Combined Heat and Power and District Energy in the U.S.

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IEA/GSEP - CHP/DHC Joint Workshop

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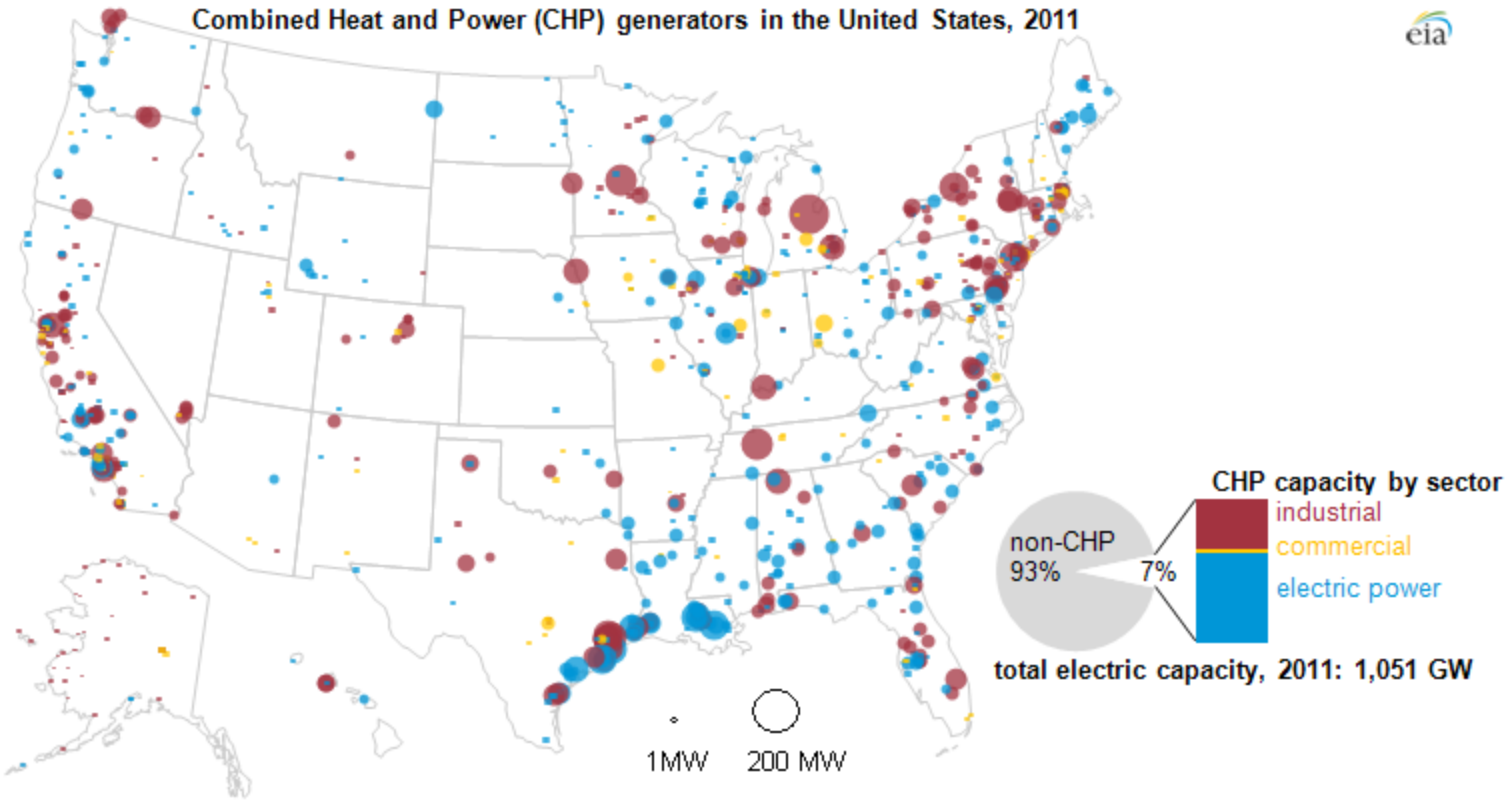
Outline

