

# Modeling Hybrid Air Conditioners



DEPARTMENT OF ENERGY  
UNDERGRADUATE  
RESEARCH FELLOWSHIP  
FOR ENERGY EFFICIENCY IN BUILDINGS



## PROJECT OBJECTIVES

Hybrid air conditioners incorporate the advantages of various cooling components in variable speed, multi-mode, machines. These systems are climate appropriate energy measures that recognize how cooling needs and efficiency opportunities are different in each region. In collaboration with several industry partners, UC Davis students are developing modeling tools to support broader application of climate appropriate hybrid air conditioners.

## DATA AND INFORMATION FLOW

1. Manufacturers input performance data to Technology Performance Exchange
  - » Nominal info
  - » Performance maps for each mode
2. Data is compiled, and translated into a format for use in EnergyPlus.
3. Transferable performance curves available to model users on Building Component Library.

## EFFORTS UNDERWAY

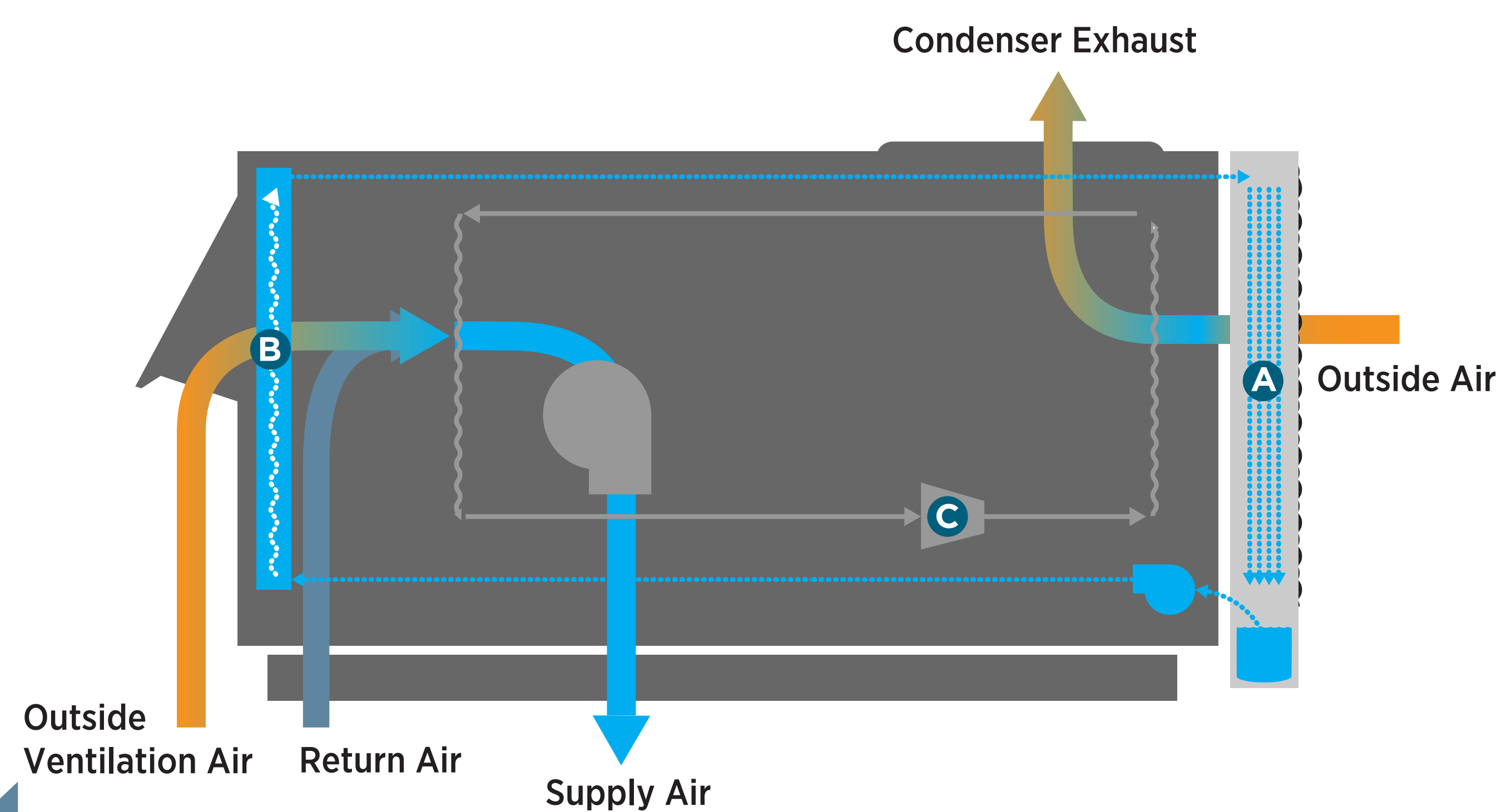
- » Undergraduate students are working with manufacturers to populate performance maps for various hybrid air conditioners.
- » UC Davis and LBNL are developing an EnergyPlus module specific to hybrid RTUs
- » UC Davis and NREL are expanding the Technology Performance Exchange





