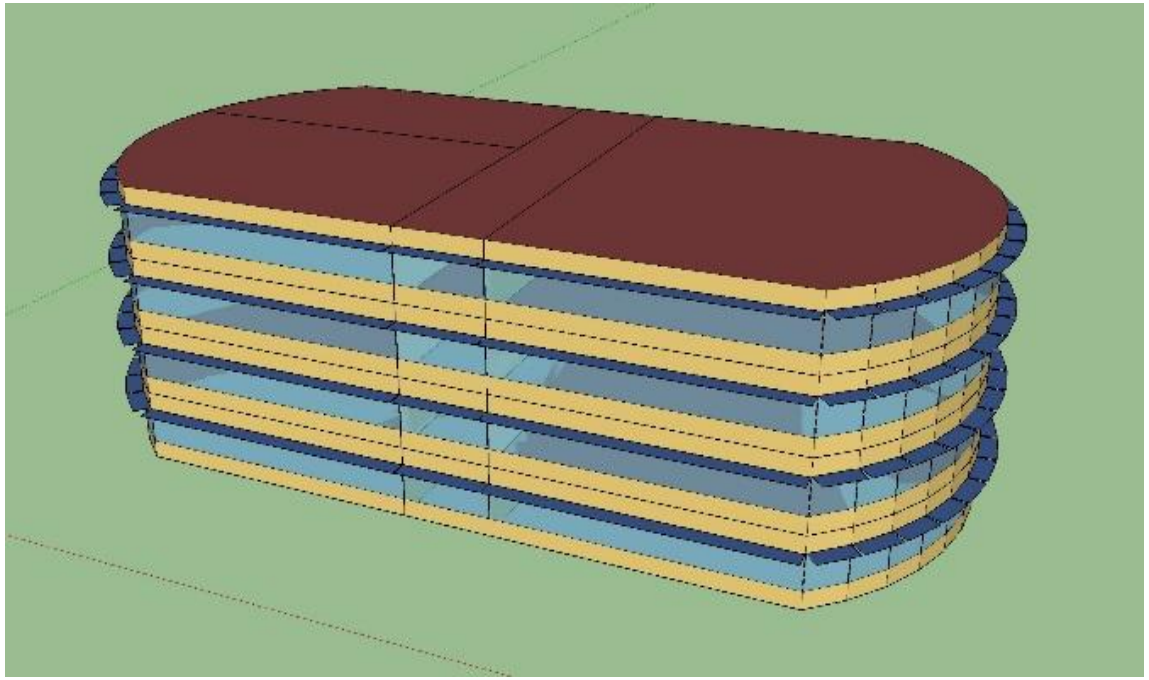
OPEN STUDIO PROJECT

The first part of this project concerns in the analysis of the behaviour of the same building in three different thermal zones. The evaluation regards a commercial buiding located in Piacenza, in Singapore and in Stockholm.

Weather Data:

- Piacenza: Latitude 44.92°N - Longitude 9.73°E - Thermal Zone 4
- Stockholm: Latitude 59.65°N - Longitude 17.95°E - Thermal Zone 6
- Singapore: Latitude 1.37°N - Longitude 103.98°E - Thermal Zone 1

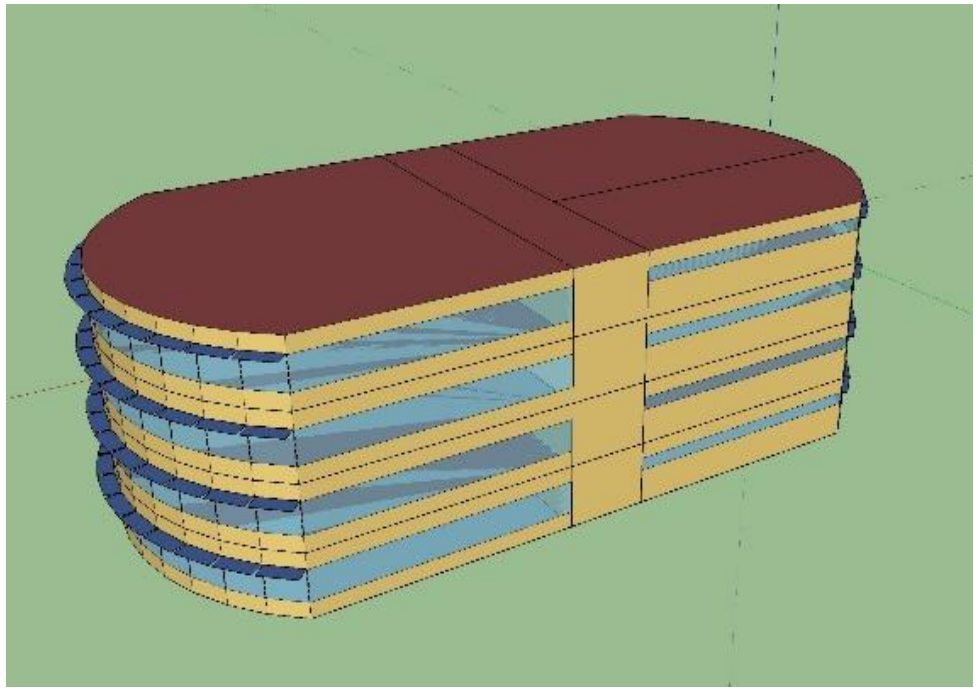


Dimensions:

- Atot = 1067.94 m^2
- h = 12 m
- Windows/Wall ratio = 41.73%

Characteristics:

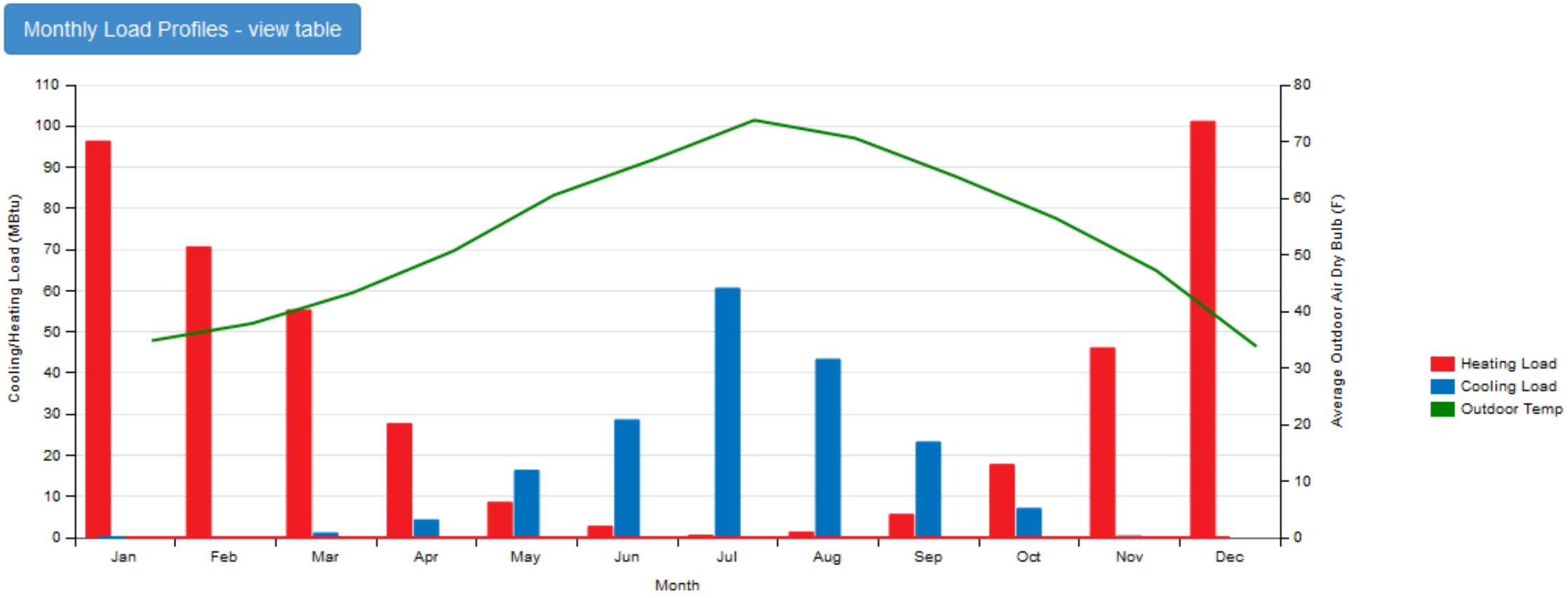
- 4 floor
- 5 Thermal Zones(OpenOffice, Corridor, BreakRoom, Conference, RestRoom)
- No shadowing at north side



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	457.29	0.00
Cooling	0.00	0.00	0.00	194.93	0.00	0.00
Interior Lighting	133.45	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	232.32	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	365.78	0.00	0.00	194.93	457.29	0.00

Piacenza Base Case

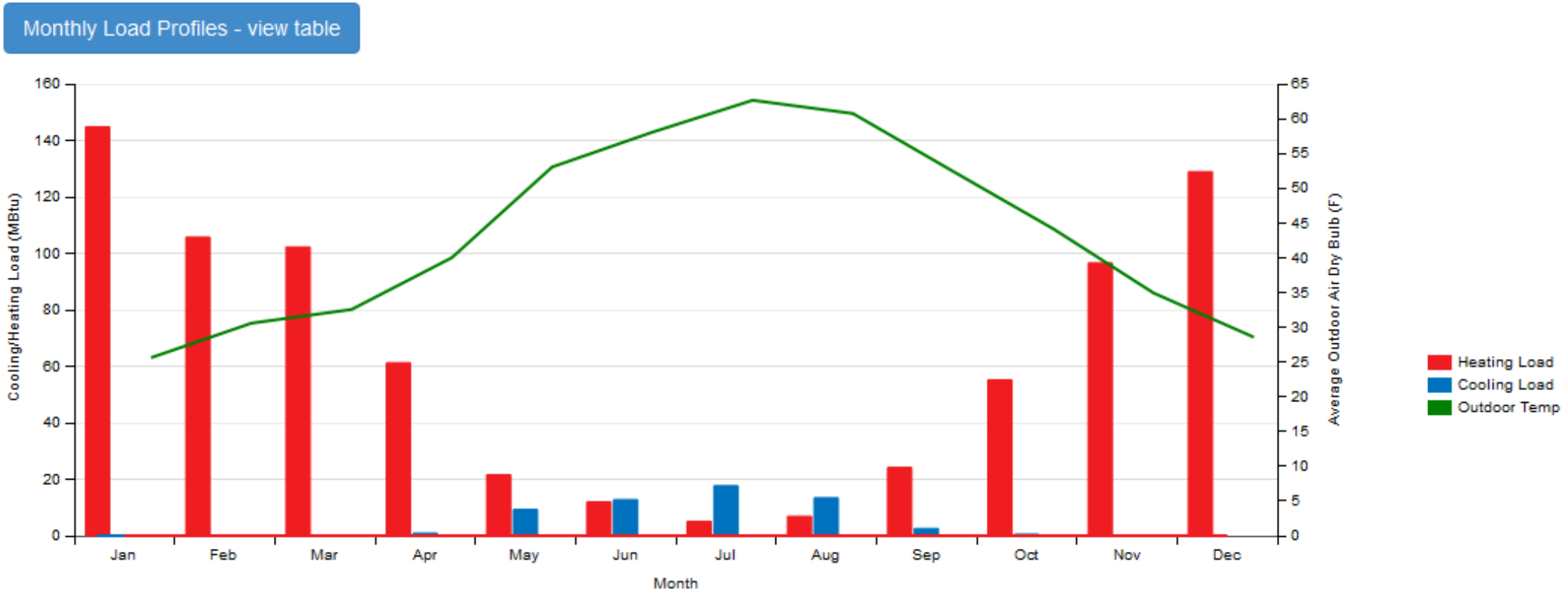


- Heating from September to June
- Cooling from March to October

Stockholm 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	806.34	0.00
Cooling	0.00	0.00	0.00	60.48	0.00	0.00
Interior Lighting	133.45	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	232.32	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	365.78	0.00	0.00	60.48	806.34	0.00

