



Energy 2002

Session 5

Distributed Energy Barriers and Opportunities – Industry Perspective

by Andrew Wang

CHP Applications Manager



A Microturbine Perspective

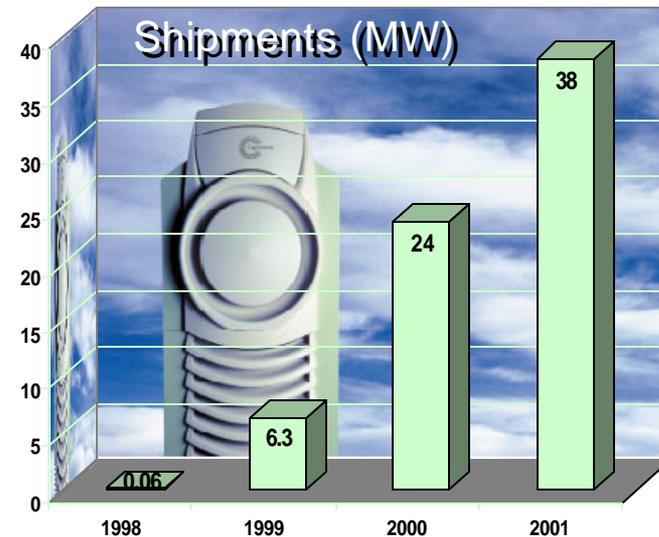
- Capstone Turbine – the Company
- The MicroCHP Opportunity
- Real World Examples
- Barriers to Overcome
- Questions





A Big Small Company

- Founded 1988
 - Capitalized by venture capital in 1993, led by Ben Rosen
 - Raised \$400M in private placements and IPO
 - IPO June 2000: Nasdaq CPST
- 100% focused on MicroTurbine
 - 30kW (NG, Diesel, Biogas..)
 - 60kW (NG)
- 60 patents, 100 pending
- 275 employees; more than 75 in engineering R&D
- 2,200 30/60-kW production units sold and shipped
- 2 million+ cumulative hours of operation worldwide





