



# Capstone MicroTurbine for the Oil and Gas Industry

Blake Zimmerman  
Pumps & Service  
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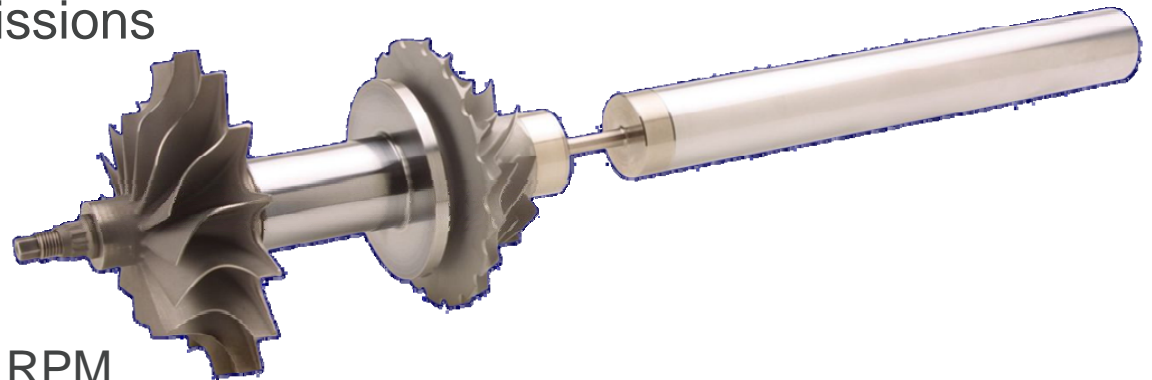




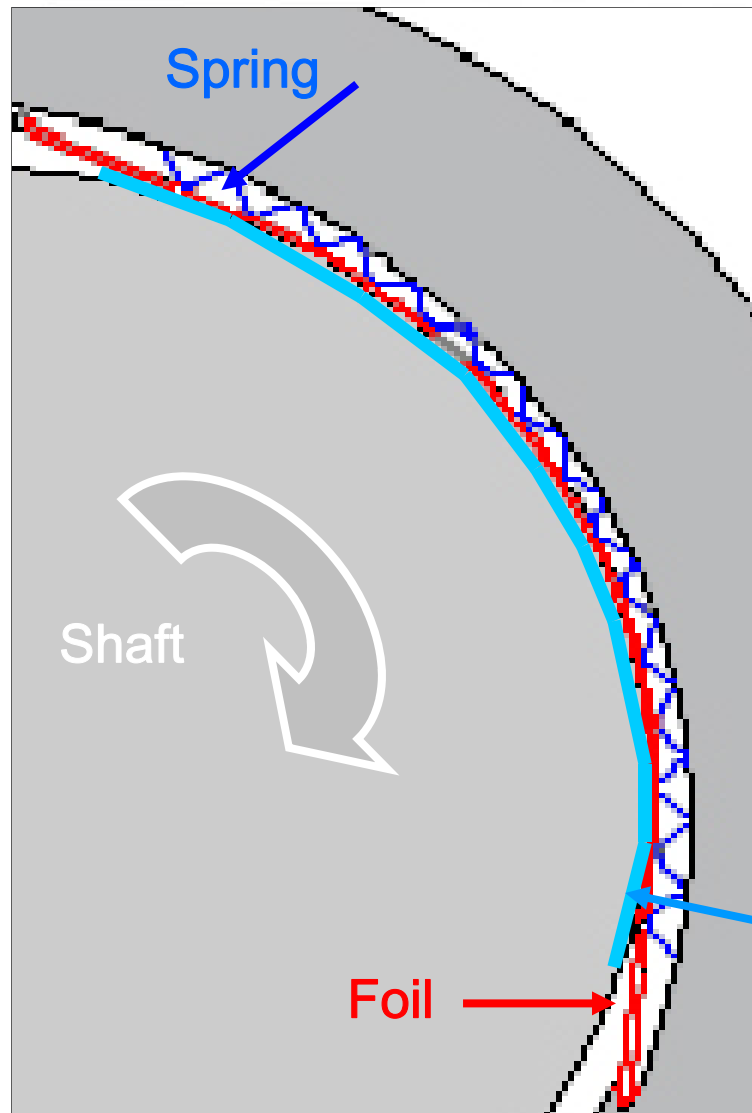
# What is a MicroTurbine?

Power generator driven by a small scale gas turbine

- Electrical Efficiency of 26-33%
- CHP can achieve thermal efficiency of 80%+
- Wide range of fuels – 350 btu to 2500 btu
  - Up to 7% H<sub>2</sub>S with C30
- Extremely Low Emissions
- Air Bearings
- Air Cooled
- Dry Engine
- Variable Speed
  - 45,000 to 96,000 RPM
- Proven reliability
  - >25 million hours of operation



# The Capstone Difference



## AIR BEARINGS

Within 5 rotations of the shaft, we accelerate to around 20,000 RPM. This achieves lift off.

