Integration of MicroCHP in the United States

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ICF International

Building Integration of Micro-Generation Technologies
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National Institute of Standards and Technology

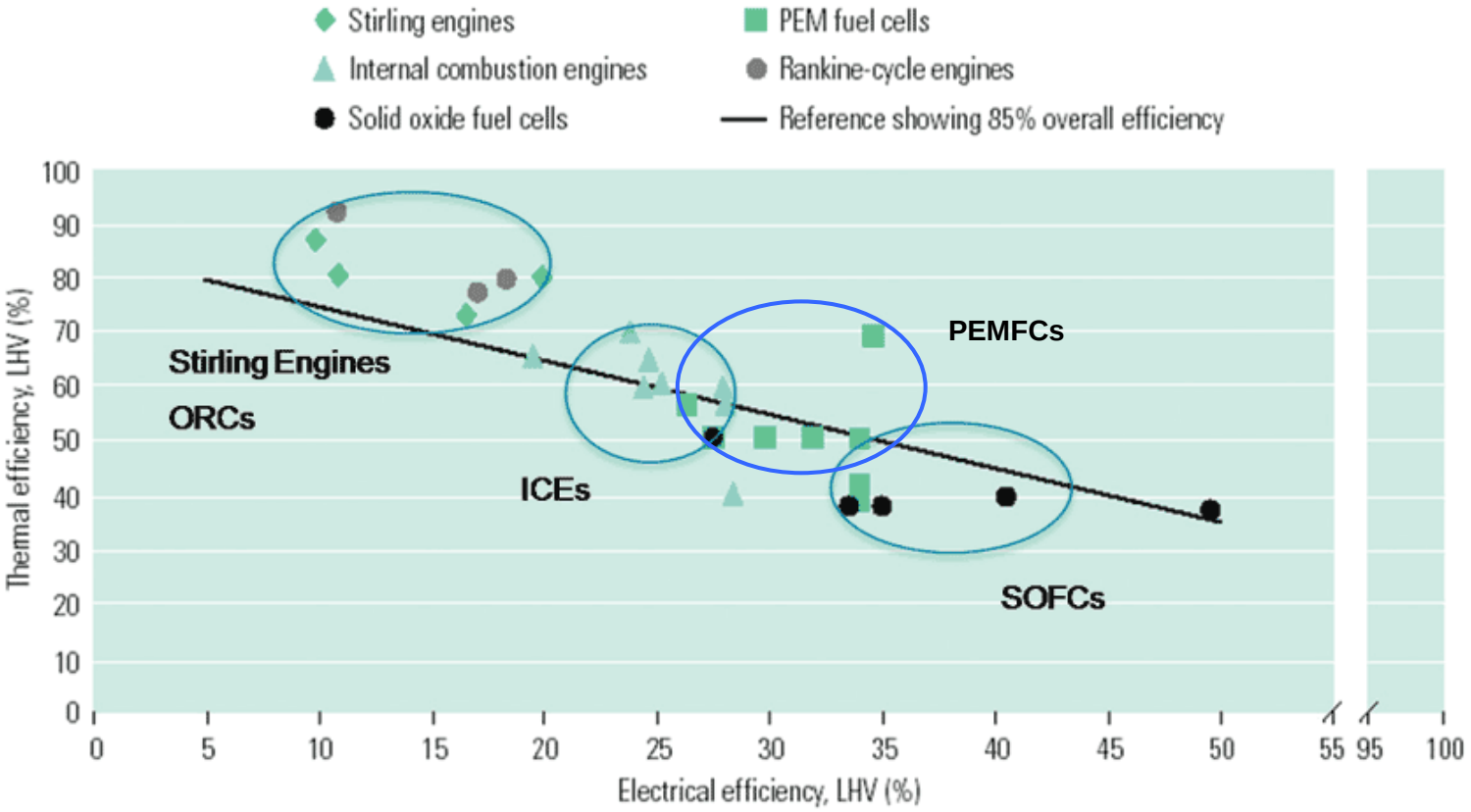
Introduction

- Public company on NASDAQ with symbol “ICFI”
- ICF is in its 41st year– founded in 1969
- End-to-end management, technology, and policy services – advise, implement, improve
- Diverse client base – 77% federal, state, and local agencies; 17% commercial; and 6% international governments.
  - Energy & Climate work 50% commercial/international and 50% government
- 2009 revenue of $674.4 million
- More than 3,500 employees (500 energy and climate change professionals and 600 environment and infrastructure professionals)
- Global presence with 50 offices with headquarters in the Washington, D.C. area

What Is MicroCHP?

