

# BUILDING PERFORMANCE ANALYSIS

City Green Court / Richard Meier & Partners

Energy Plus + Open Studio Simulation

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# Building Performance Analysis

Energy Plus and Open Studio Simulation

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# Brief

In this project, a geometry of a commercial building should be first introduced in Sketch Up.  
The other characteristics of the building should be then defined using Open Studio.  
The later software should next be used to calculate the yearly heating and cooling consumption of the building for a base case.  
Next, a parametric study, should be conducted in order to investigate the effect of changing the position and wall characteristics on the building's yearly energy consumption.  
Accordingly, the simulation should be performed for three different cities and three different walls.  
The corresponding obtained yearly consumptions should be compared with the ones of the base case.

## Key words :

*commercial building, three cities, three envelopes, annual energy consumption*

# Content

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- 03 Methodology
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- 05 Conclusion

# 01 Introduction

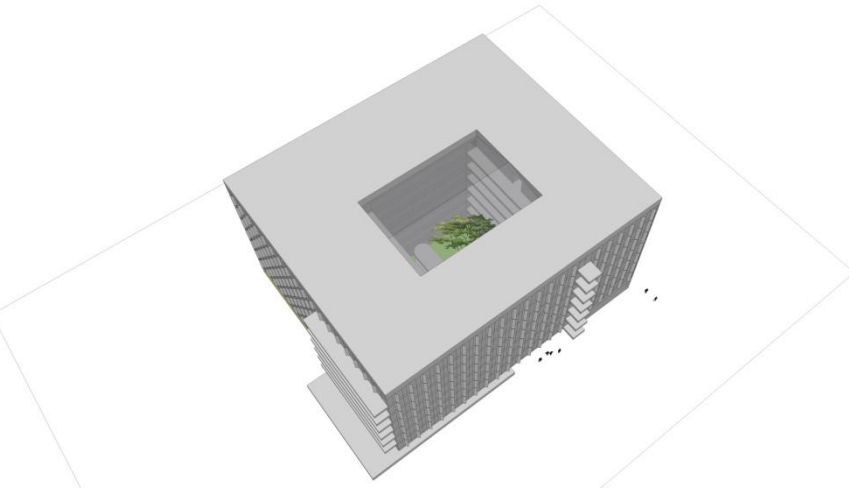
City Green Court, designed by Richard Meier & Partners, located in the Pankrac area of Prague. The building is conceived of as a geometric volume in dialogue with the near context while offering respected contrast to the surrounding buildings. It is equally inspired by the language of Czech Cubism, with a façade that while addressing issues of conservation and sustainability incorporates forms reminiscent of this avant-garde movement.

Distinctive vertical solid panels with fins, angled according to the sun orientation and integrated into the design of the curtain wall, emerge from both the south and west facades to minimize solar heat gain and to provide balanced shading and comfort towards the interiors. The combination of fin panels, clear vision glass and shadow box give the south and west facades a singular rhythm, texture and articulation.

City Green Court has achieved LEED Platinum certification by reducing energy consumption, efficient building envelope, natural ventilation of the atrium during the summer, state-of-the-art mechanical systems, reduction of water runoff and storm water collection, green roof, indoor air quality control and the use of local and recycled materials.



## 02 Building Characteristic



The building consists of 8 floors. Ground floor consist of lobby, break area and small leasable office, and the seven floor is open typical office function.

### Façade/ Building Envelope

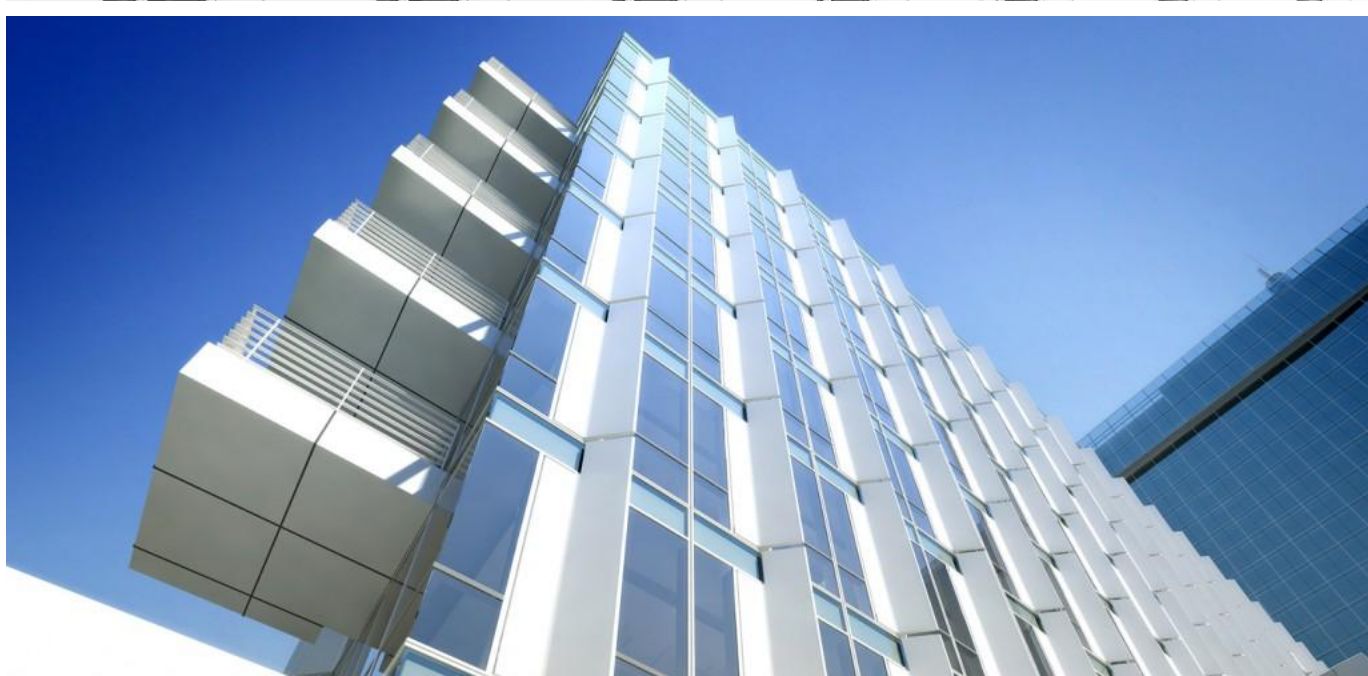
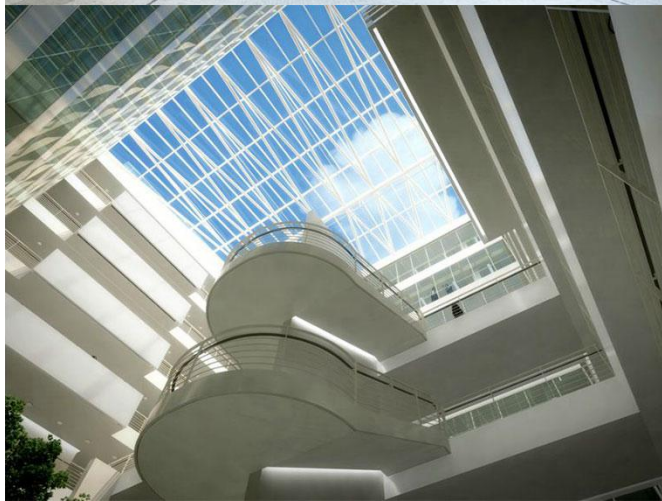
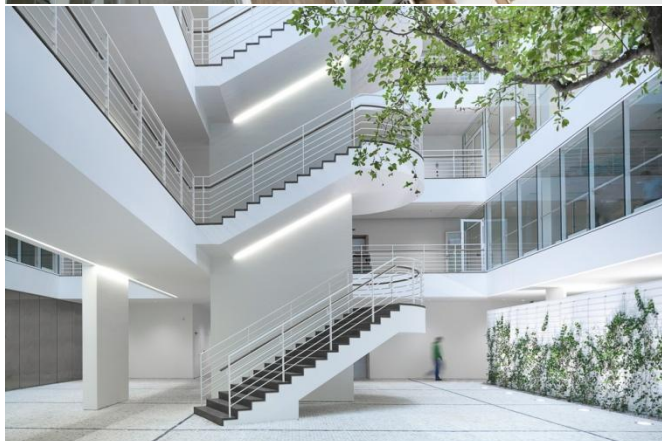
The South and West Façade consist of curtain wall 60 from slab level, with vertical fins as sun shading. North and East consist of curtain wall with similar pattern and ratio, but without vertical shading panels.



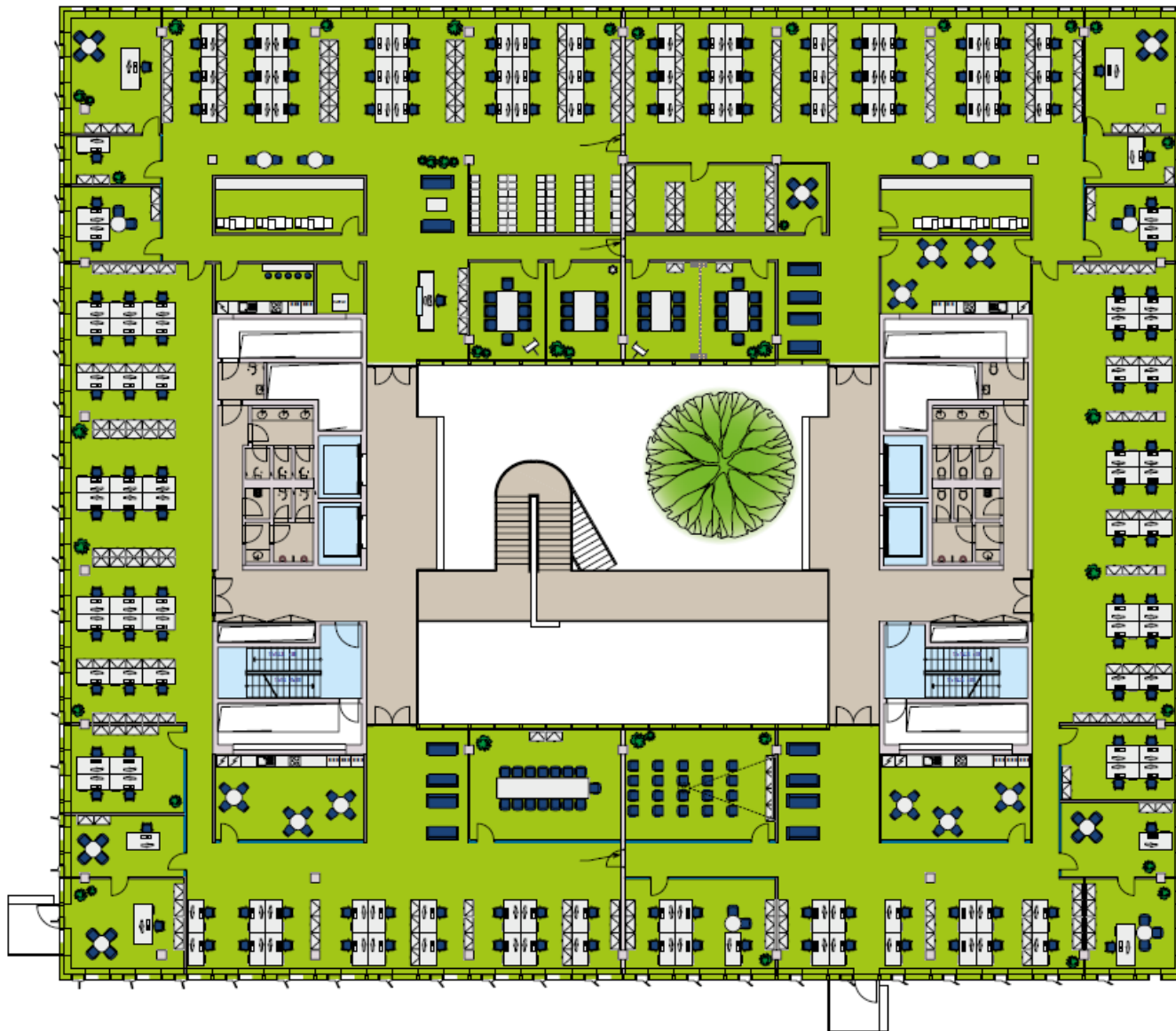
### Scope of Analysis

The building performance analysis is conducted in one typical floor of the building, as an area sample.





## 02 Building Characteristic

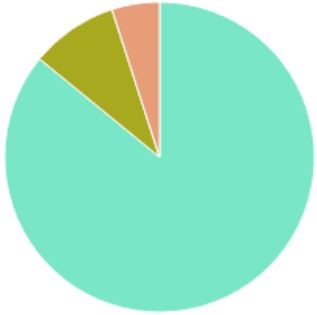


### Typical Floor Plans

- Open Office
- Common Area

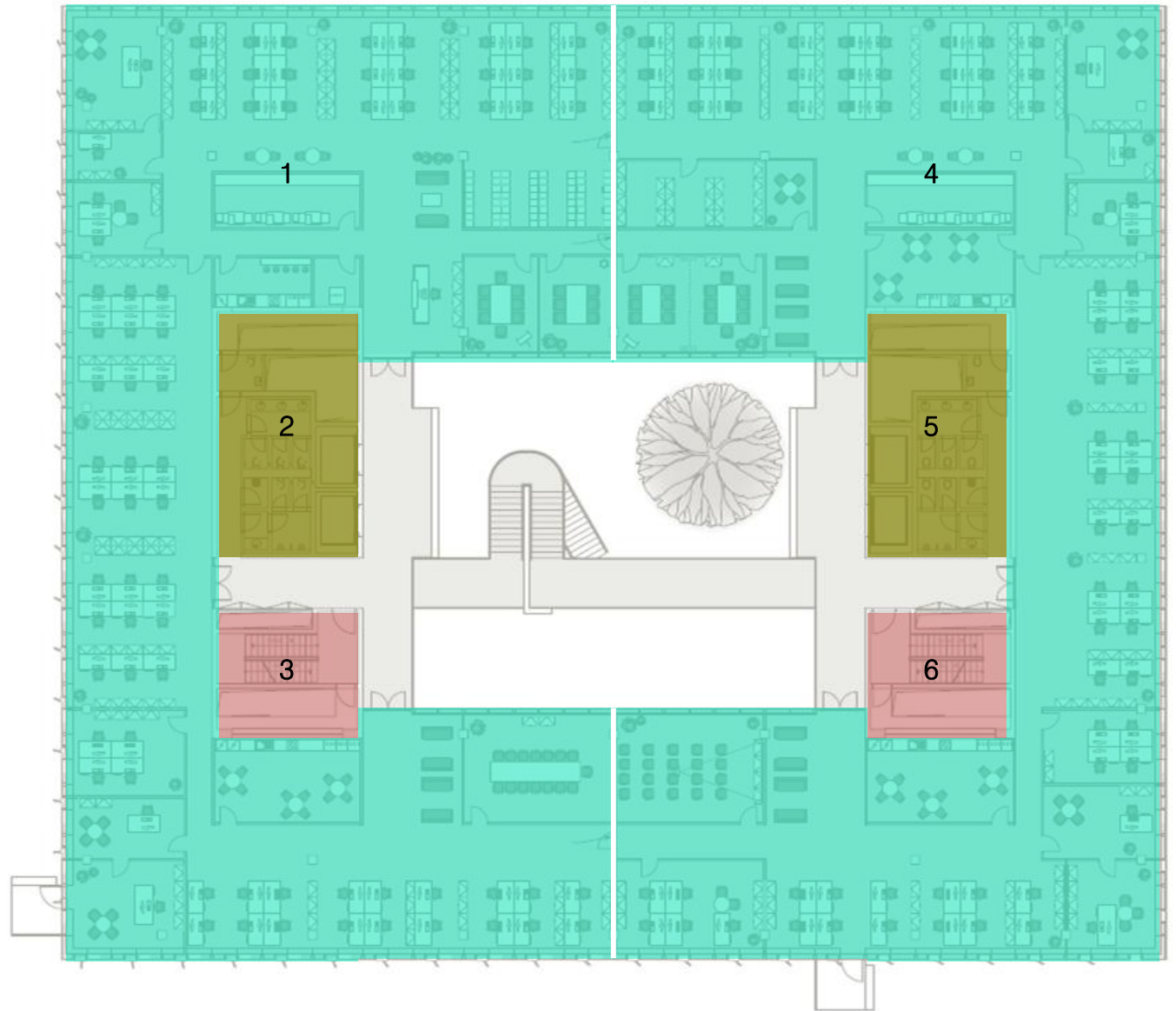
	Area [m2]
Total Building Area	1689
Net Conditioned Building Area	1689
Unconditioned Building Area	0





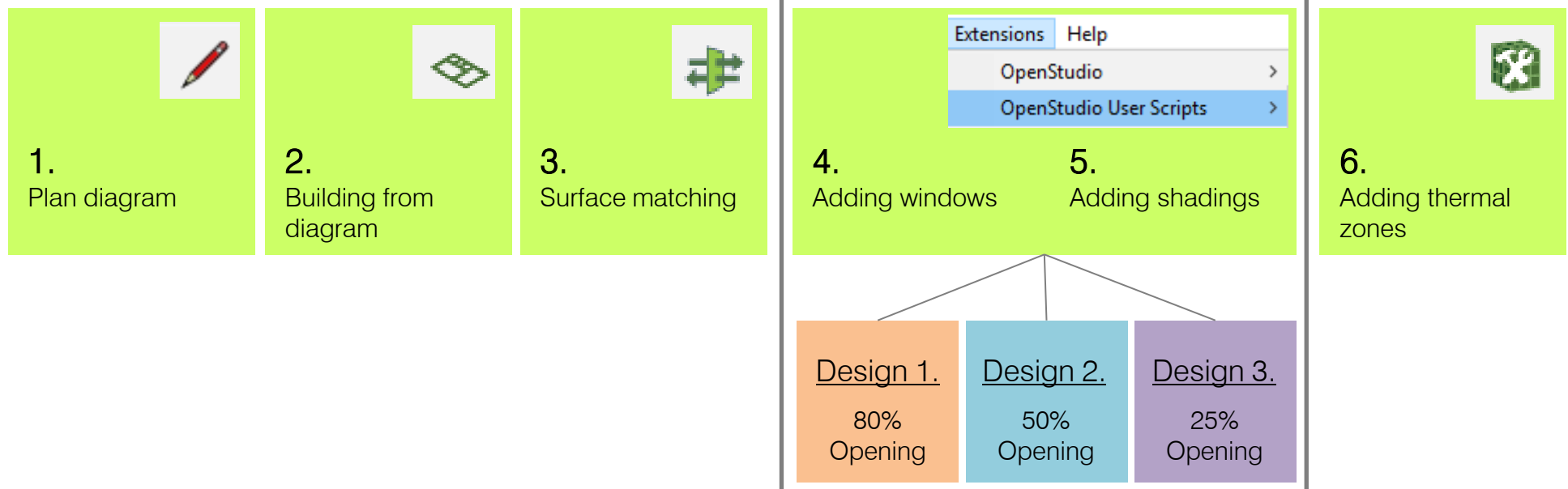
## Thermal Zone

- Thermal Zone 1 - Open Office
- Thermal Zone 2 - Rest Room
- Thermal Zone 3 - Stairs
- Thermal Zone 4 - Open Office
- Thermal Zone 5 - Rest Room
- Thermal Zone 6 - Stairs



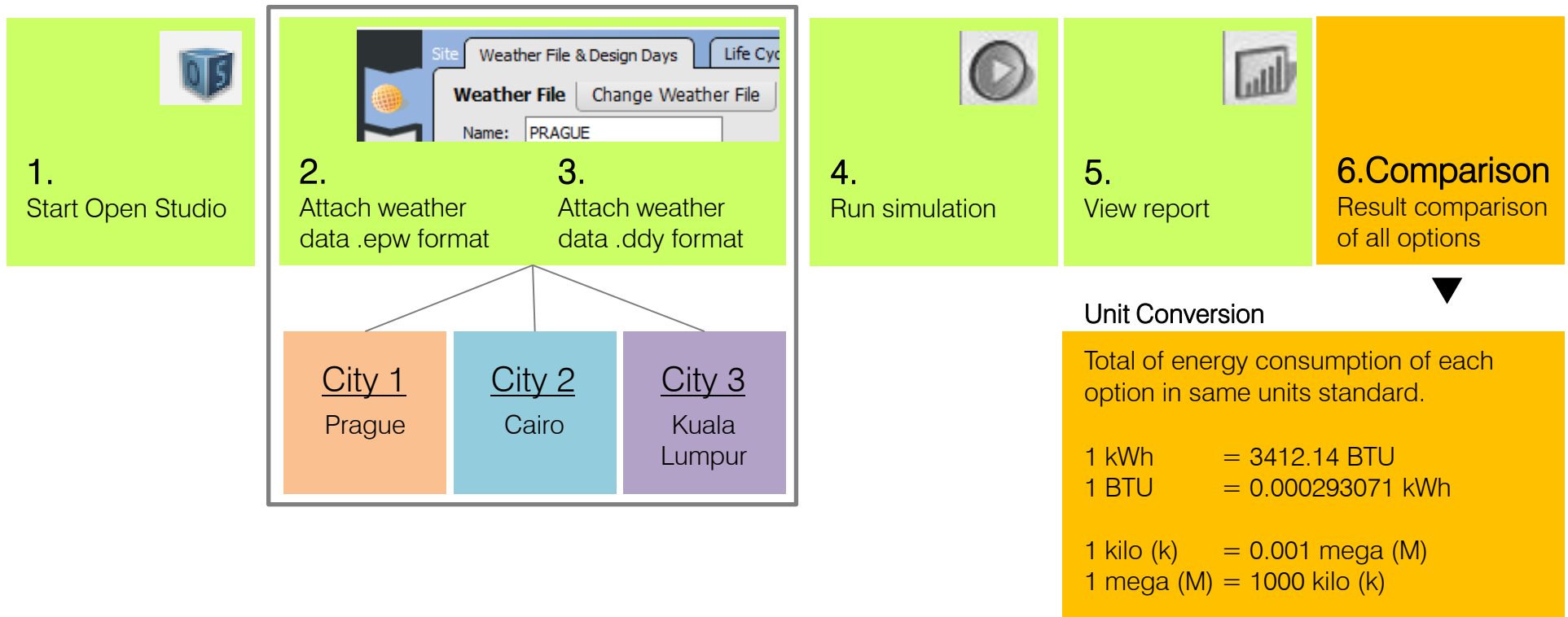
## A. Building Modeling

In this step, the building is prepared using Open Studio tools in Sketch Up. Opening ratio and shading devices prepared in three different alternatives; based on actual design and two different modification to compare energy consumption changes.



