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# Ventilation Integrated Space Conditioning

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# Outline

1. Space conditioning principles
2. Current offerings
3. Modeling study
4. Musings

# Sensible Sizing Principles

- OA required based on exhaust rates
- Internal gains help in cold climates, hinder in hot climates
- Insulation resists heat flow through the envelope

Goal is to determine how to keep air flow as close to ventilation requirements as possible

$$q = 1.08 * \text{CFM} * \text{dT}$$

# Design considerations

- Sizing
- Efficiency
- Simplicity
- Maintenance
- Controls
- Aesthetics



# Current systems

- Small, unitary systems
- 100-300 cfm
- Heat Pump for space conditioning and ventilation recovery
- Multi-mode
  - Recirculation
  - Ventilation
- Modular add ons

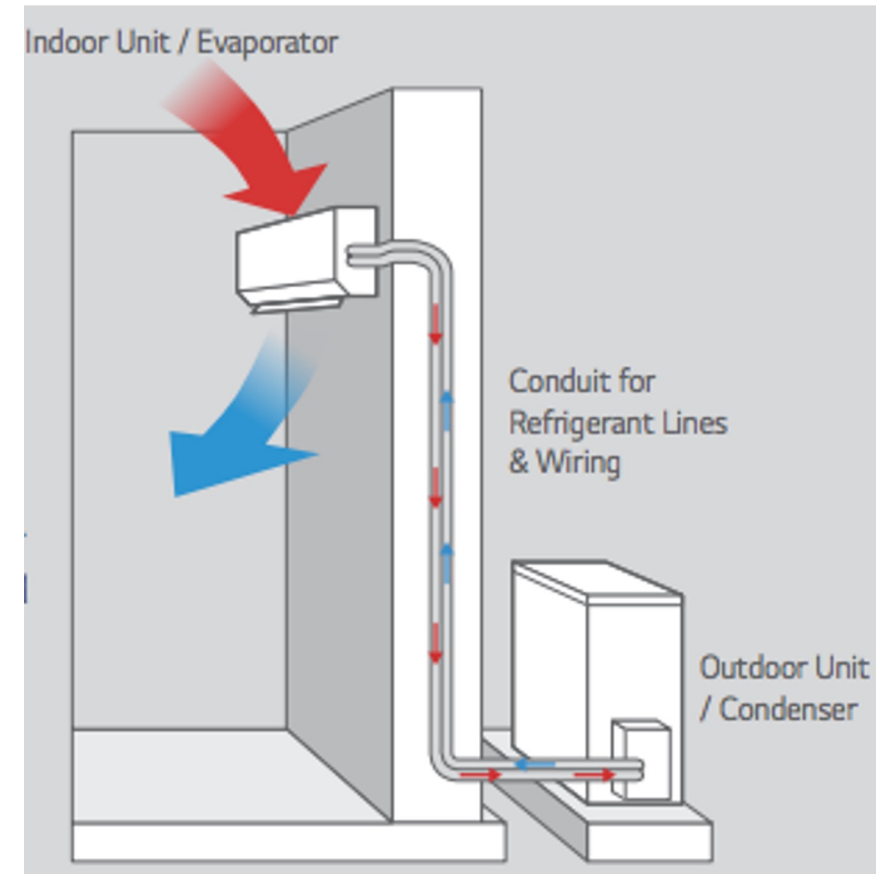


# Standard Passive Building system

- Minisplit
  - Heat pump space conditioning
  - Multiple inside options
- ERV/ HRV
  - Passive recovery ventilation

## Advantages

- Efficient
- Seperated
  - Run just ventilation if needed
- Cost effective
- Commonly available