# The Climate Appropriate Hybrid Technologies

## DUAL-EVAPORATIVE PRE-COOLING FOR ROOFTOP UNITS

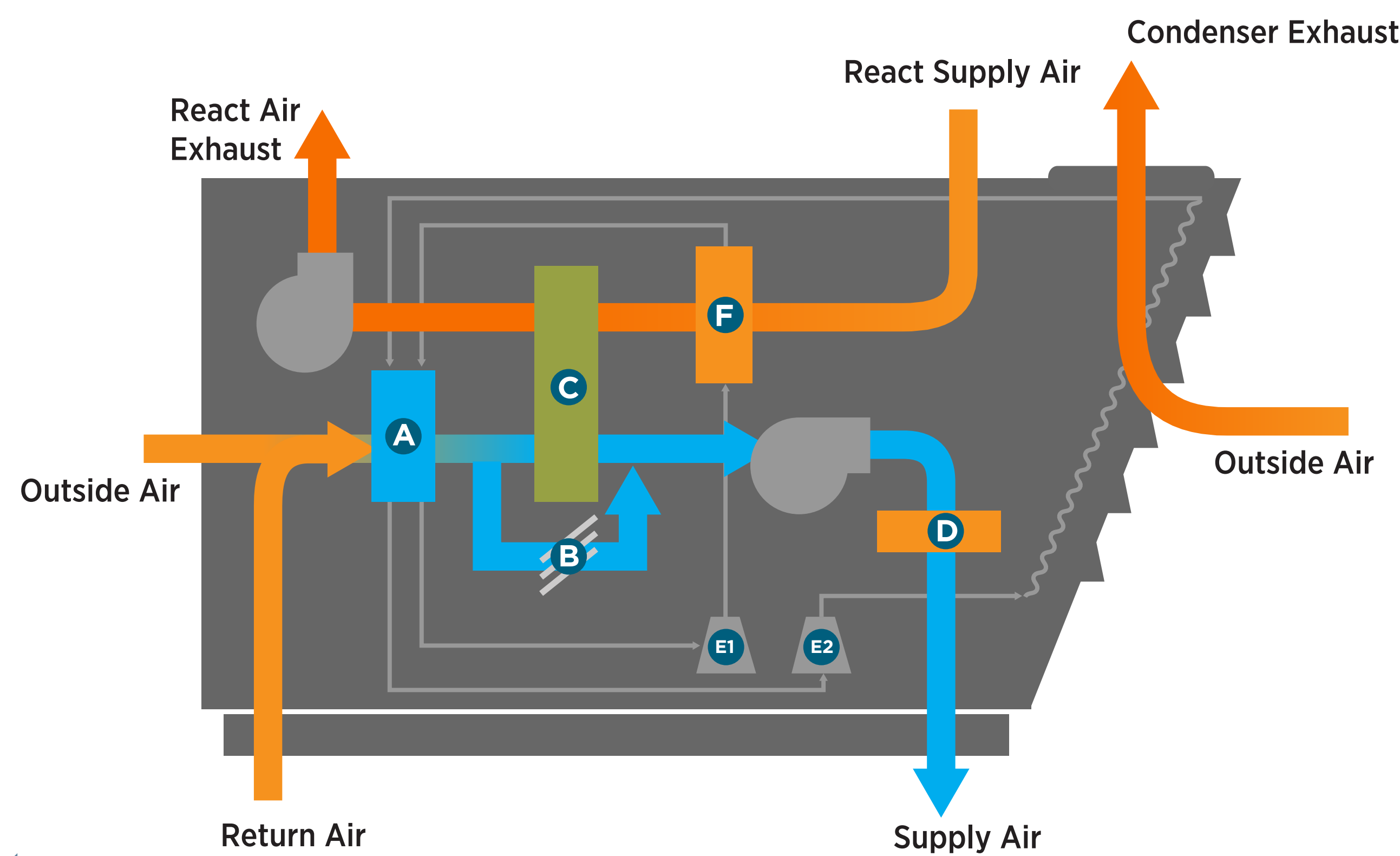


Integrated Comfort's DualCool is an add-on efficiency measure for conventional rooftop units. As the name implies, DualCool reduces energy consumption in two ways: direct evaporative condenser air pre-cooling improves vapor compression cycle efficiency and indirect cooling of the ventilation air reduces sensible load for the building. DualCool is best suited for dry, hot climates where dehumidification is not necessary, and where evaporative cooling achieves the greatest cooling capacity.