## B. Simulation

In this step, the simulation is conducted by launching Open Studio tools in Sketch Up.  
After the Open Studio is opened, weather data is attached based on selected location and the simulation is ready to run.

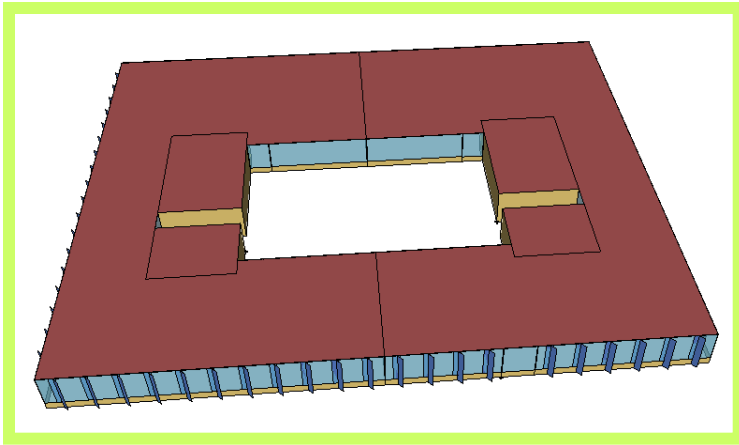








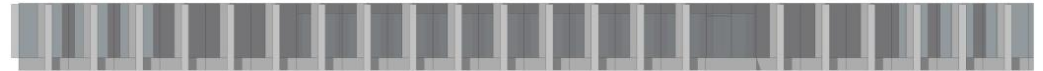
## Design 1 - Actual Design



### Envelope Character :

- 3.2 meter elevation
- 80% opening ratio in all elevation (60cm above floor)
- Vertical shading at South and West façade

### Envelope Elevation



South Elevation – 80% opening with



North Elevation



West Elevation



East Elevation

## Window-Wall Ratio

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [m2]	912.00	272.00	184.00	272.00	184.00
Above Ground Wall Area [m2]	912.00	272.00	184.00	272.00	184.00
Window Opening Area [m2]	588.80	181.76	112.64	181.76	112.64
Gross Window-Wall Ratio [%]	64.56	66.82	61.22	66.82	61.22
Above Ground Window-Wall Ratio [%]	64.56	66.82	61.22	66.82	61.22

Conditioned Window-Wall Ratio

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [m2]	912.00	272.00	184.00	272.00	184.00
Above Ground Wall Area [m2]	912.00	272.00	184.00	272.00	184.00
Window Opening Area [m2]	588.80	181.76	112.64	181.76	112.64
Gross Window-Wall Ratio [%]	64.56	66.82	61.22	66.82	61.22
Above Ground Window-Wall Ratio [%]	64.56	66.82	61.22	66.82	61.22

Zone Summary

	Area [m2]	Conditioned (Y/N)	Part of Total Floor Area (Y/N)	Volume [m3]	Multipliers	Gross Wall Area [m2]	Window Glass Area [m2]	Lighting [W/m2]	People [m2 per person]	Plug and Process [W/m2]
THERMAL ZONE 1	725.50	Yes	Yes	2321.60	1.00	368.00	294.40	10.6563	17.70	7.6424
THERMAL ZONE 2	77.00	Yes	Yes	246.40	1.00	51.20	0.00	8.7188	9.29	0.7535
THERMAL ZONE 3	42.00	Yes	Yes	134.40	1.00	36.80	0.00	5.8125		0.0000
THERMAL ZONE 4	725.50	Yes	Yes	2321.60	1.00	368.00	294.40	10.6563	17.70	7.6424
THERMAL ZONE 5	77.00	Yes	Yes	246.40	1.00	51.20	0.00	8.7188	9.29	0.7535
THERMAL ZONE 6	42.00	Yes	Yes	134.40	1.00	36.80	0.00	5.8125		0.0000
Total	1689.00			5404.80		912.00	588.80	10.2387	17.13	6.6342
Conditioned Total	1689.00			5404.80		912.00	588.80	10.2387	17.13	6.6342
Unconditione d Total	0.00			0.00		0.00	0.00			
Not Part of Total	0.00			0.00		0.00	0.00			

Design 1

## City 1. PRAGUE

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	1,326,934	kBtu
Total Building Area	18,180	ft^2
EUI (Based on Net Site Energy and Total Building Area)	72.99	kBtu/ft^2
OpenStudio Standards Building Type		

	Value
Weather File	PRAGUE - CZE IWECC Data WMO#=115180
Latitude	50.10
Longitude	14.28
Elevation	1201 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	



Sizing Period Design Days

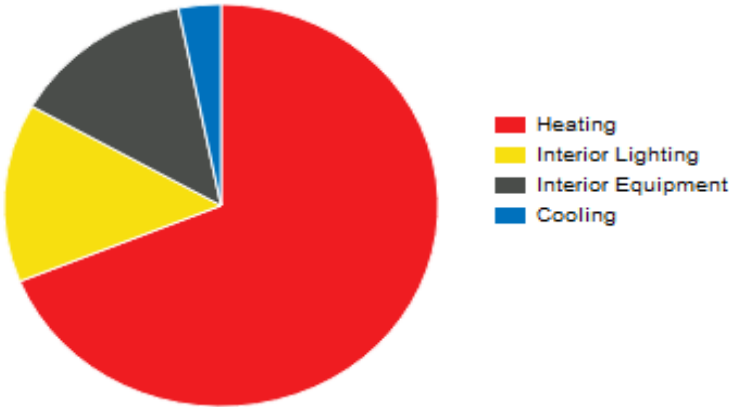
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
PRAGUE ANN CLG .4% CONDNS DB=>MWB	84.56	19.08	65.84	Wetbulb [F]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS DP=>MDB	72.86	19.08	63.86	Dewpoint [F]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS ENTH=>MDB	79.88	19.08	25.19	Enthalpy [Btu/lb]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS WB=>MDB	79.7	19.08	68.0	Wetbulb [F]	7.61	130.0
PRAGUE ANN HTG 99.6% CONDNS DB	5.72	0.0	5.72	Wetbulb [F]	4.25	230.0
PRAGUE ANN HTG WIND 99.6% CONDNS WS=>MCDB	40.1	0.0	40.1	Wetbulb [F]	36.69	230.0
PRAGUE ANN HUM_N 99.6% CONDNS DP=>MCDB	7.52	0.0	1.76	Dewpoint [F]	4.25	230.0

Unmet Hours Tolerance

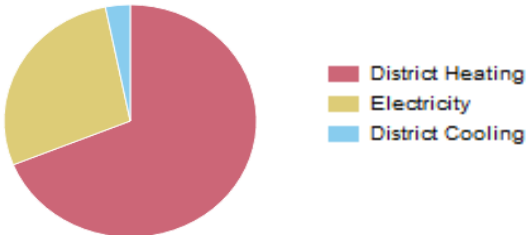
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

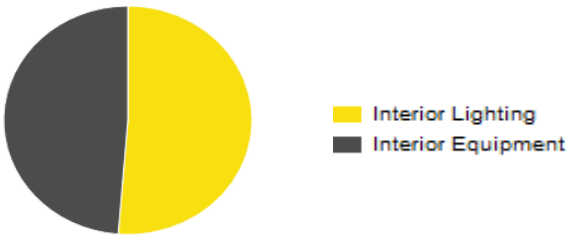
End Use	Consumption (kBtu)
Heating	913,620
Cooling	41,903
Interior Lighting	190,312
Exterior Lighting	0
Interior Equipment	181,099



Fuel	Consumption (kBtu)
Electricity	371,402
Natural Gas	0
Additional Fuel	0
District Cooling	41,903
District Heating	913,620

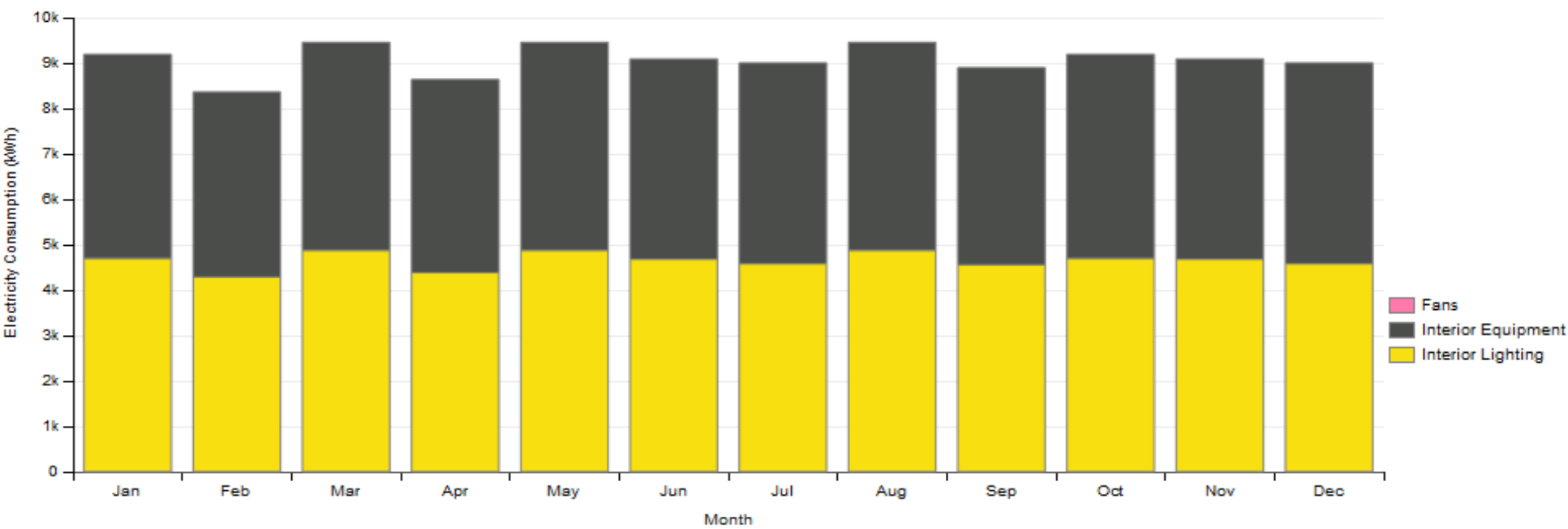


End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	55,775
Exterior Lighting	0
Interior Equipment	53,075



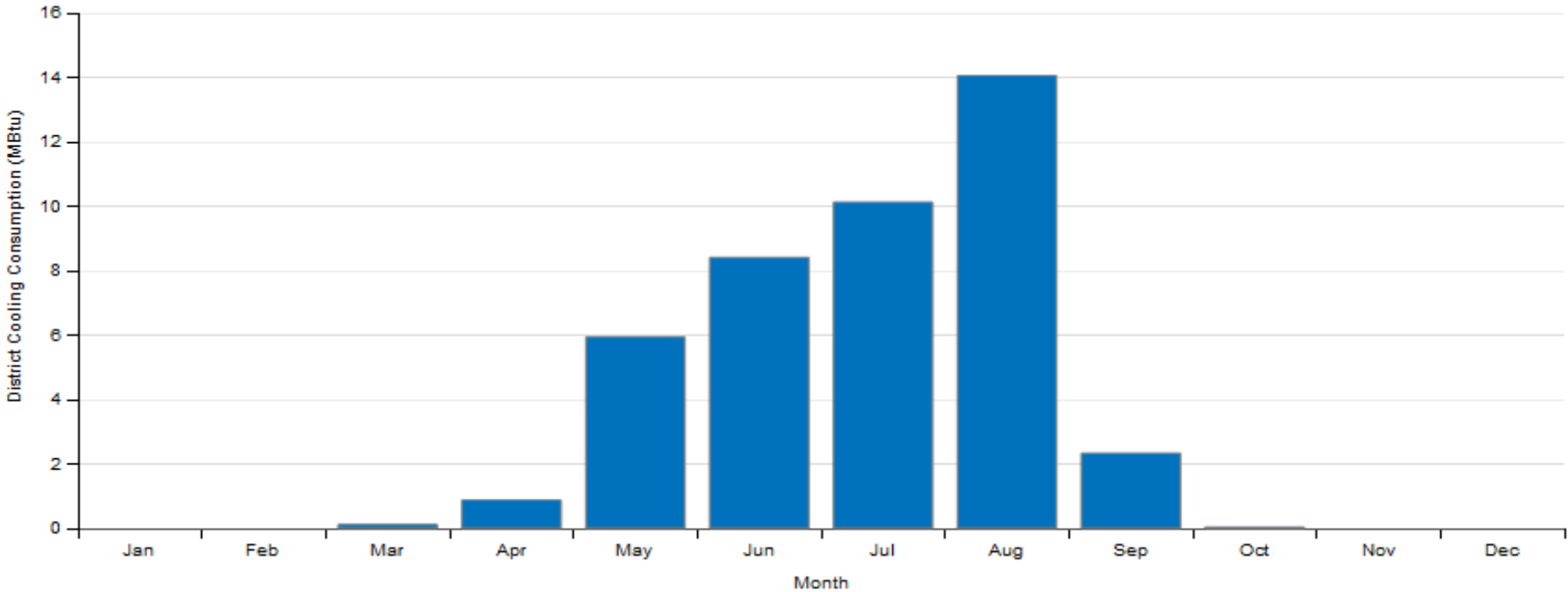
# Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	4700.28	4288.72	4874.94	4383.83	4874.94	4679.53	4579.25	4874.94	4558.47	4700.28	4679.53	4579.25	55773.97
Interior Equipment	4493.25	4076.42	4580.67	4255.14	4580.67	4412.58	4423.22	4580.67	4342.56	4493.25	4412.58	4423.22	53074.22
Total	9193.53	8365.14	9455.61	8638.97	9455.61	9092.11	9002.47	9455.61	8901.03	9193.53	9092.11	9002.47	108848.19



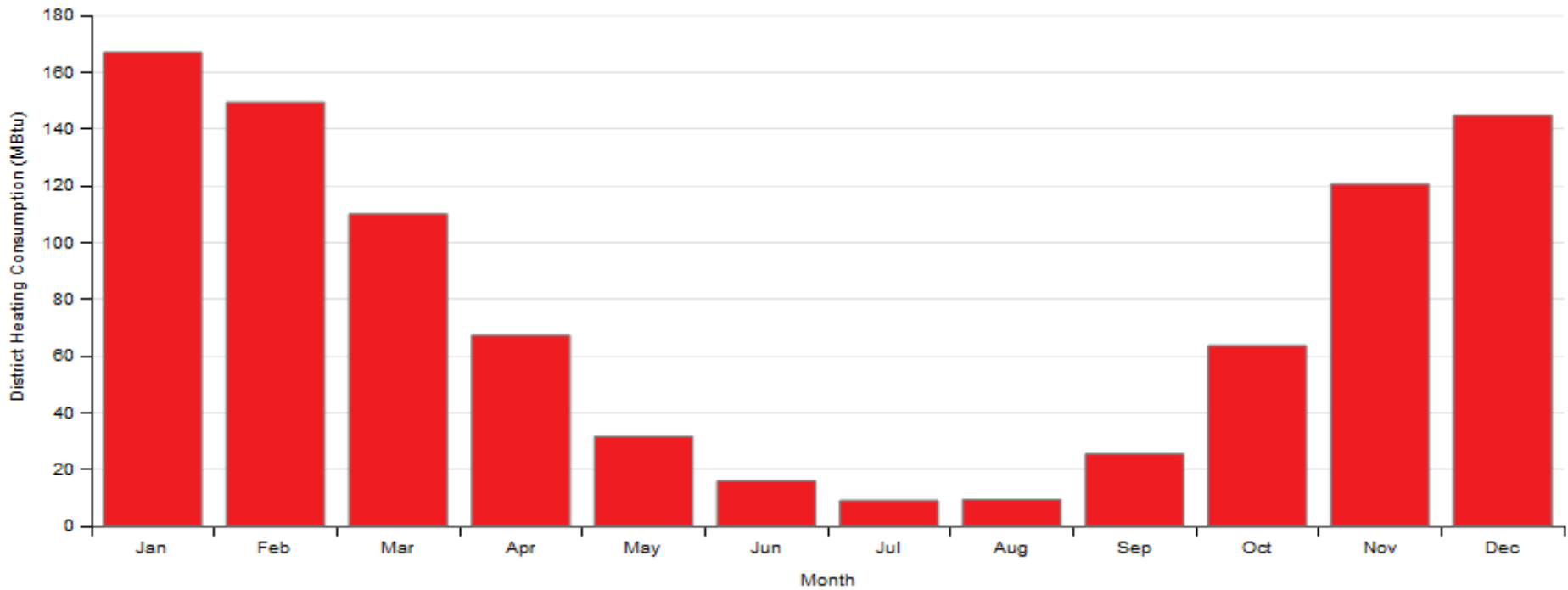
Monthly Cooling Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling			0.12	0.88	5.94	8.41	10.13	14.05	2.34	0.04			41.9



Monthly Heating Consumption

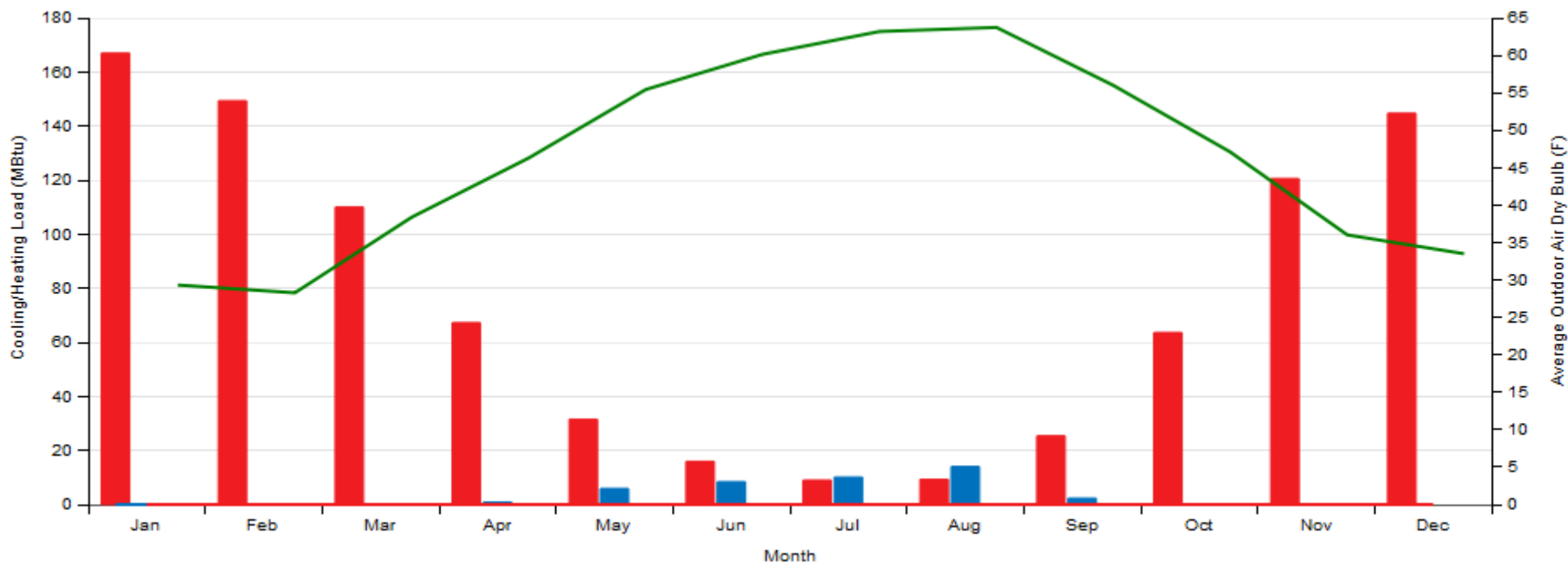
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating	166.95	149.35	110.0	67.25	31.53	15.97	9.01	9.3	25.4	63.6	120.56	144.72	913.62
Cooling													





Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	29.3	28.3	38.4	46.3	55.4	60.1	63.2	63.7	56.0	47.1	36.0	33.5
Cooling Load (MBtu)	0.0	0.0	0.12	0.88	5.94	8.41	10.13	14.05	2.34	0.04	0.0	0.0
Heating Load (MBtu)	166.95	149.35	110.0	67.25	31.53	15.97	9.01	9.3	25.4	63.6	120.56	144.72



# Conclusion

Design 1. Actual Design  
City 1. Prague

Yearly Energy Consumption:

Heating : 913.6 MBtu  
Cooling : 41.9 MBtu  
Electricity : 108848.2 kWh = 371.4 MBtu

Total : 1326.9 MBtu

Design 1

## City 2. CAIRO

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,064,535	kBtu
Total Building Area	38,750	ft^2
EUI (Based on Net Site Energy and Total Building Area)	53.28	kBtu/ft^2
OpenStudio Standards Building Type		

	Value
Weather File	CAIRO - EGY IWECC Data WMO#=623660
Latitude	30.13
Longitude	31.40
Elevation	243 (ft)
Time Zone	2.00
North Axis Angle	0.00
ASHRAE Climate Zone	

