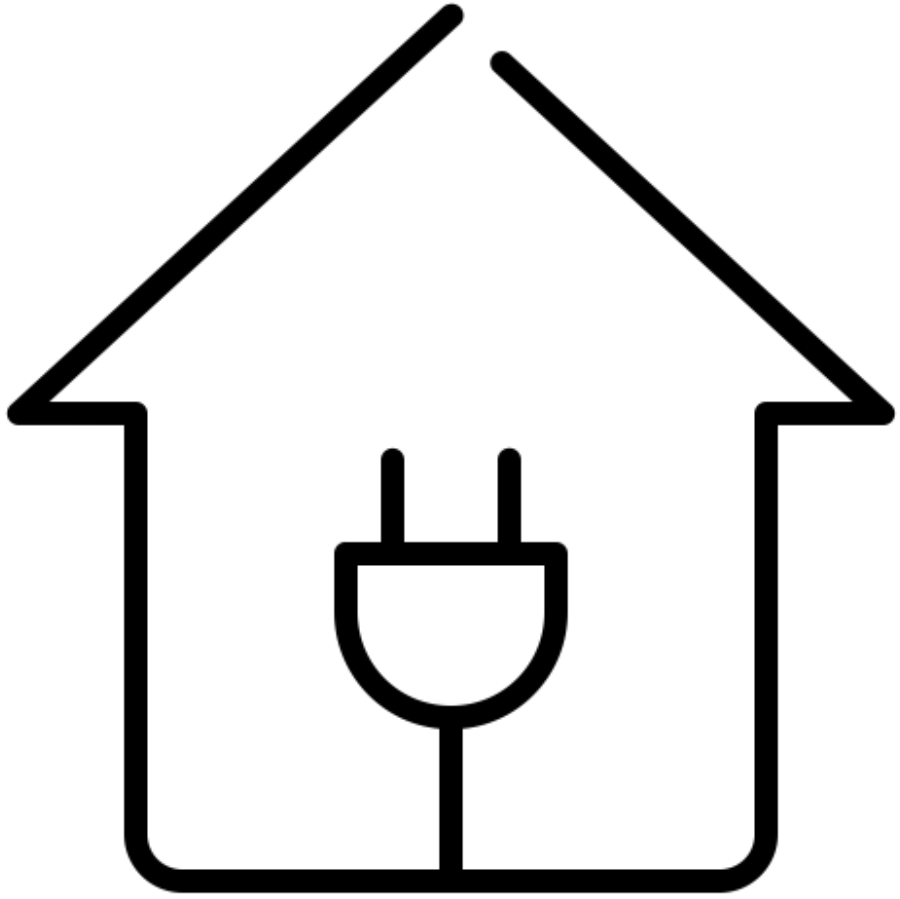


# ENERGY SIMULATION

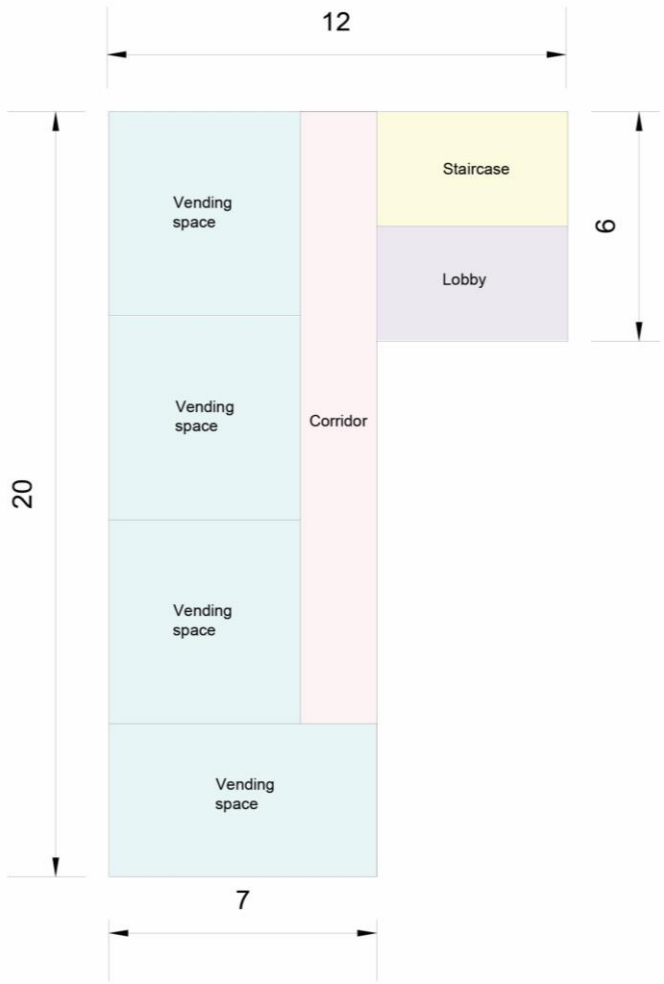
## Sketchup make & Open studio

## Technical environmental systems

Rimi Janka
Alessandra Brembati
Alberto Grilli
Michela Marullo

# GEOMETRY AND BUILDING'S CHARATERISTICS

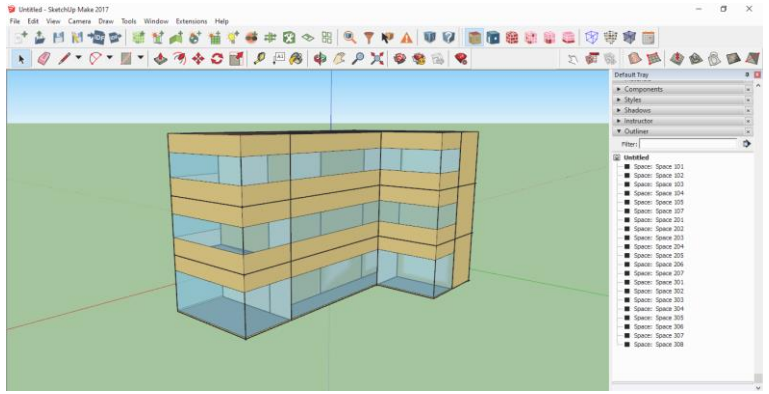
/SKETCHUP STEPS



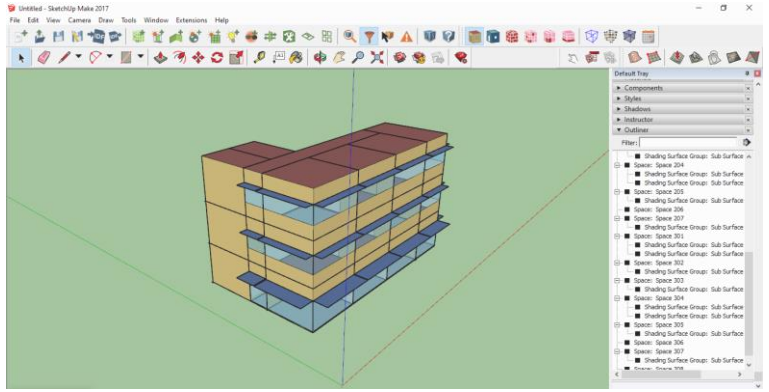

GROUND FLOOR


FIRST AND SECOND FLOOR

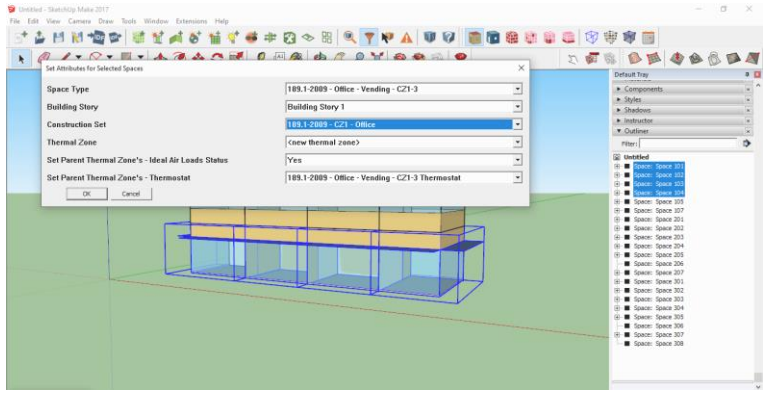
1. For the ground floor, the window ratio is 0.7, for all the others floors, we used a window ratio of 0.5 (staircase excluded).



2. We added overhangs keeping the North face excluded. In case of the windows at the g. floor, we've used a different projection factor.



3.We have add the thermal zones . This need to be added separately for every time there's a different function or a different floor (building story 1,2 or 3).



