Sustainable Architecture and Landscape Design

Assignment Report

Technical Environmental Systems

Prof. Renzo Marchesi

Prof. Behzad Najafi

Group Members

Dila Merve Pasmakcioglu 10597069

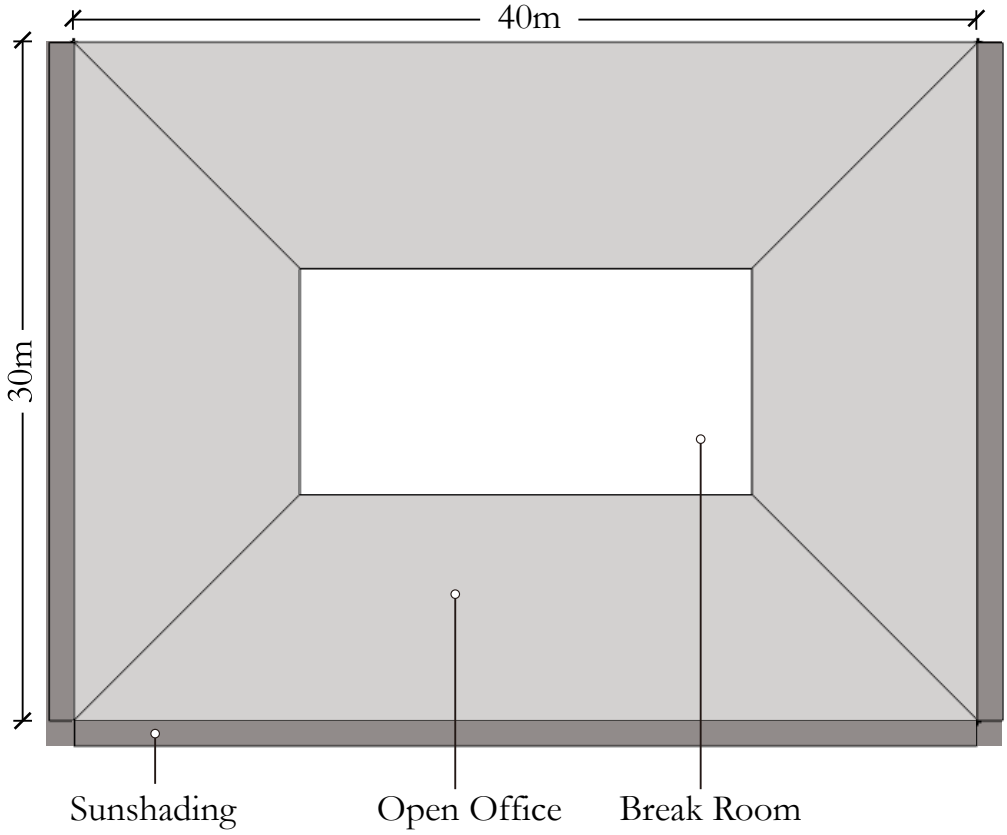
Turku Tunceri 10553069

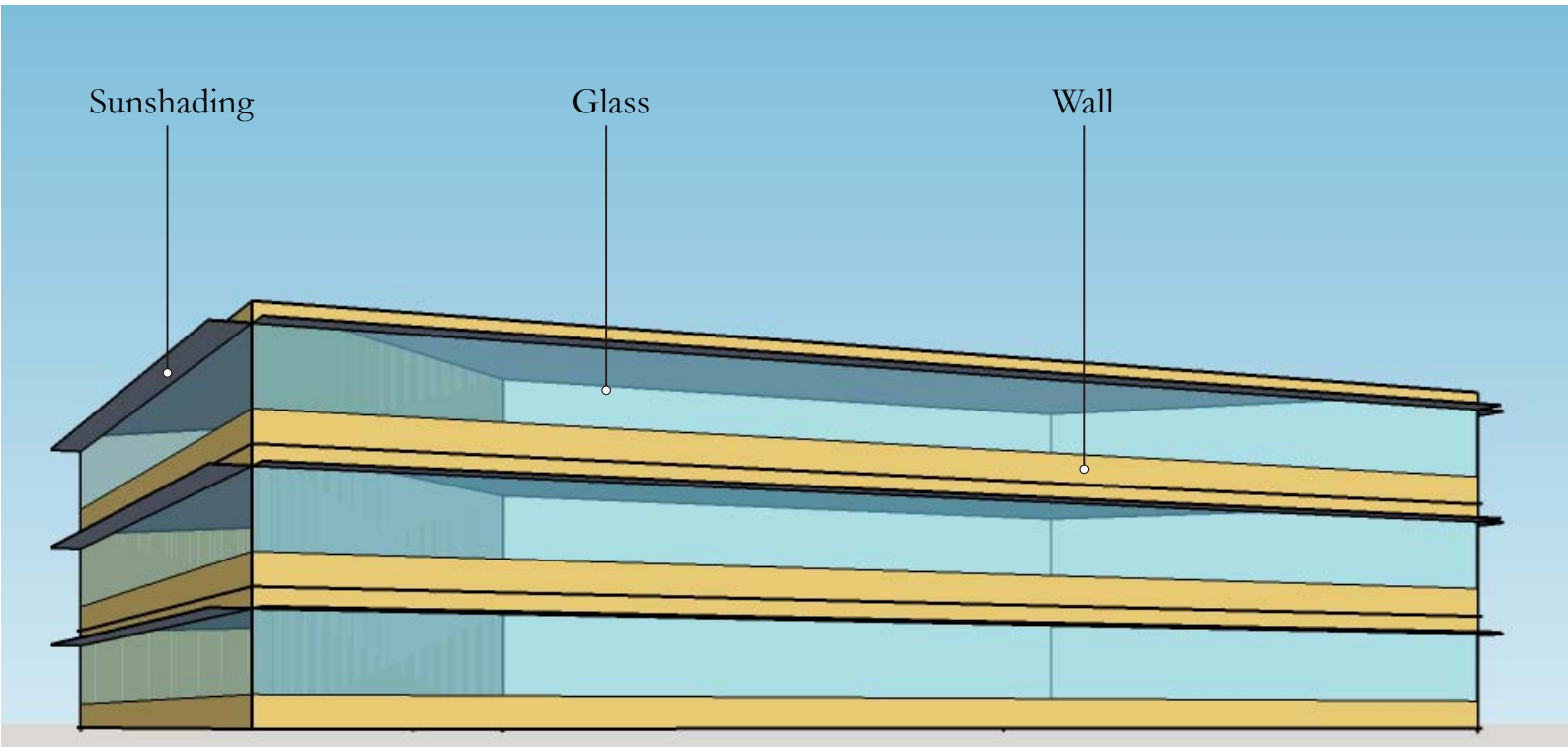
Enze Wu 10581888

Introduction

In this report, we considered the energy consumption of an office building, whose area is 3,600 sqm with 3 floors mainly consisting of open offices and break rooms. In terms of default condition, we took Piacenza as a basic city for building details. In order to have comparisons, we also took Shanghai and Moscow as the other two objective cites which have quite different weather comparing with Piacenza. In addition, we changed constructions of external walls to enhance the possibilities of sustainability. Here below is the building plan and information of the building we have chosen.

