WINDOW MASTER® Fresh Air. Fresh People.

Where is automated natural ventilation (NV) possible in North America?

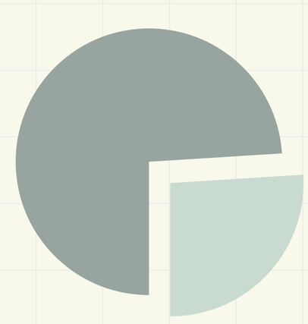
For example, can I use natural ventilation in

Atlanta, GA?

But what about in other North American cities?

Find more data in the map below

Yes!



74% of the year!

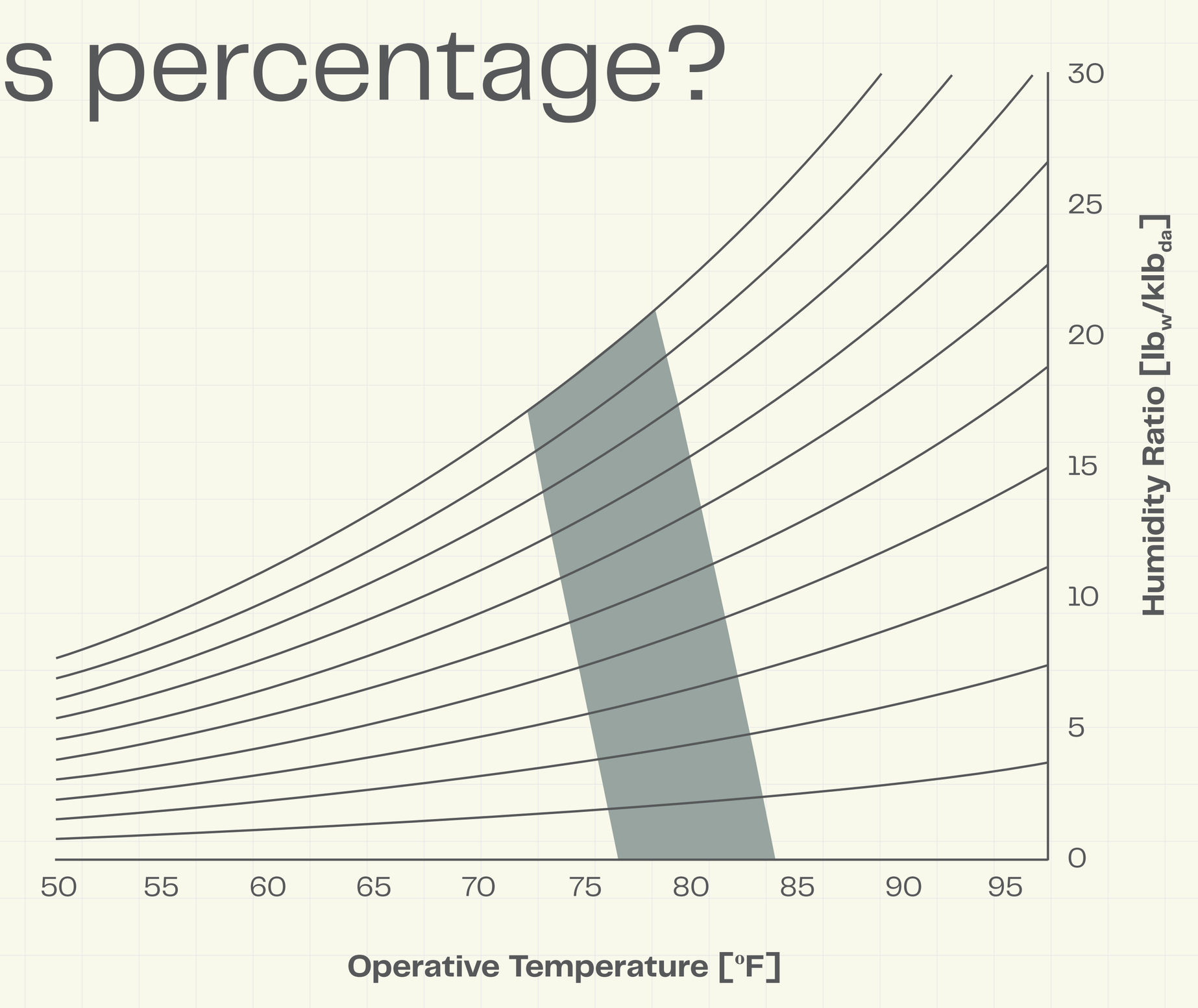
How did we determine this percentage?

