

High Efficiency 370kW Microturbine with Integral Heat Recovery

DOE AWARD DE-EE0004258

Capstone Turbine Corporation/Oak Ridge National Laboratory/NASA
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Project Objectives

- Design a small turbine power generation system with the following:
 - 42% Engine Efficiency
 - 85% Total System Efficiency with CHP
 - 2007 CARB-level emissions without combustion after treatment
 - Improved Customer Value: \$600/kW
- Technical Challenges
 - High Temperature Hot Section Radial Turbine
 - Multiple Highly Efficient Waste Heat Recovery System
 - Dual Spool Dual Engine/Generator Control Algorithms

Higher Efficiency & Low Emissions at Competitive Prices

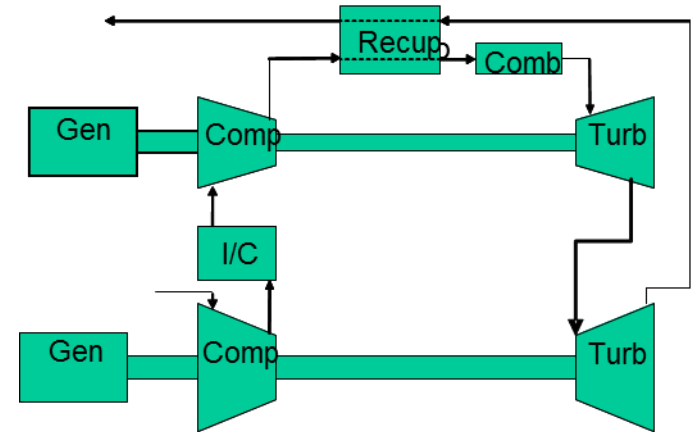
Technical Approach

Current Small Turbine Technology Approach:

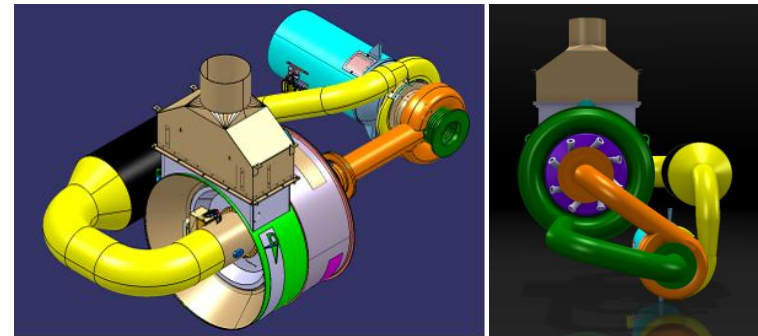
- Single Stage compression and expansion
- No coordinated heat recovery system
- Traditional nickel alloy high temperature metals limit engine efficiency

C370 Unique Approach:

- Builds on Capstone's unique design approach that uses air bearings, power electronics and advanced combustion system
- Water cooled components used for coordinated heat recovery
- Two stage compression and expansion on two independent shafts with full speed control authority
- Bi-metallic single crystal alloy turbine wheel allows step change in engine efficiency



C370 Engine Cycle



C370 Production Concept Layouts

Technical Approach

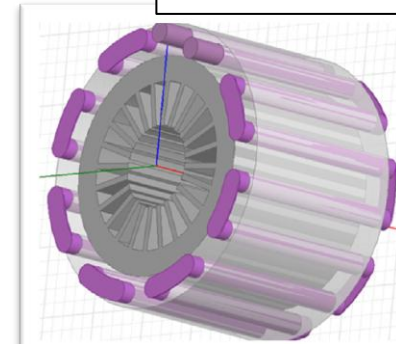


C370 Innovations:

- Using a single water system to cool/capture heat from multiple components: targeting a 2% to 4% increase in overall efficiencies
- Working with ORNL to design a radial turbine wheel with single crystal alloy bonded tips: targeting a 2% to 4% increase in engine efficiency
- Using two independent shafts with full speed control authority will allow high engine efficiencies at part load conditions while also reducing the need for bleed and bypass valves components.



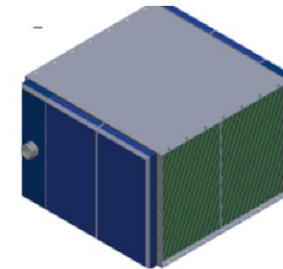
Water Cooled Power Electronics



Water Cooled Motor/Generator



Water Thermal Storage

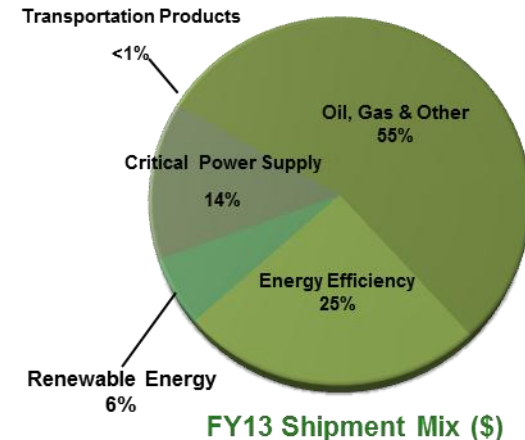
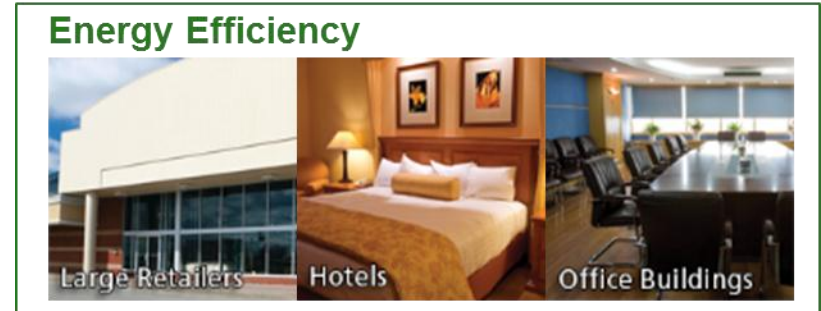


