COMBINED HEAT AND POWER ALLIANCE

Combined Heat and Power (CHP) and Waste Heat to Power (WHP) National Overview

The industrial and commercial sectors, which represent roughly one-half of total U.S. energy use,[1] hold great potential for energy efficiency improvements. Encouraging manufacturers and commercial property owners to generate power onsite with technologies like Combined Heat and Power (CHP) and Waste Heat to Power (WHP) can create jobs, strengthen America's competitiveness, and make our grid more resilient.

CHP uses a single fuel source to generate both heat and electricity. CHP's key advantage is efficiency – more than twice the energy efficiency of the average power plant.[2] [Fig. 1]

WHP uses industrial waste heat (typically released into the atmosphere) and captures it to generate electricity with no additional fuel, and no incremental emissions.[3] [Fig. 2]

Fig. 1: Energy Efficiency Advantage of CHP Compared to Traditional Energy Supply

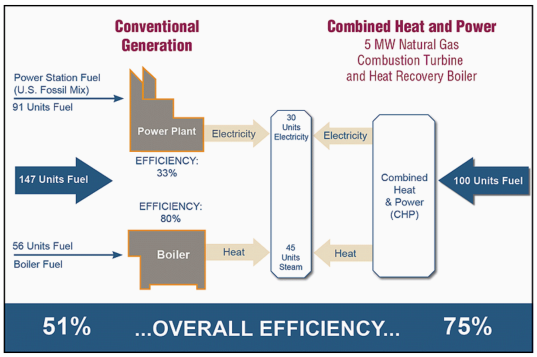
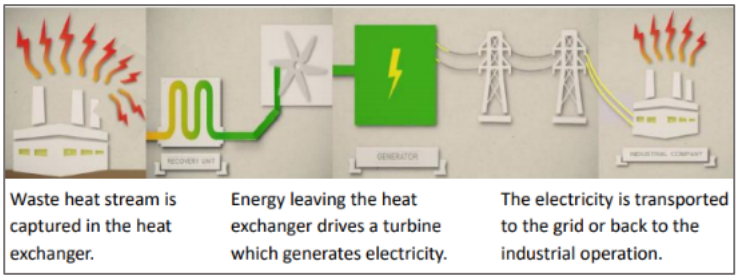


Fig. 2: WHP System Electricity Generation Process with No Fuel, Combustion, or Emissions



CHP and WHP have several direct benefits:

- Reduced energy costs
- Insulation from volatile electricity prices
- Increased energy efficiency
- Reduced emissions and air pollutants
- Increased reliability and grid support
- Increased manufacturing competitiveness

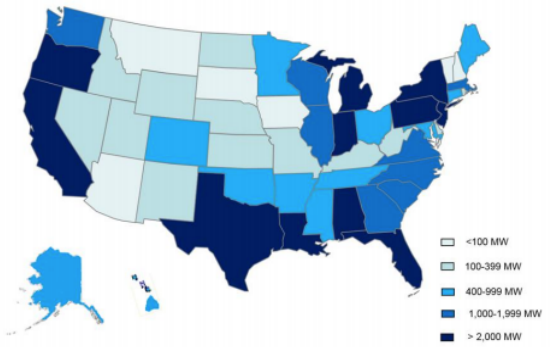
CHP and WHP are prevalent in the industrial and commercial sectors but there is huge additional potential:

- To date, 82.7 gigawatts (GW) of CHP capacity exists across 4,400 facilities in the United States (Figure 3)
  - 766 megawatts (MW) of WHP exists across 96 systems in the United States
- The U.S. Department of Energy has identified nearly 241 GW of remaining CHP technical potential capacity at more than 291,000 sites nationwide.[4] (Figures 4 and 5). That is equivalent to 480 conventional power plants.[5]
- In addition, the EPA has identified 15 GW of WHP technical potential capacity in the U.S.[6] and twenty states include WHP in their renewable portfolio standard (or similar program).

CHP and WHP Efficiency & Savings: If states installed only those CHP and WHP projects that could be paid back within 10 years, the U.S. could:[7]

- **Save $140.6 billion** from 2016-2030
- **Reduce carbon emissions by 32,625,000 short tons** – equal to emissions from 8.6 conventional power plants or 3.1-million homes[8]
- **Save 183,855,000 megawatt hours (MWh) annually** – enough electricity to power over 17-million homes[9]

Fig. 3: Existing CHP Capacity by State



Source: DOE CHP Installation Database (U.S. installations as of December 31, 2014)

