

# DREAM ROOM AT PHILADELPHIA

WESTON HUANG

## INTRODUCTION

**Location:** Philadelphia (  $39^{\circ}57'N$   $75^{\circ}10'W$  )

**Köppen climate classification:** Humid subtropical climate zone

**Trewartha climate classification:** Temperate maritime climate

**Average annual precipitation:** 1,050 mm

**Driest month average precipitation:**

67 mm on February's

**Snowfall:** Fluctuates from light snow to snowstorms every year but is rare in November or April.

**Normal seasonal snowfall:** 57 cm.

**Seasonal snowfall accumulation:** 200 cm

**Heaviest single-storm snowfall:** 78 cm, occurred in January 1996.

**January average temperature:**  $0.6^{\circ}\text{C}$

**July average temperature:**  $25.6^{\circ}\text{C}$

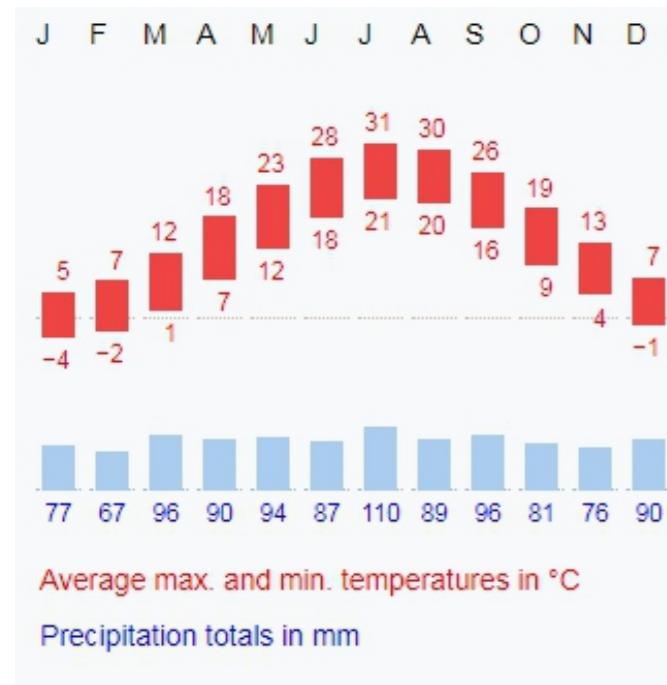
**The average window for freezing temperatures:** November 6 thru April 2

**Summer average dewpoint range:**

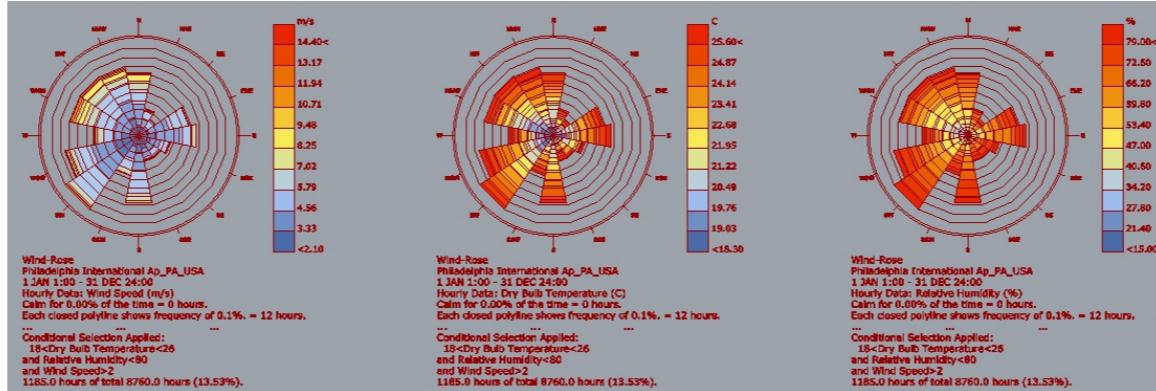
$15^{\circ}\text{C}$ ~ $18^{\circ}\text{C}$

