



PROJECT ON ENERGY AND ENVIRONMENTAL TECHNOLOGIES FOR BUILDING SYSTEMS

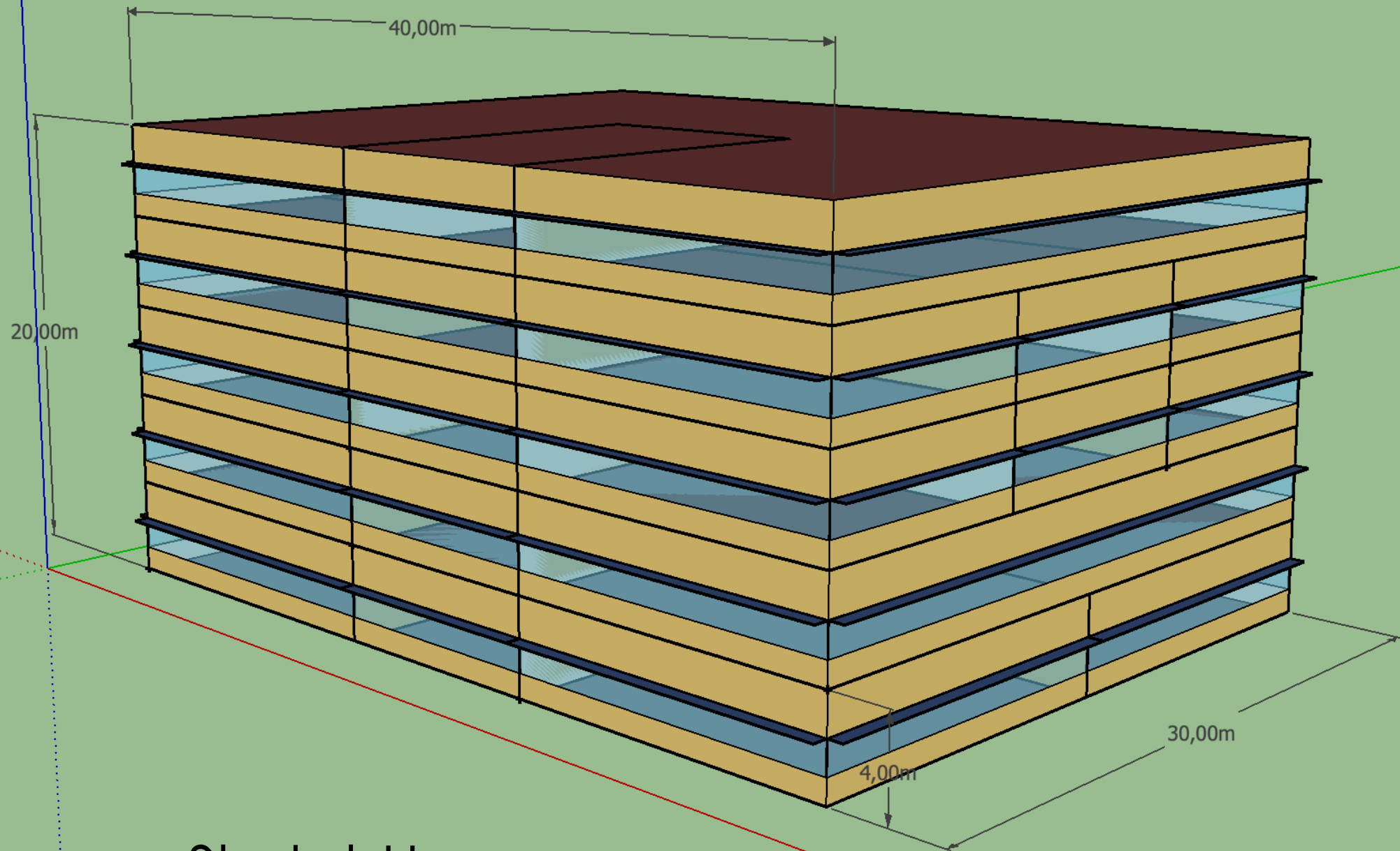
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LORENZO FERRÉ
FEDERICO GUERMANDI

