De-Carbonizing the Campus: Planning, Tools & Technologies

CampusEnergy2023

February 27 – March 2, 2023

Gaylord Texan Resort & Convention Center | Grapevine, Texas

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

UC Davis Harnesses the Power of the Sun to Offset Heating Load

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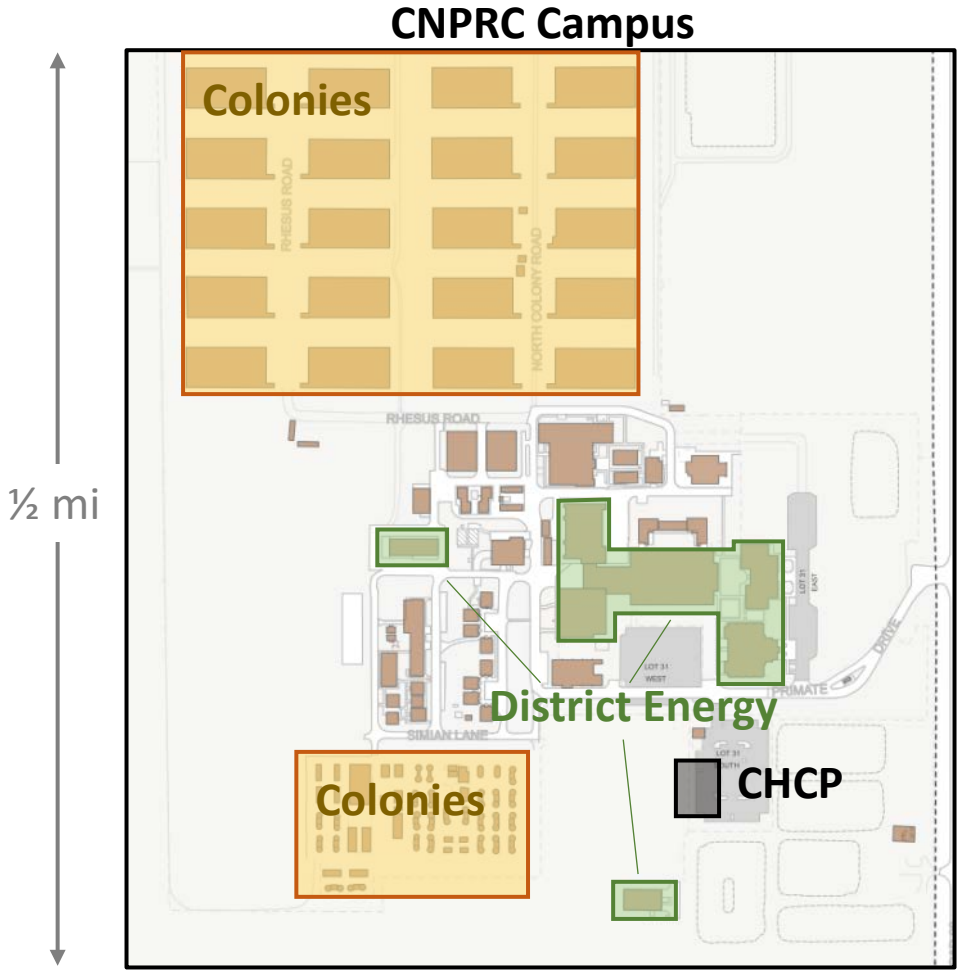
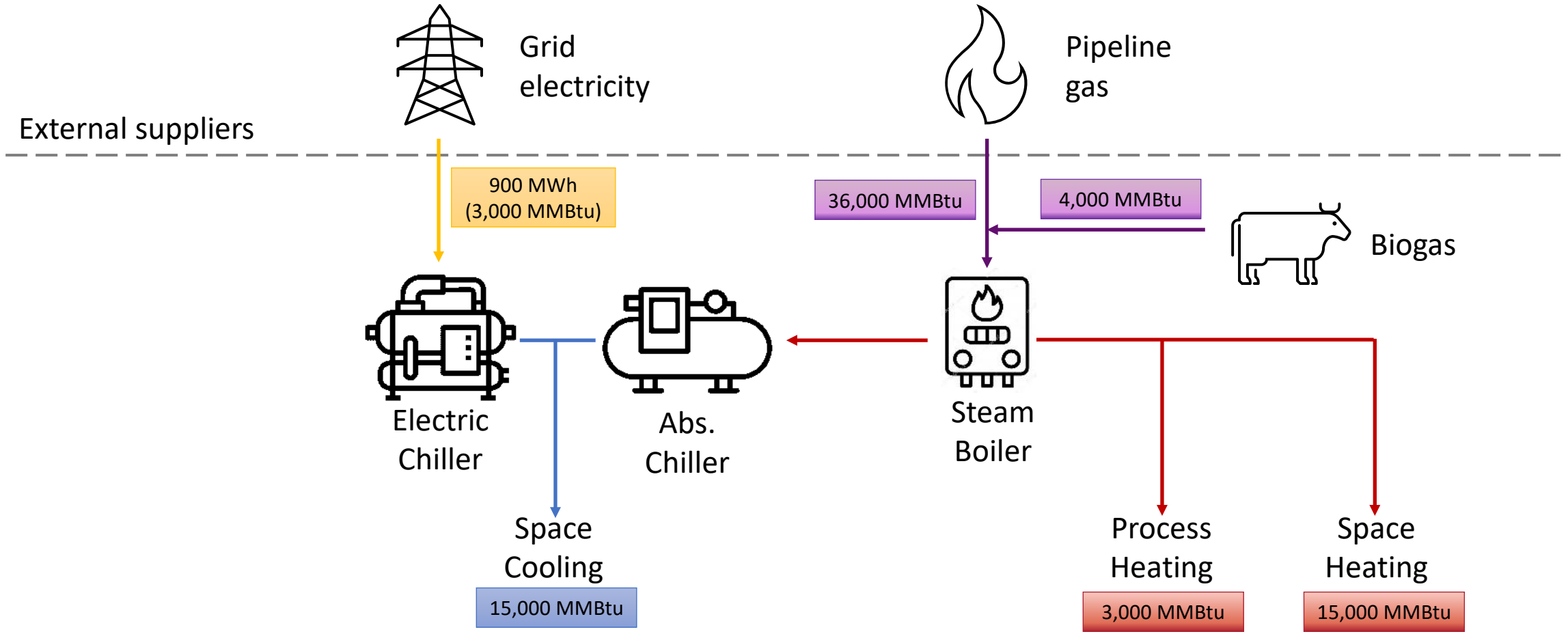
California National Primate Research Center (CNPRC)