By running a dynamic simulation and following the CBE comfort tool based on ASHRAE 55[1]

Comfort criteria

- Air speed **40fpm**
- Metabolic rate **1.2**
- Clothing level **0.61***

*trousers and long-sleeved shirt



Dynamic Simulation using IESVE throughout 1-year

Weather data
This simulation uses the newest edition of data sets available for each location called TMY3 or Typical Meteorological Year 3 which is data from 1991 to 2005.

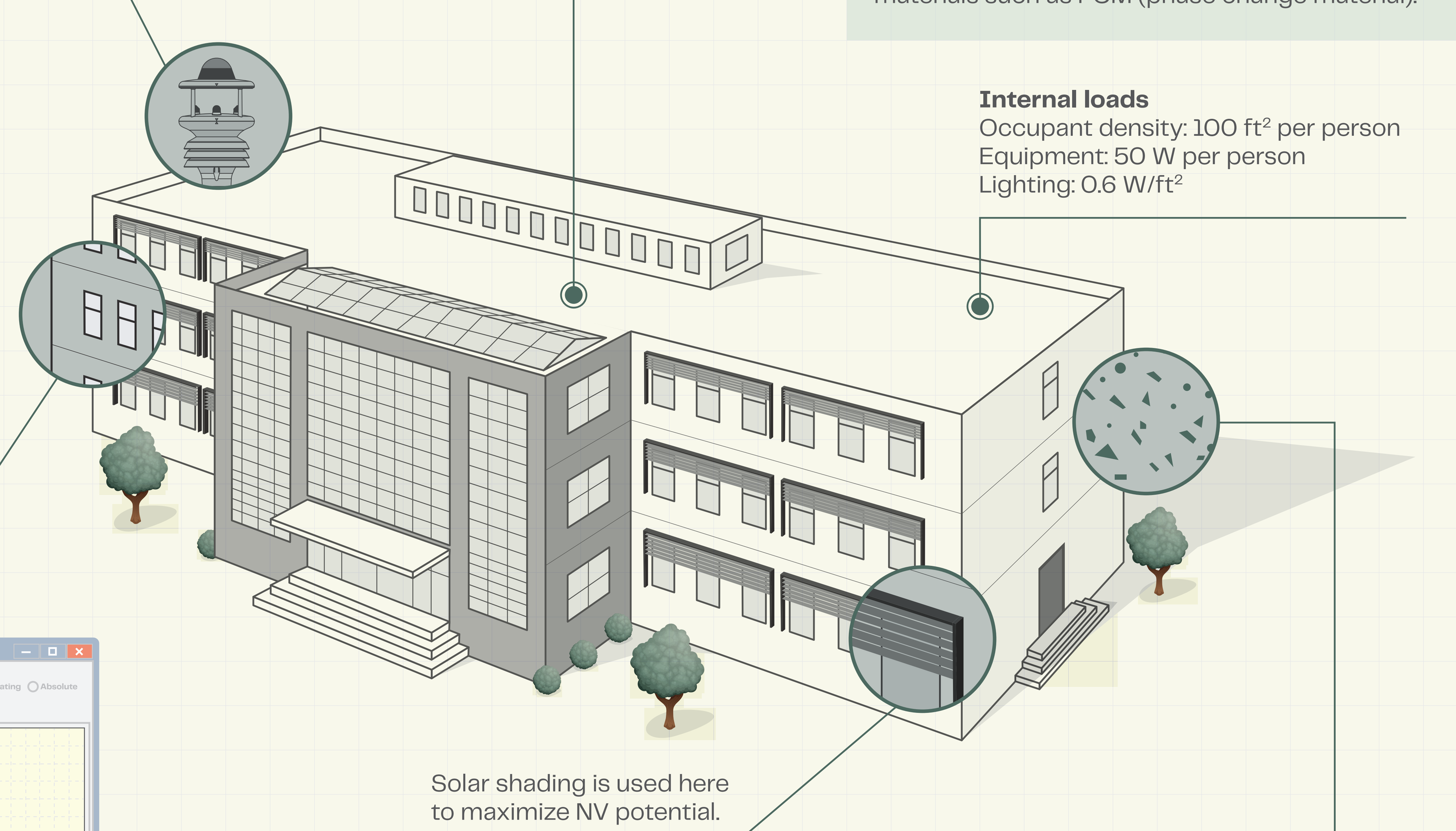
Building design features a large central atrium and 3 floors of office space

Can these assumptions be used for other building types?

