# Modeling Capabilities for Non-Residential and Large Multi-Family Heat Pumps

NRDC supported by Energy350

# Purpose

- California needs to quickly move towards an **all-electric energy code** to align with science-based climate targets
- **CBECC-Com has gaps and limitations** for the modeling of **all-electric system types**, which hinder the pursuit of electrification in commercial buildings.
- CBECC-Com must support a **larger variety of heat pumps** to facilitate cost-effective all-electric designs

# Approach

- Does the requirement of Time-Dependent Source (TDS) in addition to TDV factors make it difficult for heat pumps to comply? (Using 2022 factors)
- Are there prohibitive simulation limitations that cause real-world designs to not comply?

**Note: all models were exported from CBECC-Com and run natively in EnergyPlus to allow for more advanced heat pump models*

# Decarbonization Technologies

| # | Technology | Description |
|---|---|---|
| 1 | **Air-to-Water Heat Pumps** | An air-to-water heat pump transfers heat from the surrounding air to water that is used for space heating purposes. It works similarly to a heat pump water heater, except that the water is used for space heating. |
| 2 | **Water-to-Water Heat Pumps** | A water-to-water heat pump is like an air-to-water heat pump, except that the heat source is a water body or loop (such as a geothermal loop) rather than the surrounding air. |
| 3 | **Water-to-Water Heat Recovery Chillers (modular/reversible)** | Modular/reversible heat recovery chillers have the capacity to operate primarily as chillers, as heat pumps, or in simultaneous heating and cooling mode, where heating and cooling loads are matched. The exact characteristics depend on the specific model of HRC, but they can be modular units that are used in sequence together or single large units. Some units (e.g. Multistack) have the capability to control to either a heating or cooling set point at a given time (but not simultaneously), whereas others (Aermec) have modular storage tanks that allows them to be controlled to both heating and cooling set points simultaneously. *However generally don't have reversing valve. |
| 4 | **Water-to-Water Heat Recovery Chillers – (primary chillers)** | Heat recovery chillers that operate primarily as chillers are used to serve a building's cooling load, with the heat recovery component coming secondary to this main load. Waste heat that would normally be rejected to the air or a cooling tower is recovered instead to offset heating load that occurs simultaneous to the cooling load.[1] This recovered heat can be used for space heating or domestic water heating but is typically insufficient to meet a building's total heating load. |
| 5 | **Air-to-Water Heat Recovery Chillers (modular/reversible)** | Like category 1, but with a reversing valve. |
| 6 | **Air-to-Water Heat Recovery Chillers (primary chillers)** | Like category 1, but with heat recovery capabilities. |
| 7 | **Thermal Storage** | Thermal storage allows for the storage of heating or cooling produced and can be used in conjunction with the equipment described here to balance non-simultaneous heating and cooling loads. |

