STEAM TO HOT WATER CONVERSION FOR CAMPUS HEATING
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Abstract

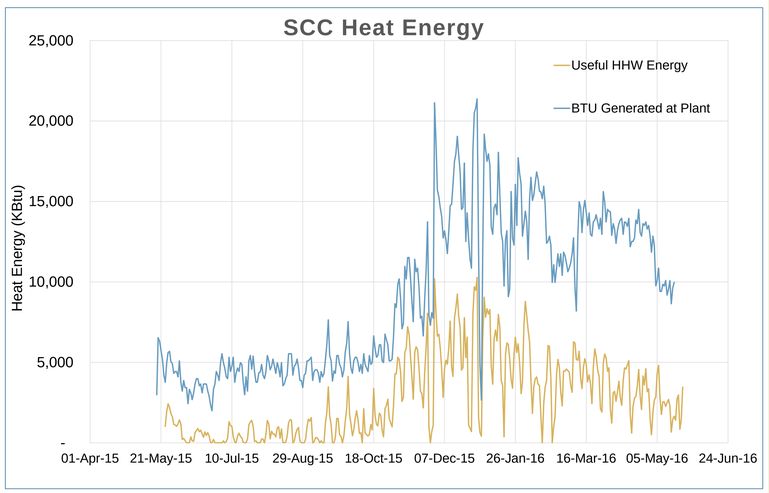
The goal of this study is to determine the **Energy** savings at the building level associated with switching from a **Steam** based heating system to a **Hot Water** based system for campus heating. This will result in lower transport losses as well as enable the use of **Renewables** as a source of energy. The current system relies exclusively on natural gas combustion, which accounts for 45% of GHG emissions for UC Davis. This effort will also be in alignment with a campus wide initiative to achieve Net Zero Carbon from Scope 1 & 2 by 2025. The conversion from steam to hot water heating can be achieved by the replacement of current Heat Exchangers with newer models as well as new piping infrastructure.

Background

- Existing Steam System
  - Losses primarily due to high temperature gradient (30~50 %)
  - Leaks & high maintenance costs
  - Primarily generated by combustion of fossil fuels
- Proposed Hot Water System Pilot
  - Lower temperatures = fewer losses (~15%)
  - Maintenance is less frequent and less involved
  - Can be generated by solar thermal
- Steam-to-Hot Water conversions have been done at Stanford and UBC

