Maxium Thermal Comfort & Energy Balance

Week 8

Fan Cao

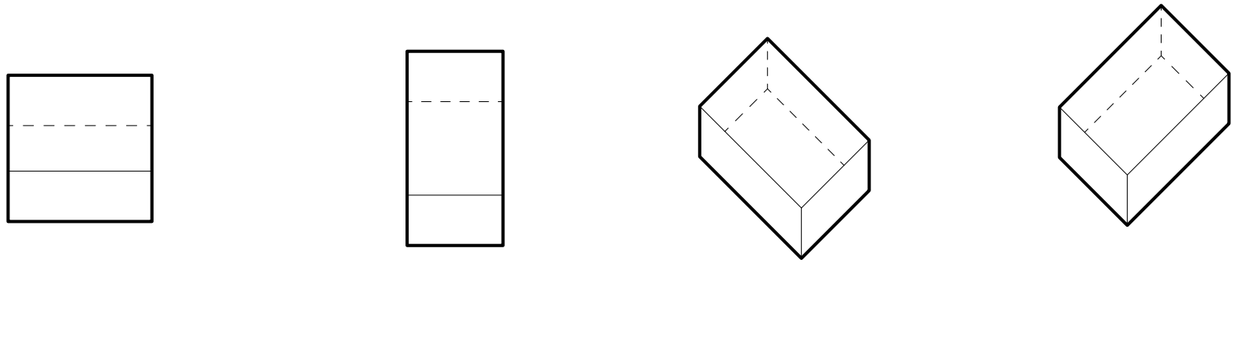
Analysis of the Existing Condition

First of all, we need to analysize the conditon. The room is 5m*12m*4.2m. We can change the glazing condition and the orientation. So, for the height of this room, can not be changed. So, the difference would be the long edge and the short edge and how many heat they can gain from the radiance and the could be lost cause of the window.

And then, is the construction way. The material will only matter how could the heat deliever by this part. What matters will be the **thermal resistance** about this material. But this is an rather **complicated process.** Since the Philadelphia is in the Zone 4, Region A. So, it has winter and summer temperature. So, you can not only consider extreme hot or extreme cold. Since when ever you change the construction material, it will change in different condition. Which makes it hard to decided.

In addtion to these two factors, the ventilation hour would be an important factor. But, I don't know whether we can control the specific time to do the ventilation. Since the time would be much important for the thermal comfort. So, I threat it as the most extreme condition.

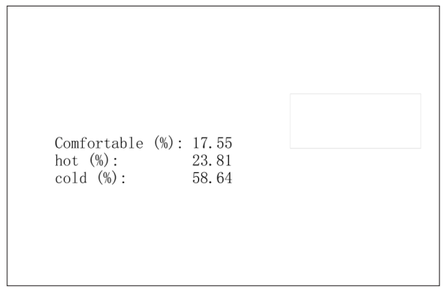
Also for the shading system, the best condition would be block some extract sun during the summer and do not influence the radiance during the winter time.