**Highest recorded temperature:**  $41^{\circ}\text{C}$

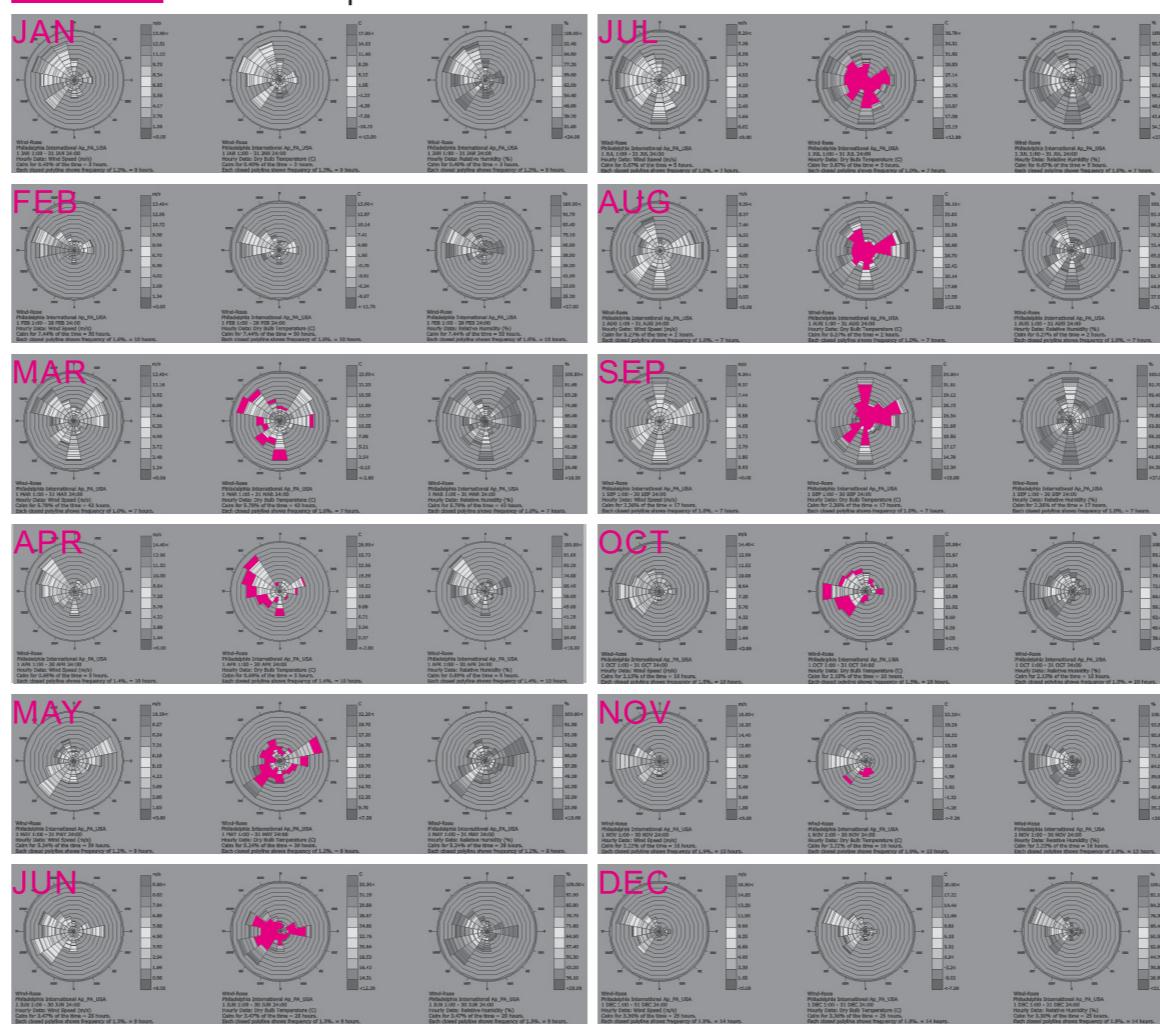
**Lowest recorded temperature:**  $-24^{\circ}\text{C}$



