

## DISTRIBUTED ENERGY PROGRAM REPORT

# Current CHP Opportunities at U.S. Colleges and Universities

November 2003

By

International District Energy Association



**U.S. Department of Energy**  
**Energy Efficiency**  
**and Renewable Energy**

Bringing you a prosperous future where energy  
is clean, abundant, reliable, and affordable



# Current CHP Opportunities at U.S. Colleges and Universities

---

**Report for Oak Ridge National Laboratory and  
the U.S. Department of Energy**

**November 2003**



# Project Overview

---



# Project Background

---

- The DOE is committed to doubling CHP in the U.S. from 46 GW to 92 GW by 2010
- DOE worked with IDEA to identify current CHP projects, prioritize them, and determine how to support them
- Project was focused on U.S. colleges and universities for the following reasons:
  1. The sector's leadership in adopting CHP
  2. The sector's potential for CHP growth in the near future due to:
    - Multiple building loads under common ownership enable loads to be aggregated and served by a central plant
    - Close proximity of buildings ensures that connecting buildings with piping is not cost prohibitive
    - Buildings are occupied by "owners" making a higher degree of control and comfort desirable
    - Occupancy levels are high creating high load factors that amortize the investment in CHP systems
  3. IDEA's relationships within this sector, which facilitated the data collection process

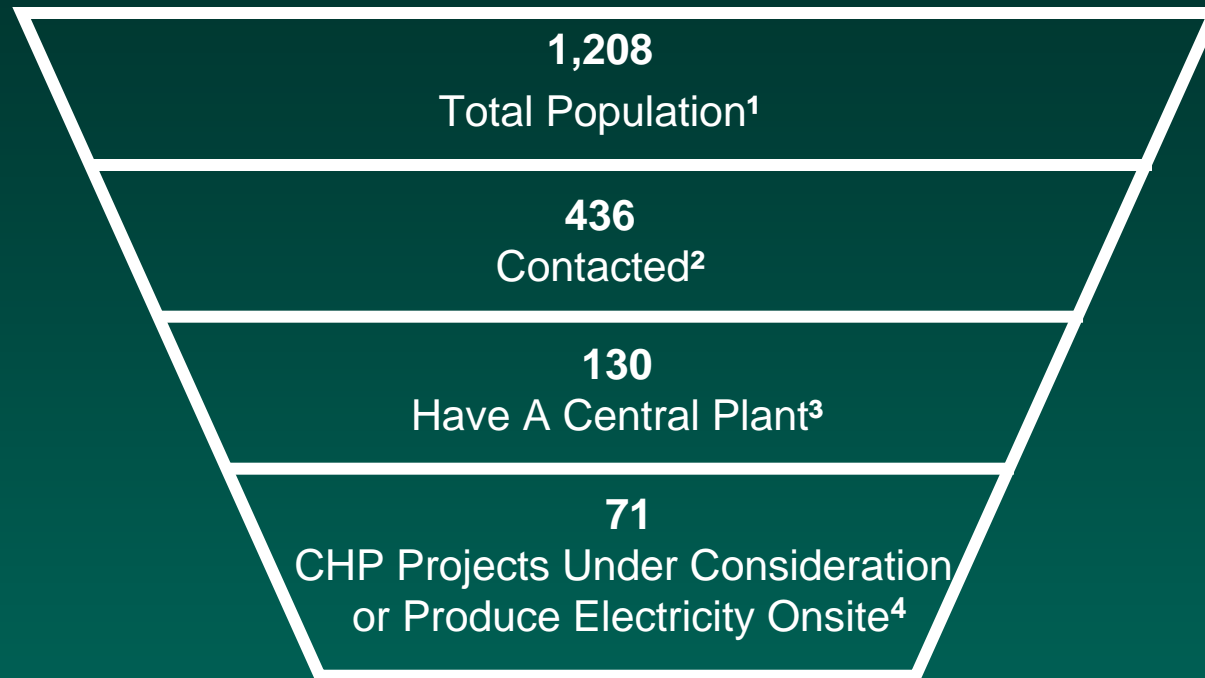
# Project Objectives

---

- The objectives of project were to:
  1. Identify through census and survey the current inventory of district energy and CHP within the campus sector **(Phase 1)**
  2. Outline the key success factors for CHP within the campus sector to support industry growth **(Phase 1)**
  3. Identify the major challenges to CHP within the campus sector and suggest strategies for overcoming these hurdles **(Phase 1)**
  4. Develop case studies on CHP projects within the campus sector to promote the industry **(Phase 2)**
  5. Work with DOE to sponsor the 2003 IDEA Campus Energy Conference including a workshop entitled “How To Build CHP on Campus” to educate and inform industry participants **(Phase 2)**
  6. Screen current CHP projects to identify those with potential for success in the near future **(Phase 3)**
  7. Suggest actions for the DOE and IDEA to support CHP projects within the campus sector with near-term potential for success **(Phase 3)**

# Project Sample

---



<sup>1</sup> Lists of U.S. colleges and universities were provided by IDEA, APPA, and the District Energy Library at the University of Rochester. Institutions with central plants were likely to be in this group.