Uses of the Capstone MicroTurbine



MicroCHP

Hybrid Electric Vehicles



Major
Application
Successes



Resource Recovery



Power Quality / Reliability



The MicroCHP Opportunity

Three Major Applications

- ✓ Direct Exhaust
- ✓ Hot Water
- ✓ Cooling



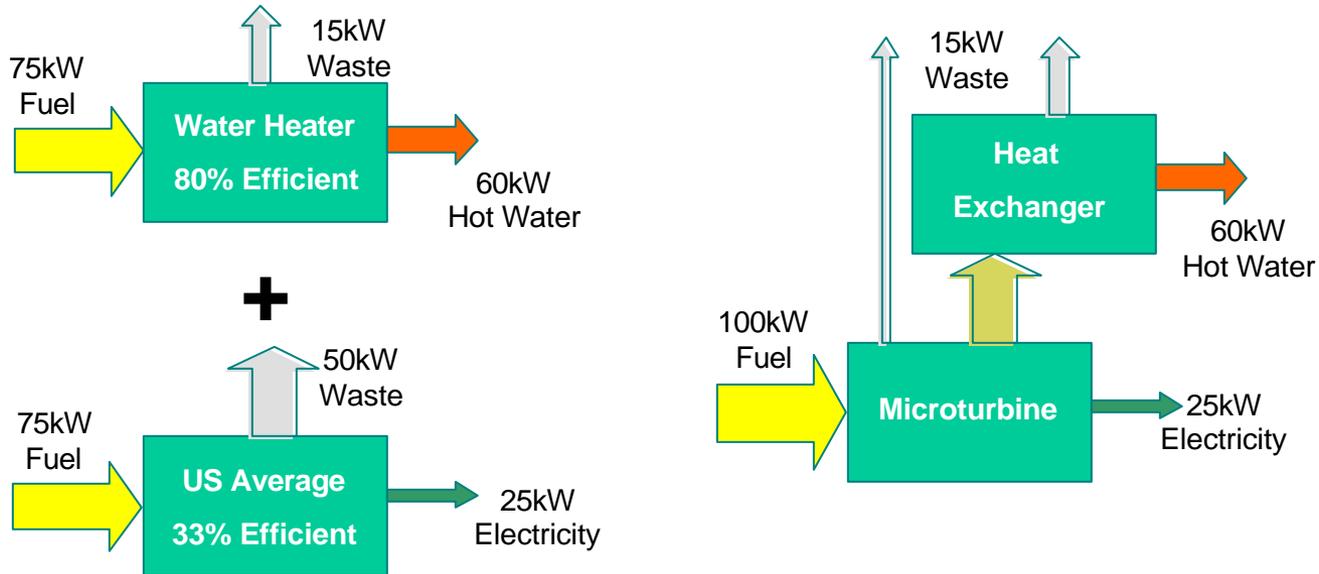


Why MicroCHP Makes Sense

- ✓ Clean Emissions → Install Anywhere
- ✓ Onsite Generation → Secure Power
- ✓ High Efficiency → Economical



MicroCHP vs. Traditional Systems



Traditional

- 57% Total Efficiency
