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Six Questions to Ask Before Building a CHP Plant

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CampusEnergy2020
THE POWER TO CHANGE
FEBRUARY 10-14 ▲ SHERATON DENVER DOWNTOWN ▲ DENVER, CO

So you think you want to build (or rebuild) a CHP plant?

So you think you want to build (or rebuild) a CHP plant?..

- When was the last time you had your head examined?
- What planet are you on?
- Have you been drinking?
  - Can I have some?
- Are you nuts?
- REALLY?

So you STILL think you want to build (or rebuild) a CHP plant?..

- What is the value of a CHP plant to your organization?
- What functions must it serve?
- What technology should be used?
- What are the environmental requirements?
- Where do we put it?
- Where does the money come from?

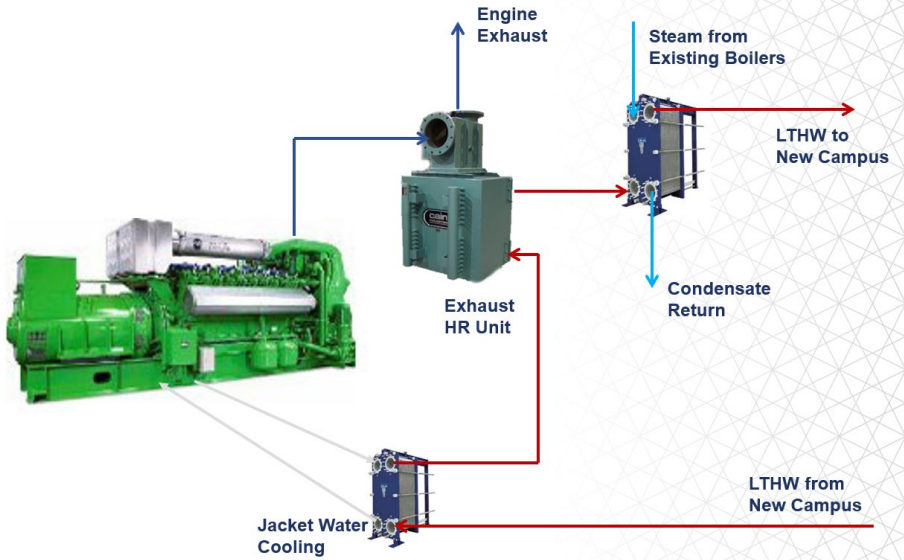
What is the value of a CHP plant to your organization?

Value | CHP Plant

- Total Cost of Ownership
  - Capital + Operating + Maintenance Costs < Current Practice
  - Payback & Return on Investment
- Environmental Stewardship
  - Value in positive environmental image
  - Utilize renewables for maximum value
    - Renewable generation: Solar, wind
    - Renewable fuels: biomass, landfill gas

University of Iowa Research Park – Iowa City, IA

Reciprocating Engine power generation and hot water heating for the Research Park designed to run on either Natural Gas or Landfill Gas



Value | CHP Plant

- Reliability of Energy Supply
  - Weak local electrical grid
  - Fuel availability
  - Weather events
  - Natural disasters
- Place of Refuge
  - For students, faculty and employees
  - For local community

University of Illinois Champaign-Urbana, IL

The University Power Plant is able to provide more than 60MW of power and 400,000 lb/hr of steam to campus using NG Turbines, Duct Firing, High Pressure NG and Coal Fired boilers feeding into both back pressure and condensing turbines. The power provided allows the campus to be self sustaining. Gas turbines and boilers are dual fuel units to provide redundancy of fuel source.

Value | CHP Plant

- Essential Loads
  - Dormitories
  - Food Service
  - Hospitals
  - Research Facilities
    - Data Centers
    - Labs
    - Vivariums

University of Iowa – Iowa City, IA

The main power plant generates high pressure steam that is passed through back pressure and condensing turbines to provide power, heating, and cooling to campus where the U of Iowa Hospital and various research labs host clinical and research projects that have more than 50 years of history that would be lost without guaranty of power and temperature control provided by the tri-gen capabilities on campus. NG reciprocating engines provide peak shaving opportunities during high demand periods.