Yes, these assumptions and comfort criteria are valid with a range of materials. In this case, we made a building with concrete. Some materials will have greater or lesser thermal mass which will affect the potential hours for NV use. The thermal mass effect can also be emulated by materials such as PCM (phase change material).

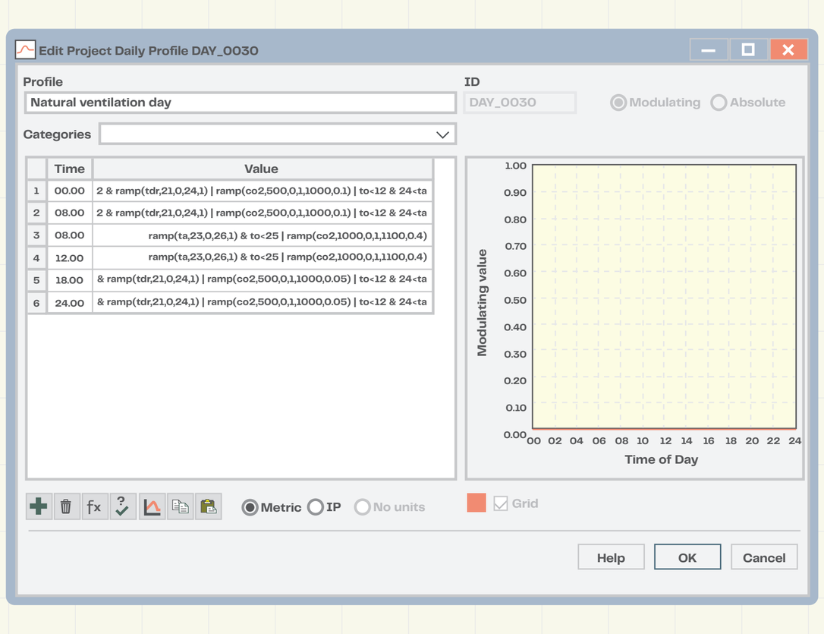
Internal loads
Occupant density: 100 ft² per person
Equipment: 50 W per person
Lighting: 0.6 W/ft²

Automated window operation based on:
- Indoor CO_2 levels (1,000 ppm)
- Indoor and outdoor temperature
- Indoor and outdoor humidity

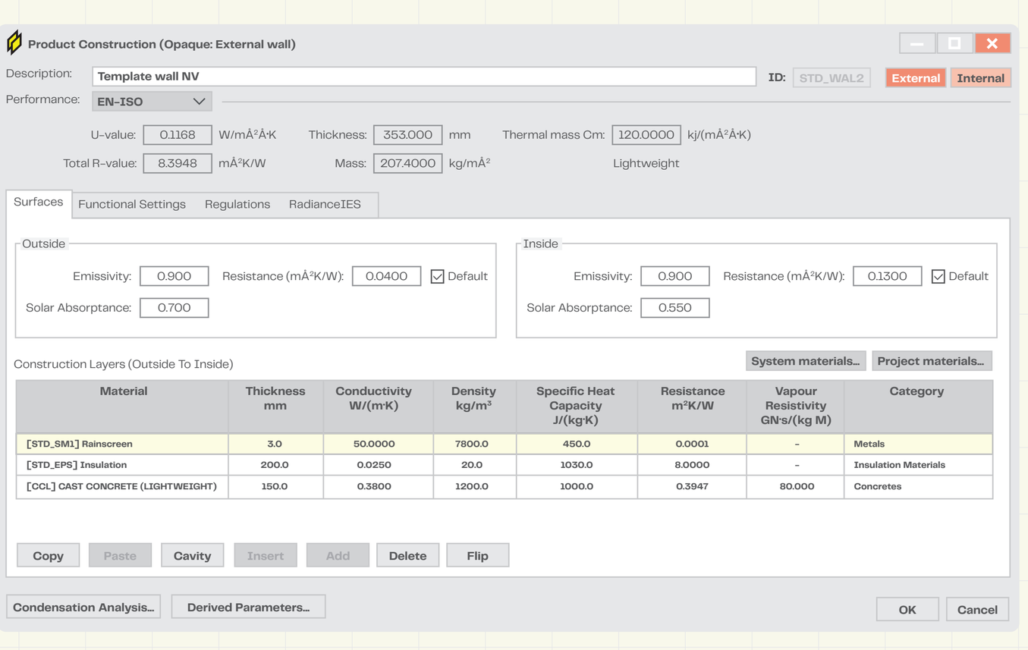


Solar shading is used here to maximize NV potential.

