BUILDING ENERGY RETROFIT MODELING

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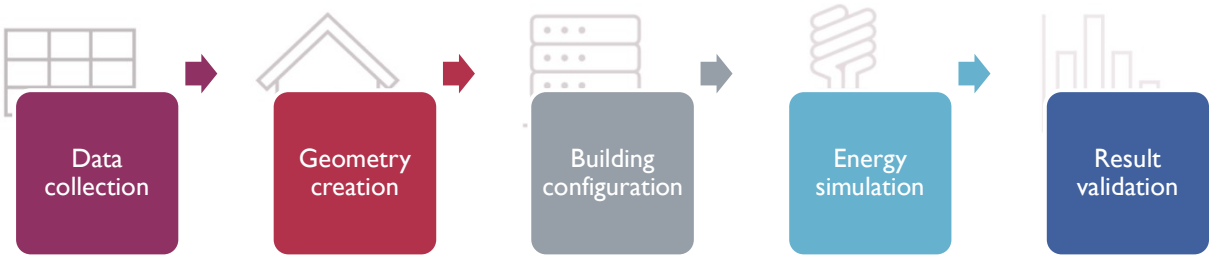
BUILDING MODELING, SIMULATION AND VALIDATION

Why building energy modeling?

- Building energy optimization before construction
- Cost savings
- Ability to simulate different scenarios

Steps



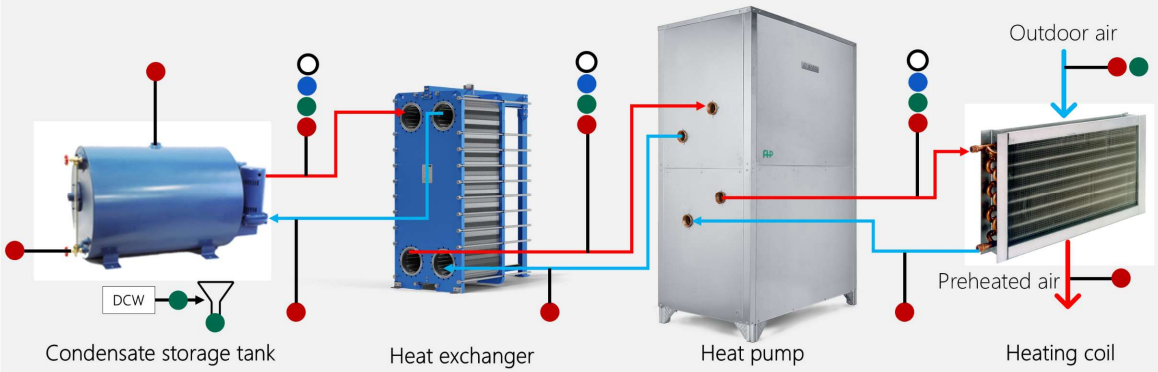
Software

SketchUp
OpenStudio
MODELICA
python
Revit
EnergyPlus
MATLAB
Excel

Waste Heat Energy Recovery Living Lab

CSU
Washkewicz College of Engineering

System Components



Key: Temperature sensor · Flow meter · Pump power meter · Pump on/off sensor

Monitored Variables

Tank inlet water temperature
Storage tank temperature
Heat exchanger hot side outlet temperature
Heat exchanger cold side inlet temperature
Heat exchanger cold side outlet temperature
Heat pump hot side inlet temperature
Heat pump hot side outlet temperature
Outside air inlet temperature
Outside air preheat temperature
Tank level
Domestic cold water mass flow rate
Drained condensate mass flow rate
Heat pump compressor electrical work
Outside air volumetric flow rate
Pump 1 on/off signal
Pump 2 on/off signal
Pump 3 on/off signal

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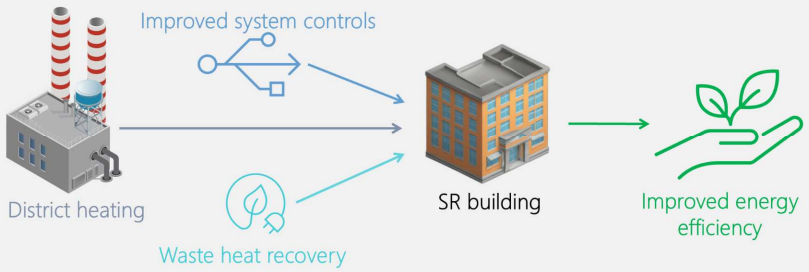
Current project: Heat pump upgrade in CSU Science Research building



Significance

Goal: Design, install, and validate a novel heat recovery system to improve the efficiency and effectiveness of the existing district energy heating system

Impact: Reduce energy costs and emissions required to heat the building, while demonstrating the effectiveness of the heat recovery system for adoption on other district energy systems

Sponsors

U.S. DEPARTMENT OF ENERGY

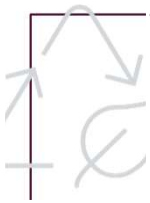
PARAGON ROBOTICS LLC

corix | Cleveland Thermal

CSU CASE STUDY: ESTIMATED BENEFITS OF RETROFITS

13.21% steam supply savings

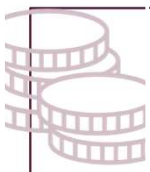
5% system efficiency increase



4.8% heat recovery ratio

19.69% emissions savings

8.78% annual cost savings



7-year payback period [14 without DOE funding]