

Prime Mover Technologies

Micro CHP

**Capstone[®]
MicroTurbine
Energy Solutions**

ISO 9001:2000
Capstone Turbine Corp.
11211 Industrial Blvd.
Chattworth, CA 91311

TEXAS COMBINED HEAT & POWER INITIATIVE

★
Clean, Efficient, and Reliable Energy to Power Texas

Prime Mover Technologies

Micro CHP

Four Major Market Segments



Large Retailers



Office Buildings

Energy Efficiency



Hotels



U.S. Government



Data Centers



Oil & Gas

Critical Power Supply



Telecom



Hospitals



Landfills

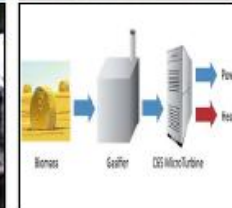


Wastewater Plants

Renewable Energy



Farm Digesters



Hybrid Electric Vehicles



LA Auto Show 2009

Capstone powered supercar debuting

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What is a Capstone
Microturbine?



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- One moving part
- No coolants, oils or grease
- Low total cost of ownership
- Ultra low emissions
- High reliability

Power Ratings

C30 = 30 KW

C65 = 65 KW

TA 100 = 100 KW

C200 = 200 KW

C600 = 600 KW

C800 = 800 KW

C1000 = 1 MW



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95 U.S. Technology Patents

- Air bearing technology
- One moving part
- No coolants, oils or grease
- Ultra Low Emissions

Capstone value proposition

- Low total cost of ownership
- High reliability
- Minimal scheduled maintenance
- No External Synchronization Panels



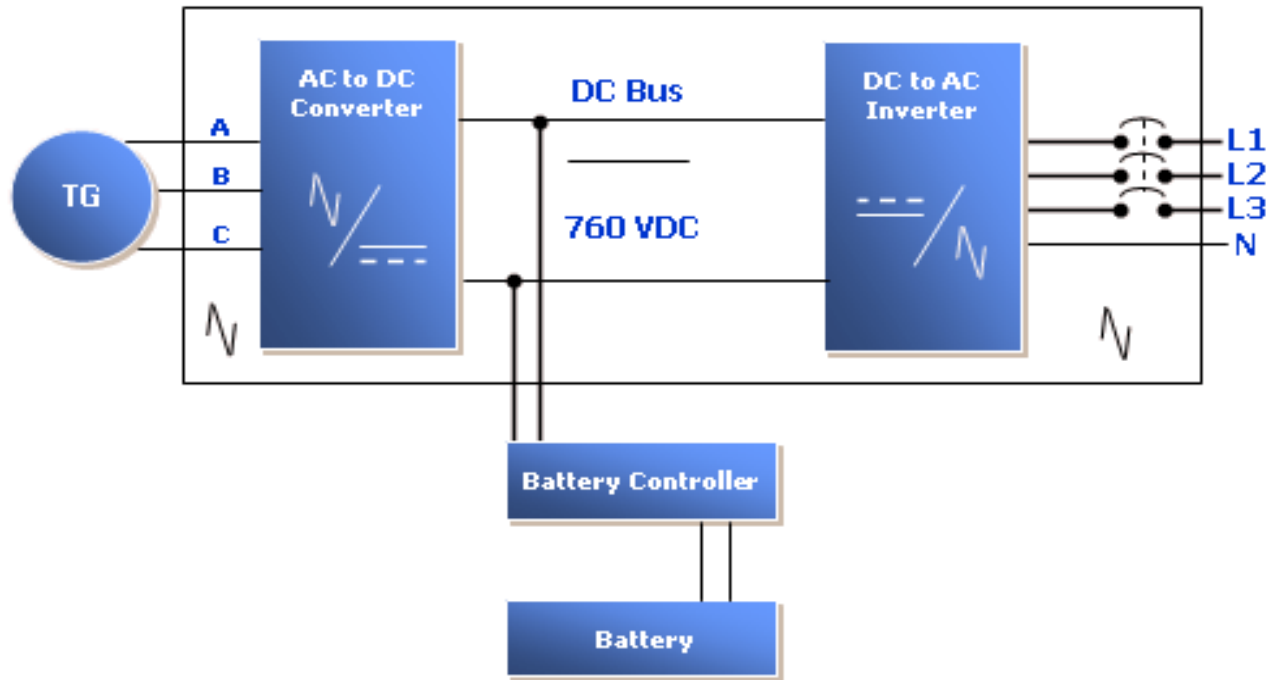
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**Certified to UL 2200 and UL 1741 for natural gas operation (UL files AU2687, E209370)
Complies with IEEE 1547 and meets statewide utility interconnection requirements for
California Rule 21 and the New York State Public Service Commission**

