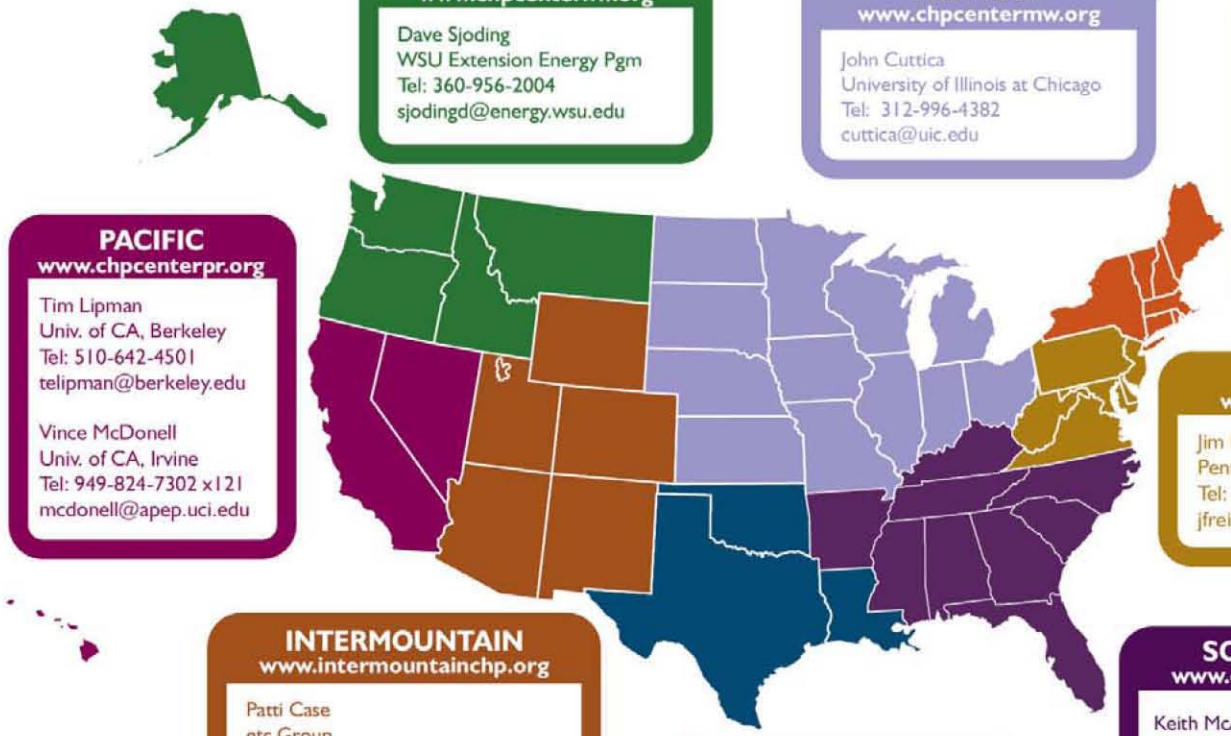
U.S. Department of Energy
Mid-Atlantic Clean Energy Application Center
Promoting CHP, District Energy, and Waste Heat Recovery

CHP Technologies and Applications
25 Oct 11

DOE Clean Energy Application Center Locations, Contacts, and Web Sites



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For more information visit http://www1.eere.energy.gov/industry/distributedenergy/racs.html

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RAC Services & Capabilities

Unbiased Information

Develop & distribute informational materials

Perform market research to identify high profile candidate applications

Targeted Education

Develop & conduct target market workshops, seminars, internet programs to educate end users, regulators, and other stakeholders

Assist in overcoming policy and other market barriers

Technical Assistance

Provide technical assistance to potential user sites

Provide or coordinate on-site assessments for entities considering deployment of clean energy technologies

"Clean Energy" Technologies

CHP

The sequential production of electric and thermal power from a single dedicated fuel source

