



Improving energy performance with CHP

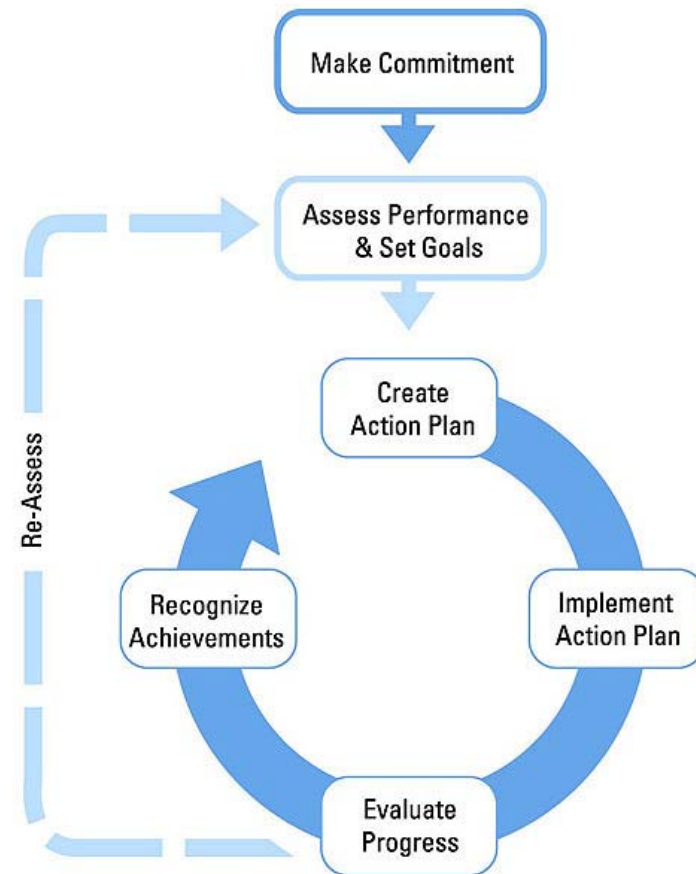
October 20, 2004

**ENERGY STAR Partner Web
Conference**

About The Web Conferences



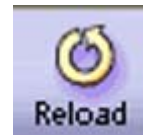
- **Monthly**
- **Topics are structured on a strategic approach to energy management**
- **Help you continually improve energy performance**
- **Opportunity to share ideas with others**
- **Slides are a starting point for discussion**
- **Open & Interactive**



Web Conference Tips



- Mute phone when listening!
Improves sound quality for everyone.
- If slides are not advancing, hit reload button or close presentation window and press the launch button again.



Web Conference Tips



- Chat Feature



- Presentation Slides will be sent by email to all participants following the web conference.
- Hold & Music – If your phone system has music-on-hold, please don't put the web conference on hold!



Today's Web Conference



- Background
- Duane Kiihne – Johnson & Johnson
- Joe Sullivan – The College of New Jersey
- Kim Crossman – EPA's CHP Partnership
- Questions & Discussion
- Announcements

What is CHP?



- Combined Heat and Power (CHP) is the simultaneous production of electrical and thermal energy from one fuel source.
- By recovering the waste heat from electricity production or industrial processes and using it in a facility, system efficiencies are greatly increased.

CHP

Evaluating and Engineering the Right CHP fit for You

Duane Kiihne

Johnson & Johnson

Pharmaceutical Research & Development, LLC.

Overview

- Johnson & Johnson
- San Diego CA
- Pharmaceutical Research and Development
- 120,000 Sq Ft Original Site,
- 180,000 Sq Ft Building Addition
- Total Site 300,000 Sq Ft

Agenda

- Project Overview
- How we got started
- What type of Cogen was installed
- Lessons learned or tips for installing CHP
- Benefits of Cogen system

Project Overview

- 2-1100 kW Natural Gas IC Engines
- Generates 90% of Site Usage
- Available Heat used for Chilled Water and Building Reheat
- Designed to stay on during Utility Outage
- Required to take 5% from Grid

How we got started

- Asked to do Fuel Cell ROI
- Study of Electrical, Heating and cooling requirements for site
- Seven options including Fuel Cell
- Initial ROI looked good
- Incorporated CHP into Building Design

