Microturbines: Activities within the Office of Distributed Energy Resources

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DOE DER Program Information

www.eren.doe.gov/der

DER Microturbine Program Activities

- Baseline Microturbine Testing
  - University of California-Irvine (UCI) & Southern California Edison (SCE)
  - National Rural Electric Cooperative Association (NRECA)
- Advanced Microturbine Technology Program
  - Program planning with Industry
    - Workshop – 11/98
    - Program Plan – 12/99
  - Competitive solicitation, 6 awards announced 7/00
- Supporting Materials Technology Projects

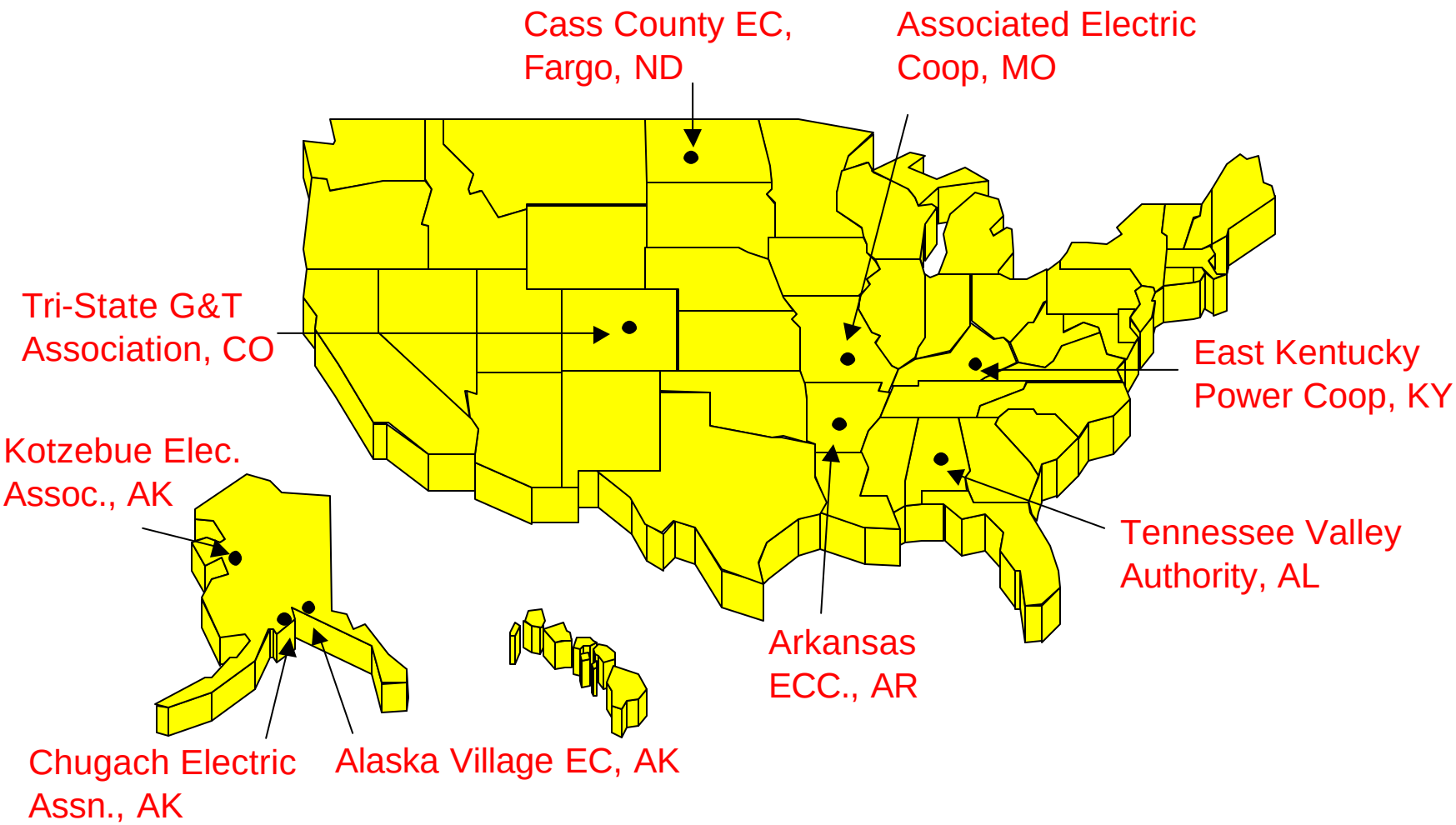
Baseline Microturbine Evaluation Program