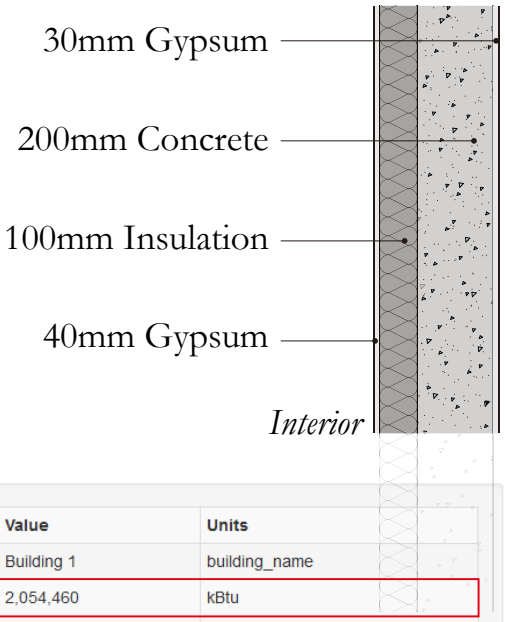
Building Type : Office
Area : 3,600 sqm
Height : 11m(36 inches)
Floors : 3
Location 1 : Piacenza
Location 2 : Shanghai
Location 3 : Moscow





Analysis 1_Piacenza_Wall 1

External Wall Detail_Type 1



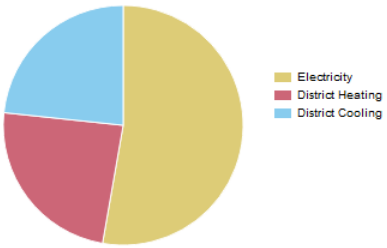
Weather Summary

	Value
Weather File	Piacenza - ITA IGDG WMO#=160840
Latitude	44.92
Longitude	9.73
Elevation	440 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,054,460	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	56.14	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

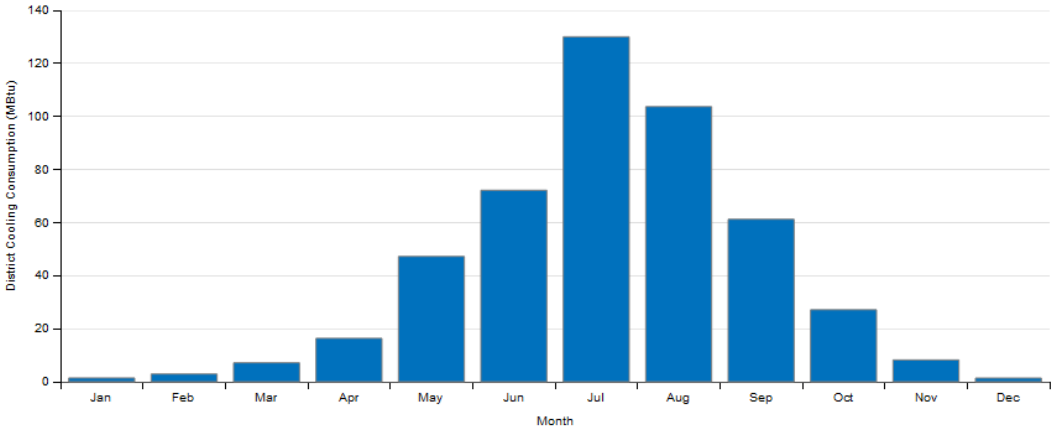


In this condition, the annual engergy consumption is about 2054450 kBtu, which equals to 602099.87 kWh.

From the fan chart, we know that more than half of the engergy are used in the form of elecricity. At the same time, district heating and cooling has almost the same value.

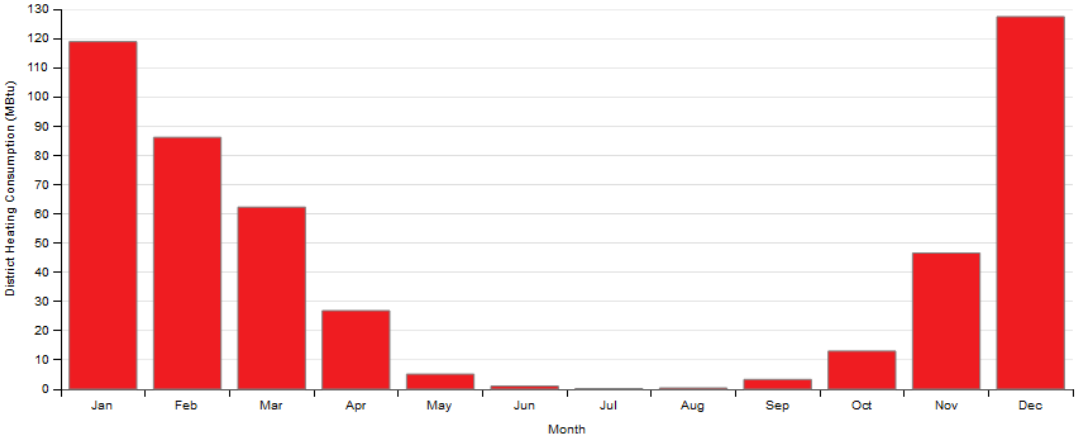
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. We can tell that both in winter and summer, the peak value goes to 120 kWh.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

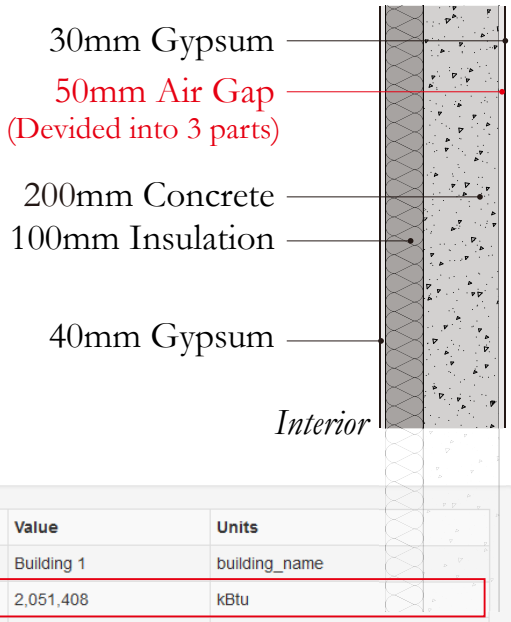
District Heating Consumption (MBtu) - view table



In winter, heating system consumes plent of energy.

Analysis 2_Piacenza_Wall 2

External Wall Detail_Type 2



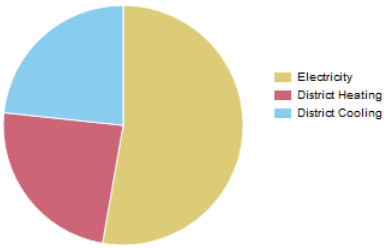
Weather Summary

	Value
Weather File	Piacenza - ITA IGDG WMO#=160840
Latitude	44.92
Longitude	9.73
Elevation	440 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,051,408	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	56.05	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

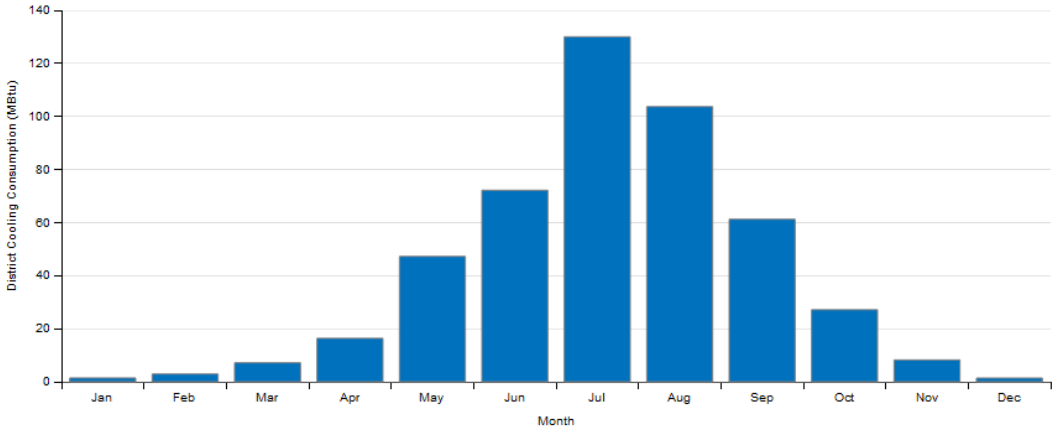


In this condition, the annual engergy consumption is about 2051408 kBtu, which equals to 601177.87 kWh.