Stockholm Base Case

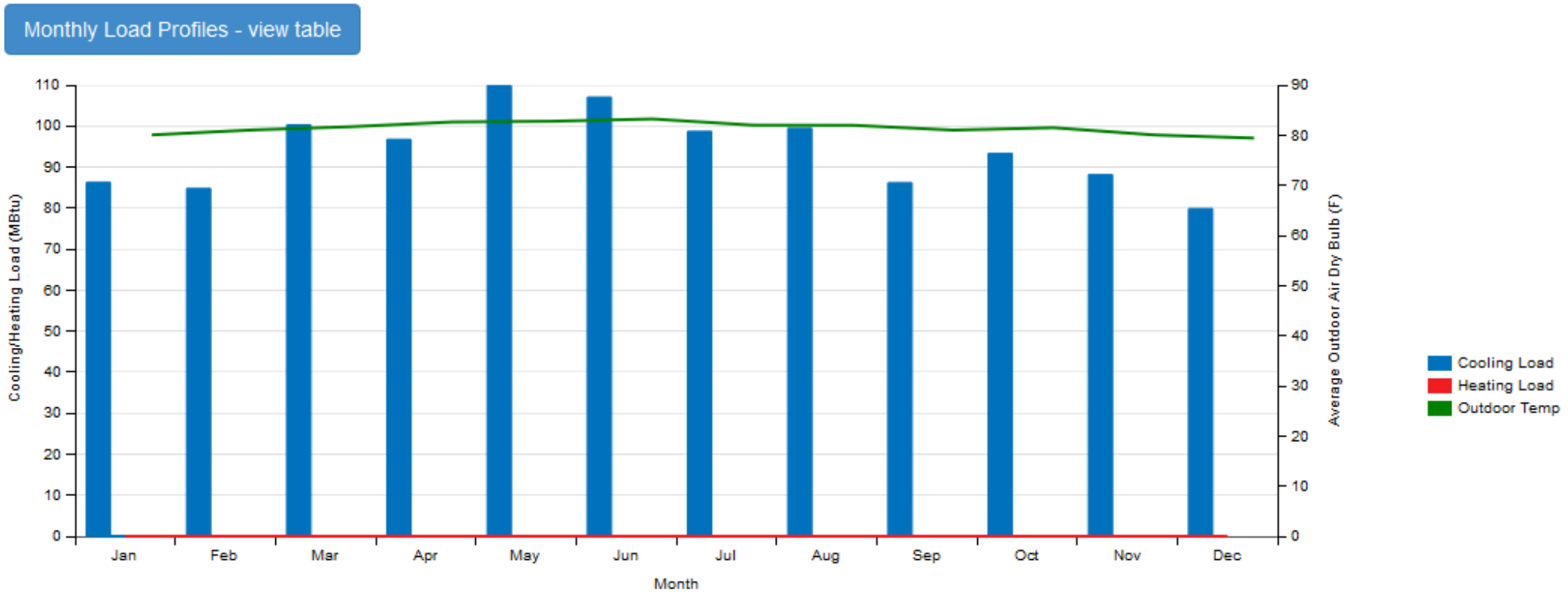


- Heating during all year
- Cooling from April to September

Singapore 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	0.00	0.00
Cooling	0.00	0.00	0.00	1192.83	0.00	0.00
Interior Lighting	133.45	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	232.32	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	365.78	0.00	0.00	1192.83	0.00	0.00

Singapore Base Case



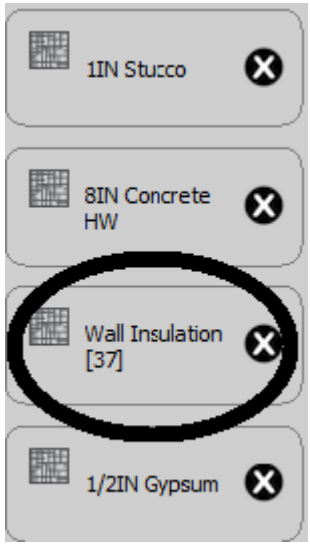
- Constant outside temperature during all year (26.6°C)
- Only cooling required

The second part of this project regards the evaluation of the same commercial buiding located in Piacenza with different characteristics. The analysis consists of four distinct cases. The goal is to compare the Piacenza Base Case with a building which presents other components.

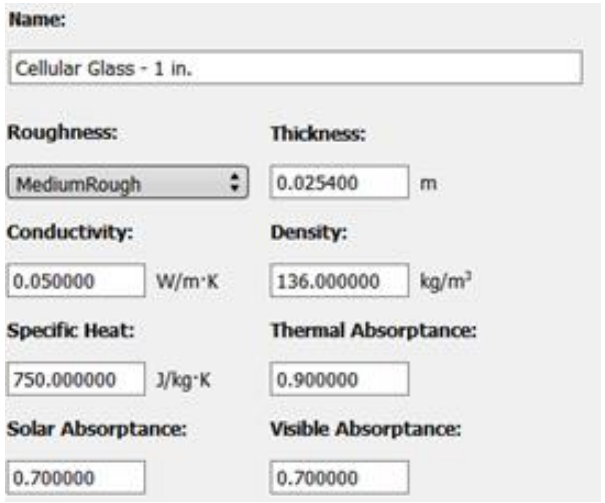
Walls:

Piacenza Base Case:

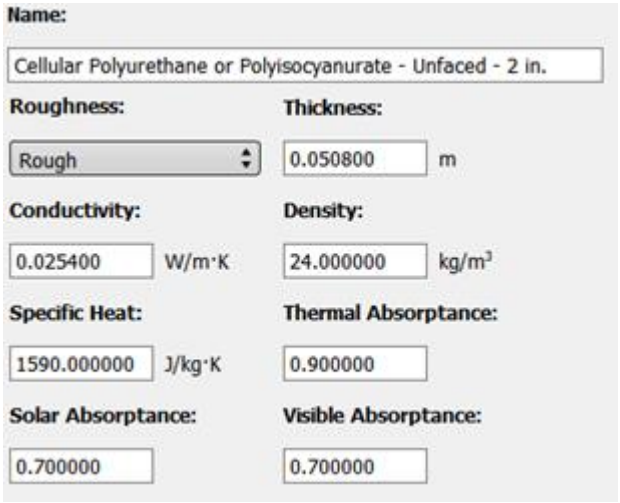
Default CZ4 walls



Less performing walls: Wall Insulation replaced with Cellular Glass



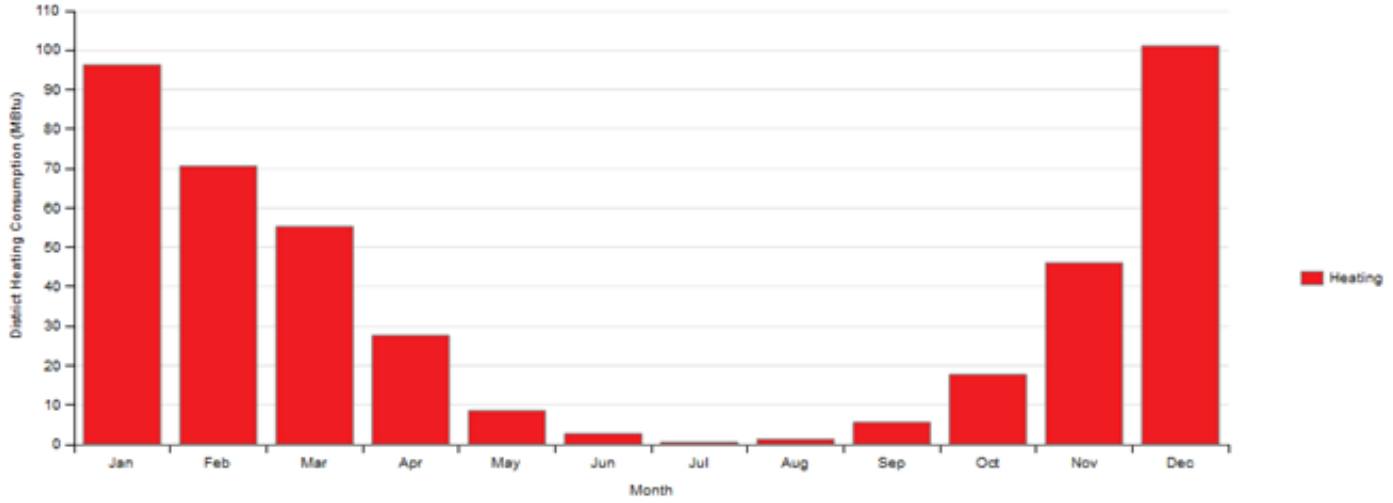
More performing walls: Wall Insulation replaced with Cellular Polyurethane



