Building America Case Study

Technology Solutions for New and Existing Homes

Improving Comfort in Hot-Humid Climates with a Whole-House Dehumidifier

Windermere, Florida

PROJECT INFORMATION

Project Name: Systems Evaluation at the Cool Energy House

Location: Windermere, FL

Partners:

Southern Traditions Development,
http://southerntraditionsdev.com/

Consortium for Advanced Residential Buildings
www.carb-swa.com

Building Component: HVAC

Application: Retrofit, single family

Year Tested: 2012

Applicable Climate Zone(s): Hot–humid

PERFORMANCE DATA

(of the measure alone, not whole house)

Cost of Energy Efficiency Measure (including labor): $2,600

Projected Energy Savings: 8.2% reduction in air conditioning

Projected Energy Cost Savings: $53/year

Other Benefits:

- Improved humidity control
- Potential to downsize AC capacity

Building America SM U.S. Department of Energy

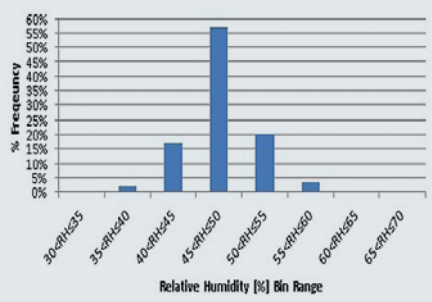
Maintaining comfort in a home can be challenging in hot-humid climates. At the common summer temperature set point of 75°F, the perceived air temperature can vary by 11°F because higher indoor humidity reduces comfort. Often the air conditioner (AC) thermostat set point is lower than the desirable cooling level to try to increase moisture removal so that the interior air is not humid or "muggy." However, this method is not always effective in maintaining indoor relative humidity (RH) or comfort.

In order to quantify the performance of a combined whole-house dehumidifier (WHD) AC system, researchers from the U.S. Department of Energy's Building America team Consortium of Advanced Residential Buildings (CARB) monitored the operation of two Lennox AC systems coupled with a Honeywell DH150 TrueDRY whole-house dehumidifier for a six-month period. By using a WHD to control moisture levels (latent cooling) and optimizing a central AC to control temperature (sensible cooling), improvements in comfort can be achieved while reducing utility costs. Indoor comfort for this study was defined as maintaining indoor conditions at below 60% RH and a humidity ratio of 0.012 lbm/lbm while at common dry bulb set point temperatures of 74°-80°F. In addition to enhanced comfort, controlling moisture to these levels can reduce the risk of other potential issues such as mold growth, pests, and building component degradation. Because a standard AC must also reduce dry bulb air temperature in order to remove moisture, a WHD is typically needed to support these latent loads when sensible heat removal is not desired.

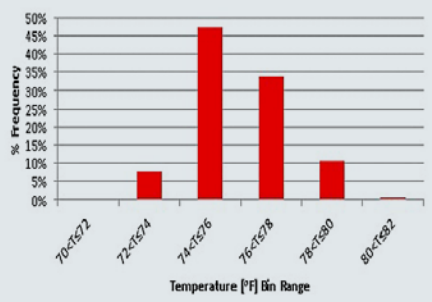
AC and WHD systems are very similar in that each uses a vapor compression cycle and share many of the same components. One difference is the location of the condensing coil—the AC system rejects condenser heat outdoors, and WHDs reject heated and dehumidified air indoors. In addition, a WHD is able to operate at a low airflow rate to allow the airstream more time for moisture (latent load) to be removed as condensate.

Description

Monitoring was performed over a six-month period to verify the indoor conditions maintained by the combined whole-house dehumidifier and air conditioning systems.



Indoor RH was maintained below the upper limit of 60% RH for 99.86% of the time.

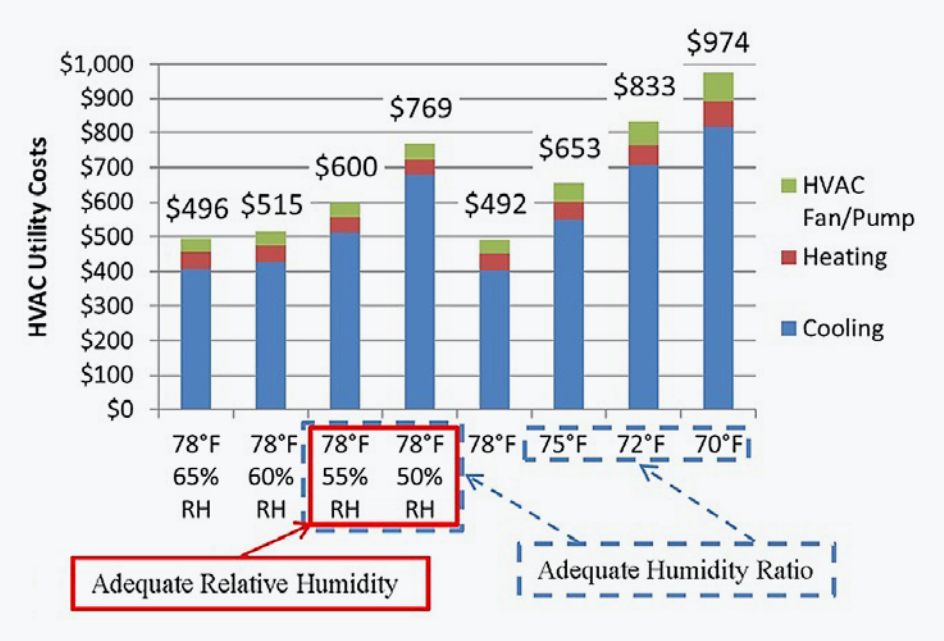


Indoor temperature was maintained within comfortable limits of 74°F to 80°F for 91.5% of the monitoring period. Excluding the sub-74°F indoor conditions (lower than cooling set point temperature), the home was kept within the comfort zone temperature range for 99.3% of the cooling portion of the monitored period.

For more information, see the Building America report, *Systems Evaluation at the Cool Energy House,* at *www.buildingamerica.gov*

Image credit: All images were created by the CARB team.

The CARB study collected data on the indoor conditions in the home as well as energy usage and operational functionality of each of the mechanical systems. Long-term monitoring results show that the system was able to adequately control moisture in the home to sub-60% RH levels for 99.86% of the monitoring period. Additionally, the cooling system was able to achieve these improved comfort conditions while saving energy. Modeling with the National Renewable Energy Laboratory's BEopt energy simulation software shows a projected energy savings of 8.2% in the building's space conditioning related costs over the course of a year



CARB used NREL's BEopt energy simulation software to analyze the cost effectiveness of various cooling system configurations.

Lessons Learned

- Integrating a WHD with a traditional AC system (set to 55% RH and 78°F, respectively) can provide better indoor comfort conditions in hot-humid climates than a traditional AC only system (set to 75°F). This is especially true during the swing seasons (spring/fall) when sensible cooling may not be needed, but dehumidification is required.

> *"We are happy with the systems and surprised that we can set the thermostat so much higher than before and still be very comfortable."*
>
> – Homeowner

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