From the fan chart, we know that more than half of the engergy are used in the form of elecricity. At the same time, district heating and cooling has almost the same value.

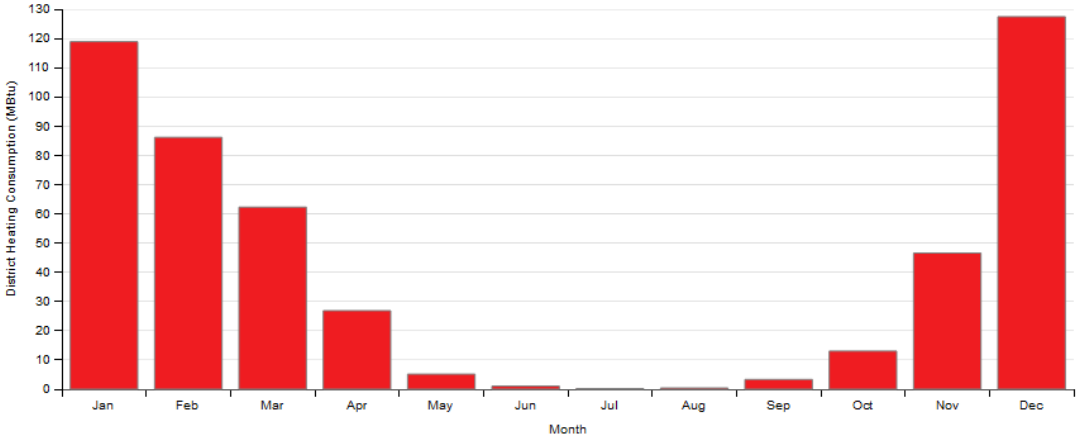
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. We can tell that both in winter and summer, the peak value goes to 120 kWh.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

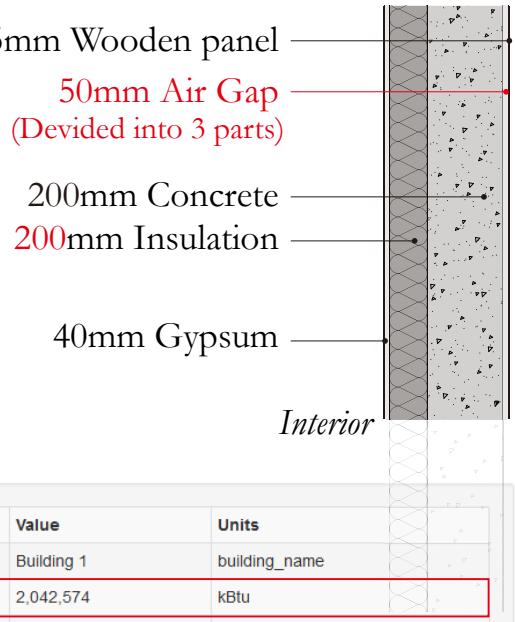
District Heating Consumption (MBtu) - view table



In winter, heating system consumes plent of energy.

Analysis 3_Piacenza_Wall 3

External Wall Detail_Type 3



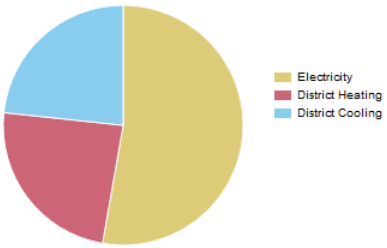
Weather Summary

	Value
Weather File	Piacenza - ITA IGDG WMO#=160840
Latitude	44.92
Longitude	9.73
Elevation	440 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,042,574	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	55.81	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

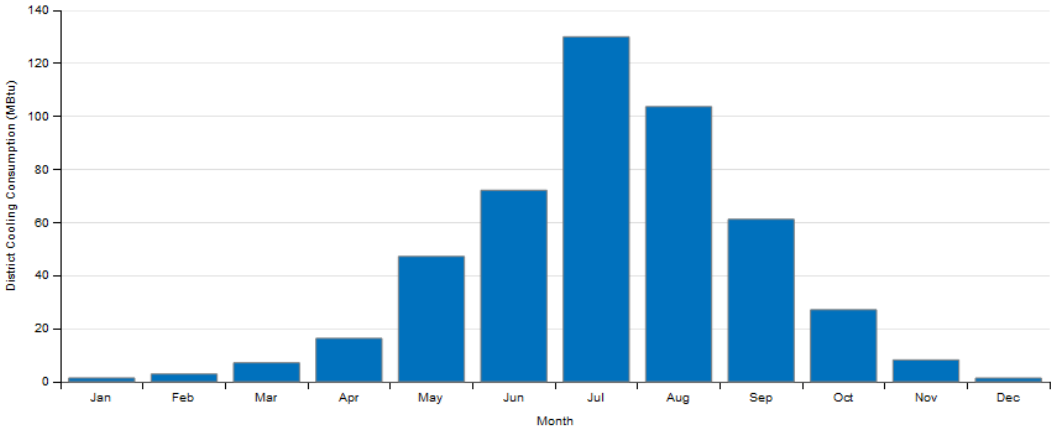


In this condition, the annual engergy consumption is about 2042574 kBtu, which equals to 598619.36 kWh.

From the fan chart, we know that more than half of the engergy are used in the form of elecricity. At the same time, district heating and cooling has almost the same value.

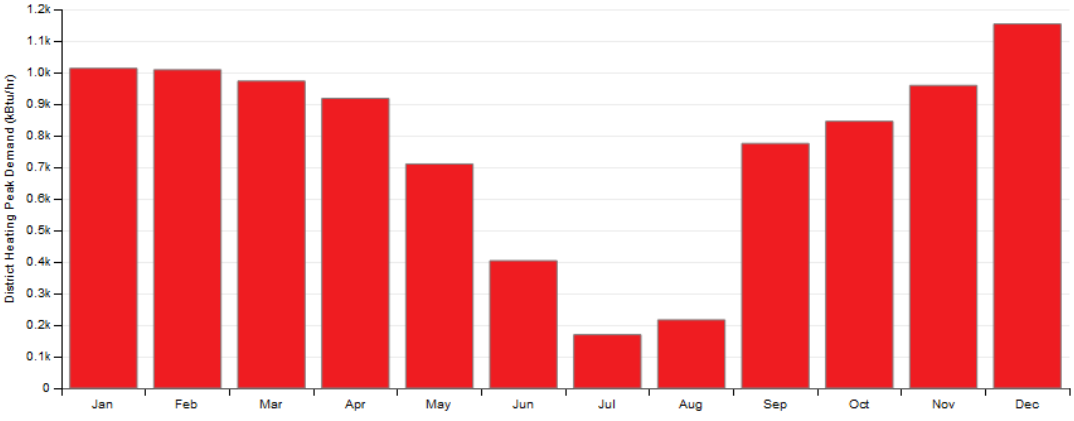
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. We can tell that both in winter and summer, the peak value goes to 120 kWh.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

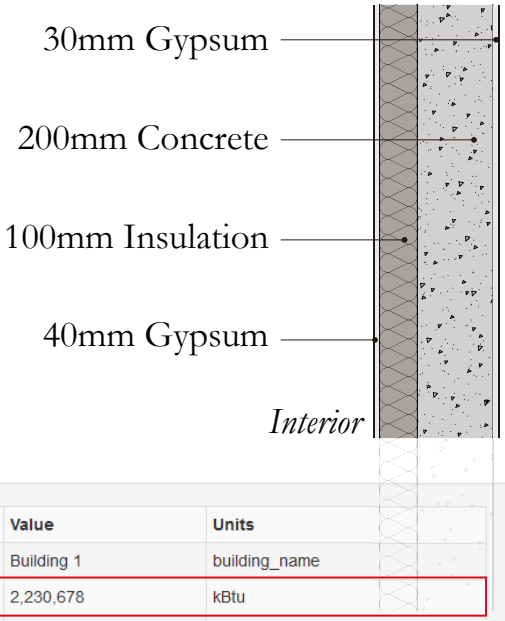
District Heating Peak Demand (kBtu/hr) - view table



In winter, heating system consumes plent of energy.