## Sizing Period Design Days

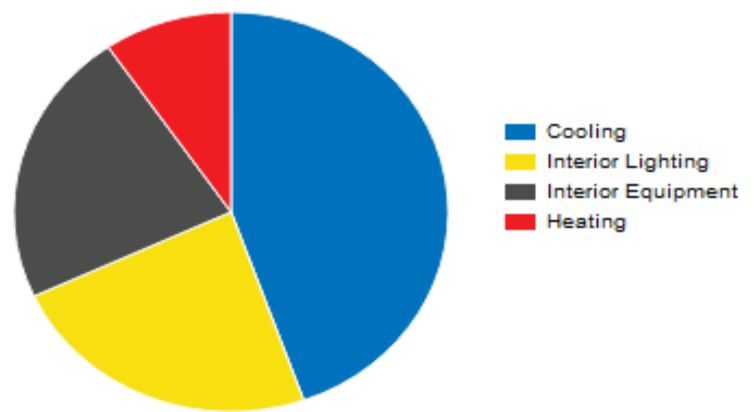
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
CAIRO ANN CLG .4% CONDNS DB=>MWB	100.58	20.7	69.98	Wetbulb [F]	12.08	350.0
CAIRO ANN CLG .4% CONDNS DP=>MDB	81.14	20.7	73.58	Dewpoint [F]	12.08	350.0
CAIRO ANN CLG .4% CONDNS ENTH=>MDB	89.6	20.7	32.72	Enthalpy [Btu/lb]	12.08	350.0
CAIRO ANN CLG .4% CONDNS WB=>MDB	89.24	20.7	76.82	Wetbulb [F]	12.08	350.0
CAIRO ANN HTG 99.6% CONDNS DB	45.86	0.0	45.86	Wetbulb [F]	5.14	90.0
CAIRO ANN HTG WIND 99.6% CONDNS WS=>MCDB	58.46	0.0	58.46	Wetbulb [F]	25.95	90.0
CAIRO ANN HUM_N 99.6% CONDNS DP=>MCDB	68.36	0.0	24.98	Dewpoint [F]	5.14	90.0

## Unmet Hours Tolerance

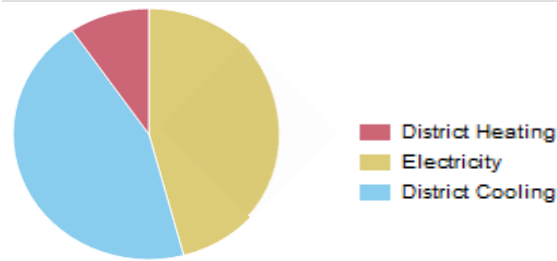
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

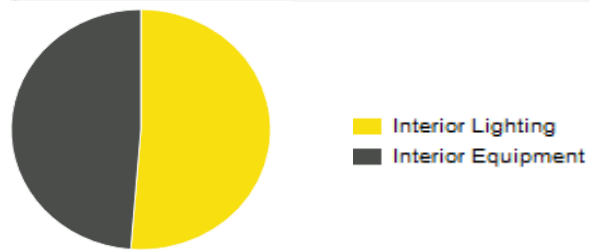
End Use	Consumption (kBtu)
Heating	77,446
Cooling	360,938
Interior Lighting	190,312
Exterior Lighting	0
Interior Equipment	181,099



Fuel	Consumption (kBtu)
Electricity	371,402
Natural Gas	0
Additional Fuel	0
District Cooling	360,938
District Heating	77,446



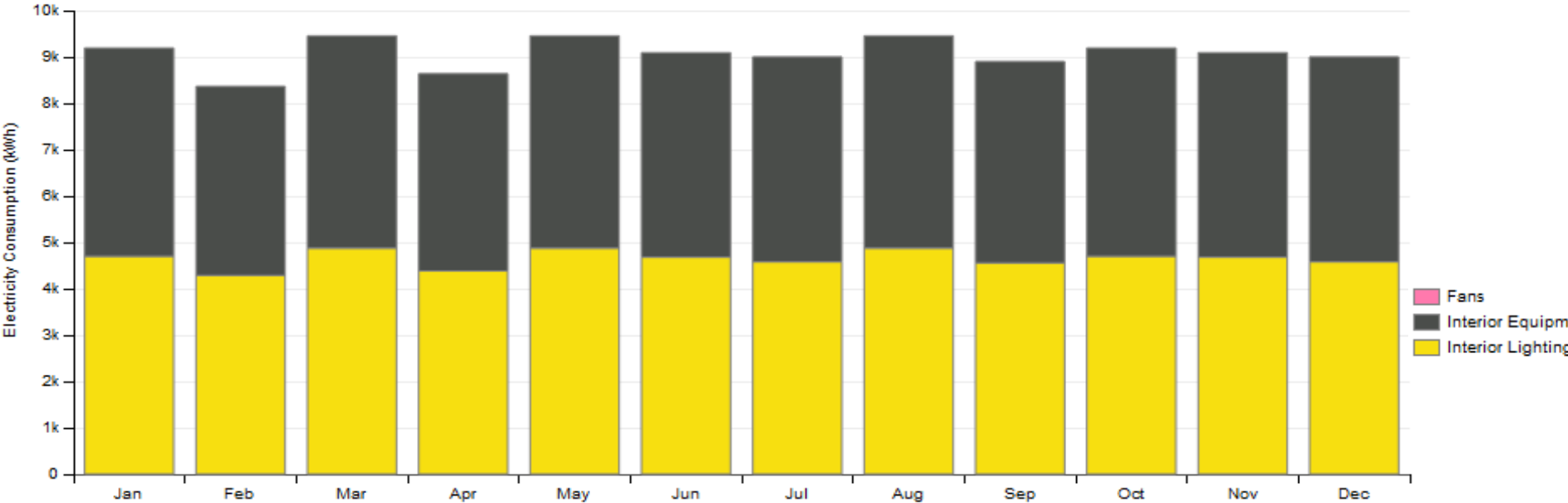
End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	55,775
Exterior Lighting	0
Interior Equipment	53,075





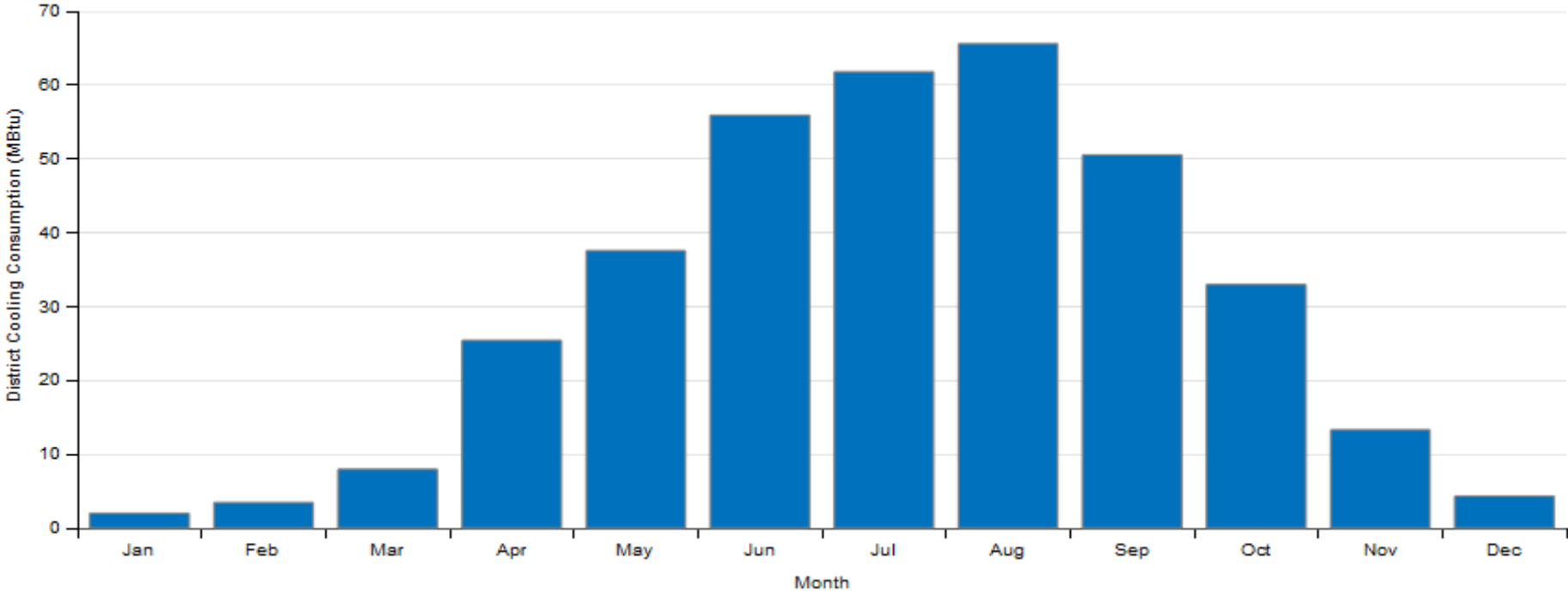
Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	4700.28	4288.72	4874.94	4383.83	4874.94	4679.53	4579.25	4874.94	4558.47	4700.28	4679.53	4579.25	55773.97
Interior Equipment	4493.25	4076.42	4580.67	4255.14	4580.67	4412.58	4423.22	4580.67	4342.56	4493.25	4412.58	4423.22	53074.22
Total	9193.53	8365.14	9455.61	8638.97	9455.61	9092.11	9002.47	9455.61	8901.03	9193.53	9092.11	9002.47	108848.19



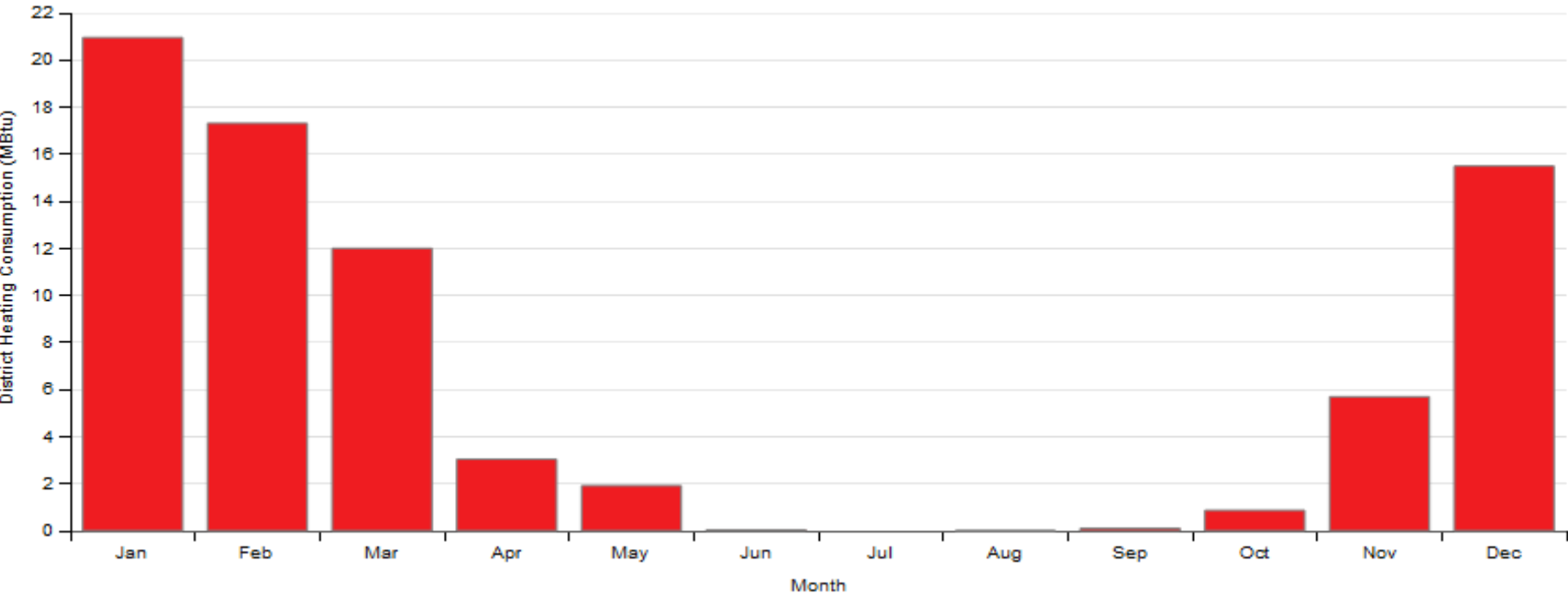
Monthly Cooling Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling	2.01	3.46	7.97	25.43	37.57	55.92	61.8	65.6	50.55	32.98	13.31	4.34	360.94



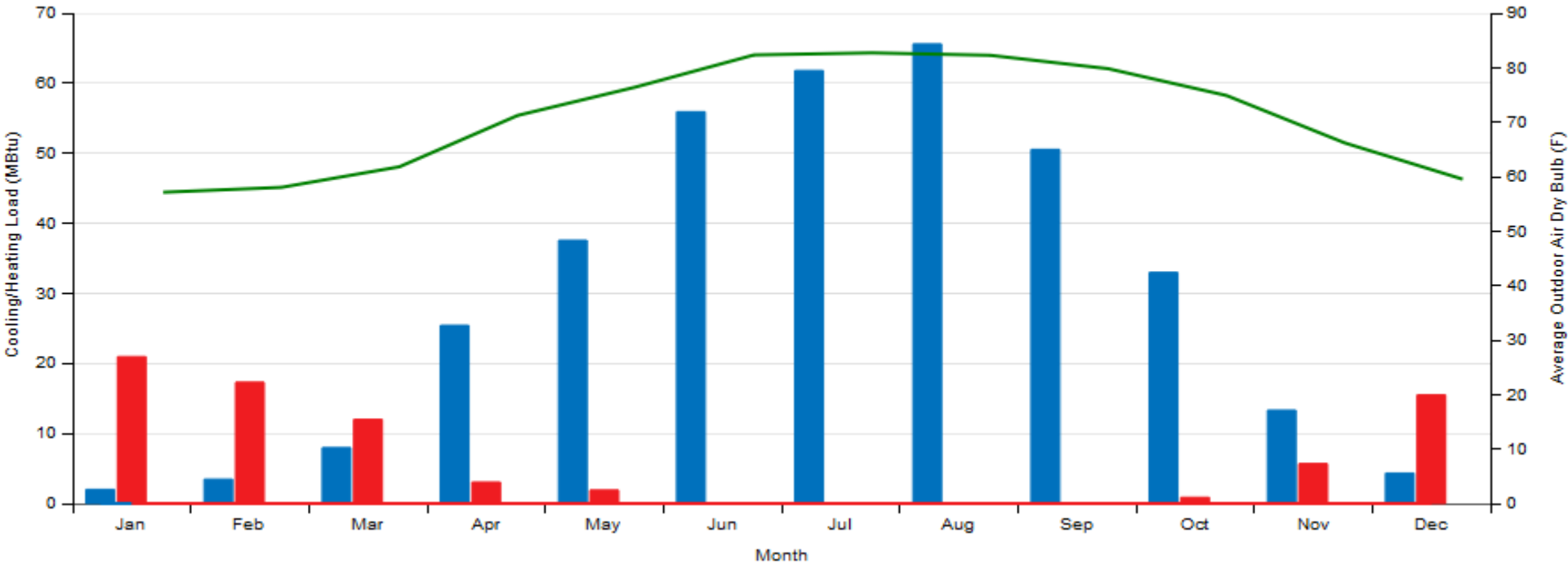
Monthly Heating Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating	20.96	17.31	12.0	3.04	1.91	0.04		0.0	0.11	0.87	5.7	15.5	77.44
Cooling													



Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	57.1	58.0	61.8	71.2	76.4	82.3	82.7	82.3	79.8	74.9	66.2	59.5
Cooling Load (MBtu)	2.01	3.46	7.97	25.43	37.57	55.92	61.8	65.6	50.55	32.98	13.31	4.34
Heating Load (MBtu)	20.96	17.31	12.0	3.04	1.91	0.04	0.0	0.0	0.11	0.87	5.7	15.5



# Conclusion

Design 1. Actual Design  
City 2. Cairo

Yearly Energy Consumption:

Heating : 77. 4 MBtu  
Cooling : 360.9 MBtu  
Electricity : 108848.2 kWh = 371.4 MBtu

Total : 809.7 MBtu

Design 1

City 3.  
KUALA  
LUMPUR

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	1,078,929	kBtu
Total Building Area	18,180	ft^2
EUI (Based on Net Site Energy and Total Building Area)	59.35	kBtu/ft^2
OpenStudio Standards Building Type		

	Value
Weather File	KUALA LUMPUR - MYS IWECC Data WMO#=486470
Latitude	3.12
Longitude	101.55
Elevation	72 (ft)
Time Zone	8.00
North Axis Angle	0.00
ASHRAE Climate Zone	

## Sizing Period Design Days

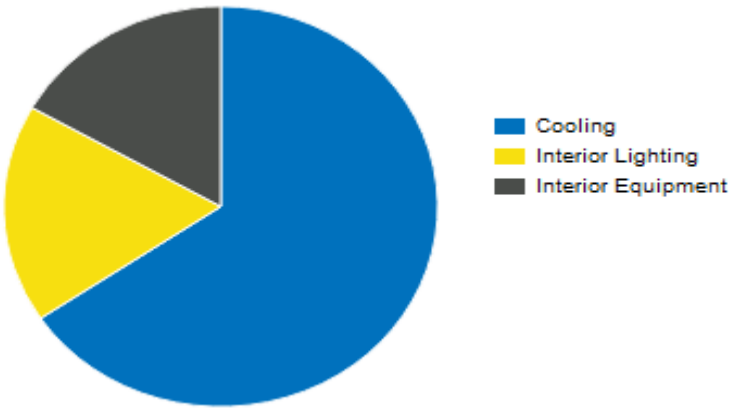
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
KUALA LUMPUR ANN CLG .4% CONDNS DB=>MWB	93.56	14.22	78.08	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS DP=>MDB	84.74	14.22	79.16	Dewpoint [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS ENTH=>MDB	89.06	14.22	37.62	Enthalpy [Btu/lb]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS WB=>MDB	88.7	14.22	81.5	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN HTG 99.6% CONDNS DB	71.6	0.0	71.6	Wetbulb [F]	1.34	350.0
KUALA LUMPUR ANN HTG WIND 99.6% CONDNS WS=>MCDB	84.02	0.0	84.02	Wetbulb [F]	14.99	350.0
KUALA LUMPUR ANN HUM_N 99.6% CONDNS DP=>MCDB	87.8	0.0	66.2	Dewpoint [F]	1.34	350.0

## Unmet Hours Tolerance

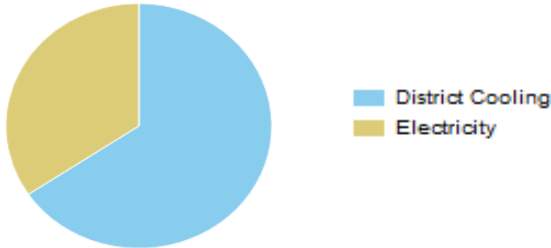
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

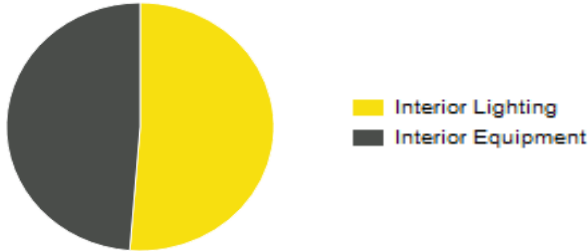
End Use	Consumption (kBtu)
Heating	0
Cooling	707,527
Interior Lighting	190,312
Exterior Lighting	0
Interior Equipment	181,099



Fuel	Consumption (kBtu)
Electricity	371,402
Natural Gas	0
Additional Fuel	0
District Cooling	707,527
District Heating	0



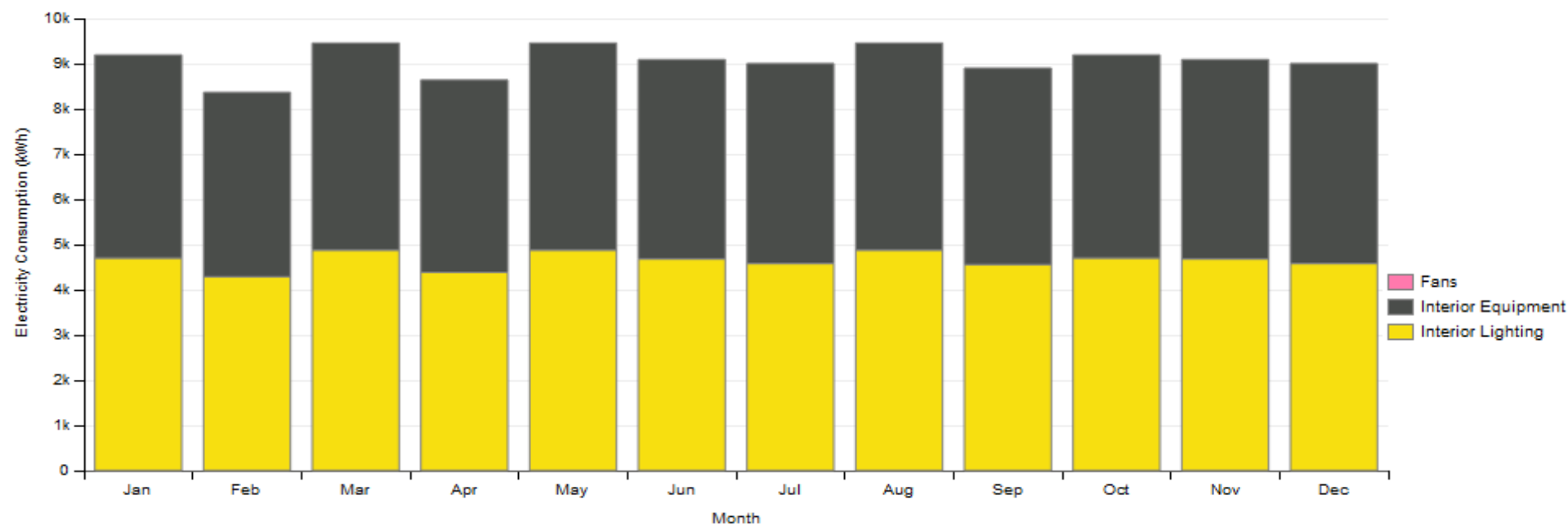
End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	55,775
Exterior Lighting	0
Interior Equipment	53,075