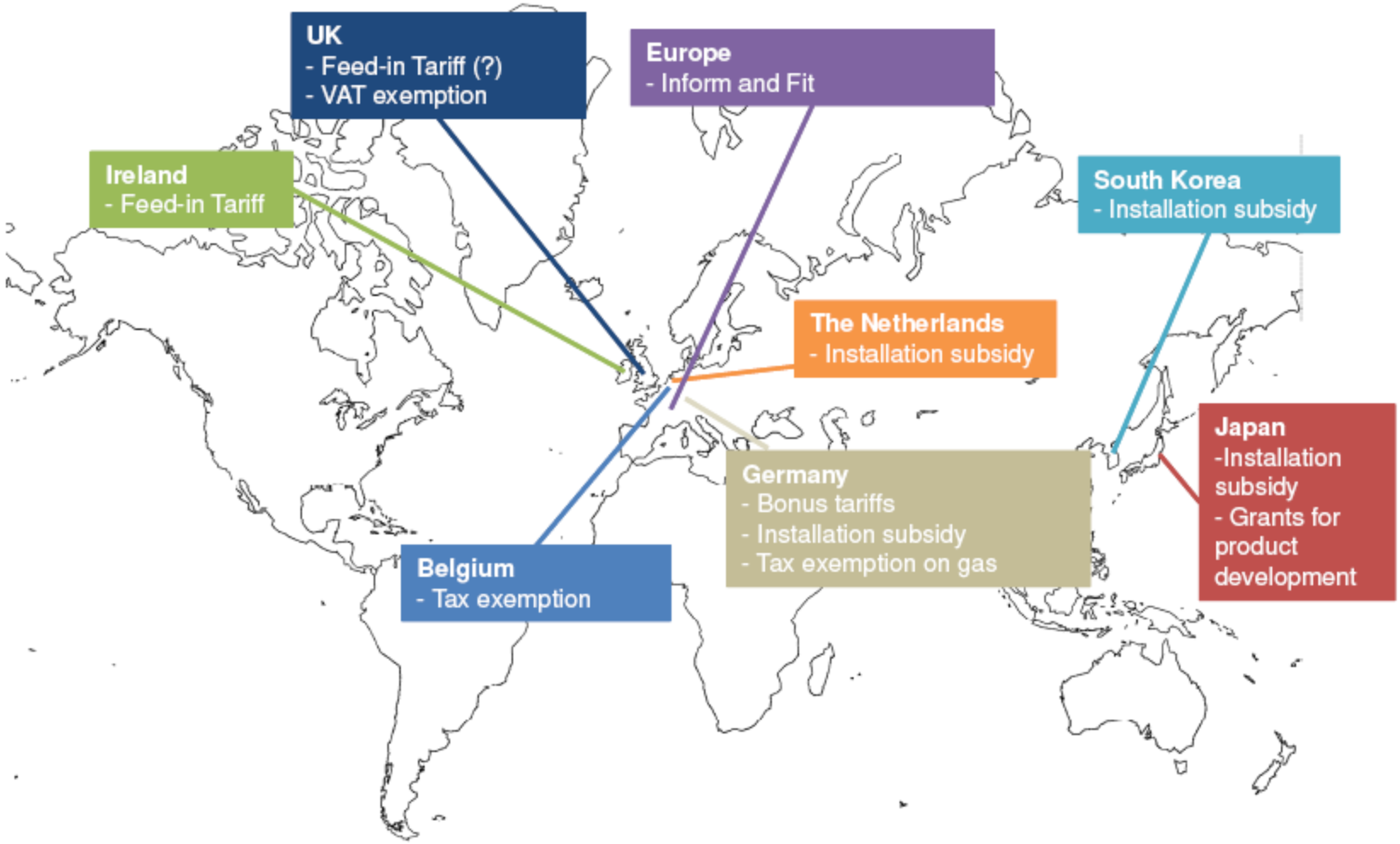
- < 10 kWe
- Residential and commercial applications
- Fueled by natural gas, LPG, fuel oil or biomass
- Provides space heating (hydronic and warm air) and/or water heating
- Uses a variety of technologies (IC engines, Stirling engines, Fuel Cells, Rankine cycles)

