do We Go After & Why?
NEW PROPANE SALES 2016

- Light Duty: 38%
- Medium & Heavy Duty: 62%

PROPAINE EDUCATION & RESEARCH COUNCIL
Traditional Autogas Vehicle Market

• For years we’ve done well in lighter-duty vehicles
  – Taxis, pickups, vans, (especially high mileage)
  – Box vans like chip/bread trucks & small cutaway buses
  – Most <20,000 GVW
• But also some larger medium-duty vehicles
  – Bobtails (Ford propane engine), service/crane trucks & buses
Traditional Vehicle & Engine Challenges

• Issues of space, tankage & range for smaller vehicles
• Working w conversion systems & certification: delays
• OEMs continued to show little interest or success
• Heavier-duty engines were either rich burn w high heat problems, or lean burn w boost & higher pressures but knock limited
• Nagging warranty issues, some engine durability problems
• Higher costs & less competitive vehicles associated w above
• Always close enough to do some, but rarely went big
Progress for Propane in Medium- & Heavy-Duty Vehicles / Engines

- Roush very helpful in quality of vehicles w OEM involvement
- Other fuel suppliers keep making better systems
- 6.0L, 6.8L, 8.0L & 8.8L engines creating new opportunities
- But still all expensive, and not fully competitive w other options
- P has emerged as a leading ultra low NOx & low particulate fuel, we’re amazingly clean w affordable & workable technology
HD NOx & PM Emission Standards (30 years)
New Opportunities for Propane in Engines

- P is still a high energy fuel with many advantages
- Engine technology continues to improve & change
- Direct Injection (DI, GDI or SIDI) is a game changer
- PERC working with SwRI began to look into benefits of P in DI
- Started confirming engineering design prospects for:
  - Higher cylinder pressures for efficiency
  - Managed combustion for high power output
New Opportunities for Propane in Engines

- SwRI conducted extensive tests on the Ford 3.5L 2 turbo V6 DI with positive results as reported by Mike Ross

- In summary we found higher output, manageable exhaust temps, higher efficiency, and low emissions. Quite a combination!

- We also had been looking into other engine strategies applicable to P such as high EGR developed in the DOE ARES program in the 2000s and implemented by Cummins Westport using NG

- And Mike found an engine created by Cummins called ETHOS running on ethanol using these same strategies we wanted for P
Cummins Ethos Engine

This HD 2.8L engine was demonstrated in a large bread/chip van.
New Opportunities for Propane in Medium- & Heavy-Duty Vehicles / Engines

• Turns out that ethanol & P are premium fuels for DI
  – High octane rating
  – P vaporizes rapidly
  – Good cooling from vaporization
• CWI uses some of these technologies in their NG engines
• E-Controls is using many of these in their new NG engines
• But neither can use and gain further DI advantages w NG
• P can provide high torque, and high HP engines
BMEP for Different Fuels & Engine Technologies

- 26-30  Propane in high-tech engines
- 26-29  Ethanol in high-tech engines
- 20-25  Diesel
- 17-24  High-tech gaso engines
- 10-13  Typical gasoline engines

BMEP = The average (mean) pressure which, if imposed on the pistons uniformly from the top to the bottom of each power stroke, would produce the measured (brake) power output.
So What’s Next?

• High output and efficient P engines are under development

• These engines will change the market for using P in medium- and HD engines & vehicles

• The technologies discussed & technical advantages for P are applicable in high output HD industrial engines, and vehicle engines in classes 3-8.

• Many of these advantages & some of the technologies can be used to lesser degrees in OEM light duty vehicles, too

• Have to get competition in engine availability
So Where Do We Go w P in Medium & HD Applications?

- Classes 3-7 should be ripe for P
- How do we get OEMs involved to take advantage of P vehicles?
- How big do we go?
- What about class 8?
- Your thoughts and questions?