FIGURE 4.3-1
Natural Gas Consumption
JJPRD Phase 1, 2001

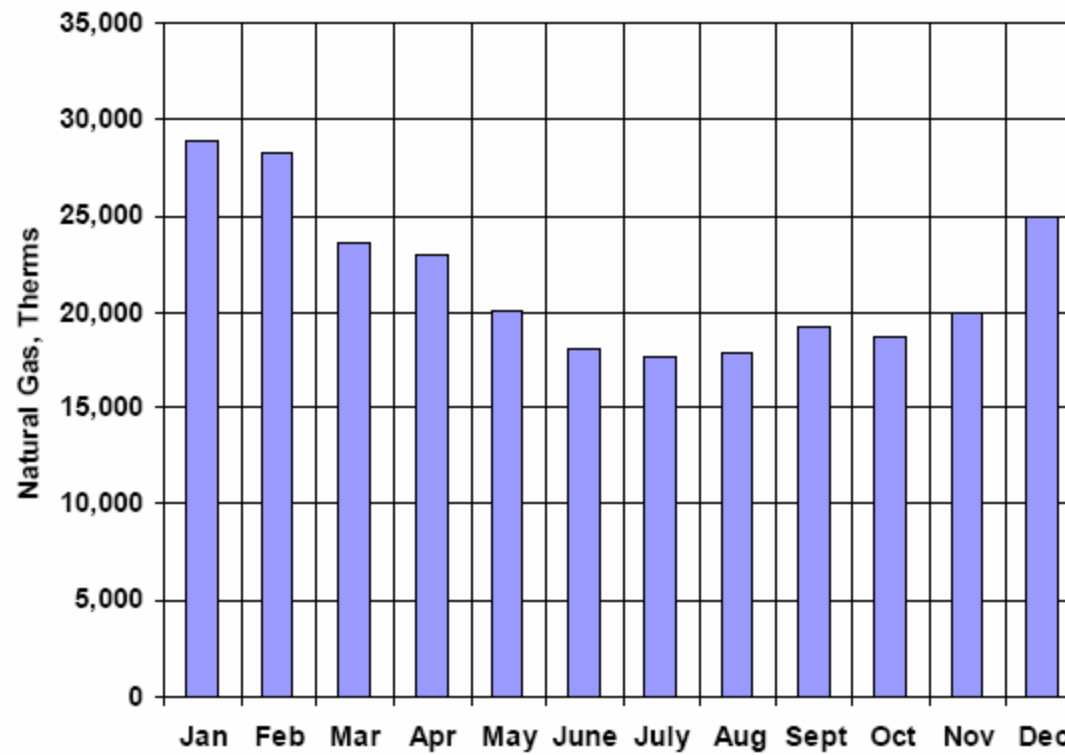


FIGURE 4.3-2
Estimated Heating Hot Water Demand - Average Annual Day
JJPRD Phases 1 & 2