# CITY WEATHER INFORMATIONS

/ MOSCOW – ROME – SAN PAULO


WEATHER DATA

| Moscow | |
|---|---|
| Latitude | 55.75 |
| Longitude | 37.63 |
| Average annual temperature | 4.9 °C |

| Rome | |
|---|---|
| Latitude | 41.80 |
| Longitude | 12.58 |
| Average annual temperature | 15.7 °C |

| San Paulo | |
|---|---|
| Latitude | -23.6 |
| Longitude | -46.6 |
| Average annual temperature | 18.5 °C |

# ANNUAL OVERVIEW

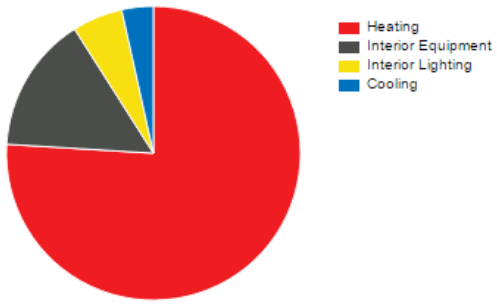
/ MOSCOW – ROME – SAN PAULO

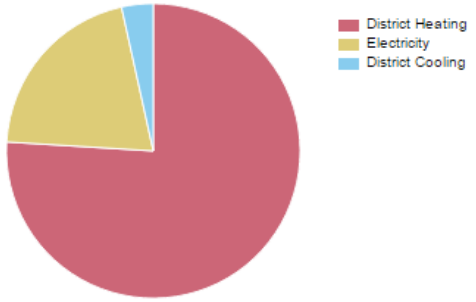
BASE CASE LAYERS
(outside wall)

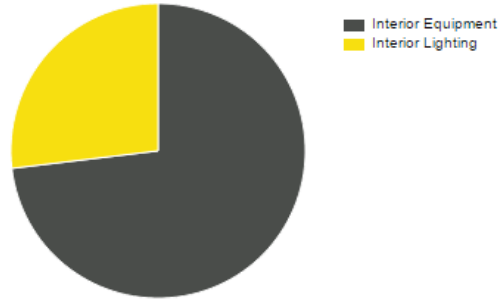
| Material | Dimension |
|---|---|
| 1IN Stucco | 0.02 m |
| 8IN Concrete | 0.20 m |
| Wall Insulation (31) | 0.03 m |
| 1/2IN Gypsum | 0.01 m |

TOTAL BUILDING AREA = 510 $m^2$

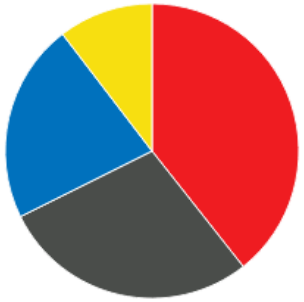
MOSCOW
Net site energy = 846,16 GJ



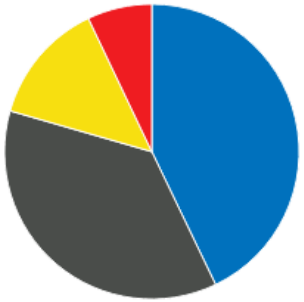




ROME
Net site energy = 448,42 GJ



SAN PAULO
Net site energy = 347,47 GJ



# MONTHLY OVERVIEW

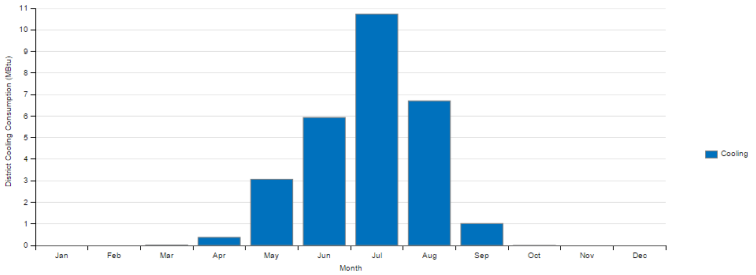
/ MOSCOW – ROME – SAN PAULO

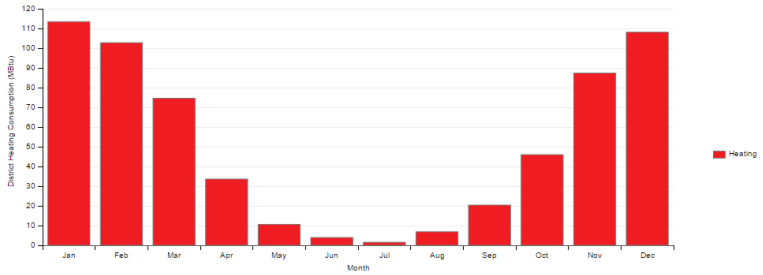
BASE CASE LAYERS
(outside wall)

| Material | Dimension |
|---|---|
| 1IN Stucco | 0.02 m |
| 8IN Concrete | 0.20 m |
| Wall Insulation (31) | 0.03 m |
| 1/2IN Gypsum | 0.01 m |