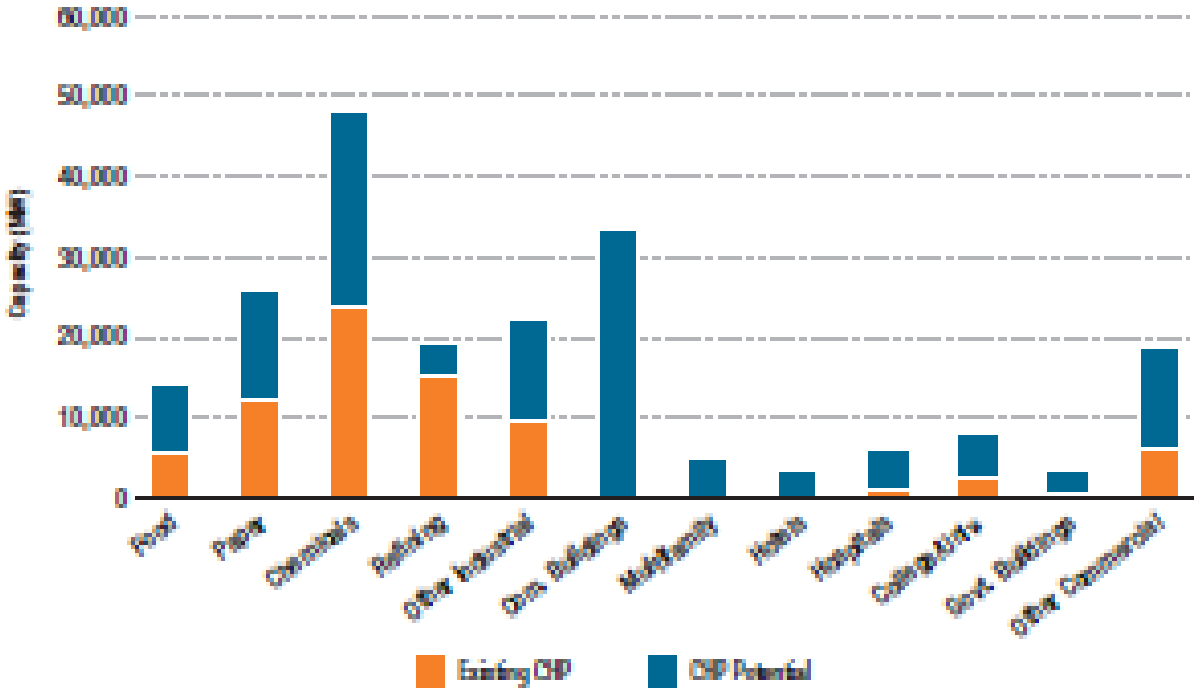
- Overview of Technology Deployment in the U.S.
- Key Barriers
- Key Opportunities
- U.S. Department of Energy: Programs to Promote CHP/DE