- 0.1 lb/hr NO_x
- 60 lb/hr CO₂

MicroCHP

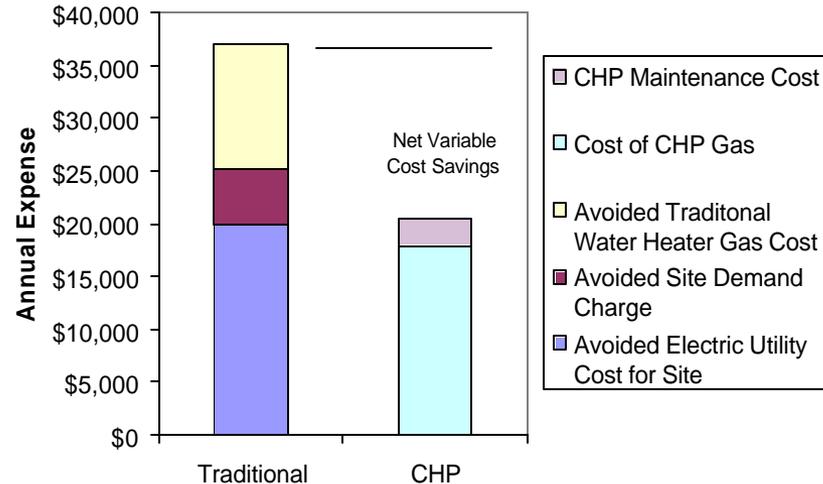
- 85% Total Efficiency
- 0.01 lb/hr NO_x
- 45 lb/hr CO₂



MicroCHP Payback Example

Example CHP Systems with the following Characteristics:

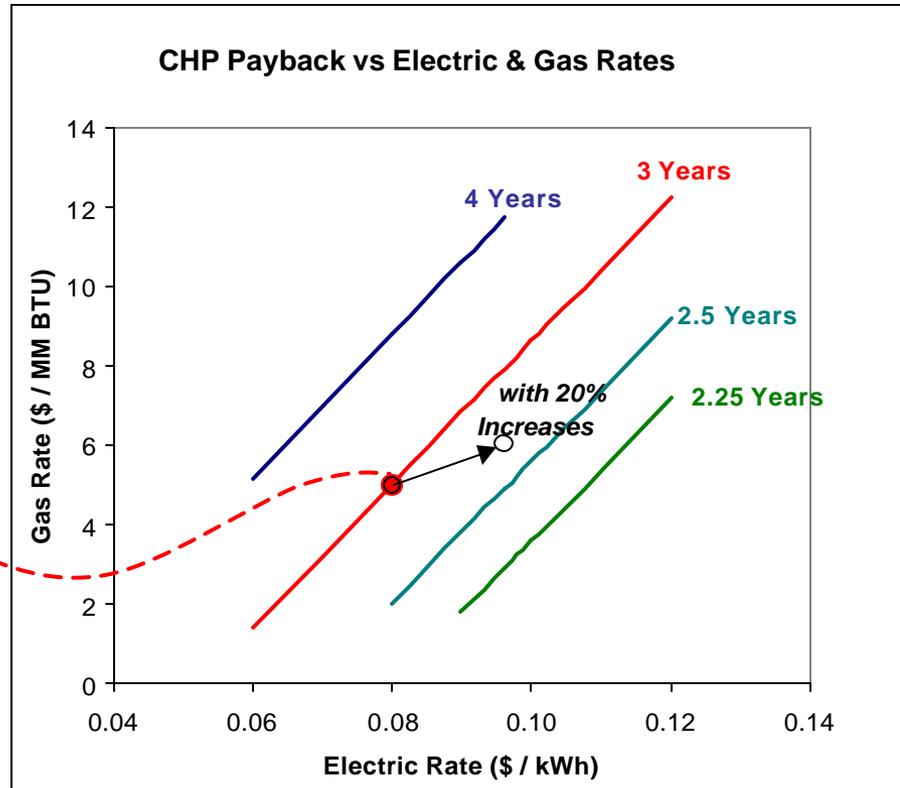
60kW Rated Output
\$1,100 per kW System Cost
50kW Avg. Electrical Output
100kW Thermal Load
5,000 hr per year Operation
Electric Utility Rates:
 \$.08 per kWh
 \$15 Demand
Gas Utility Rates:
 \$5 per MM BTU
\$.01 per kWh Maintenance Cost