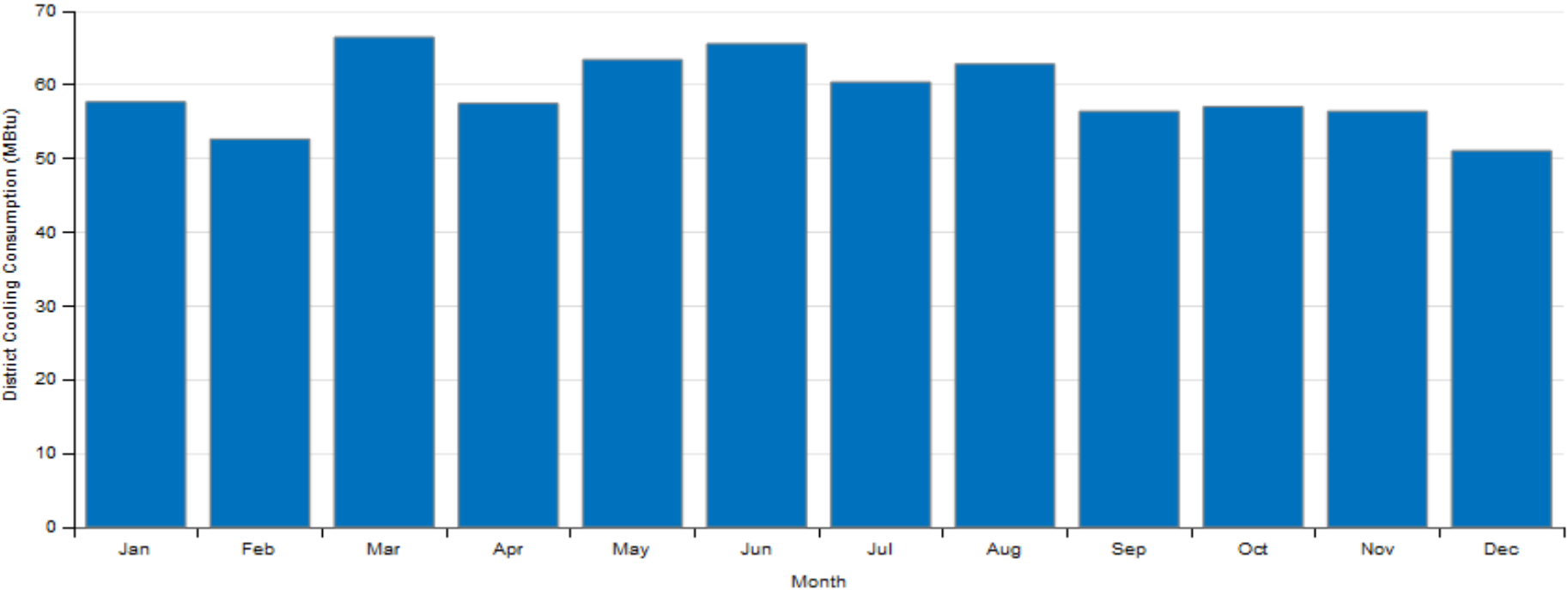
# Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	4700.28	4288.72	4874.94	4383.83	4874.94	4679.53	4579.25	4874.94	4558.47	4700.28	4679.53	4579.25	55773.97
Interior Equipment	4493.25	4076.42	4580.67	4255.14	4580.67	4412.58	4423.22	4580.67	4342.56	4493.25	4412.58	4423.22	53074.22
Total	9193.53	8365.14	9455.61	8638.97	9455.61	9092.11	9002.47	9455.61	8901.03	9193.53	9092.11	9002.47	108848.19



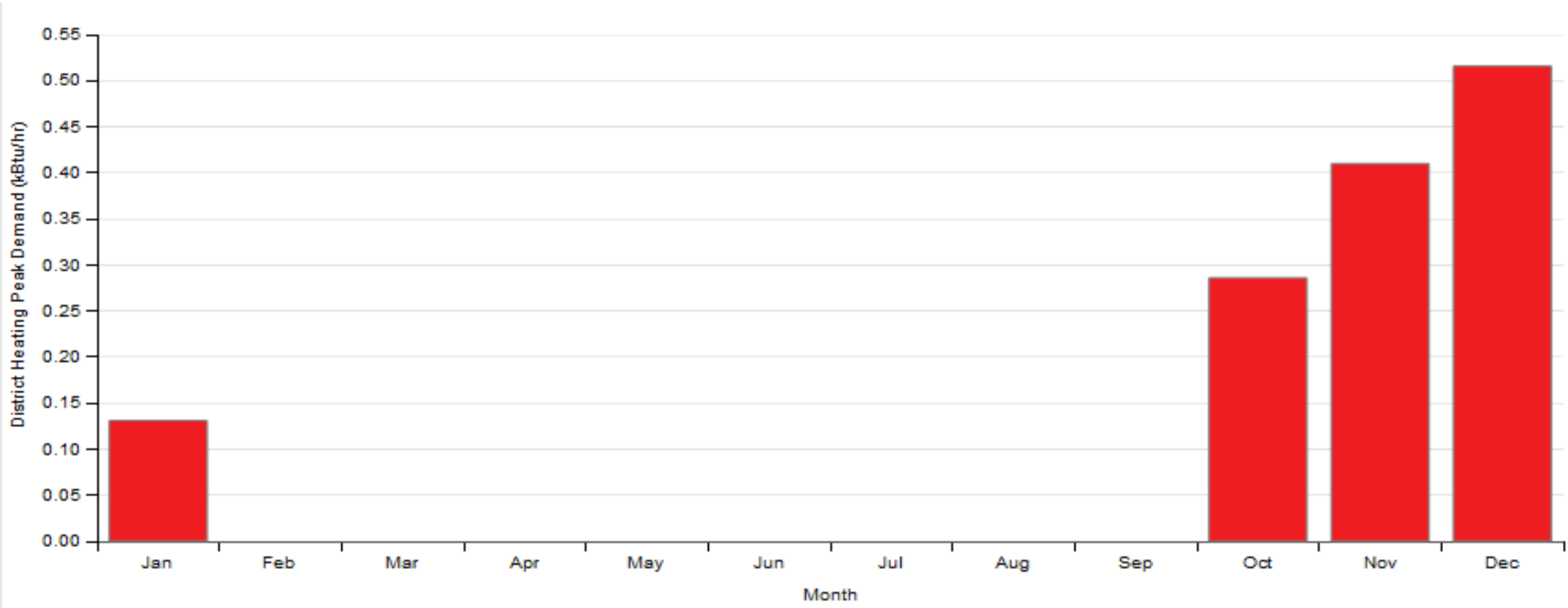
Monthly Cooling Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling	57.7	52.64	66.48	57.49	63.43	65.58	60.39	62.83	56.43	57.06	56.43	51.07	707.52



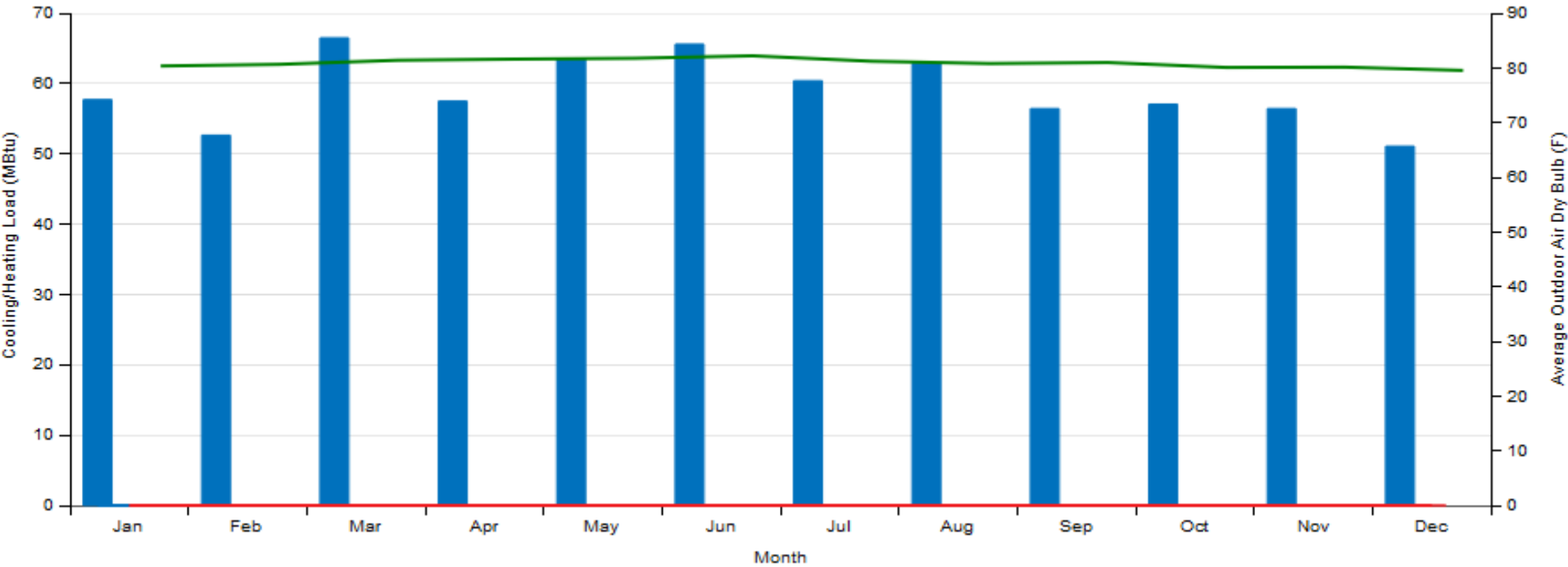
Monthly Heating Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating	0.1311									0.286	0.41	0.5158
Cooling												



Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	80.3	80.6	81.4	81.6	81.8	82.2	81.2	80.8	81.0	80.1	80.1	79.5
Cooling Load (MBtu)	57.7	52.64	66.48	57.49	63.43	65.58	60.39	62.83	56.43	57.06	56.43	51.07
Heating Load (MBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



# Conclusion

Design 1. Actual Design  
City 3. Kuala Lumpur

## Yearly Energy Consumption:

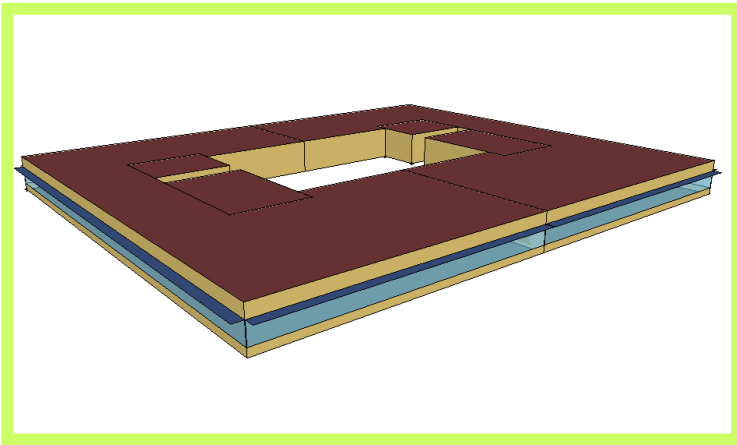
Heating : -  
Cooling : 707.5 MBtu  
Electricity : 108848.2 kWh = 371.4 MBtu

Total : 1078.9 MBtu





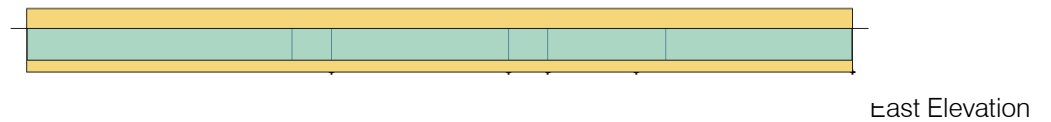
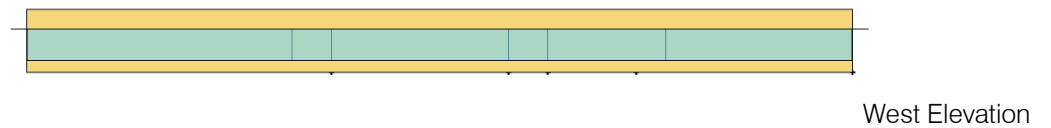
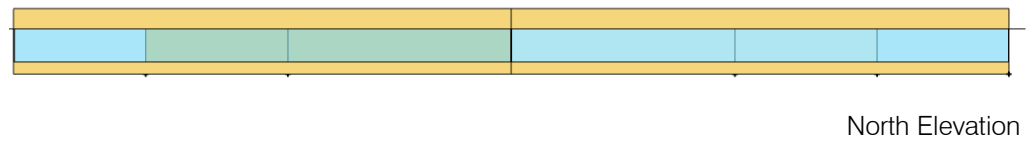
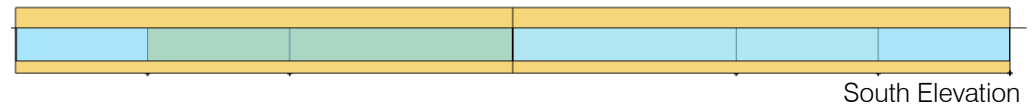
## Design 2 - 50% Opening



### Envelope Character :

- 3.2 meter elevation
- 50% opening ratio in all elevation (60cm above floor)
- Horizontal shading on all four sides.

### Envelope Elevation





## Window-Wall Ratio

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [m2]	582.40	156.80	134.40	156.80	134.40
Above Ground Wall Area [m2]	582.40	156.80	134.40	156.80	134.40
Window Opening Area [m2]	291.20	78.40	67.20	78.40	67.20
Gross Window-Wall Ratio [%]	50.00	50.00	50.00	50.00	50.00
Above Ground Window-Wall Ratio [%]	50.00	50.00	50.00	50.00	50.00

Conditioned Window-Wall Ratio

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [m2]	582.40	156.80	134.40	156.80	134.40
Above Ground Wall Area [m2]	582.40	156.80	134.40	156.80	134.40
Window Opening Area [m2]	291.20	78.40	67.20	78.40	67.20
Gross Window-Wall Ratio [%]	50.00	50.00	50.00	50.00	50.00
Above Ground Window-Wall Ratio [%]	50.00	50.00	50.00	50.00	50.00

Zone Summary

	Area [m2]	Conditioned (Y/N)	Part of Total Floor Area (Y/N)	Volume [m3]	Multipliers	Gross Wall Area [m2]	Window Glass Area [m2]	Lighting [W/m2]	People [m2 per person]	Plug and Process [W/m2]
THERMAL ZONE 1	725.50	Yes	Yes	2321.60	1.00	368.00	294.40	10.6563	17.70	7.6424
THERMAL ZONE 2	77.00	Yes	Yes	246.40	1.00	51.20	0.00	8.7188	9.29	0.7535
THERMAL ZONE 3	42.00	Yes	Yes	134.40	1.00	36.80	0.00	5.8125		0.0000
THERMAL ZONE 4	725.50	Yes	Yes	2321.60	1.00	368.00	294.40	10.6563	17.70	7.6424
THERMAL ZONE 5	77.00	Yes	Yes	246.40	1.00	51.20	0.00	8.7188	9.29	0.7535
THERMAL ZONE 6	42.00	Yes	Yes	134.40	1.00	36.80	0.00	5.8125		0.0000
Total	1689.00			5404.80		912.00	588.80	10.2387	17.13	6.6342
Conditioned Total	1689.00			5404.80		912.00	588.80	10.2387	17.13	6.6342
Unconditione d Total	0.00			0.00		0.00	0.00			
Not Part of Total	0.00			0.00		0.00	0.00			

Design 1

## City 1. PRAGUE

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	1,161,626	kBtu
Total Building Area	22,152	ft^2
EUI (Based on Net Site Energy and Total Building Area)	52.44	kBtu/ft^2
OpenStudio Standards Building Type		

	Value
Weather File	PRAGUE - CZE IWECC Data WMO#=115180
Latitude	50.10
Longitude	14.28
Elevation	1201 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	3A

Sizing Period Design Days

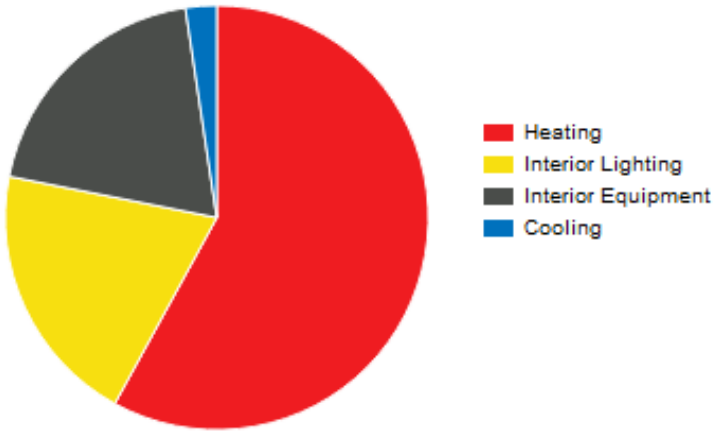
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
PRAGUE ANN CLG .4% CONDNS DB=>MWB	84.56	19.08	65.84	Wetbulb [F]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS DP=>MDB	72.86	19.08	63.86	Dewpoint [F]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS ENTH=>MDB	79.88	19.08	25.19	Enthalpy [Btu/lb]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS WB=>MDB	79.7	19.08	68.0	Wetbulb [F]	7.61	130.0
PRAGUE ANN HTG 99.6% CONDNS DB	5.72	0.0	5.72	Wetbulb [F]	4.25	230.0
PRAGUE ANN HTG WIND 99.6% CONDNS WS=>MCDB	40.1	0.0	40.1	Wetbulb [F]	36.69	230.0
PRAGUE ANN HUM_N 99.6% CONDNS DP=>MCDB	7.52	0.0	1.76	Dewpoint [F]	4.25	230.0

Unmet Hours Tolerance

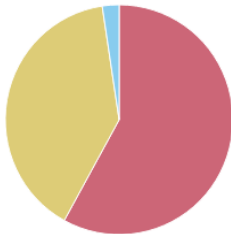
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

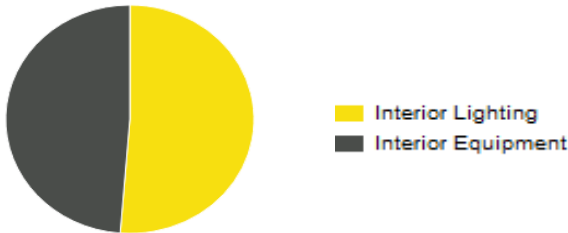
End Use	Consumption (kBtu)
Heating	673,794
Cooling	27,581
Interior Lighting	233,580
Exterior Lighting	0
Interior Equipment	226,670



Fuel	Consumption (kBtu)
Electricity	460,260
Natural Gas	0
Additional Fuel	0
District Cooling	27,581
District Heating	673,794

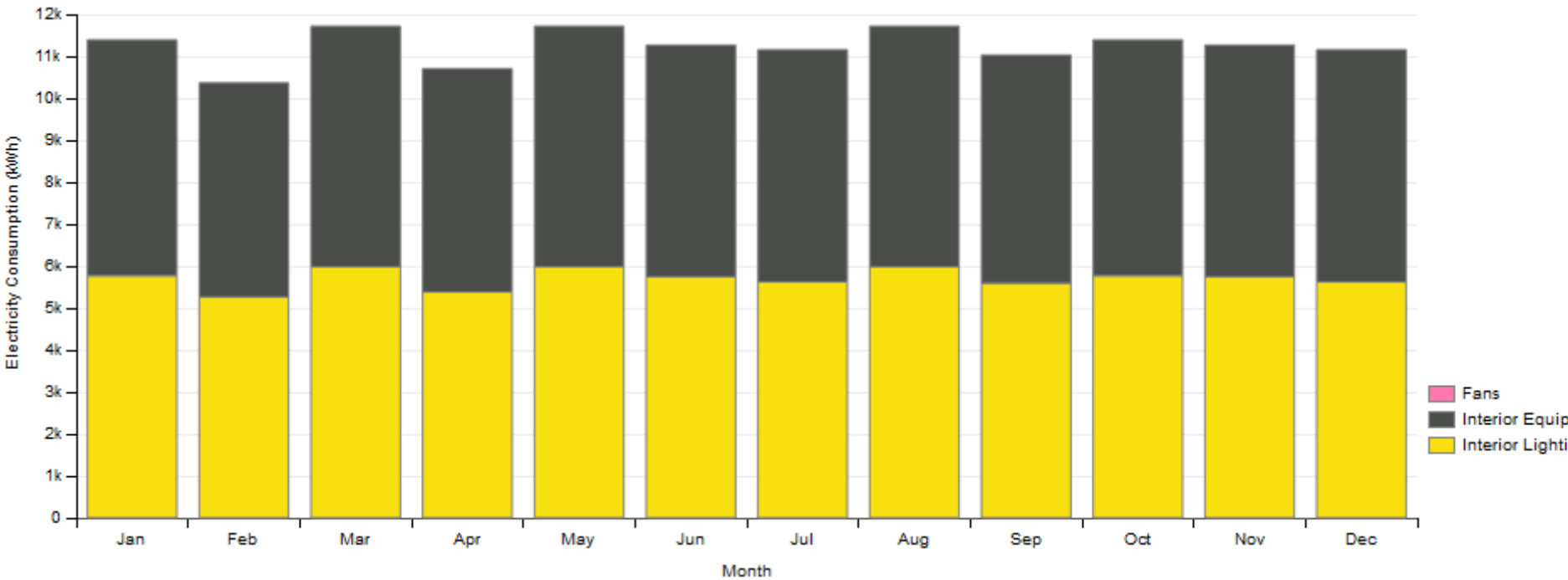


End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	55,775
Exterior Lighting	0
Interior Equipment	53,075