- $2.9+ Million Program begun by Southern CA Edison and University of CA-Irvine in 1996
- Funded by: SCE, DOE, CEC, EPRI, CERA, CERTS
- Project Goal:
  - Determine the availability, operability, reliability and performance characteristics of commercially available microturbines
- Project Objectives
  - Compare manufacturer claims to actual experiences from installation, operation and testing of units
  - Assess microturbine performance against SCAQMD emissions rule and IEEE power quality standards

Microturbine Field Tests at U.S. Rural Electric Cooperatives

- Project Partners: National Rural Electric Cooperative Assn. (NRECA) Central Research Network (CRN), ORNL, EPRI
- Conduct nationwide field tests of microturbines from several different manufacturers
- Collect application and operation data on microturbine installation and performance
- Assess microturbine feasibility and reliability in diverse applications and environments
- Benchmark future improvements in microturbine performance, operation, and maintenance

Participating Co-ops and Sites



Specifics of Each Co-op Field Test

#	Coop	MTG*	Thermal Recovery	Application	Location	Install Date
1	AVEC	C 30-kW	Space Heating	Warehouse and Office	Anchorage, AK	Apr-01
2	Arkansas Electric	H 75-kW	Boiler Freeze Protection	Power at Generating Facility	Agusta, AR	May-01
3	Associated Electric	E 45-kW	TBD	Power for city water pumps	Kearney, MO	Jul-01
4	Cass County	C 30-kW	Preheat and Feed Hot Water Boilers	Hotel and Convention Center	Fargo, ND	Aug-00
5	Chugach	C 30-kW	TBD	Warehouse and Office	Anchorage, AK	Oct-00
6	East Kentucky	E 80-kW	TBD	Power at Generating Facility	Winchester, KY	2002
7	Kotzebue Electric	C 60-kW	TBD	Power plant and later a commercial customer	Kotzebue, AK	Jan-02
8	Tennessee Valley Authority	C 30-kW	None	TVA Power Institute R&D Building	Muscle Shoals, AL	May-00
9	Tri-State G&T	I 70-kW	Preheat Irrigation Water	Industrial Greenhouse	Brigton, CO	Dec-01

*C-Capstone, H-Honeywell (being replaced by 80-kW Elliott), E-Elliott, I-Ingersoll-Rand

Advanced Microturbine Program

- Six year program (FY 2000 - 2006), $60+ million Govt. investment
- Program to include:
  - Competitive solicitation(s) for engine conceptual design, development, and demonstration; component, sub-sub-system development
  - Competitive solicitation(s) for technology base in areas such as materials, combustion, sensors and controls, etc
  - Technology evaluations and demonstrations
- End-use applications open to include stationary power applications in industrial, commercial, and institutional sectors

Advanced Microturbine Program Goals

Next Generation Microturbine System (< 1,000 kW) by 2006 :

- **High Efficiency** - Fuel-to-electricity conversion efficiency of at least 40%
- **Environmental Superiority** - NOx < 7 ppm (natural gas)
- **Durable** - 11,000 hours of reliable operations between major overhauls and a service life of at least 45,000 hours
- **Economical** - System costs < $500/kw, costs of electricity that are competitive with the alternatives (including grid) for market applications
- **Fuel Flexible** - Options for using multiple fuels including diesel, ethanol, landfill gas, bio-fuels