MicroCHP Technologies



Source: Delta Energy and Environment

MicroCHP Support Mechanisms



Source: Delta Energy and Environment

Commercial MicroCHP Products

Japan

- IC Engines — 80,000 units to-date
  - Honda ECOWILL (1 kW)
- Fuel Cells — 6 to 8,000 units in 2010
  - Toshiba (0.7 kW)
  - JX Nippon Oil (0.75 kW)
  - Panasonic (1 kW)

Europe

- IC Engines — >20,000 units to-date
  - Vaillant Ecopower (4.7 kW)
  - Baxi Senertec (5 kW)
- Stirling Engines — 3,000+ demo units
  - WhisperGen (1 kW)
  - Disenco (3 kW)
- Fuel Cells — 800 demo units by 2010
  - Baxi Innotech, Hexis, Vaillant

Commercial MicroCHP Products

United States

- IC Engines|
  - ECR International *freewatt* (1.2 kW) — 275 units
  - Marathon Engine *Ecopower* (4.7 kW) — 25 units
- Fuel Cells
  - ClearEdge Power *CE5* (5 kW) — 25 to 40 units
- Applications
  - Residential and light commercial
  - Space heating and hot water
  - Thermally driven
  - Annual operating hours – 2,500 to 4,500
  - Stand alone capability

Source: EIA Residential Energy Consumption Survey

The Market Environment

Europe, Japan, S. Korea

- High energy prices
- Primarily hydronic heating
- Government support
- Utility support
- Developed in partnership with gas utilities and/or boiler manufacturers
- Variety of incentives (FITs, subsidies, tax exemptions)
- Priority on carbon reductions

United States

- Lower energy prices
- Primarily forced air heating
- Little government support
- Limited utility support
- Limited heating equipment suppliers support
- Pending 30% investment tax credit
- Carbon legislation stalled

ECR International *freewatt*

- IC Engine CHP
  - 1.2 kWe, 3.26 kW thermal
  - 85 to 90% total efficiency
  - Honda CHP package
  - Climate Energy integrated boiler/furnace
- Residential applications
  - Hydronic space heating
  - Forced air space heating
  - Stand alone capability

Marathon Engine *Ecopower*

- IC Engine CHP
  - 4.7 kWe, 12.9 kW thermal
  - Over 3,500 installed in Europe
- Applications
  - High end residential
  - Multi-family
  - Laundries
  - Hotel/Motel
  - Car washes
  - Assisted living facilities