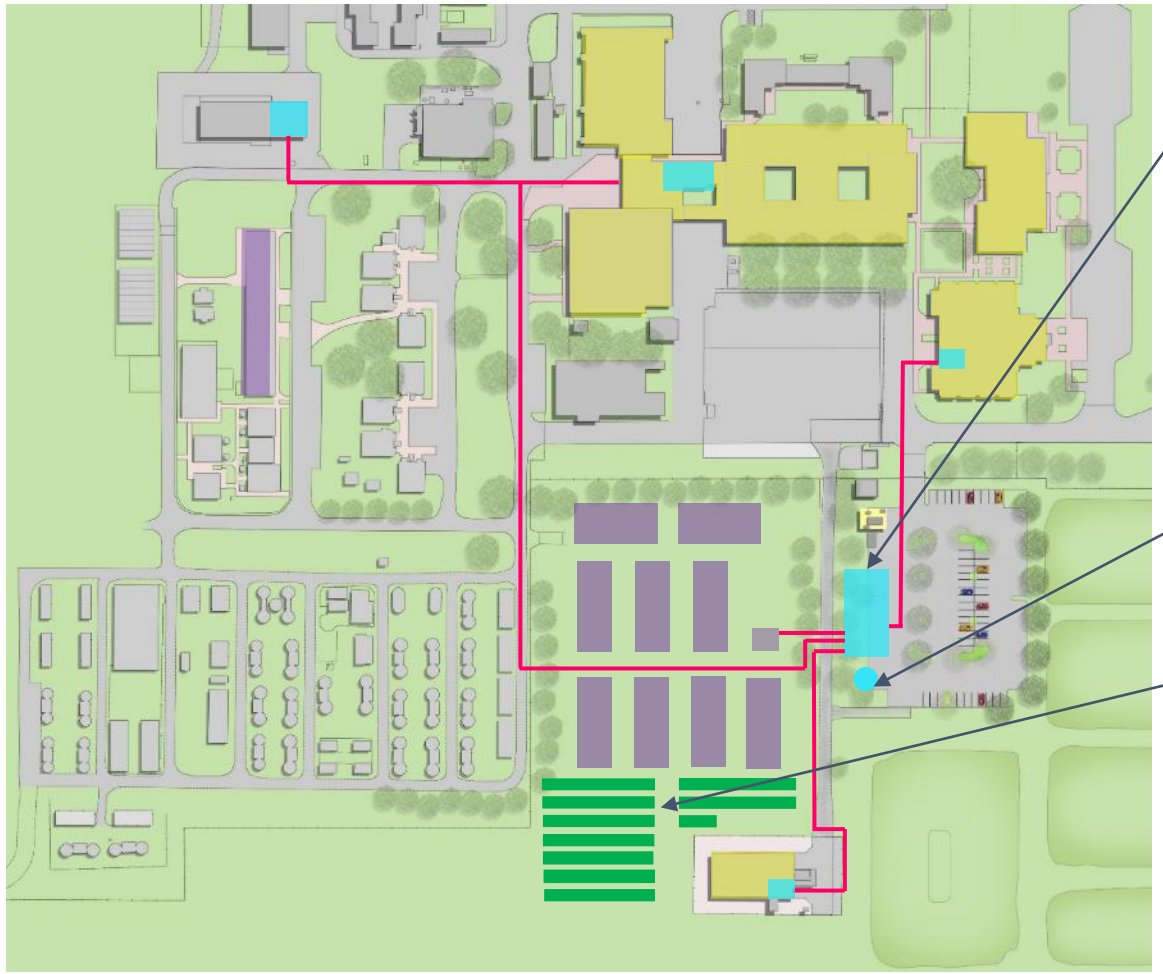
Replacing an Obsolete District Energy System