Advanced Microturbine Projects

2000

- 17-30% Efficiency (LHV*)
- Double digit ppm NO_x

FY00 – 6 Awards

- Ingersoll-Rand
- UTC
- GE
- Honeywell
- Capstone
- Solar

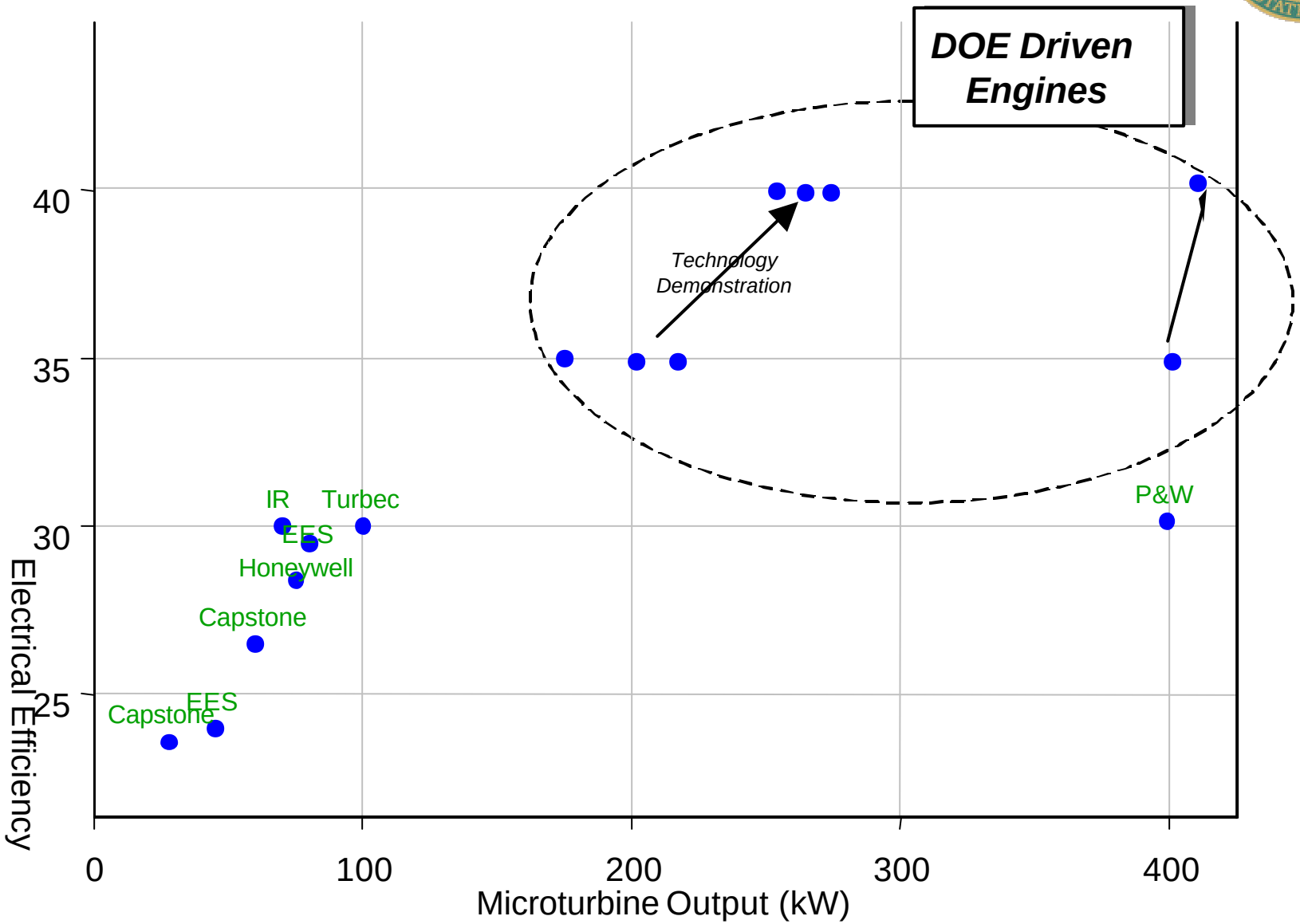
Average cost share for total program ~ 50%, staged over development – 30, 45, 60%