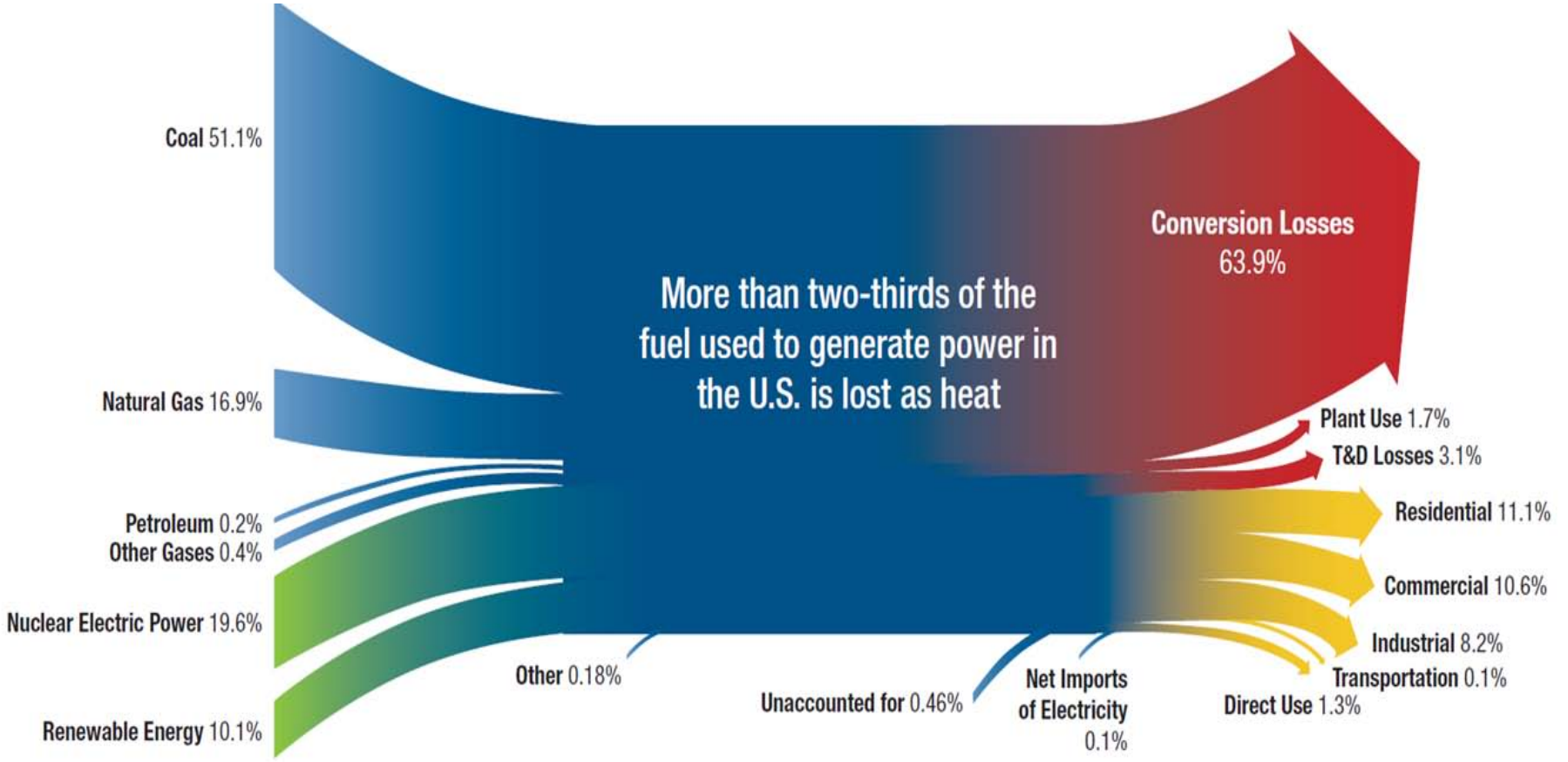
Waste Heat Recovery

Captures heat otherwise wasted in an industrial process and utilizes it to produce electric power. These systems may or may not produce additional thermal energy

District Energy

Central heating & cooling plants that incorporate electricity generation along with thermal distribution piping networks for multiple buildings (campus / downtown area)

Today's Electric Grid



What is CHP

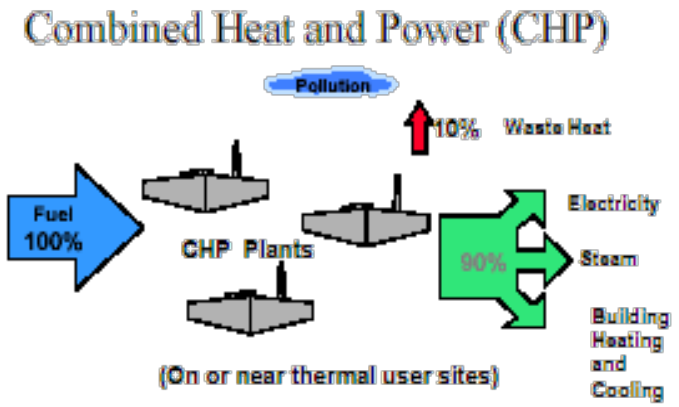
- **ASHRAE Handbook:** "Combined heat and power (CHP). Simultaneous production of electrical or mechanical energy and useful thermal energy from a single energy stream."