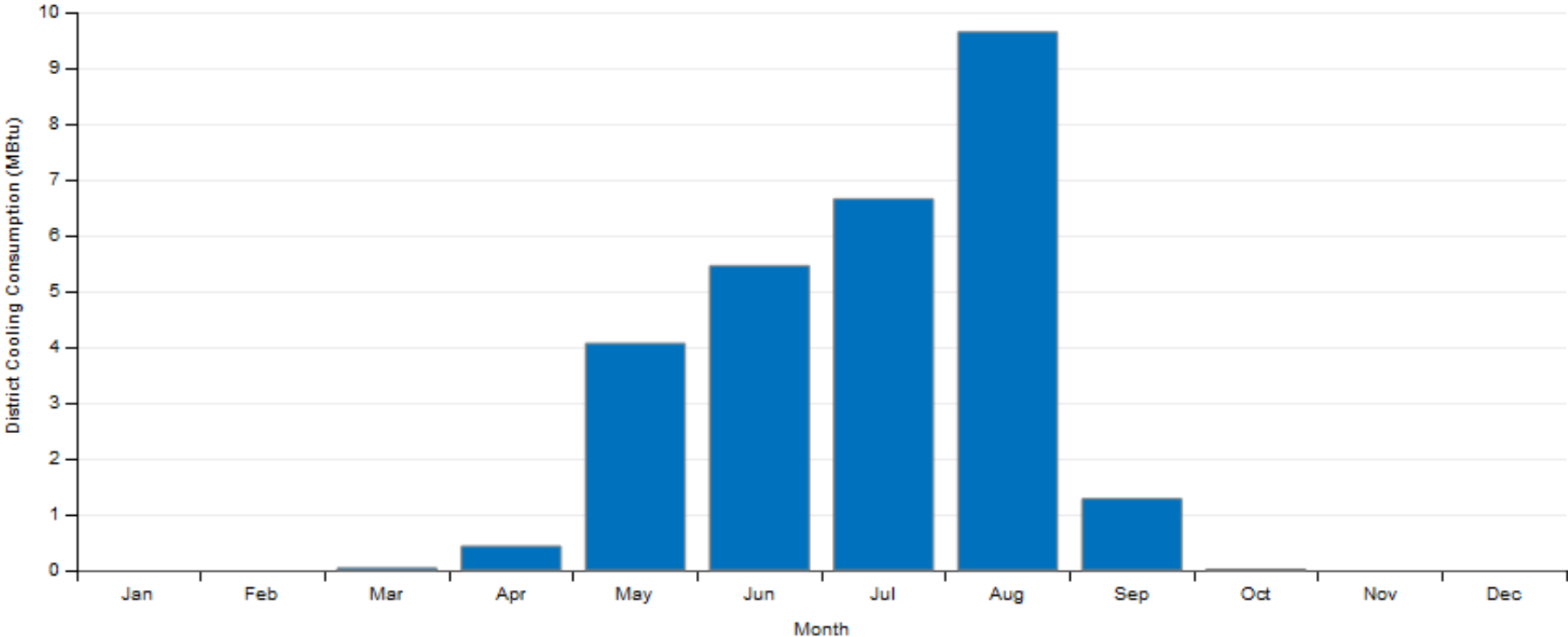
# Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	5769.06	5263.89	5983.42	5380.64	5983.42	5743.58	5620.47	5983.42	5595.0	5769.06	5743.58	5620.47	68456.0
Interior Equipment	5624.08	5102.36	5733.47	5326.06	5733.47	5523.11	5536.44	5733.47	5435.44	5624.08	5523.11	5536.44	66431.56
Total	11393.14	10366.25	11716.89	10706.69	11716.89	11266.69	11156.92	11716.89	11030.44	11393.14	11266.69	11156.92	134887.56



Monthly Cooling Consumption

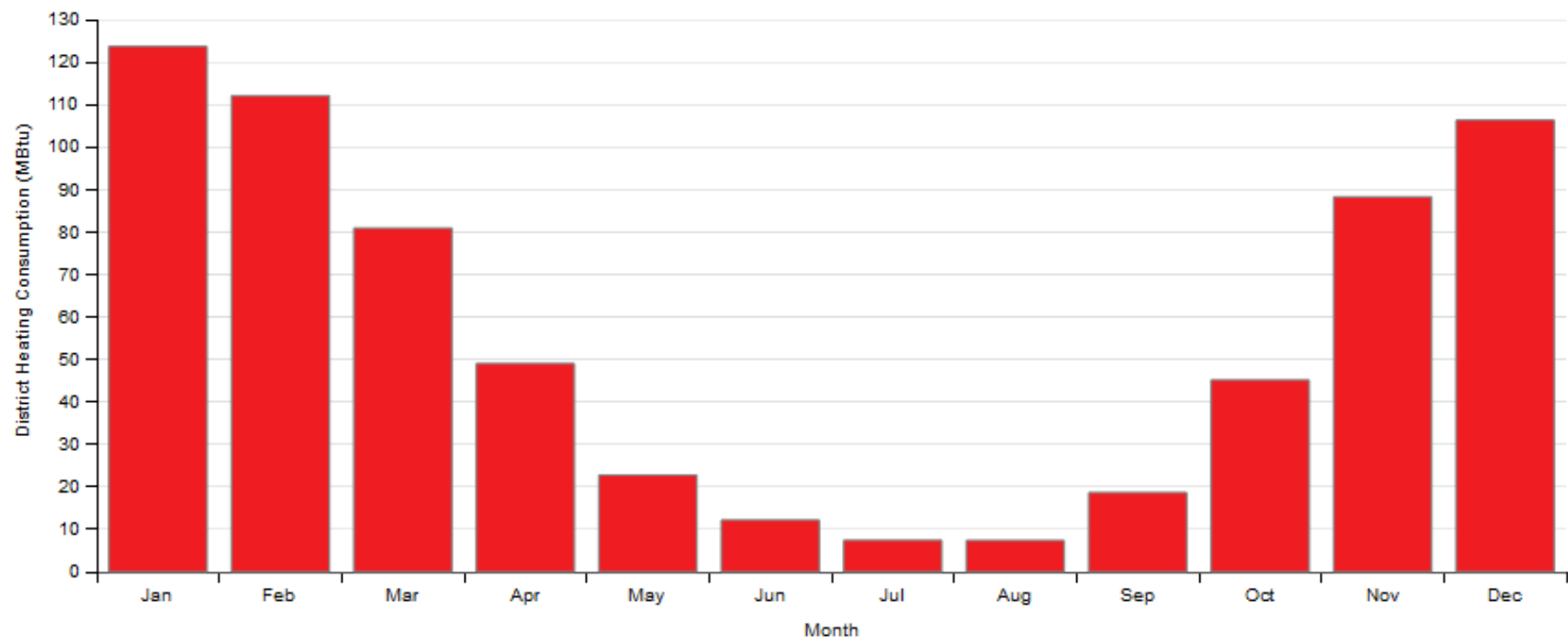
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling			0.04	0.43	4.06	5.46	6.65	9.64	1.28	0.01			27.58





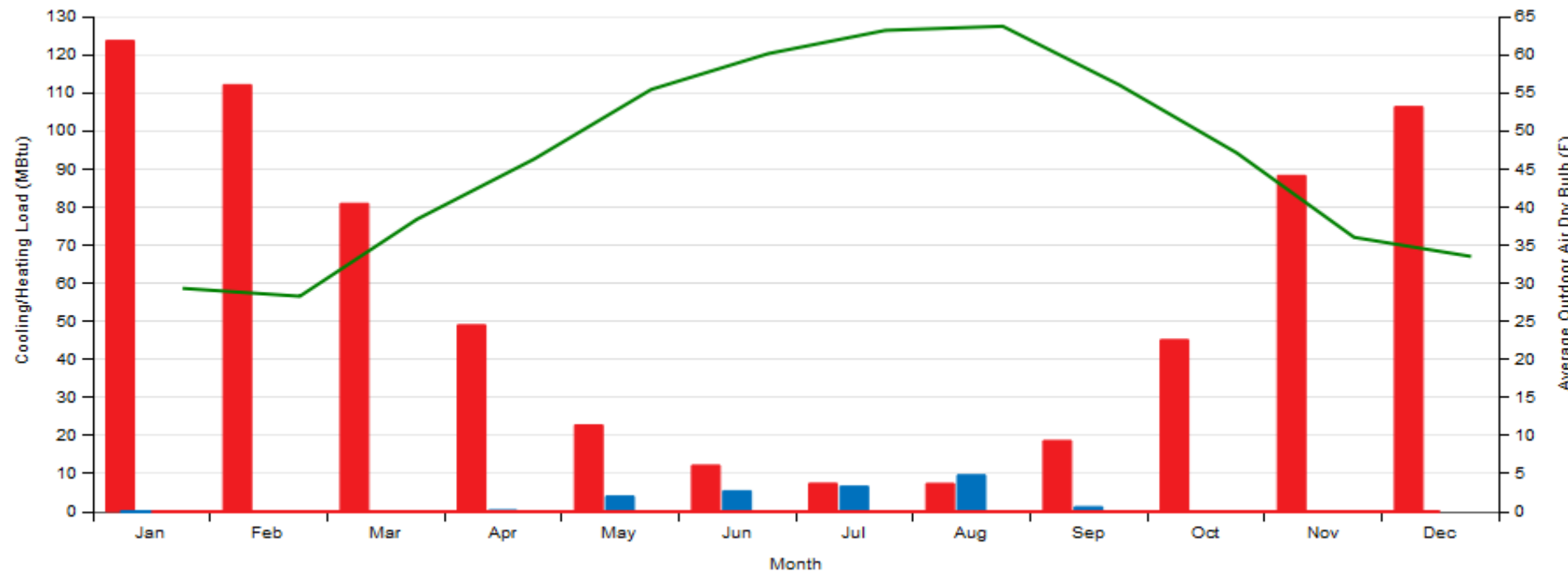
Monthly Heating Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating	123.67	112.07	80.92	49.02	22.76	12.18	7.43	7.39	18.65	45.14	88.26	106.32	673.8
Cooling													



Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	29.3	28.3	38.4	46.3	55.4	60.1	63.2	63.7	56.0	47.1	36.0	33.5
Cooling Load (MBtu)	0.0	0.0	0.04	0.43	4.06	5.46	6.65	9.64	1.28	0.01	0.0	0.0
Heating Load (MBtu)	123.67	112.07	80.92	49.02	22.76	12.18	7.43	7.39	18.65	45.14	88.26	106.32



# Conclusion

Design 2. Design with 50% Openings  
City 1. Prague

## Yearly Energy Consumption:

Heating : 673.8 MBtu  
Cooling : 27.6 MBtu  
Electricity : 134887.6 kWh = 460.2 MBtu

**Total : 1161.6 MBtu**

Design 1

## City 2. CAIRO

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	797,512	kBtu
Total Building Area	22,152	ft^2
EUI (Based on Net Site Energy and Total Building Area)	36.00	kBtu/ft^2
OpenStudio Standards Building Type		

	Value
Weather File	CAIRO - EGY IWECC Data WMO#=623660
Latitude	30.13
Longitude	31.40
Elevation	243 (ft)
Time Zone	2.00
North Axis Angle	0.00
ASHRAE Climate Zone	3A

## Sizing Period Design Days

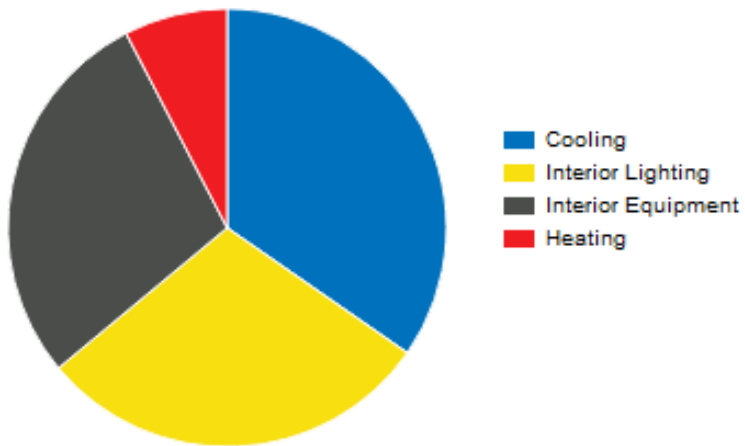
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
CAIRO ANN CLG .4% CONDNS DB=>MWB	100.58	20.7	69.98	Wetbulb [F]	12.08	350.0
CAIRO ANN CLG .4% CONDNS DP=>MDB	81.14	20.7	73.58	Dewpoint [F]	12.08	350.0
CAIRO ANN CLG .4% CONDNS ENTH=>MDB	89.6	20.7	32.72	Enthalpy [Btu/lb]	12.08	350.0
CAIRO ANN CLG .4% CONDNS WB=>MDB	89.24	20.7	76.82	Wetbulb [F]	12.08	350.0
CAIRO ANN HTG 99.6% CONDNS DB	45.86	0.0	45.86	Wetbulb [F]	5.14	90.0
CAIRO ANN HTG WIND 99.6% CONDNS WS=>MCDB	58.46	0.0	58.46	Wetbulb [F]	25.95	90.0
CAIRO ANN HUM_N 99.6% CONDNS DP=>MCDB	68.36	0.0	24.98	Dewpoint [F]	5.14	90.0

## Unmet Hours Tolerance

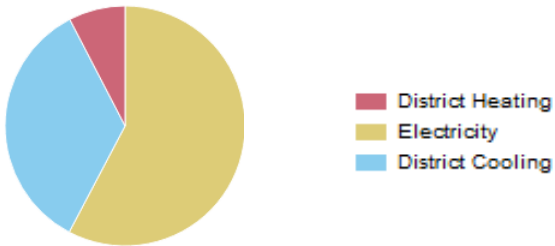
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

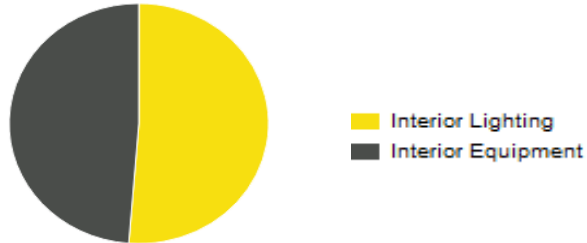
End Use	Consumption (kBtu)
Heating	60,793
Cooling	276,459
Interior Lighting	233,580
Exterior Lighting	0
Interior Equipment	226,670



Fuel	Consumption (kBtu)
Electricity	460,260
Natural Gas	0
Additional Fuel	0
District Cooling	276,459
District Heating	60,793

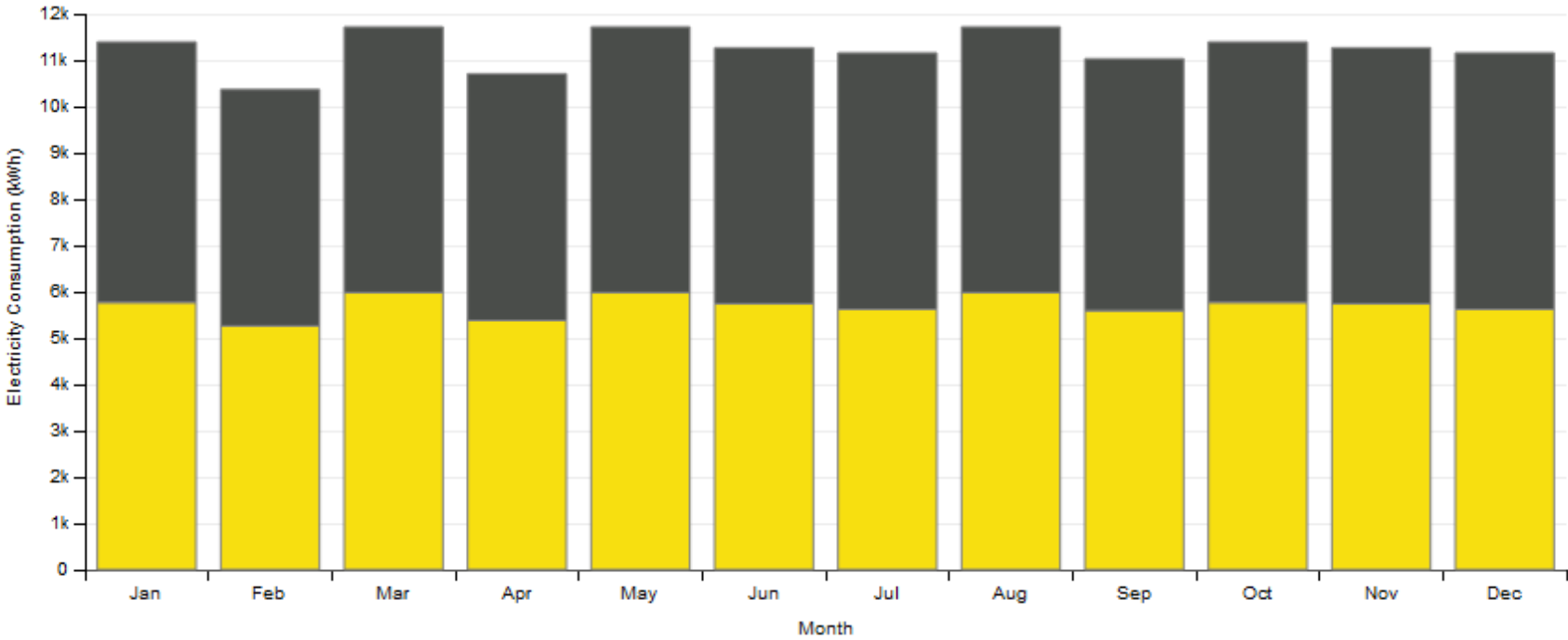


End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	68,456
Exterior Lighting	0
Interior Equipment	66,431



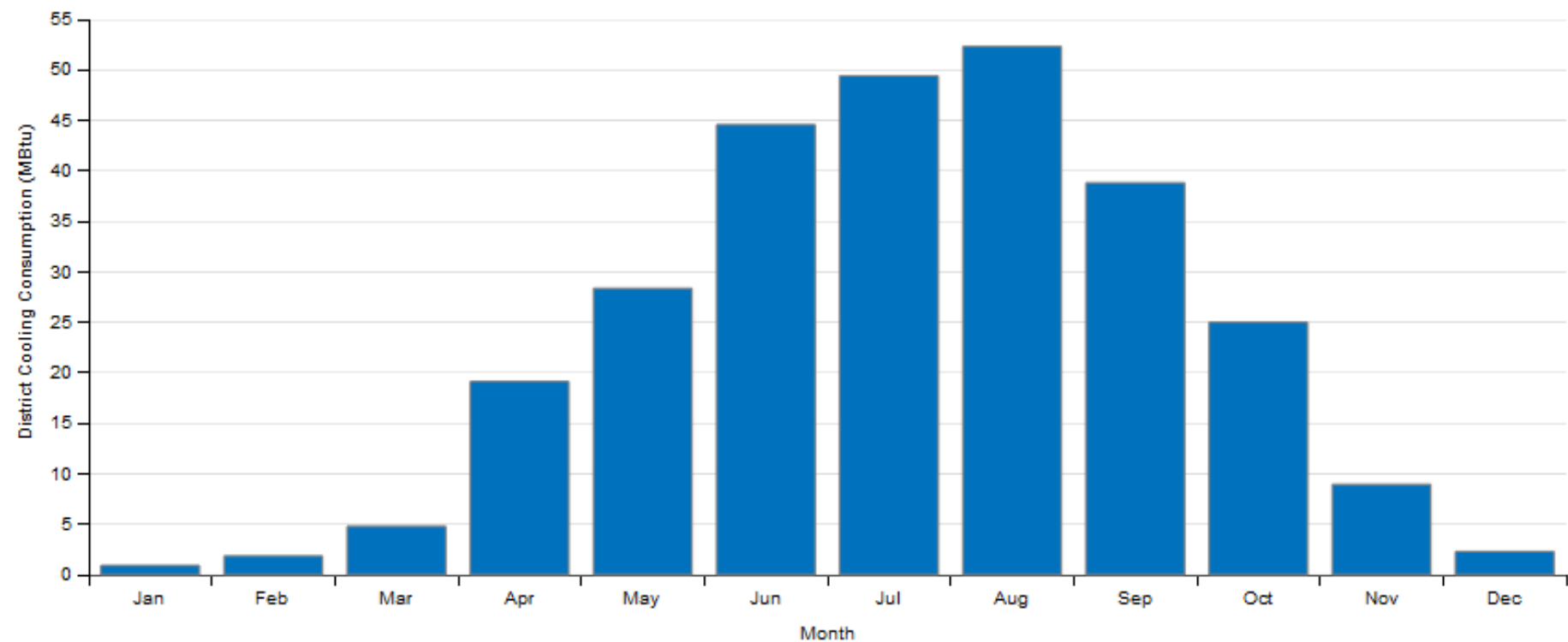
# Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	5769.06	5263.89	5983.42	5380.64	5983.42	5743.58	5620.47	5983.42	5595.0	5769.06	5743.58	5620.47	68456.0
Interior Equipment	5624.08	5102.36	5733.47	5326.06	5733.47	5523.11	5536.44	5733.47	5435.44	5624.08	5523.11	5536.44	66431.56
Total	11393.14	10366.25	11716.89	10706.69	11716.89	11266.69	11156.92	11716.89	11030.44	11393.14	11266.69	11156.92	134887.56