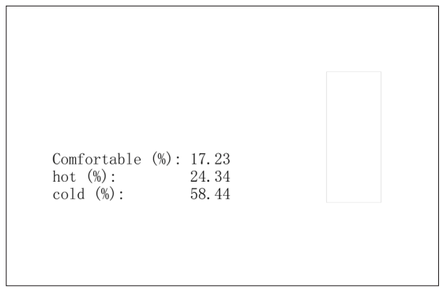


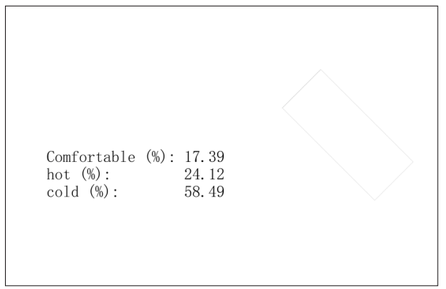
Maxium the thermal Comfort

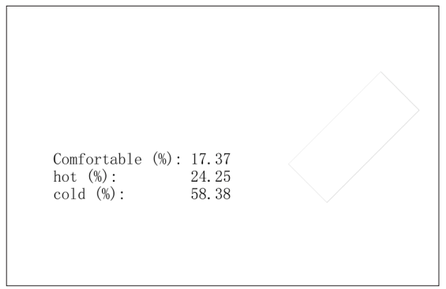
For this condition, in my understanding would be make the EP and HB zone unconditioned. So, that I choosed four direction to analysis the thermal condition. As I listed above, each condition has its own character of how much sun ray could get in. And also try the condition as **AII WALL** or **ALL GLASS** and then keep analysis. The rest parameter leave them untouched.

AII WALL

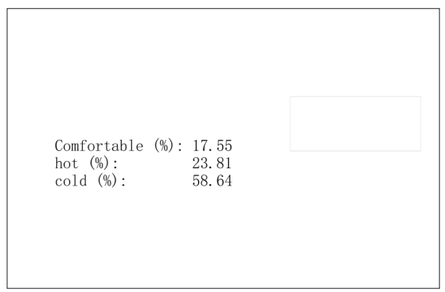


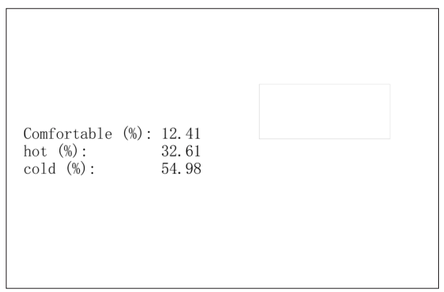


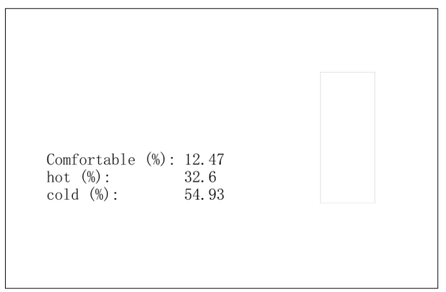


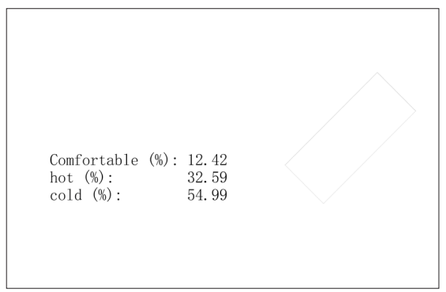


AII GLASS









TWO EXTREME CONDITON

In order to get the maxium thermal comfort rate, I though we should get the lowest rate for the hot and cold condition, and then the rest would be maxium rate for the thermal comfort.

The **minimum rate for the hot** would be using the most isolation material for the enclosure. So, I try all the material list in the Grasshopper and using the whole wall without any windows. And as for the ventilation, I want to keep all the heat in, so no ventilation hour.

The **minimum rate for the cold** would be using the most exchangeable material for the enclosure. So, I try all the material list in the Grasshopper and using the whole glass. And as for the ventilation, I want to make them exchange the heat as much as possible, so I use 10 hours per day.