# Modeling Scope

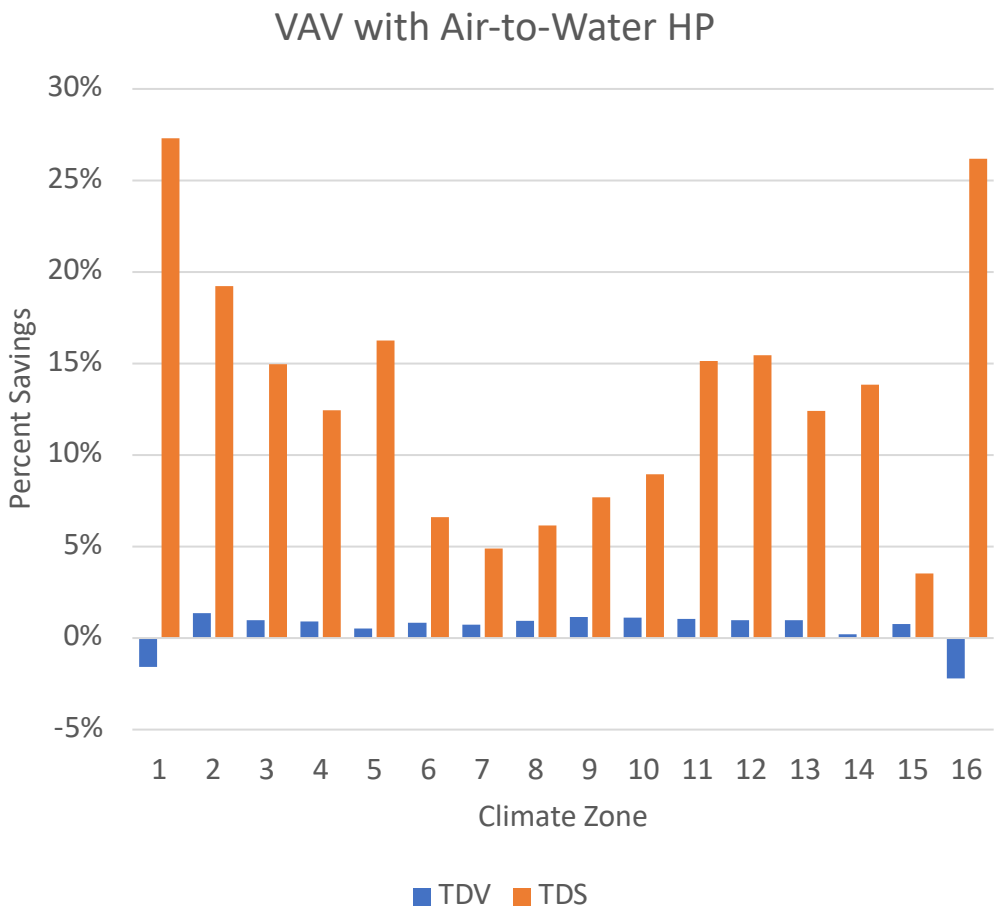
**CBECC-Com Prototypes**

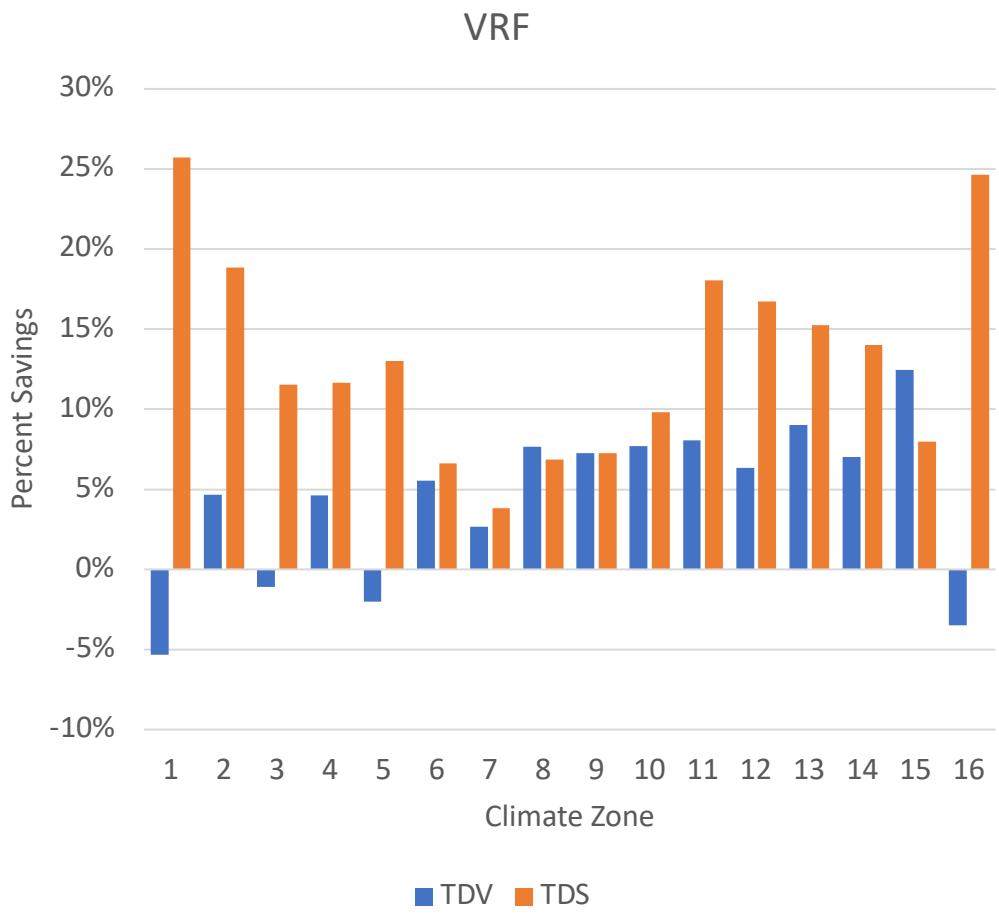
- Medium Office
- Large Office
- Small Restaurant
- 10-Story Residential High-Rise

