

# Thermally Activated Technologies: Combined Cooling, Heating, and Power

Distributed Energy Resources (DER) are a suite of onsite, grid-connected or stand-alone technology systems that can be integrated into residential, commercial, or institutional buildings and/or industrial facilities. These energy systems include distributed generation, renewable energy, and hybrid generation technologies; energy storage; thermally activated technologies that use recoverable heat for cooling, heating, or power; transmission and delivery mechanisms; control and communication technologies; and demand-side energy management tools. Such decentralized resources offer advantages over conventional grid electricity by offering end users a diversified fuel supply; higher power reliability, quality, and efficiency; lower emissions; and greater flexibility to respond to changing energy needs.

**A**pproximately two-thirds of the fuel used to generate electricity in the United States is wasted in the form of discarded heat. Combined heat and power systems produce electricity or mechanical power and capture recoverable heat for process use.

Currently, only 7 percent of this country's electricity is provided by cooling, heating, and power (CHP) systems. These systems take advantage of the "waste" heat of combustion from onsite microturbines, turbines, fuel cells, and reciprocating engines for space conditioning, steam, hot water, or further power generation.



CHP Package System at the University of Maryland

residential, and institutional buildings. This involves the installation of a system that generates part or all of the building's electricity and thermal requirements.

**The Industrial Sector** — The industrial sector offers the greatest potential for near-term growth. Large industrial

CHP systems are currently used in the petroleum refining, petrochemical, and pulp and paper industries. Thousands of boilers provide process steam to a broad range of U.S. manufacturing plants. This offers a large potential for adding new electricity generation between 50 kW and 25 MW by either modifying boiler systems to

add electricity generation, or replacing the existing boiler with a new CHP system. Small manufacturers represent an important growth segment over the coming decade.

## Applications

### Smaller Commercial and Institutional Systems —

With the arrival of reliable reciprocating engines and smaller combustion turbines, microturbines, and fuel cells, CHP is becoming feasible for small commercial,

**District Energy Systems** — A growing market for CHP systems, district energy systems distribute steam, hot water, and chilled water from a central plant to buildings through a network of pipes.

## Market Potential

- ▶ According to EPRI, CHP systems can increase power reliability, offsetting an estimated \$119 billion in annual power outage costs.
- ▶ The potential market for peak shaving could total 460 GW, according to a recent DOE study.
- ▶ CHP defers new transmission and distribution (T&D) capital investments and reduces line losses.

## Environmental Benefits

- ▶ CHP systems could reduce annual greenhouse gas emissions by at least 25 million metric tons of carbon if goals to double U.S. installed capacity by 2010 were met.
- ▶ CHP systems greatly reduce heat, carbon, NO<sub>x</sub>, and SO<sub>x</sub> released into the atmosphere.

## Program Goals and Activities

The CHP System Program goal is to double the capacity of CHP in the United States to 92 GW by 2010 and create integrated mechanical equipment in overall building system design. The National CHP Roadmap will be used to guide the program's activities.

Other objectives of the program include the following:

- ▶ **Raise CHP Awareness** — Strengthen efforts to build a more effective industry coalition dedicated to CHP, intensify federal coordination, and expand existing awareness efforts by regional and state groups.
- ▶ **Eliminate Regulatory and Institutional Barriers** — Implement uniform interconnection standards, develop effective and fair utility policies and practices for utility-CHP interconnections, develop output-based emissions standards, develop streamlined siting and permitting processes, develop uniform building codes and standards that address CHP systems and components, and develop equitable tax provisions for CHP equipment.
- ▶ **Develop CHP Markets** — Install 27 GW of additional industrial CHP capacity, 8 GW of additional buildings CHP capacity, 8 GW of additional district energy capacity, and 5 GW of additional CHP capacity in federal facilities.
- ▶ **Develop CHP Technologies** — Research is being conducted to improve cooling, heating, air-conditioning, and power components for more efficient system integration. Working with building developers and equipment manufacturers, the program is identifying and implementing test centers in small commercial buildings. The program will also conduct full-scale demonstrations of commercial systems and analyze their technical and economic performance. Universal connection standards are also being developed to simplify installation and maintenance.

Program activities include the following:

- ▶ Design test packages and modular CHP systems to assist manufacturers and packagers in setting specifications for next-generation systems and evaluating their performance.
- ▶ Integrate mechanical equipment systems with overall building design.
- ▶ Integrate replicable CHP systems in fluid heating processes in the chemical, refining, manufacturing, and industrial sectors (e.g., in New York State).
- ▶ Effectively integrate desiccant dehumidification/enthalpy exchange devices with thermal cooling, heating, and storage devices.
- ▶ Accelerate humidity control in buildings to significantly improve indoor air quality, productivity, and occupant health.
- ▶ Form the Midwest CHP Applications Center at the University of Illinois at Chicago to help the building owning, operating, and engineering communities successfully apply CHP systems.
- ▶ Assist the Federal Energy Management Program in deploying CHP in the federal sector.



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## For further information:

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**Distributed Energy Resources**  
[www.eren.doe.gov/der](http://www.eren.doe.gov/der)

**CHP for Buildings**  
[www.bchp.org/home.html](http://www.bchp.org/home.html)

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