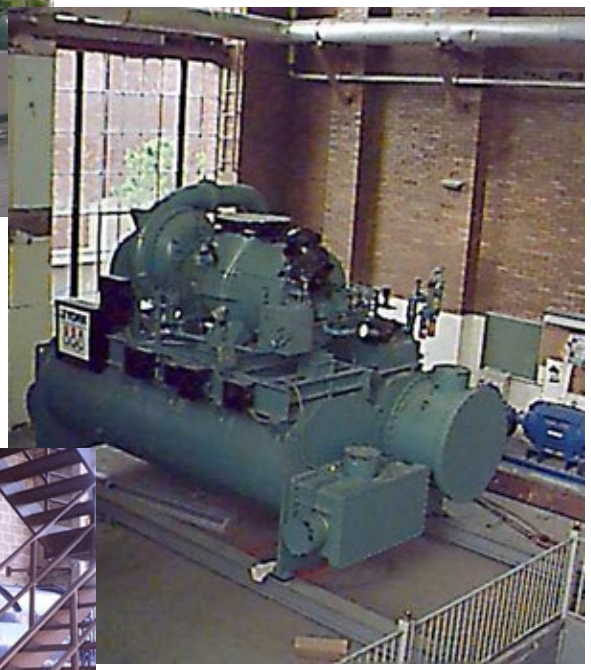
What functions must it serve?

Functions | CHP Plant

- Electrical Generation
  - Generate most or all of campus power
  - Peak shaving
  - Coincidental generation
- Campus Heating
  - Primary supplier
  - Coincidental supplier

Functions | CHP Plant

- Campus Cooling
  - Generate power to run electric chillers
  - Utilize excess steam to run steam driven chillers
  - Utilize excess steam or hot water to run adsorption chillers



What technology should be used?

Technology | CHP Plant

- Depends On Campus Energy Needs
- Large Demand for Heat
  - Boilers
  - Utilize back pressure turbines for coincidental power generation
  - Utilize condensing and extracting turbines for peaking or demand following