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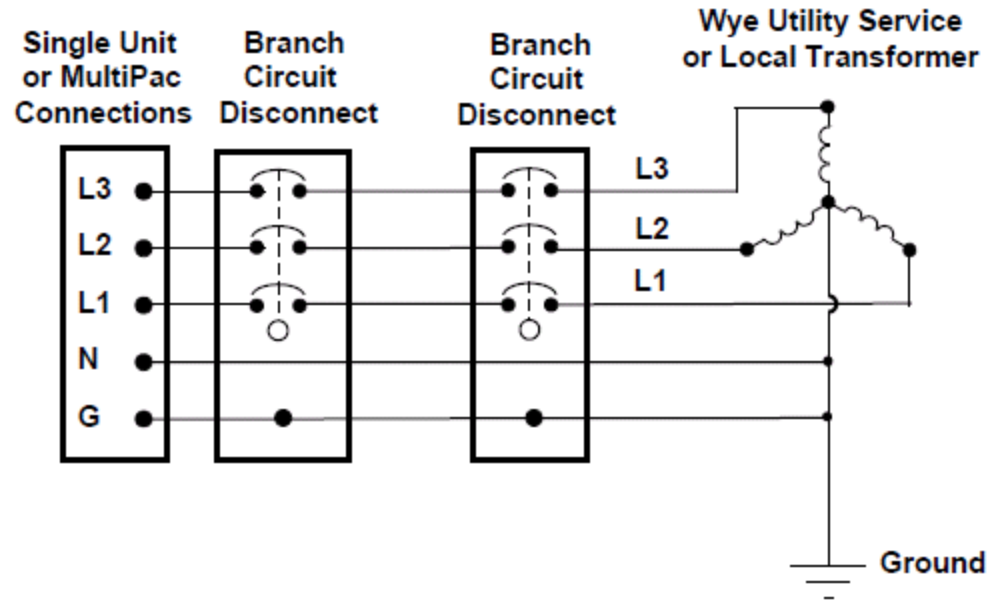
Multiple Modes of Operation

- **Grid Connect**
- **Island (Stand Alone)**
- **Dual Mode (Grid Connect or Island)**
 - **Base Load**
 - **Load Following (with Electrical Priority)**
 - **Load Following (with Thermal Priority)**
 - **Time of Day (with Electrical or Thermal Priority)**



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“Grid Connect” Interconnections

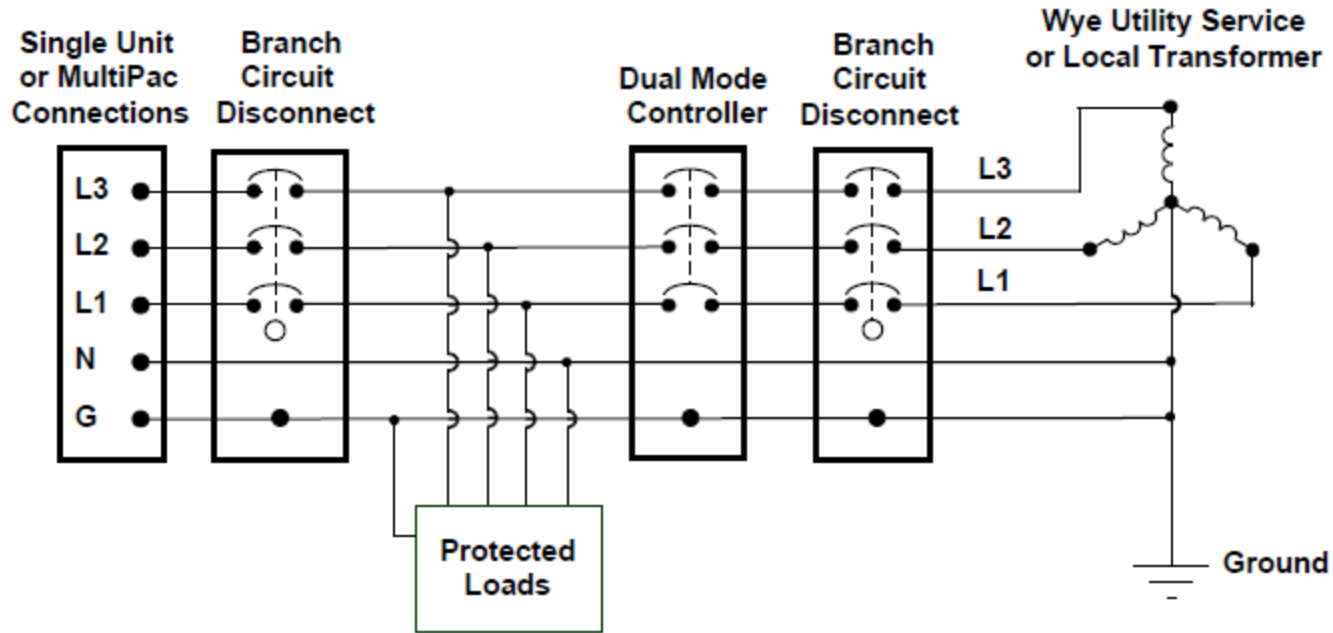
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Dual Mode Interconnections