INTRODUCTION

For this project

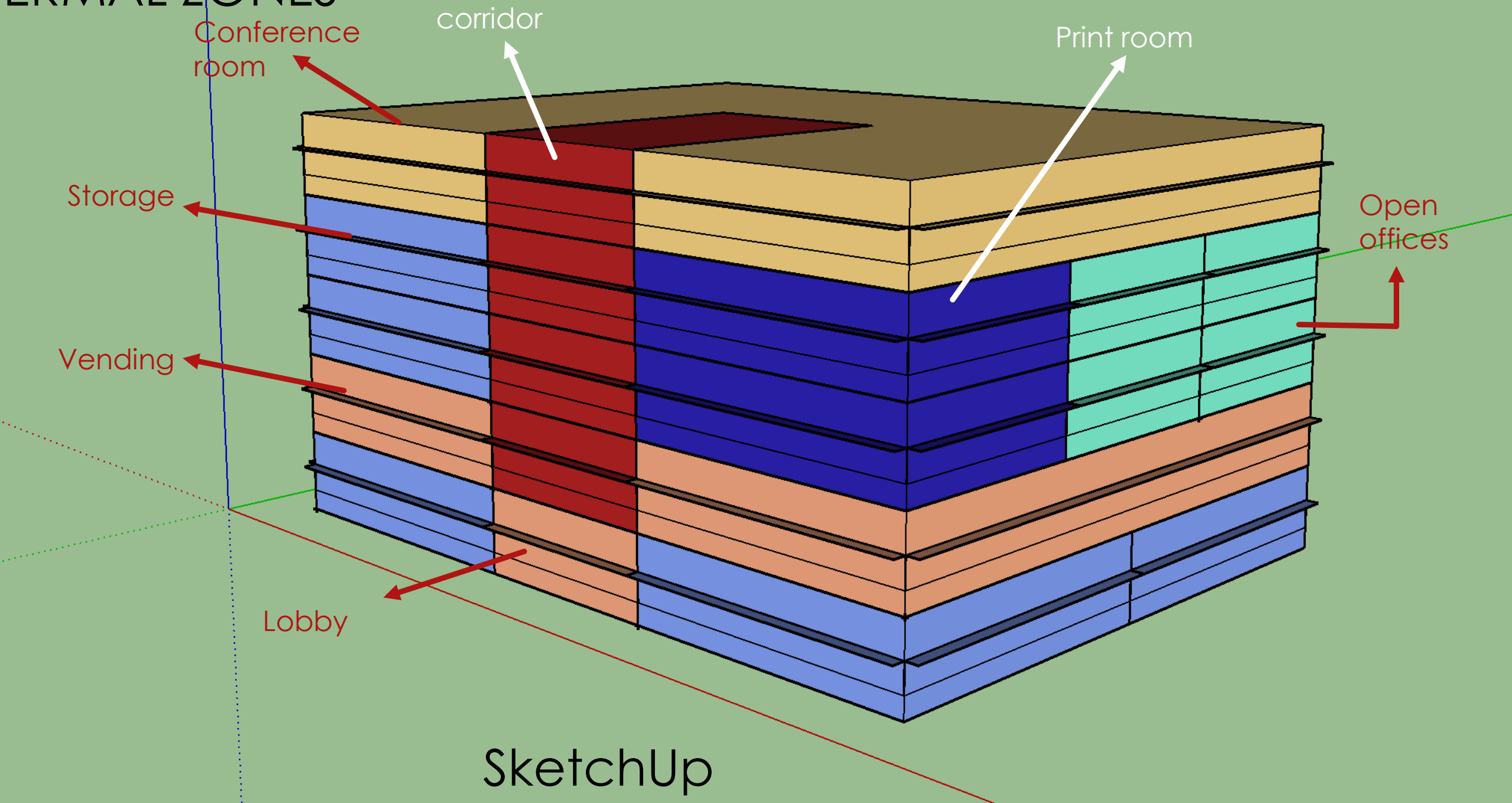
- ▶ The geometry of a 5-story multi-commercial building was designed using Sketch-up
- ▶ Walls and windows were selected on Open Studio for 3 cases; Piacenza, Accra and Yakutsk, with a Base location in Piacenza, Italy
- ▶ With data on various locations on the yearly consumption of the HVAC systems in Open Studio, we obtained results for the three cases and did a base case comparison on them