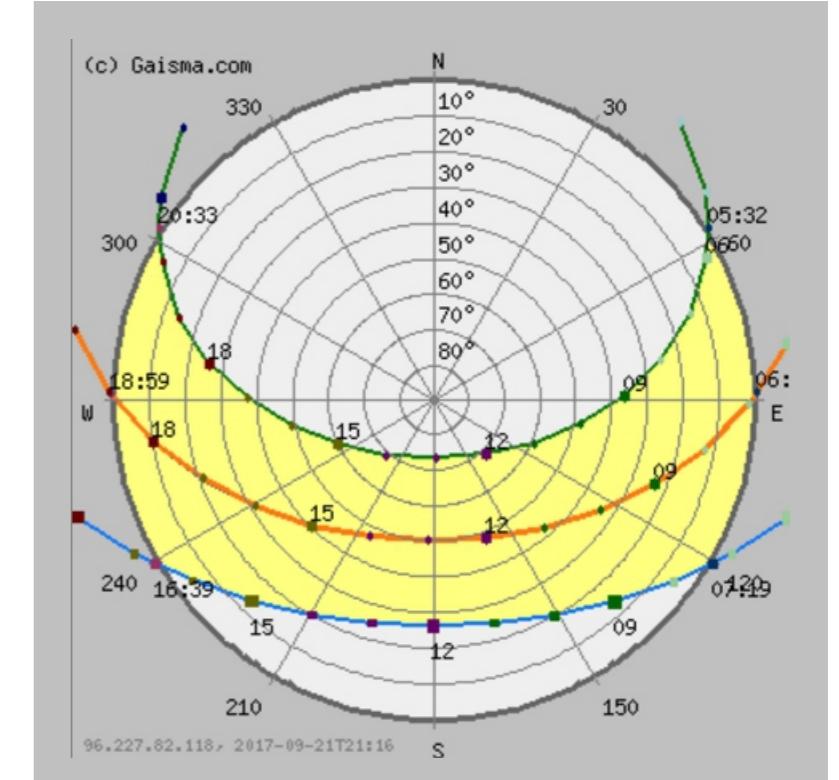
## WIND ROSE



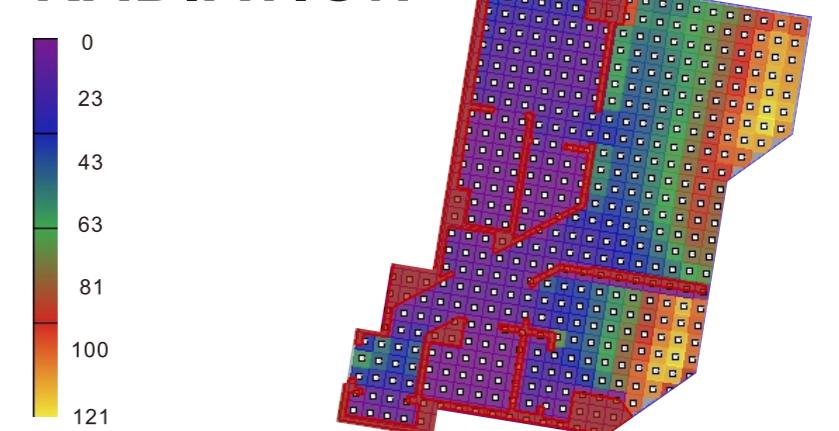
Wind temperature within  $18^{\circ}\text{C}$  to  $26^{\circ}\text{C}$