- A. Evaporative Condenser Pre-Cooler
- B. Ventilation Water-to-Air Heat Exchanger
- C. Conventional Vapor Compression System

RTU Add On // Evaporative Condenser Air Pre-Cooling // Indirect Evaporative Ventilation Air Cooling // Scaleable to small and large systems

## CLIMATE APPROPRIATE HYBRID DEDICATED OUTDOOR AIR SYSTEMS (DOAS)

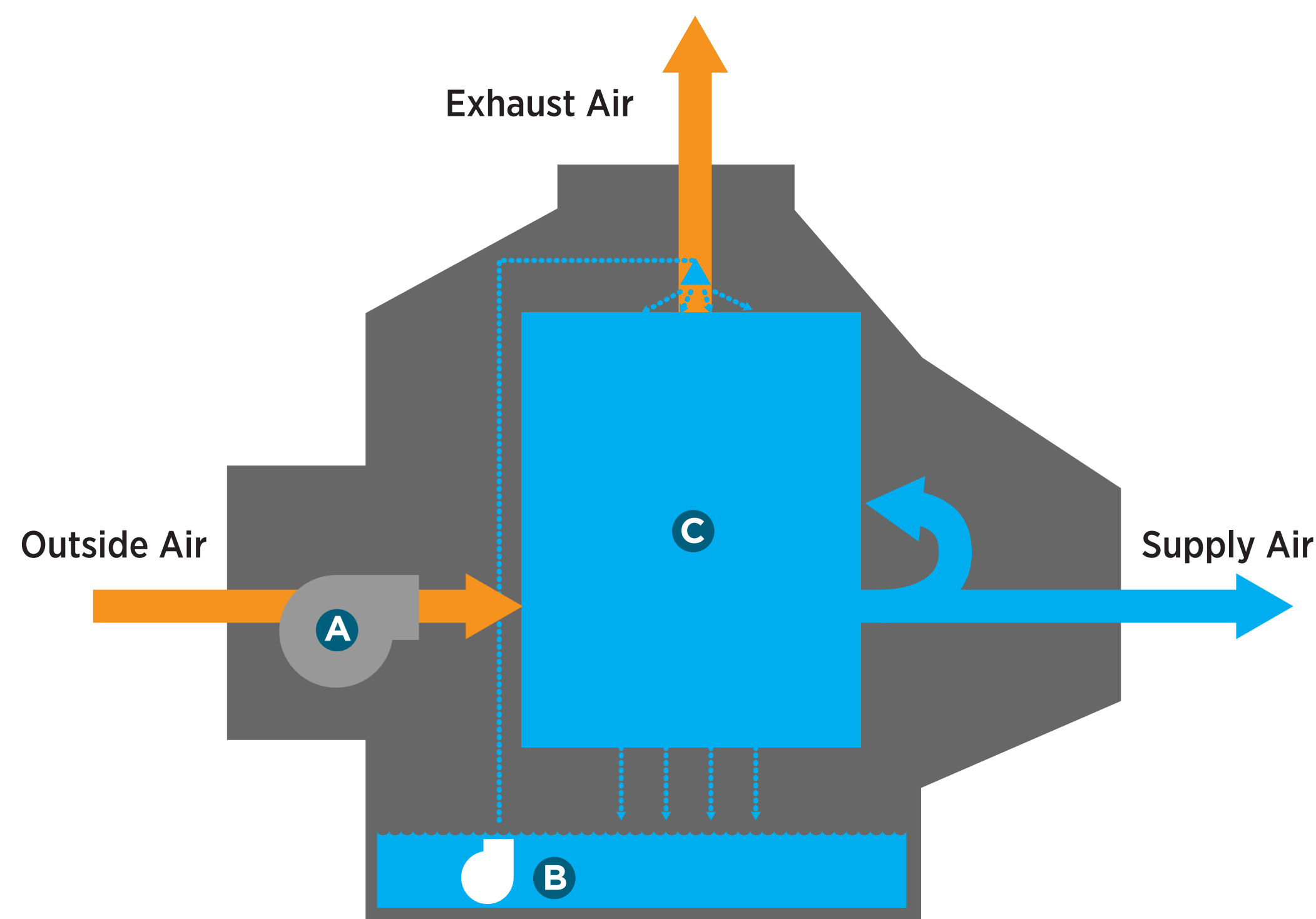


The Munters DryCool Humidity Control Unit is a packaged hybrid DOAS unit designed for treating ventilation air in hot humid climates. The core feature of the DryCool is a desiccant wheel that reduces energy use especially by avoiding the re-heat that is necessary when vapor compression is used for dehumidification. Uniquely, this system utilizes waste heat from the vapor compression cycle to enhance desiccant regeneration. Heating of the ventilation air can be provided by natural gas, electricity, or hot water.

- A. Evaporator Coil
- B. Desiccant Bypass
- C. Desiccant Wheel
- D. Heating
- E1-2. Multi-stage Compressors
- F. Stage 1 Condenser Coil for Reactivation Heat

DOAS // 100% Outdoor Air // 3000-6000CFM // Optional Heating // Optional Return Air

## STAND ALONE INDIRECT EVAPORATIVE COOLING



Seeley's Climate Wizard® uses water evaporation to produce cooled air well below the wet bulb temperature. This system operates with 100% outside air, and achieves full-load efficiency EER>50. At part load, efficiency can be even higher, EER>80. The system is best suited to supply ventilation air in dry, hot climates, but since the technology generates supply air temperatures near that of vapor compression equipment, it can also be used to provide substantial amount of room cooling, usually in combination with separate vapor compression equipment.

- A. Centrifugal Fan
- B. Water System and Pump
- C. Indirect Evaporative Heat Exchanger

100% Outdoor Air // 2500CFM // Variable-Speed Fan // Sump Water Quality Control