# Integrated Pros/ Cons

## Pros:

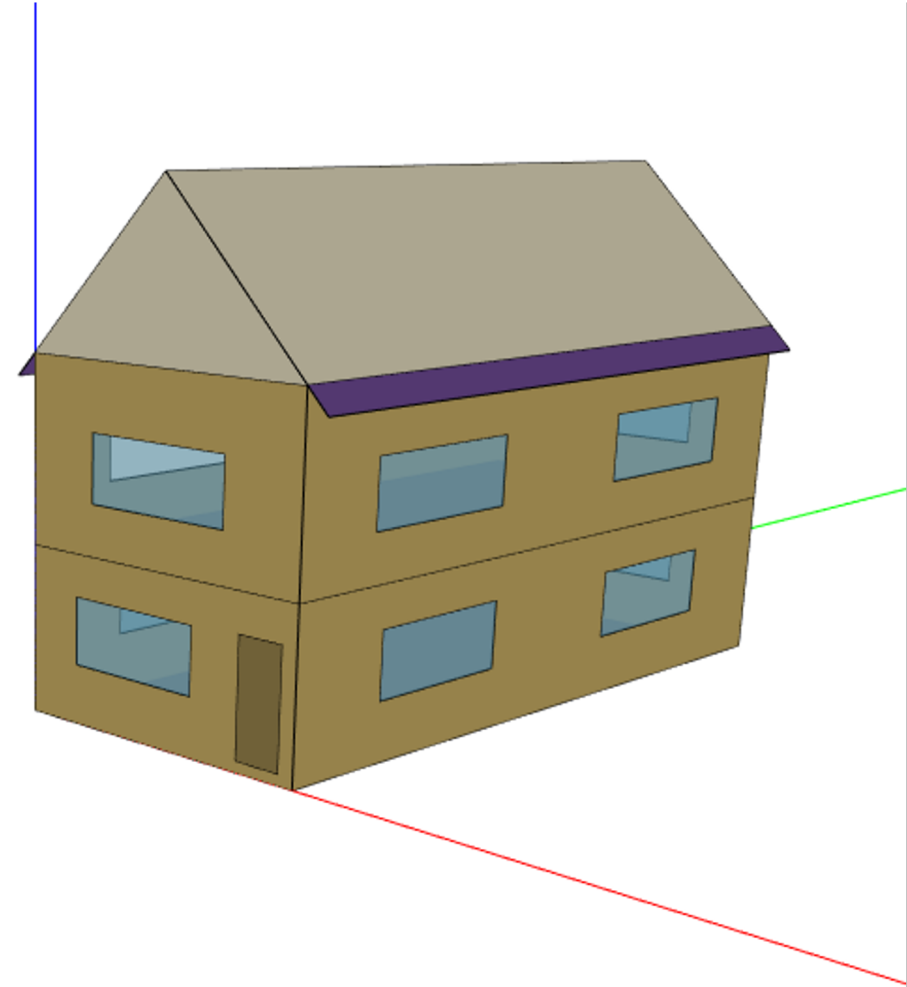
- Small package
- Efficient
- One set of ductwork
- Advanced controls/  
metering
- Units function well  
together

## Cons:

- Little too small for  
extreme climates
- Low airflow for high latent
- Complicated controls
- Requires more electrical  
input for heat exchange
- Modeling is behind for  
this type of equipment
- High electric input