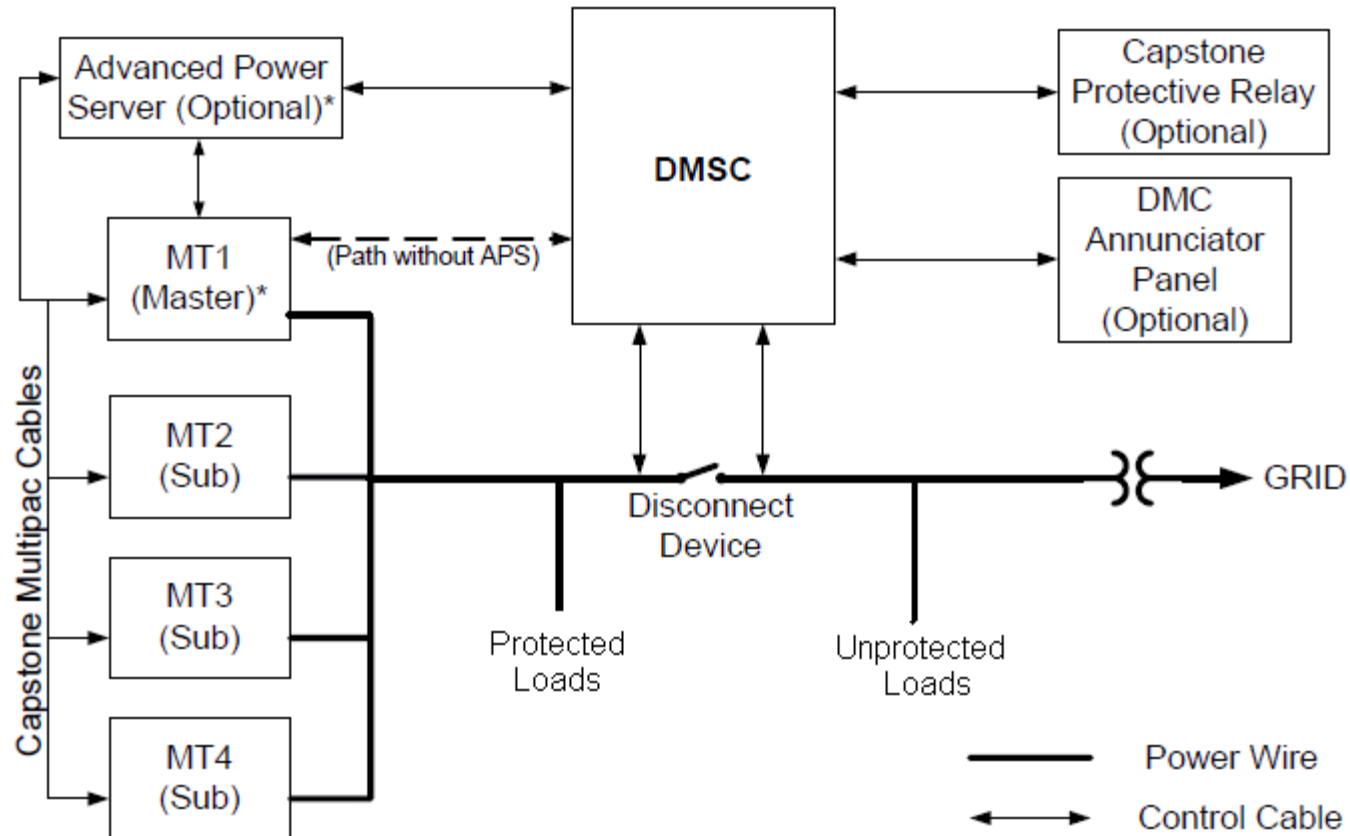
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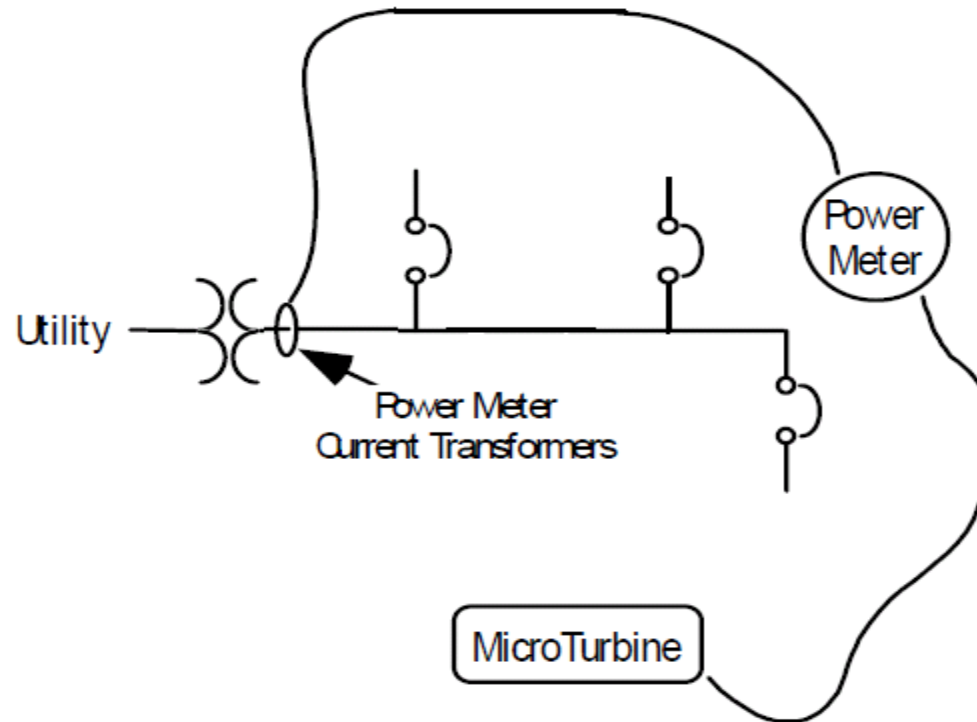
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Typical Power Meter Interconnection