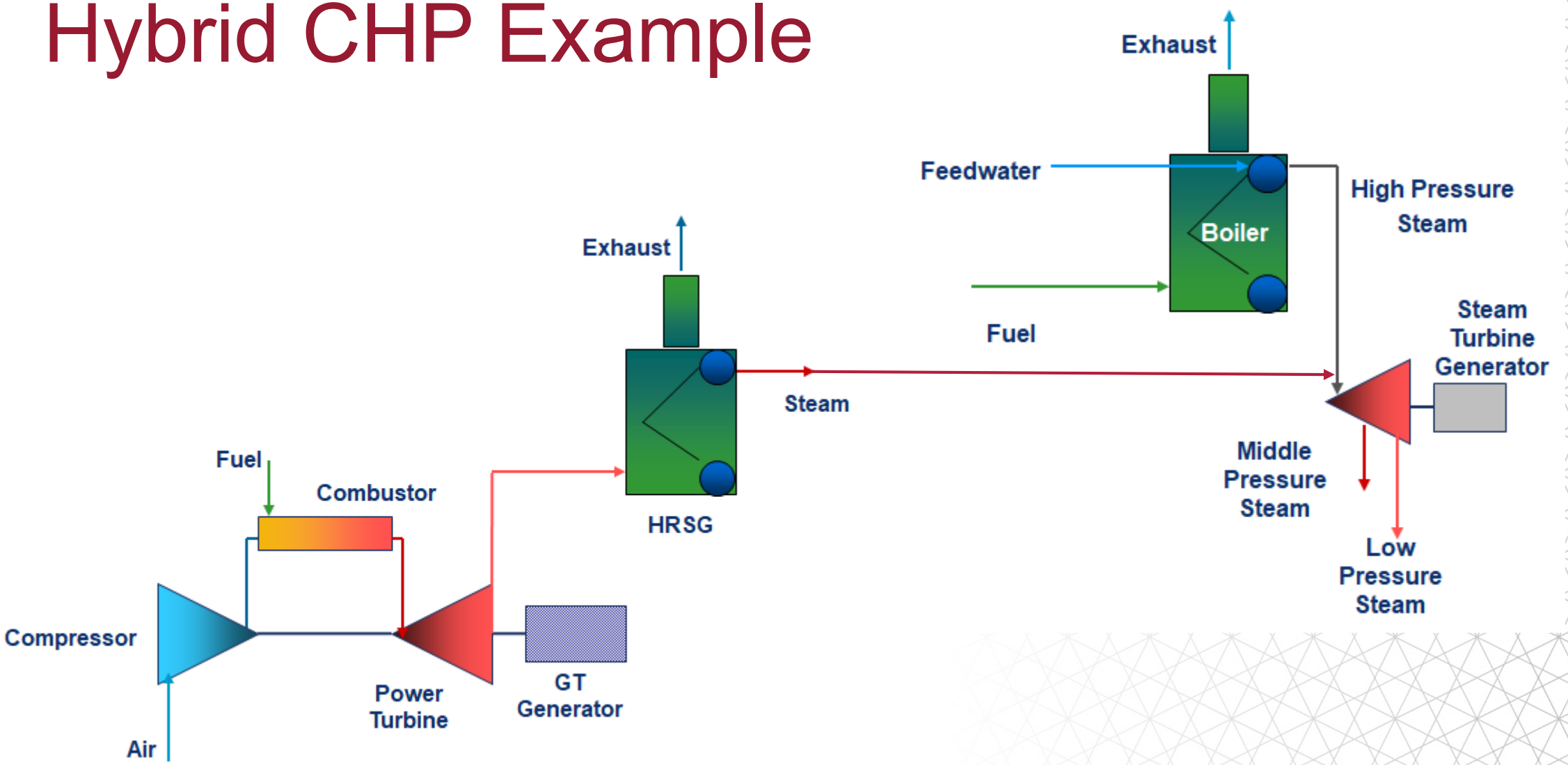
Technology | CHP Plant

- Large Demand for Electricity (Cooling)
  - Combustion Turbines
    - Generates more steam or hot water than reciprocating engines
    - Exhaust energy can be supplemented with duct firing
  - Reciprocating Engines
    - Coincidental generation of hot water or low-grade steam

Technology | CHP Plant

- Large Demand for Electricity (Cooling) - Continued
  - Technology Considerations
    - Reciprocating engines are more efficient in simple cycle or load following applications
    - Combined cycle combustion turbines are most efficient at base load, unfired.
- Mixed demands for heat and electricity
  - A hybrid solution may be best

Hybrid CHP Example



Environmental Requirements | CHP Plant

- Existing Emissions Sources
- Location Specific Concerns
  - Pollutant non-attainment areas
  - Neighbors
  - Local ordinances
- Fuel Source
  - Coal (no, really)
  - Natural gas
  - Biofuels

University of Alaska Fairbanks – Fairbanks, AK

In order to provide continuous power and heating to campus a new Co-Gen power plant was designed and built to replace the existing facility. The fuel source for the new facility was driven by supply chain limitations as NG was not a viable option, and Diesel fuel was considered less viable than Coal.