GEOMETRY



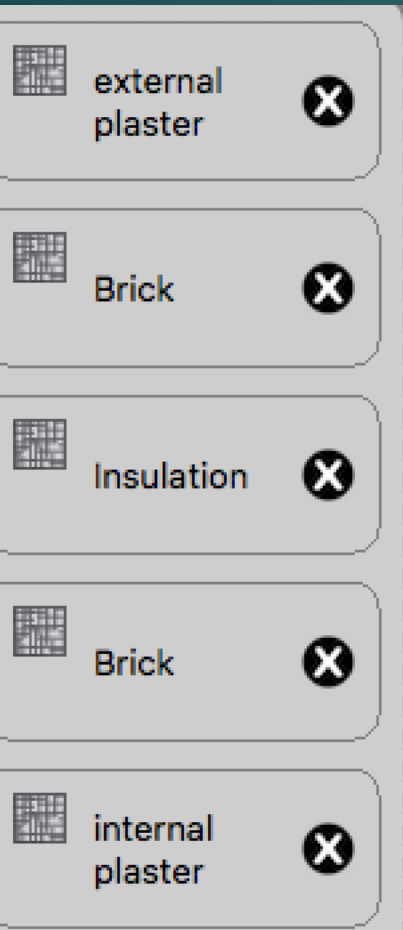
SketchUp

ERMA ZONES



OUR WALLS

k=0.07
d=5 mm



BASE

k=1.2
d= 80 mm

k=0.0432
d= 50 mm

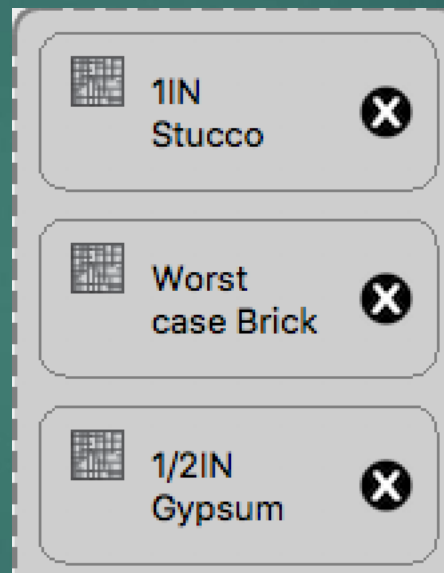
k=1.2
d= 80 mm

k=0.075
d= 5 mm

k=0.69
d= 25.3 mm

k=1.2432
d= 180 mm

k=0.16
d= 12.7 mm



WORSE

k=0.07
d=5 mm

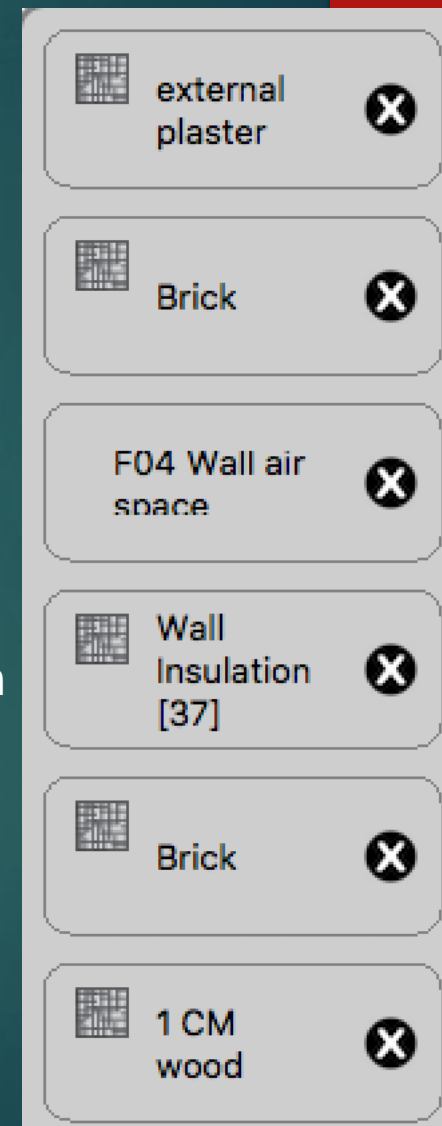
k=1.2
d= 80 mm

R= 0.15

k=0.0432
d= 68.1 mm

k=1.2
d= 80 mm

k=0.02
d= 10 mm

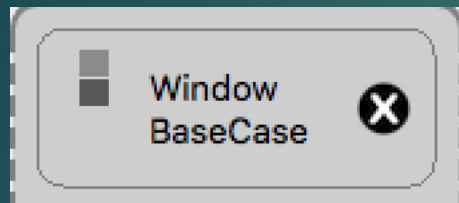


BEST

$$k \text{ (conductivity)} = \frac{W}{m \cdot K}, \quad R \text{ (resistance)} = \frac{m^2 \cdot K}{W}$$

OUR WINDOWS

k=0.8
d= 6 mm



BASE

k=0.9
d= 3 mm



WORSE

k=0.0415
d= 3 mm

k=0.0415
d= 3 mm

k=0.0415
d= 3 mm



BEST

$$k \text{ (conductivity)} = \frac{W}{m \cdot K}, \quad R \text{ (resistance)} = \frac{m^2 \cdot K}{W}$$