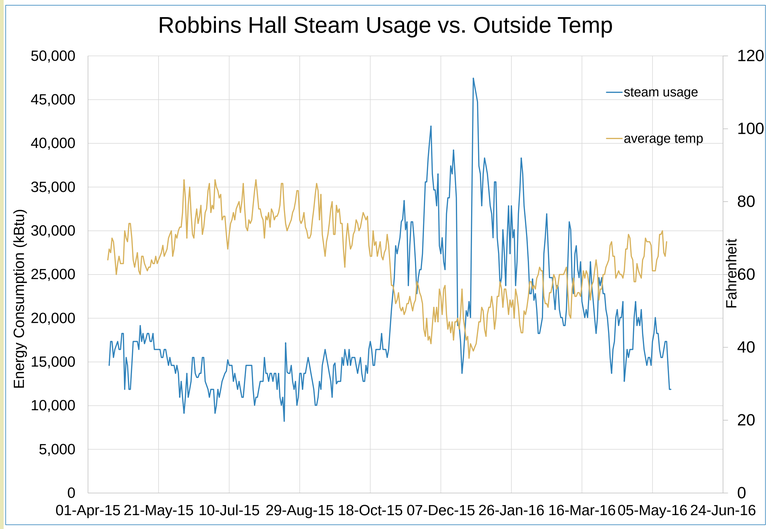
Objectives

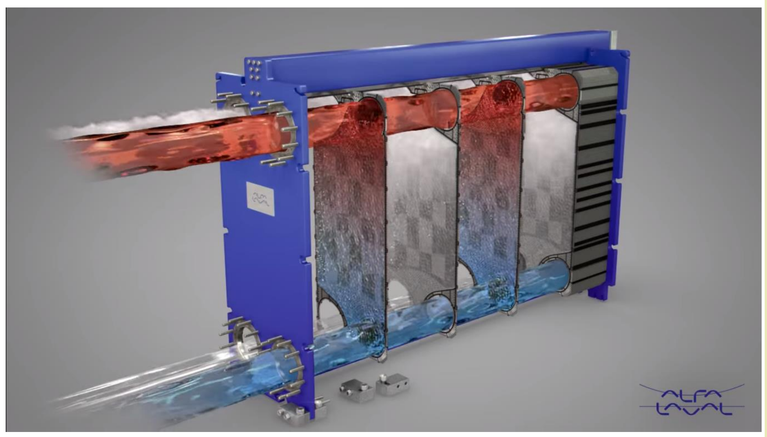
- Develop Model of Energy needs
- Analyze energy savings of conversion
- Make Recommendations for conversion
- Document building assessment process
- Determine hardware upgrades necessary



Methodology

- Analyze **Steam** system to determine minimum requirements and losses:
  - Collect **condensate** data, calculate energy (**BTUs**) supplied by steam
  - Collect **usage** data (flow rate and temperatures used by building systems) and convert to energy (**BTUs**) required
- Design **Hot Water** system to meet building requirements
  - Determine specifications of **Heat Exchangers** needed for Hot Water based system
  - Calculate energy (**BTUs**) supplied to new heat exchangers and compare with steam
- Determine (direct steam) **process** loads
  - Collect equipment and usage data
  - Develop alternative supplies of process steam (small boiler, different source, etc)



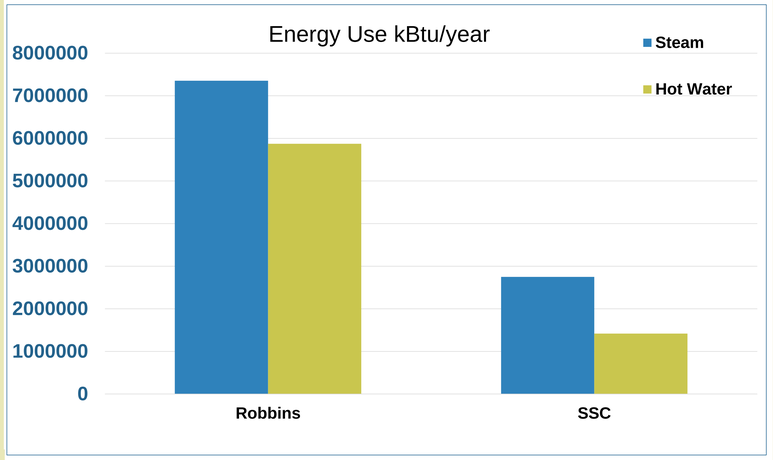


Alfa Laval gasketed plate-and- frame Heat Exchanger

Results

	Steam Energy Consumed kBtu	Estimated Hot Water Energy kBtu	Energy Savings kBtu	Natural Gas Saved $
Robbins Hall	7,352,818	5,874,650	1,478,168	10,119
SCC	2,750,323	1,418,053	1,332,270	9,192

- Energy Savings will be significant
- Process loads can be replaced
- Considerations
  - Additional savings of **10%** are expected when campus boilers are updated from Steam to Hot Water
  - Process loads can be supplied using 30 kW electric steam boilers.
- Recommendations:
  - Start collecting data from all buildings currently on steam loop
  - Ensure Reliability of data collected from buildings



Conclusions

- Based on our calculations, if Robbins Hall and the Student Community Center convert their heating system from Steam based to Hot Water based, we estimate energy use savings of 20% for Robbins Hall and 48% for the Student Community center.
- This conversion will result in annual cost savings of approximately $19,000.

References

- Data provided by Facilities Management – Energy Conservation Office
- Heat Exchanger image courtesy of Alfa Laval Corp.