# Modeling study

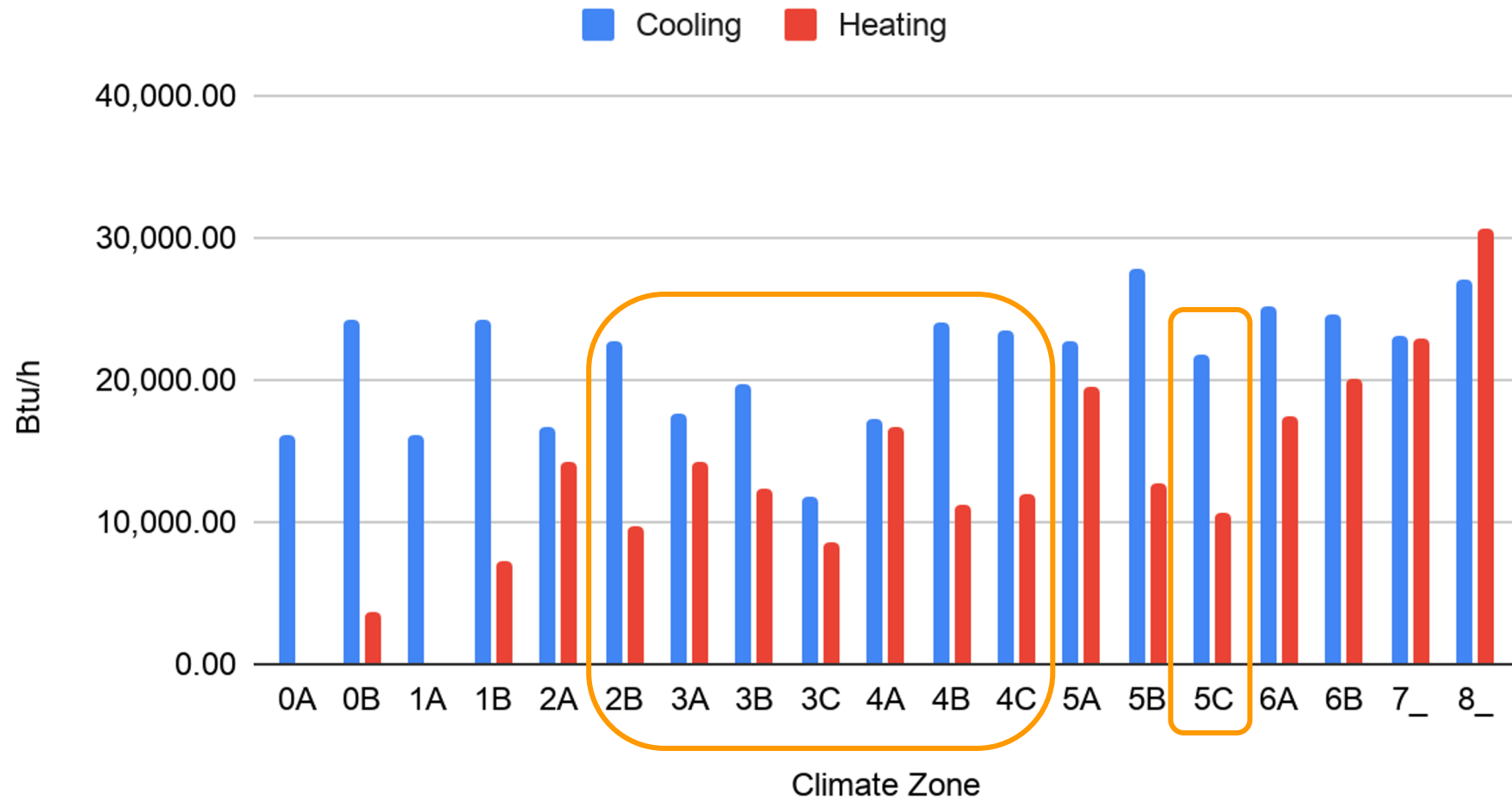
- **Test House**
  - 1548 iCFA
  - 3 bed, 4 occ
  - 18% WWR
  - Follows phius 2021 prescriptive
- **19 Climates**
  - 0A-8
- **HVAC Options**
  - Ideal air loads
  - Split w/ ERV/ HRV
  - Packaged unit