Fig. 4: On-site Industrial Sector Technical Potential

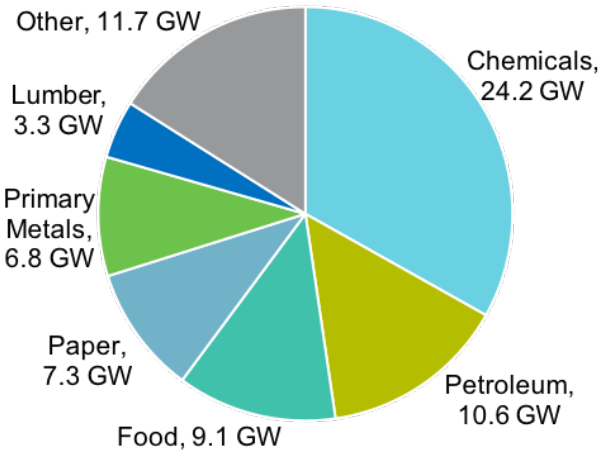
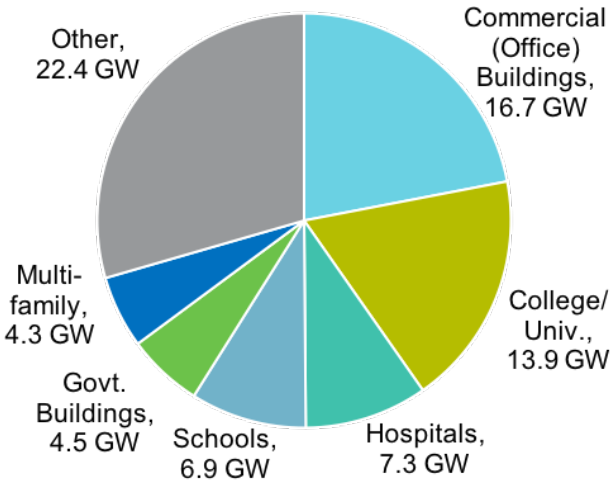


Fig. 5: On-site Commercial Sector Technical Potential



Success Stories

Texas Medical Center

Texas Medical Center and TECO (Houston, TX):[10] The Texas Medical Center (TMC) – the largest medical center in the world, with over 50 hospitals and institutions – installed a CHP system in 2010 for reliability, energy security, and environmental benefits. The 48 MW gas turbine, run by Thermal Energy Corporation (TECO), reduces CO_2 emissions by 305,000 short tons a year and generates annual energy savings ranging from $6-12 million. The steam and chilled water is distributed to roughly 85% of the medical center, and comprises the largest district cooling system in the U.S.

Solvay Specialty Polymers (Marietta, OH):[11] Searching for a replacement for its thermal energy source, Solvay Specialty Polymers installed an 8 MW gas turbine CHP system in 2015, which provides 100% of steam needs and 97% of the electrical load for the 24/7 chemical processing facility. Built, owned, operated, and maintained by DTE Energy services, the CHP system is expected to produce energy savings exceeding its installation costs by $6 million. The CHP plant not only preserved 350 jobs in the existing area, but also created new manufacturing jobs.

Solvay Specialty Polymers

[1] U.S. EIA, January 2017, "Energy Consumption Estimates by Sector" https://www.eia.gov/consumption/
[2] U.S. EPA, Combined Heat and Power Partnership, "CHP Benefits" https://www.epa.gov/chp/chp-benefits
[3] Heat is Power, August 2017, "About Waste Heat to Power" http://www.heatispower.org/waste-heat-to-power/
[4] U.S. DOE, March 2016, "Combined Heat and Power Technical Potential in the United States https://www.energy.gov/sites/prod/files/2016/04/f30/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf
[5] Based on a national average power plant capacity of 500 megawatts (MW)
[6] ICF, March 2015, "Waste Heat to Power Market Assessment" http://www.heatispower.org/wp-content/uploads/2015/02/ORNL-WHP-Mkt-Assessment-Report-March-2015.pdf
[7] Combined Heat and Power Alliance, September 2016, "National Factsheet AIE State Ranking Report" https://chpalliance.org/resources/state-industrial-efficiency-ranking/
[8] U.S. EPA, January 2017, "Greenhouse Gas Equivalencies Calculator" https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator
[9] In 2015, EIA data shows average annual electricity consumption for a U.S. residential utility customer was 10.812 MWh. https://www.eia.gov/tools/faqs/faq.php?id=97&t=3
[10] U.S. DOE SW CHP TAP, 2015, "Texas Medical Center and TECO" http://www.southwestchptap.org/data/sites/1/documents/profiles/Texas_Medical_Center-Project_Profile.pdf
[11] CHPA, "Case Study: Energy Efficiency is Good for Business" https://chpalliance.org/wp-content/uploads/2017/02/Solvay_case_study_FINAL.pdf