## SUN PATH



## RADIATION



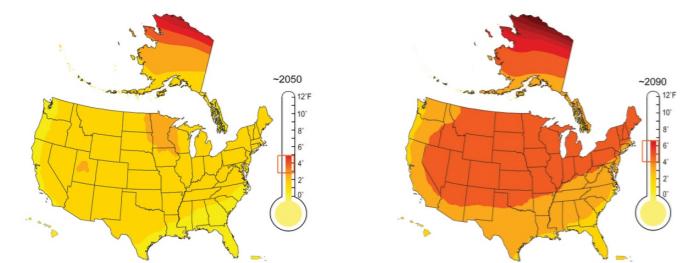
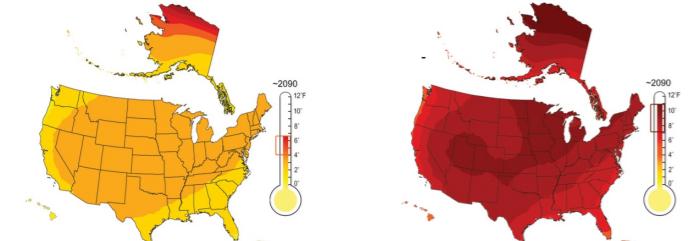
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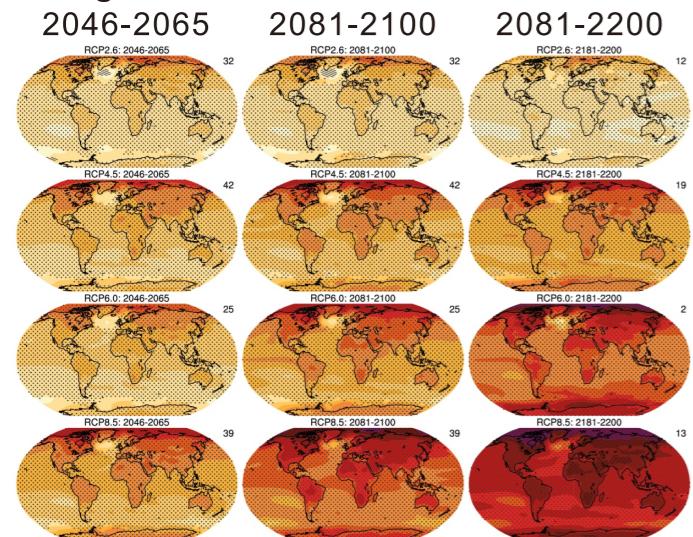
# Official Forecast