3 Year Simple Payback !!



MicroCHP Rate Sensitivity



Previous Example:

\$0.08 / kWh

\$5 / MMBtu



Sanyo Chemical Factory

Nagoya, Japan

- Replace traditional NG dryers
 - 44 C60s
 - Heat to drying process
 - 90% total system efficiency





California State University, Northridge

Northridge, CA

- Boiler offset
- 6 x Model 330
- 2 Unifin heat exchangers
- 10 am – 6 pm operation





Harbec Plastics Processing Facility

Rochester, NY

- Space Heating for Warehouse in Winter
- Air Conditioning for Offices in Summer
- Reliable Electric Power All Year Long



20 Capstone Model 330 MicroTurbines



200 Ton Absorption Chiller

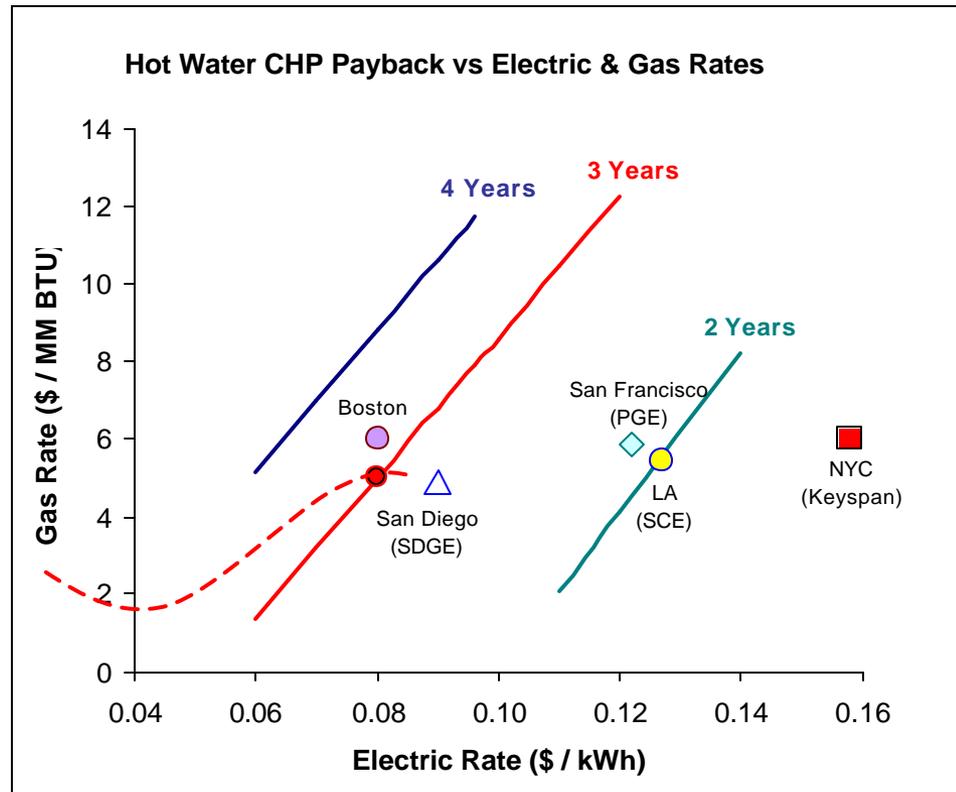


Barriers (i.e. Lessons Learned)