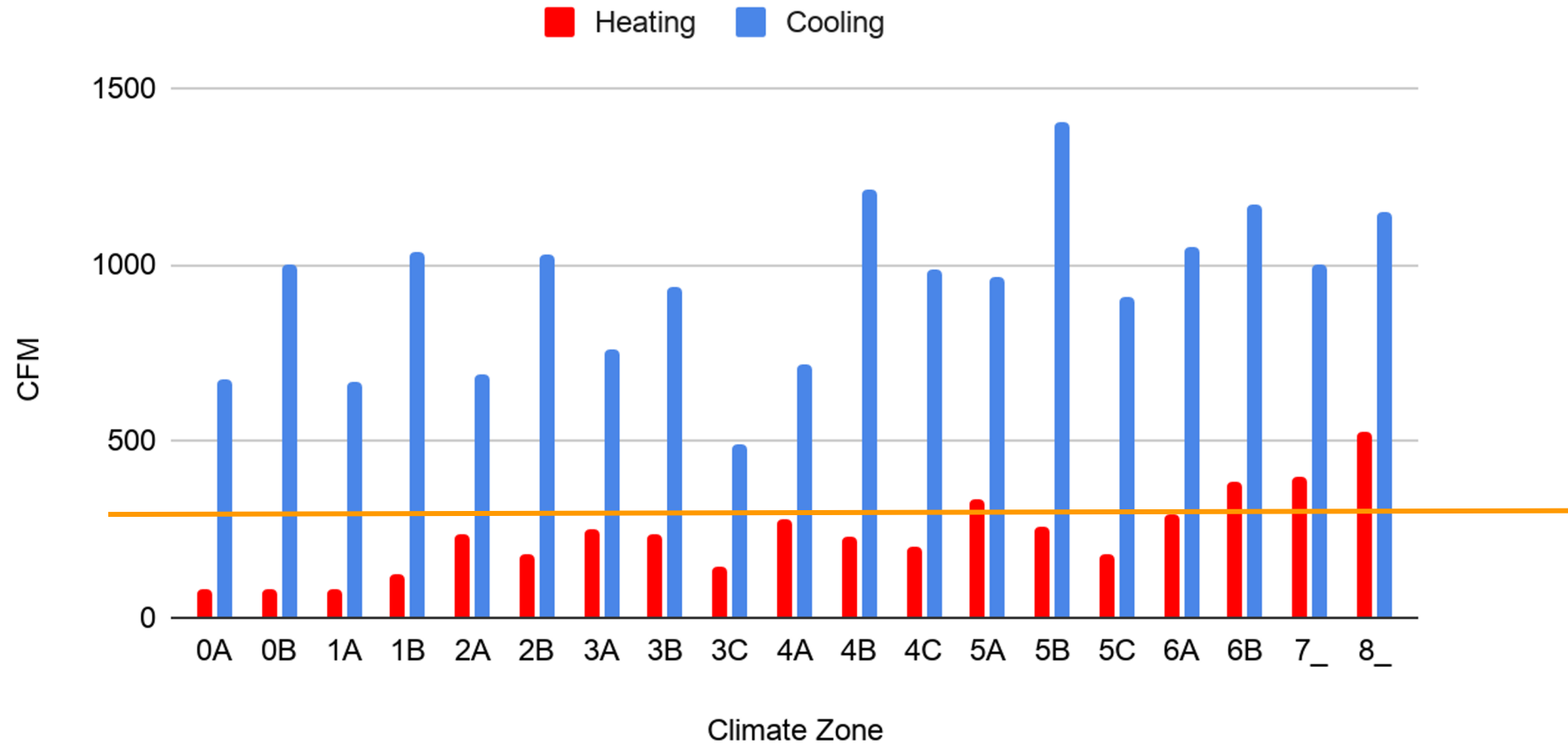
# Ideal Loads

## Ideal Heating and Cooling Loads



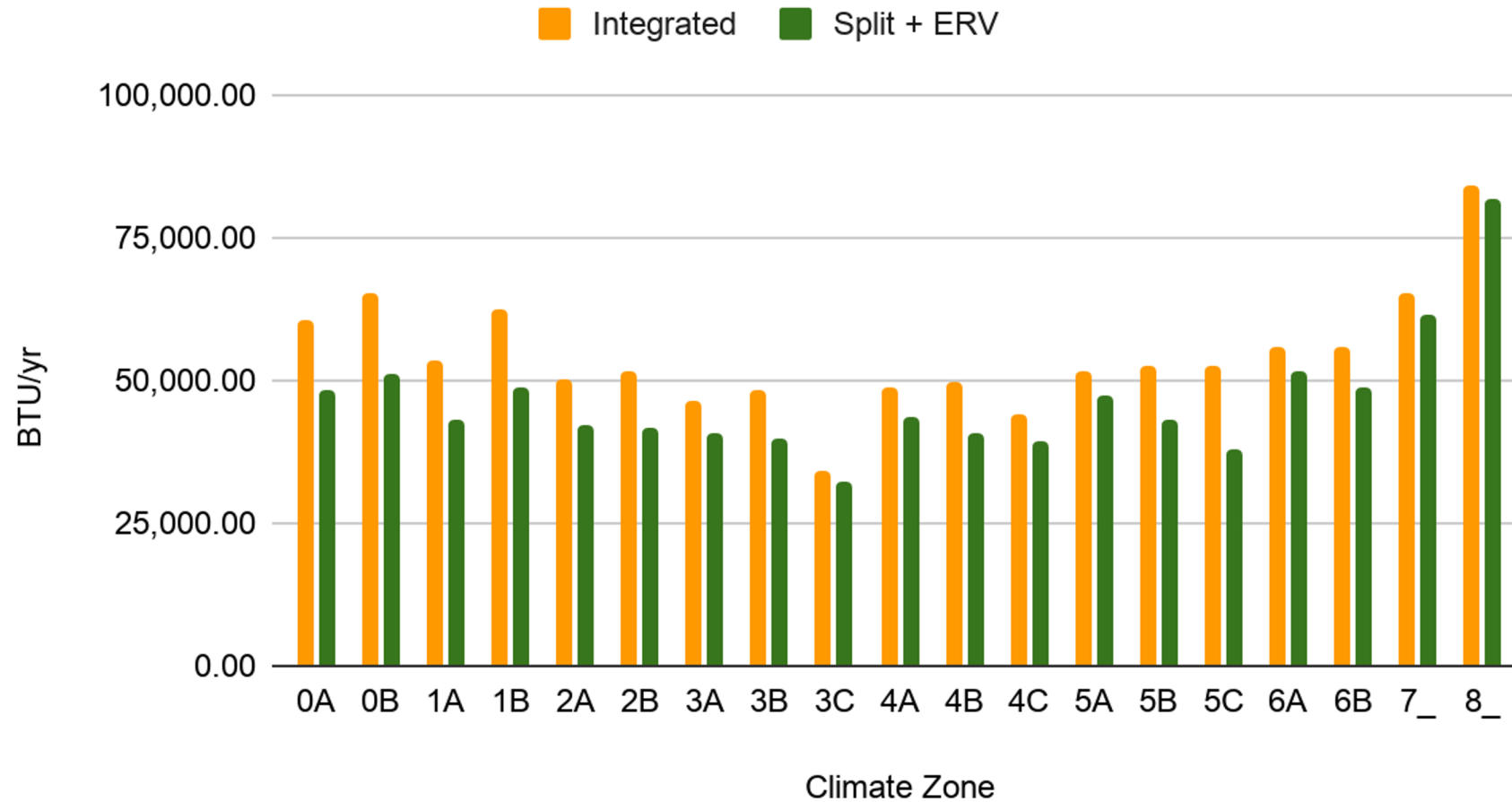
# Ideal Loads

## Heating and Cooling Air Flows



# Electrical Loads

## Total Electrical Consumption



# Musings

- Heat pump exchange requires more electrical input than passive core
- Compactness seems more valued than performance
- Lacks dehumidification

E DIN EN 13141-7:2018-09  
prEN 13141-7:2018 (E)

- Entwurf -

Annex A  
(informative)

Example of some possible arrangements of heat recovery heat exchanger and/or heat pumps for category I

Figure A.1 to Figure A.4 give example of possible arrangements of heat recovery heat exchanger and/or heat pumps for category I.