Environmental Requirements | CHP Plant

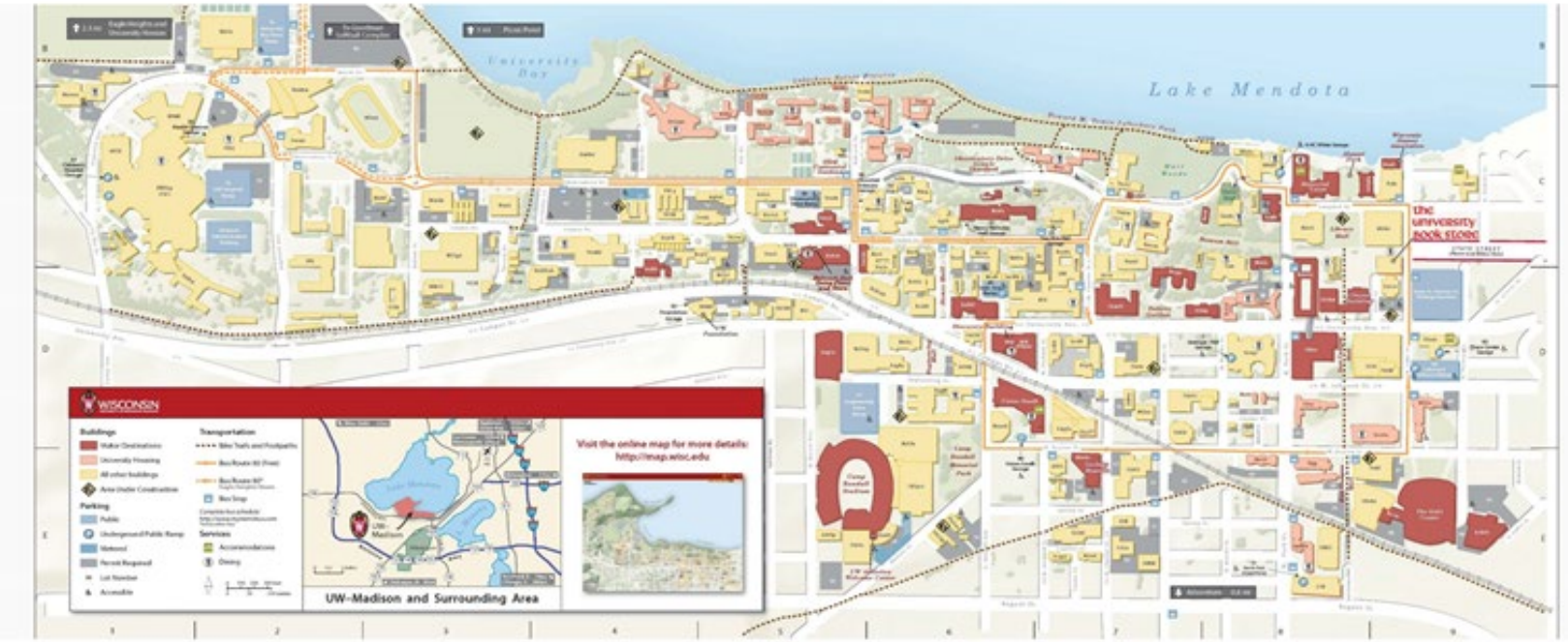
- Combustion Technology
  - Circulating fluidized bed boilers
  - Low NOx burners
- Emissions Control Equipment
  - Nitrogen oxide control
  - Sulfur oxide control
  - Control of other pollutants

Where do we put it?

Location | CHP Plant

- Centralized location
  - Smaller distribution systems
  - Bigger nuisance to nearby facilities
  - Real estate is very desirable
- Remote location
  - Out of sight, out of mind
  - Large distribution systems
  - Allow for campus expansion
  - Locations adjacent to existing substations are possible