Total Heating Load

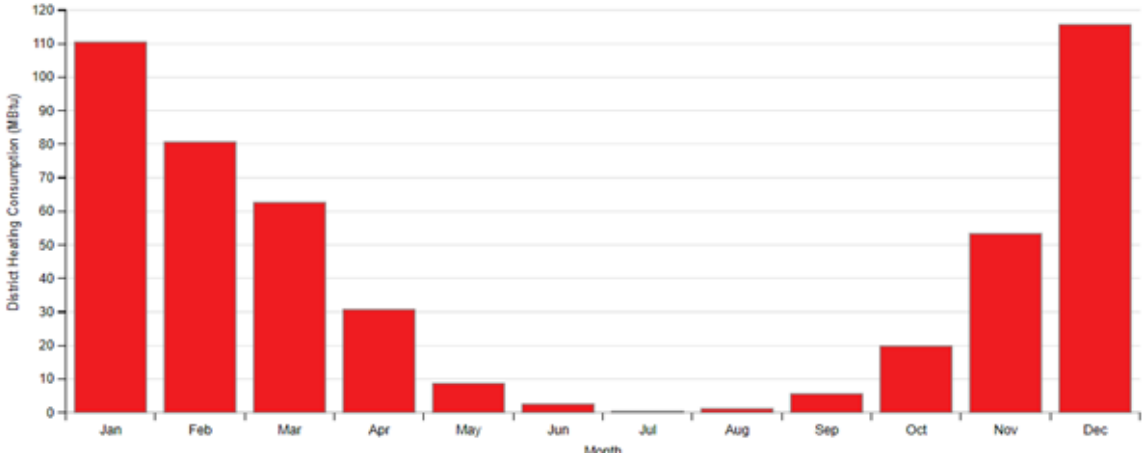
Piacenza Base Case

457.29 GJ



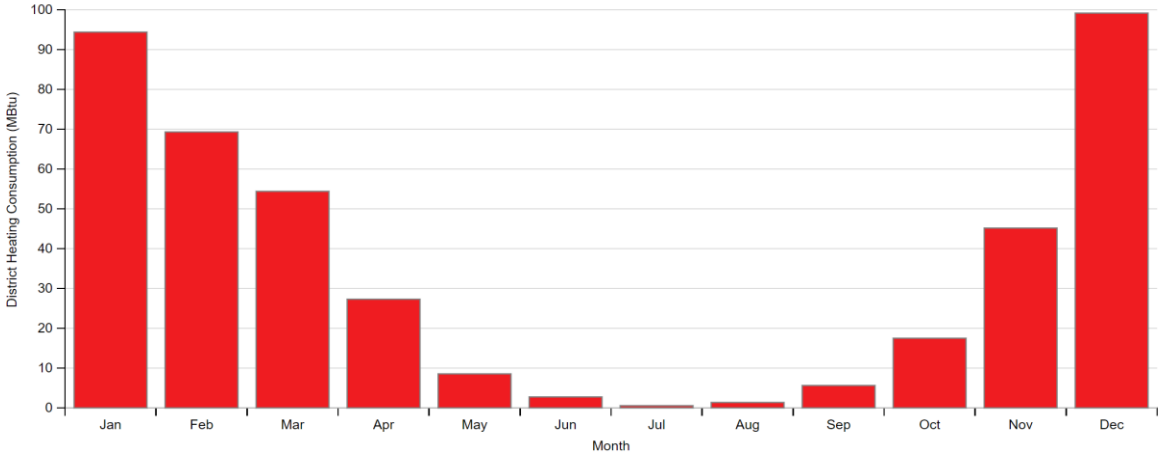
Less performing walls

518.59 GJ



More performing walls

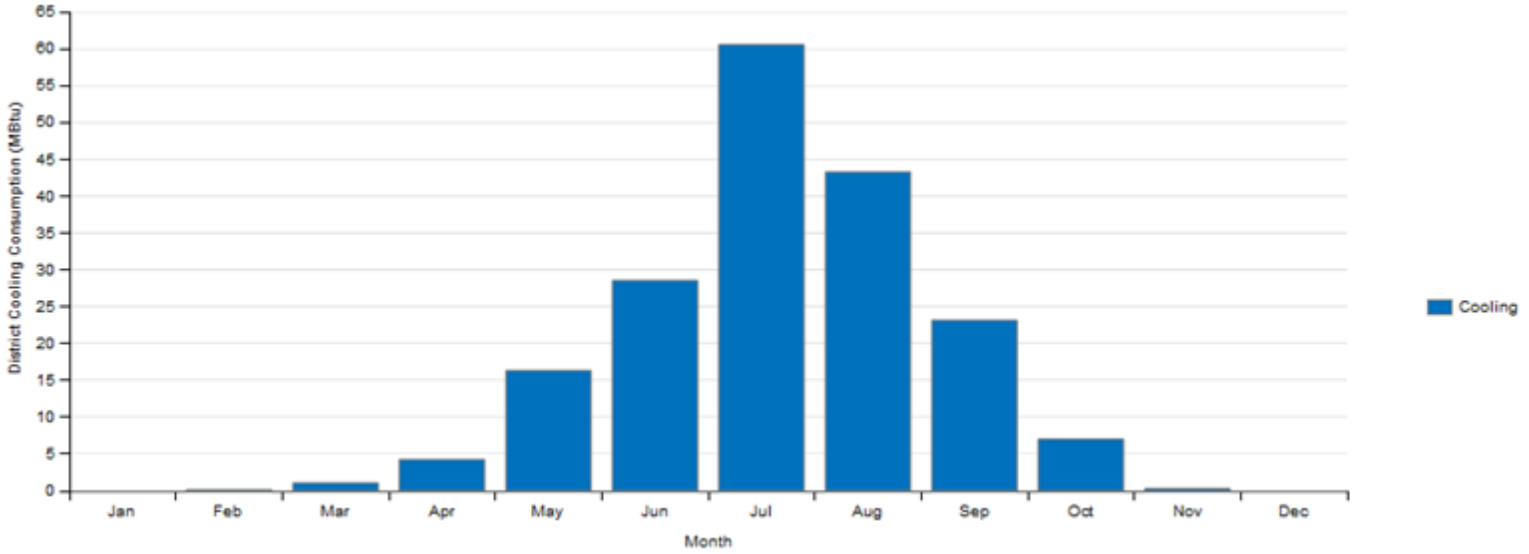
449.47 GJ



Total Cooling Load

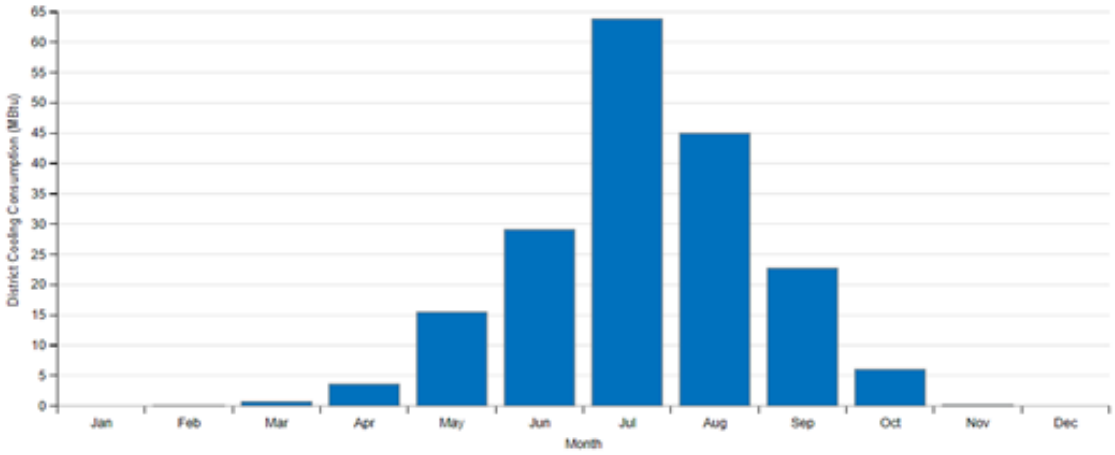
Piacenza Base Case

194.93 GJ



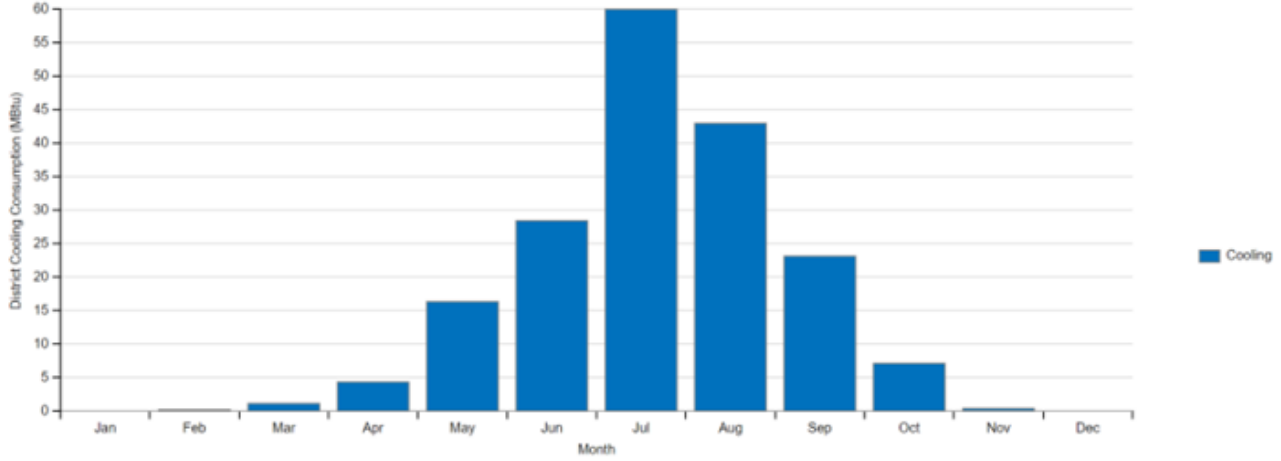
Less performing walls

196.60 GJ



More performing walls

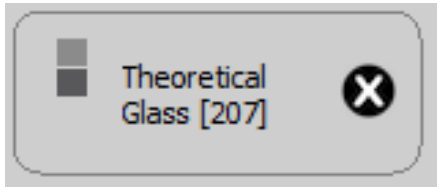