2007

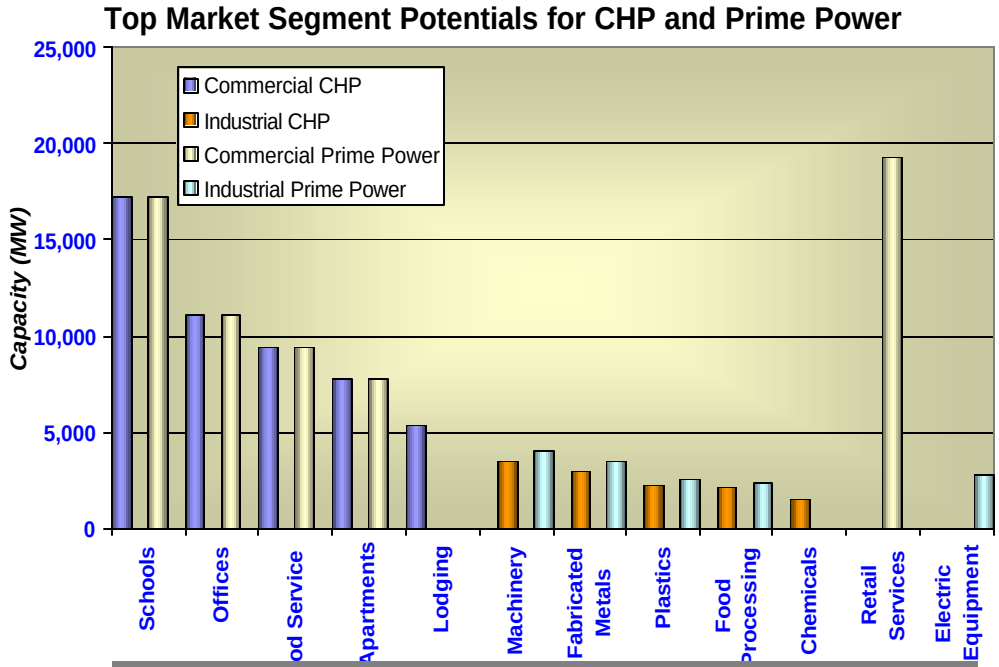
- 40% Efficiency (LHV*)
- Single digit ppm NO_x