- Aging equipment
- Decaying infrastructure
- Insufficient redundancy
- Not aligned with campus vision

Pre-Project Energy Supplies and Uses (Annual)



System Overview



New CHCP Building:

- Electric chiller
- HHW Boilers – NG, Propane, future Biogas
- Water source solar thermal heat pumps

25,000 MBtu HW Thermal Energy Storage Tank

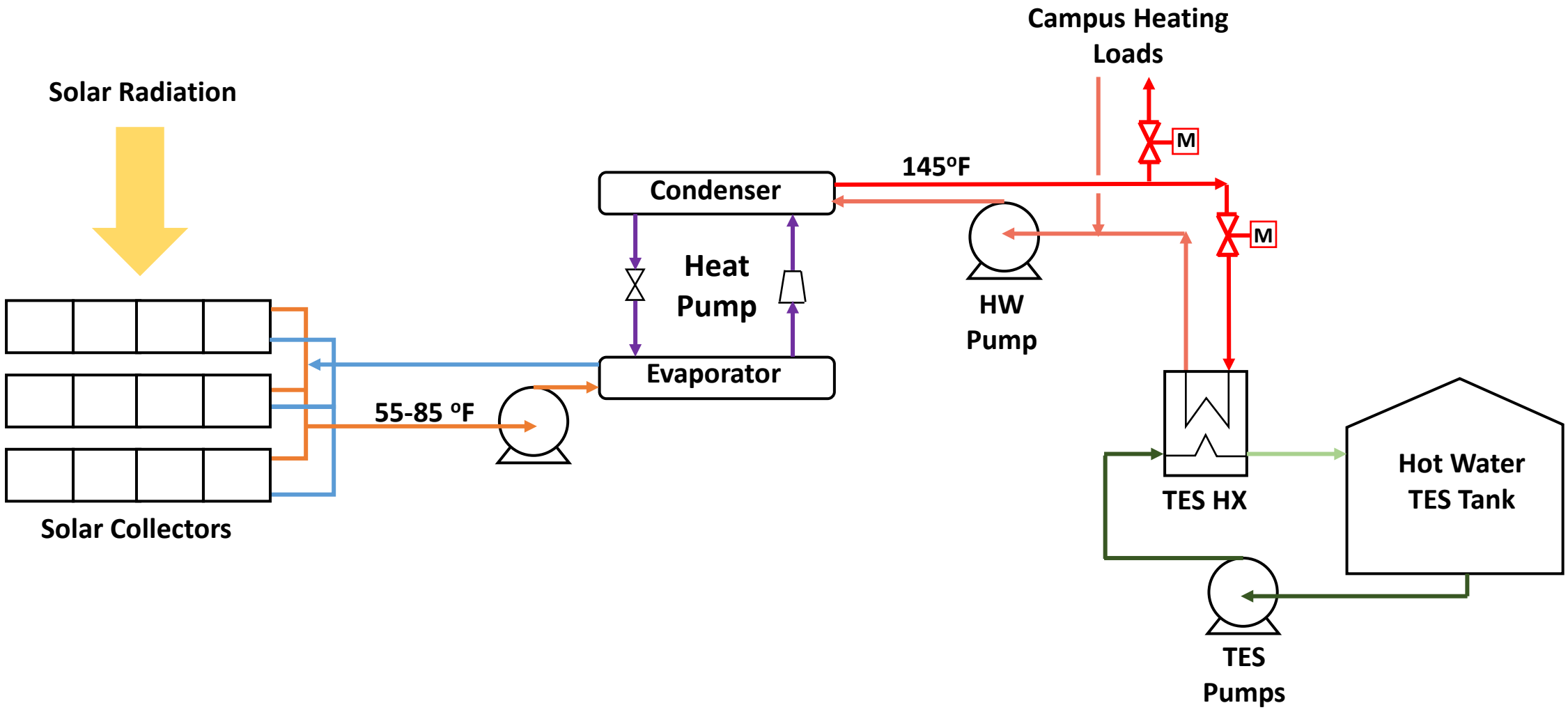
Solar Thermal Collector field

Chilled Water System

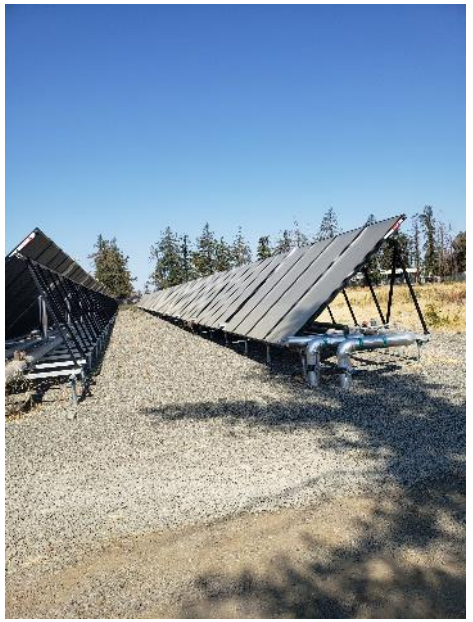
System features:

- 585 ton centrifugal chiller and single paired counterflow cooling tower
- Variable Primary CHW pumping configuration
- Expansion capabilities to double capacity in the future.

Solar Thermal System Overview



Solar Thermal Collector System



System features:

- 300 flat plate collectors oriented due south and 40 Deg. incline
- 20% propylene glycol solution for freeze protection
- Eligible for California Solar Initiative Solar Thermal Incentive program

Water Source Heat Pump & TES

System features:

- Modular scroll style heat pumps – 4 modules with 8 total load steps
- Evaporator temps vary with outdoor temperatures
- Leaving condenser setpoint typically 145 Deg. F.
- Hot Water Thermal Energy Storage on a 145-130 Deg. F. thermocline

Boilers and Heat Exchangers

System features:

- Three non-condensing watertube boilers @ 3,985 MBH output each
- Burners capable of operation on natural gas, propane and future biogas
- Boilers isolated from distribution system with P&F heat exchangers
- Packaged indirect water heaters used at outlying buildings for DHW and IHW

Heating Hot Water Distribution

System features:

- All underground piping is pre-insulated PEX in sizes up to 6” (150 mm)
- Manifold and home run distribution from central plant
- Direct buried valves

Autoclave Replacements

System features and Challenges:

- Total of nine autoclaves across three buildings needed to taken off central steam, many were old and in need of replacement
- Design originally featured clusters of 9.5 hp “California Special” boilers.
- Team found that new autoclaves with dedicated electric steam generators was close to a wash in cost