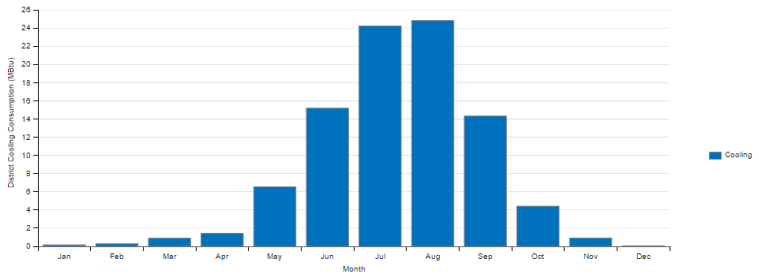
TOTAL BUILDING AREA = 510 $m^2$

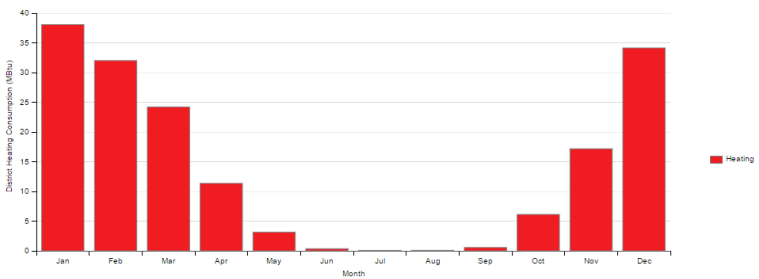
## MOSCOW



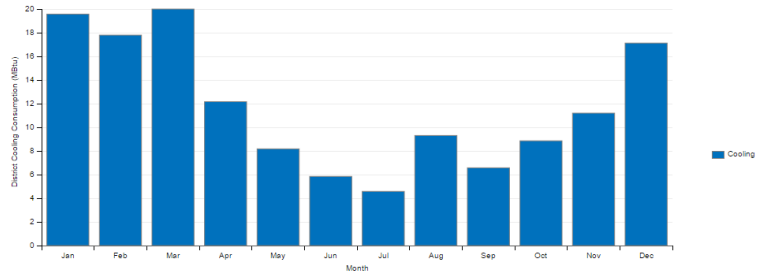



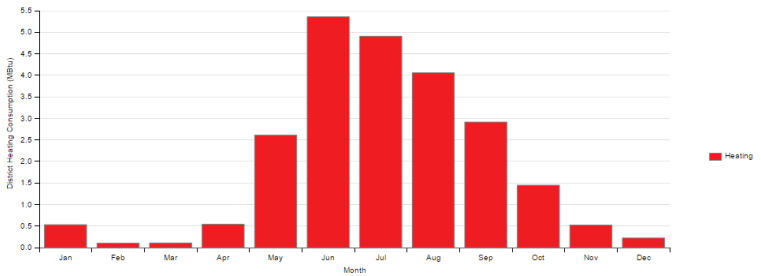

## ROME




## SAN PAULO



# 1st WALL ANALYSIS

/ ROME

WALL 1 LAYERS
(outside wall)

| Material | Dimension |
|---|---|
| Stucco | 0.03 m |
| Wall Insulation | 0.05 m |
| Concrete | 0.20 m |
| Acoustic tile | 0.02 m |
| Gypsum | 0.02 m |