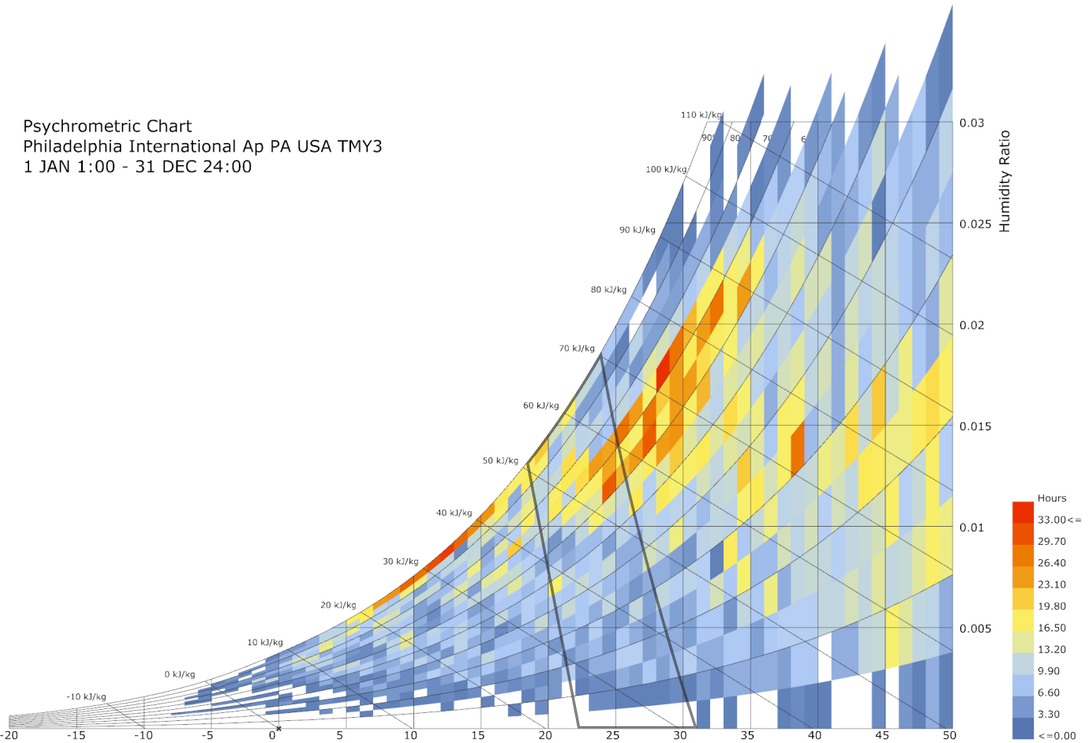
The Minimum Rate for Cold

Windows Rate:
N: 0%
S: 0%
E: 0%
W: 0%

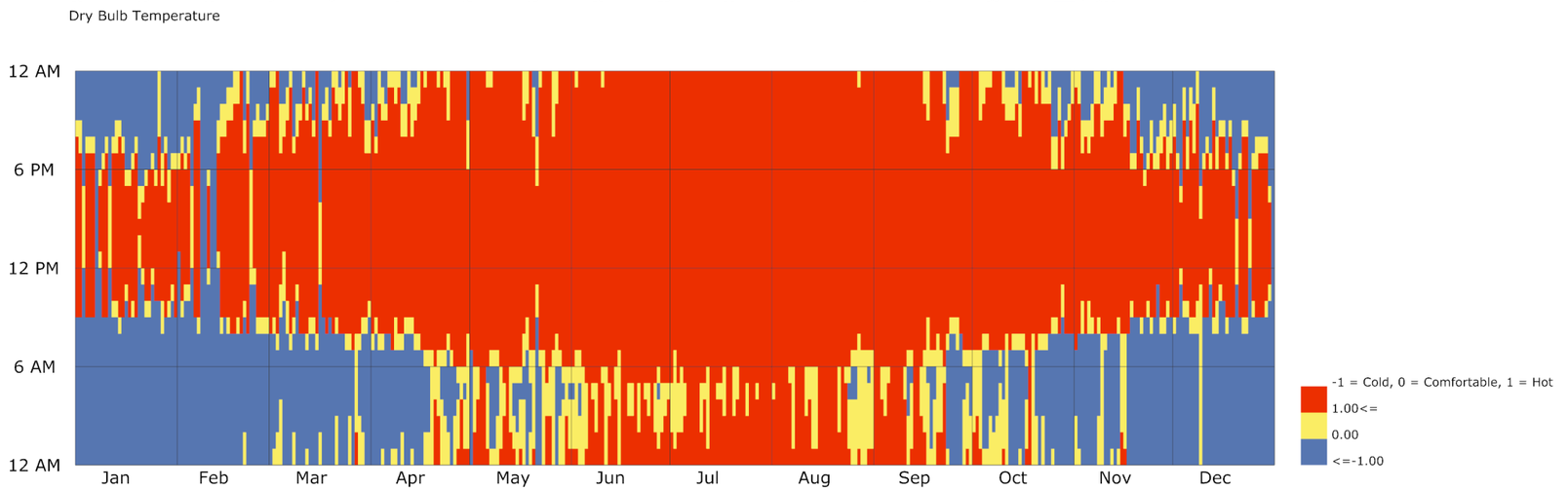
Exterior Wall: R5.8
Exterior Windows: R0.7
Exterior Roof: R34.4