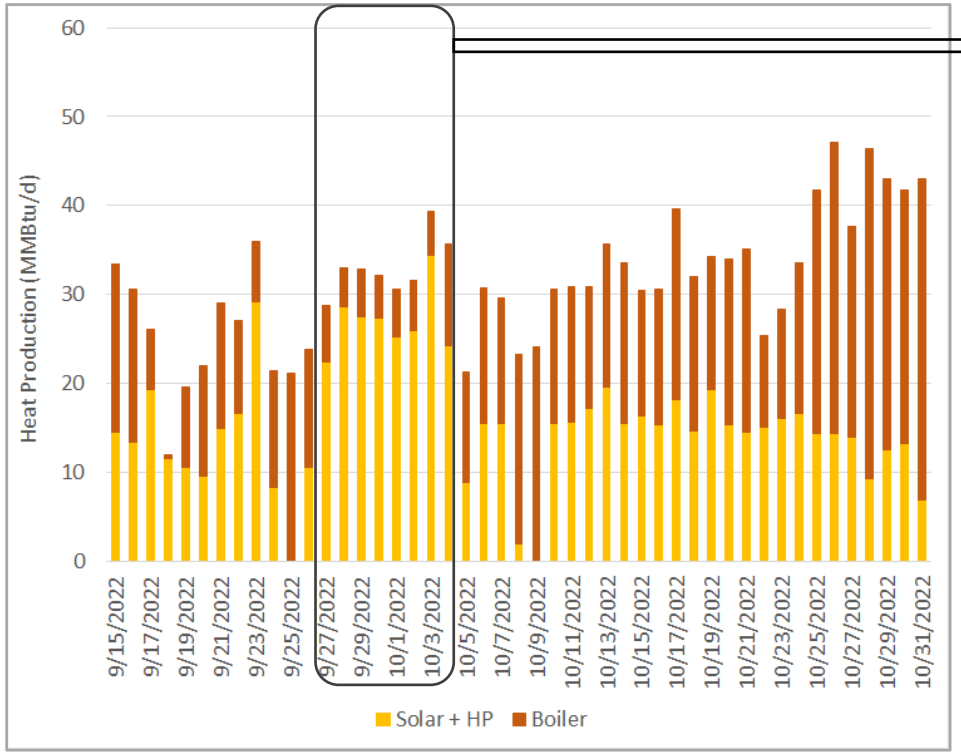
Cage Washer Conversions

System features and Challenges:

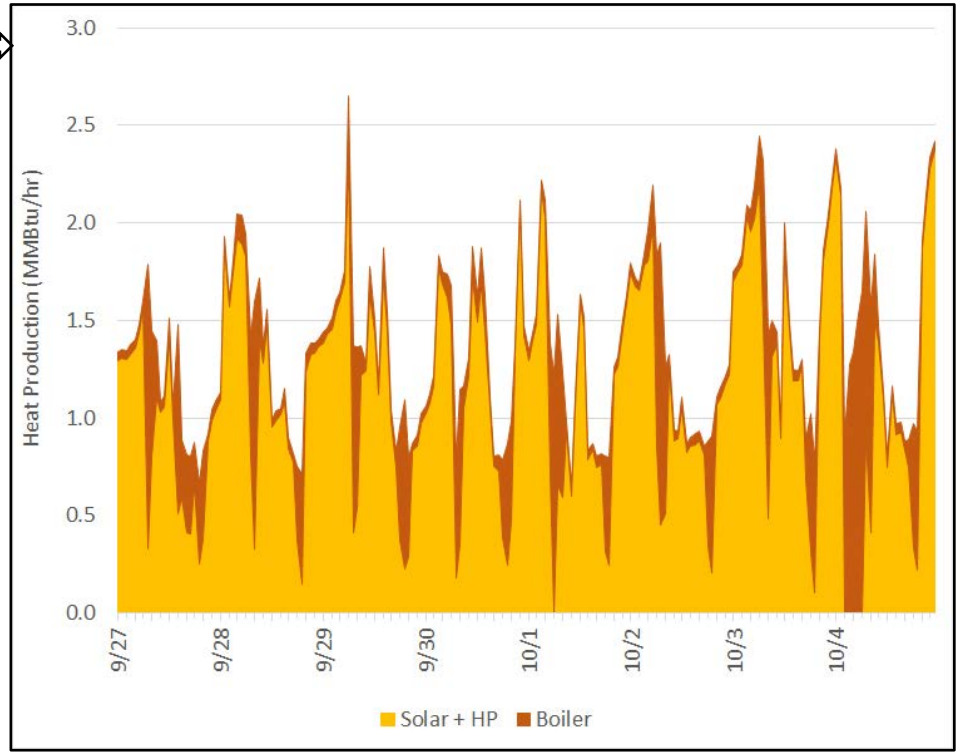
- Large steam use with very dynamic and intermittent load profile.
- Washers do not use steam directly, only needs to reach a temperature target
- Converted to utilize 195 Deg. F. water to eliminate steam usage
- Generated in two stages from HHW and polished with electric resistance tank style heaters