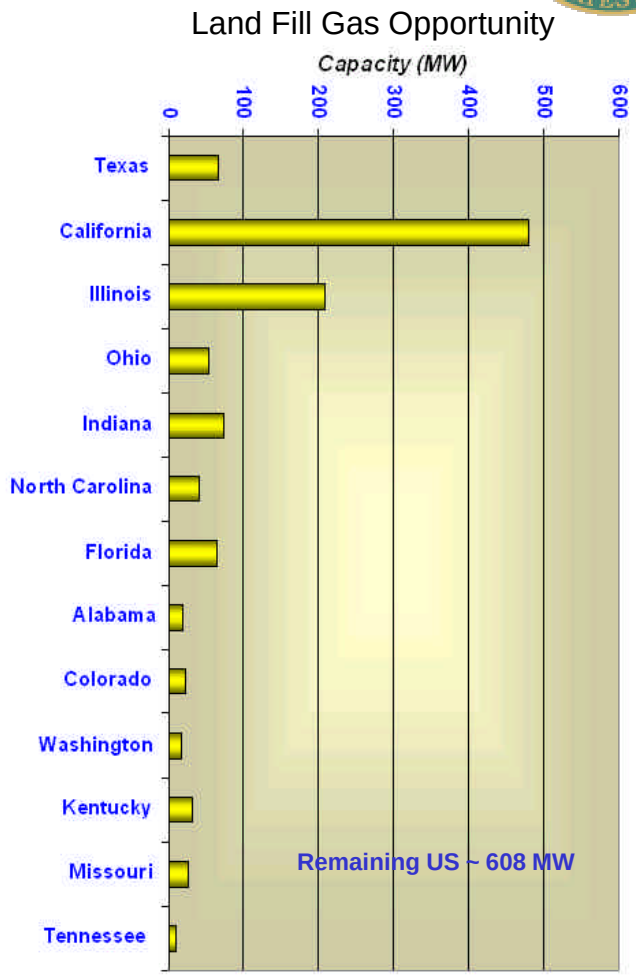
** Lower Heating Value*

Anticipated Advanced Microturbines from DOE program



Cumulative Market Potentials Through 2010



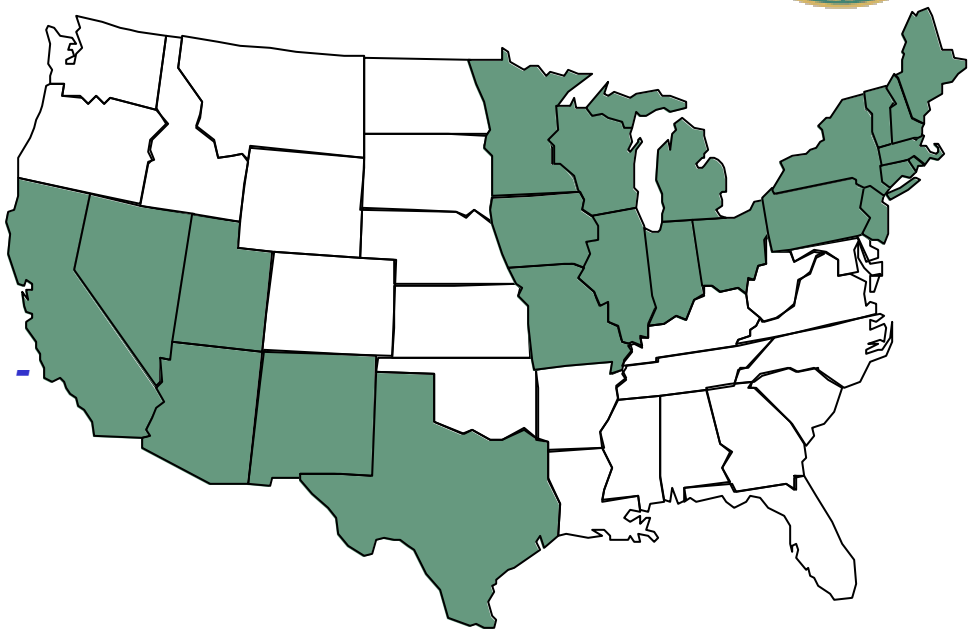


Total DG Market Potential Through 2010		
	CHP	Prime Power
Commercial	*50,900 MW*	*64,923 MW*
Industrial	*12,250 MW*	*15,325 MW*

Potentially Significant Opportunity for Distributed Generation

Source: Onsite Energy Corporation Market Study – Spring 2001 (Includes all DG Potential)

Target Market Areas



- ***Areas with high electric rates -***
  - New England
  - Northeast
  - Upper Midwest
  - California
  - Southwest
- ***Areas with power supply constraints -***
  - Midwest
  - Texas
  - California
  - Southwest
  - parts of New England
  - New York
- ***States that have included pro-distributed generation measures as part of electric industry restructuring -***
  - Illinois
  - Ohio
  - Michigan
  - New Jersey
  - New York
  - Maine
  - Massachusetts
  - Connecticut
  - Texas

Advanced Materials for Microturbines

- Advanced materials are a key enabling technology for advanced microturbines:
  - Monolithic ceramics: hot section components, combustor liners
  - Ceramic composites: combustor liners
  - High temperature metal foils: recuperators
  - High conductivity carbon foam: power electronics
- A materials program to support microturbines is underway and managed by ORNL
  - Program designed to meet needs of advanced microturbine developers to develop materials technology base
  - “Peer Review” held June 2001

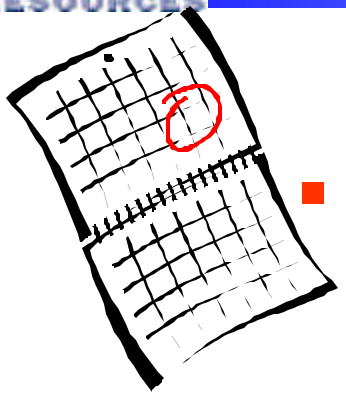
Examples of Program Coordination

- External Coordination
  - States (CEC, NYSERDA)
    - CEC EPAG solicitation
    - NYSERDA solicitations
  - EPRI
  - Natural Resources Canada (CANMET)
- Internal DOE
  - Industrial Gas Turbines (materials and low emissions)
  - Integrated Energy Systems (DER)
  - CHP (DER)
  - Interconnection (DER)
  - Industrial Distributed Generation (DER)
  - Energy Storage (DER)
  - Micro-Grid/Integration (DER/CERTS)
  - Fuel cell hybrid systems (FE)
  - Federal sites (FEMP)

Summary

- Microturbines are an emerging technology choice in DER markets and applications
- Public/private partnerships have been established to develop “next-generation” microturbines
- Key technology challenges need to be overcome to meet program goals

Mark Your Calendars



- DOE DER Gas Turbine and Microturbine Peer Review, March 12-14, 2002 Fairfax, VA
- Watch DER website for additional information

For Additional Information

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