Air Exchange hours: 0

Shading: None



Comfortable (%): 11.4
hot (%): 62.67
cold (%): 25.92



Adaptive Comfort for ZONE_0_T (-1 = Cold, 0 = Comfortable, 1 = Hot) - Hourly
Philadelphia International Ap PA USA TMY3
1 JAN 1:00 - 31 DEC 24:00

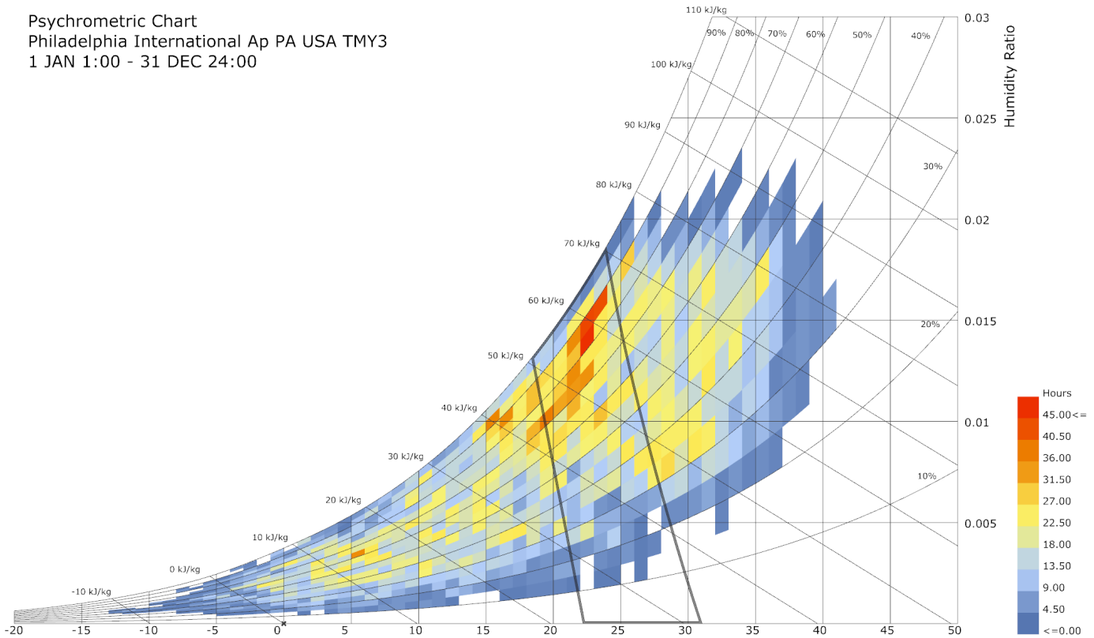
The Minimum Rate for Hot

Windows Rate:
N: 95%
S: 95%
E: 95%
W: 95%

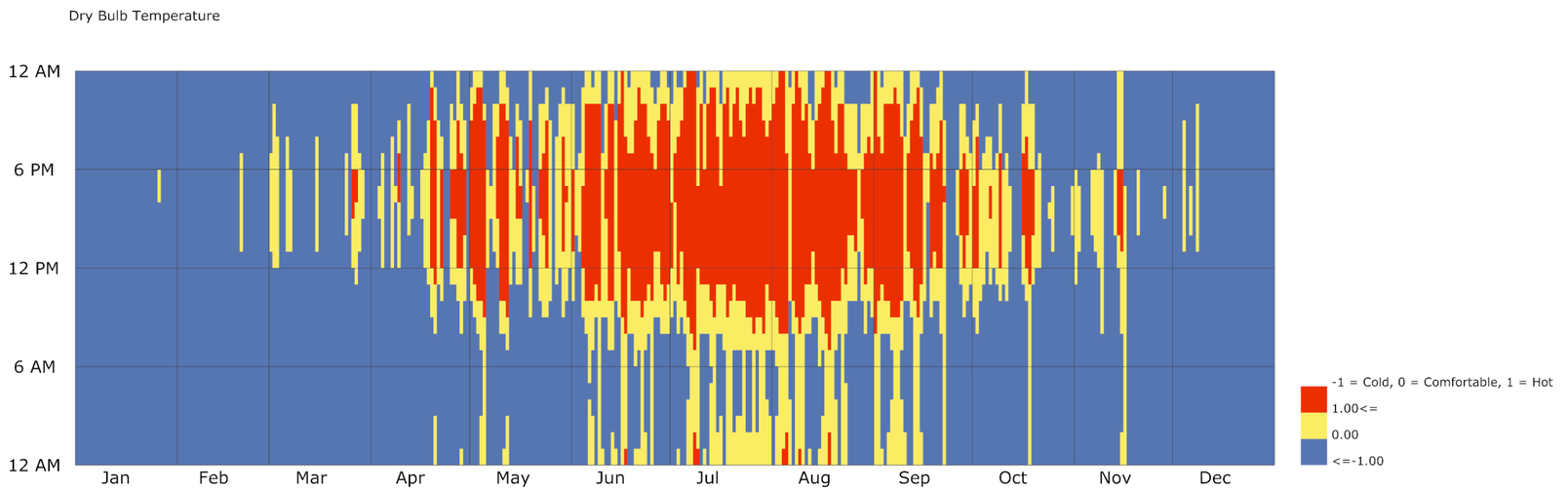
Exterior Wall: R7.2
Exterior Windows: None
Exterior Roof: R34.4

Air Exchange hours: 10 hours

Shading: None



Comfortable (%): 18.16
hot (%): 15.72
cold (%): 66.12



Adaptive Comfort for ZONE_0_T (-1 = Cold, 0 = Comfortable, 1 = Hot) - Hourly
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The Maxium Rate for Thermal Comfot

The Minimum Rate for Hot would be: 15.72%

The Minimum Rate for Cold would be: 25.92%

The Maxium Rate for Thermal Comfot: 100%-15.72%-25.92%=**58.36%**

But, this is just an idea condition, since for the model, we cannot set the ventilation time and the material can not change through the time. For the model I tried would be around 22% of the thermal comfot.