**Heating Systems**

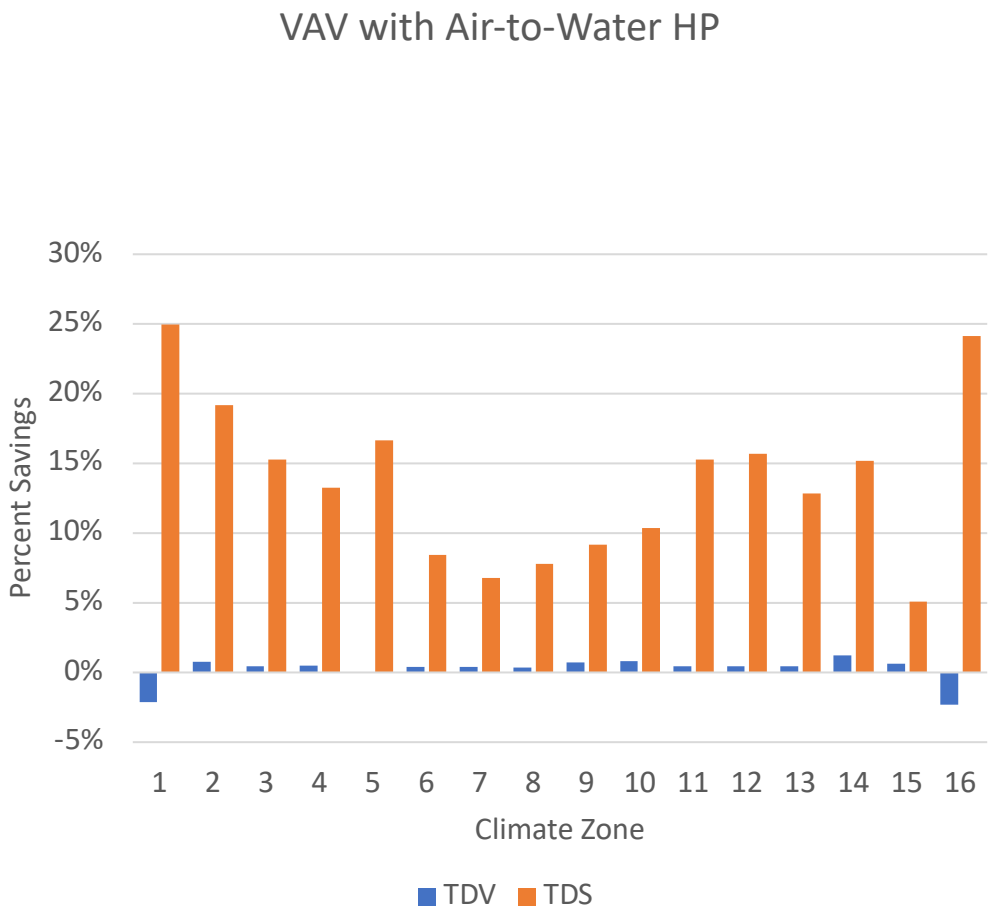
- Prescriptive Code Baseline
- VRF
- Central Heat Pump