<sup>2</sup> Institutions that were considered likely to have central plants based on their size, geography, and other factors

<sup>3</sup> Of the 436 institutions that were contacted, 130 reported having a central plant

<sup>4</sup> Of the 130 that reported having a central plant, 71 had electricity generation projects in the planning or construction stage or reported producing their own electricity.

# Current Phase

---

- Third phase of the study
- Scope:
  - Surveyed U.S. colleges and universities that reported undertaking CHP projects or generating their own electricity in Phase 1
  - Prioritized current opportunities for ORNL/DOE
  - Suggested actions for the DOE and IDEA to ensure the success of top priority projects
- Confidential Information Collected:
  - In order to encourage survey respondents to share details about their current CHP plans they were assured that the information would not be shared with the public, other IDEA members, or beyond direct client reports at ORNL/DOE in connection to the specific institution.

# Screening Criteria

---

- Initial Screening Criteria:
  - Value of offset power purchases
  - Value of offset thermal production
  - Size of thermal and power loads and the relationship between the two
  - Thermal and electric load factors
  - Age of existing thermal capacity and plans for replacement or additional capacity
  - Temperature/pressure of required thermal energy
  - Fuel availability and costs
  - Capital and operating cost comparisons



# Screening Criteria (cont.)

---

- Other Market Factors:
  - Plans for capital outlay
  - Urgency of need for additional capacity
  - Access to capital; project phase
  - CHP project support/champion
  - Potential for public recognition
  - Replicability
  - Openness to publicity
  - Regulatory pressures
  - Ease of decision making
  - Risk management ability
  - Existing relationships with the DOE and IDEA