193.96 GJ

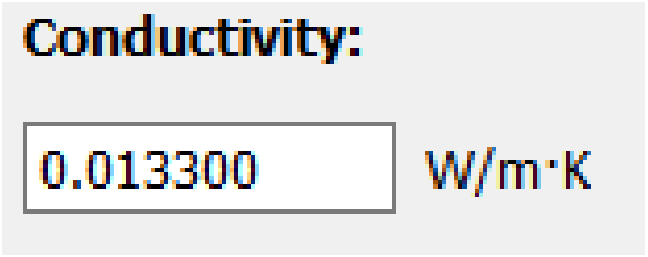


Windows:

Piacenza
Base Case:

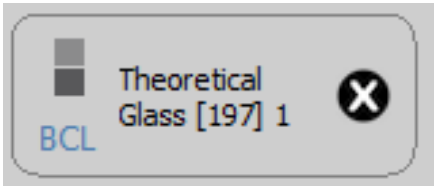
Default CZ4 windows

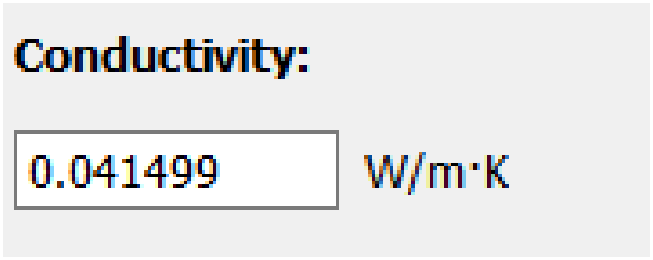




Less performing windows:

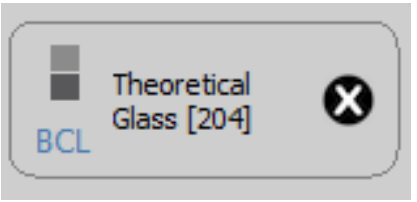
Theoretical Glass [207] replaced with Theoretical Glass [197]

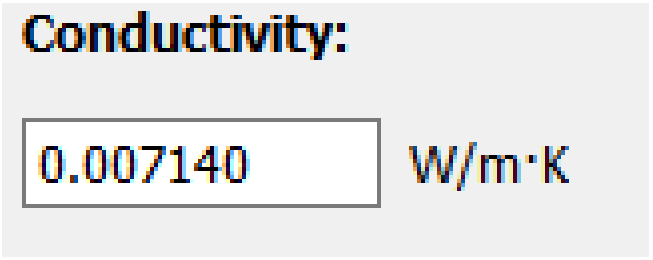




More performing windows:

Theoretical Glass [207] replaced with Theoretical Glass [204]