Monthly Cooling Consumption

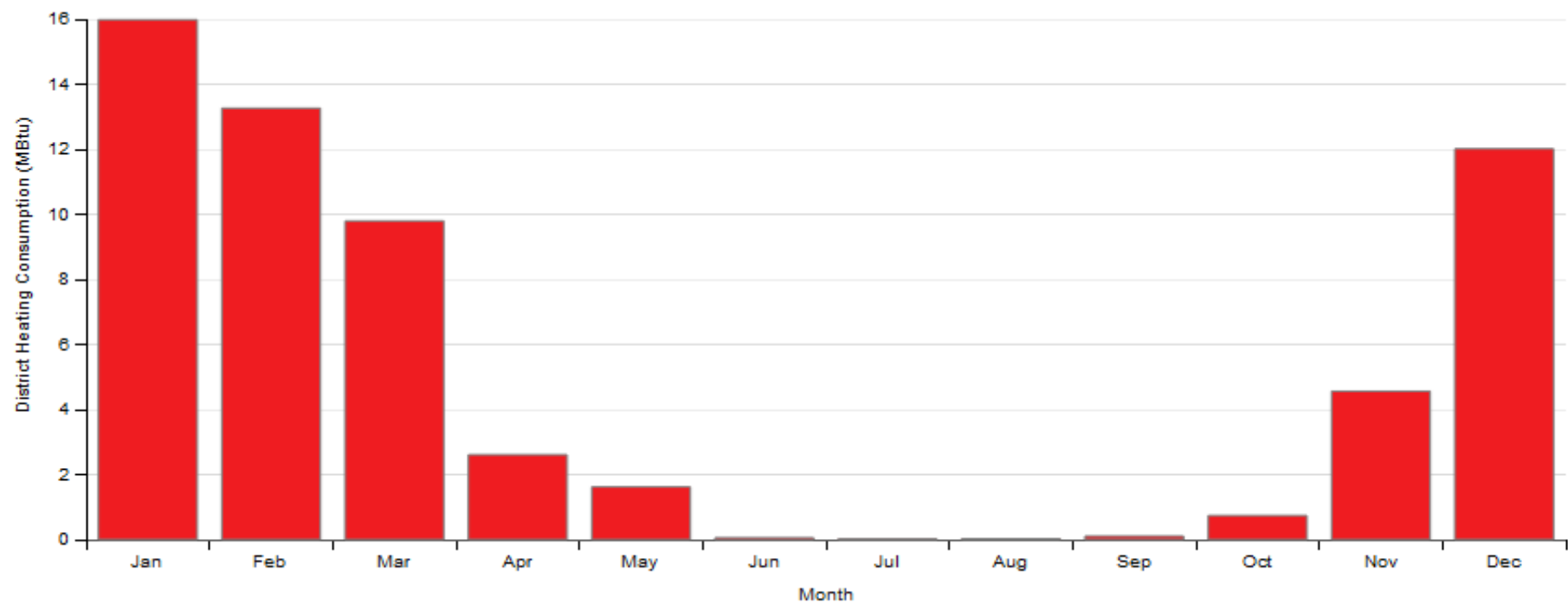
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling	0.92	1.85	4.79	19.14	28.36	44.58	49.42	52.32	38.83	25.0	8.95	2.3	276.46





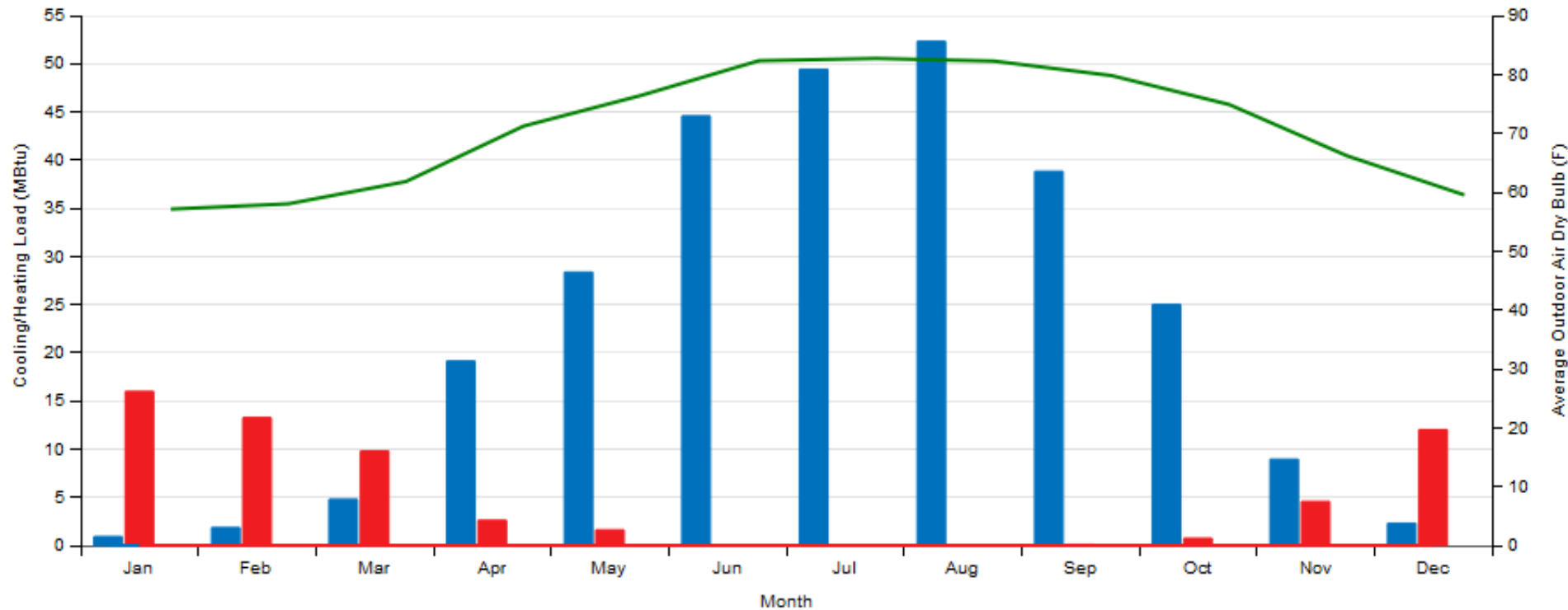
Monthly Heating Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating	15.98	13.26	9.8	2.61	1.62	0.06	0.02	0.03	0.11	0.74	4.56	12.01	60.8
Cooling													



Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	57.1	58.0	61.8	71.2	76.4	82.3	82.7	82.3	79.8	74.9	66.2	59.5
Cooling Load (MBtu)	0.92	1.85	4.79	19.14	28.36	44.58	49.42	52.32	38.83	25.0	8.95	2.3
Heating Load (MBtu)	15.98	13.26	9.8	2.61	1.62	0.06	0.02	0.03	0.11	0.74	4.56	12.01



# Conclusion

Design 2. Design with 50 % Openings  
City 2. Cairo

## Yearly Energy Consumption:

Heating : 60.8 MBtu  
Cooling : 276.5 MBtu  
Electricity : 134887.6 kWh = 460.2 MBtu

Total : 797.5 MBtu

Design 1

City 3.  
KUALA  
LUMPUR

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	1,037,424	kBtu
Total Building Area	22,152	ft^2
EUI (Based on Net Site Energy and Total Building Area)	46.83	kBtu/ft^2
OpenStudio Standards Building Type		

	Value
Weather File	KUALA LUMPUR - MYS IWECC Data WMO#=486470
Latitude	3.12
Longitude	101.55
Elevation	72 (ft)
Time Zone	8.00
North Axis Angle	0.00
ASHRAE Climate Zone	

## Sizing Period Design Days

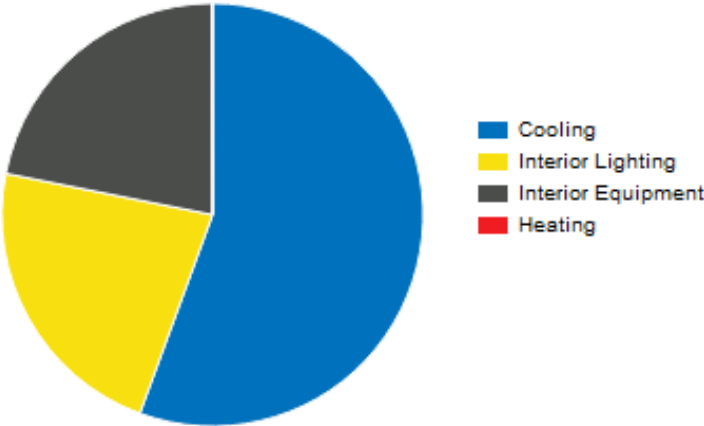
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
KUALA LUMPUR ANN CLG .4% CONDNS DB=>MWB	93.56	14.22	78.08	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS DP=>MDB	84.74	14.22	79.16	Dewpoint [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS ENTH=>MDB	89.06	14.22	37.62	Enthalpy [Btu/lb]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS WB=>MDB	88.7	14.22	81.5	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN HTG 99.6% CONDNS DB	71.6	0.0	71.6	Wetbulb [F]	1.34	350.0
KUALA LUMPUR ANN HTG WIND 99.6% CONDNS WS=>MCDB	84.02	0.0	84.02	Wetbulb [F]	14.99	350.0
KUALA LUMPUR ANN HUM_N 99.6% CONDNS DP=>MCDB	87.8	0.0	66.2	Dewpoint [F]	1.34	350.0

## Unmet Hours Tolerance

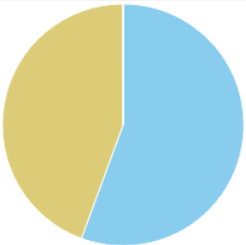
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

End Use	Consumption (kBtu)
Heating	284
Cooling	576,879
Interior Lighting	233,580
Exterior Lighting	0
Interior Equipment	226,670



Fuel	Consumption (kBtu)
Electricity	460,260
Natural Gas	0
Additional Fuel	0
District Cooling	576,879
District Heating	284

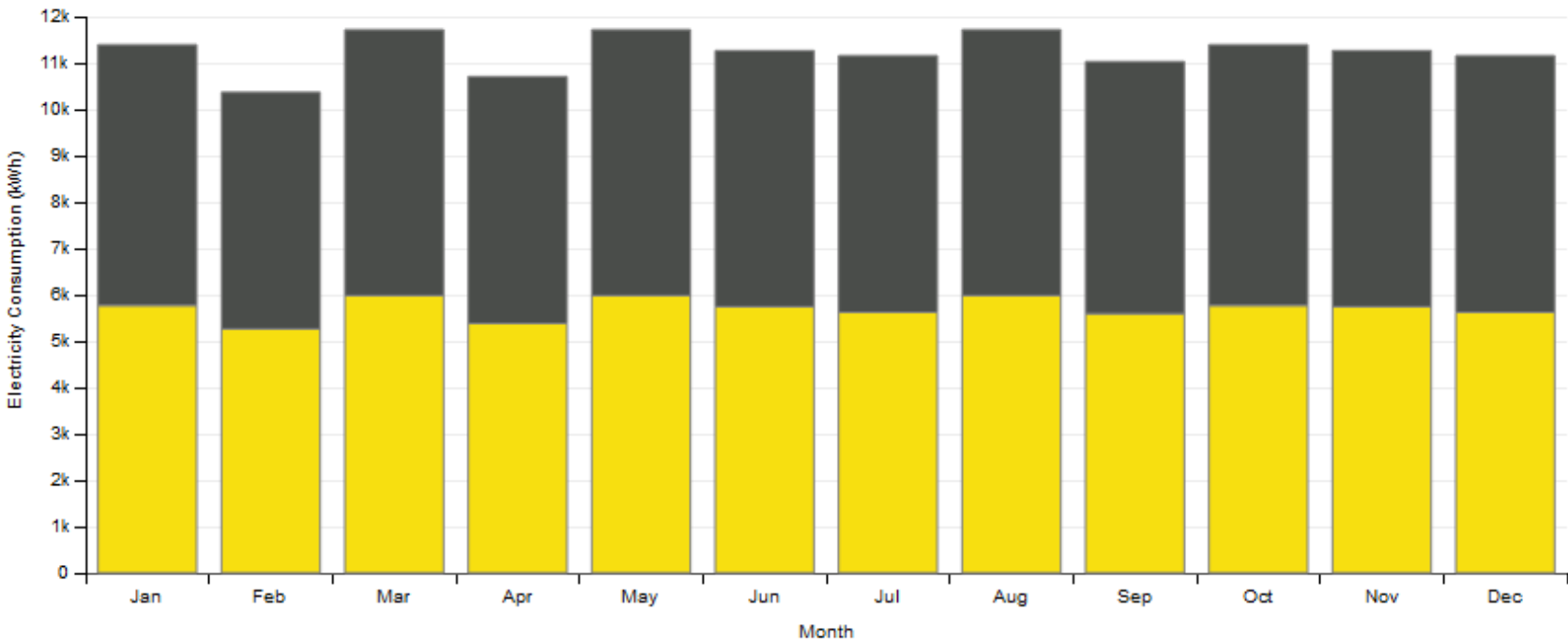


End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	68,456
Exterior Lighting	0
Interior Equipment	66,431



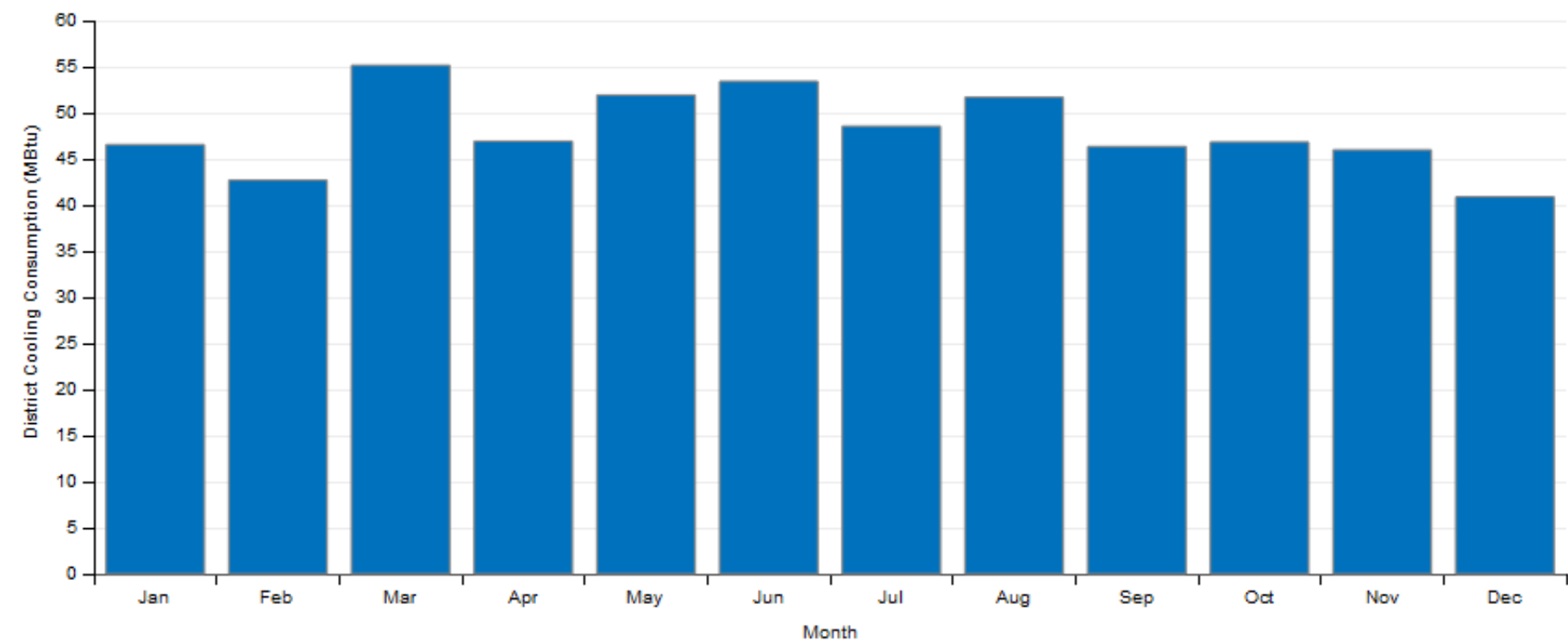
# Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	5769.06	5263.89	5983.42	5380.64	5983.42	5743.58	5620.47	5983.42	5595.0	5769.06	5743.58	5620.47	68456.0
Interior Equipment	5624.08	5102.36	5733.47	5326.06	5733.47	5523.11	5536.44	5733.47	5435.44	5624.08	5523.11	5536.44	66431.56
Total	11393.14	10366.25	11716.89	10706.69	11716.89	11266.69	11156.92	11716.89	11030.44	11393.14	11266.69	11156.92	134887.56



Monthly Cooling Consumption

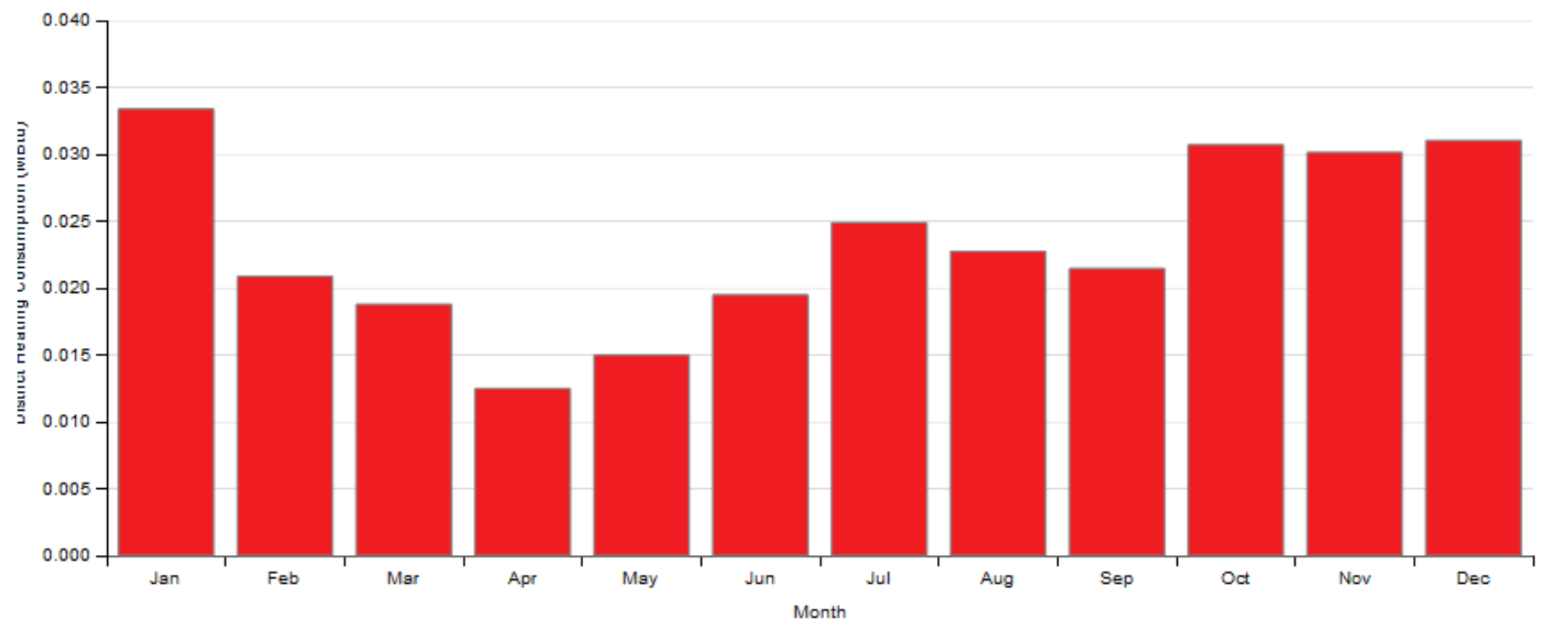
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling	46.54	42.69	55.16	46.91	51.92	53.41	48.55	51.68	46.34	46.82	45.98	40.89	576.88





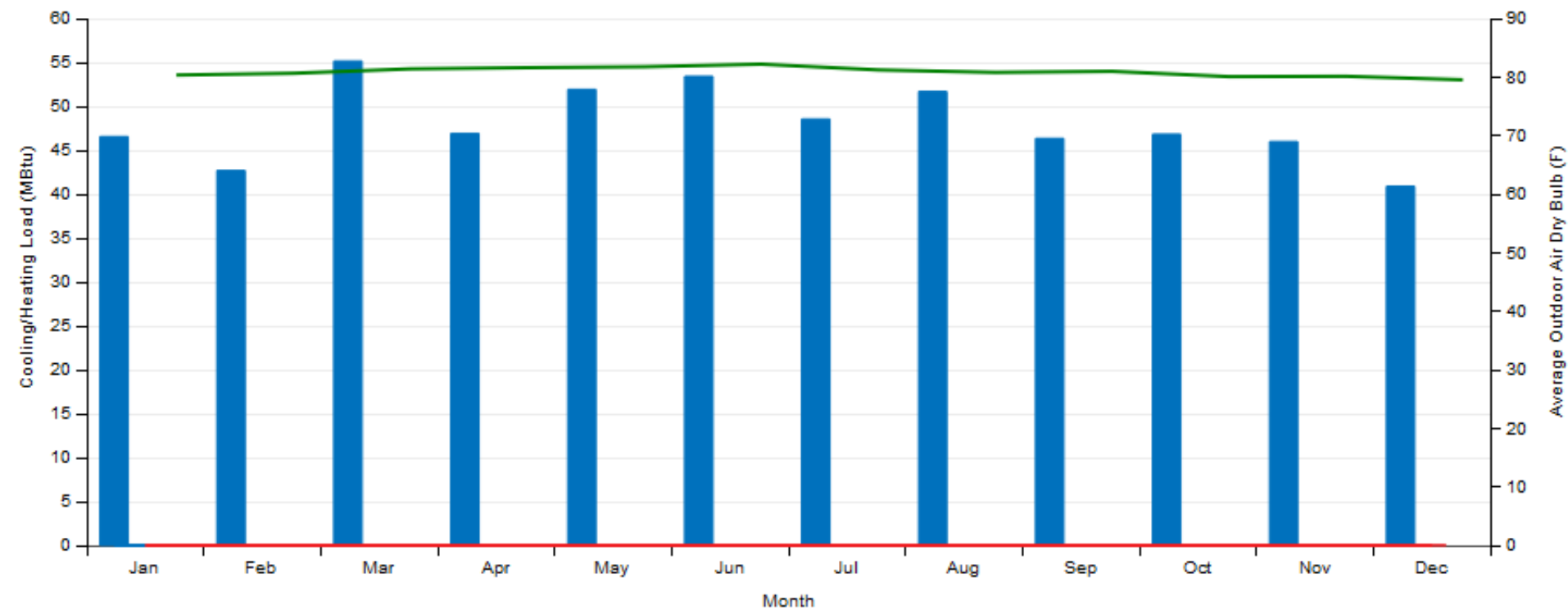
Monthly Heating Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating	0.03	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.28
Cooling													



Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	80.3	80.6	81.4	81.6	81.8	82.2	81.2	80.8	81.0	80.1	80.1	79.5
Cooling Load (MBtu)	46.54	42.69	55.16	46.91	51.92	53.41	48.55	51.68	46.34	46.82	45.98	40.89
Heating Load (MBtu)	0.03	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03



# Conclusion

Design 2. Design with 50 % Openings

City 3. Kuala Lumpur

Yearly Energy Consumption:

Heating : 0.3 MBtu

Cooling : 576.9 MBtu

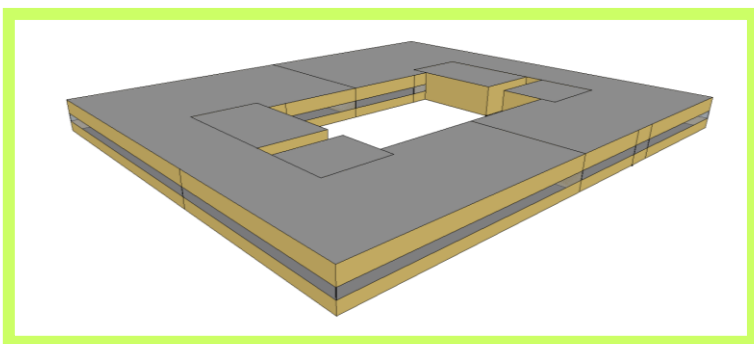
Electricity : 134887.6 kWh = 460.2 MBtu

Total : 1037.4 MBtu





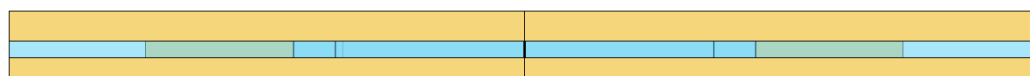
## Design 3 - 25% Opening



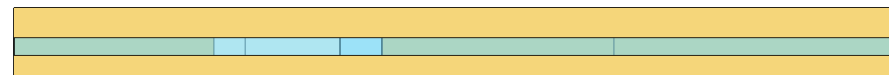
### Envelope Character :

- 3.2 meter elevation
- 25% opening ratio in all elevation (60cm above floor)
- No Shading

Envelope Elevation



North and South Elevation



East and West Elevation

### Window-Wall Ratio

Description	Total (%)	North (%)	East (%)	South (%)	West (%)
Gross Window-Wall Ratio	20.18	20.88	19.13	20.88	19.13
Gross Window-Wall Ratio (Conditioned)	20.18	20.88	19.13	20.88	19.13
Skylight-Roof Ratio	0.0				

## Zone Summary

	Area (ft^2)	Conditioned (Y/N)	Part of Total Floor Area (Y/N)	Volume (ft^3)	Multiplier	Gross Wall Area (ft^2)	Window Glass Area (ft^2)	Lighting (W/ft^2)	People (ft^2/person)	Plug and Process (W/ft^2)
THERMAL ZONE 1	7809.22	Yes	Yes	81986.53	1.00	3961.12	990.28	0.99	190.52	0.71
THERMAL ZONE 2	7809.22	Yes	Yes	81986.53	1.00	3961.12	990.28	0.99	190.52	0.71
THERMAL ZONE 3	828.82	Yes	Yes	8701.53	1.00	551.11	0.0	0.81	100.0	0.07
THERMAL ZONE 4	828.82	Yes	Yes	8701.53	1.00	551.11	0.0	0.81	100.0	0.07
THERMAL ZONE 5	452.08	Yes	Yes	4746.29	1.00	396.11	0.0	0.54	0.0	0.0
THERMAL ZONE 6	452.08	Yes	Yes	4746.29	1.00	396.11	0.0	0.54	0.0	0.0
Total	18180.24			190868.7		9816.69	1980.56	0.95	184.39	0.62
Conditioned Total	18180.24			190868.7		9816.69	1980.56	0.95	184.39	0.62
Unconditioned Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0
Not Part of Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0

Design 1

## City 1. PRAGUE

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	1,082,426	kBtu
Total Building Area	18,180	ft^2
EUI (Based on Net Site Energy and Total Building Area)	59.54	kBtu/ft^2
OpenStudio Standards Building Type		

	Value
Weather File	PRAGUE - CZE IWECC Data WMO#=115180
Latitude	50.10
Longitude	14.28
Elevation	1201 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	



# Sizing Period Design Days

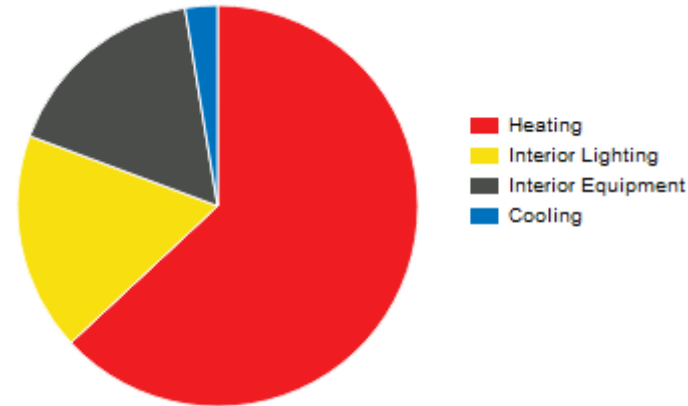
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
CAIRO ANN CLG .4% CONDNS DB=>MWB	100.58	20.7	69.98	Wetbulb [F]	12.08	350.0
CAIRO ANN CLG .4% CONDNS DP=>MDB	81.14	20.7	73.58	Dewpoint [F]	12.08	350.0
CAIRO ANN CLG .4% CONDNS ENTH=>MDB	89.6	20.7	32.72	Enthalpy [Btu/lb]	12.08	350.0
CAIRO ANN CLG .4% CONDNS WB=>MDB	89.24	20.7	76.82	Wetbulb [F]	12.08	350.0
CAIRO ANN HTG 99.6% CONDNS DB	45.86	0.0	45.86	Wetbulb [F]	5.14	90.0
CAIRO ANN HTG WIND 99.6% CONDNS WS=>MCDB	58.46	0.0	58.46	Wetbulb [F]	25.95	90.0
CAIRO ANN HUM_N 99.6% CONDNS DP=>MCDB	68.36	0.0	24.98	Dewpoint [F]	5.14	90.0
KUALA LUMPUR ANN CLG .4% CONDNS DB=>MWB	93.56	14.22	78.08	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS DP=>MDB	84.74	14.22	79.16	Dewpoint [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS ENTH=>MDB	89.06	14.22	37.62	Enthalpy [Btu/lb]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS WB=>MDB	88.7	14.22	81.5	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN HTG 99.6% CONDNS DB	71.6	0.0	71.6	Wetbulb [F]	1.34	350.0
KUALA LUMPUR ANN HTG WIND 99.6% CONDNS WS=>MCDB	84.02	0.0	84.02	Wetbulb [F]	14.99	350.0
KUALA LUMPUR ANN HUM_N 99.6% CONDNS DP=>MCDB	87.8	0.0	66.2	Dewpoint [F]	1.34	350.0
PRAGUE ANN CLG .4% CONDNS DB=>MWB	84.56	19.08	65.84	Wetbulb [F]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS DP=>MDB	72.86	19.08	63.86	Dewpoint [F]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS ENTH=>MDB	79.88	19.08	25.19	Enthalpy [Btu/lb]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS WB=>MDB	79.7	19.08	68.0	Wetbulb [F]	7.61	130.0
PRAGUE ANN HTG 99.6% CONDNS DB	5.72	0.0	5.72	Wetbulb [F]	4.25	230.0
PRAGUE ANN HTG WIND 99.6% CONDNS WS=>MCDB	40.1	0.0	40.1	Wetbulb [F]	36.69	230.0
PRAGUE ANN HUM_N 99.6% CONDNS DP=>MCDB	7.52	0.0	1.76	Dewpoint [F]	4.25	230.0

## Unmet Hours Tolerance

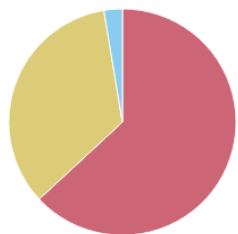
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

End Use	Consumption (kBtu)
Heating	682,760
Cooling	28,264
Interior Lighting	190,312
Exterior Lighting	0
Interior Equipment	181,099



Fuel	Consumption (kBtu)
Electricity	371,402
Natural Gas	0
Additional Fuel	0
District Cooling	28,264
District Heating	682,760

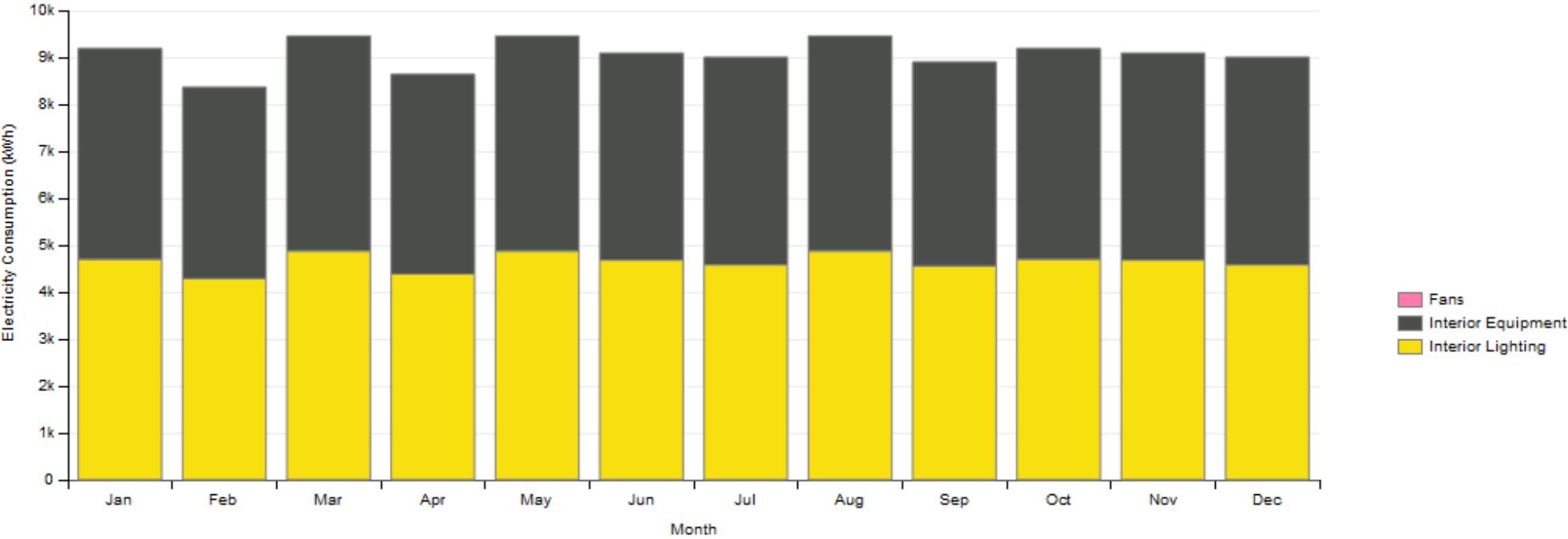


End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	55,775
Exterior Lighting	0
Interior Equipment	53,075



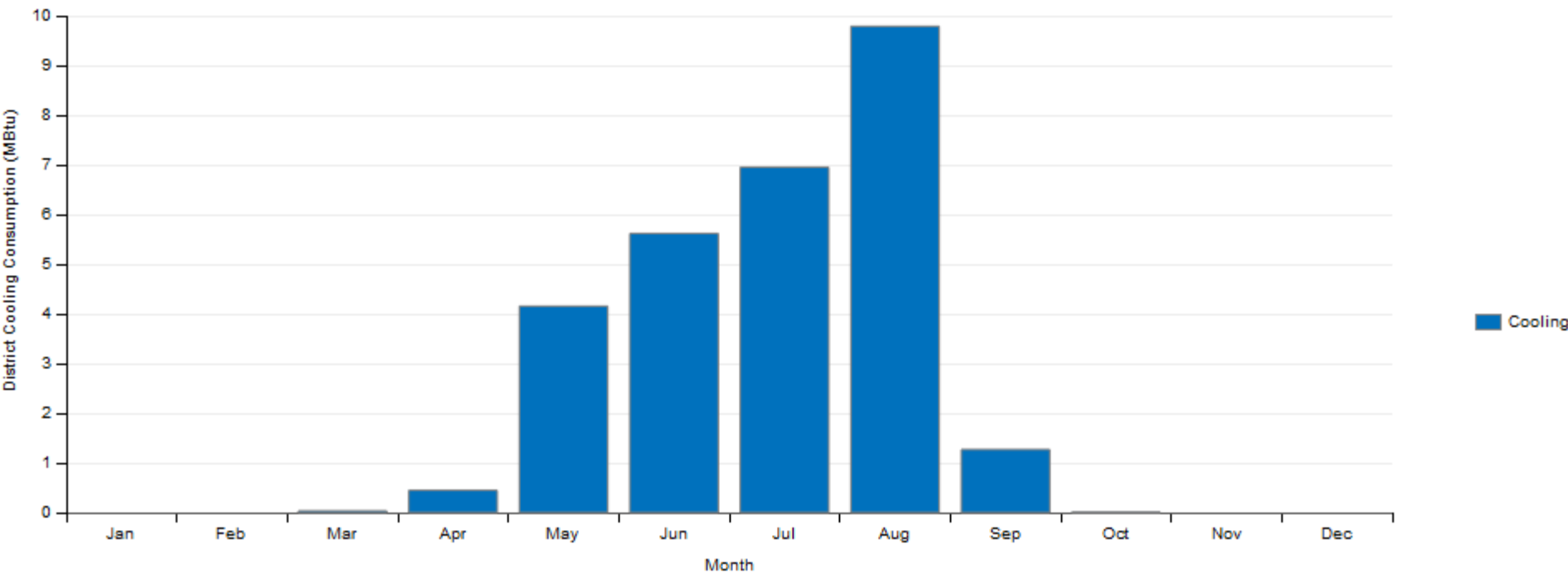
# Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	4700.28	4288.72	4874.94	4383.83	4874.94	4679.53	4579.25	4874.94	4558.47	4700.28	4679.53	4579.25	55773.97
Exterior Lighting													
Interior Equipment	4493.25	4076.42	4580.67	4255.14	4580.67	4412.58	4423.22	4580.67	4342.56	4493.25	4412.58	4423.22	53074.22
Total	9193.53	8365.14	9455.61	8638.97	9455.61	9092.11	9002.47	9455.61	8901.03	9193.53	9092.11	9002.47	108848.19



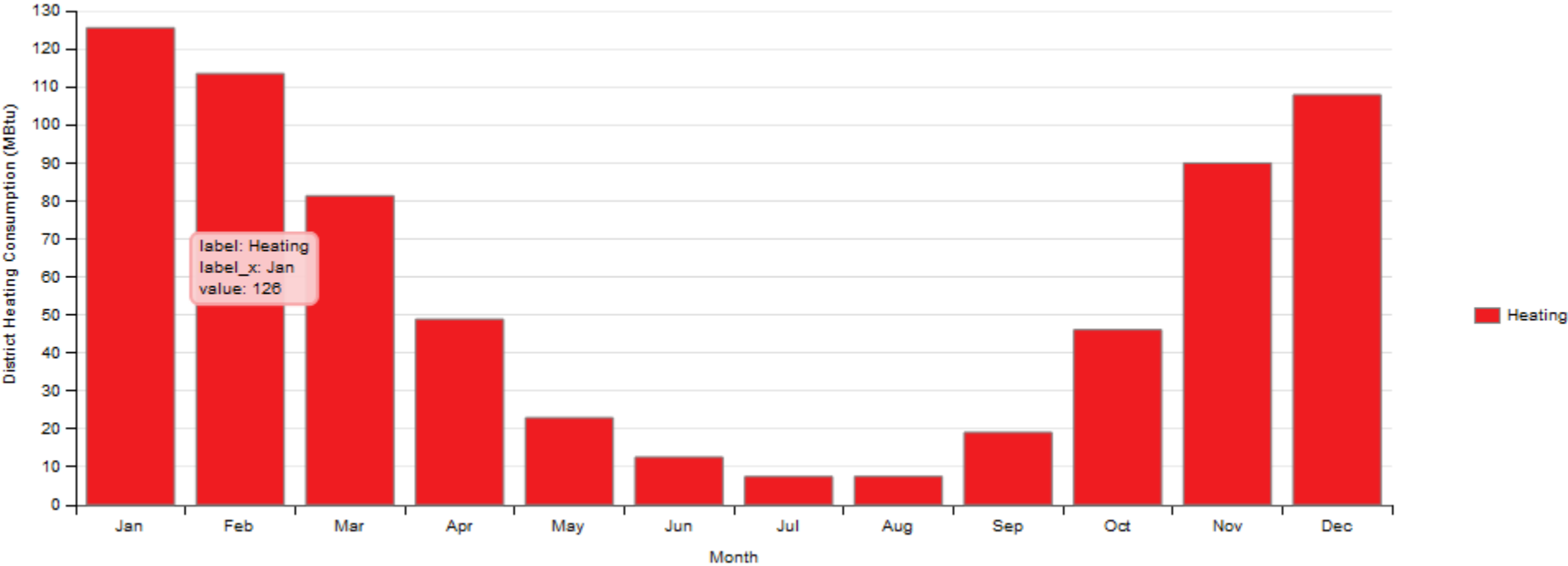
# Monthly Cooling Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling			0.03	0.45	4.15	5.62	6.95	9.79	1.27	0.01			28.27



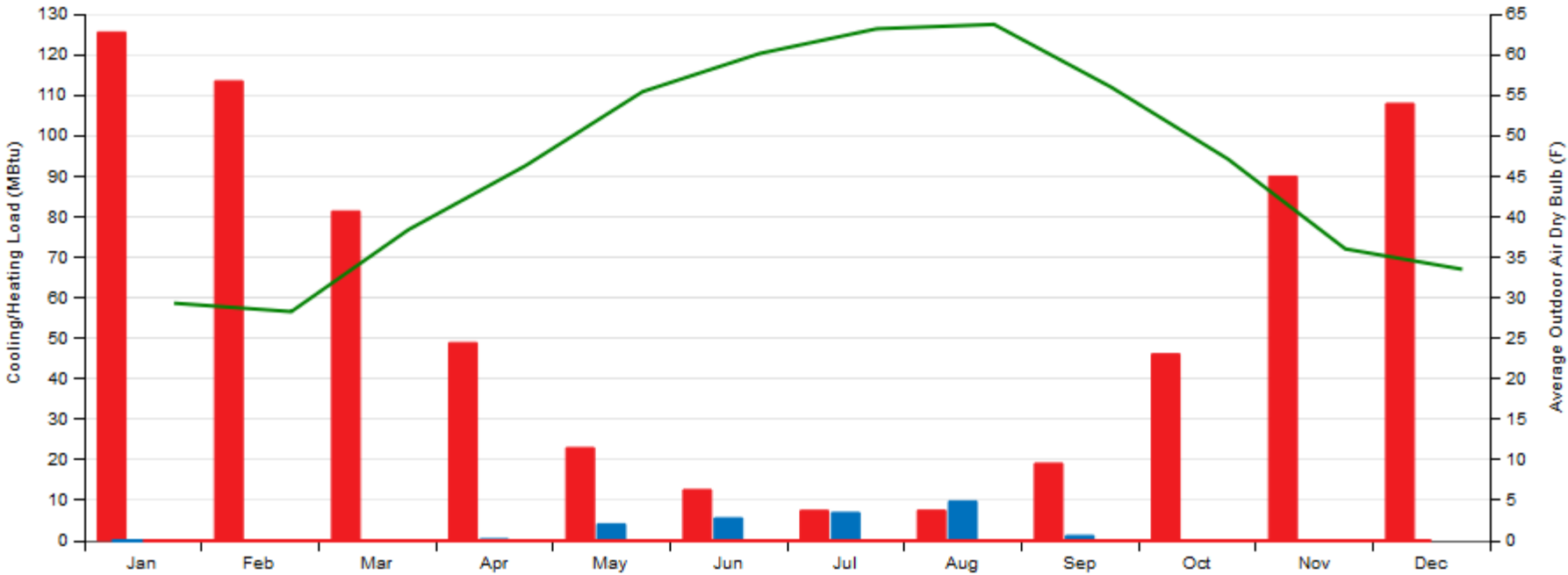
# Monthly Heating Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating	125.51	113.47	81.33	48.88	22.95	12.59	7.47	7.5	19.1	46.1	89.94	107.91	682.76
Cooling													



Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	29.3	28.3	38.4	46.3	55.4	60.1	63.2	63.7	56.0	47.1	36.0	33.5
Cooling Load (MBtu)	0.0	0.0	0.03	0.45	4.15	5.62	6.95	9.79	1.27	0.01	0.0	0.0
Heating Load (MBtu)	125.51	113.47	81.33	48.88	22.95	12.59	7.47	7.5	19.1	46.1	89.94	107.91