PIACENZA

Base case

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	1044.74	0.00
Cooling	0.00	0.00	0.00	695.52	0.00	0.00
Interior Lighting	615.82	0.00	0.00	0.00	0.00	0.00
Interior Equipment	1388.42	0.00	0.00	0.00	0.00	0.00
Total End Uses	2004.24	0.00	0.00	695.52	1044.74	0.00

Worst case

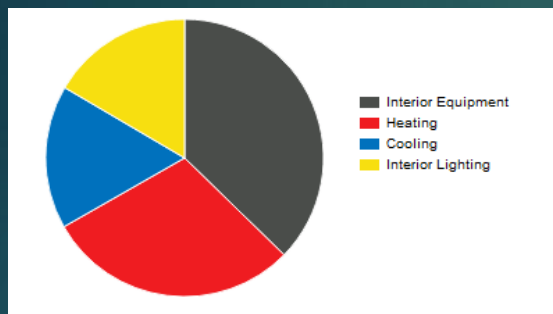
	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	1140.59	0.00
Cooling	0.00	0.00	0.00	951.63	0.00	0.00
Total End Uses	2004.24	0.00	0.00	951.63	1140.59	0.00

Best case

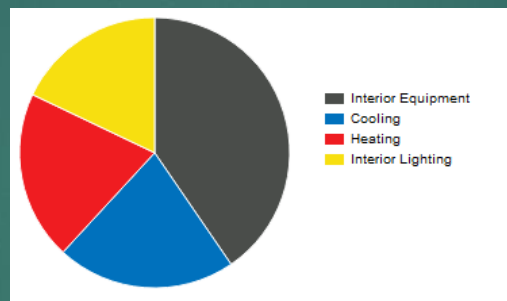
	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	710.44	0.00
Cooling	0.00	0.00	0.00	717.74	0.00	0.00
Total End Uses	2004.24	0.00	0.00	717.74	710.44	0.00