Analysis 1_Shanghai_Wall 1

External Wall Detail_Type 1



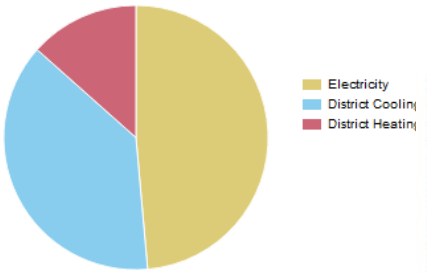
Weather Summary

	Value
Weather File	SHANGHAI/HONGQIAO - CHN SWERA WMO#=583620
Latitude	31.17
Longitude	121.43
Elevation	23 (ft)
Time Zone	8.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,230,678	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	60.95	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

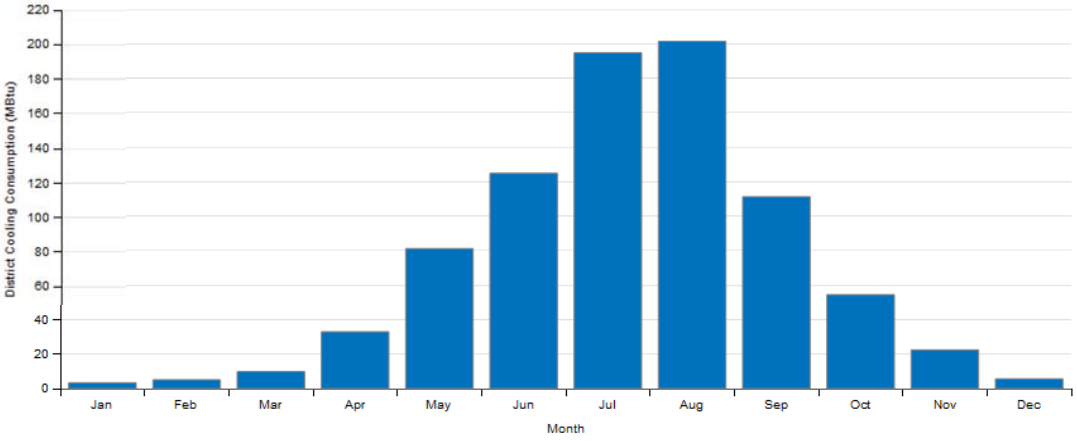


In this condition, the annual engergy consumption is about 2230678 kBtu, which equals to 653747.2 kWh.

From the fan chart, we know that almost half of the engergy are used in the form of elecricity. At the same time, district cooling engergy using is nearly 3 times than heating.

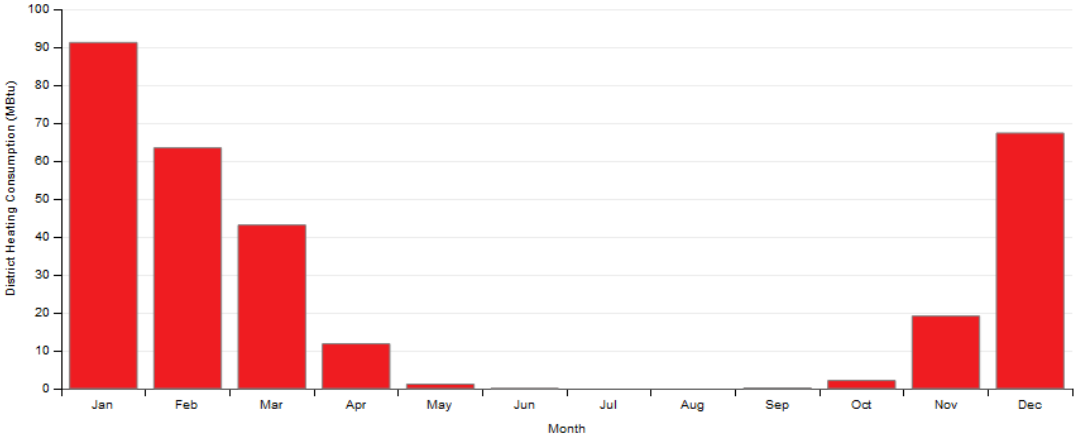
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. Also the peak energy consumption of cooling is much more than the value of heating.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

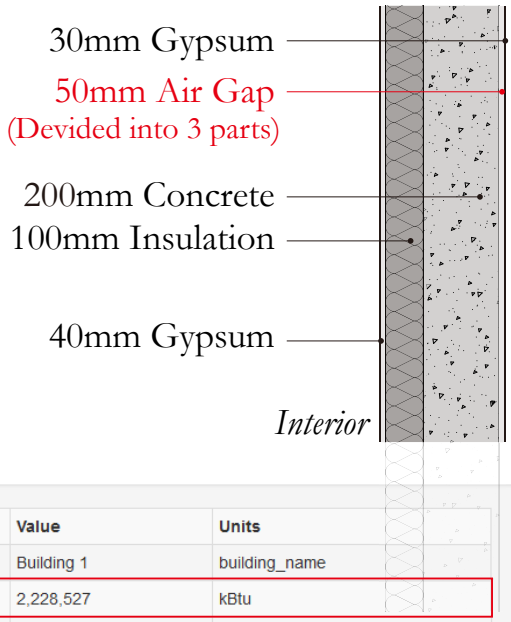
District Heating Consumption (MBtu) - view table



In winter, heating system consumes plent of energy.

Analysis 2_Shanghai_Wall 2

External Wall Detail_Type 2



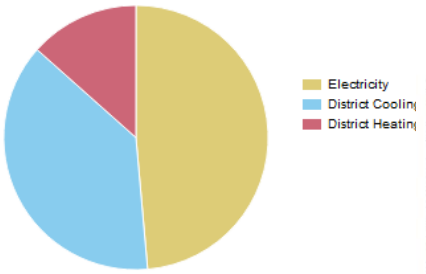
Weather Summary

	Value
Weather File	SHANGHAI/HONGQIAO - CHN SWERA WMO#=583620
Latitude	31.17
Longitude	121.43
Elevation	23 (ft)
Time Zone	8.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,228,527	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	60.89	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