Energy Balance

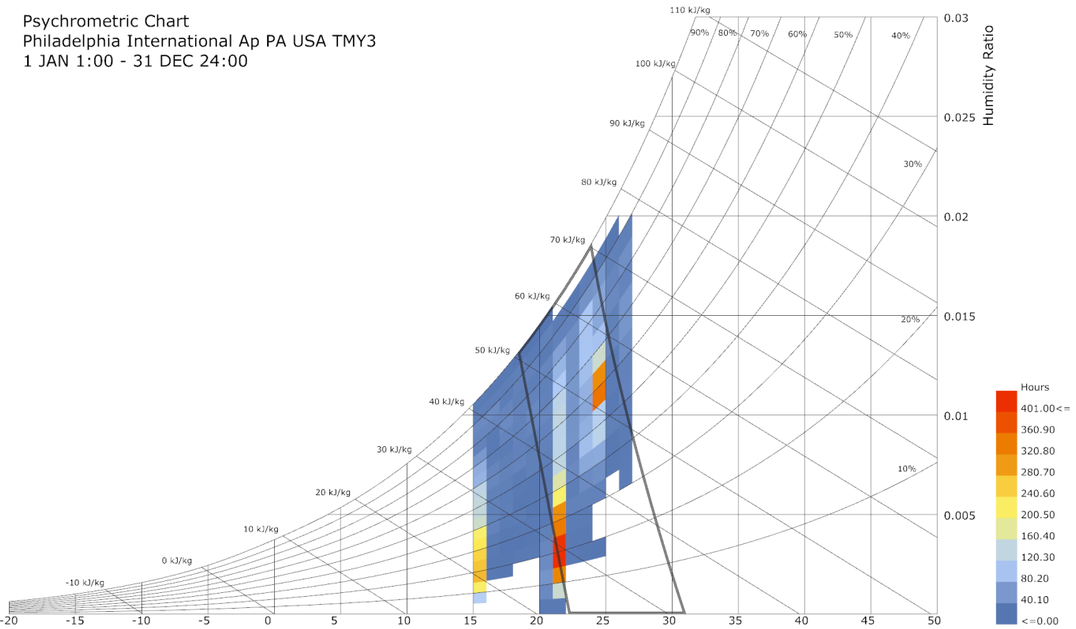
This is the condition that I did the best, and I treat this space as an office, so and the density is 0.2 per units.

Windows Rate:
N: 0%
S: 27%
E: 41%
W: 0%

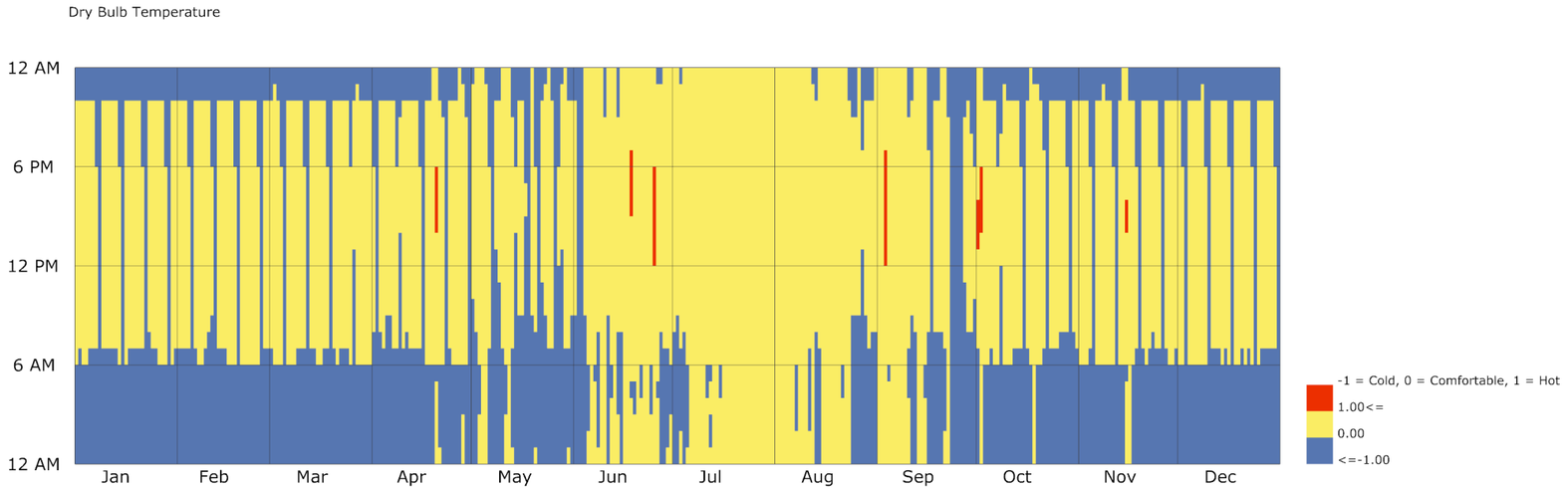
Exterior Wall: R5.8
Exterior Windows: R1.7
Exterior Roof: R34.4