PIACENZA GRAPHIC RESULTS

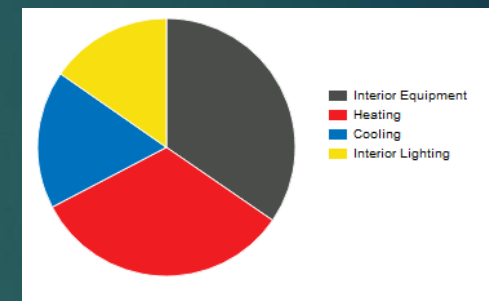
BASE CASE
ENERGY USE



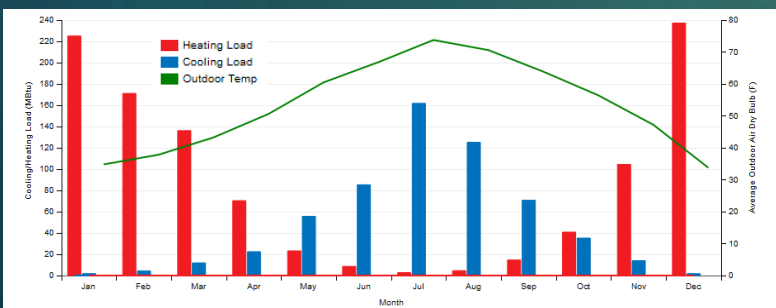
BEST CASE
ENERGY USE



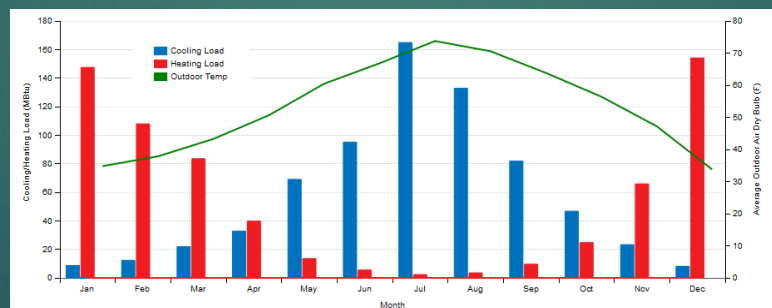
WORST CASE
ENERGY USE



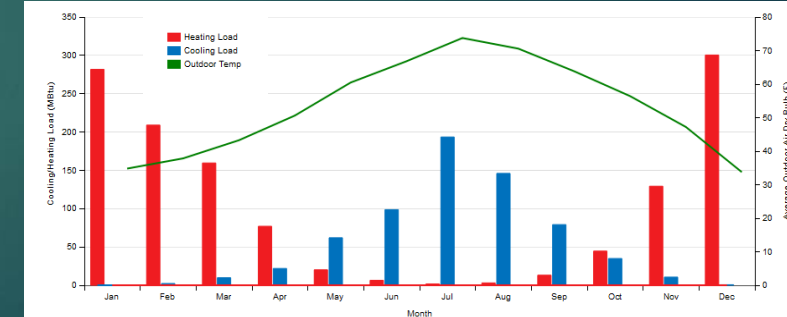
HEATING/COOLING CONSUMPTION



HEATING/COOLING CONSUMPTION



HEATING/COOLING CONSUMPTION



BASE CASE (in different geographical zones)

Yakutsk, Russia (Lat. 62° 08')

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	6619.04	0.00
Cooling	0.00	0.00	0.00	281.05	0.00	0.00
Interior Lighting	615.82	0.00	0.00	0.00	0.00	0.00
Interior Equipment	1388.42	0.00	0.00	0.00	0.00	0.00
Total End Uses	2004.24	0.00	0.00	281.05	6619.04	0.00

Piacenza, Italy (Lat. 44° 92')