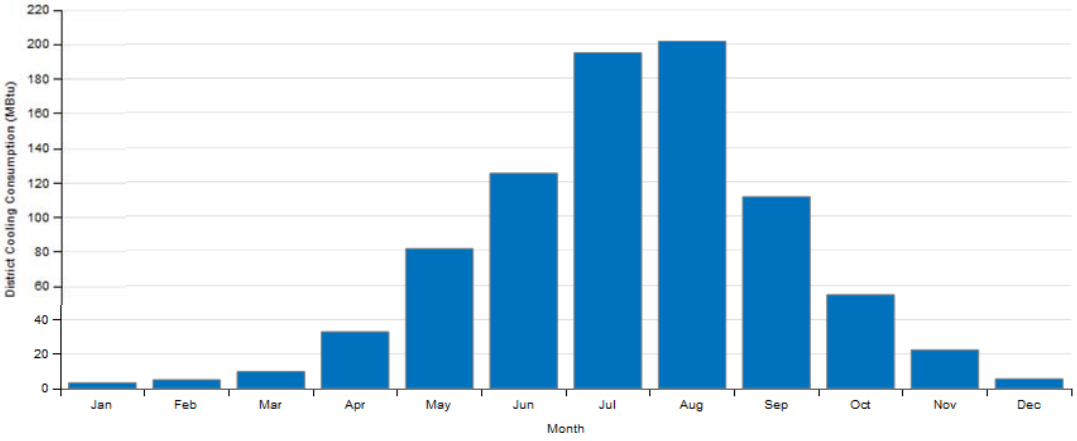


In this condition, the annual engergy consumption is about 2228527 kBtu, which equals to 653116.81kWh.

From the fan chart, we know that almost half of the engergy are used in the form of elecricity. At the same time, district cooling engergy using is nearly 3 times than heating.

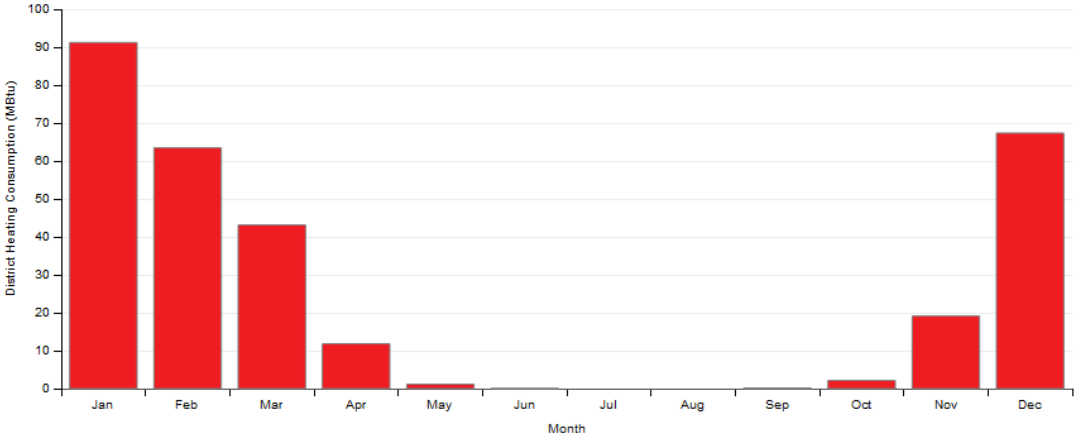
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. Also the peak energy consumption of cooling is much more than the value of heating.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

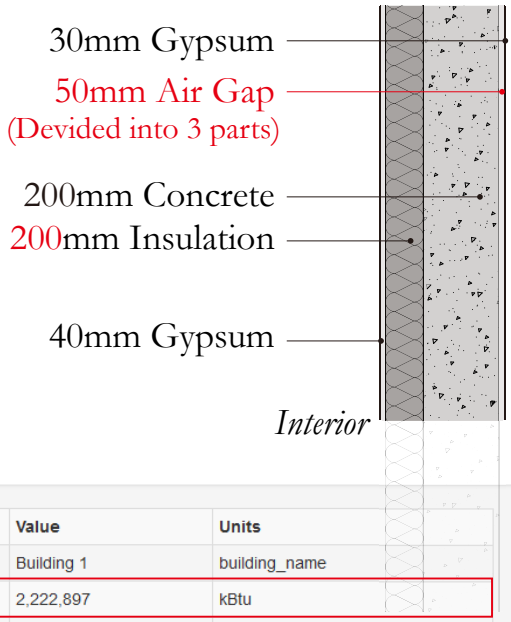
District Heating Consumption (MBtu) - view table



In winter, heating system consumes plent of energy.

Analysis 3_Shanghai_Wall 3

External Wall Detail_Type 3



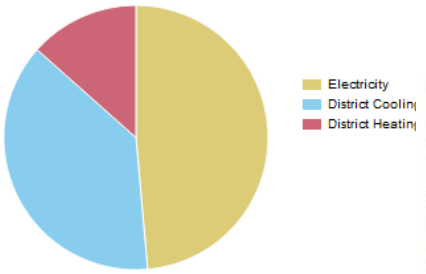
Weather Summary

	Value
Weather File	SHANGHAI/HONGQIAO - CHN SWERA WMO#=583620
Latitude	31.17
Longitude	121.43
Elevation	23 (ft)
Time Zone	8.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,222,897	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	60.74	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

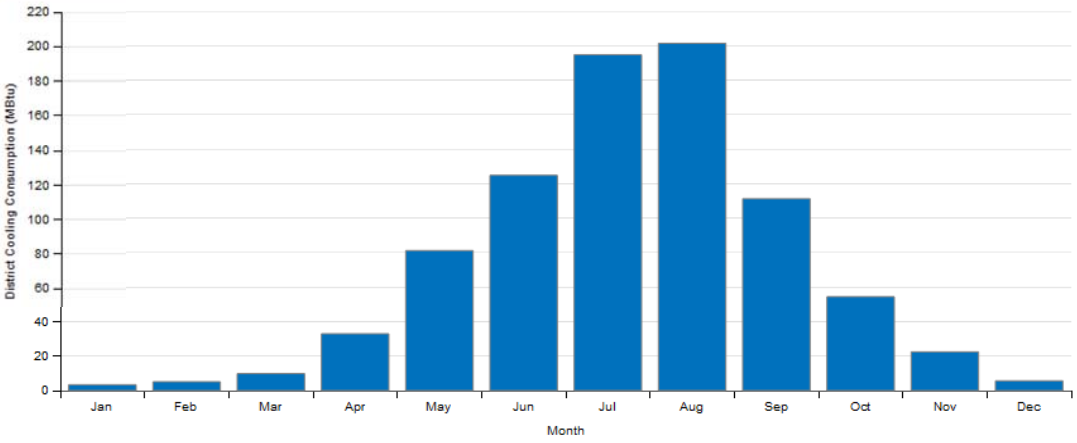


In this condition, the annual engergy consumption is about 2222897 kBtu, which equals to 651466.82kWh.

From the fan chart, we know that almost half of the engergy are used in the form of elecricity. At the same time, district cooling engergy using is nearly 3 times than heating.