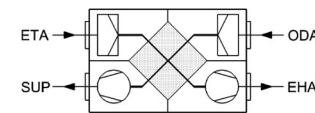


Figure A.1 — Example of ventilation unit with exhaust/supply air heat exchanger

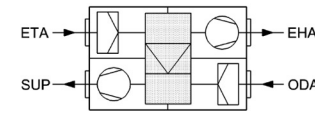


Figure A.2 — Example of ventilation unit with exhaust air/supply air heat pump

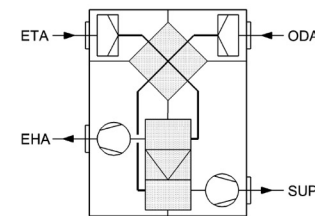
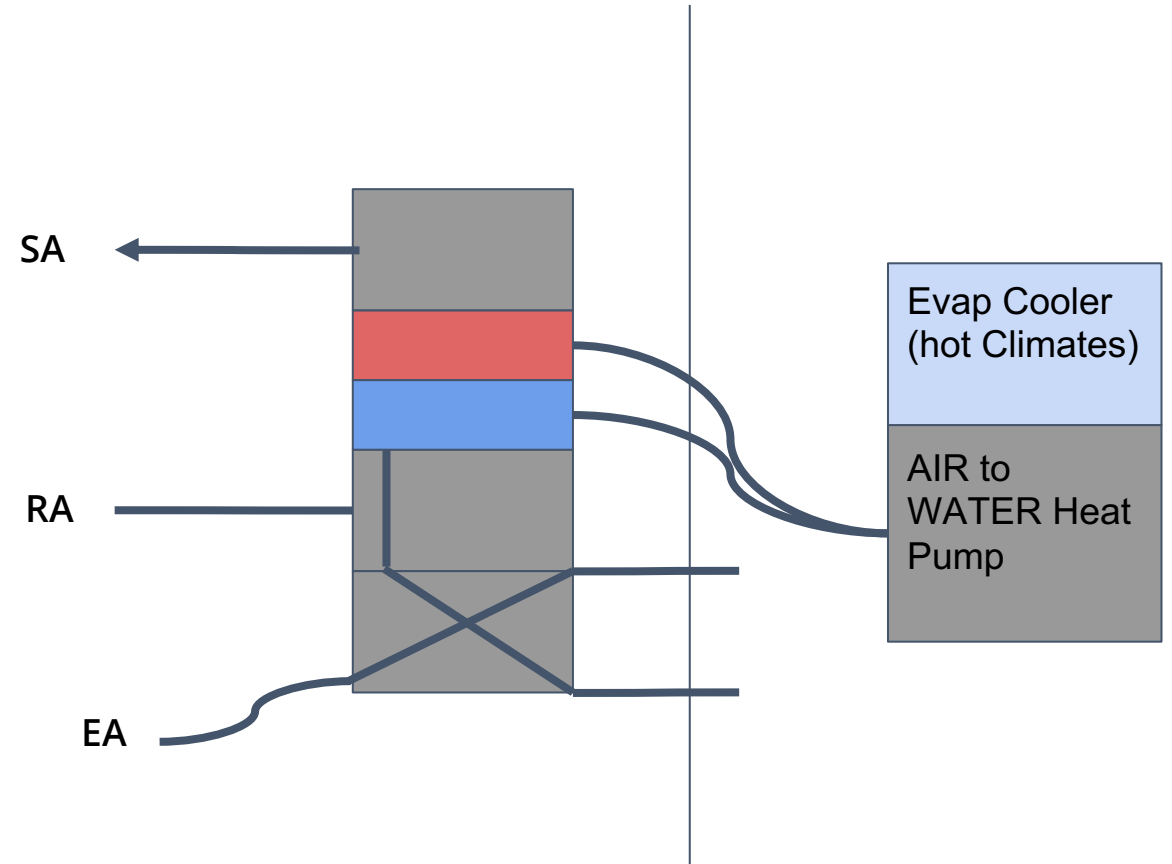