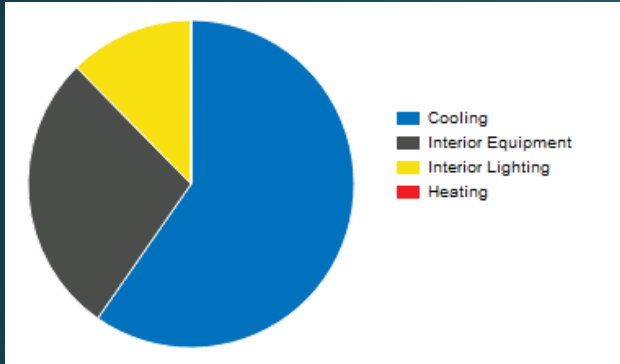
	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	1044.74	0.00
Cooling	0.00	0.00	0.00	695.52	0.00	0.00
Total End Uses	2004.24	0.00	0.00	695.52	1044.74	0.00

Accra, Ghana (Lat. 5° 6')

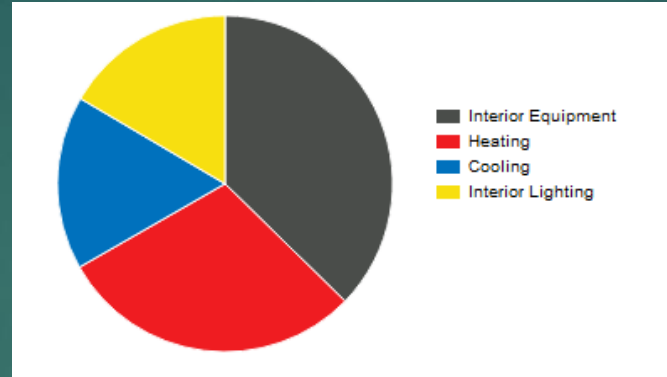
	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	0.23	0.00
Cooling	0.00	0.00	0.00	3227.99	0.00	0.00
Total End Uses	2004.24	0.00	0.00	3227.99	0.23	0.00

