COMBINED HEAT AND POWER PROJECTS
FOCUS ON COSTS SAVINGS, RESILIENCY AND GHG REDUCTIONS
Combined heat and power (CHP), also known as cogeneration, is:

• **The concurrent production** of electricity or mechanical power and useful thermal energy (heating and/or cooling) from a single source of energy.

• **A type of distributed generation**, which, unlike central station generation, is located at or near the point of consumption.

• **A suite of technologies** that can use a variety of fuels to generate electricity or power at the point of use, allowing the heat that would normally be lost in the power generation process to be recovered to provide needed heating and/or cooling.
COMBINED HEAT & POWER

- **Water** flows through the **Heat Recovery Unit**.
- **Hot Exhaust Gases** from the **Engine or Turbine** are recycled.
- **Steam or Hot Water** is used for **Cooling/Heating**.
- **Electricity** generated by the **Generator** is distributed to the **Building or Facility** and **Grid**.
• **What is CHP?**
  - Electricity and thermal energy produced onsite for local consumption:
    - Electrical efficiency up to 46%
    - Electrical + thermal efficiency up to 95%
  - Thermal energy for:
    - Hot water heating and process
    - Steam production for heating and process
    - Driving absorption chillers

• **You avoid:**
  - The need to purchase electricity for the amount of electricity produced by the engine
  - The waste steam or hot water allows you to off-set the fuel required fire a boiler to create steam or hot water
  - Direct connect – generating electricity near the source of need, avoids electricity losses that occur in the transmission and distribution processes from the power generation source, to the Electric Distribution Utility and eventually your facility
  - Additional capital expense for back-up generation
    - Avoiding GHG increases transmitted from backup diesel engines
HOW DOES CHP WORK?

- **Heat Recovery sources include:**
  - Jacket water
  - Lube oil cooler
  - Intercooler
  - Exhaust gas

**Heat Recovery**
- Hot water
- Steam > 170 psig
- Chilled water

CHP can cut your energy use by more than 40 percent
Novartis Institute for Biomedical Research

Combined Heat and Power

The Novartis Institute for Biomedical Research’s is a 824,787 square foot Research Laboratory and manufacturing facility located in Cambridge, Massachusetts. Construction started in 2014.

Decision was made to incorporate CHP into the overall HVAC and utility plant design.

The schedule and building design required the CHP and utility plant equipment to be installed in the basement prior to construction of the upper floors of the building.

Project Details

- Two Jenbacher natural gas fired reciprocating engine generators rated at 1.4 MW each
- Medium Voltage Switchgear
- Four 800-Ton Electric Chillers
- One 460-Ton Absorption Chiller
- Marley Cooling Towers
- NOx SCR & Urea Systems
- Steam/HOT Water Systems
- Vapor Phase exhaust heat recovery boiler
Novartis Institute for Biomedical Research
Combined Heat and Power

System requirements

- The ability to operate 24/7
- Operate in parallel with utility
- Have “black start” capability
- Operate in island mode/ no utility
- Use the latest emission control technology
- Recovery heat in the form of HW
- Qualify for utility grant program
- Integrate with the utility plant
- Minimize sound and vibrations
- Achieve an overall efficiency of 75%

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REASONS TO INCORPORATE CHP INTO THE UTILITY PLANT DESIGN, EXPECTATIONS

• Resiliency
• Energy Savings
• GHG corporate reduction
REASONS TO INCORPORATE CHP INTO THE UTILITY PLANT DESIGN, EXPECTATIONS

• Energy Savings
  • Novartis’s goal was to reduce energy costs by 30 percent using a combined heat and power solution
    - First year savings in excess of $300,000!
  • Generate electricity waste heat captured and utilized in the hot water cycle
REASONS TO INCORPORATE CHP INTO THE UTILITY PLANT DESIGN, EXPECTATIONS

• Resiliency – Critical Process
  • The requirement of the research conducted at the site and the manufacturing of the pharma products, mandated an uninterruptible supply of electricity, thermal and cooling

A CHP system was selected with the following requirements
• Black start capability
• Sized to support critical loads
• Ability to operate island without the utility
• Heat could be recovered from the CHP system
REASONS TO INCORPORATE CHP INTO THE UTILITY PLANT DESIGN, EXPECTATIONS

• GHG corporate reduction mandate
  Novartis uses combined heat and power worldwide as part of their global GHG corporate reduction program

The CHP systems uses the latest emission control technology to reduce
  • NOX
  • CO
  • VOC’s
  • Formaldehydes
Bradley International Airport  
*Design, Build, Operate & Maintain CHP Plant*

Ameresco designed and built, and now operates and maintains a 5.8 MW CHP plant to offset electric purchases from the local utility and to provide greater power reliability for a major expansion of the airport.