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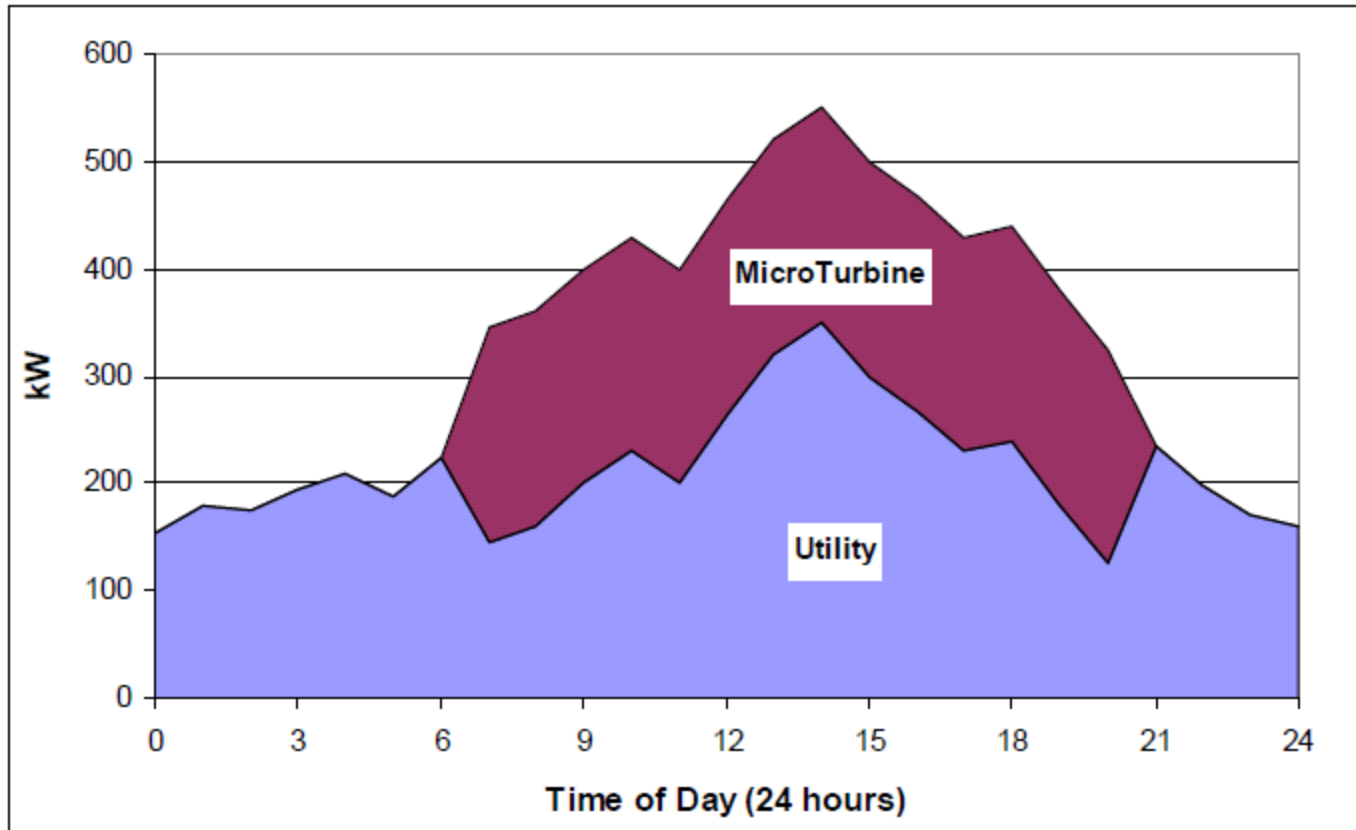