Combined Heat and Power in US

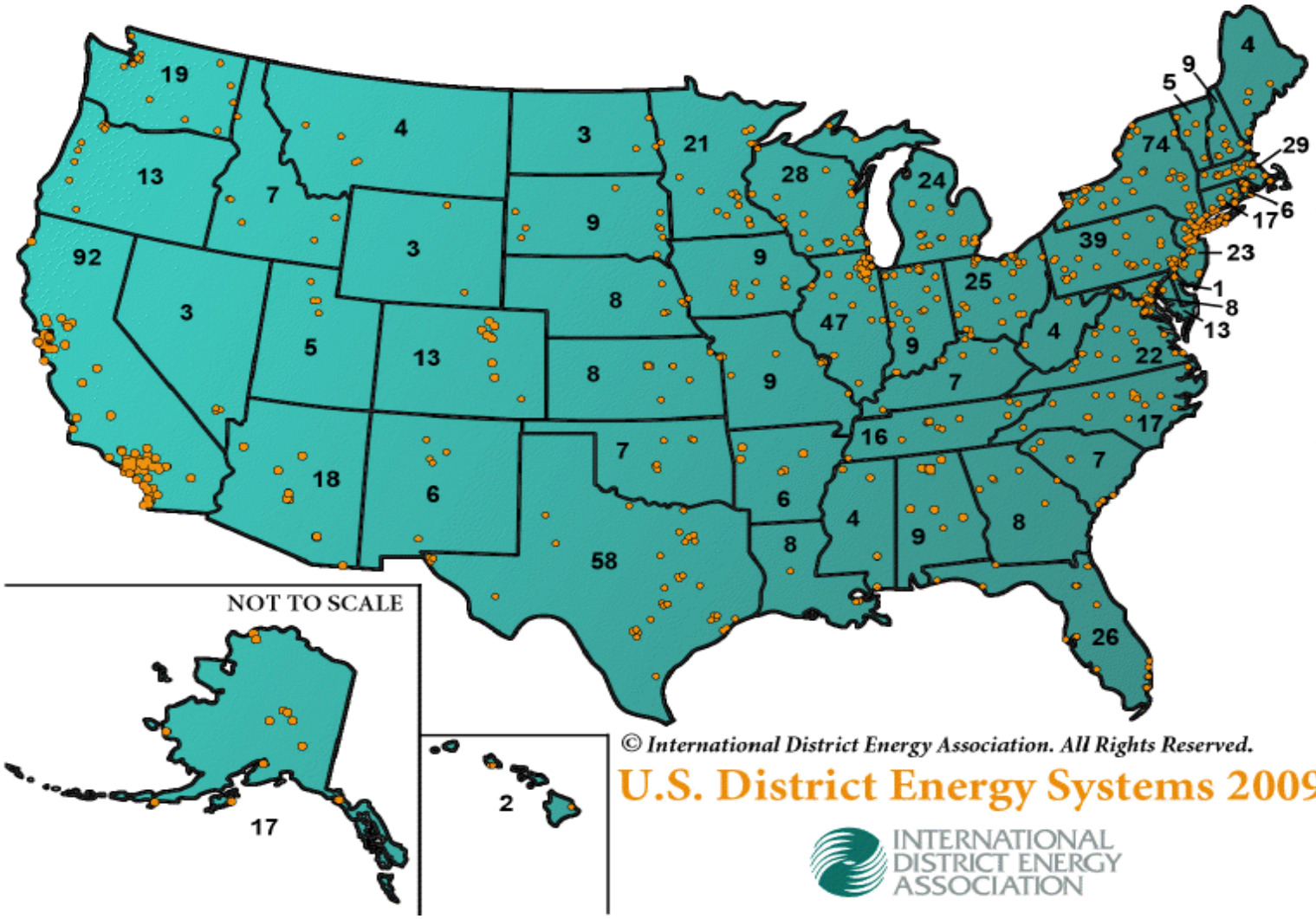


Energy Information Administration, October 4, 2012
http://www.eia.gov/todayinenergy/detail.cfm?id=8250

Technical Potential for Additional CHP at Existing Industrial and Commercial Facilities



District Energy in the US



U.S. District Energy Systems 2009

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

- **3.5 % of the total final energy demand**
- **DE serves more than 4.3 billion sq ft of building space.**

Key Barriers

- Utility barriers, such as high standby rates, a lack of shared standards for interconnection, and a low return on the sale of excess electricity to the grid
- Market and financial barriers
- A lack of awareness of energy-saving opportunities related to DE/CHP.

Key Opportunities

- Changing market conditions
- Improved state and local policy context
- Recent federal policy developments
  - Executive Order
  - EPA Boiler MACT Rule

White House Executive Order

White House Executive Order, Aug 30, 2012

"Accelerating Investment in Industrial Energy Efficiency"

- Increase CHP capacity by 40 GW (50%) by 2020

- Convene federal and regional stakeholders to address barriers – policy, financial, regulatory
- Accounting for potential emission reduction benefits of CHP in State Implementation Plans (SIPs); employ output-based emissions approaches
- Providing incentives for CHP deployment of CHP: emissions allowance trading program, state implementation plans, grants, and loans
- Expand participation and tools of Clean Energy Application Centers and support DOE Better Buildings, Better Plants to reduce energy intensity

EPA Boiler MACT Background

- Dec 2, 2011: EPA released proposed amendments to previously released rules setting air toxic standards for boilers, process heaters and certain solid waste incinerators (CIWSI) incinerators.
  - EPA initially issued final rules for these units in March 2011, setting standards intended to cut emissions of hazardous air pollutants (HAPs) such as mercury, dioxin and lead.
  - At the same time it issued the final rules in March, EPA also announced that it intended to reconsider those standards under a Clean Air Act process that allows the agency to seek additional public review and comment to ensure full transparency in its rulemaking.
- Three rules:
  - Proposed Emissions Standards for **Area** Source Industrial, Commercial, and Institutional Boilers
  - Proposed Emissions Standards for **Major** Source Industrial, Commercial, and Institutional Boilers and Process Heaters
  - Proposed Emissions Standards for **Commercial/Industrial Solid Waste Incinerators** (CISWI)
- DOE's effort focused on **Major Source** rule

EPA Boiler MACT (2)

