UNSW Engineering
School of Photovoltaic and Renewable Energy Engineering

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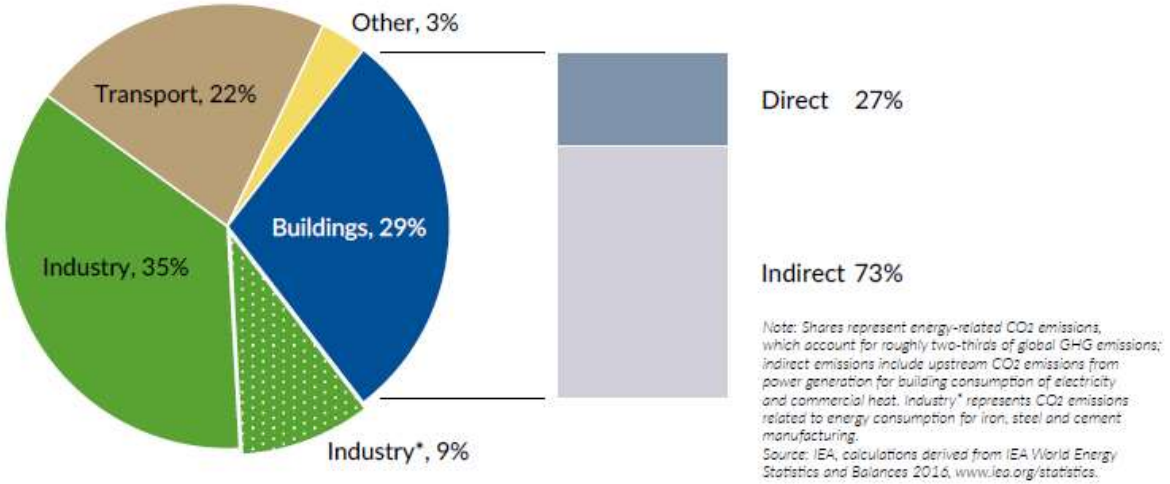
The Impact of Climate Change on Weather Data Applied to BPS

Nicholas Bell

Problem Statement

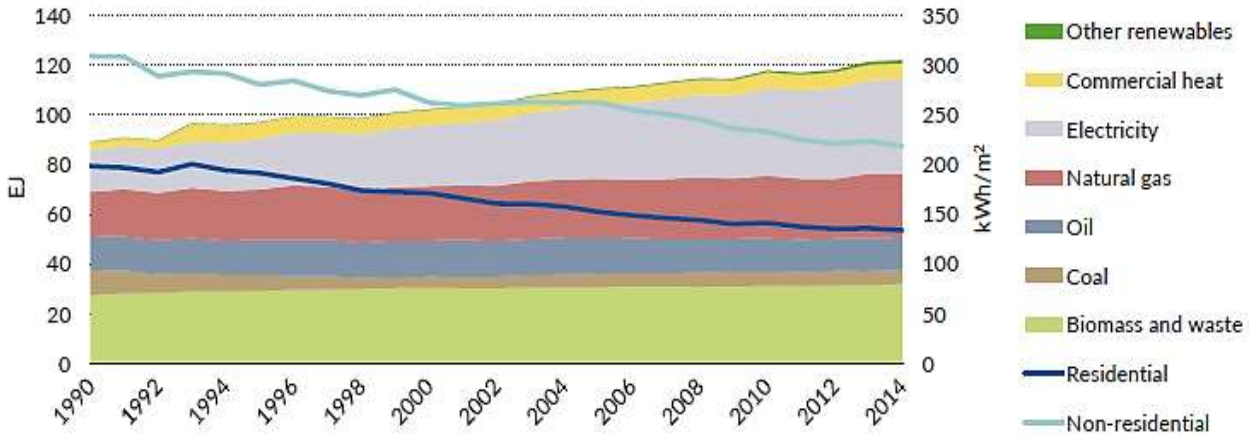
Buildings contribute almost 30% of global emissions (Ürge-Vorsatz, 2012)

- Potential for significant energy and emissions reductions



Temperature and humidity can impact building performance

- Energy Consumption
- Peak Demand for Energy Sources
- Thermal Comfort
- Climate change directly temperature and humidity profiles



Source: Global Alliance for Buildings and Construction, 2016

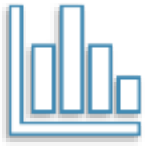
Aims

Investigate the impact of weather data input, which varies with climate change, on building simulation tools for future designs

Quantify the impact of climate change on building performance and annual energy use patterns

Methodology

Develop template building for initial testing



Test template building against existing EPW, historic weather data and morphed weather data

