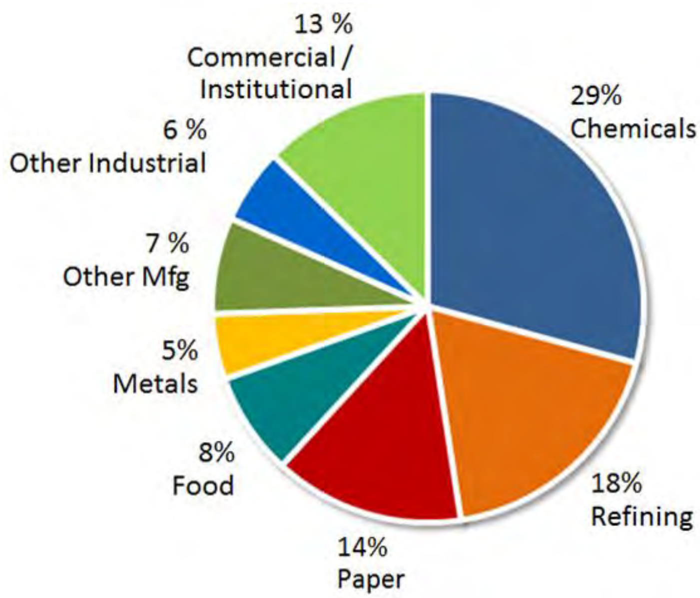
Appendix B: CHP Outlook

CHP is already an important resource for the United States—the existing 82 GW of CHP capacity at more than 4,100 industrial and commercial facilities represents approximately 8% of current U.S. generating capacity and more than 12% of total MWh generated annually.[200] CHP can be utilized in a variety of applications that have significant and coincident, power and thermal loads. Figure B.1 shows the sectors currently using CHP—87% of existing CHP capacity is found in industrial applications, providing power and steam to energy intensive industries such as chemicals, paper, refining, food processing, and metals manufacturing. CHP in commercial and institutional applications is currently 13% of existing capacity, providing power, heating, and cooling to hospitals, schools, university campuses, hotels, nursing homes, office buildings, and apartment complexes. District energy CHP systems in cities and university campuses represent approximately 5 GW of installed CHP.[201]

Current United States CHP installations use a diverse set of fuels, although natural gas is by far the most common fuel at 72% of installed CHP capacity. Biomass, process wastes, and coal comprise the remaining CHP fuel mix. Compared to the average fossil-based electricity generation, the entire existing base of CHP saves 1.8 quads of energy annually and mitigates 240 MMTCO_2e each year (equivalent to the emissions of more than 40 million cars).

There is a long history of using CHP in the United States. Decentralized CHP systems located at industrial and municipal sites were the foundation of the early electric power industry in the United States. However, as power generation technologies advanced, the power industry began to build larger central station facilities to take advantage of increasing economies of scale. CHP became a limited practice primarily utilized by a handful of industries (paper, chemicals, refining, and steel) which had high and relatively constant steam and electric demands and access to low-cost fuels. Utilities had little incentive to encourage customer-sited generation, including CHP. Various market and non-market barriers at the state and federal level served to further discourage broad CHP development.[202]



Source: "CHP Installation Database." ICF International. www.eea-inc.com/chpdata/index.html.

Figure B.1. Currently installed CHP capacity by application

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200 "CHP Installation Database." Developed by ICF International for Oak Ridge National Laboratory and the U.S. DOE. 2012. www.eea-inc.com/chpdata/index.html.

201 International District Energy Association.

202 Oak Ridge National Laboratory. 2008. *Combined Heat and Power: Effective Energy Solutions for a Sustainable Future*." ORNL/TM-2008/224.

Spurred by the oil crisis, in 1978, Congress passed PURPA to encourage greater energy efficiency. PURPA provisions encouraged energy efficient CHP and small power production from renewables by requiring electric utilities to interconnect with "qualified facilities." Qualifying Facilities CHP facilities had to meet minimum fuel-specific efficiency standards[203] in order to become a qualified facility. PURPA required utilities to provide Facilities with reasonable standby and back-up charges, and to purchase excess electricity from these facilities at the utilities' avoided costs.[204] PURPA also exempted Qualifying Facilities from regulatory oversight under the Public Utilities Holding Company Act and from constraints on natural gas use imposed by the Fuel Use Act. Shortly after enacting PURPA, Congress also provided tax credits for investments in cogeneration equipment under the Energy Tax Act of 1978 (P.L. 95-618; 96-223) and the Crude Oil Windfall Profits Tax Act of 1980 (P.L. 96-223; 96-471). The Energy Tax Act included a 10% tax credit on waste-heat boilers and related equipment, and the Windfall Profits Tax Act extended the 10% credit to remaining CHP equipment for qualified projects.[205] The Windfall Profits Act limited the amount of oil or natural gas that a Qualifying Facility could use.[206] The implementation of PURPA and the tax incentives were successful in dramatically expanding CHP development; installed capacity increased from about 12,000 MW in 1980 to more than 66,000 MW in 2000.[207]