- Standards for hazardous air pollutants from major sources: industrial, commercial and institutional boilers and process heaters (excludes any unit combusting solid waste)
  - Major source is a facility that emits:
    - 10 tpy or more of any single Hazardous Air Pollutant, or 25 tpy or more of total Hazardous Air Pollutants (HAPs)
  - Emissions limits applicable to new and existing units > 10 MMBtu/hr
    - Mercury (Hg)
    - Particulate Matter (PM) as a surrogate for non-mercury metals (alternative limits for total selective metals (TSM))
    - Hydrogen Chloride (HCl) as a surrogate for acid gases
    - Carbon Monoxide (CO) as a surrogate for non-dioxin organics

U.S. Department of Energy

Programs to promote CHP/DE adoption

U.S. DOE Activities

- R&D
- Regional Clean Energy Application Centers
- State and local stakeholder working groups
- Activities in support of Executive Order
- EPA Boiler MACT Technical Assistance

R&D Technical Approach

- **Technology research and development**
  - Research to address first cost and life-cycle cost
    - Pursue dramatic increases in prime mover efficiency to reduce life-cycle cost (e.g., gas engine efficiency from 35% to 50%)
    - Package prime mover and thermal technology to maximize performance and minimize costs
    - Develop small and mid-size systems for new markets
  - Identify and develop innovative approaches to simultaneously deliver electric power and heat, such as fuel cell-based CHP
  - Enable use of alternative fuels and low-value waste heat

R&D Projects

Advanced Reciprocating Engine Systems (ARES)

Multi-partner, pre-commercial collaboration aimed at developing high efficiency, clean gas-fired reciprocating engines for electricity generation

- Phase I: 45% BTE, NO_x < 0.5 g/bhp-hr
- Phase II: 47% BTE, NO_x < 0.1 g/bhp-hr
- Phase III 50% BTE, NO_x < 0.1 g/bhp-hr

In all cases, maintenance costs to be <$0.01/EkW-hr, with competitive purchase costs.

Project Status:

- Caterpillar
  - Phase I: Complete, product being sold
  - Phase II: Demonstrated 2008
  - Phase III To be completed in 2013
- Cummins
  - Phase I: Complete, product being sold
  - Phase II: Demonstrated 2012
  - Phase III To be completed in 2013
- GE Dresser Waukesha
  - Phase I: Complete, product being sold
  - Phase II: Demonstrated 2012
  - Waukesha purchased by GE in 2010. Withdrew from ARES.

Packaged CHP Systems

Competitively awarded projects aimed at developing small (< 1 MWe) packaged CHP systems with high efficiency (> 70% HHV), in three prime mover classes:

- Micro-turbines (three projects)
- Reciprocating engines (two projects)
- Fuel cells (one project)

All projects will be completed in FY 2013

Microturbine Projects

- 370 kWe Microturbine CHP System
- 100 kWe “Flex-CHP” System
- 65 kWe Boiler/burner CHP System

Reciprocating Engine Projects

- 330 kWe Reciprocating Engine CHP System
- Low Temperature Chiller CHP System

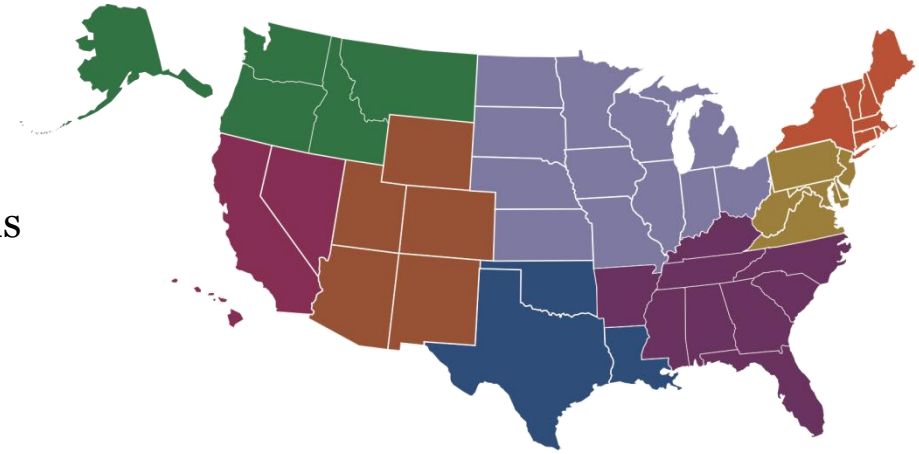
Fuel Cell Projects

- High Temperature Fuel Cell CHHP System

DOE CHP Assistance:
Regional Clean Energy Application Centers (CEACs)