Compare energy, peak demand and comfort performance of template building

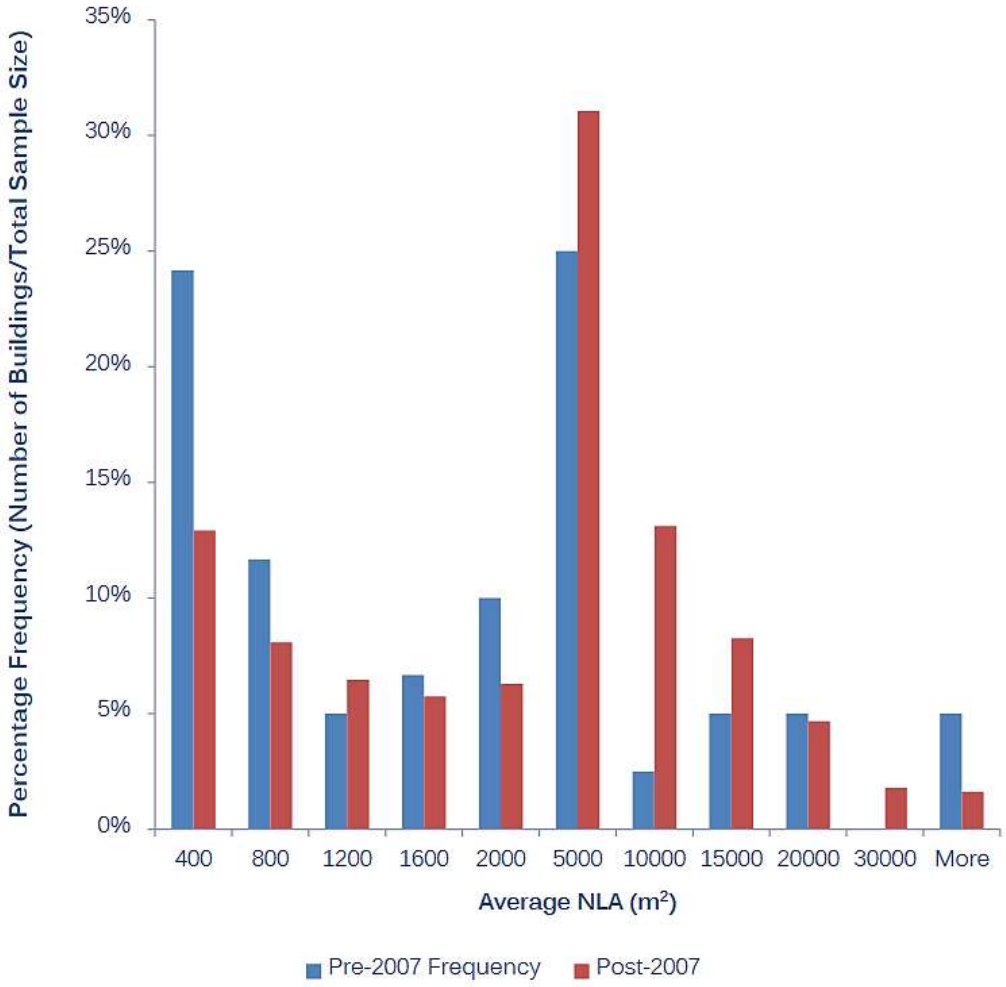
NABERs Rated Office Building Distribution

Three size categories:

- Small office buildings (~5,000 m2)
- Medium office buildings (~10,000 m2)
- 1 large (25,000+ m2)

Medium buildings:

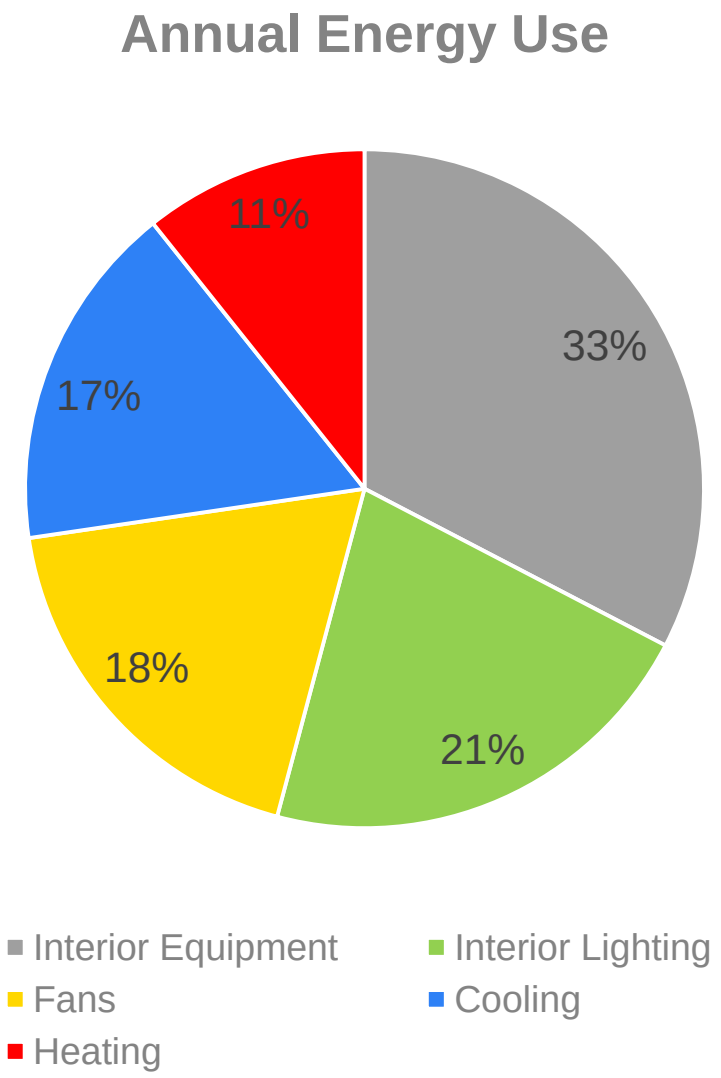
- Fastest growing building size since 2007
- Larger building size to isolate climate impact