Post-Project Energy Use

Daily Heat Production

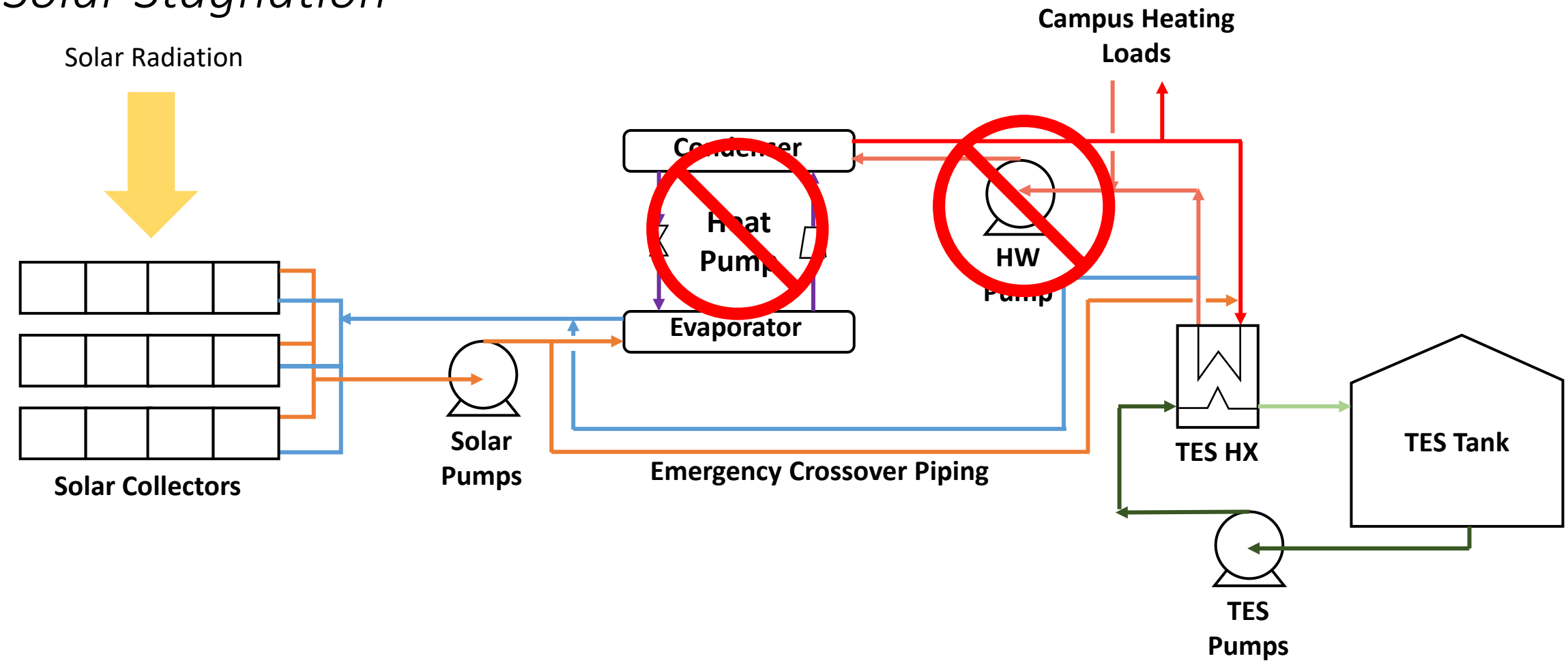


Hourly Heat Production



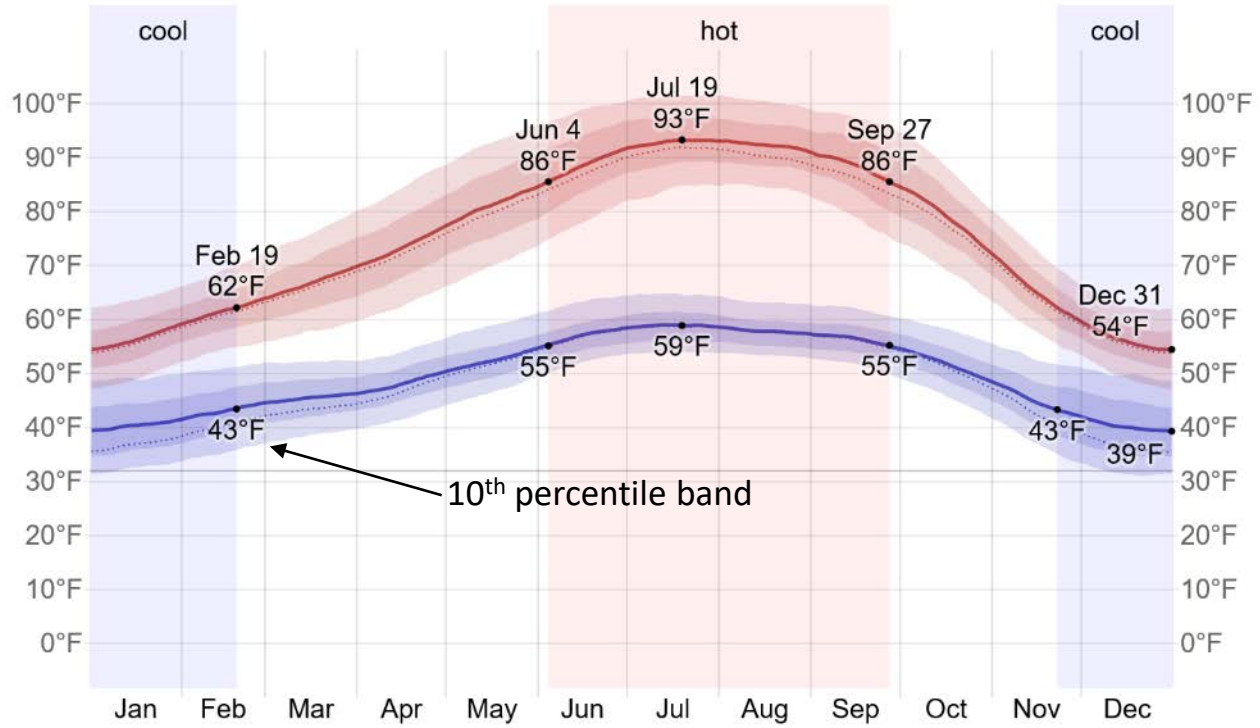
Lessons Learned

Solar Stagnation



Lessons Learned