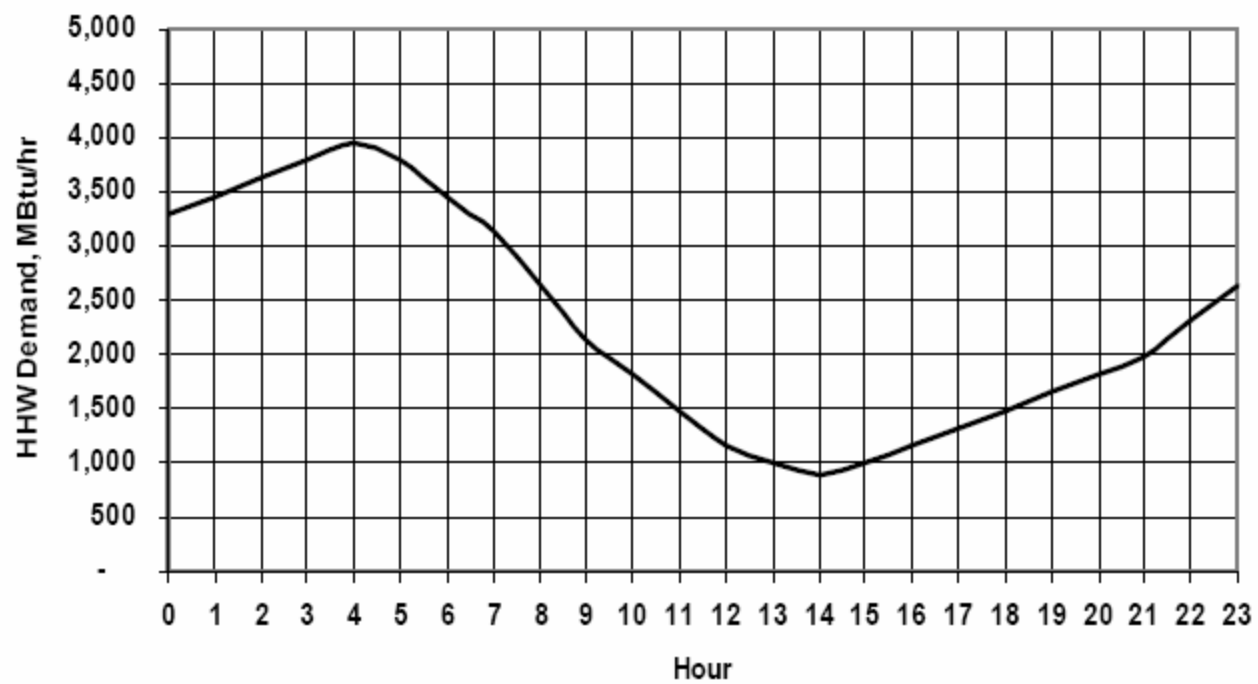
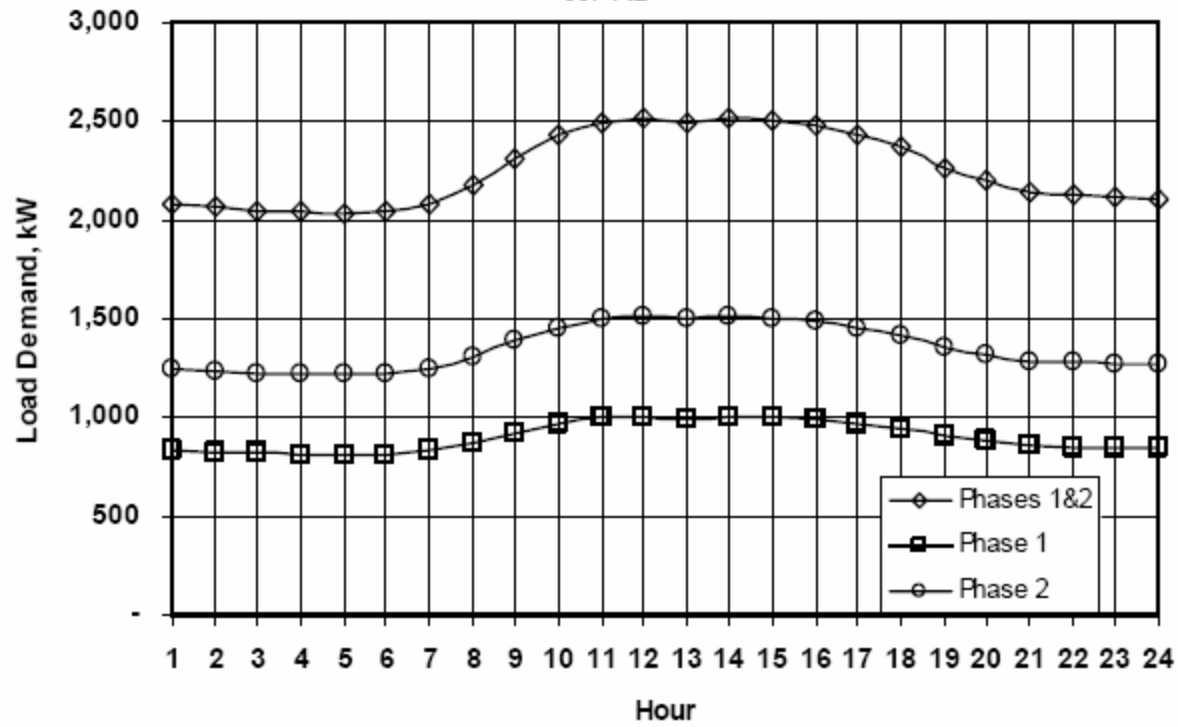