- Economics
 - ✓ Doesn't Work Everywhere
 - ✓ Government Incentives Help
- Air Quality Permits
- Utility Interconnection
- New Technology Risk



Payback Periods across America



Earlier Example:

\$0.08 / kWh

\$5 / MMBtu



Government Incentives Help

- State Energy Programs
 - NYSERDA
 - CEC
- AB970 “self-generation incentive” in California
 - Up to 30% Rebate for Microturbines with CHP
 - Up to 40% Rebate for Fuel Cells with CHP
 - Up to 50% Rebate for Renewables (wind, solar, etc.)
- DOE Support for DER Product Development
 - B CHP projects
 - FEMP assistance



Streamlined Air Permitting

Clean Distributed Energy is Easy to Site!



South Coast Air Quality Management District (SCAQMD) supported the installation of fifty Capstone MicroTurbines at Lopez Canyon Landfill through its Priority Reserve Fund



Reduced Interconnection Challenges

- Streamlining the Process for Qualified Systems
 - CA: Rule 21
 - NY: Standardized Interconnection Requirement (SIR)
 - TX: PUC Substantive Rule 25.211 and 25.212
- UL 1741 Inverter Standard
- IEEE 1547 Interconnection Standard in Process
- USCHPA national interconnection language and equitable tax treatment for CHP assets



Overcoming New Technology Risk

Increasing Real World Experience

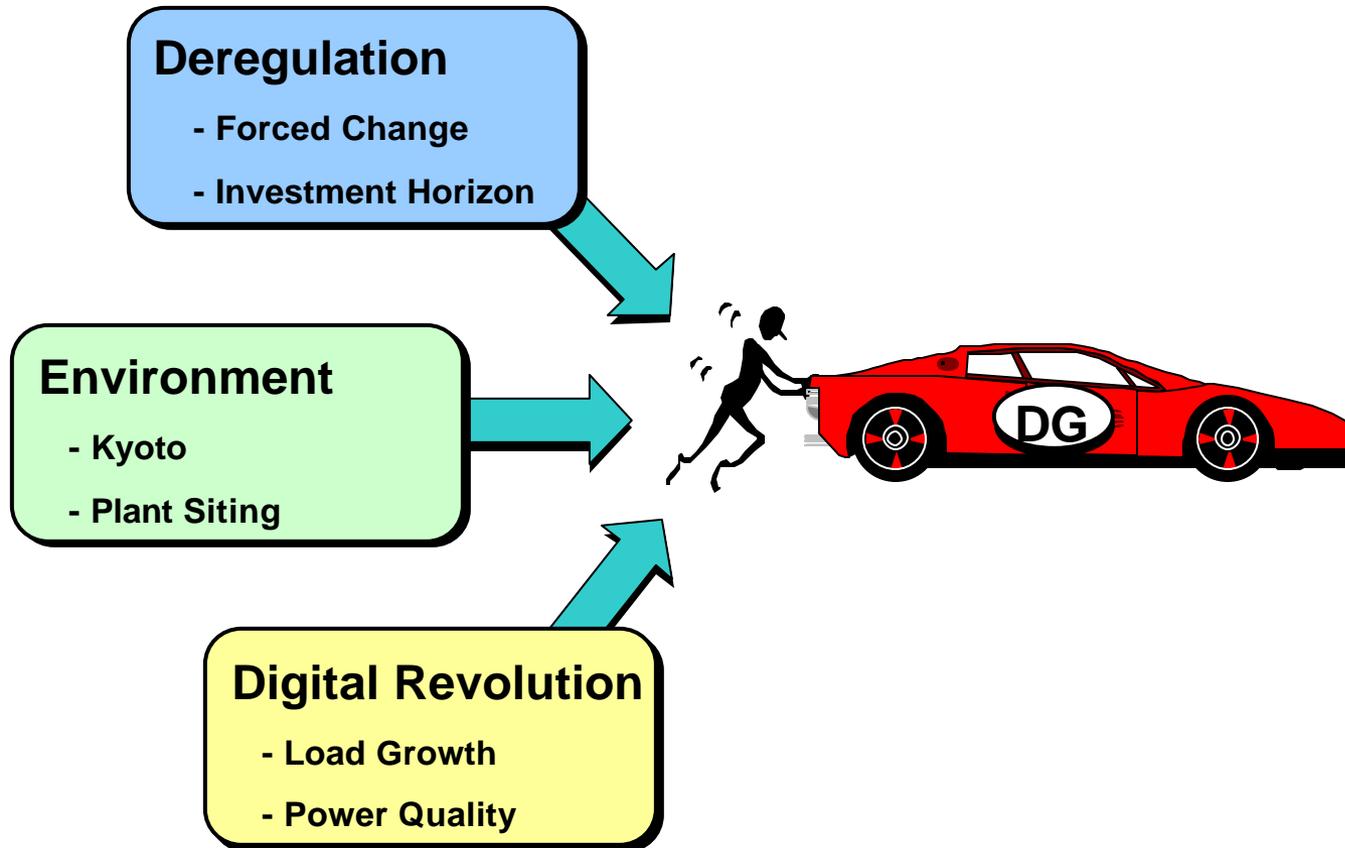
>1,500 Capstone Microturbines
installed and operating

