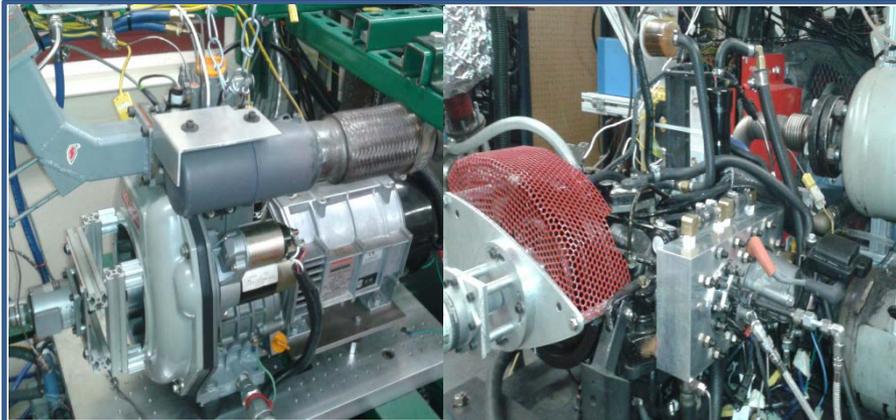


Engine Research Center (ERC) – UW-Madison



Advanced Combustion

- Yanmar L70AE (0.3L)
- BRP 2-stroke (0.4L/cyl)
- CAT SCOTE (2.3L)
- Hybrid Car (0.5L/cyl)



- Largest US academic research center focused on IC Engines
- >65-year existence (Est. 1946)
- DOE, DOD Consort/Industry
 - **WSEC - Wisconsin Small Engine (6+)**
 - **DERC - Direct-injection Engine Research (30+)**

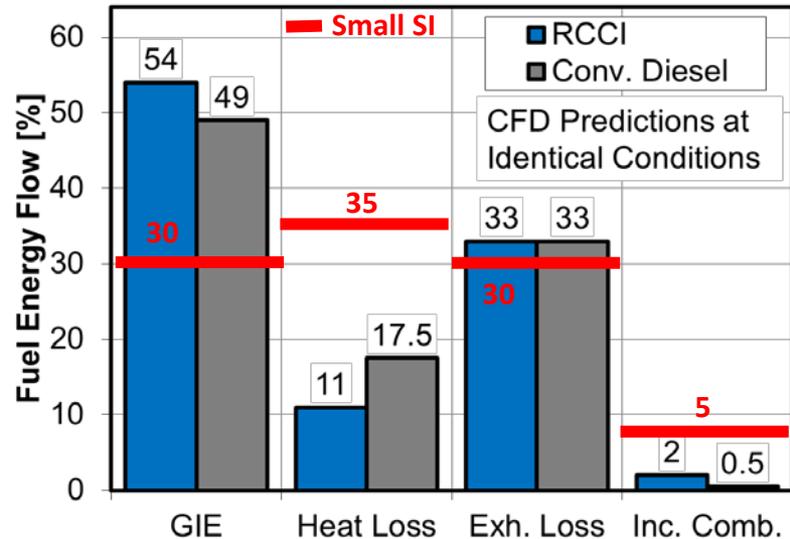
Technical Expertise

- High efficiency, low emission combustion
- High-fidelity engine codes, detailed chemistry for emission prediction, spray & turbulence modeling
- In-cylinder gaseous species measurement and high resolution spray analysis
- Control strategies for advanced comb
- Fuel , air, and combustion optimization
- Aftertreatment experiments and modeling

Engine Research Center (ERC) – UW-Madison



- Why engine research at a university; IC Engines have been around for over a century - surely everything is known?
 - ✓ Significant advancements continue to be made every year.
 - ✓ Advance combustion engines are 10% more fuel efficient than Diesel and 75% more than small SI engines



CHP Research Center Needs for Improved Market Acceptance

- Scaling current larger engine technology to 1 to 5 kW engines
- Reduced heat rejection and friction from small engines
- Higher combustion and brake efficiency at low cost
- Meeting emissions and noise requirements
- Fuel flexibility without converting to other forms
- Achieving long durability with small engines (e.g. 5 years)
- Trade-off of different features (size vs efficiency, size vs cost...)

Engine Research Center (ERC) – UW-Madison



ERC Tools for Small-scale CHP Research Needs

- Two Industry Consortia for Pre-competitive Research
- Validated High Fidelity Engine Simulation Models
 - ✓ High Efficiency Low Temperature Combustion (i.e. RCCI, GCI, PCI)
 - ✓ Detailed cyclic Heat Transfer and Reduction Technologies
 - ✓ Highly Accurate Emissions and Noise Predictions
 - ✓ Flexible Fuel Combustion (including NG, Bio, dual, etc)
 - ✓ Combustion Simulation of Low Cost Hardware
- Seven (7) Small Engines in complete Dyno Test Labs
- In-cylinder gaseous species measurement, high resolution spray analysis for improved understanding and Simulation