FIGURE 4.1-1
Electrical Load Profiles - Average Annual Day
JJPRD



Johnson & Johnson - San Diego, CA



Exterior of Cogen Yard



Lean Green Generating Machine

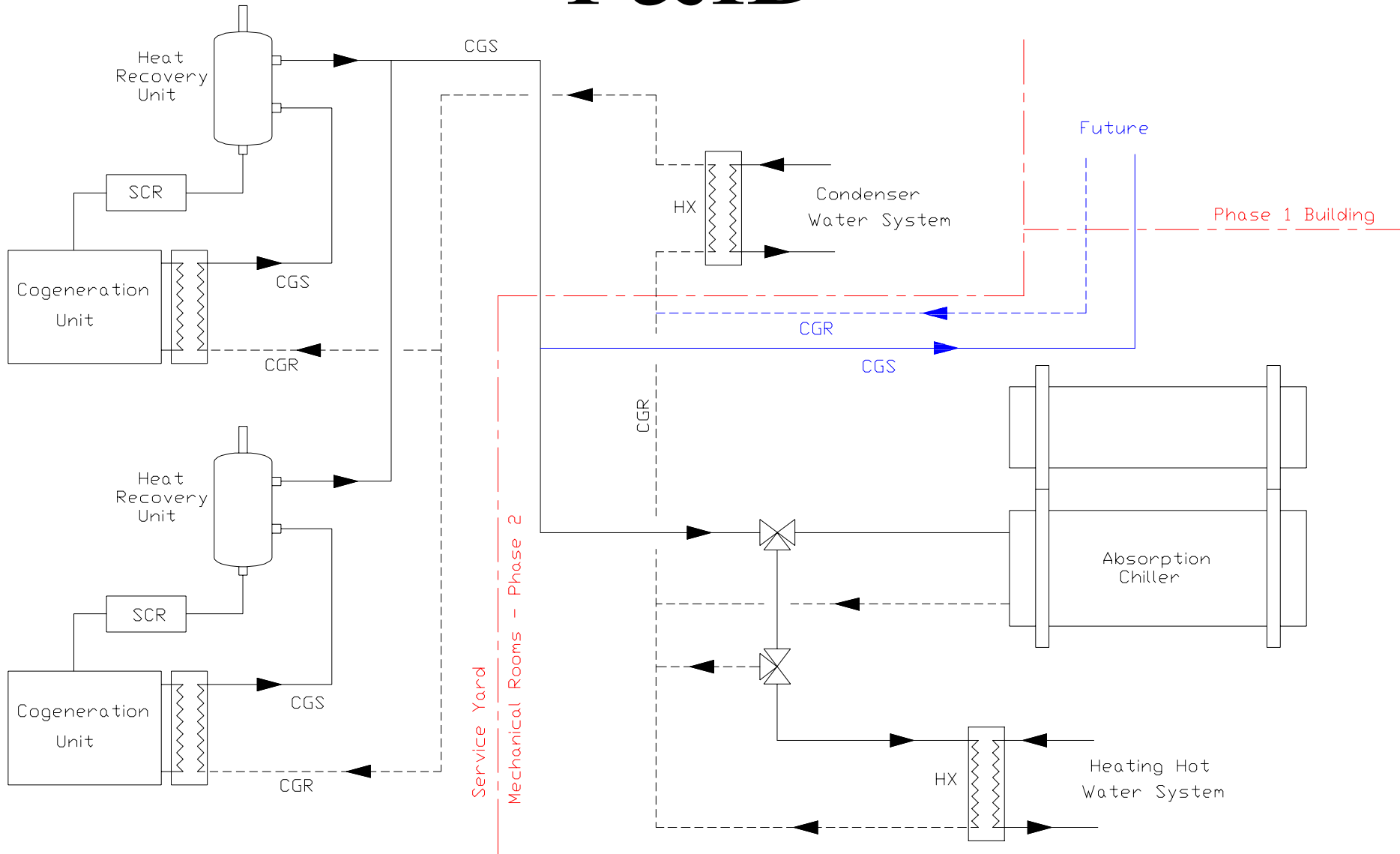


Cogeneration Unit

A large industrial cogeneration unit, primarily painted in a bright green color. The unit features a complex network of pipes, including a prominent vertical pipe on the right and a horizontal pipe at the bottom. A large, cylindrical component is wrapped in white insulation at the top. A label on the left side of the unit reads "Power Generation" with a blue logo. The unit is situated in an industrial setting, with a large fan visible in the background and a fluorescent light fixture at the top left.

IC Engines 2-1100 kW

P&ID



Absorption Chiller

A large industrial absorption chiller system is shown in a mechanical room. The system consists of several large white pipes, some of which are wrapped in black insulation. A prominent horizontal pipe in the center is wrapped in black insulation and has two red bands. To the right, there is a teal-colored control cabinet with a circular logo and the number 'LT42814'. The system is supported by metal brackets and chains. In the background, other pipes and equipment are visible, including a yellow control panel and a red fire alarm pull station.

500 Ton Absorption Chiller

Cogen Heat Exchanger



Lessons Learned

- Design multiple locations that use 100% of the available heat
- During bid Specify Overall Efficiency required
- Install sufficient instrumentation
- New/Used oil tanks
- Allow plenty of time:
 - Interconnect agreement with Utility company
 - Air Permit
 - Rebates

New & Used Oil Tanks



NO DUMPING
STORM DRAIN

Additional Lessons Learned

- Contracting Natural Gas
- Test Switchgear and Load shed Sequence by 3rd Party at the Factory
- Detail Testing or Commissioning Procedure
- Setup Electrical Distribution for Load Shedding
- A lot of things were design without Cogen in Mind
- Is to match the type of generation that best suits your site for maximum benefit