Proven Reliability in Harsh
Environments





In Summary...





www.microturbine.com

***Power when and where you need it.
Clean and simple.
Now.***



Additional Material



MicroTurbine Power Systems



- 30-60 kW power output
- Multi-fuel capability
- Very high reliability
- Very low maintenance
- Very low emissions (<9 ppm NOx)
- 2 to 100 unit multipacking
 - <30 kW to 6 MW
- Very high CHP efficiency
- UL 1741 & 2200-certified



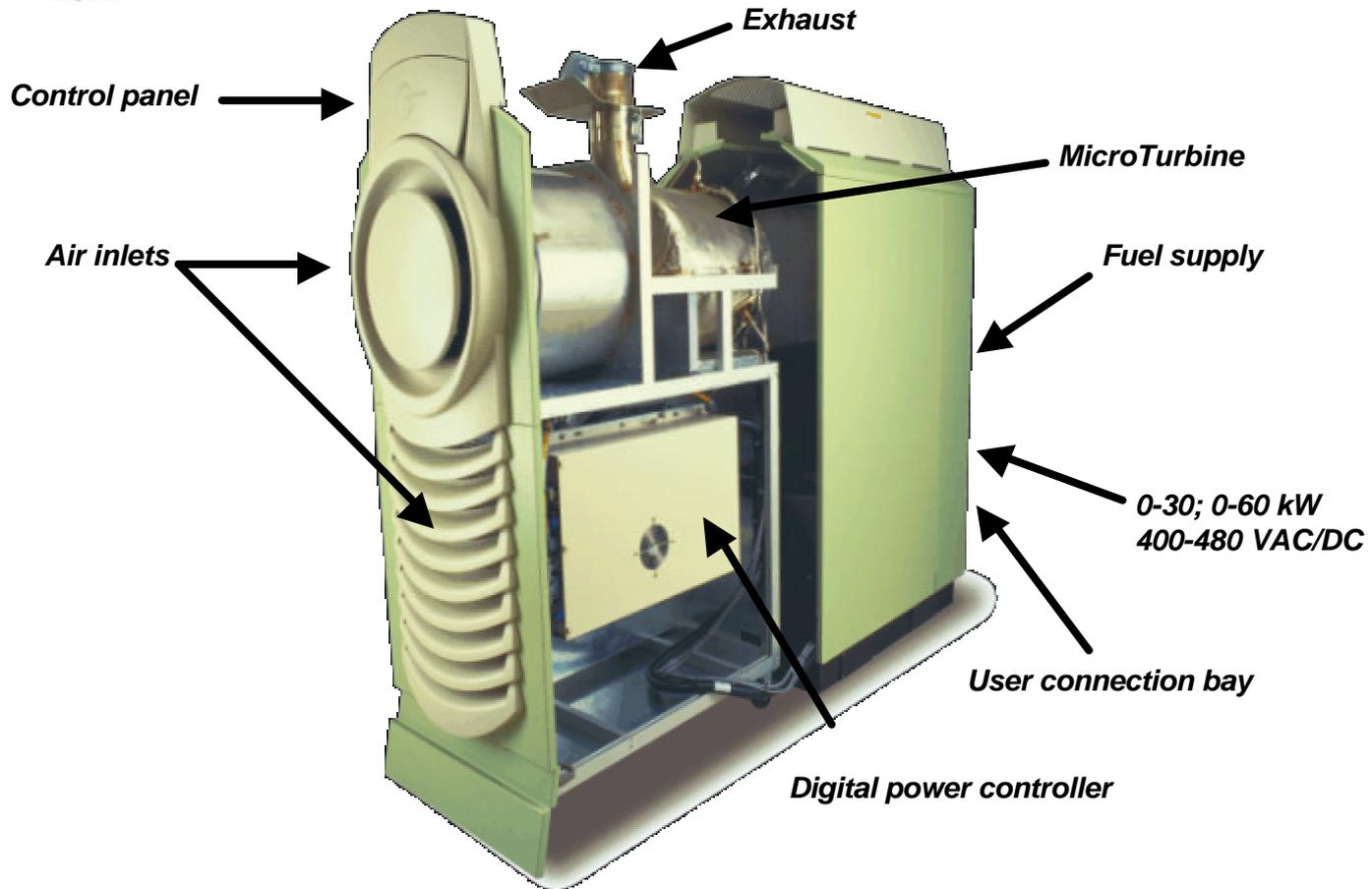
“Most Innovative Commercial Technology”
– FT Energy Global Awards 2000