BASE CASE GRAPHIC RESULTS

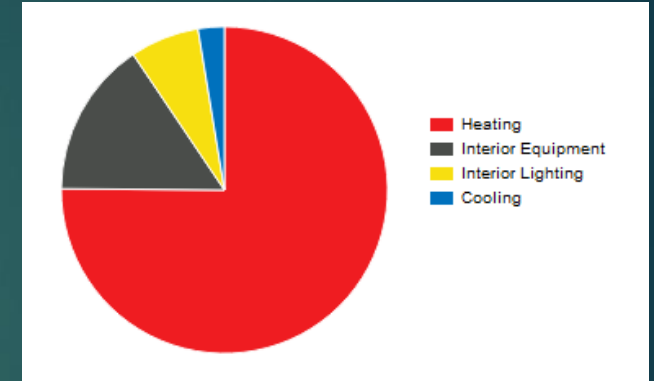
ENERGY USE



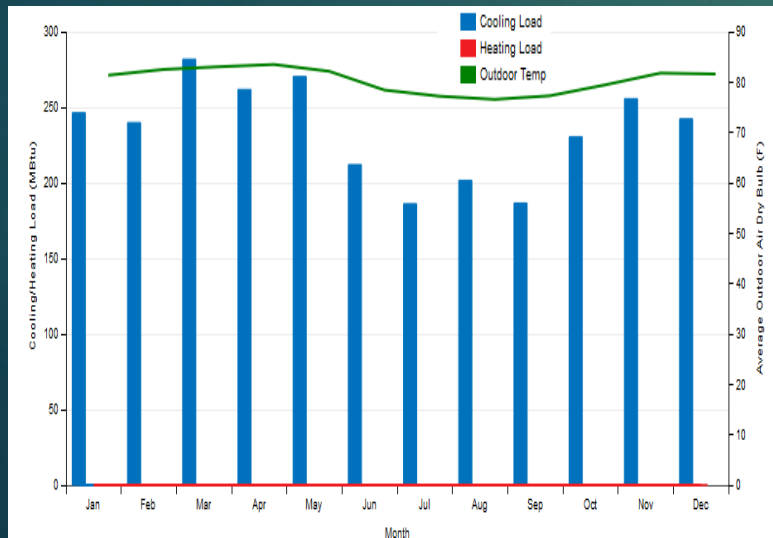
ENERGY USE



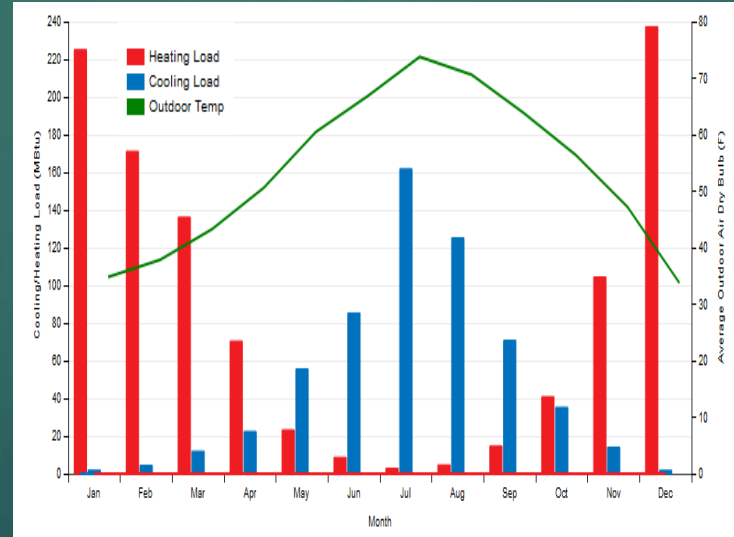
ENERGY USE



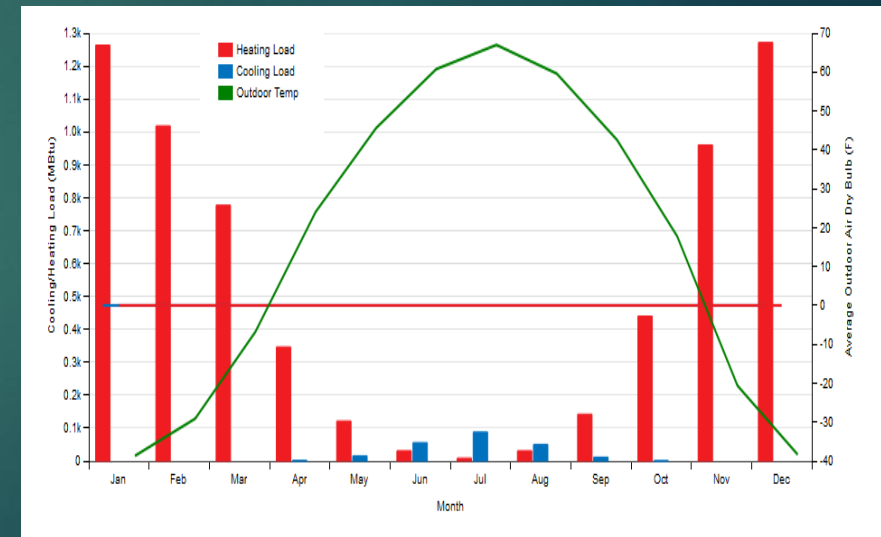
HEATING/COOLING CONSUMPTION



HEATING/COOLING CONSUMPTION



HEATING/COOLING CONSUMPTION



ACCRA

PIACENZA

YAKUTSK

CONCLUSIONS

From the results obtained;

- ▶ At different latitudes we have different weather conditions, we expect a superior heating load in Yakutsk rather than in Piacenza, while in Accra, we expect a greater cooling load rather than heating
- ▶ Our best case wall has a higher resistance, so we expect the heating load to be lesser, whereas, as regards the amount of energy for cooling our building, it is difficult to predict whether it will be higher or lesser