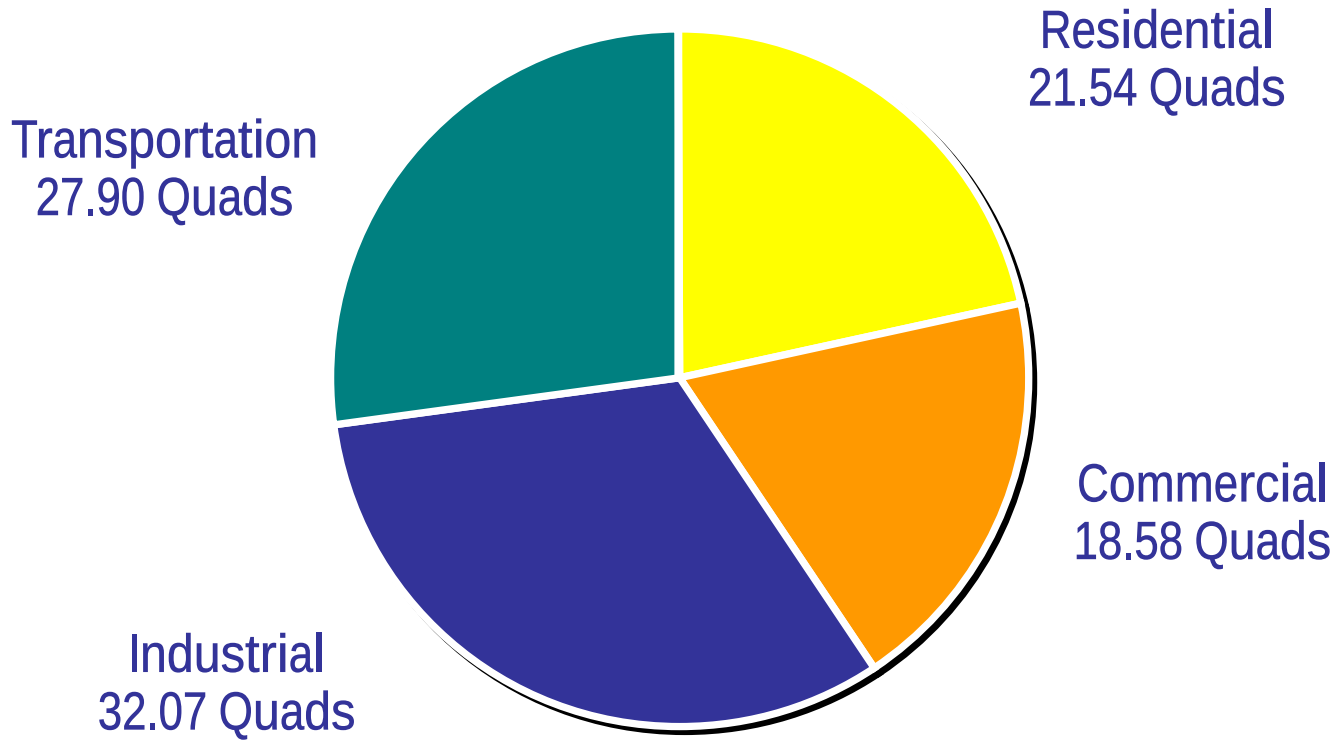
ClearEdge Power *CE5*

- PEM Fuel Cell CHP
  - 5.0 kWe
  - 5.6 kW thermal
  - Stand alone capability
- Applications
  - High end residential
  - Multi-family
  - Restaurants
  - Hotel/Motel
  - Health & athletics
  - Schools

WhisperTech *Whisper Gen*

- Stirling Engine Boiler
  - 1.0 kWe
  - 7.5 to 14 kW thermal
  - Combined experience > 500,000 hours
- Status
  - Field trials in Canada
  - Market research underway
  - Business model and distribution channels being evaluated