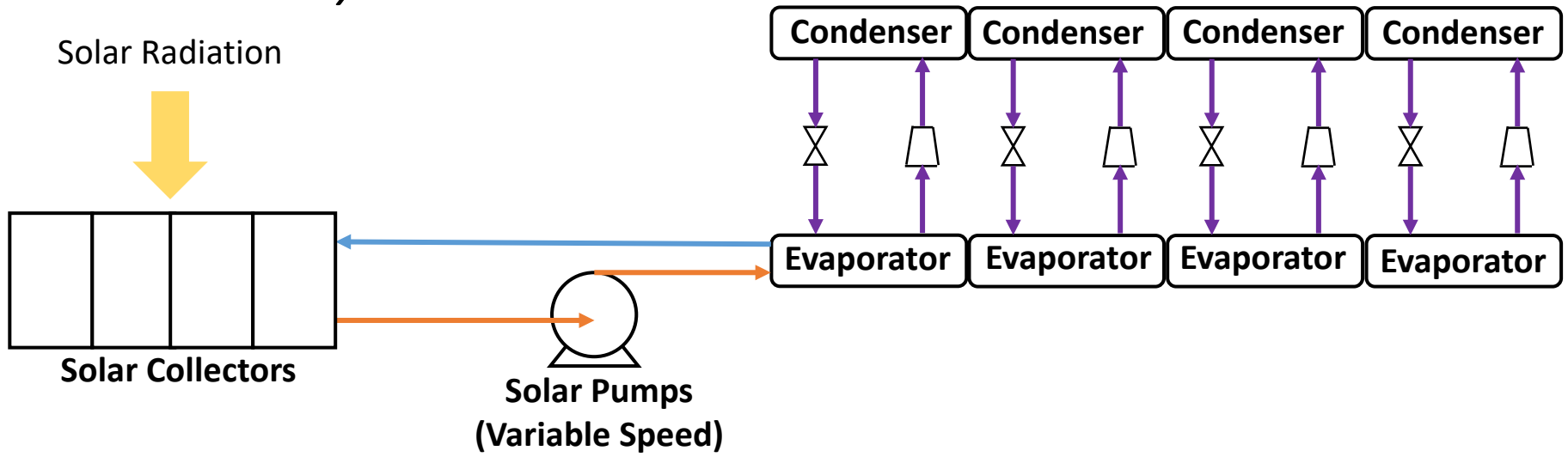
Solar Thermal Freeze Protection



- Site temp rarely below freezing
- Panels radiate heat to clear, dark-sky at night
- Panels up to 10°F colder than ambient
- “Freezing” conditions occur regularly in winter