Figure 4-3. Grid Connect Operation in Time of Use Dispatch Mode

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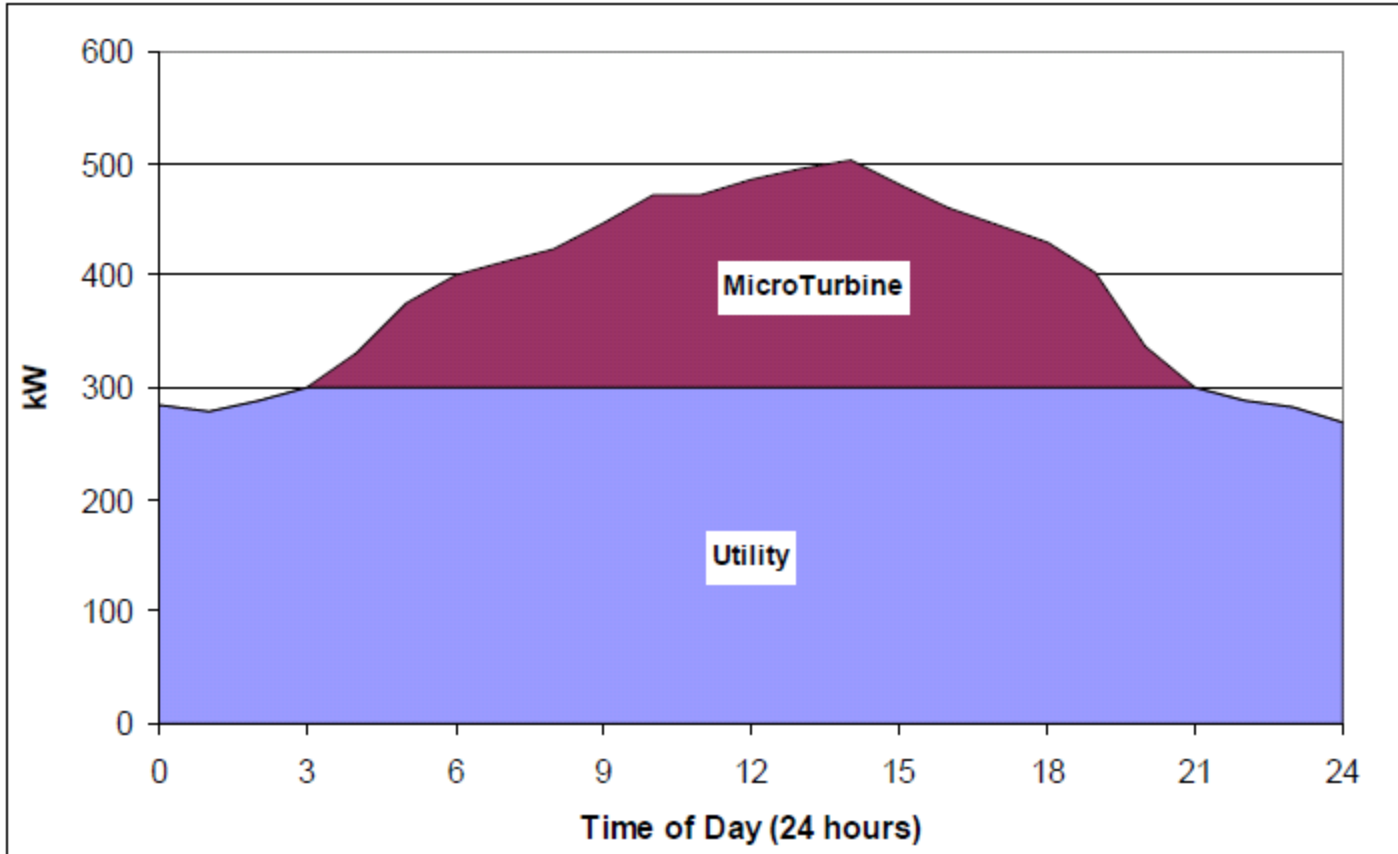


Figure 4-4. Grid Connect Operation in Load Following Dispatch Mode

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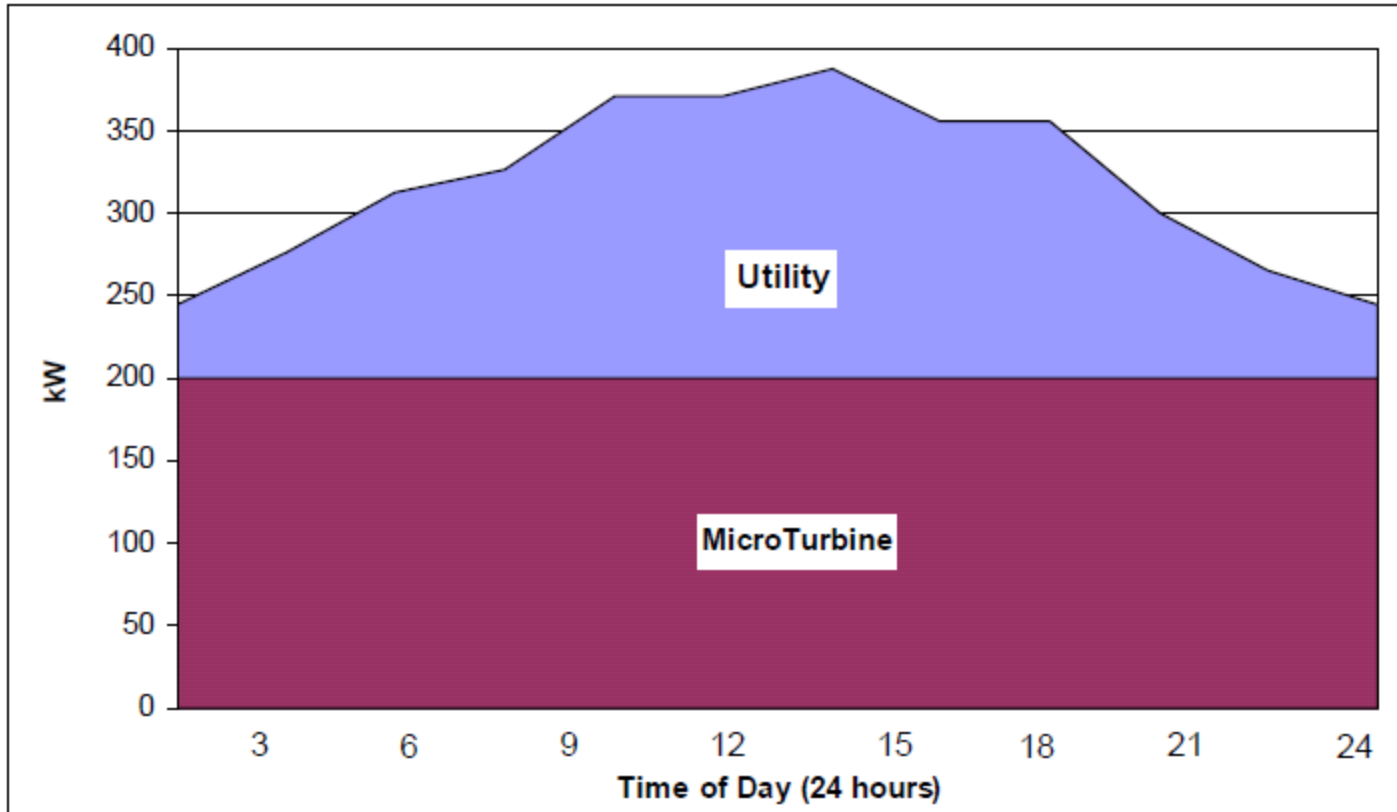