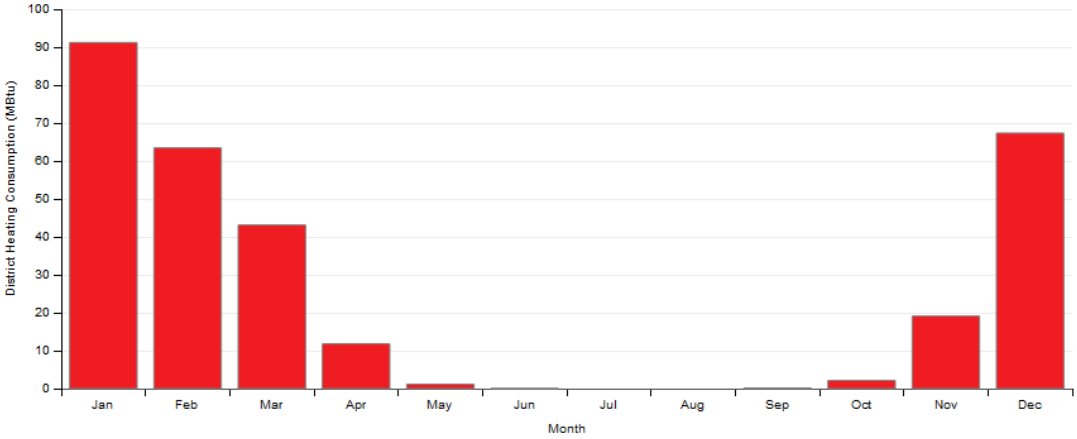
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. Also the peak energy consumption of cooling is much more than the value of heating.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

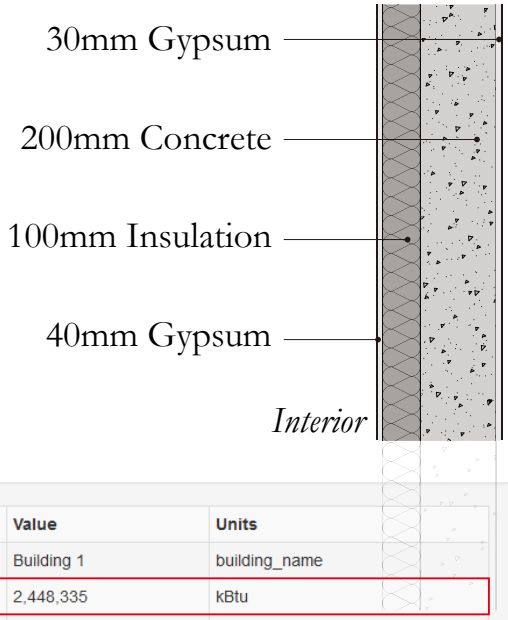
District Heating Consumption (MBtu) - view table



In winter, heating system consumes plent of energy.

Analysis 1_Moscow_Wall 1

External Wall Detail_Type 1



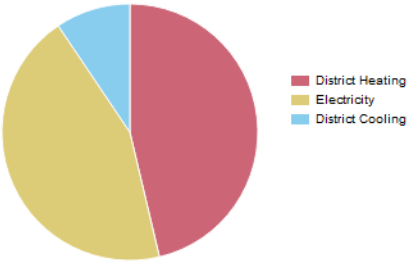
Weather Summary

	Value
Weather File	MOSCOW - RUS IWEC Data WMO#=276120
Latitude	55.75
Longitude	37.63
Elevation	512 (ft)
Time Zone	3.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,448,335	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	66.90	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

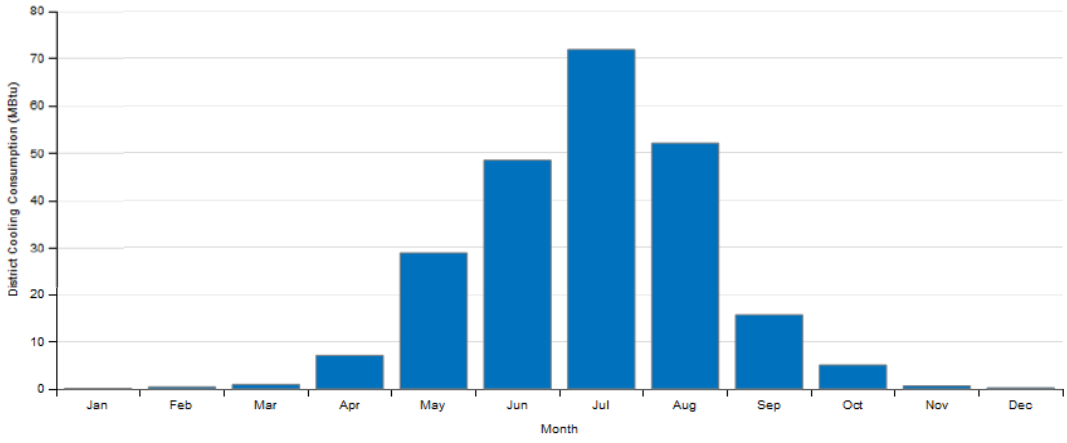


In this condition, the annual engergy consumption is about 2448335 kBtu, which equals to 717536.17 kWh.

From the fan chart, we know that district heating has alomst the same value as the electricity energy consumption, which is almost 5 times as cooling.

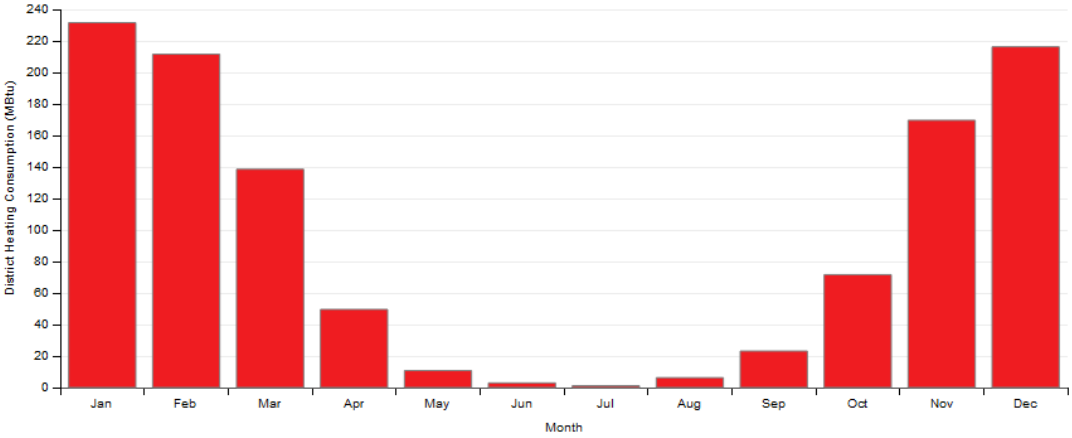
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. We can tell that the monthly peak value for heating is much more than cooling in summer, which reaches to 220 kWh.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

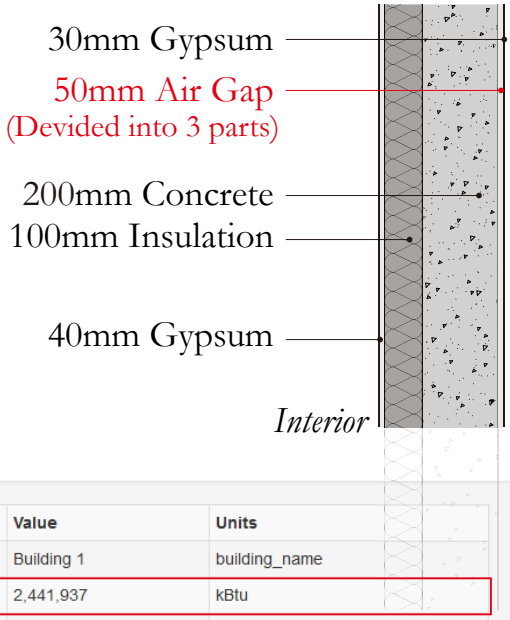
District Heating Consumption (MBtu) - view table



In winter, heating system consumes plent of energy.