TOTAL BUILDING AREA = 510 $m^2$

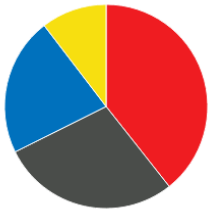
NET SITE ENERGY = 434.57 GJ

BASE CASE NET SITE ENERGY = 448,42 GJ

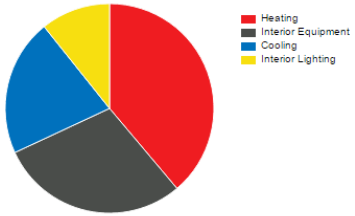
R VALUE = 9.44 ft^2*h*R/Btu

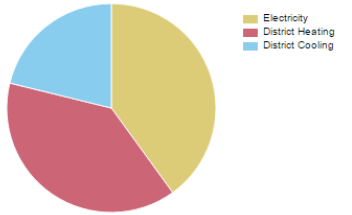
U VALUE = 0,11 ft^2*h*R/Btu

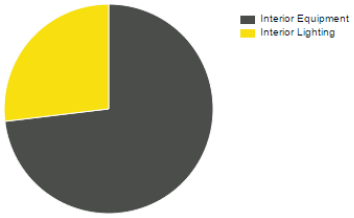
BASE CASE



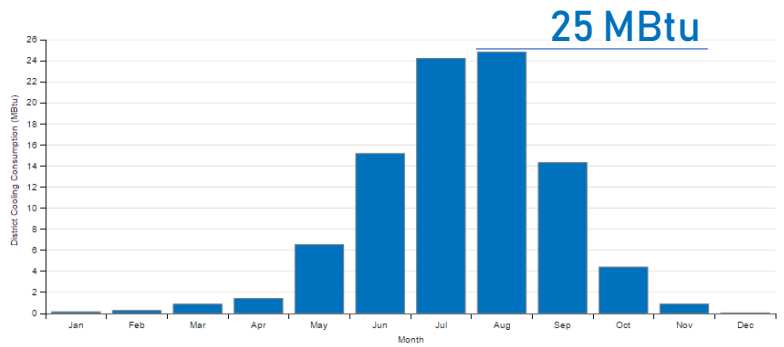
WALL 1

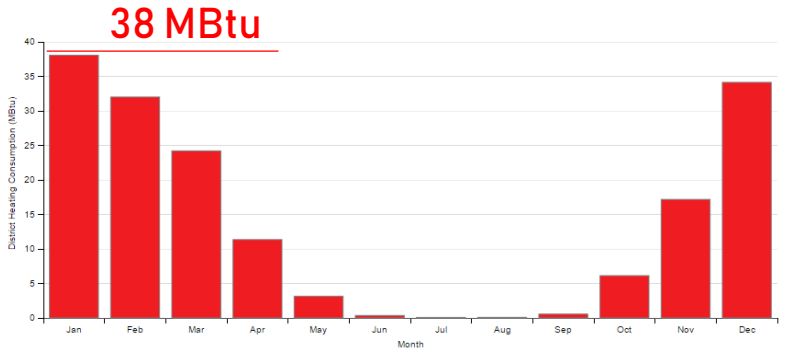


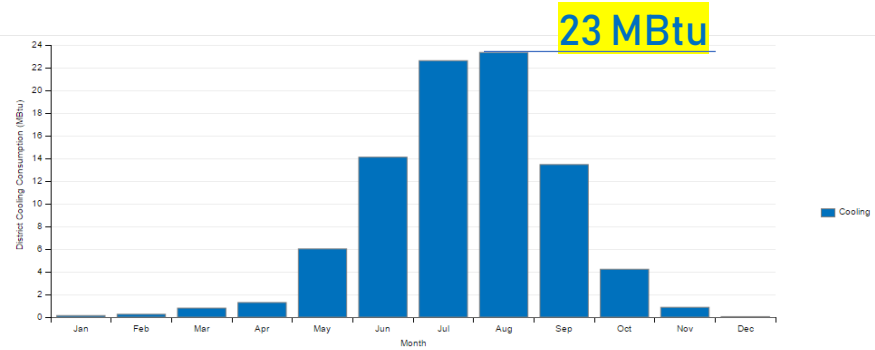



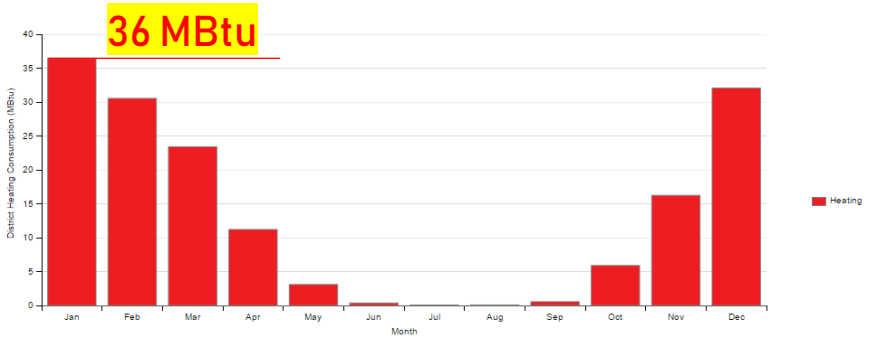

BASE CASE




WALL 1



# 2nd WALL ANALYSIS

/ ROME

WALL 2 LAYERS
(outside wall)

| Material | Dimension |
|---|---|
| Stucco | 0.03 m |
| Wall Insulation | 0.10 m |
| Concrete | 0.20 m |
| Acoustic tile | 0.02 m |
| Gypsum | 0.02 m |