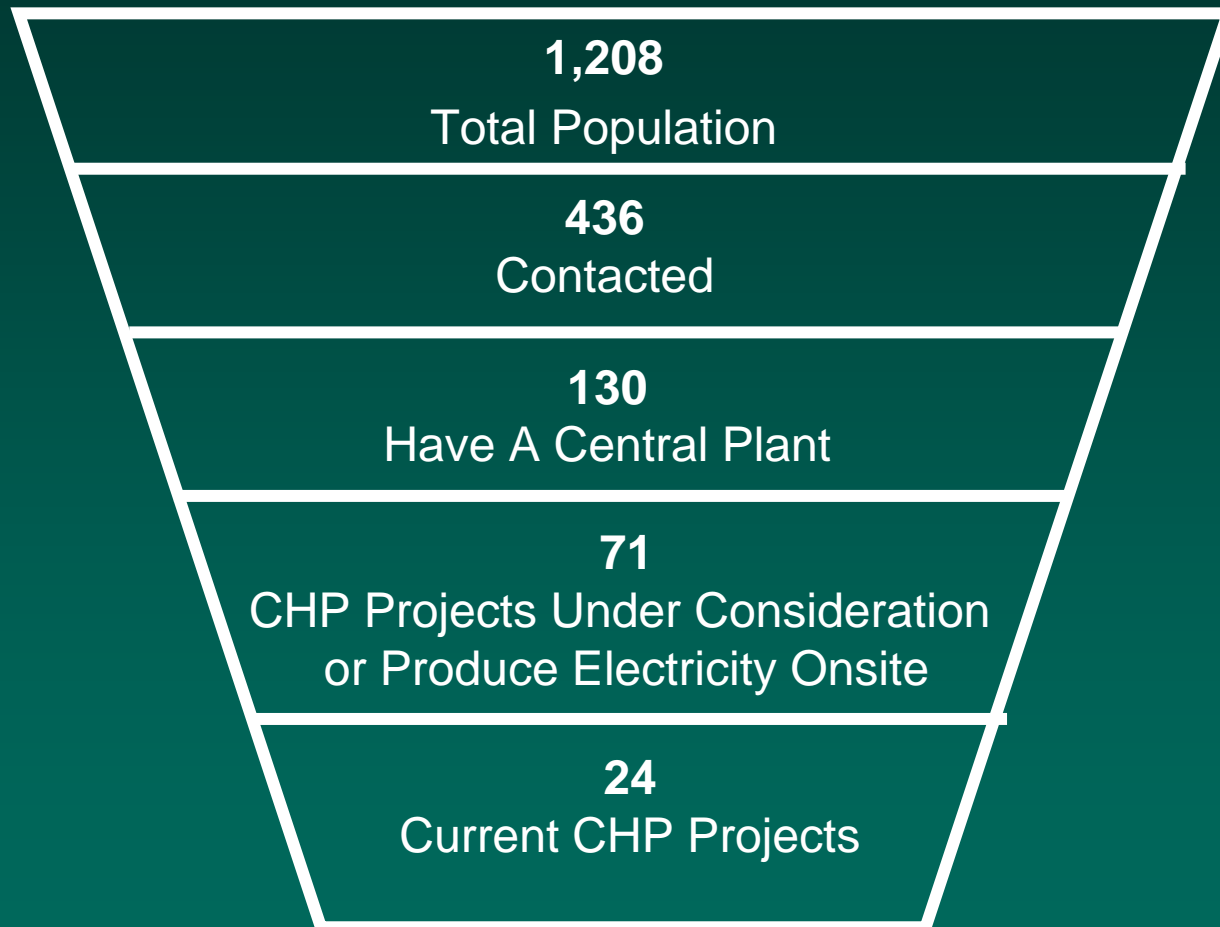
# Research Results

---



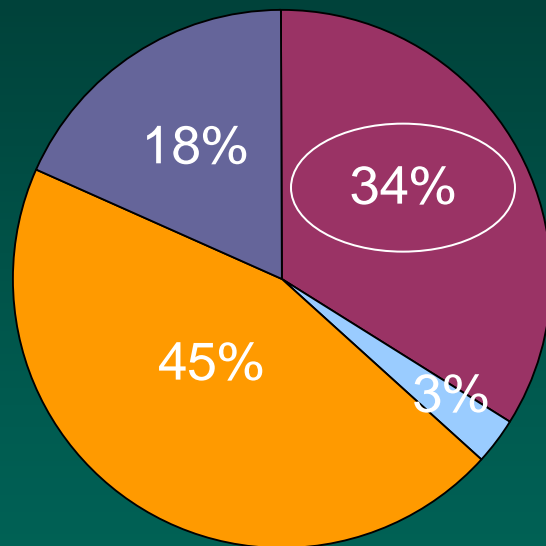
# Current CHP Projects

---



# Current CHP Projects (cont.)

## College & University Sample: 71



- Current CHP Project
- No Plans To Expand CHP
- Not Doing CHP
- Did Not Respond

- 24 current CHP projects were identified through the extensive phone survey follow-up.
- The data collection process was labor intensive and was done during June and July of 2003. Surveys were conducted over the phone in order to gather complete and consistent data in a timely manner.
- After three phone messages were left efforts were no longer made to reach potential survey respondents.

# Key Factors

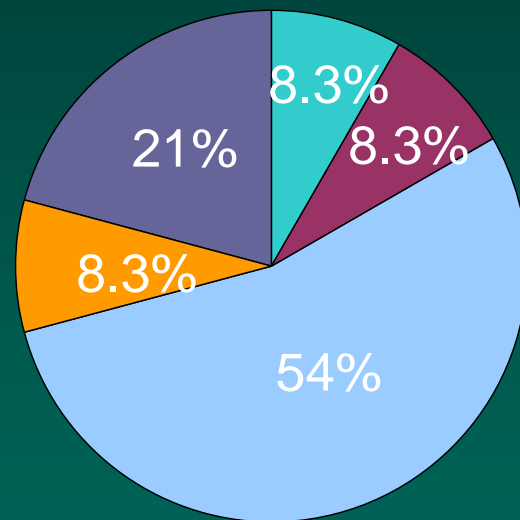
---

- The results of the 24 institutions can be generalized for U.S. colleges and universities
- Of the information collected, the following factors are considered to be most relevant from the DOE's perspective:
  1. Scale
  2. Drivers
  3. Urgency
  4. Technologies & Fuels
  5. Power Cost
  6. Fuel Cost
  7. Type of Plant (i.e. new or expansion)
  8. Leadership Support
  9. Regulatory Pressures
  10. Public Concern
  11. Funding