## Average increase U.S. temperature

2040-2059

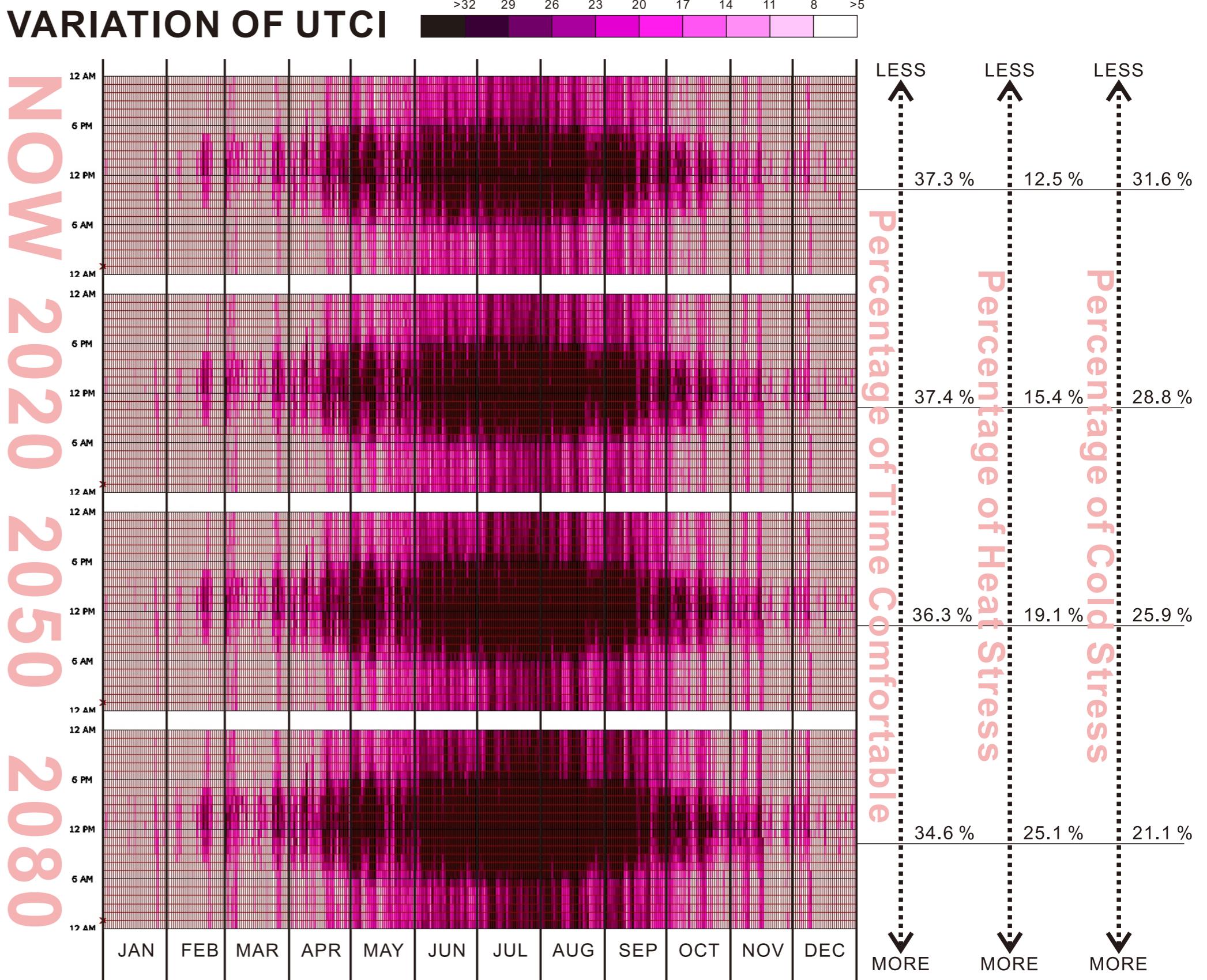


**Annual mean surface air temperature change:**



Images from United States Environmental Protection Agency:  
<https://19january2017snapshot.epa.gov/climate-change-science/future-climate-change.html>

## VARIATION OF UTCI



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## FUTURE FORECAST

### Global Warming is a reality:

According to the prediction by [United States Environmental Protection Agency](#) (*Image: Annual mean surface air temperature change*), not only United States but also the globe will suffer from the heat stress next century. Moreover, the places located at higher latitude will have more degrees of temperature increasing (*Image: Average increase U.S. temperature*). For example, Philadelphia will increase 8 F when Miami will be 6 F.

Meanwhile, by the simulating model of [CCWorldWeatherGen](#), SERG, the UTCI in Philadelphia will increase in the next six decades (*Image: VARIATION OF UTCI*). The darker color in the chart implies the higher UTCI and possibility of heat stress. The Summer night will be hotter and Winter time will be warmer slightly.

### Passive strategies will help:

In the psychrometric chart, the passive strategies will make almost half of the hours in the year within comfort zone even in the hotter future.

### Total comfort percentage:

The percentage of hours in a year within thermal comfort zone and the variation of percentage in different years in the future.

	With passive strategy	Without passive strategy
Now	48.9 %	12.2 %
2020	52.5 %	12.1 %
2050	51.7 %	10.7 %
2080	52.6 %	11.0 %