Figure 4-2. Grid Connect Operation in Normal (Base Load) Dispatch Mode

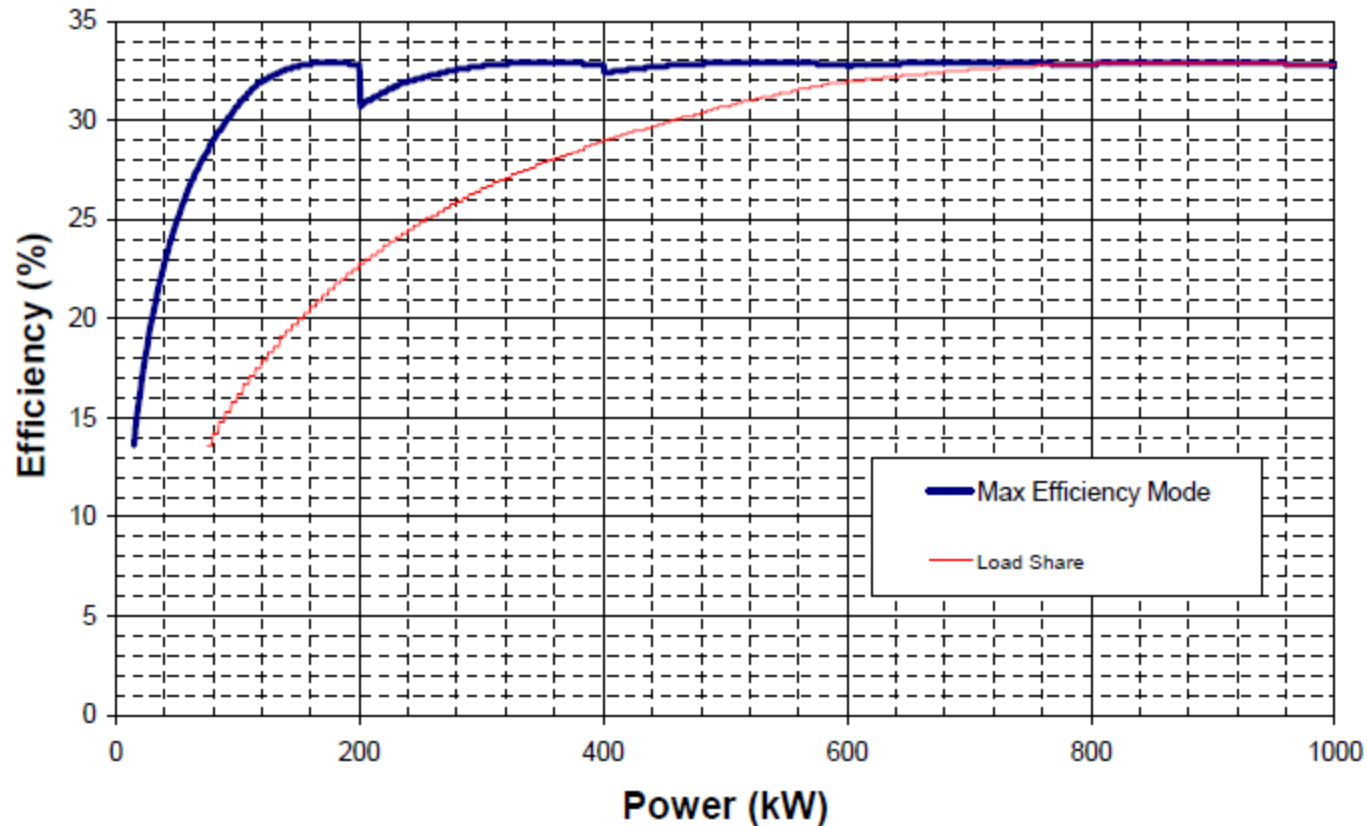
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Capstone 5 C200 units Part Load Efficiency
Max Eff vs. Load Share



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- **6 hrs planned maintenance per year – Average uptime > 99%**