# Project Scale

---

## 1. Project Scale:

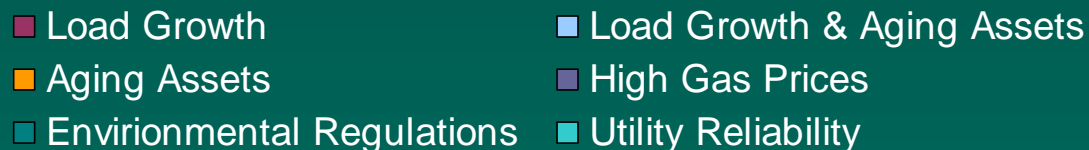
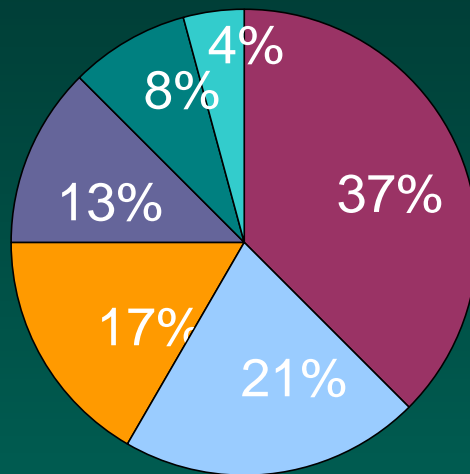


■ >50 MW ■ 25.01 - 50 M W ■ 5 - 25 M W ■ <5 MW ■ Unknown Scale

- The projects of known scale represent between 375 MW and 445 MW of additional CHP
- 63% of projects are 25 MW or less
- Breakdown of the 24 projects: <5 MW (2); 5 – 25 MW (13); 25.01 – 50 MW (2); >50 MW (2); Unknown Scale (5)

# Project Drivers

## 2. Project Drivers:



- Load growth, aging assets, or the combination is the primary driver for 75% of the projects
- Breakdown of the 24 projects: load growth (9); load growth & aging assets (5); aging assets (4); high gas prices (3); environmental regulations (2); utility reliability (1)

# Project Urgency

---

## 3. Project Urgency:

### No Timeframe

- Working on a utility master plan: 1
- Doing feasibility study: 4
- Doing preliminary planning: 8

### Projected Timeframe

- Planning to go online in 2004: 4
- Planning to go online between 2005 – 08: 7
- 83% of the projects will take more than a year to complete



# Technologies & Fuels

---

4. Technologies and fuels being considered for projects are listed below in descending order of interest.

Technologies:

- Steam Turbine
- Gas Turbine
- Gas Engine
- Fluidized Bed Boiler
- Gas Boiler
- Microturbine, Fuel Cell, Wind Power, or PV

Fuels:

- Natural gas
- Coal
- No. 2/No. 6 Fuel Oil
- Wood
- Biomass

Note: Emerging technologies (microturbine, fuel cell, wind power, PV) are generally not being integrated into the central plant utilities operations. Schools are seeking subsidies (R&D, program, education) to cover the cost of the technology.

# Project Costs & Type of Plant

---

## 5. Power Cost:

- Average weighted cost of 6.5 cents per kWh

## 6. Fuel Cost:

- Gas: \$5.55/MMBtu
- Coal: \$2.18/MMBtu
- Wood: \$2.25/MMBtu
- No. 2 Fuel Oil: \$4.64/MMBtu
- No. 6 Fuel Oil: \$4.96/MMBtu

## 7. Plant Type:

- 79% of the projects are replacement or expansion of plants

# Other Factors

---

## 8. Leadership Support:

- 83% of the projects have strong or good support from the leadership of the institution

## • Regulatory Pressures:

- 38% of the projects have above average to severe regulatory pressure on them. These pressures include: Boiler Mact Policy, Nox SIP Call, Nonattainment Zone, Title 5, Clean Air Act

## 8. Public Concern:

- 50% of the projects are sparking concern among the local community, primarily because of the proximity of the plant to the community

## 9. Project Funding:

- In most cases: 1) A funding plan has not been developed yet; 2) Outside funding sources are being considered, primarily bonds; 3) Access to capital is average or better

# Conclusion

---

There is significant near-term potential for CHP growth within the campus sector. However, institutions cannot realize this potential without help in overcoming regulatory, funding, and community challenges. Involvement by state and federal agencies, industry associations, and others is crucial to break down the barriers to CHP within the campus sector. The success of current CHP projects could be the “tipping point” for CHP adoption throughout the campus sector.

The Distributed Energy Program would like to acknowledge Oak Ridge National Laboratory for its Technical Project Input of this Report.

## OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY



### **A Strong Energy Portfolio for a Strong America**

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

#### **For more information contact:**

EERE Information Center

1-877-EERE-INF (1-877-337-3463)

[www.eere.energy.gov](http://www.eere.energy.gov)