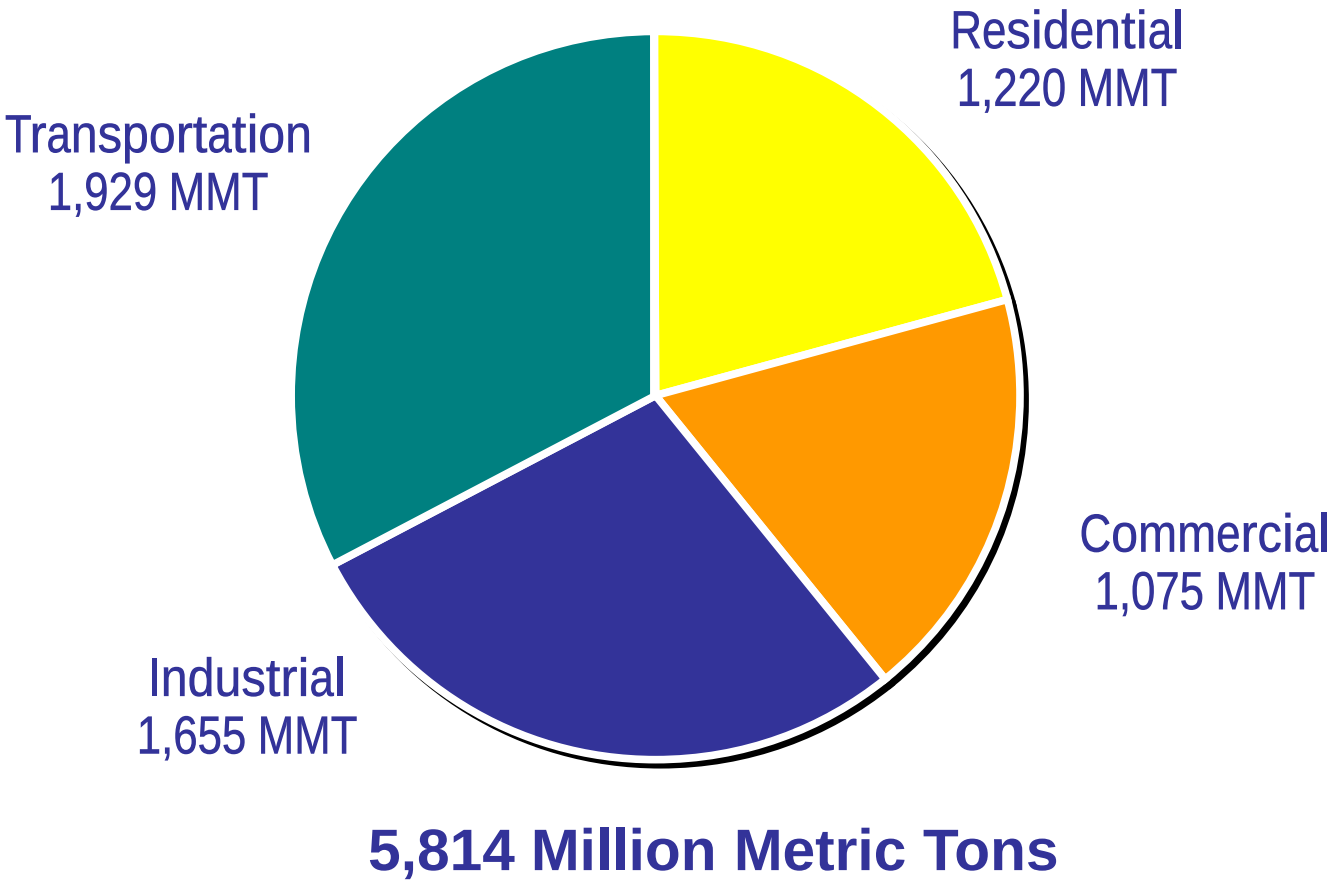
Total Resource Energy Consumption in the United States - 2008



100.09 Quadrillion Btu (106 Exajoules)

Source: EIA 2010 Annual Energy Outlook

Total CO_2 Emissions in the United States 2008



5,814 Million Metric Tons

Source: EIA 2010 Annual Energy Outlook

End-Use Applications of Residential and Commercial Energy – 2008

End Use	Residential	Commercial
Space Heating (fuel)	4.03 Quads	1.69 Quads
Water Heating (fuel)	1.53 Quads	0.46 Quads
Other (fuel)	0.52 Quads	1.42 Quads
Electricity	4.71 Quads	4.61 Quads