Source: pitt&sherry (2012)

Template Building – Baseline Energy Use Profile

- Lighting power density – 6.4 W/m^2
- Equipment power density – 10.6 W/m^2
- Derived from average NABERs rating data (pitt&sherry, 2012)
- HVAC loads from OpenStudio simulation on Sydney climate
- Energy density of 102 kWh/m^2 pa – NABERs of ~4.5 Stars
- HVAC loads expected to be influenced by climate changes



Methodology - Weather Data - Sydney

Historic Weather Data

- Sydney data 1993-2016
- RMY data
  - – Coolest/Hottest year
  - – Coolest/Hottest months
  - – Hottest Summer
  - – Coolest Winter

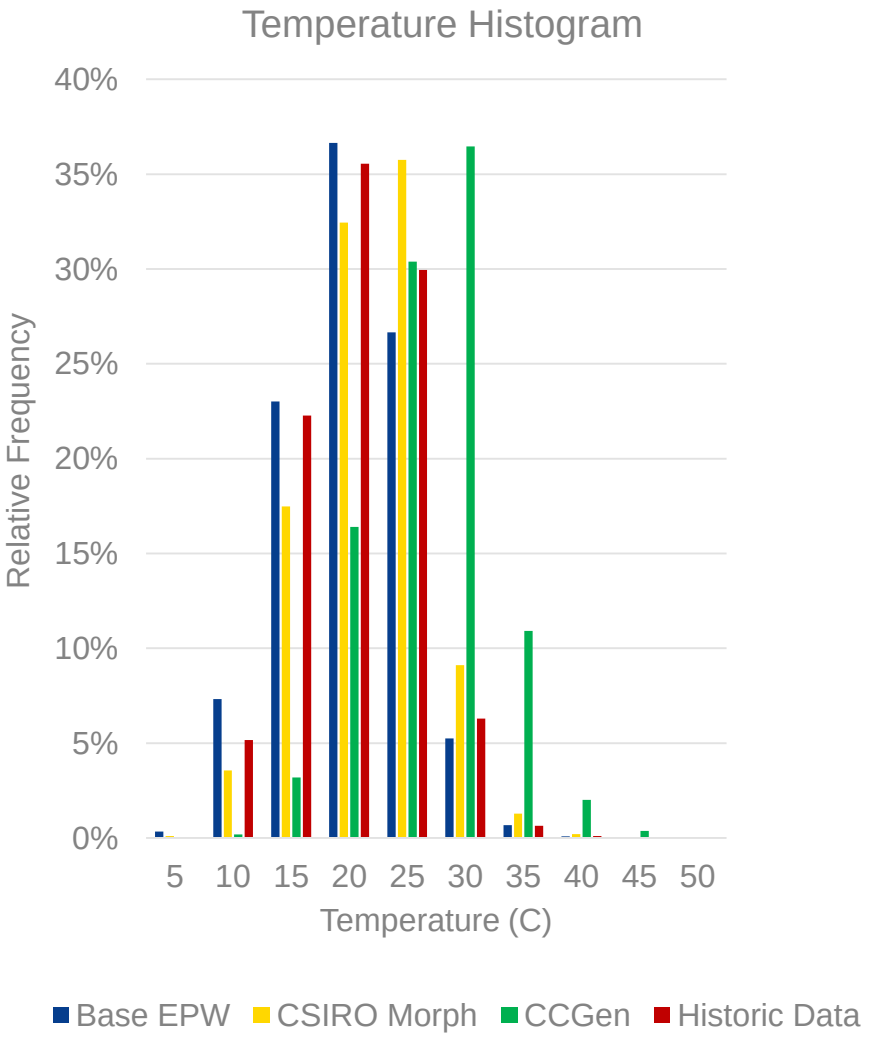
Energy Plus Weather (EPW) data file

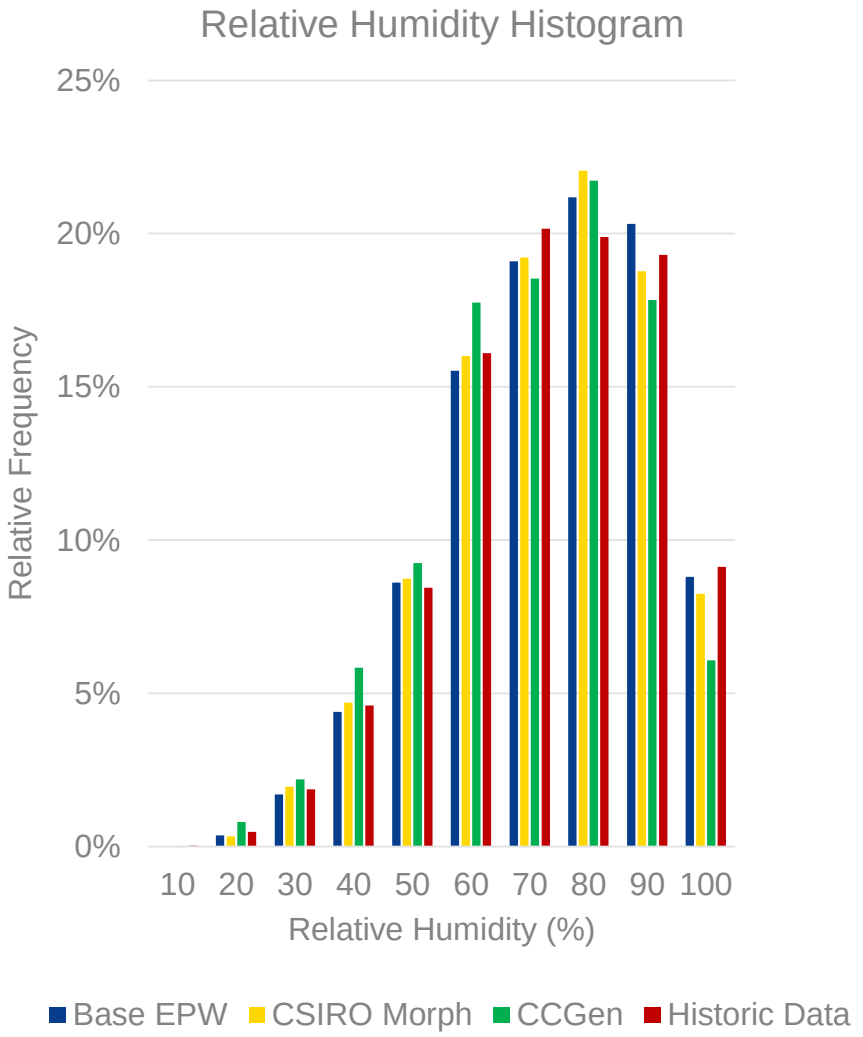
- TMY file
- Based on 1991-2005 IWEC

Morphed Future Data

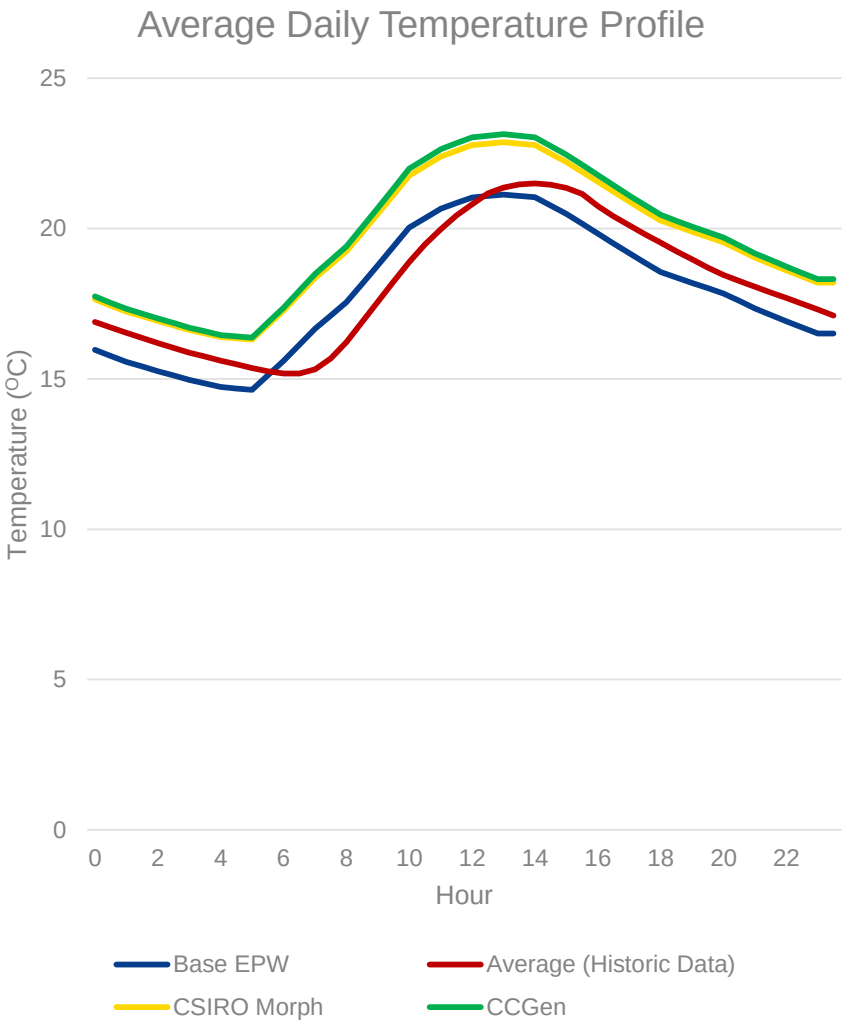
- CSIRO Morphing (Chen et al,2012)
  - - RCIP 4.5 and 8.5 2025-2050
- Climate Gen Morphing (Belcher et al, 2005)
  - - 2020, 2050