The environment for CHP changed again in the early 2000s with the advent of restructured wholesale markets for electricity in several regions of the country. Independent power producers could now sell directly to the market without the need for Qualifying Facility status. The movement toward restructuring (deregulation) of power markets in individual states also caused market uncertainty, resulting in delayed energy investments. As a result, CHP development slowed. These changes also coincided with rising and increasingly volatile natural gas prices as the supply demand balance in the United States tightened. This further dampened the market for CHP development.

While recent investment in CHP has declined, CHP's potential role as a clean energy source for the future is much greater than recent market trends would indicate. Like other forms of energy efficiency, efficient on-site CHP represents a largely untapped resource that exists in a variety of energy-intensive industries and businesses (Figure B.2). Recent estimates indicate the technical potential[208] for additional CHP at existing industrial facilities is slightly less than 65 GW, with the corresponding technical potential for CHP at commercial and institutional facilities at more than 65 GW,[209] for a total of about 130 GW. A 2009 study by McKinsey and Company estimated that 50 GW of CHP in industrial and large commercial/institutional applications could be deployable at reasonable returns with then current equipment and energy prices.[210] These estimates of both technical and economic potential are likely greater today given the improving outlook in natural gas supply and prices.

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[203] Efficiency hurdles were higher for natural gas CHP.

[204] Avoided cost is the cost an electric utility would otherwise incur to generate power if it did not purchase electricity from another source.

[205] Congressional Research Service. "Energy Tax Policy: Historical Perspectives on the Current Status of Energy Tax Expenditures." May 2011.

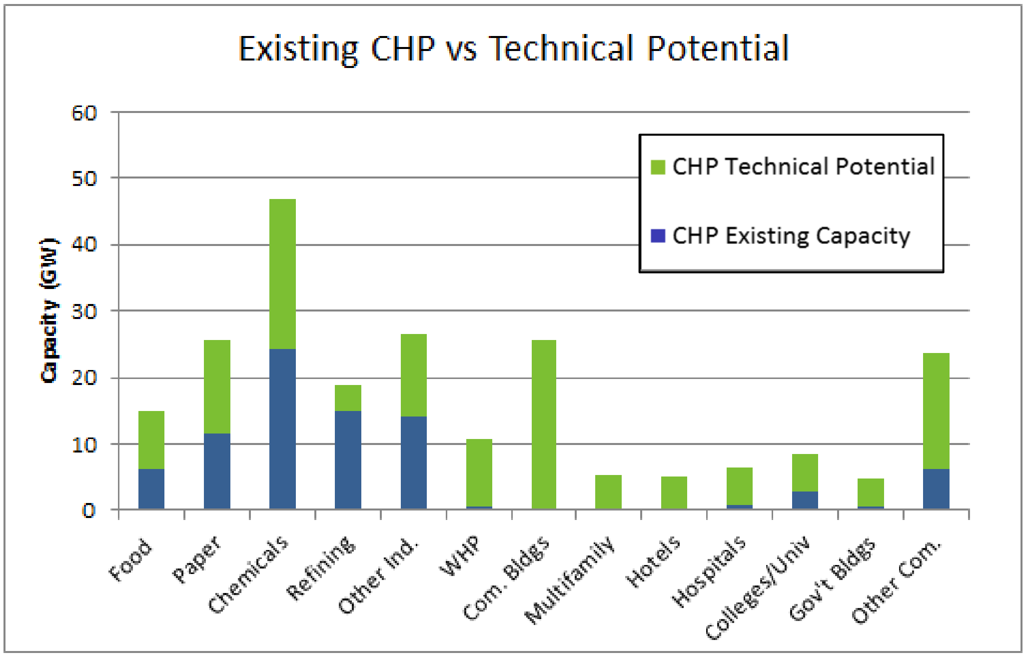
[206] G Fowler, A Baugher, and S Jansen. "Cogeneration." Illinois Issues. Northern Illinois University. December 1981.

[207] "CHP Installation Database." Developed by ICF International for Oak Ridge National Laboratory and the U.S. DOE. 2012. www.eea-inc.com/chpdata/index.html.

[208] The technical market potential is an estimation of market size constrained only by technological limits—the ability of CHP technologies to fit existing customer energy needs. The technical potential includes sites that have the energy consumption characteristics that could apply CHP. The technical market potential does not consider screening for other factors such as ability to retrofit, owner interest in applying CHP, capital availability, fuel availability, and variation of energy consumption within customer application/size classes. All of these factors affect the feasibility, cost and ultimate acceptance of CHP at a site and are critical in the actual economic implementation of CHP.