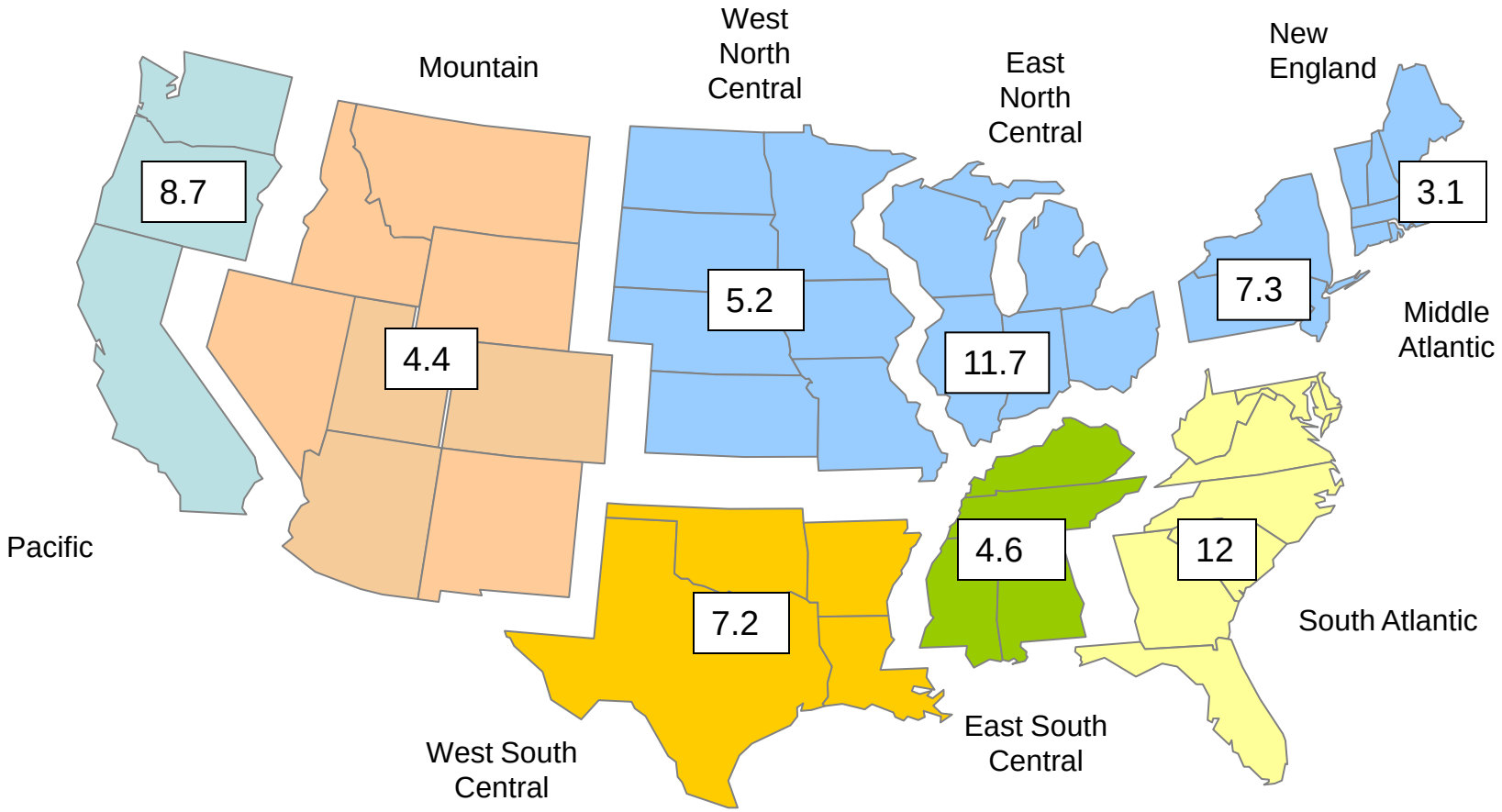
Source: EIA 2010 Annual Energy Outlook

U.S. Housing Units - 2005

- Total Housing Units: 111.1 million
- Detached, Single Family: 72.2 million
- Owner Occupied (DSF): 64.1 million
- Natural Gas Available (DSF): 55.2 million
- Heating Degree Days (DSF):
  - > 7000 HDD 8.6 million
  - 5500 – 7000 HDD 18.5 million
  - 4000 – 5499 HDD 18.4 million
  - < 3990 HDD 16.4 million

Source: EIA Residential Energy Consumption Survey

Owner-Occupied, Single-Family Detached Housing Units (millions) - 2005



Source: EIA Residential Energy Consumption Survey

Barriers to MicroCHP in the United States

- High price compared to other heating equipment
- Lack of awareness of the products and potential benefits
- Limited information on lifetime and reliability
- Lack of developed sales and service infrastructure
- No incentives to support market entry
  - Only 17 states allow CHP to qualify for net metering
  - Total Resource Costs tests do not capture all of the benefits

Potential Game Changers

- Policymakers beginning to recognize benefits of CHP
- Improved outlook for domestic natural gas supplies
- Potential for integration with Smart Grid and development of microgrids
- Future direction of carbon policy

MicroCHP Value Proposition

Category	5 kW mCHP	5 kW Solar PV
Annual Electricity Production	25 MWh	8 MWh
Annual Heat Production	28 MWh_t	None
Footprint Required	6 sq ft	500 sq ft
Annual Energy Savings	139 MMBtu	85 MMBtu
Annual CO_2 Savings	15 metric tons	6.7 metric tons

Based on: 5 kW fuel cell CHP
36 % electric efficiency
76 % total efficiency
U.S. average fossil generation

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