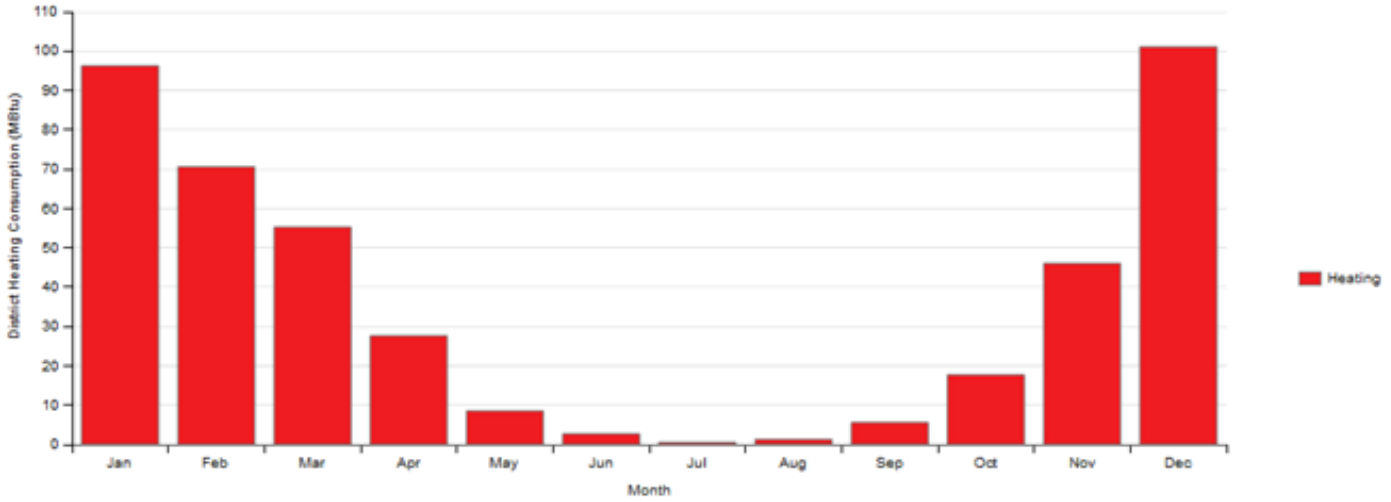




Total Heating Load

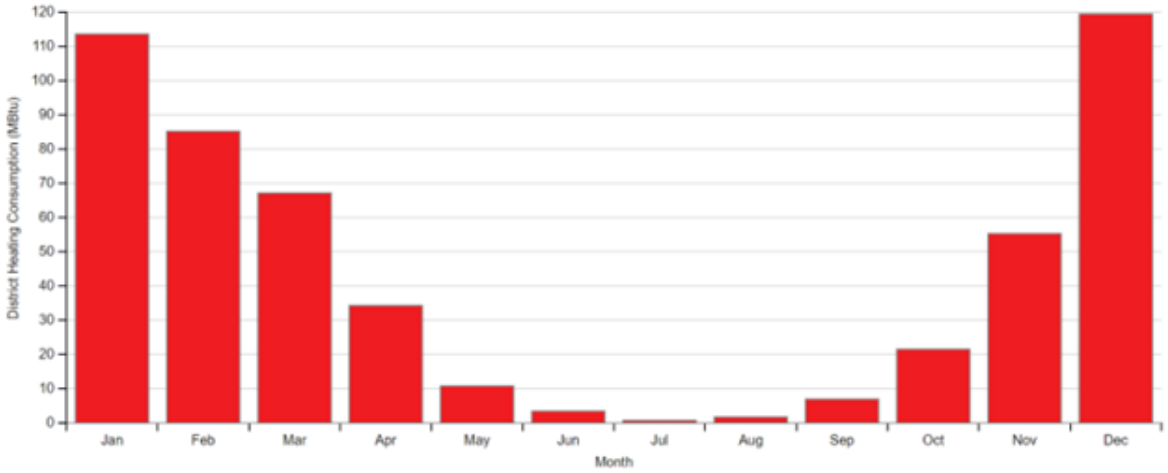
Piacenza Base Case

457.29 GJ



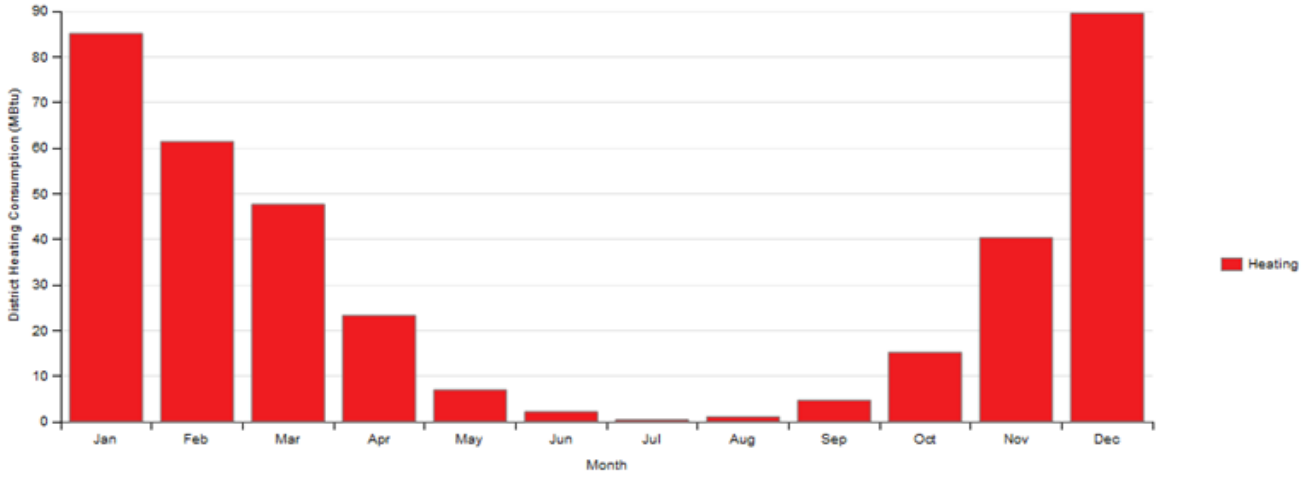
Less performing windows

548.53 GJ



More performing windows

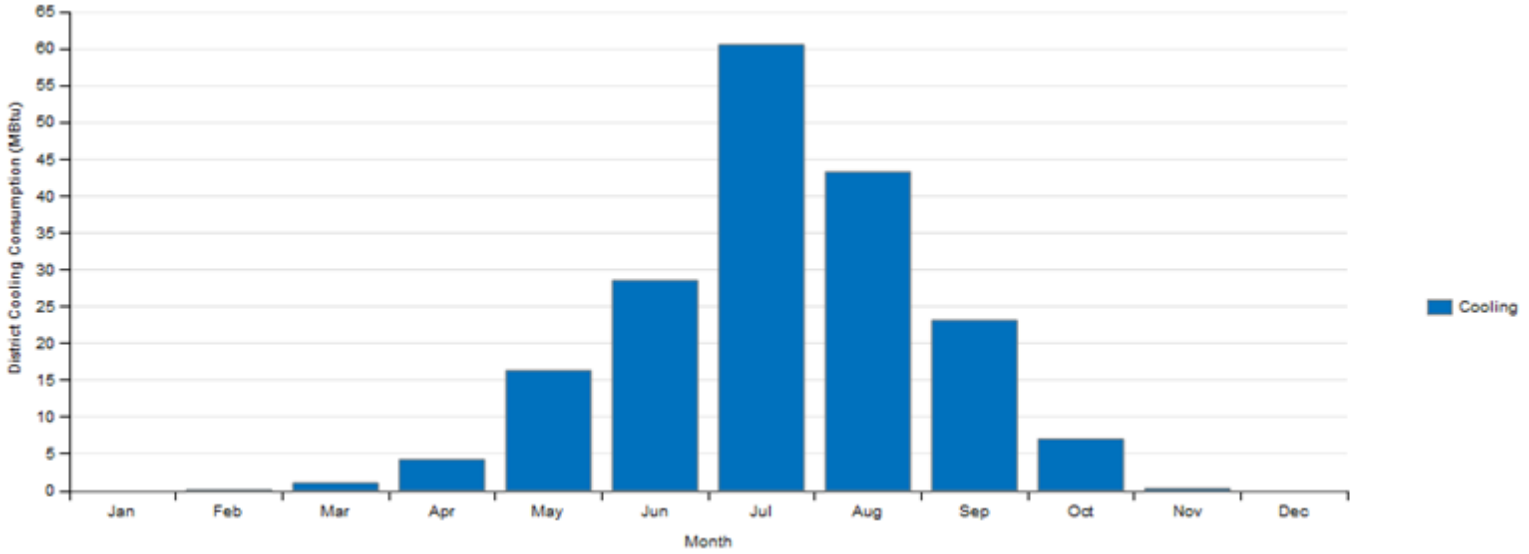
398.79GJ



Total Cooling Load

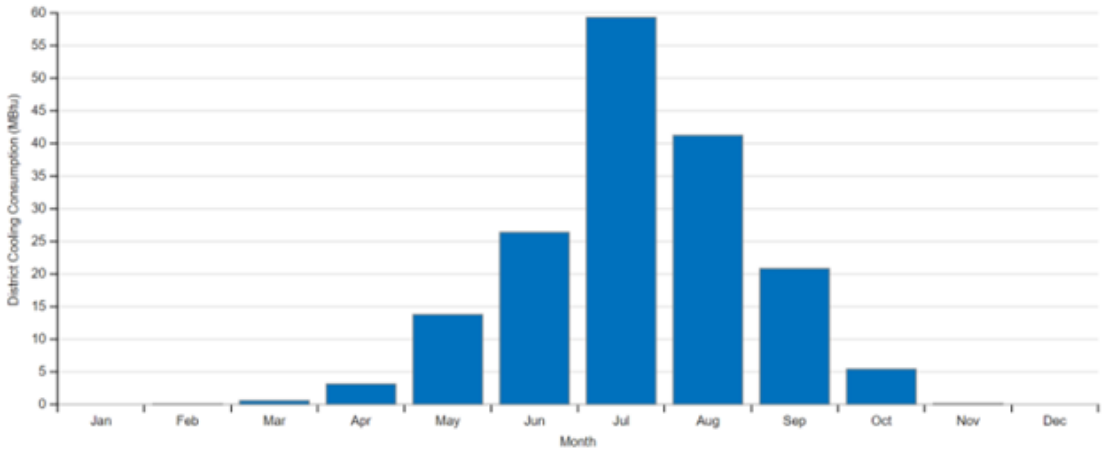
Piacenza Base Case

194.93 GJ



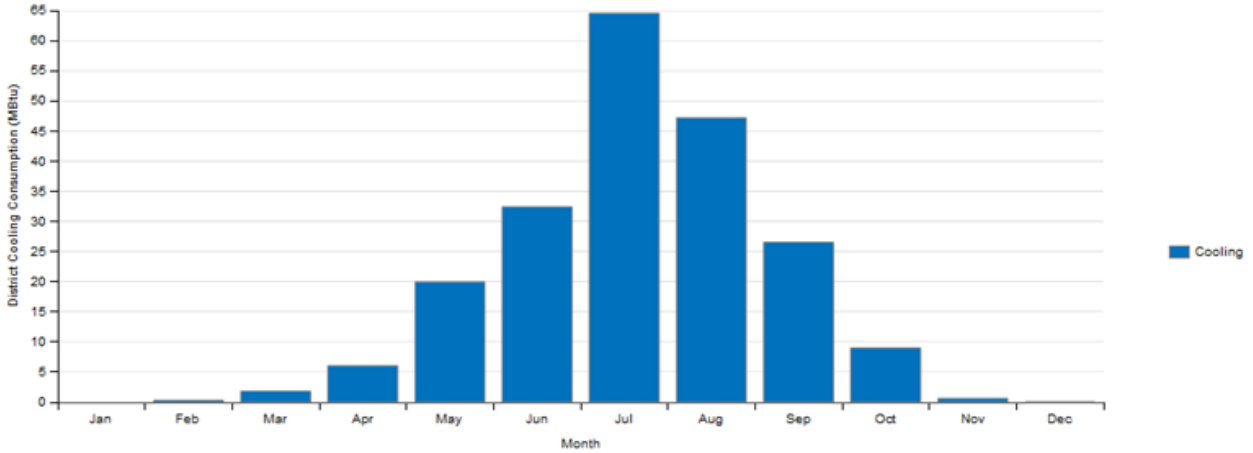
Less performing windows

180.30 GJ



More performing windows

219.94 GJ



Conclusion:

- ***Walls:***

  as expected a better insulation decreases the total load both in winter and in summer condition, while in the opposite case the load increases.

- ***Windows:***

  a more performing fenestration decreases the heating load, while a less performing one increases the heating load. The effect is way higher then in the walls case.

  In summer conditions the opposite effect occurs due to the optical characteristics of the glass. Anyway, this does not compromise the total load (heating+cooling).