Operating Hours	Maintenance Item	Action Required
8000	Air/Fuel Filters, Igniter	Replace
20,000	Injectors, Batteries	Replace
40,000	Engine/Generator	Overhaul (kit replacement)

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Model	Fuel	NOx	CO	VOC ⁽⁵⁾
C30 NG	Natural Gas ⁽¹⁾	0.64	1.8	0.23
CR30 MBTU	Landfill Gas ⁽²⁾	0.64	22.0	1.00
CR30 MBTU	Digester Gas ⁽³⁾	0.64	11.0	1.00
C30 Liquid	Diesel #2 ⁽⁴⁾	2.60	0.41	0.23
C65 NG Standard	Natural Gas ⁽¹⁾	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas ⁽¹⁾	0.17	1.30	0.10
C65 NG CARB	Natural Gas ⁽¹⁾	0.17	0.24	0.05
CR65 Landfill	Landfill Gas ⁽²⁾	0.46	4.0	0.10
CR65 Digester	Digester Gas ⁽³⁾	0.46	4.0	0.10
C200 NG	Natural Gas ⁽¹⁾	0.40	1.10	0.10
C200 NG CARB	Natural Gas ⁽¹⁾	0.14	0.20	0.04
CR200 Digester	Digester Gas ⁽³⁾	0.40	3.6	0.10

Notes:

- (1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m³ (HHV)
- (2) Emissions for surrogate gas containing 42% natural gas, 39% CO₂, and 19% Nitrogen
- (3) Emissions for surrogate gas containing 63% natural gas and 37% CO₂
- (4) Emissions for Diesel #2 according to ASTM D975-07b
- (5) Expressed as Methane

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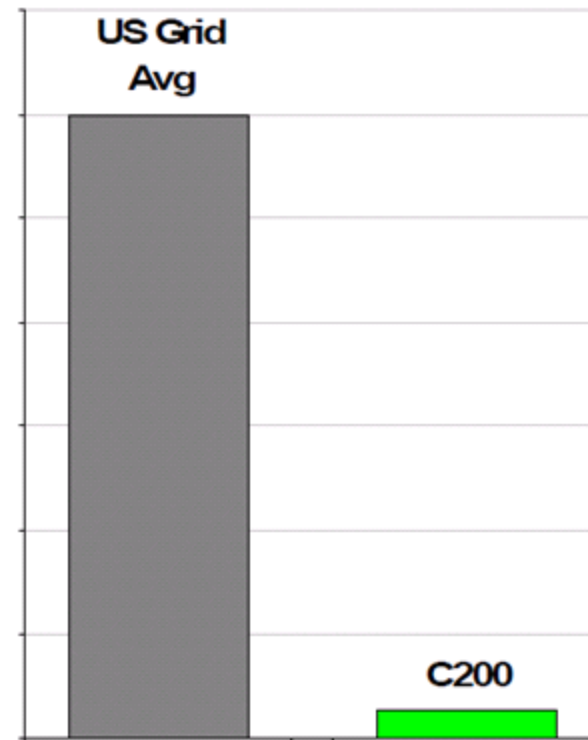
Micro CHP



Relative NOx Emissions

CARB Natural Gas Emission Standard				
	Units	2003	2007	Reduction
NOx	lb/MWh	0.5	0.07	86%
CO	lb/MWh	6.0	0.10	98%
VOC	lb/MWh	1.0	0.02	98%

- CARB 2007 - extremely stringent emissions standard that exceeds the requirements of federal standards
- Only Microturbines, Fuel Cells, Solar and Wind meet standard



Source: EPA and ASME

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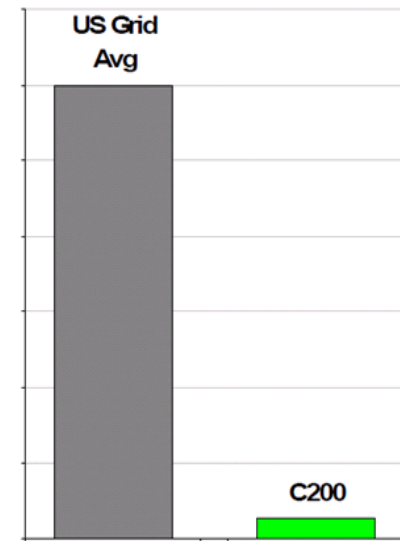
Microturbines are greener.

Compare ultra-low emission Capstone MicroTurbines to Solar PV & Wind Power*

- Microturbines remove CO₂ equivalent of 75% more cars from roads.
- Microturbines offset need for utility power (and its higher emissions) 24 hours/day; Solar PV averages less than 8 hours/day.
- Installation costs average 50% less than Solar PV and Wind.