TOTAL BUILDING AREA = 510 $m^2$

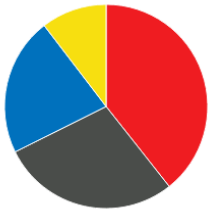
NET SITE ENERGY = 426.48 GJ

BASE CASE NET SITE ENERGY = 448,42 GJ

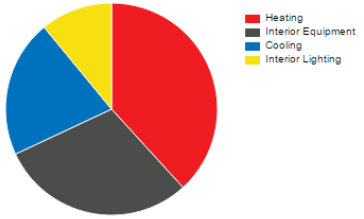
R VALUE = 16,01 ft^2*h*R/Btu

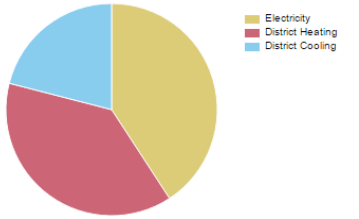
U VALUE = 0,06 ft^2*h*R/Btu

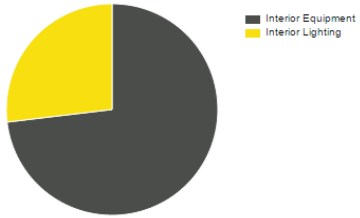
BASE CASE



WALL 2

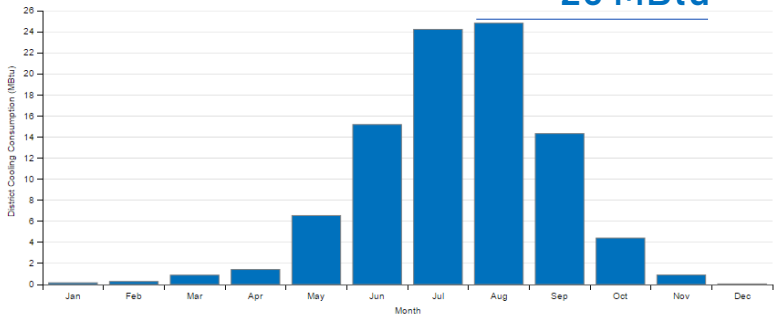


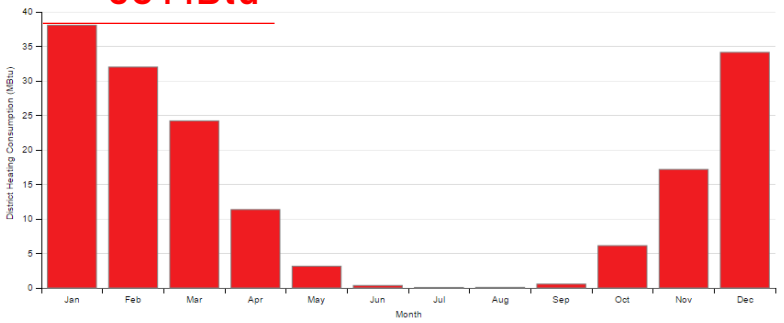




BASE CASE

25 MBtu

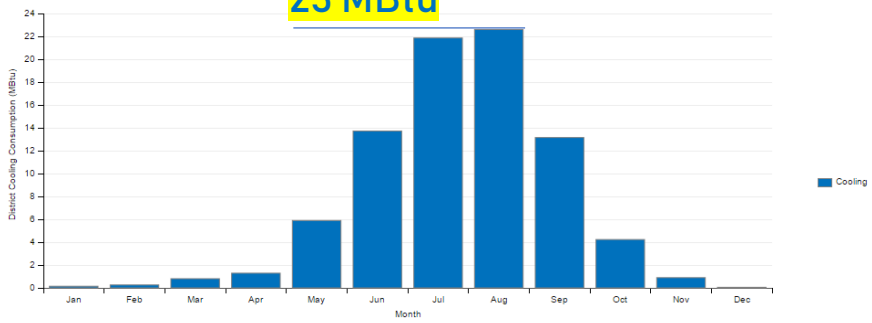



38 MBtu

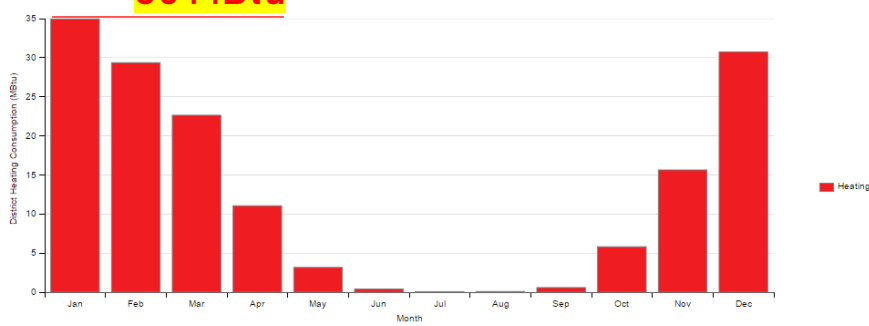



WALL 2

23 MBtu




35 MBtu



# 3th WALL ANALYSIS

/ ROME

WALL 3 LAYERS
(outside wall)

| Material | Dimension |
|---|---|
| Stucco | 0.03 m |
| Wall Insulation | 0.20 m |
| Concrete | 0.20 m |
| Acoustic tile | 0.02 m |
| Gypsum | 0.02 m |