Figure A.3 — Example of ventilation unit with exhaust air/supply air heat exchanger and exhaust air-to-supply air heat pump

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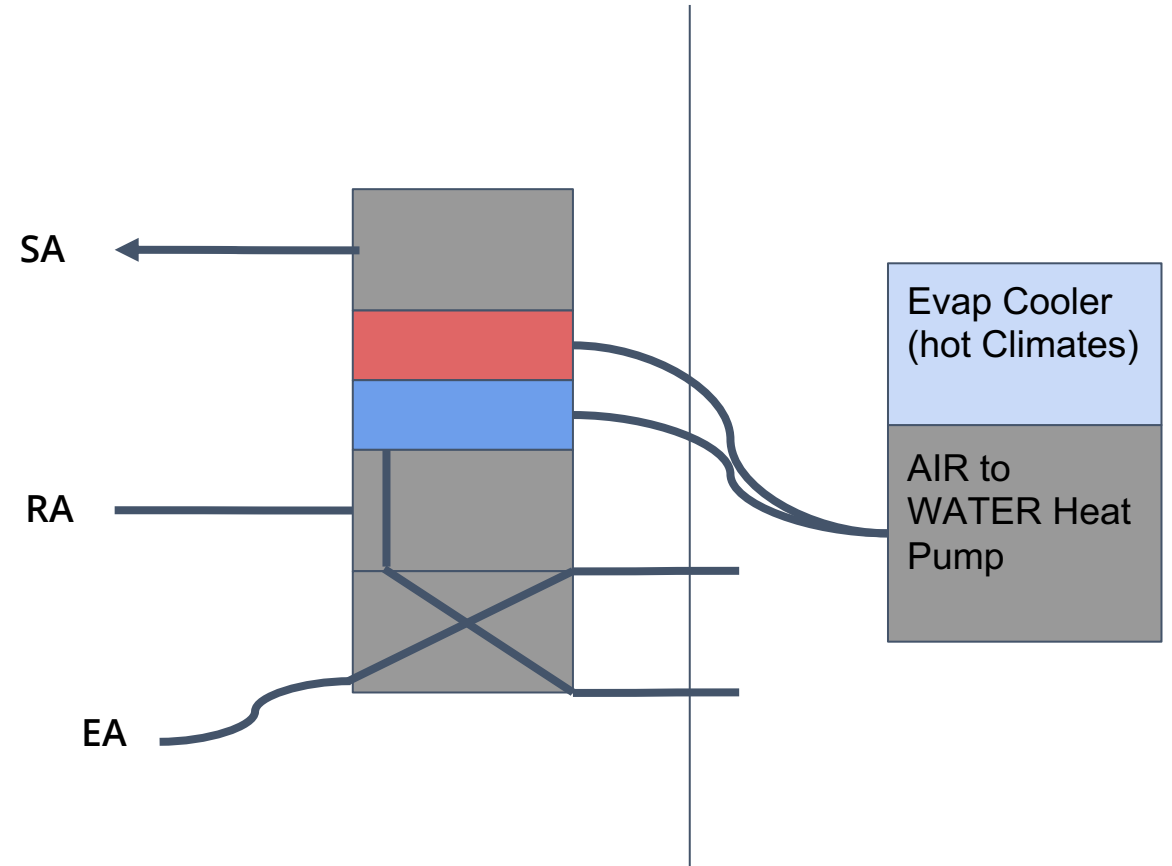
# Musings

- Make it larger
  - Decrease SHR
  - Much lower in passive buildings
  - Slower air speed
- Split out space conditioning
  - Higher efficiency
  - Evap cooler for hot climates
- Hydronic
  - Water heating mixed in
- Is this the way to go?



# Musings

- Can integrate into a district system
- Ground source heat pump?



# Questions?

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