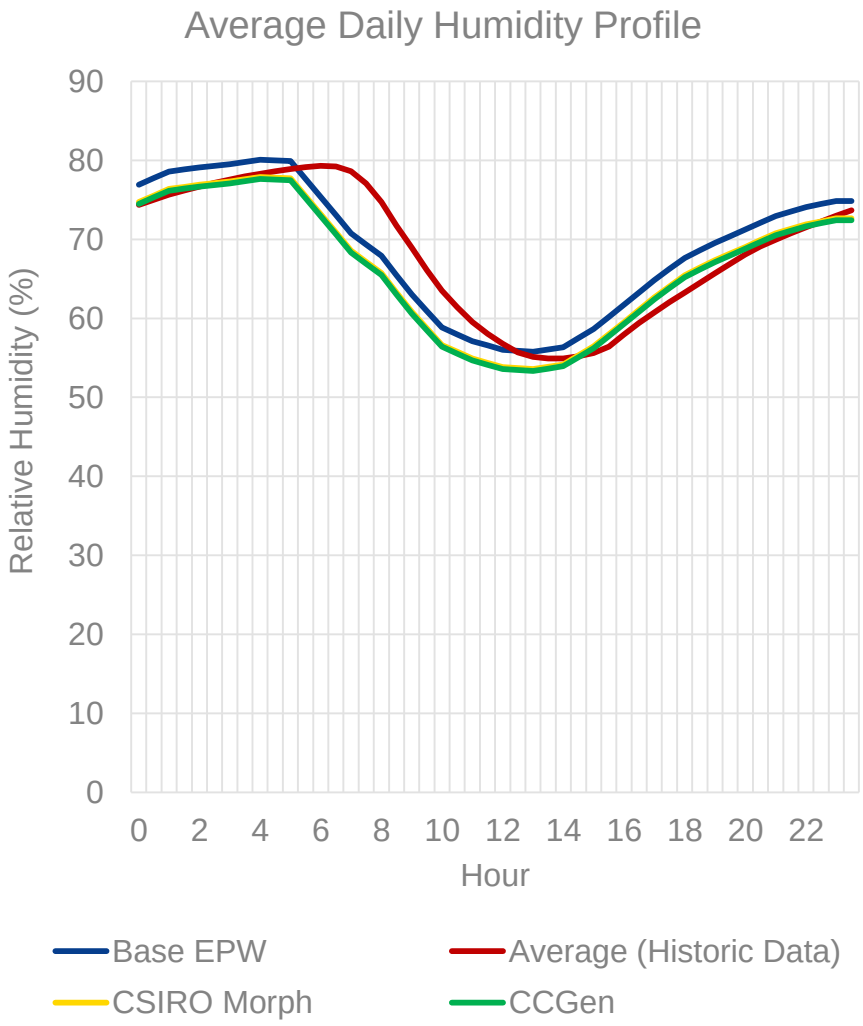
Results – Temperature and Humidity Distribution