The CHP plant was initially constructed in 2002 with 3.9 MW of capacity and since expanded to the full 5.8 MW of capacity in 2010. Ameresco operates, maintains and repairs the mechanical and electrical equipment under a long-term agreement with the airport.

**Project Details**

- The electricity needs of the main terminal are met by the engine-generator. Due to equipment redundancy, the energy center can meet the main terminal’s full electrical needs in the event of a loss of grid power.
- In addition, because heat recovered from the engines is used for absorption cooling in the summer and heating in the winter, overall energy costs are lower than a conventional heating and cooling plant.

**Technology description:**

- Four natural-gas fired reciprocating engines: three rich-burn engines installed in 2002 (two at 1.2 MW, one at 1.5 MW) with three-way catalysts for emissions reduction; and one 1.86 MW high-efficiency lean-burn engine installed in 2010 with an oxidizing catalyst
- 13,000 MBtu/hr of engine heat recovery (230°F hot water)
- Two 12,000 MBtu/hr dual-fuel hot water boilers
- Absorption chiller
Ameresco constructed a 6 MW power plant as part of the largest private microgrid in the United States at the former 1,200-acre Philadelphia Navy Yard.

Ameresco was responsible for design, engineering, and construction and will provide long-term operation and maintenance for the plant. The project is currently in the operations phase.

Ameresco also has completed work on a newly contracted expansion of the peaking plant, adding two megawatts (2 MW) of planned incremental capacity, increasing the total plant capacity to eight megawatts (8 MW).

**Project Details**
- The peaking plant is expected to run during the Navy Yard’s peak demand periods and during intervals of high-cost energy and capacity from the grid.
- The plant will be capable of providing certain resiliency services and critical support in the event of extended grid outages, in addition to shaving the peak load requirements of the microgrid.
- The Project will allow PIDC to:
  - Reliably meet the projected demand growth needs of the Navy Yard and its tenants
  - Participate in the PJM Ancillary Service Market
  - Generate revenues to help offset the cost of the increased capacity
Since the partnership between Arizona State University (ASU) and Ameresco began in 1999, Ameresco’s responsibilities have included detailed facility and energy analyses, and the design and construction management of facility and infrastructure upgrades that have resulted in more than $8 million of annual savings over 21.7 million square feet of University infrastructure. ASU has saved 98.5 gigawatt hours of electricity and 1.4 million therms of natural gas, significantly reducing its annual energy usage and its carbon footprint by over 77,247 metric tons of CO₂ annually – equivalent to 23 percent of the University’s total carbon footprint. As part of a broader commitment of attaining institutional sustainability and a University-wide goal of zero net greenhouse gas emissions, ASU selected Ameresco as its Strategic Business Partner to become climate neutral by 2025.
The U.S. Army Corps of Engineers and the U.S. Navy selected Ameresco to design and install three comprehensive energy conservation projects under an Energy Savings Performance Contract (ESPC), as well as a microgrid solution funded by a grant to demonstrate islanding capabilities which eliminates downtime during a loss of the electric public utility at Portsmouth Naval Shipyard in Kittery, Maine.

Improvements made to the Shipyard’s various systems have allowed for the elimination of older equipment. With newly installed technologies and equipment, the Shipyard regularly saves on energy and has the ability to operate self-sufficiently if necessary.
The United States Marine Corps Recruit Depot Parris Island selected Ameresco in 2015 to deploy combined heat and power (CHP) and solar photovoltaic (PV) generation assets and to integrate them with a battery energy storage system (BESS) and a microgrid control system (MCS) capable of fast load shedding.

These improvements will result in 75% reduction in utility energy demand, 25% total water reduction, 10 MW onsite electrical generation, and combined annual carbon reduction of 37,165 metric tons of CO2.
THANK YOU

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