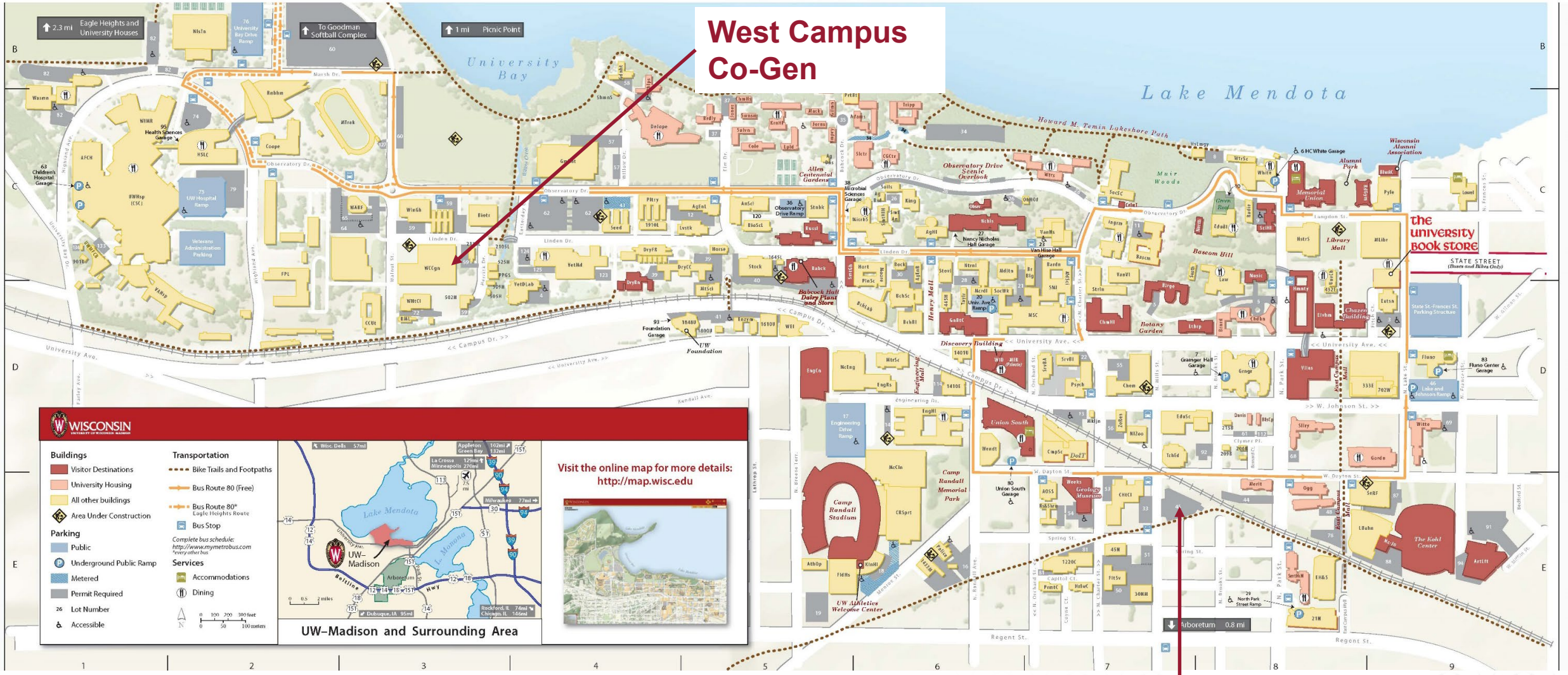
University of Wisconsin – Madison Campus



Where is Your Heating Load?

- Proximity to Concentrations of Campus/Site Heating Load
- Direction of Future Campus Growth (Campus Master Plan)
- Proximity to Other Plants (Main Plant Versus Satellite Plants)

University of Wisconsin – Madison Campus



Location | CHP Plant

- Considerations for Existing Facilities
  - Plant replacement
    - Staged replacement
    - All at once
  - Plant addition
  - Remote location with integrated operations
- Before or After the Meter
  - Depends on who is building the plant
    - Utility: Likely outside the meter
    - Self or ESCO: Likely inside the meter

Where does the money come from?

Financial Costs | CHP Plant

- Project Execution by Owner
  - Internal billing of “customers”
  - Bonds
  - Loans
  - Grants
    - **Can you find that Engineering Graduate to fund your project?**
- Project Execution by Energy Service Company (ESCO)
  - Multiple contract vehicles available

The Ohio State University – Columbus, OH

The Ohio State University recently entered into an agreement with Ohio State Energy Partners (Engie and Axium Infrastructure) to privatize the utility infrastructure and supply on campus.

Financial Costs | CHP Plant

- Project Execution by Utility
  - Utility has option of functioning as an ESCO
  - Potential for solution that benefits owner and utility

Thank You for Your Time

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