Benefits of Cogen

- Minimize site's dependency on California for electricity
- Unaffected by curtailments
- CO₂ Savings of 3,200,00 lb/yr
- Annual savings \$1.0 M, electric and gas
- Cut out an Emergency Generator and Boiler of building design

Bring your Suit to the Recognition Event



San Diego
REGIONAL ENERGY OFFICE
SAN DIEGO REGIONAL ENERGY OFFICE
8520 Tech Way, Suite 110
San Diego, CA 92123
2004

PAY TO THE ORDER OF J&JPRD, La Jolla, CA \$ 800,000
Eight Hundred Thousand DOLLARS

SELF-GENERATION INCENTIVE PROGRAM
Lucas M. Stilling

Issued under the auspices of the California Public Utilities Commission.

 **Johnson & Johnson**
PHARMACEUTICAL RESEARCH & DEVELOPMENT, L.L.C.

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THE
COLLEGE
OF NEW JERSEY

Improving Energy Performance with CHP

Joe Sullivan

The College of New Jersey

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History - Overview

- ❖ Established in 1932 (Trenton State Teachers College, less than 1 million sq. ft.)
- ❖ Currently, campus is over 2.5 million sq. ft., with 64% of its 6800 students resident on campus.

History - Overview

- ❖ The College has grown over 50% in size since 1990. Since that time, *TCNJ has seen an absolutely increase in CO₂ emissions of only 1.5%.*
- ❖ When taking into account the college's substantial growth since 1990, *TCNJ has achieved an impressive **31% reduction** in green house gas emissions per square foot of occupied space.*

Institutional Support

- ❖ TCNJ is an active *NJHEPS* (New Jersey Higher Education Partnership for Sustainability) member.
- ❖ In 2000, President R. Barbara Gitenstein signed the NJ Department of Environmental Protection's *Greenhouse Gas Action Plan Covenant* with presidents of *all other New Jersey colleges and universities*.
- ❖ The College's Committee for Cultural and Intellectual Community (CCIC), a committee of faculty, staff, and students, has selected *Communities and Earth: The Challenge of Sustainability* as the campus programming theme for the 2001-2002 academic year.