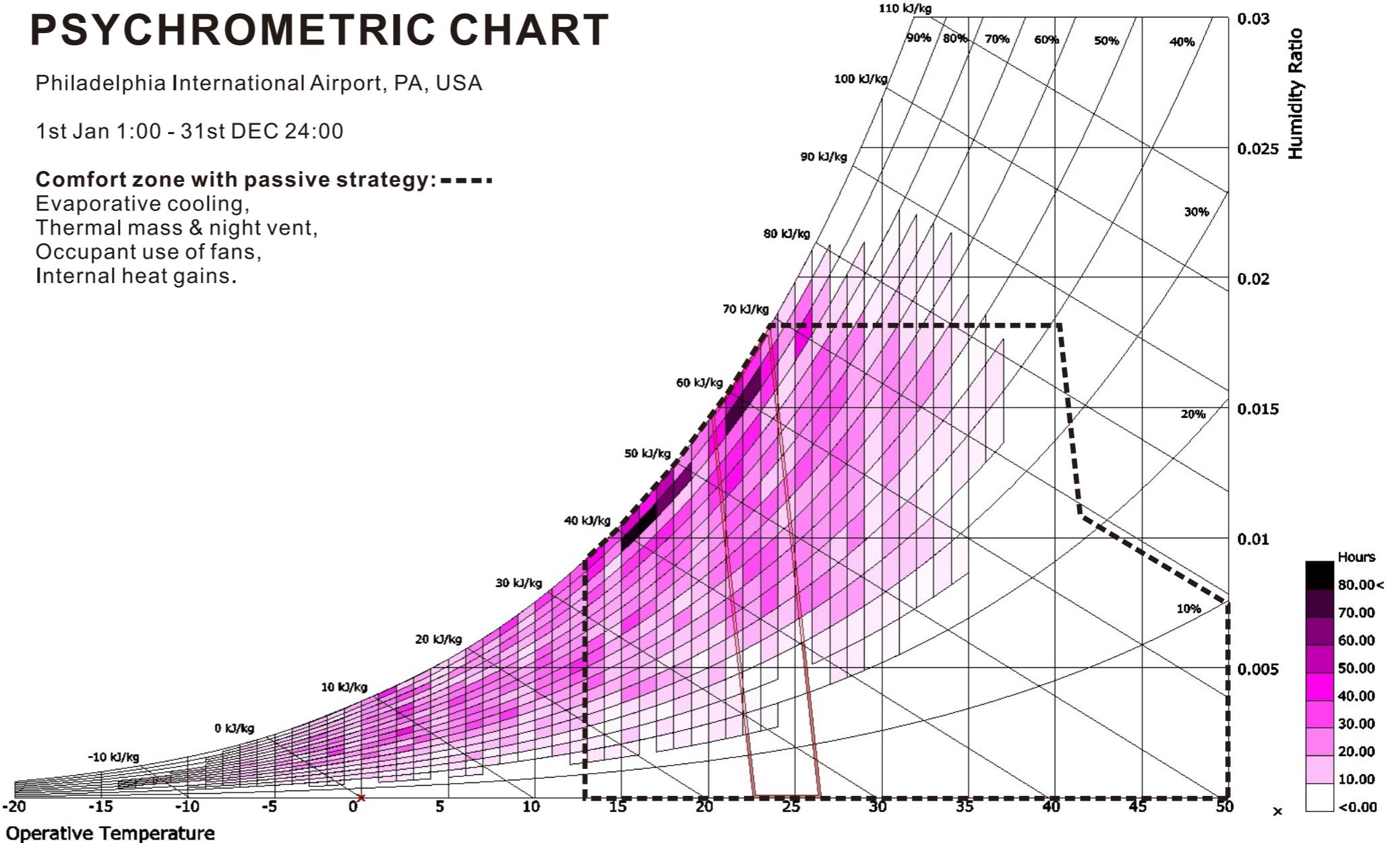
## PSYCHROMETRIC CHART

Philadelphia International Airport, PA, USA

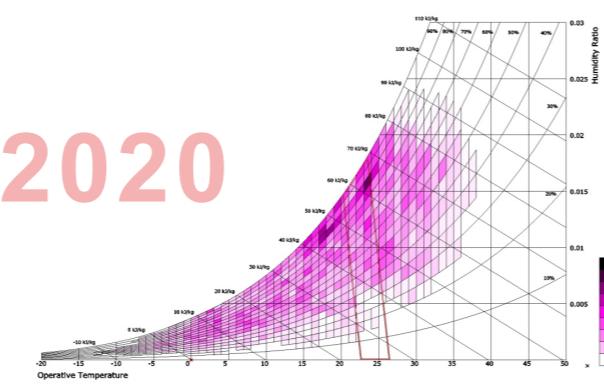
1st Jan 1:00 - 31st DEC 24:00

### Comfort zone with passive strategy:----

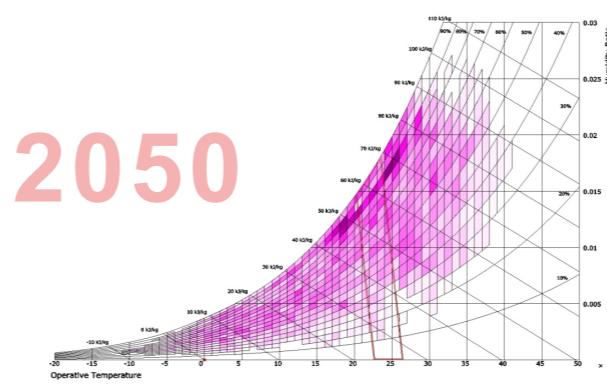
Evaporative cooling,  
Thermal mass & night vent,  
Occupant use of fans,  
Internal heat gains.