Analysis 2_Moscow_Wall 2

External Wall Detail_Type 2



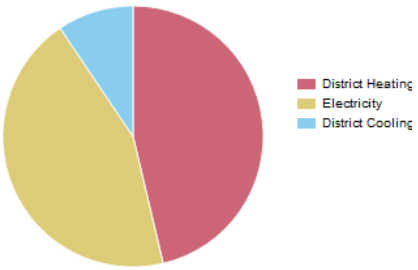
Weather Summary

	Value
Weather File	MOSCOW - RUS IWEC Data WMO#=276120
Latitude	55.75
Longitude	37.63
Elevation	512 (ft)
Time Zone	3.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,441,937	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	66.72	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

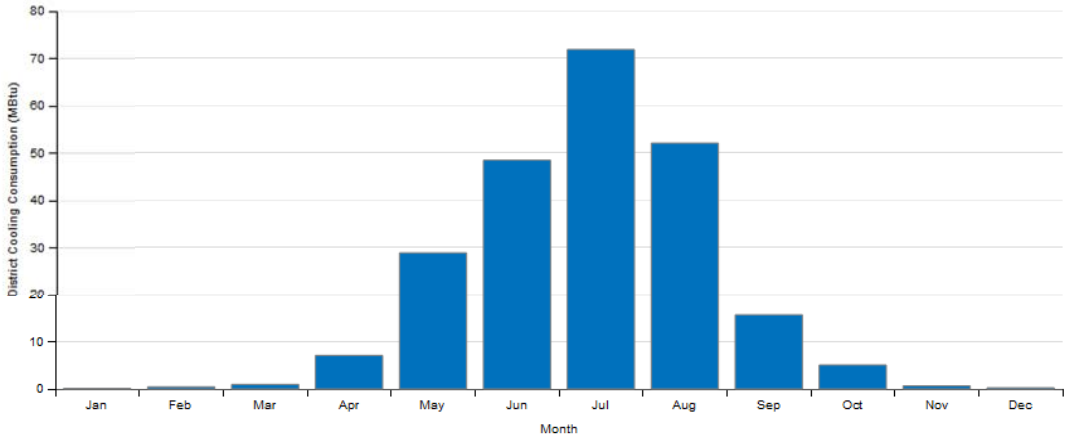


In this condition, the annual engergy consumption is about 2441937 kBtu, which equals to 715661.11 kWh.

From the fan chart, we know that district heating has alomst the same value as the electricity energy consumption, which is almost 5 times as cooling.

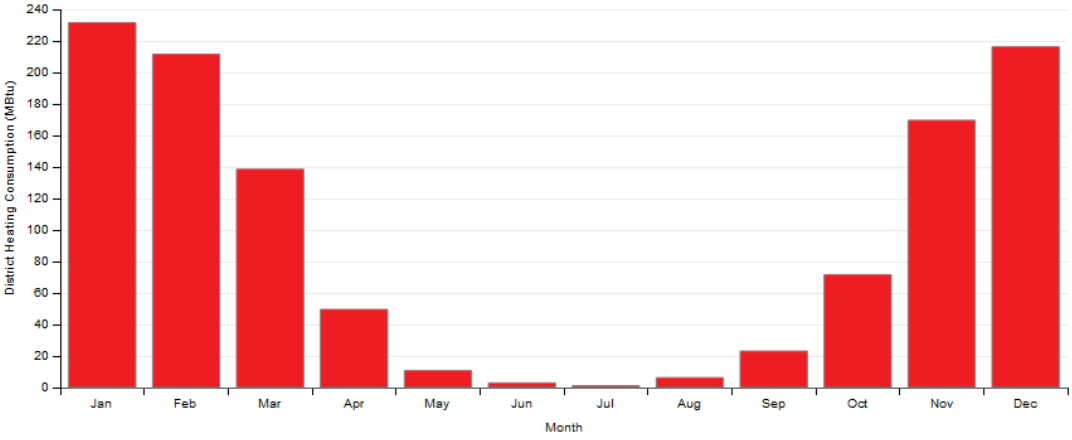
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. We can tell that the monthly peak value for heating is much more than cooling in summer, which reaches to 220 kWh.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

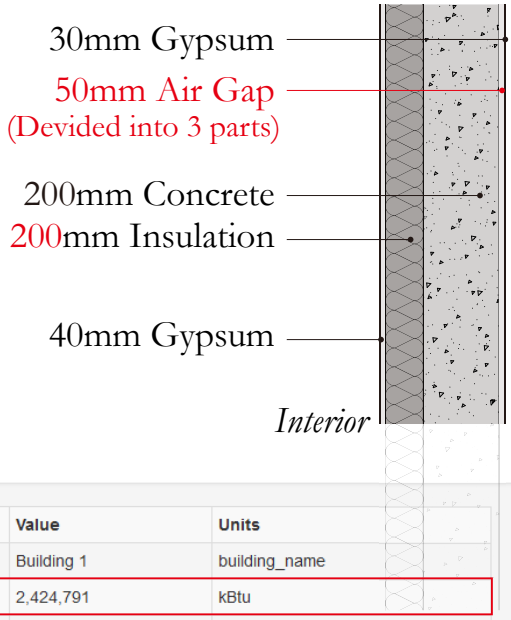
District Heating Consumption (MBtu) - view table



In winter, heating system consumes plent of energy.

Analysis 3_Moscow_Wall 3

External Wall Detail_Type 3



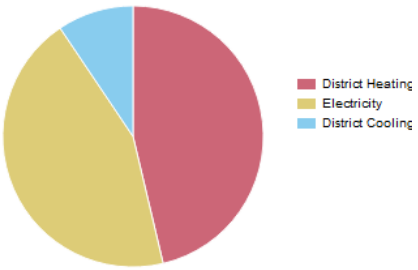
Weather Summary

	Value
Weather File	MOSCOW - RUS IWEC Data WMO#=276120
Latitude	55.75
Longitude	37.63
Elevation	512 (ft)
Time Zone	3.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,424,791	kBtu
Total Building Area	36,597	ft^2
EUI (Based on Net Site Energy and Total Building Area)	66.26	kBtu/ft^2
OpenStudio Standards Building Type		

Energy Use - view table

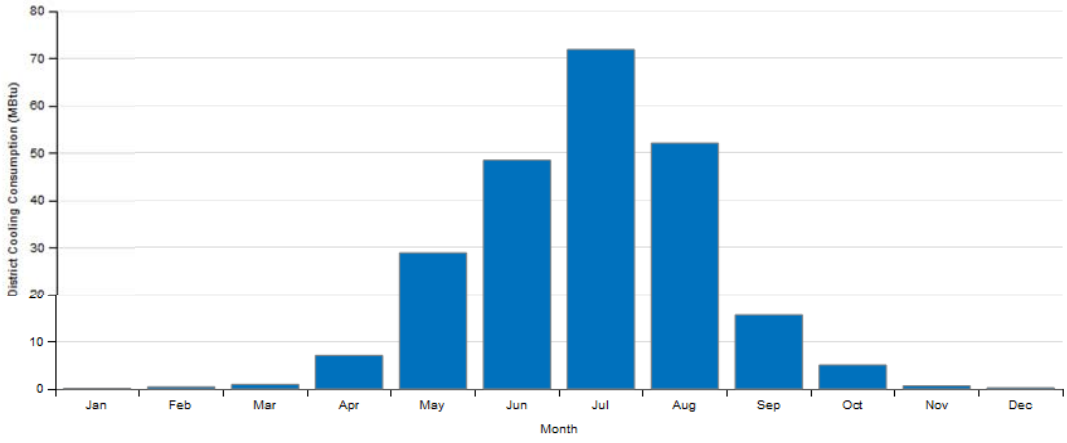


In this condition, the annual engergy consumption is about 2424791 kBtu, which equals to 710636.11 kWh.

From the fan chart, we know that district heating has alomst the same value as the electricity energy consumption, which is almost 5 times as cooling.

