Efficient air dehumidification can save 15%-50% of cooling energy in commercial buildings

Altaire ADAPT Field Demonstration

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BACKGROUND / INDUSTRY IMPACT

- Current approach to dehumidification in commercial buildings with chilled/hot water AHU systems is to overcool return + supply air to dewpoint, and then reheat before supply to zone.
- This is energy inefficient, with reheat often being gas-fired.
- To reduce energy consumption, building operators will often operate at little-to-no outside air, sacrificing IAQ.
- Decarbonizing commercial buildings requires solutions to reduce and fully electrify dehumidification energy consumption.

PROJECT OVERVIEW / OBJECTIVES

- Altaire's ADAPT system controls humidity by pre-dehumidifying outside air before it enters the AHU.
- Decoupling humidity control from cooling reduces energy consumption while enabling improved IAQ management.
- The project objective is to determine the effectiveness of the ADAPT system in removing latent loads from an AHU's outside air intake and quantify energy savings.

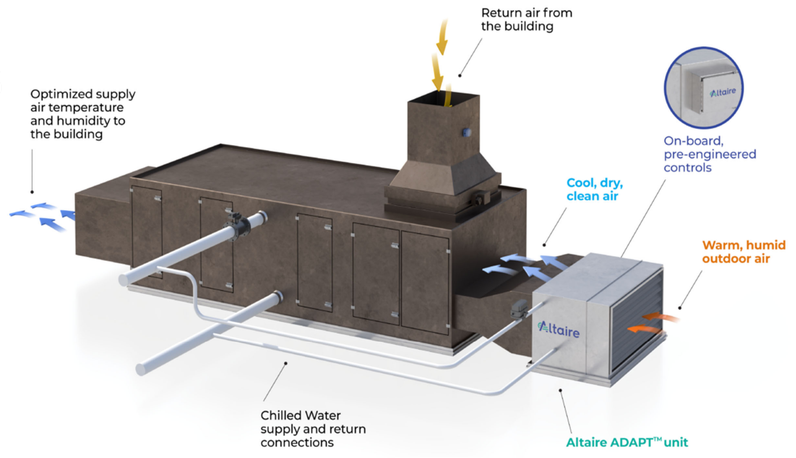
APPROACH

Leverage NREL expertise in field demonstrations and building energy modeling to:

1. Perform field validation of the very first ADAPT units at:
   - Burke Courthouse in Lufkin, TX with three AHUs in basement and attic.
   - Naval Support Activity Annex Building in Orlando, FL with one rooftop AHU.
2. Develop a component model of the ADAPT unit in EnergyPlus™ and model performance in multiple building configurations.

Research Outcomes

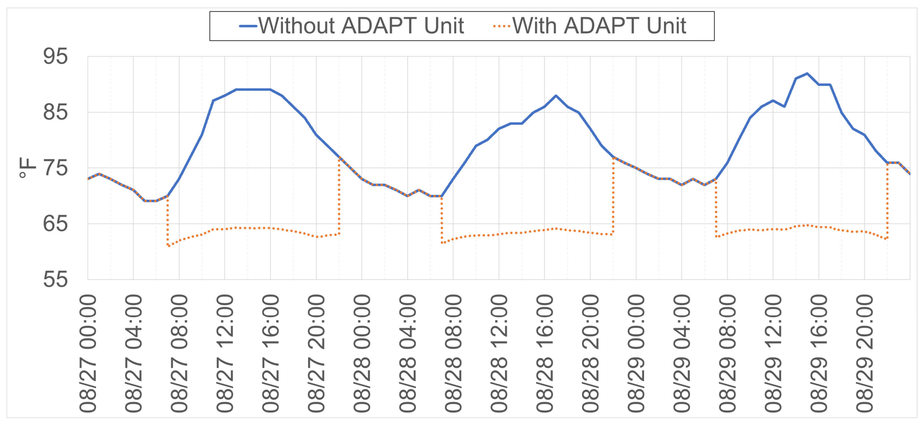
- First ever field demonstration of Altaire ADAPT dehumidification pretreatment technology.
- BAS controls adjustments for operation with ADAPT.
- Quantification of chiller and reheat energy savings potential of technology.
- Calibrated/validated component model for performance prediction in different climate zones and building configurations.



Schematic of Altaire ADAPT unit installed on an air handling unit. *Illustration from Altaire*

Impact

- Improve commercial building energy efficiency by reducing air-conditioning energy-use from latent loads.
- Reduce/eliminate gas-fired reheat energy use, enabling decarbonization of commercial buildings.
- Enable building operation with code-specified minimum outdoor air fraction with little-to-no energy penalty, thereby improving IAQ.



Energy model results showing temperature of air entering an AHU without the ADAPT unit installed (blue line) and with the ADAPT unit installed (broken orange line). Plot shows during occupied hours with ADAPT unit running the air entering the AHU is lower, allowing the air leaving the AHU to have a higher setpoint, reducing reheat energy.