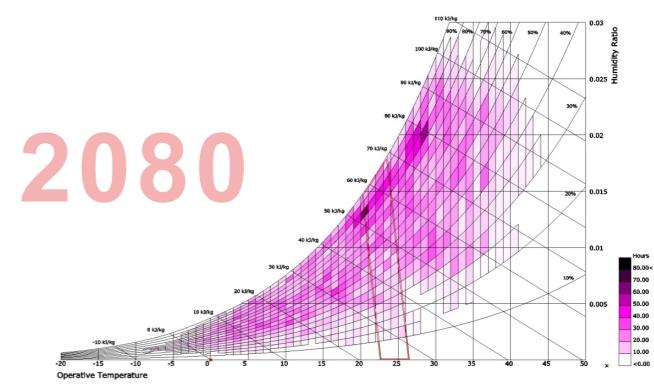
2020



2050



2080



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## ABOUT THE ROOM

**Location:** Philadelphia (39°57'N 75°10'W)

**Tower total height:** 80m, 26 floors

**Location height of the dream room:**

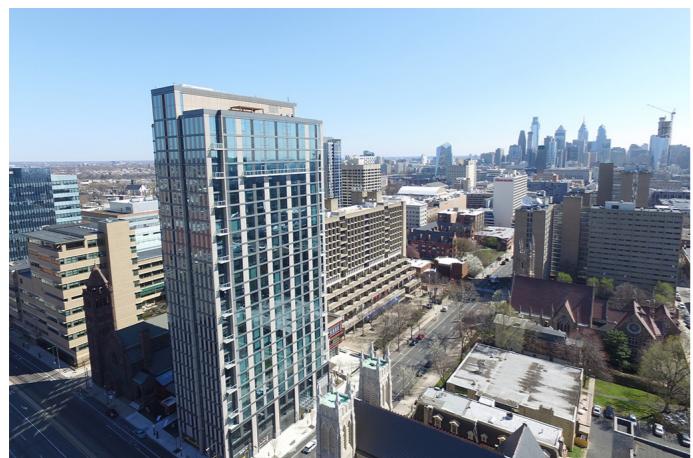
42m, 14th floor

**Using type:** Residential

**Structural type:** RC

**Room area:** 93.74 square meter

**Description:** The room is located in a high-rise condominium. Since being above surrounding buildings, the room enjoys the unblocked view of Philadelphia and the sun. However, the facades are curtain window and can not be opened. So, natural ventilation is impossible now.



## ISSUES & STRATEGIES

### • Sick building?

Due to the fixed curtain wall facade, the window rarely can be opened to let the natural air flow into or the waste air flow out the room.

#### → Open the window!

Changing the window from fixed to opened one will improve the air quality inside the room without relying on air-conditioner only. According to the Wind Rose Diagram, even though the north and west do not have wind that is strong enough and with temperature between 18 to 26 calceus, there are some months that have potential to natural ventilation. The west parts of the room may be benefitted by the fresh and temperate air from June to September.

### • Hot room?

The Radiation Diagram reveals that west sides of the room will receive too much radiation, which has made the room too hot to be comfortable. Unfortunately, since the climate-change and the inflation of global temperature, the room will be drastically hotter and more uncomfortable in the future.

#### → Improve insulation & shading!

Although the curtain walls have used the LOW-E glass, the room is still hot along the windows in the summer. The simplest way for resolving this is putting some curtains around the windows. But, if possible in adding new structure, it is recommended to hang the shading system outside the window for adjusting the radiation that will enter the room. Therefore, the room will not be heated up easily by the summer sun.

### • Unfresh air quality?

The east room suffers from not only the disability of natural ventilation but also the weak artificial ventilation through air-conditioner.

#### → Add the transom!

Even though opening the fixed window can definitely improve the ventilation. Unluckily, the Wind Rose Diagram shows that there is not a plenty of available north wind. So utilizing and importing the wind from the west is important. In order to let the wind flow into the east room, the wall between it and the living room can add a transom. This transom should be put no higher than 150 cm for better effect of ventilating.

### • Cold room?

In the winter, the places nearing the window are freezing. A lot of heats loss through the window.

#### → Improve insulation!

Adding the curtains with good insulating ability, such as animal fur or wool, along the window can prevent heat escaping easily from the interior space.