A boundary layer of air will form between the foils and the shaft.

This layer of air will effectively lift the foils up and away from the shaft.

The springs provide counterforce to the foils and air, effectively keeping the shaft centered on its cushion of air.

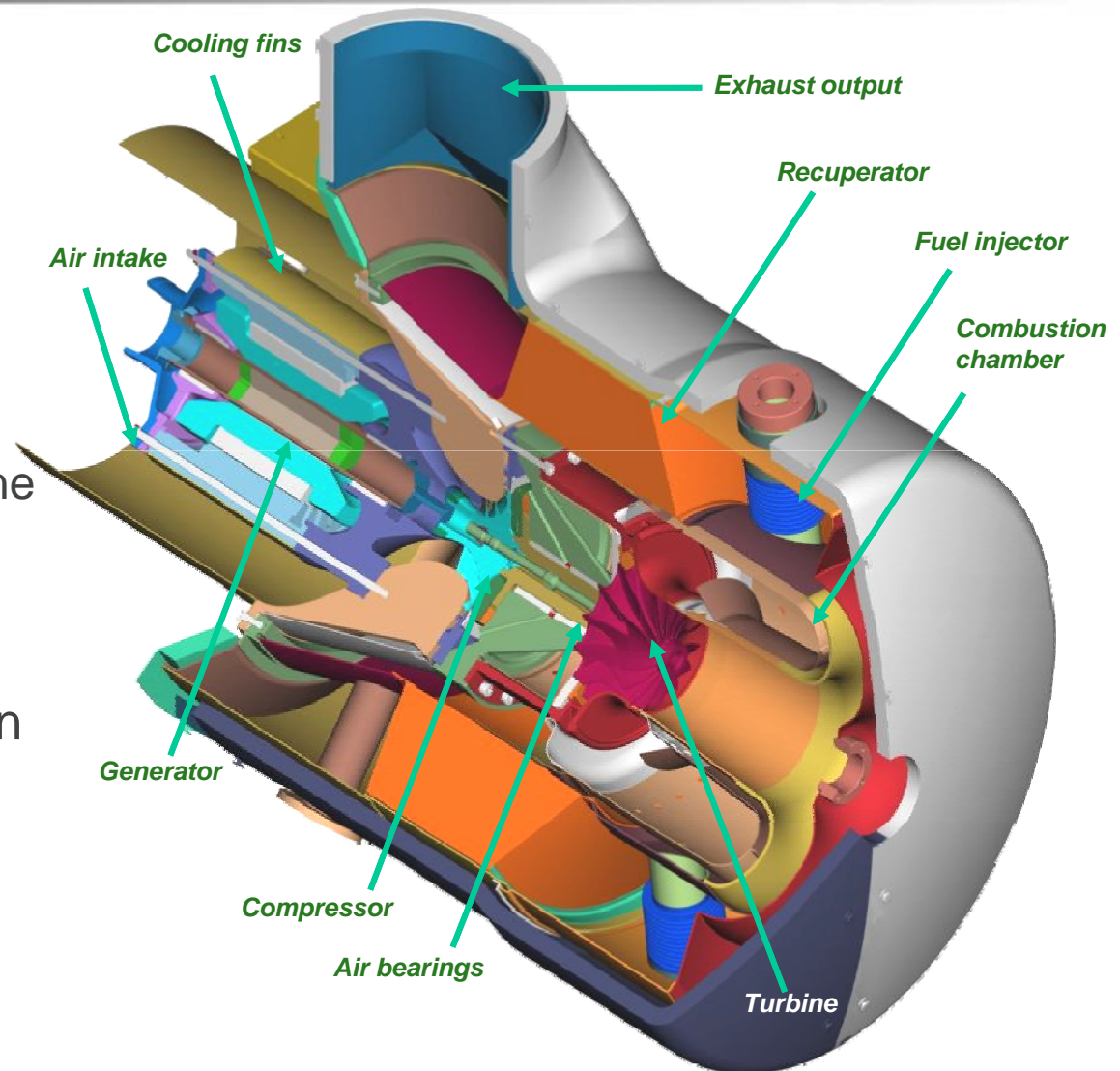
After lift-off there is no metal-metal contact in the bearing, hence no friction and no wear.