CURRENT STATUS & FUTURE WORK

- Measurement and validation plan for both sites is complete.
- Installation of measurement and instrumentation equipment is underway at both sites.
- EnergyPlus™ component model has been built and validated with lab test data.
- Future work includes installation and commissioning of ADAPT units, data collection, model calibration, and parametric study.

Conservant HEDS Field Demonstration

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PROJECT OVERVIEW / OBJECTIVES

- The Conservant High Efficiency Dehumidification System (HEDS) recovers dehumidification heat for air reheat, reducing need for external energy.
- Optimized controls for dew point, air flow and chiller operation.

APPROACH

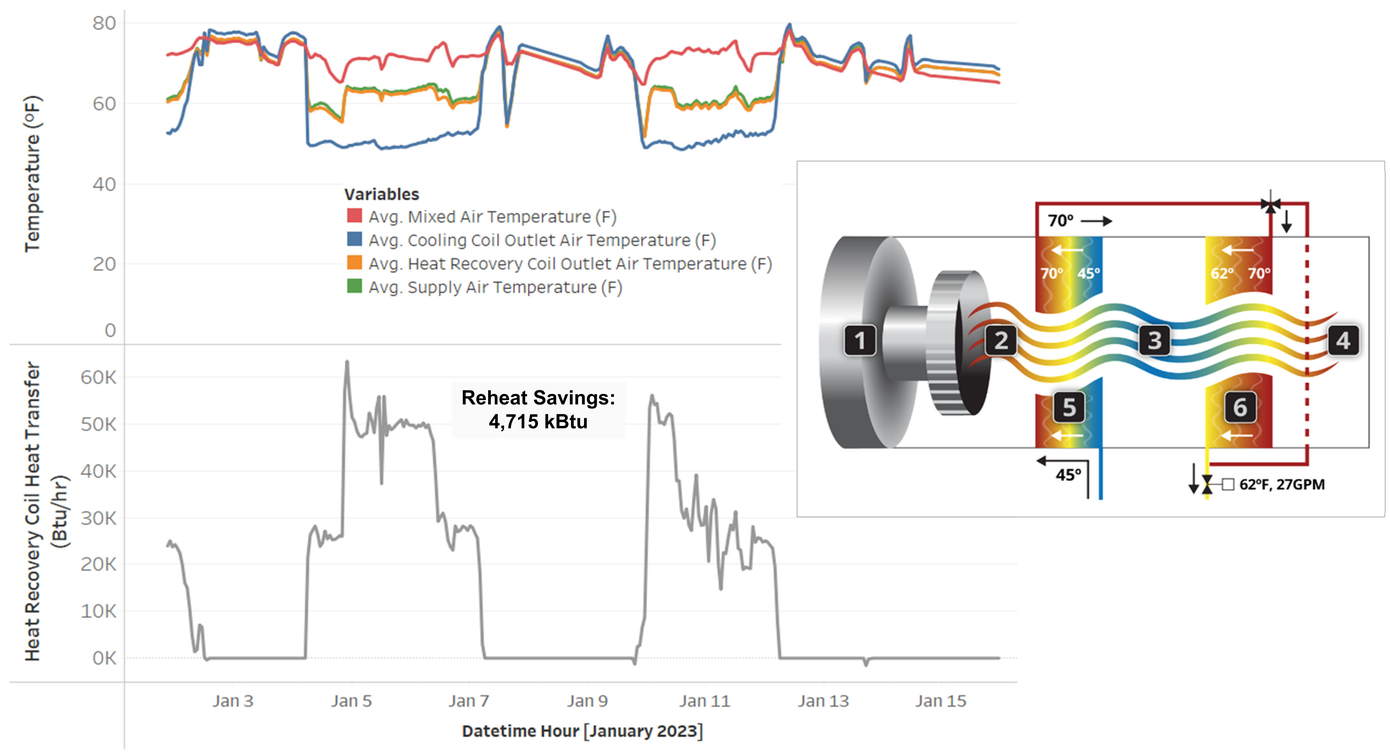
- Field evaluation of HEDS technology will be conducted at the Timken Museum in San Diego, California to validate energy savings >20%.
- Performance validation using a full year of instrumentation data.
- Direct comparisons of energy consumption will be made for operation with and without the HEDS system.

FUTURE WORK

- Development and validation of detailed EnergyPlus™ model will be completed to assess energy savings for different building types and climates.
  - Identify applications with greatest potential.
  - Assess impacts of widespread deployment nationwide.

Impact

- Improve commercial building energy efficiency by reducing air-conditioning energy-use from latent loads while improving humidity control.
- HEDS is enabling technology for commercial building decarbonization, eliminating need for gas-fired reheat.



The study analyzed timeseries data from the Building Automation System of the Timken Museum located in San Diego, CA. The top graphic shows air temperatures at several locations in the air handler, while the HEDS diagram (right inset) shows the corresponding points for mixed air temperature (2), cooling coil outlet air temperature (3), and heat recovery coil outlet air temperature (4). The bottom graphic shows the reheat energy, as calculated from measurements during normal operation. *Illustration from Conservant*

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