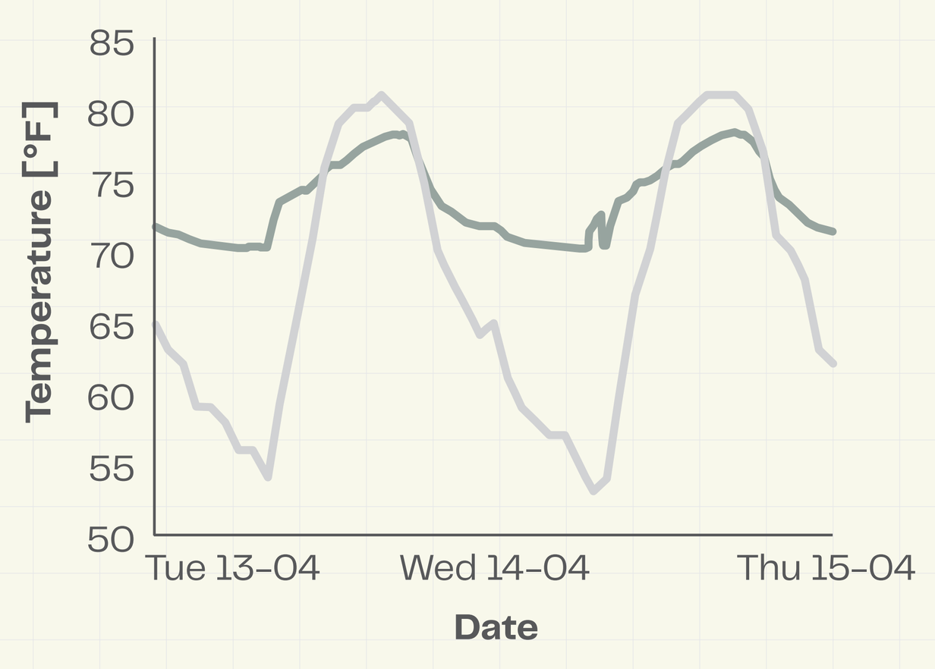
Control sequences



Construction example (external wall)



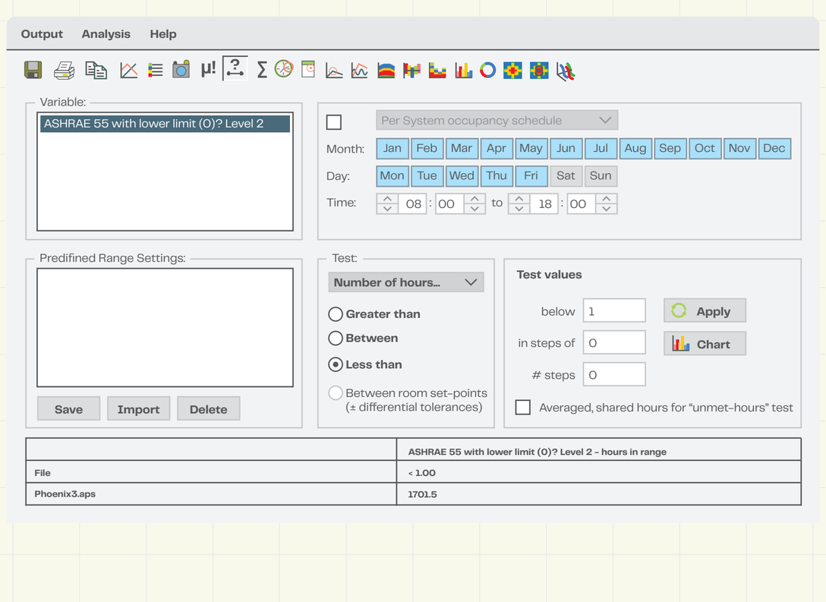
Daily Temperature with Night Cooling



Night cooling reduces the temperature in the building during the night and pre-cools the thermal mass, extending NV's potential.

If effective night cooling is used, it is possible to keep using NV even when the outdoor temperature exceeds the indoor temperature. This is done by operating with a demand-controlled strategy to limit the air supplied to the zone while letting the pre-cooled thermal mass condition the space.