“Most Innovative”
– Gas Industry Awards UK 2001

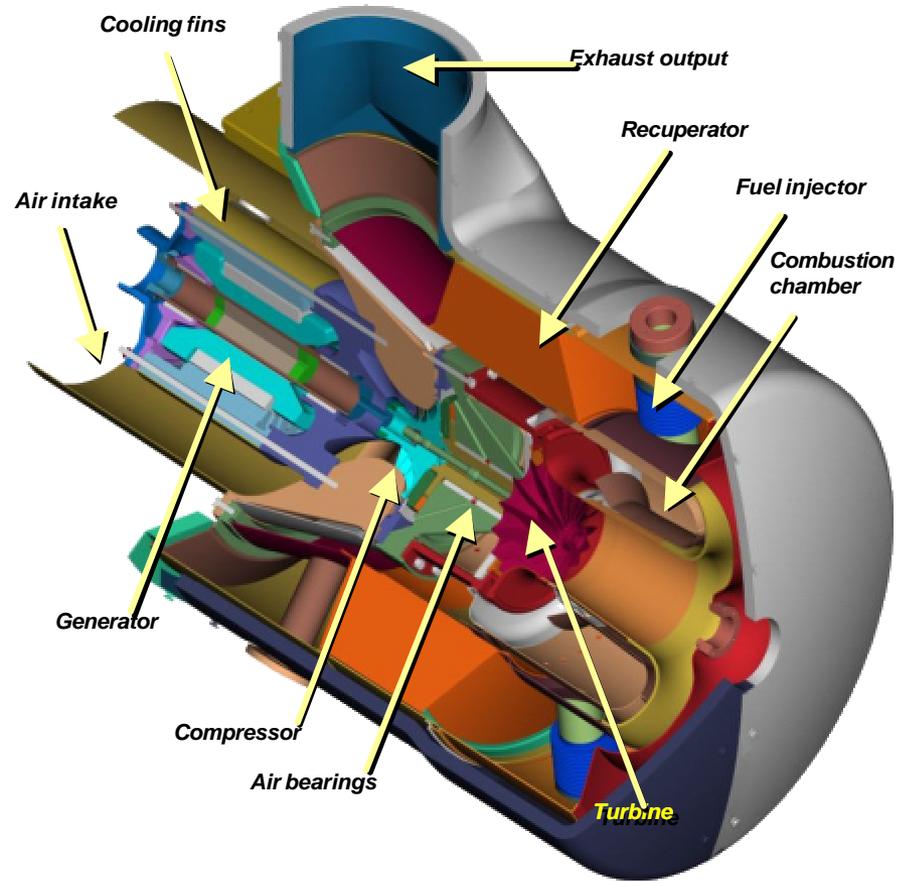


Inside the Capstone





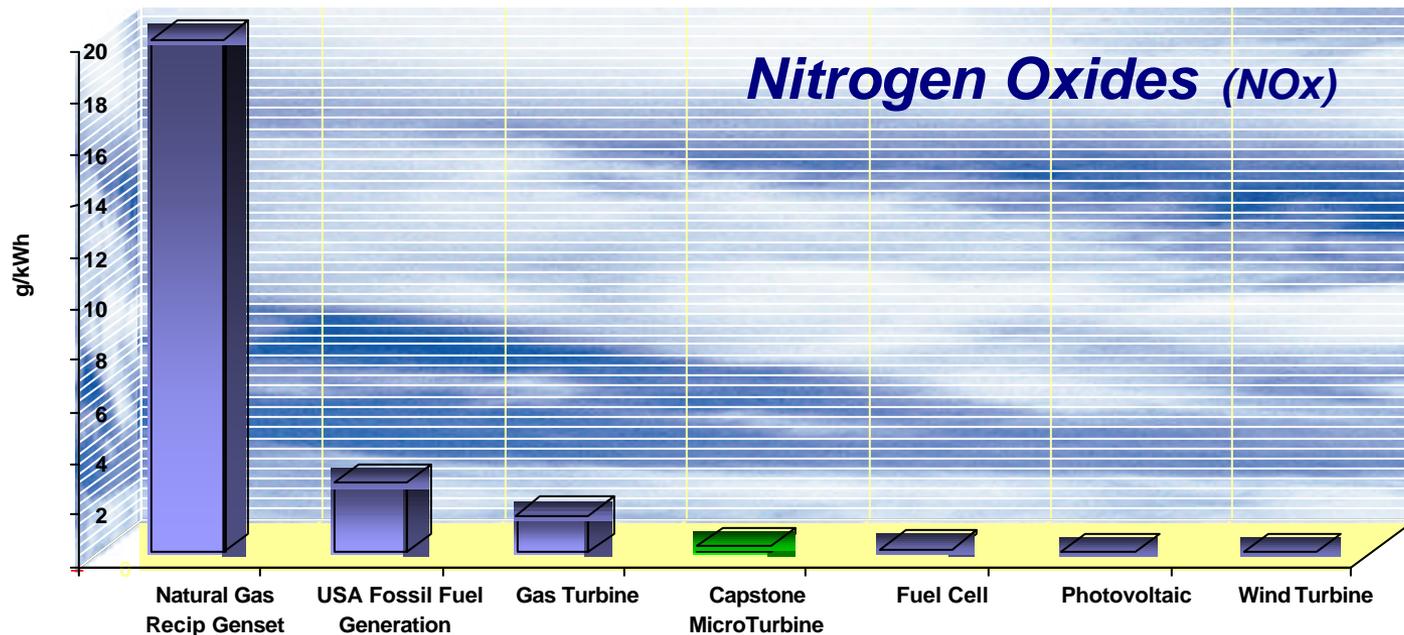
Deep Inside the Capstone





Ultra-Clean Combustion

The Capstone MicroTurbine approaches the performance of zero-emissions technologies, but at a fraction of the cost...



Source: EPA Report AP-42: Compilation of Air Pollutant Emission Factors



Active Public Programs

- **Future Combat Vehicle Systems (FCVS)**
DARPA & Boeing, remote-controlled hybrid electric vehicle
- **National Missile Defense System**
Stationary CHP for satellite stations
- **South Coast Air Quality Management District (SCAQMD)**
City buildings, POTWs, landfills
- **Los Angeles Dept. of Water & Power (LADWP)**
Landfills, public hybrid electric buses
- **Camp Pendleton Marine Base**
6-pack stationary power