Eight Regional CEACs & International District Energy Association

- **Market Assessments:** Analyses of CHP market potential in diverse sectors, such as health care, industrial sites, hotels, & new commercial and institutional buildings.
- **Education and Outreach:** Providing information on the benefits and applications of CHP to state and local policy makers, regulators, energy end-users, trade associations and others.
- **Technical Assistance:** Providing technical information to energy end-users and others to help them consider if CHP makes sense for them. Includes performing site assessments, producing project feasibility studies, and providing technical and financial analyses.



http://www1.eere.energy.gov/manufacturing/distributedenergy/ceacs.html

State/Local Policy and Action Guides

- Guidance being designed to consider energy in comprehensive planning, brownfield/revitalization projects, Climate Action Plans
  - IDEA Planning Guide for Community Energy

www.districtenergy.org/community-energy-planning-development-and-delivery

  - Guide to Successful Implementation of State CHP Policies (being drafted)

DOE Activities in Support of Executive Order

- August 30, 2012 Executive Order – "Accelerating Investments in Industrial Energy Efficiency"
- DOE Activities in Support of Executive Order
  - Regional Industrial Energy Efficiency & Combined Heat and Power Dialogue Meetings
  - Better Buildings, Better Plants
  - "CHP as a Clean Energy Resource" new report
  - State technical assistance
  - CHP assistance: Regional Clean Energy Application Centers
- For More Information

DOE Regional Dialogue Meetings

- Upcoming DOE Regional Industrial Energy Efficiency & Combined Heat and Power Regional Dialogue Meetings
  - In-person, one day dialogue meetings that focus on developing and implementing state best practice policies and investment models that address the multiple barriers to greater investment in industrial energy efficiency and combined heat and power (CHP).

- **Southeast** Industrial Energy Efficiency & Combined Heat and Power Regional Dialogue Meeting
- January 24, 2013, Little Rock, Arkansas
  http://www1.eere.energy.gov/manufacturing/newsandevents/events_detail.html?event_id=7304

- **Northeast / Mid-Atlantic** Industrial Energy Efficiency & Combined Heat and Power Regional Dialogue Meeting
- March 13, 2013, Baltimore, Maryland
  http://www1.eere.energy.gov/manufacturing/newsandevents/events_detail.html?event_id=7305

DOE Boiler MACT Technical Assistance

- DOE currently provides technical information and assistance, market development, and education on CHP, Waste Heat to Power, and District Energy options through its 8 regional Clean Energy Application Centers (CEACs)
- DOE is supplementing this ongoing effort by providing site-specific technical and cost information on clean energy compliance strategies to those major source facilities affected by the Boiler MACT rule currently burning coal or oil.
  - These facilities may have opportunities to develop compliance strategies, such as CHP, that are cleaner, more energy efficient, and that can have a positive economic return for the plant over time
- DOE Boiler MACT Technical Assistance program is being piloted in Ohio now, and will be rolled out nationally when the EPA rule reconsideration process is complete

DOE Boiler MACT Assistance Available

- DOE webpage on Boiler MACT Technical Assistance: http://www1.eere.energy.gov/manufacturing/distributedenergy/boilermact.html
  - DOE Boiler MACT Technical Assistance Fact Sheet: http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/boilermact_tech_asst_factsheet.pdf
- List of available state incentives for emissions controls, EE measures, boiler replacements/tune-ups, CHP, and energy assessments (DOE)
  - http://www1.eere.energy.gov/industry/states/pdfs/incentives_boiler_mact.pdf
- Extensive assistance materials for Area Source rule available from EPA
  - Tune-up guidance, fast facts, brochure, table of requirements, small entity compliance guide, etc.
  - www.epa.gov/ttn/atw/boiler/boilerpg.html

More Information

- **Executive Order**: http://www.whitehouse.gov/the-press-office/2012/08/30/executive-order-accelerating-investment-industrial-energy-efficiency
- **Regional Industrial EE and CHP Dialogue Meetings:** http://www1.eere.energy.gov/manufacturing/newsandevents/events.html
- **DOE Boiler MACT Technical Assistance Fact Sheet:**
  http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/boilermact_tech_asst_factsheet.pdf
- **Better Buildings, Better Plants:** http://www1.eere.energy.gov/manufacturing/tech_deployment/betterplants/index.html
- **New Report, "Combined Heat and Power: A Clean Energy Resource":** http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_clean_energy_solution.pdf