**when compared to a CARB Certified Capstone C200 natural-gas CHP system running 8,000 hours/year.*

Relative NOx Emissions



Source: EPA and ASME

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Micro CHP Capstone's Competition

- **Other microturbines – Ingersoll Rand, Turbec**
- **Reciprocal Engine Driven Generators**
- **Fuel Cells**
- **Solar PV**
- **Wind Driven Generators**

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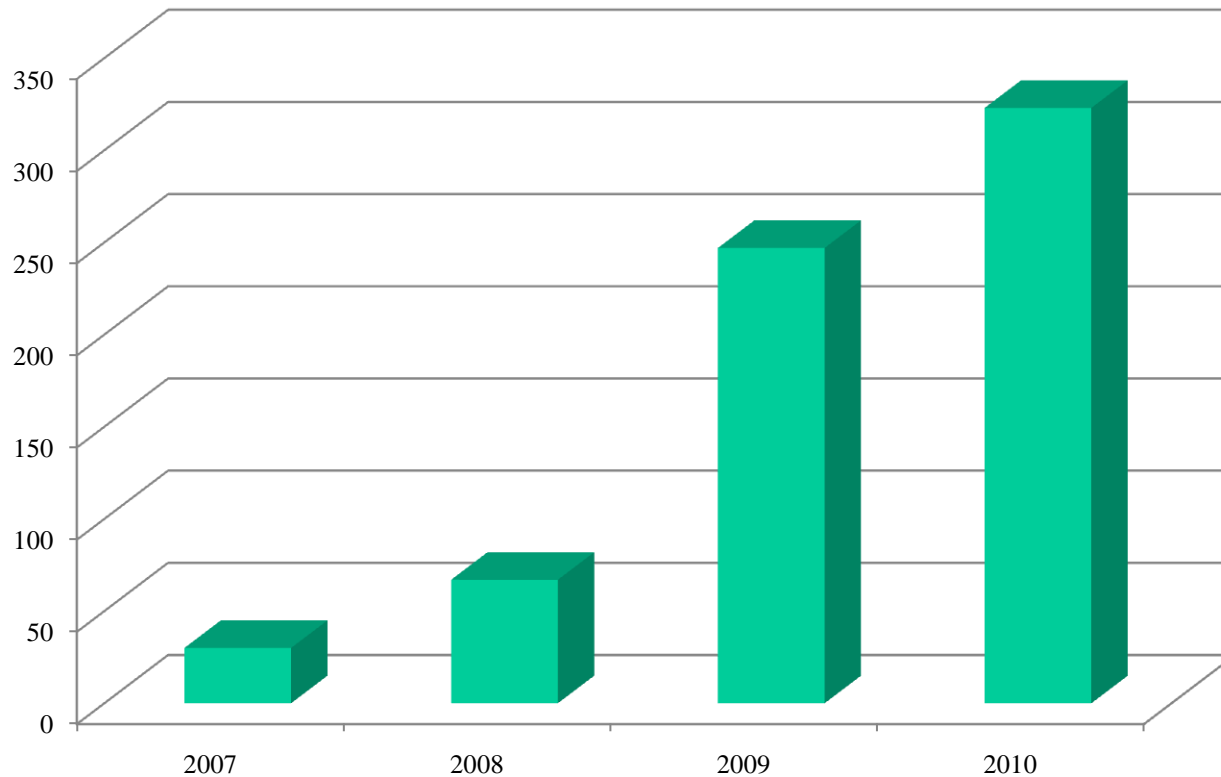
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Annual Shipments in MW



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Green Building Case Study: Oregon Health & Science University



**U.S. Green Building Council awarded
Platinum LEED certification**
The highest level of certification granted



- 16 Story 400,000 SF medical facility
- Five C60-ICHP's
- Units provide 300kW of power and building heating

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Syracuse University, IBM, New York State Launch One of the World's Greenest Data Centers

December 2, 2009

<http://www-03.ibm.com/press/us/en/pressrelease/28946.wss#release>

ARMONK and SYRACUSE, N.Y. - 02 Dec 2009: IBM (NYSE: IBM), Syracuse University, with partners IBM and New York State, today celebrated the construction of its new Green Data Center (GDC) – a showcase of world-class innovations in advanced energy-efficient information technology and building systems.

Announced in late May 2009 and constructed in just over six months, the \$12.4 million, 12,000-square-foot facility (6,000 square feet of infrastructure space and 6,000 square feet of raised-floor data center space) uses an innovative on-site power generation system for electricity, heating and cooling, and incorporates IBM's latest energy-efficient servers, computer-cooling technology and system management software.



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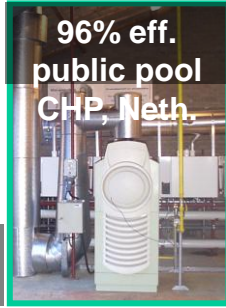


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Meidensha-Sumitomo
OEM CHP unit at a
supermarket



96% eff.
public pool
CHP, Neth.



City hall heating, UK



Greenhouse
direct heat, UK



OEM CHP 8-pack at a
hospital in Japan



6-pack of C30s preheats inlet water to
boilers at California State University
Northridge, CA



Brick drying,
Netherlands



Nursing home,
NY



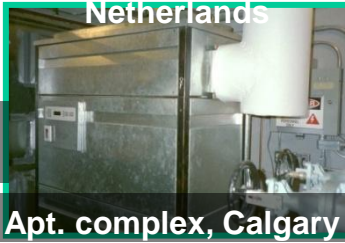
City hall heating, CA



Building heating,
Northridge, CA



San Diego Navy



Apt. complex, Calgary



Reliant LNG Storage,
MN



YMCA heating,
NY



Nursing home, IA

Hundreds of MicroCHP Sites Worldwide

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