The Challenge: Growth

- ❖ Growth presents the greatest challenge for TCNJ to meet its target: *a 3.5% reduction in emissions from 1990 levels.*
- ❖ From 1990 to 2000 TCNJ grew from 1.7 million square feet to 2.5 million square feet.
- ❖ Emissions during this period increased only 1.5%. This represents a 31% reduction of greenhouse gas emissions per square foot.

The Challenge: Growth

- ❖ A glance at TCNJ's Campus Master Plan dramatizes the growing challenge that growth poses to energy conservation at TCNJ.
- ❖ Four substantial new buildings will be added to the campus by 2005, adding 374,000 sq. ft. (a 15% increase).
- ❖ To meet its Greenhouse Gas Action Plan goal, TCNJ must "green" its energy by 20% (to compensate for its growth).



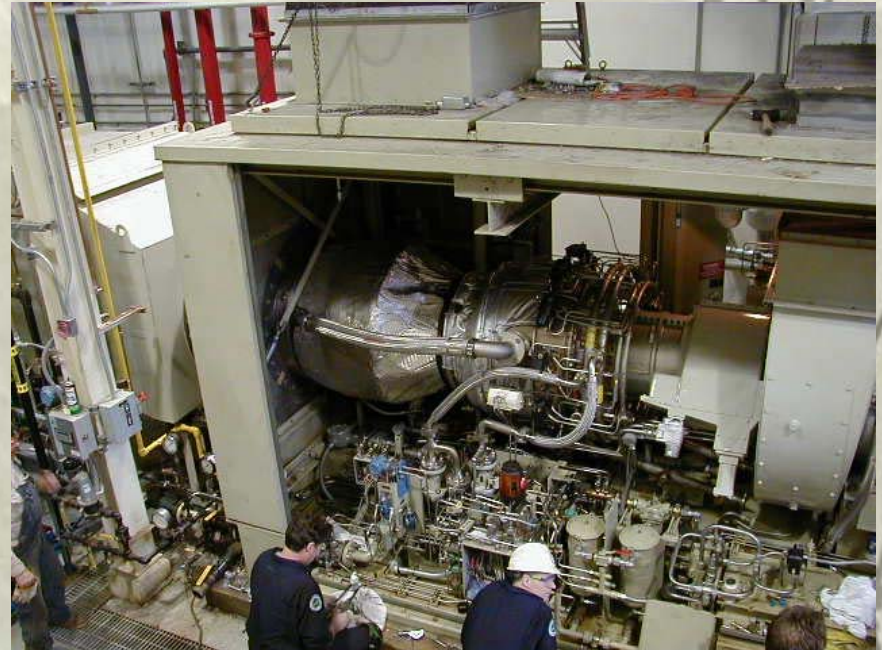
THE
COLLEGE
OF NEW JERSEY

Cogeneration Strategy



Cogeneration

- ❖ The largest contribution thus far to energy efficiency and reduced emissions at TCNJ is the cogeneration plant.
- ❖ The plant went on line in 1996 and was upgraded in 2000.
- ❖ 5.2 MW capacity, with 28 MMBTU recovered heat unfired and 42 MMBTU fired.



Cogeneration

- ❖ The plant generates 35 million kWh each year and utilizes 375,000 MMBTU per year, thereby avoiding 21,885 tons of CO₂ each year.
- ❖ Additionally, the primary fuel was changed from #6 fuel oil to natural gas.
 - **Cost:** \$7 million.
 - **Annual savings:** \$900,000.



Cogeneration

- ❖ In 2001, TCNJ was awarded The ENERGY STAR Award by the U.S. EPA for the cogeneration plant's overall efficiency rating.



Future Plans

Supply upgrades:

- ❖ ***1.3 MW Cogeneration Plant.*** Natural gas engine with heat recovery.
- ❖ ***Fuel Cells.*** Three 200-kw fuel cells are currently being installed
- ❖ ***Solar.*** 500 kw of photovoltaic generating capacity.