**Foil** → **Boundary Air**



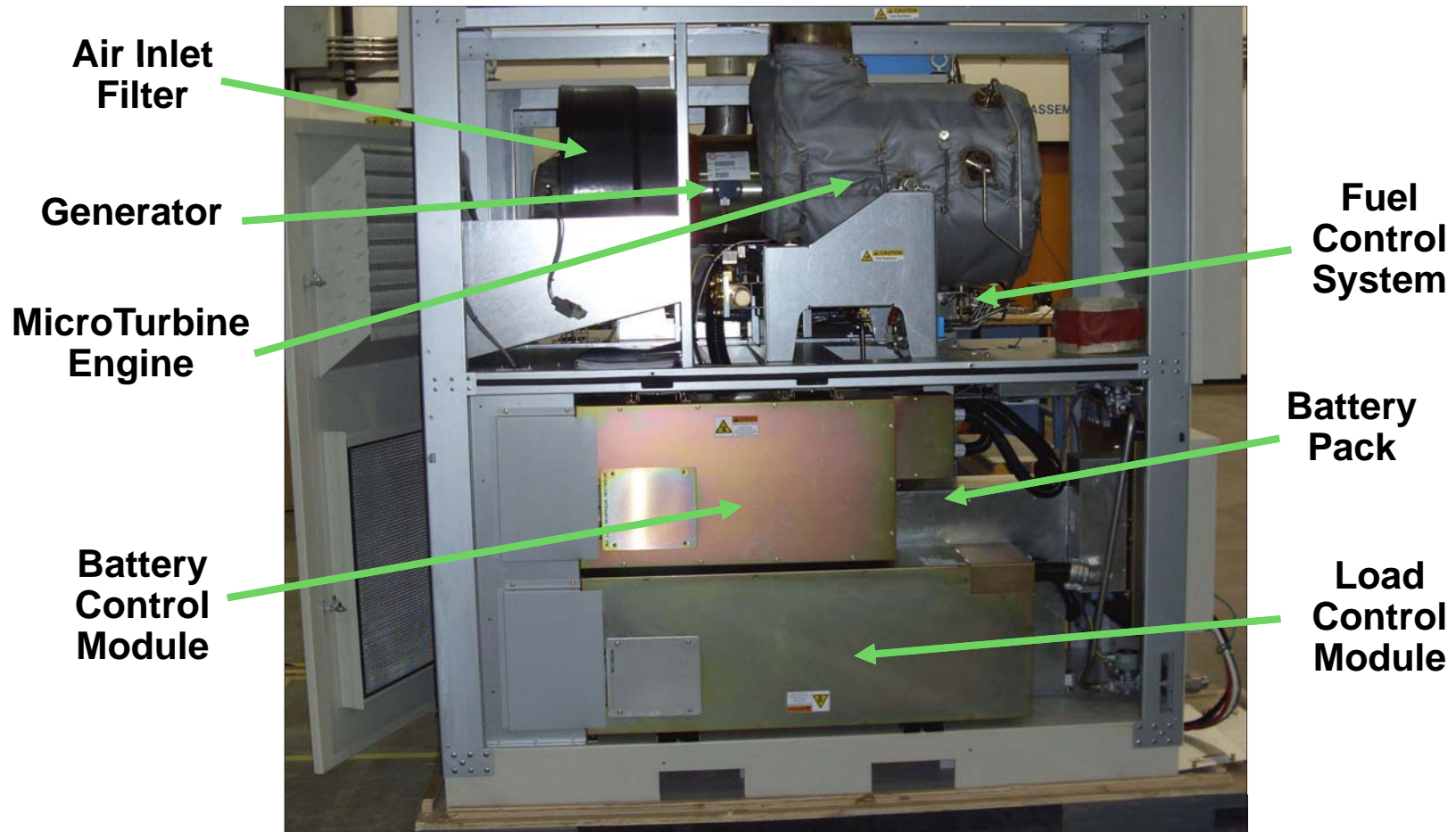
# Inside the Capstone MicroTurbine

- No gearbox, pumps, or other mechanical components
- Recuperated Engine
  - All welded design
  - Fabricated by Capstone
- Permanent magnet alternator
- Lean premix combustion





# Key Components (C65)



# Capstone Products



**Available with gas & liquid fuels**



**C30 & C65**



**C65 CHP**



**C200 & C200 CHP**



## C600/C800/C1000 Series

- 3, 4, or 5 of the C200 series turbine are installed in a 30 foot enclosure for 600kW, 800kW, or 1,000kW output