Lessons Learned

Solar Thermal System

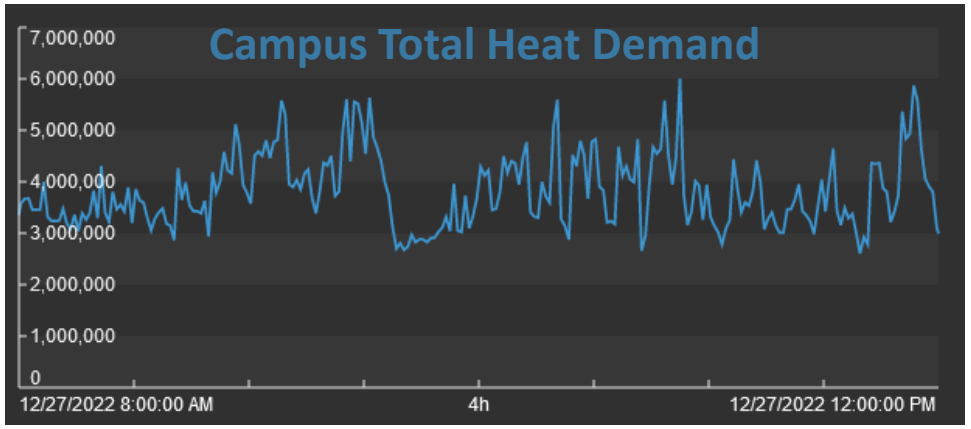


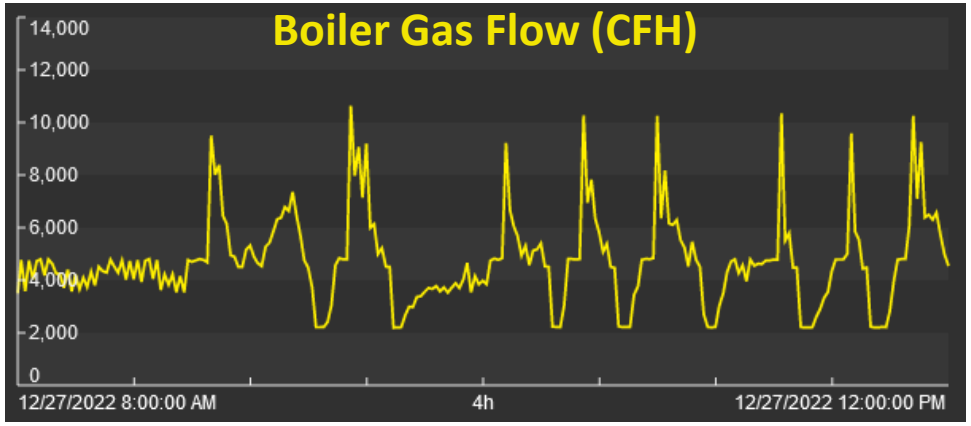
System Challenges and Lessons Learned:

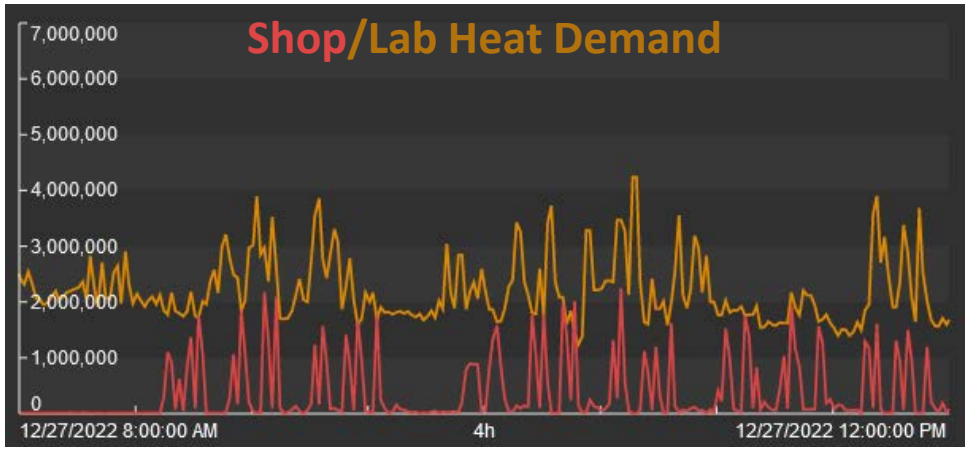
- Had to turn a variable volume system into a nearly constant volume system
- Solar Radiation / conduction started and ended later than anticipated
- Ran evaporator colder than anticipated in the summer

Lessons Learned

Dynamic Process Loads on a Small Campus







Cage Washers (2 MMBtu/hr peak, Ea.)

Thank You!

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UCDAVIS | FACILITIES MANAGEMENT

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