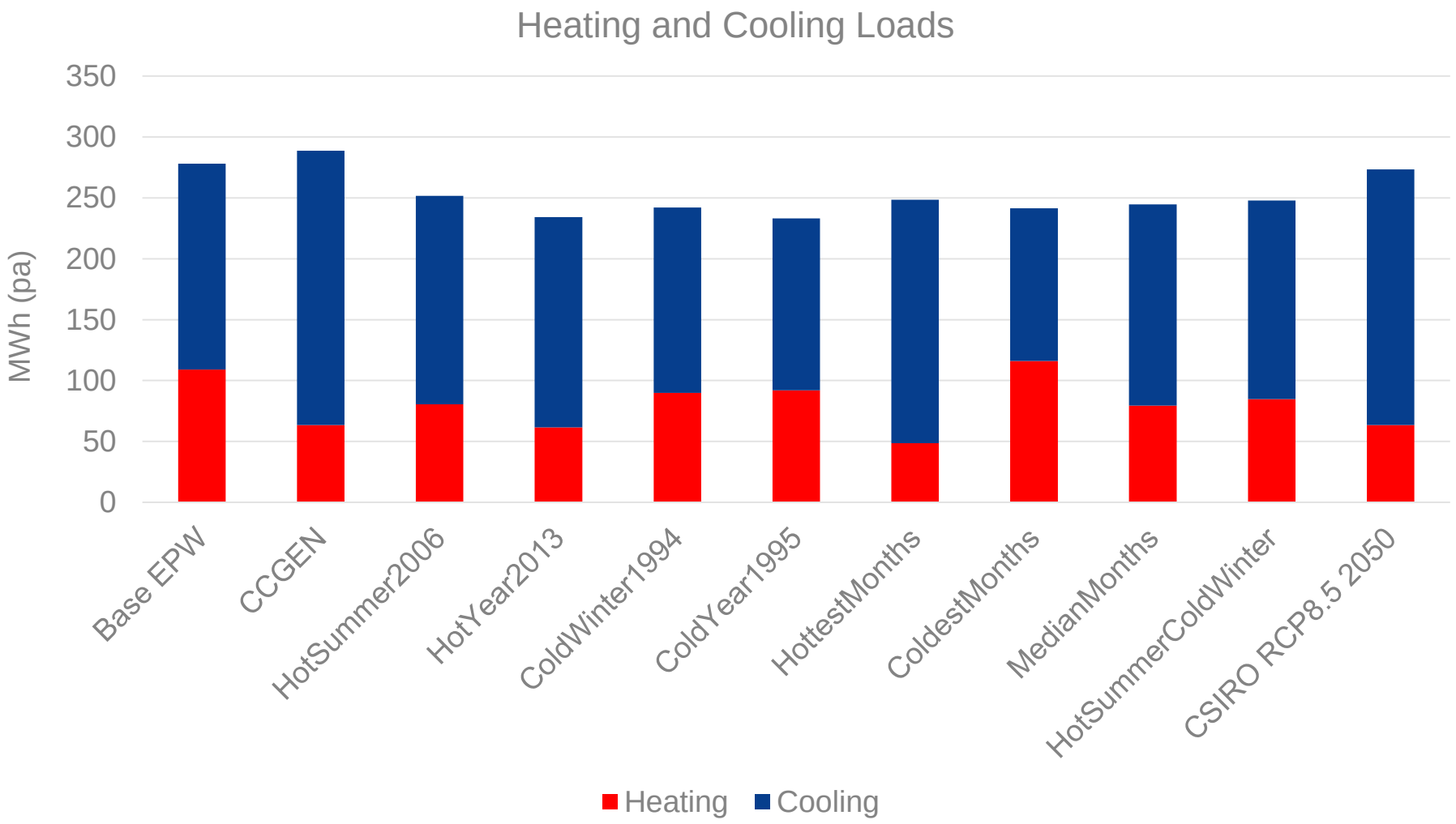


Results - Temperature and Humidity Daily Profiles

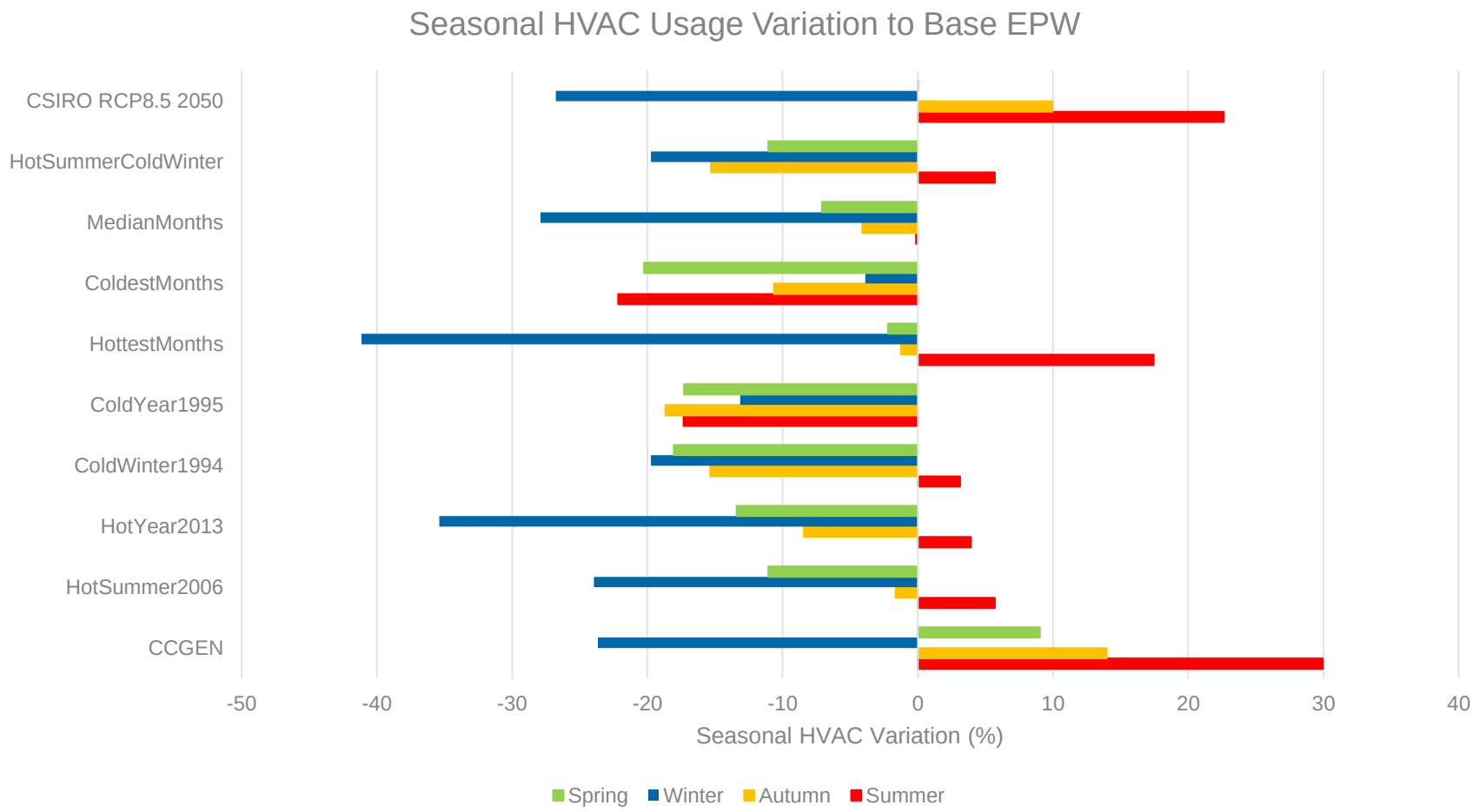




Results – Annual Energy Consumption

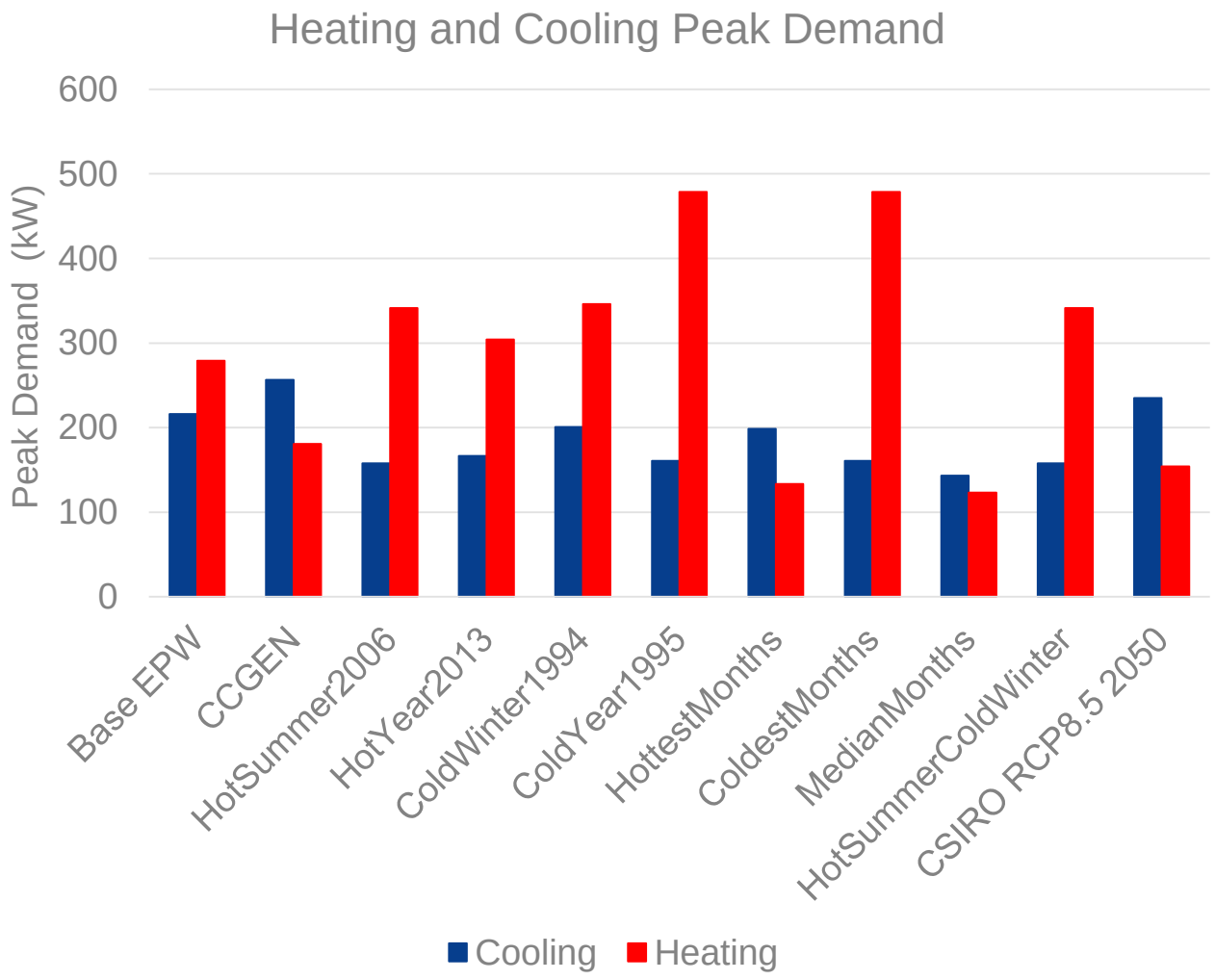


Results – Monthly Energy Usage Variation

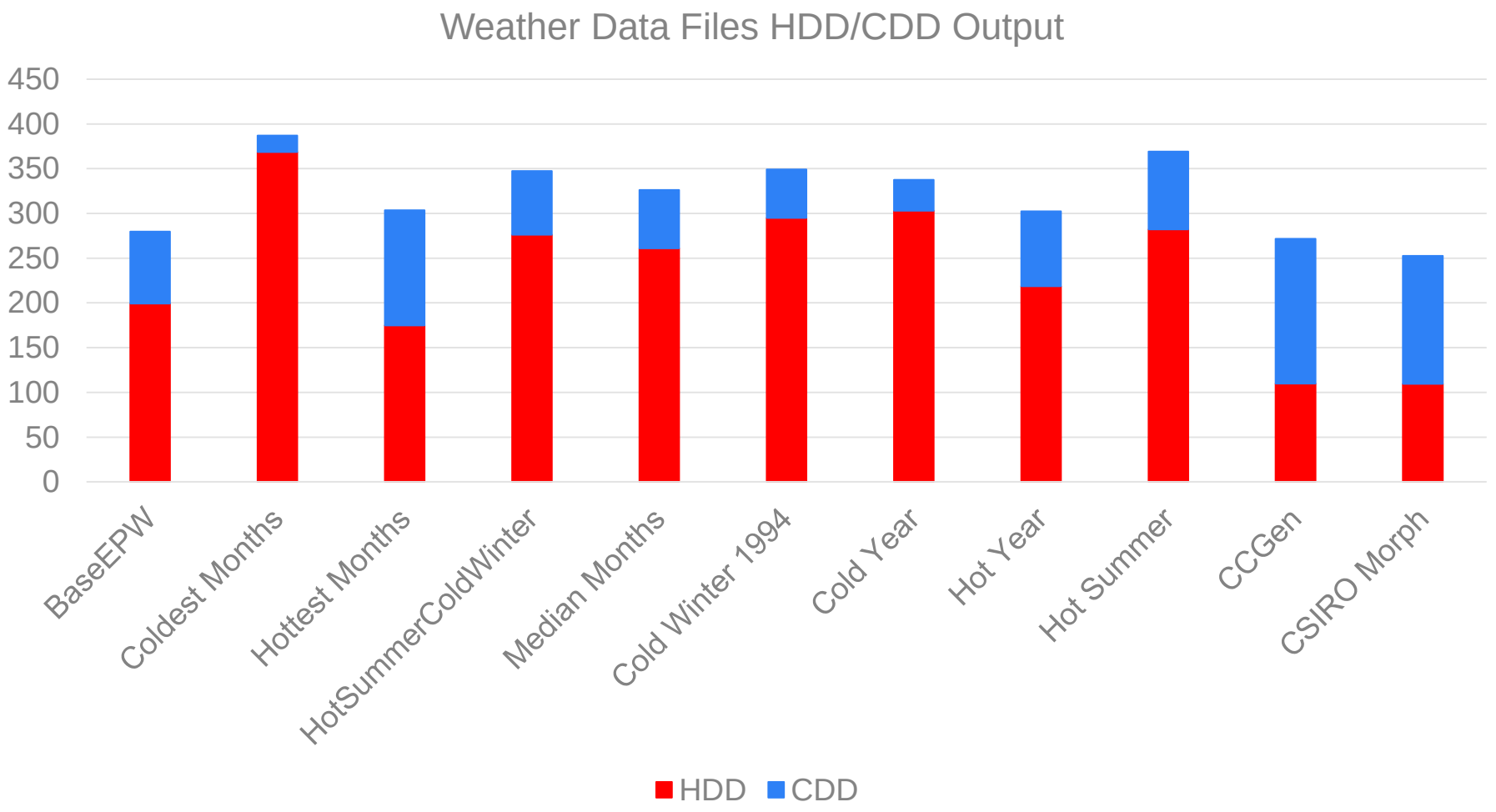


Results – Heating and Cooling Peak Demand

- Reduction in cooling demand for historic data sets and increase across future weather data sets
- Increase in heating peak demand historic weather data sets and reductions observed over future datasets



Results – Heating and Cooling Degree Days



Key Findings

SIGNIFICANT EARLY MORNING TEMPERATURE AND HUMIDITY DAILY PROFILES BETWEEN HISTORIC DATA AND EPW

LOW ANNUAL ENERGY USE IMPACT FROM CHANGES IN INPUT WEATHER DATA

HIGH COOLING AND HEATING PEAK DEMAND VARIATION RESULTING FROM CHANGES IN WEATHER DATA INPUT

Implications and Future Work

Impact of peak demand events across the entire building fleet

Impact of changes in climate, HVAC system and building size

Verification against real building performance data

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