TOTAL BUILDING AREA = 510 $m^2$

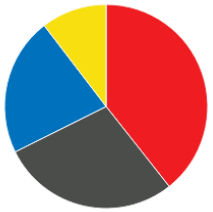
NET SITE ENERGY = 424.68 GJ

BASE CASE NET SITE ENERGY = 448,42 GJ

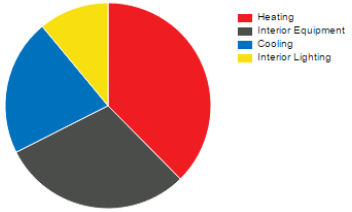
R VALUE = 29.48 ft^2*h*R/Btu

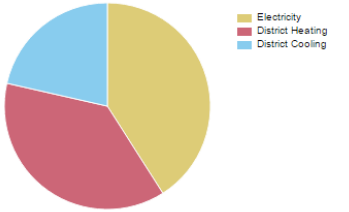
U VALUE = 0,03 ft^2*h*R/Btu

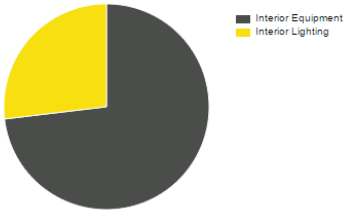
BASE CASE



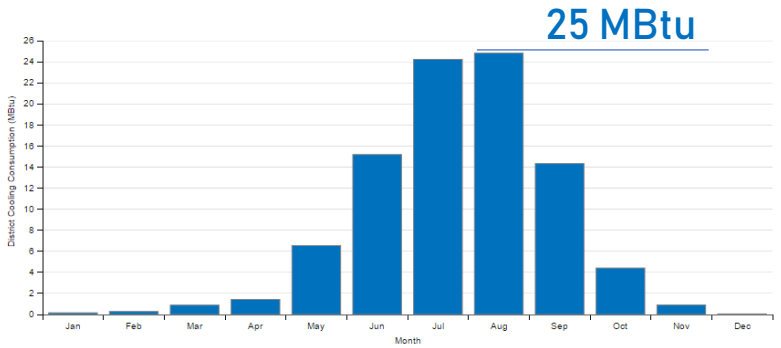
WALL 3

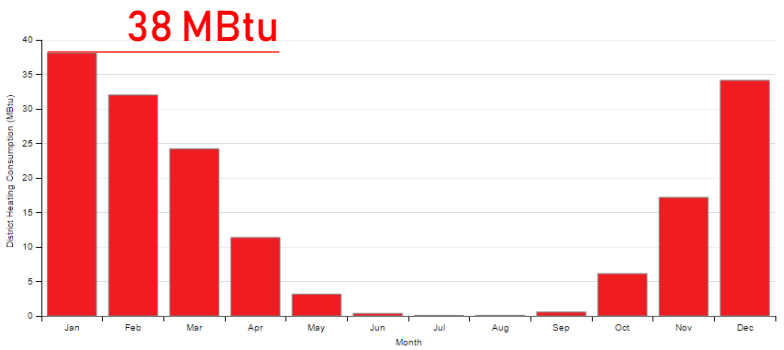


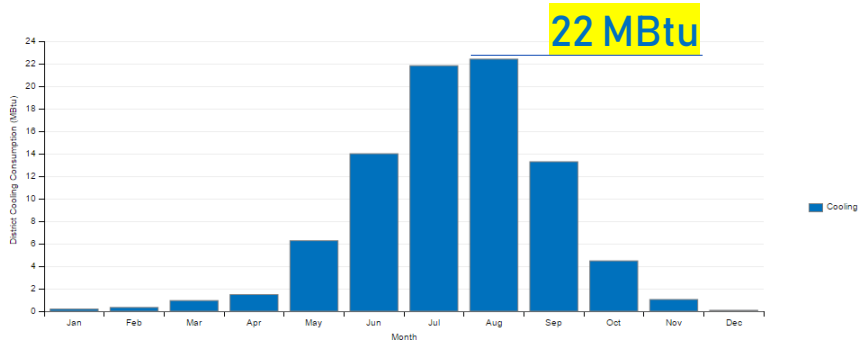



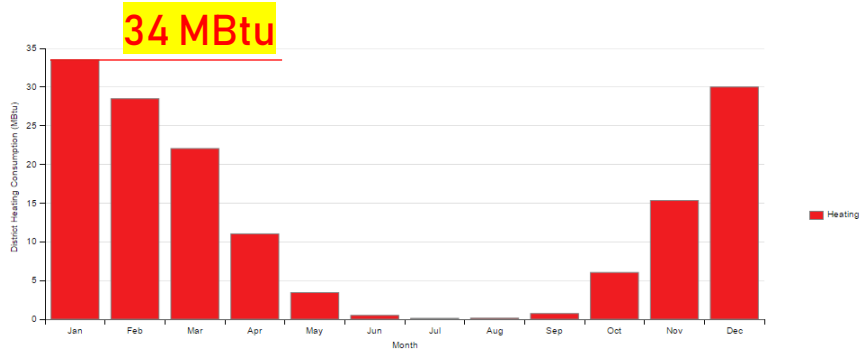

BASE CASE




WALL 3



# CONCLUSION

/ CLIMATE AND WALLS

TOTAL PERIMETER = 64 m
TOTAL HEIGHT = 12 m
STARTING EXT. WALLS VOLUME = 153,6 $M^3$

WALL 1 THICKNESS ≈ 0,28 m
WALL 2 THICKNESS ≈ 0,33 m
WALL 3 THICKNESS ≈ 0,43 m

## FROM BASE CASE TO WALL 1 (FROM 0 TO 5CM OF INSOLATION)

NET SITE ENERGY DECREASE $= \frac{448,42\ GJ}{(448,42 - 434,57)} \times 100 \approx 3,2\%$

EXT. WALLS VOLUME = (64 x 12 x 0,28) = 215,04 $m^3$

$\frac{215,04}{153,6} = 1,4 \approx 40\%$

## FROM WALL 1 TO WALL 2 (FROM 5 TO 10CM OF INSOLATION)

NET SITE ENERGY DECREASE $= \frac{(434,57 - 426,48)GJ}{434,57GJ} \times 100 \approx 1,9\%$

EXT. WALLS VOLUME = (64 x 12 x 0,33) = 253,44 $m^3$

$\frac{253,44}{215,04} = 1,18 \approx 18\%$

## FROM WALL 2 TO WALL 3 (FROM 10 TO 20CM CM OF INSOLATION)

NET SITE ENERGY DECREASE $= \frac{(434,57 - 424,68)GJ}{426,48GJ} \times 100 \approx 0,4\%$

EXT. WALLS VOLUME = (64 x 12 x 0,43) = 330,44 $m^3$

$\frac{330,44}{253,44} = 1,30 \approx 30\%$

By making a comparison among the NET SITE ENERGY values, we can calculate in percentage the increase of the performance of the building (taking in account we are only considering external walls without all the other parameters) and it's possible to state that even though every addition of insolation material produces an efficiency improvement, the improvement became less and less significant the more material is added.

This means that, depending on each design case, there's always a point where the increase of wall thickness as well as the increase of the insulation layer, does not produce benefits compared with the amount of used material and the costs it implies.