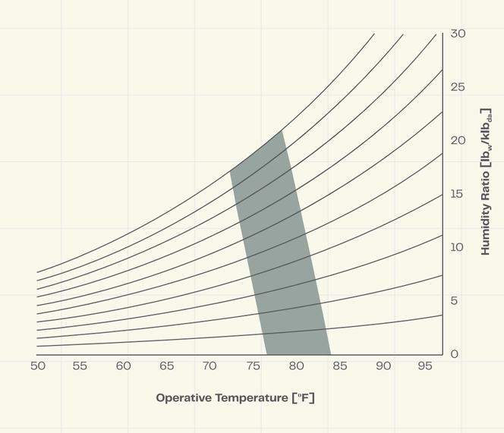
Counting NV Hours



The NV potential of this study is based on the work hours in the time frame: 8 AM to 6 PM. While night cooling is used to cool the building at night in this simulation, these hours are not counted as they fall outside of work hours.

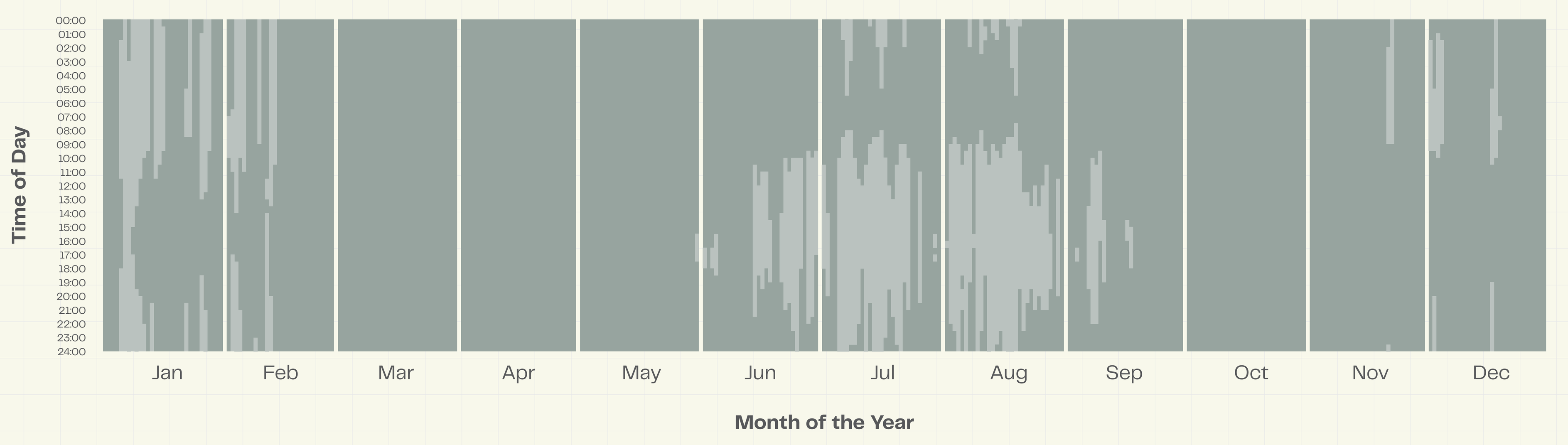
Custom variable for Comfort Criteria based on ASHRAE 55

Algorithm used for Comfort Criteria in IESVE
IF(OR(AND(A>26,B>0.02),AND(A>26.5,B>0.019), AND(A>27,B>0.015),AND(A>27.5,B>0.011), AND(A>28,B>0.007),AND(A>28.5,B>0.002), AND(A>29,B>0),C<0),1,0)