# Capstone Products



**C30 & C65  
Class I Div 2  
ATEX Zone 2**



**C30 & C65 SS**



# Maintenance

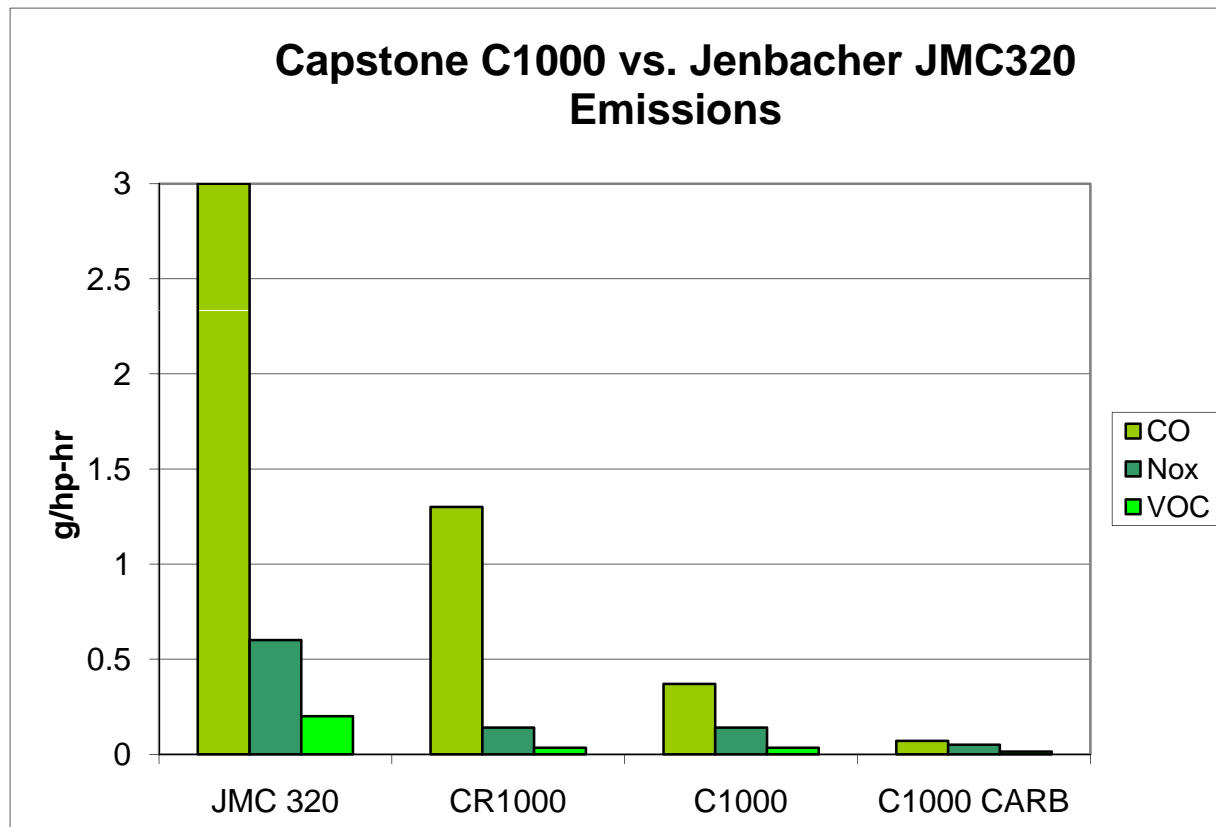
8,000 Hours (4,000 Hours for C1000)	Air Filters	Clean/Replace
	Fuel Filter	Replace
	Igniter	Replace
20,000 Hours	Injectors	Replace
	Battery Pack	Replace
	Thermocouple	Replace
40,000 Hours	Engine & <u>Generator</u>	Exchange

- *Typical Maintenance cost of \$0.003 kWh vs. \$0.015 for Recips*
- *Average of 6 Hours of Planned Maintenance per year*
- *Factory Protection Plan*



*Inspecting unit at 20,000 hrs  
on an offshore platform*

# Ultra Low Emissions



- Much Lower Emissions Than Traditional NG Reciprocating Engines



# Benefits of MicroTurbines in O&G



*2 C65's as prime power for LACT unit*

- Low Maintenance
- Lower Total Cost of Ownership
- Short Commissioning Period
- Easy Interconnects to Local Grid or Bus
- Ease of Operations
- No Lubricants or Coolants
- Small Footprint, Light Weight
- < 65dBA Acoustic Emissions
- Ultra-low emissions with no post-combustion devices or chemicals
- Accepts 350-2500 Btu w/up to 7% H<sub>2</sub>S (C30)



# Exhaust Heat Utilization - CHP

- Heat to glycol or hot oil systems
- Preheat fuel gas to larger turbines
- Preheat water to steam boilers
- Direct heat to oil/water separators
- Additional heat to regas LNG
- Building or utility heat
- Amine plant applications

*Heat from two C30s running on untreated wellhead gas goes to "heatertreater" separator*



# Oil & Gas in North America



- EagleFord Shale
- San Juan Basin
- Haynesville Shale
- Marcellus Shale
- Barnett Shale
- Bakken Shale
- North Slope Alaska
- Canada
- Fayetteville Shale
- Jonah Field
- Piceance Basin
- Permian Basin



- **More than 70 O&G customers worldwide**
- **Over 80 packages installed offshore**

**~ 80% of all Microturbines  
Sold Worldwide are Capstone**



# Points of Contact

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