[209] Based on internal estimates as detailed in ICF International. *Effect of a 30 Percent Investment Tax Credit on the Economic Market Potential for Combined Heat and Power.* October 2010. Prepared for WADE and USCHPA. These estimates are on the same order as recent estimates developed by McKinsey and Company (see following footnote).

[210] McKinsey Global Energy and Materials. (2009). *Unlocking Energy Efficiency in the U.S. Economy*. www.mckinsey.com/Client_Service/Electric_Power_and_Natural_Gas/Latest_thinking/Unlocking_energy_efficiency_in_the_US_economy.



Source: Internal estimates by ICF International and "CHP Installation Database." Developed by ICF International for Oak Ridge National Laboratory and the U.S. DOE. 2012. www.eea-inc.com/chpdata/index.html.

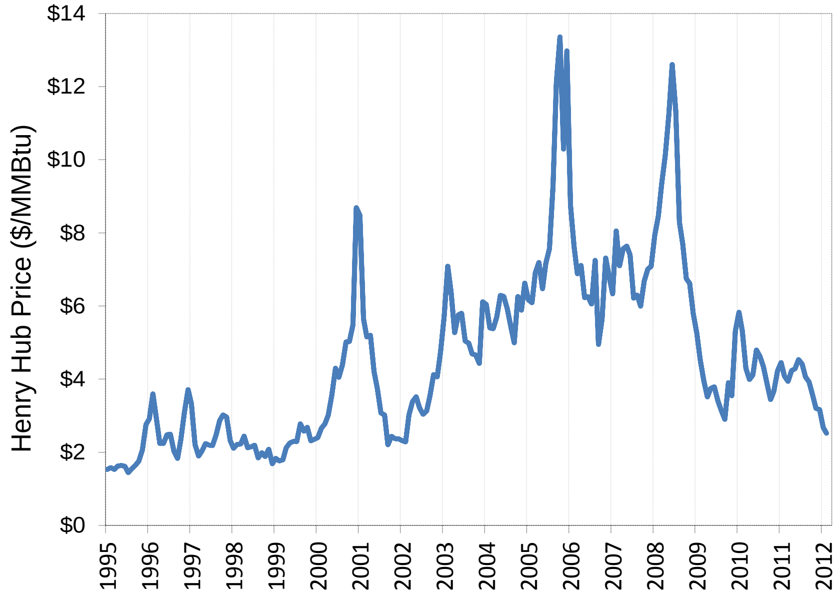
Figure B.2. Technical potential for CHP at industrial and commercial facilities

The outlook for increased use of CHP is improving. Policymakers at the federal and state level are beginning to recognize the potential benefits of CHP and the role it could play in providing clean, reliable, cost-effective energy services to industry and businesses. A number of states have developed innovative approaches to increase the deployment of CHP to the benefit of users as well as ratepayers. CHP is being looked at as a productive investment by some companies facing significant costs to upgrade old coal and oil-fired boilers. In addition, CHP can provide a cost-effective source of new generating capacity in many areas confronting retirement of older power plants. Finally, the economics of CHP are improving as a result of the changing outlook in the long-term supply and price of North American natural gas—a preferred fuel for many CHP applications.

Regarding natural gas prices, a recent report[211] summarizes the changing supply outlook for natural gas in North America and its impact on prices and CHP deployment:

> "The development of shale gas has had a significant moderating effect on natural gas prices. Prices in the five years prior to the recession averaged approximately $7.50/MMBtu; since 2008, gas prices have averaged approximately $4/MMBtu. Continuing advancements in technology are driving reassessments of long term gas outlook as analysts project more and more shale gas is economically recoverable at prices below $5/MMBtu. Estimates of the natural gas resource base in North America that can be technically recovered using current exploration and production technologies now range from 2,000 to more than 4,000 trillion cubic feet—enough natural gas to supply the United States and Canada for 100 to 150 years at current levels of consumption. Henry Hub gas prices remain in the $4 to $7 range through 2030 in current EIA projections; sufficient to support the levels of supply development in the projection, but not high enough to discourage market growth. Continuing moderate, and less volatile, gas prices will be a strong incentive for CHP market development. As detailed above, 72% of existing CHP capacity is fueled by natural gas, and the clean burning and low carbon aspects of natural gas will make it a preferred fuel for future CHP growth."

[211] U.S. DOE. *Combined Heat and Power: A Clean Energy Solution*. August 2012. www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_clean_energy_solution.pdf.



Source: Energy Information Administration. www.eia.gov/dnav/ng/hist/rngwhhdm.htm.

Figure B.3. Henry Hub natural gas prices