Air to Water Intercooler

Water Cooled Components

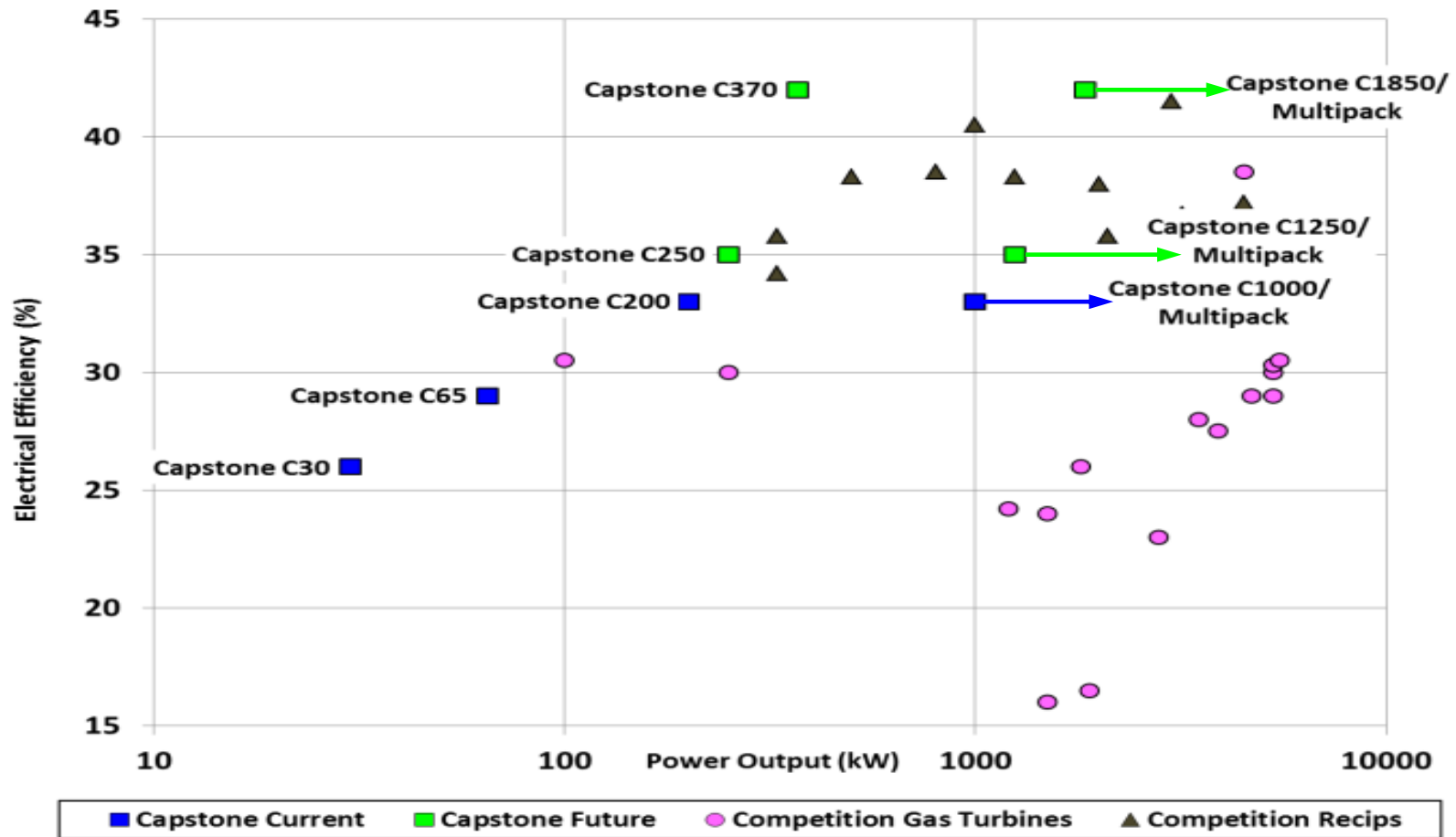
Transition and Deployment

- Technology developed will make distributed generation not just an option, but the better option to centralized power generation
 - Lower Emissions
 - Higher Delivered Electrical Efficiency
 - Heat recovery for localized heating and cooling
 - Cost competitive electricity
 - Support for Smart Grid infrastructure



C370 Technology has the potential to transition us away from the centralized generation approach

Measure of Success



Capstone C370 is Leading Edge Technology

Project Management & Budget



Total Project Budget	
DOE Investment	\$5,000,000
Capstone Cost Share	\$6,721,937
Project Total	\$11,721,937

On Budget & Schedule

Results and Accomplishments

- Prototype Engine Layout Nearly Complete
 - Volute geometries are critical for high engine efficiency
- Bonding of High Temperature Turbine Wheel Blade
 - Bonding process proven successful on a single blade tensile test showing strength in excess of 100 ksi (target was 40 ksi)