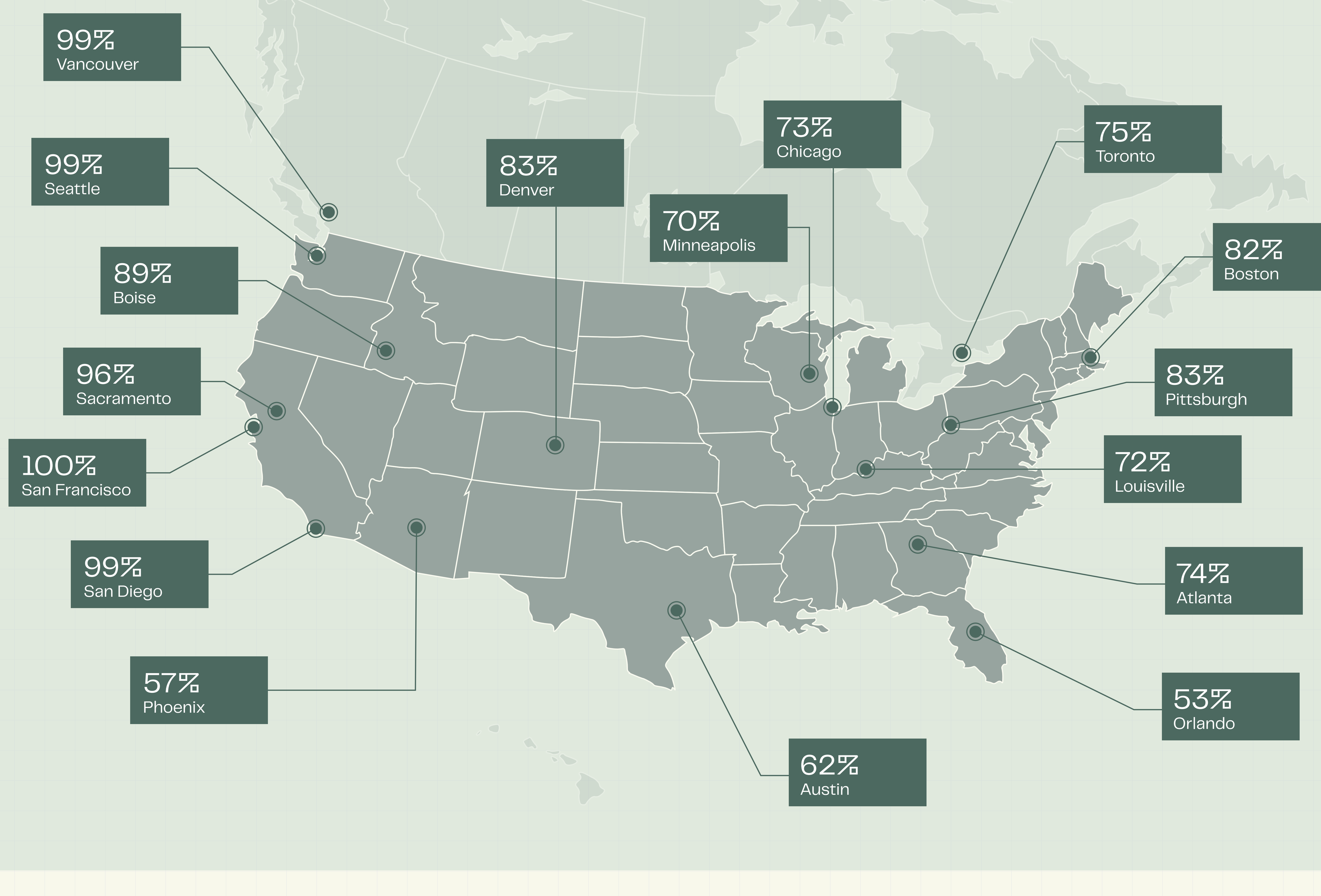


The criteria for the indoor environment impacting the potential for natural ventilation is based on ASHRAE 55 2019. The upper limits are based on the correlation between maximum operative temperature and maximum relative humidity. The lower limits are based on the outdoor temperature being above the freezing point (0°C / 32°F). However, we've seen great success with lower limits below freezing.

NV throughout the year in Atlanta



Automated NV in North America



How can I use these assumptions to optimize my design for natural ventilation?

One way is to challenge the conventional thinking that natural ventilation can only be used in certain climates or with very specific outdoor conditions. For example, hot, arid climates can easily take advantage of the benefits offered by night cooling to cool the thermal mass before occupancy.

Thermal mass of the building and solar shading are other key design elements that can help extend the use and success of NV.

Window/vent control technology and distribution are a must for optimizing the potential of NV. Especially during the warmest and coldest conditions, robust controls will ensure indoor comfort and air quality by regulating the degree and frequency with which the vents open and close in coordination with other building systems.

And finally, the design should offer an even distribution of operable windows throughout the NV zones to ensure that all occupants have a direct source of fresh air. And by locating occupants near the outer perimeter of the building, the design supports their access to fresh air, daylight, and the benefits these provide.

Let our experienced cleantech specialists consult you through your building project

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Source
1: https://comfort.cbe.berkeley.edu/