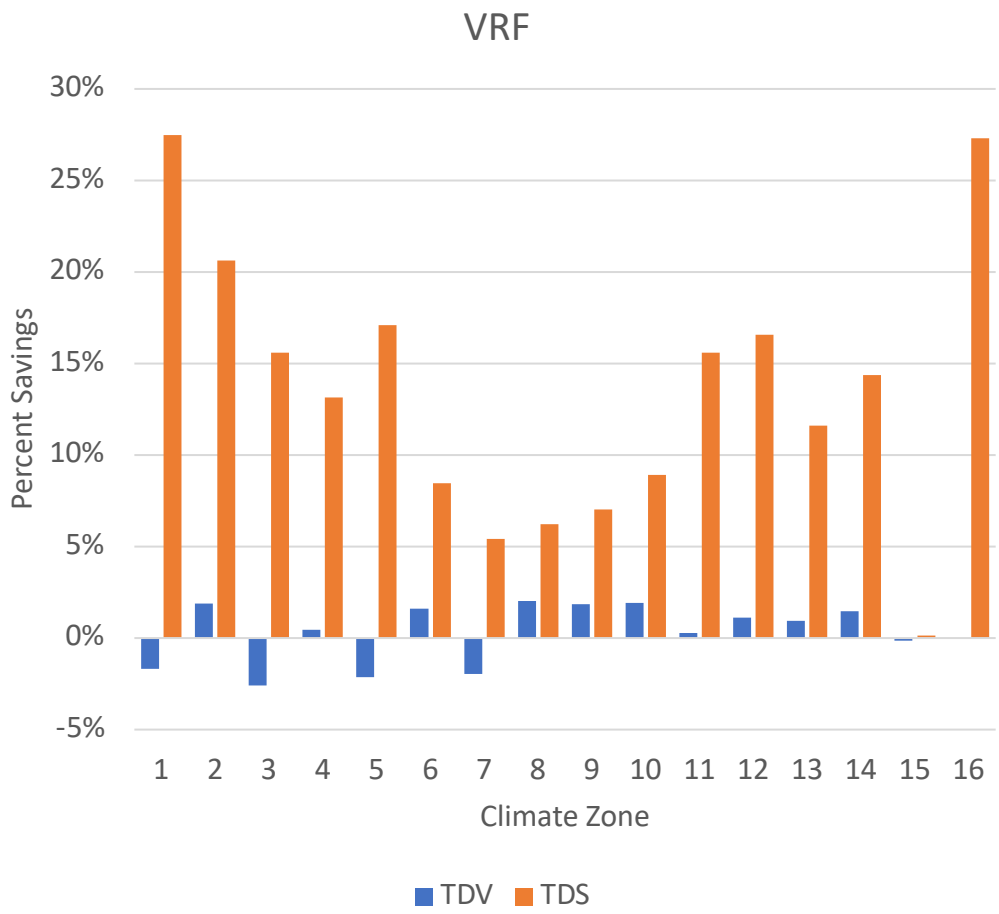
# Medium Office



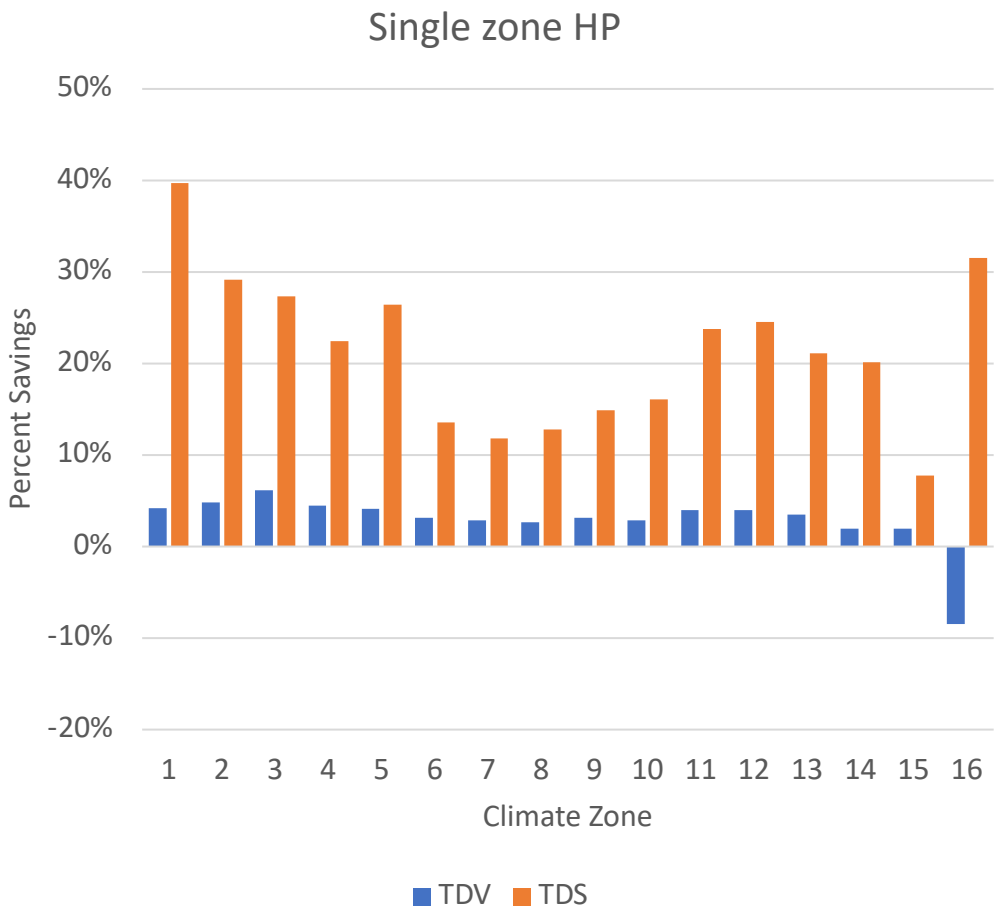



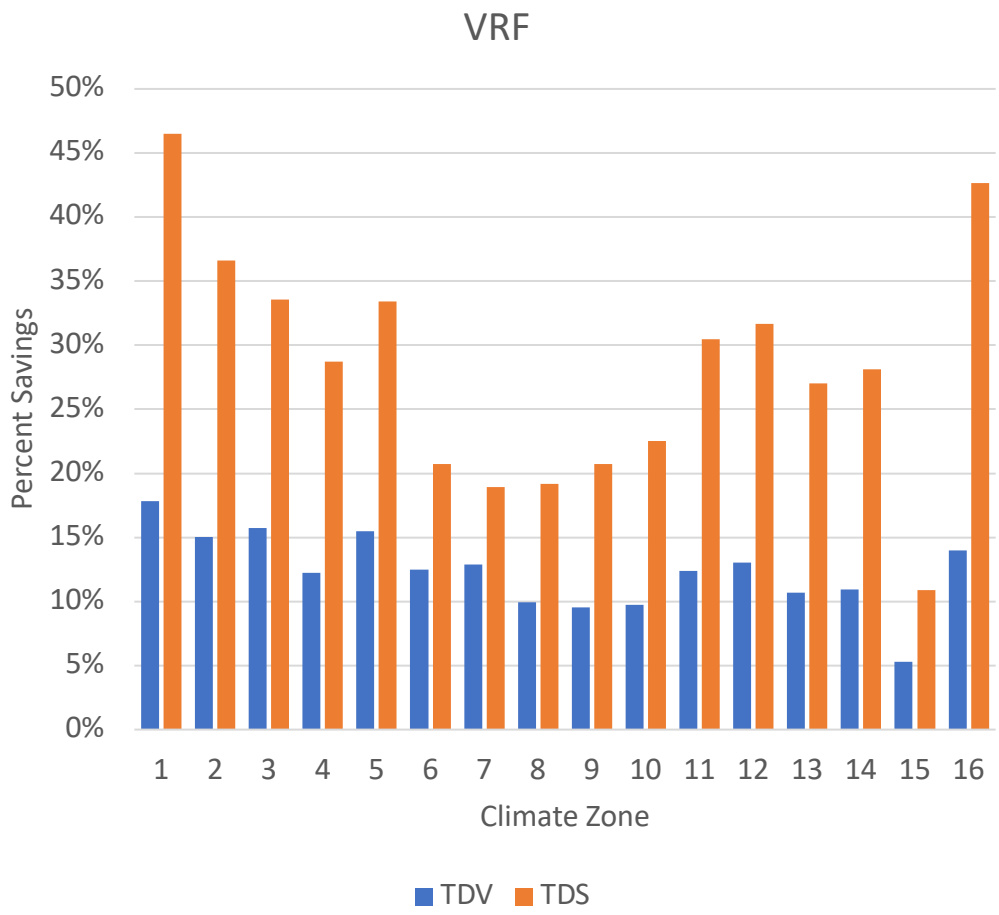
# Large Office



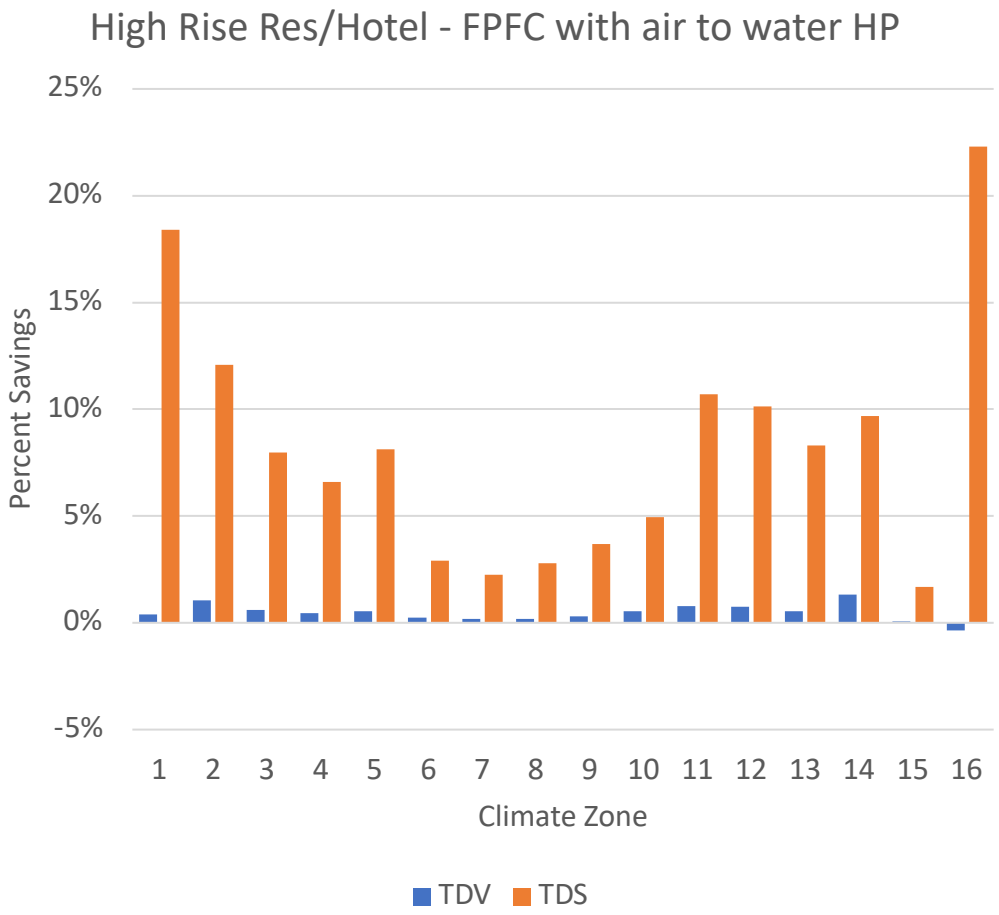



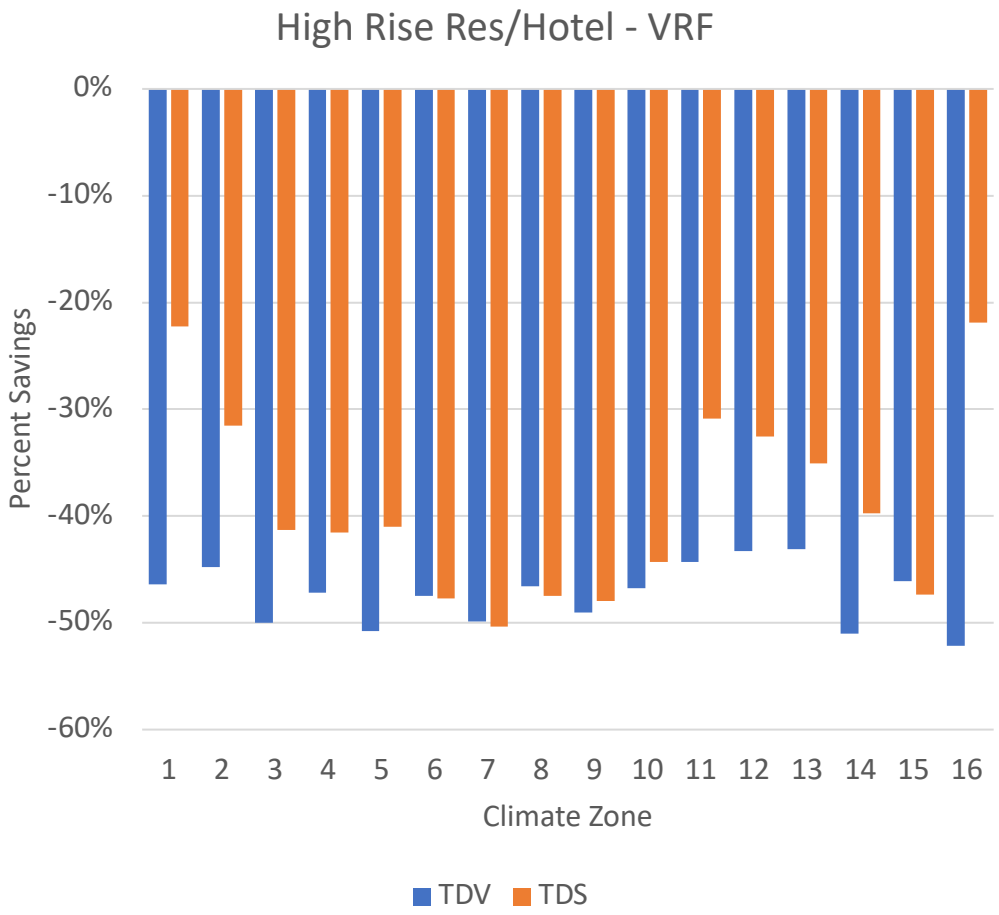
# Small Restaurant



# High Rise Residential



# Results

- TDS does **not** seem to be prohibitive to all electric buildings
- Only VRF and packaged air to air heat pumps are currently implemented in CBECC-Com, which does not represent the market. **Central air and water-based heat pumps are vital.**

# Recommended Prioritization

1. *__Air-to-water heat pumps__
2. *__Water-to-water chillers__ (with heat recovery capabilities & reversible)
3. **Air-to-water heat recovery chillers** (with heat recovery capabilities & reversible)
4. **Water-to-water heat pumps**

*in time for 2022 CBECC-Com release

# Questions

- Did we miss anything (key use cases)?
- Any comments on the priority rankings
- Any heat pump configurations or electrification technologies that we missed
- What could we (presenters + attendees) do to help the CEC/NORESCO move things along?
- Does anyone have any data that would be useful?  Project data, equipment performance, etc.?