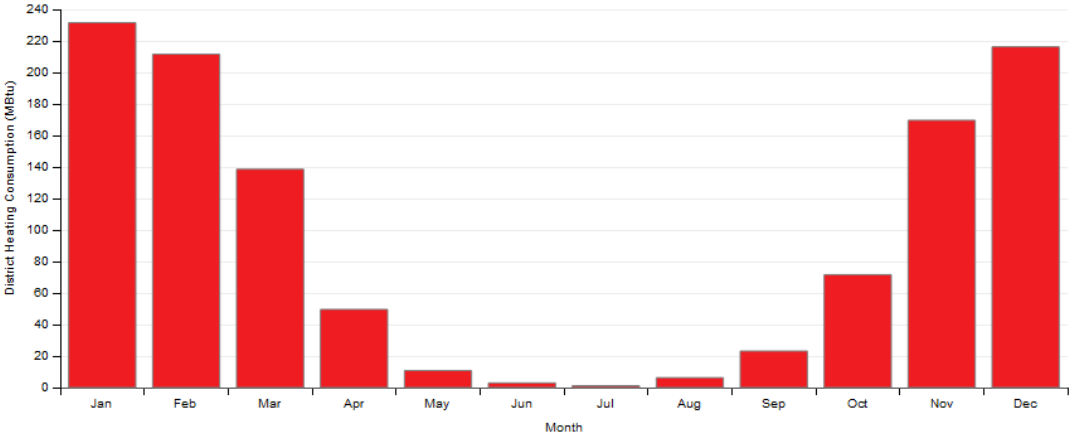
From the other two bar charts, we analyse monthly value of energy consumption in cooling and heating. We can tell that the monthly peak value for heating is much more than cooling in summer, which reaches to 220 kWh.

District Cooling Consumption (MBtu) - view table



In summer, cooling system consumes plent of energy.

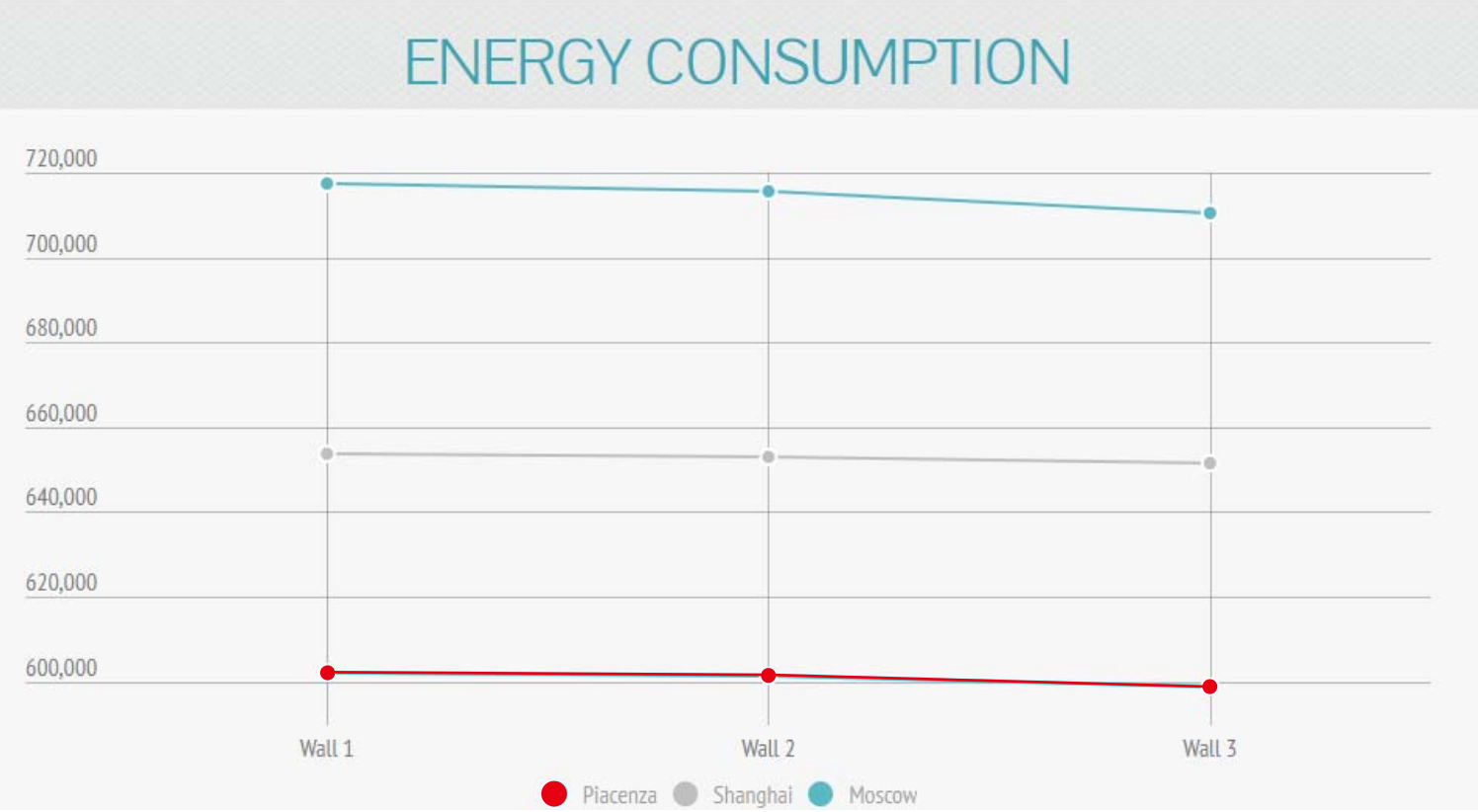
District Heating Consumption (MBtu) - view table



In winter, heating system consumes plent of energy.

Comparision

Here below is the chart of annual energy consumption in different conditions.



Decreasing Energy Consumption by Changing Walls (Units, kWh)							
	Wall 1	Wall 2	Wall 3	Difference_1 (Value)	Difference _1 (Percentage)	Difference_2 (Value)	Difference _2 (Percentage)
Piacenza	602099.87	601208.35	598619.36	891.52	0.15%	3480.51	0.58%
Shanghai	653747.2	653116.81	651466.82	630.39	0.10%	2280.38	0.35%
Moscow	717536.17	715667.11	710636.11	1869.06	0.26%	6900.06	0.96%

*Difference_1 is decreasing energy consumption while comparing Wall 2 with Wall 1.
*Difference_2 is decreasing energy consumption while comparing Wall 3 with Wall 2.

Increasing Energy Consumption by Changing Cities (Units, kWh)							
	Piacenza	Shanghai	Moscow	Difference_3 (Value)	Difference _3 (Percentage)	Difference_4 (Value)	Difference _4 (Percentage)
Wall 1	602099.87	653747.2	717536.17	51647.33	8.58%	115436.3	19.17%
Wall 2	601208.35	653116.81	715667.11	51908.46	8.63%	114458.76	19.04%
Wall 3	598619.36	651466.82	710636.11	52847.46	8.83%	112016.75	18.71%

*Difference_3 is increasing energy consumption while comparing Shanghai with Piacenza.
*Difference_4 is increasing energy consumption while comparing Moscow with Piacenza.

After all the analysis, we have at least two kinds of comparisions.
The first one is to compare data based on the same type of wall but indifferent cities, which shows how the weather condition infulences the value of energy consumption. In this case, Piacenza has the least energy consumption.
The second one is to compare data based on different types of walls but in the same city, which shows how the building constructions affect the value of energy consumption. In this case, building constructed by wall type 3 has the least energy consumption because this kind of construction has air gap and double insulation layer than the first type.