Combined with:

- ❖ ***Chiller Upgrades***
- ❖ ***Geothermal Heat pumps***
- ❖ ***Building Management Systems***
- ❖ ***Lighting Upgrades***
- ❖ ***Variable Speed Drive upgrades***

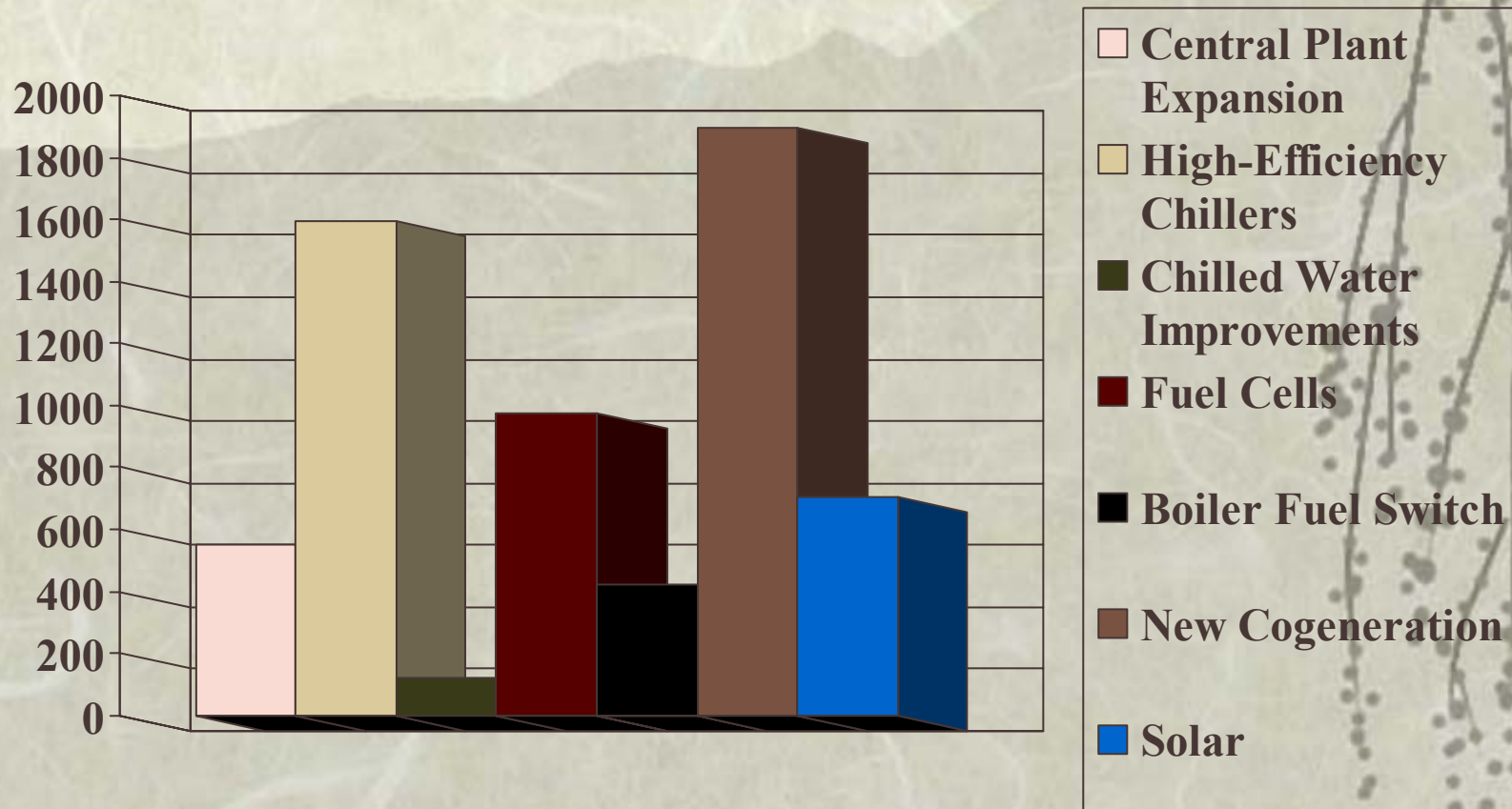
Fuel Cell Strategy

- ❖ *Fuel Cells.* Three 200-kw fuel cells are currently being installed. The electric output will be hooked up to the campus grid and the thermal output will be used to drive the heat pumps in the new 220,000 square foot apartment complex. The fuel cells will produce 5 million kWh per year or about 12% of the current campus load. (TCNJ received a \$1.63M SmartStart subsidy to purchase the fuel cells.)