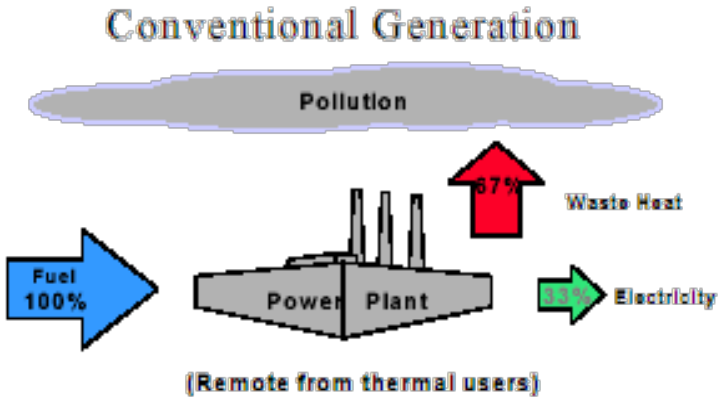
- CHP is not a single technology but a suite of technologies that can use a variety of fuels to generate electricity or power at the point of use.

- CHP technology can be deployed quickly, cost-effectively, and with few geographic limitations.

What is CHP?

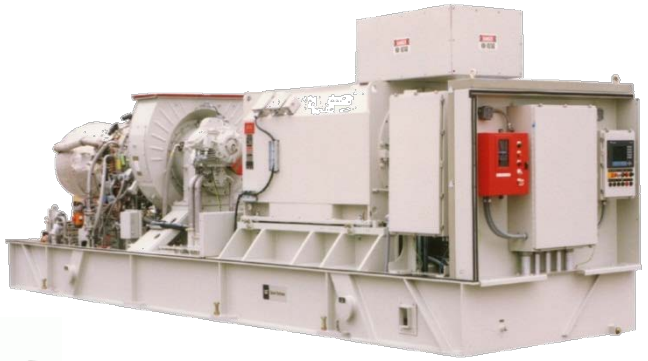
- **On-site generation of Power and Thermal Energy from a single fuel source**
- **'Conventional' grid based generators are located remote from thermal applications while CHP plants are located close to thermal applications**





Prime Movers

- Gas Combustion Turbines > 1 MW
- Microturbines 35 kW – 250 kW
- IC Engines 30 kW – 6 MW
- Fuel Cells 250 kW

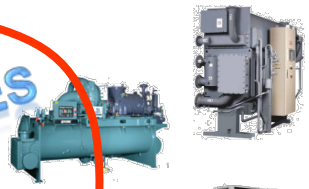


- 75% - 60% HEAT
- 25% - 40% Electricity

Thermally Activated Technologies

- **Technologies:**
  - Hot Water Systems
  - Boilers/Steam Generators
  - Organic Rankin Cycle
  - Backpressure Turbines
  - Absorbers
  - Steam Turbines
  - Desiccants
  - Adsorbers

COOLING TECHNOLOGIES



- **Applications:**
  - Process Heat
  - Space Heat
  - Domestic Hot Water
  - Cooling
  - Freezing
  - Dehumidification
  - Power Generation

Distributed Generation Technologies

Thermally-Activated Technologies

1,000 F

900 F

800 F

700 F

600 F

500 F

400 F

300 F

200 F

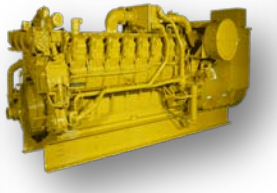
100 F

EFFICIENCY

Gas-turbine

Solid Oxide Fuel Cell

Molten Carbonate Fuel Cell



I.C. Engine Exhaust

Microturbine

Steam Turbine Centrifugal Chiller

Stirling

ORC

Steam Turbine Generator

Liq – Liq HX

Double-Effect Absorption Chiller

Phosphoric Acid Fuel Cell

Stirling

PEM Fuel Cell

I.C. Engine Jacket + Exhaust

Single-Effect Absorption Chiller

Desiccant Air Conditioner

Load Factor vs Efficiency

"No matter which basis is used to choose the prime mover, the degree of use of the available heat …is the critical factor in economic feasibility.

……. ASHRAE Design Guide, Chapter 7 – CHP Systems

Current CHP Drivers

- **Cost Savings**
  - Offset Utility/3rd Party kWh's + Therms
  - Reduce Utility Demand Charges - Demand Response
  - Improved Power Reliability/Quality

- **Emissions Reductions**
  - In the same way that it saves fuel cost, CHP reduces pollution by using the fuel's energy twice, yielding half to a third of the emissions from separate fossil fuelled grid power and boilers.
  - Supported by US DOE & US EPA

U.S. DEPARTMENT OF ENERGY

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