Air Exchange hours: 2 hours

Shading: Yes
Depth: 0.9m
Numbers: 4



Comfortable (%): 62.72
hot (%): 0.34
cold (%): 36.94



Adaptive Comfort for ZONE_0_T (-1 = Cold, 0 = Comfortable, 1 = Hot) - Hourly
Philadelphia International Ap PA USA TMY3
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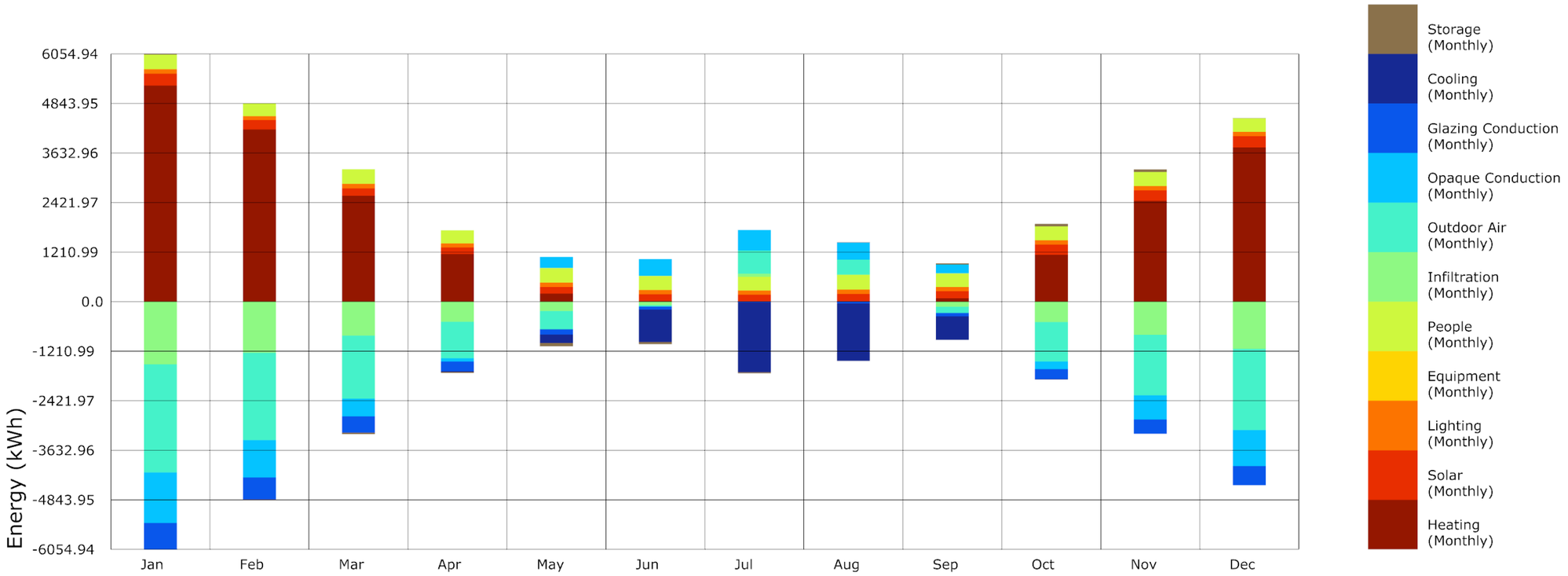

Office Energy Balance