Key Lessons Learned

- ❖ Anyone can generate electricity economy of scale and fuel cost are advantages of utilities
- ❖ It is all about maximizing the heat in CHP
- ❖ You need a place to use heat in the summer CHP with a air conditioning load is optimal
- ❖ Understand the demand side of energy use
- ❖ Fuel risk and cost management are critical

Supply & Demand-Side Measures to Reduce Emissions



Total Reduction: 6,264 tons per year of CO₂

Supply & Demand-Side Measures to Reduce Emissions

- ❖ **Net Emissions Projections for 2005:**
- ❖ *Year 2,000 Emissions + New Buildings – Supply/Demand Measures:*
- ❖ 31,963 Tons + 4,665 Tons – 6,264 Tons = 30,364 Tons
- ❖ *Reduction from 1990 levels, as percentage:*
- ❖ $(31,503 \text{ Tons} - 30,364 \text{ Tons}) / 31,503 \text{ Tons} =$
3.62%

Questions?





Improving Energy Performance with CHP

Project Resources and Assistance

Kim Crossman

US EPA CHP Partnership

ENERGY STAR Energy Management Webcast

November 17, 2004

The benefits of CHP

- **Economic:** reduces energy costs
- **Environment:** reduces GHG emissions
- **Reliability:** decreases impact of power outages
- **Security:** increases national energy security

Coincident Electrical and Thermal loads

- CHP systems shave base of electrical loads.
- Thermal loads can be DHW, HW, steam, CW, dehumidification, refrigeration, process heat.
- Systems can be tied in to multiple heat loads to use maximum thermal energy from system.
- Thermal storage can be incorporated but is less desirable.

Thermally baseloading CHP

- Economic and environmental benefits are tied to utilizing maximum thermal and electrical output of CHP.
- Most systems going in are sized to meet thermal demand, stay in-the-fence electrically.
- In facilities with large thermal loads, increasing gas consumption with CHP can protect against rising gas prices.

Spark spread – electrical and gas costs

- Electrical costs are primary indicator of feasibility
- Uncertainty – importance of sensitivity analysis
- Most systems still gas fired – where and why does this still work at \$7.00?
- Alternative/ opportunity fuels – poised for takeoff.

CHP for power reliability

- Systems can be configured to run in island mode during grid outage
- Costs and benefits can be substantial, can override all other economic factors
- Quantify the costs and benefits of installing the system with this capability

Offset equipment costs

- The best time to consider CHP is when planning for equipment upgrade, replacement or new construction.
- CHP can replace boilers, chillers and backup generators. These equipment offsets increase ROI of the system substantially.

Technology improvements

- All CHP systems have been improved by developments in controls/ EMS.
- Packaged/ integrated systems have decreased costs of smaller system installation.
- Adsorption/ absorption chillers and thermally activated dessicants

Public Policy impacts on CHP projects

- Many states actively promoting CHP through utility policy (standardized interconnection, exit and standby rates), environmental policy (output based emissions standards), and grants and incentives for CHP projects.
- Federal government promotes CHP through EPA, DOE, USDA programs.

EPA & Combined Heat and Power

- The EPA CHP Partnership is a voluntary program that seeks to reduce the environmental impact of power generation by fostering the use of highly-efficient CHP
- In the past 4 years, the CHPP has helped put into operation more than **100 CHP projects** representing **2,250 MW** of capacity.

CHP Project Assistance

- CHP project development can be lengthy and difficult - sometimes years!
- The CHP Partnership acts as a clearinghouse for information and referrals and can provide technical assistance directly to those considering installation of CHP at their site.

How Can We Help With Your Project?

- General information on CHP at our website www.epa.gov/chp
- Check out “Is my facility a good candidate for CHP?” tab or call us to discuss
- Answer technical or policy questions, provide referrals
- Technical assistance/ feasibility analysis
- Funding database coming soon
- Public recognition with the Energy Star CHP Award

For More Information

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Questions & Discussion

Upcoming Web Conferences



December – No web conference –
Happy Holidays!

January 19 – ENERGY STAR Update

www.energystar.gov/networking



Thank You!