# Conclusion

Design 3. Design with 25% Openings  
City 1. Prague

## Yearly Energy Consumption:

Heating : 682.8 MBtu  
Cooling : 28.3 MBtu  
Electricity : 108848.2 kWh = 371.4 MBtu

Total : 1082.5 MBtu

Design 1

## City 2. CAIRO

### Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	713,621	kBtu
Total Building Area	18,180	ft^2
EUI (Based on Net Site Energy and Total Building Area)	39.25	kBtu/ft^2
OpenStudio Standards Building Type		

### Weather Summary

	Value
Weather File	CAIRO - EGY IWECData WMO#=-623660
Latitude	30.13
Longitude	31.40
Elevation	243 (ft)
Time Zone	2.00
North Axis Angle	0.00
ASHRAE Climate Zone	



Sizing Period Design Days

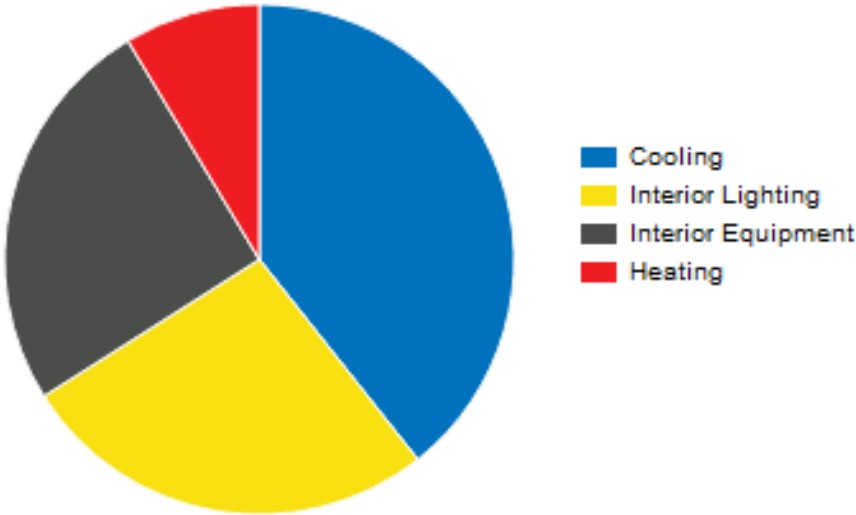
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
CAIRO ANN CLG .4% CONDNS DB=>MWB	100.58	20.7	69.98	Wetbulb [F]	12.08	350.0
CAIRO ANN CLG .4% CONDNS DP=>MDB	81.14	20.7	73.58	Dewpoint [F]	12.08	350.0
CAIRO ANN CLG .4% CONDNS ENTH=>MDB	89.6	20.7	32.72	Enthalpy [Btu/lb]	12.08	350.0
CAIRO ANN CLG .4% CONDNS WB=>MDB	89.24	20.7	76.82	Wetbulb [F]	12.08	350.0
CAIRO ANN HTG 99.6% CONDNS DB	45.86	0.0	45.86	Wetbulb [F]	5.14	90.0
CAIRO ANN HTG WIND 99.6% CONDNS WS=>MCDB	58.46	0.0	58.46	Wetbulb [F]	25.95	90.0
CAIRO ANN HUM_N 99.6% CONDNS DP=>MCDB	68.36	0.0	24.98	Dewpoint [F]	5.14	90.0
KUALA LUMPUR ANN CLG .4% CONDNS DB=>MWB	93.56	14.22	78.08	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS DP=>MDB	84.74	14.22	79.16	Dewpoint [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS ENTH=>MDB	89.06	14.22	37.62	Enthalpy [Btu/lb]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS WB=>MDB	88.7	14.22	81.5	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN HTG 99.6% CONDNS DB	71.6	0.0	71.6	Wetbulb [F]	1.34	350.0
KUALA LUMPUR ANN HTG WIND 99.6% CONDNS WS=>MCDB	84.02	0.0	84.02	Wetbulb [F]	14.99	350.0
KUALA LUMPUR ANN HUM_N 99.6% CONDNS DP=>MCDB	87.8	0.0	66.2	Dewpoint [F]	1.34	350.0
PRAGUE ANN CLG .4% CONDNS DB=>MWB	84.56	19.08	65.84	Wetbulb [F]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS DP=>MDB	72.86	19.08	63.86	Dewpoint [F]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS ENTH=>MDB	79.88	19.08	25.19	Enthalpy [Btu/lb]	7.61	130.0
PRAGUE ANN CLG .4% CONDNS WB=>MDB	79.7	19.08	68.0	Wetbulb [F]	7.61	130.0
PRAGUE ANN HTG 99.6% CONDNS DB	5.72	0.0	5.72	Wetbulb [F]	4.25	230.0
PRAGUE ANN HTG WIND 99.6% CONDNS WS=>MCDB	40.1	0.0	40.1	Wetbulb [F]	36.69	230.0
PRAGUE ANN HUM_N 99.6% CONDNS DP=>MCDB	7.52	0.0	1.76	Dewpoint [F]	4.25	230.0

Unmet Hours Tolerance

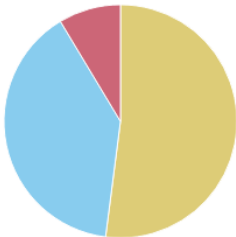
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

End Use	Consumption (kBtu)
Heating	61,523
Cooling	280,696
Interior Lighting	190,312
Exterior Lighting	0
Interior Equipment	181,099



Fuel	Consumption (kBtu)
Electricity	371,402
Natural Gas	0
Additional Fuel	0
District Cooling	280,696
District Heating	61,523

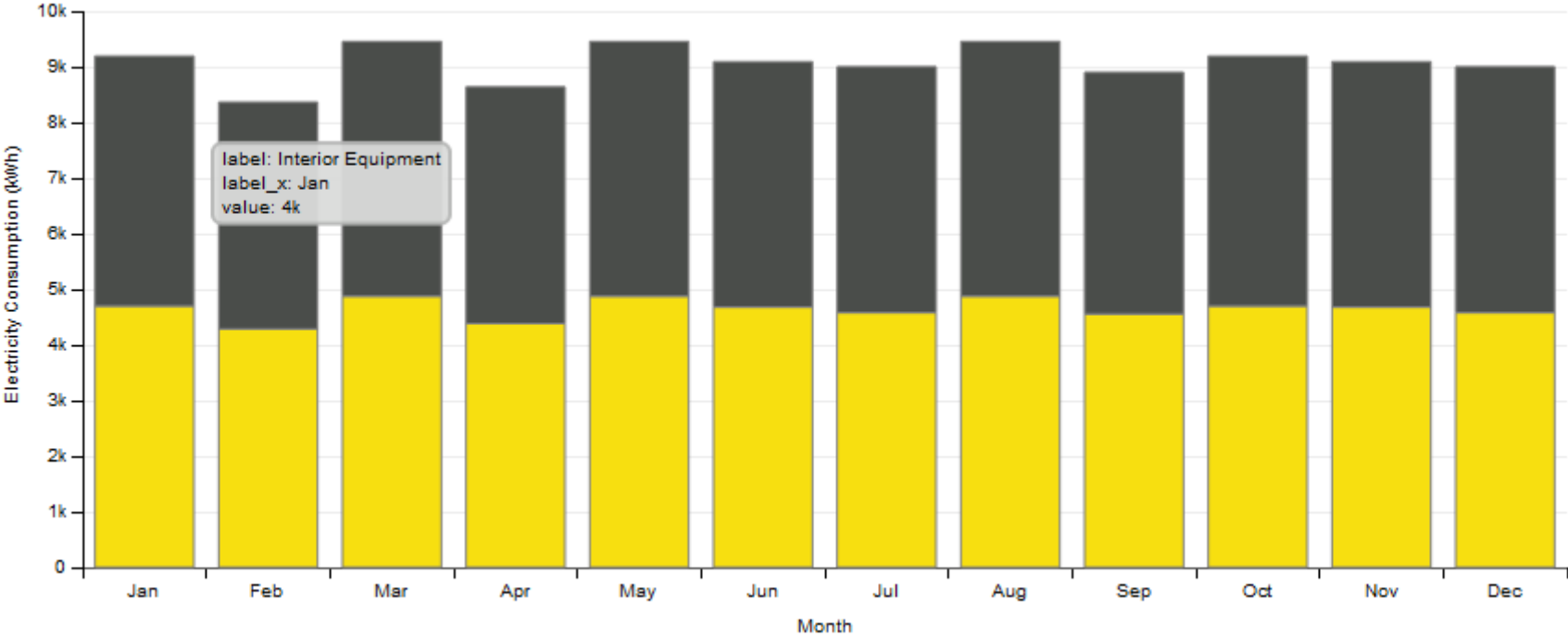


End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	55,775
Exterior Lighting	0
Interior Equipment	53,075



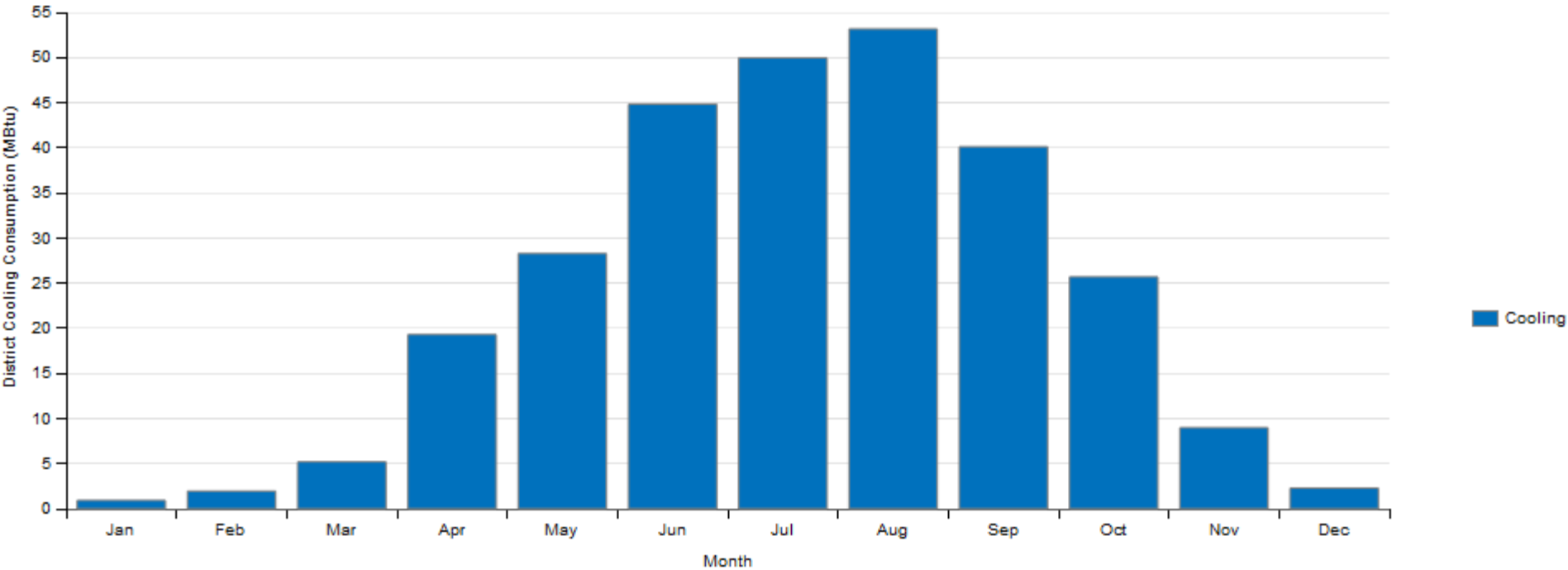
# Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	4700.28	4288.72	4874.94	4383.83	4874.94	4679.53	4579.25	4874.94	4558.47	4700.28	4679.53	4579.25	55773.97
Interior Equipment	4493.25	4076.42	4580.67	4255.14	4580.67	4412.58	4423.22	4580.67	4342.56	4493.25	4412.58	4423.22	53074.22
Total	9193.53	8365.14	9455.61	8638.97	9455.61	9092.11	9002.47	9455.61	8901.03	9193.53	9092.11	9002.47	108848.19



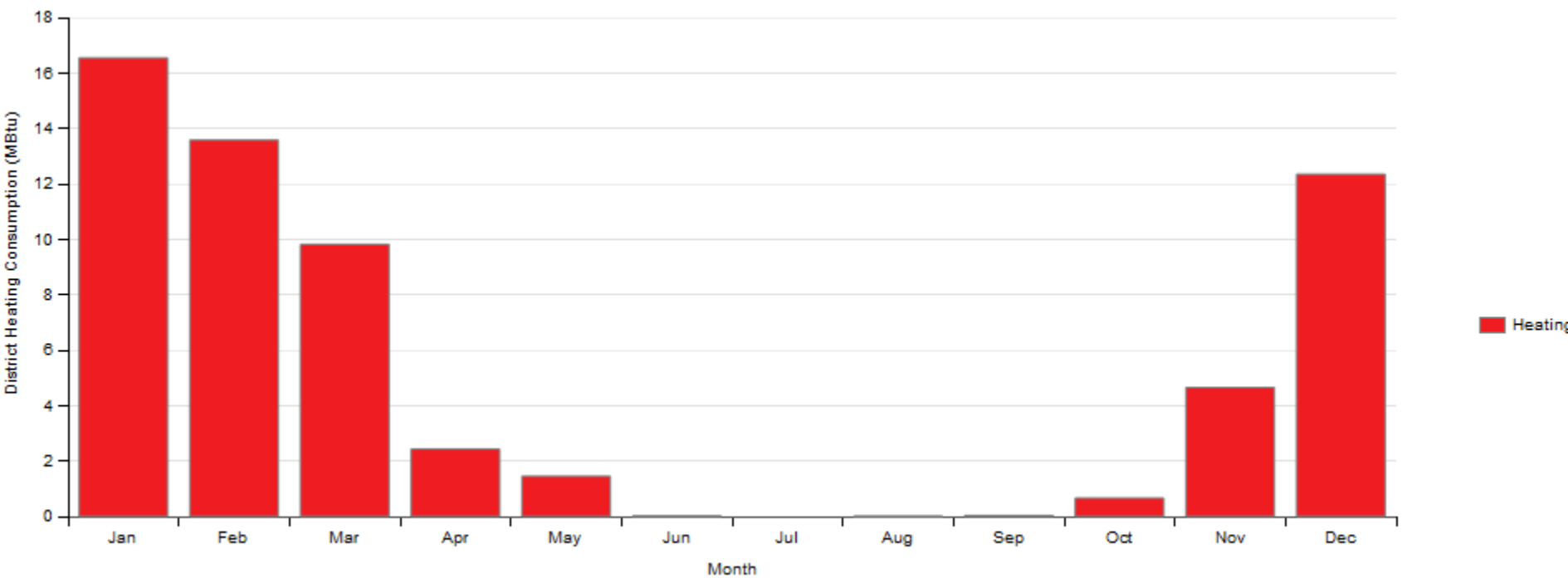
Monthly Cooling Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling	0.93	1.96	5.2	19.3	28.28	44.83	49.96	53.16	40.12	25.69	8.98	2.29	280.69



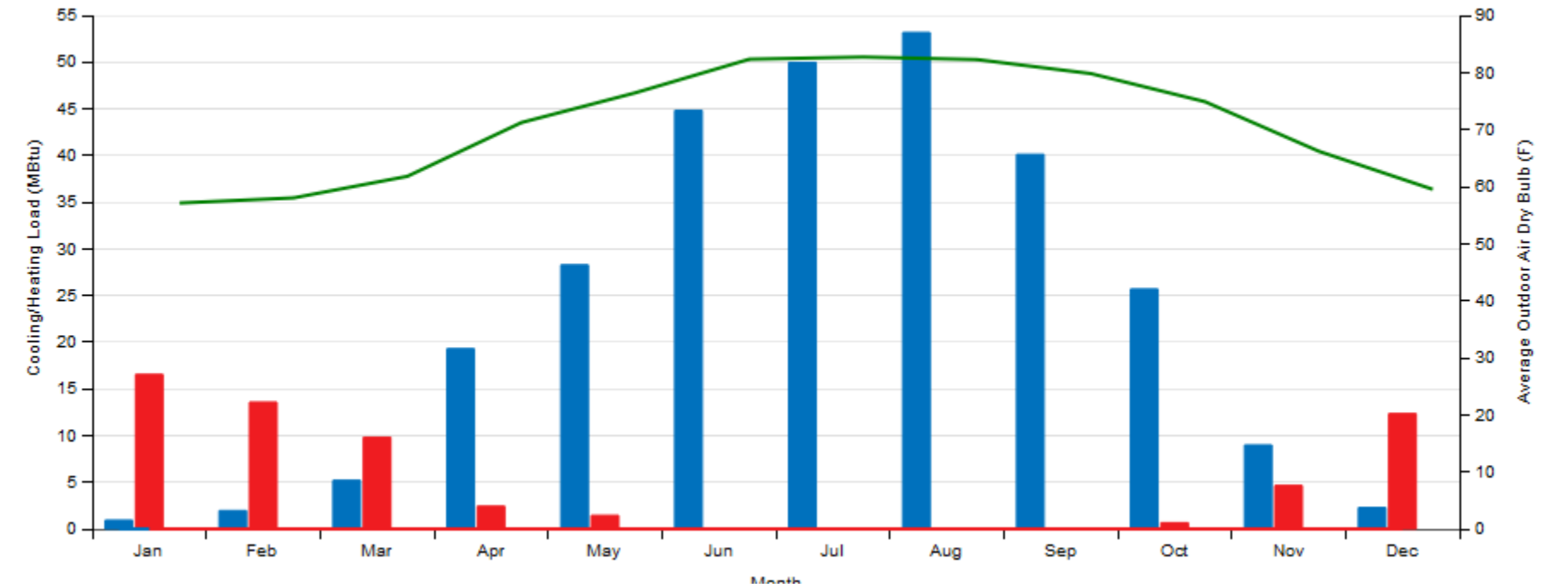
Monthly Heating Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating	16.54	13.58	9.82	2.43	1.45	0.01		0.0	0.03	0.66	4.65	12.35	61.52
Cooling													



Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	57.1	58.0	61.8	71.2	76.4	82.3	82.7	82.3	79.8	74.9	66.2	59.5
Cooling Load (MBtu)	0.93	1.96	5.2	19.3	28.28	44.83	49.96	53.16	40.12	25.69	8.98	2.29
Heating Load (MBtu)	16.54	13.58	9.82	2.43	1.45	0.01	0.0	0.0	0.03	0.66	4.65	12.35



# Conclusion

Design 3. Design with 25% Openings  
City 2. Cairo

Yearly Energy Consumption:

Heating : 61.5 MBtu  
Cooling : 280.7 MBtu  
Electricity : 108848.2 kWh = 371.4 MBtu

Total : 713.6 MBtu

Design 1

City 3.  
KUALA  
LUMPUR

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	960,527	kBtu
Total Building Area	18,180	ft^2
EUI (Based on Net Site Energy and Total Building Area)	52.83	kBtu/ft^2
OpenStudio Standards Building Type		

	Value
Weather File	KUALA LUMPUR - MYS IWECData WMO#=486470
Latitude	3.12
Longitude	101.55
Elevation	72 (ft)
Time Zone	8.00
North Axis Angle	0.00
ASHRAE Climate Zone	



## Sizing Period Design Days

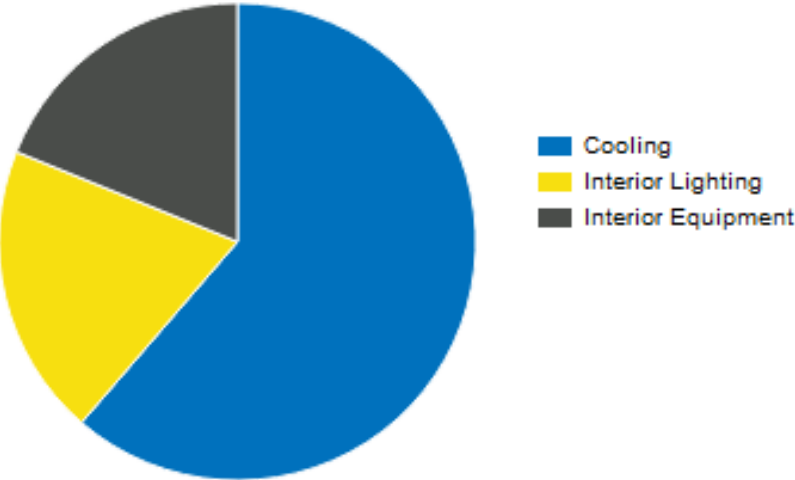
	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
KUALA LUMPUR ANN CLG .4% CONDNS DB=>MWB	93.56	14.22	78.08	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS DP=>MDB	84.74	14.22	79.16	Dewpoint [F]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS ENTH=>MDB	89.06	14.22	37.62	Enthalpy [Btu/lb]	7.38	180.0
KUALA LUMPUR ANN CLG .4% CONDNS WB=>MDB	88.7	14.22	81.5	Wetbulb [F]	7.38	180.0
KUALA LUMPUR ANN HTG 99.6% CONDNS DB	71.6	0.0	71.6	Wetbulb [F]	1.34	350.0
KUALA LUMPUR ANN HTG WIND 99.6% CONDNS WS=>MCDB	84.02	0.0	84.02	Wetbulb [F]	14.99	350.0
KUALA LUMPUR ANN HUM_N 99.6% CONDNS DP=>MCDB	87.8	0.0	66.2	Dewpoint [F]	1.34	350.0

## Unmet Hours Tolerance

Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Energy Consumption

End Use	Consumption (kBtu)
Heating	0
Cooling	589,125
Interior Lighting	190,312
Exterior Lighting	0
Interior Equipment	181,099



Fuel	Consumption (kBtu)
Electricity	371,402
Natural Gas	0
Additional Fuel	0
District Cooling	589,125
District Heating	0

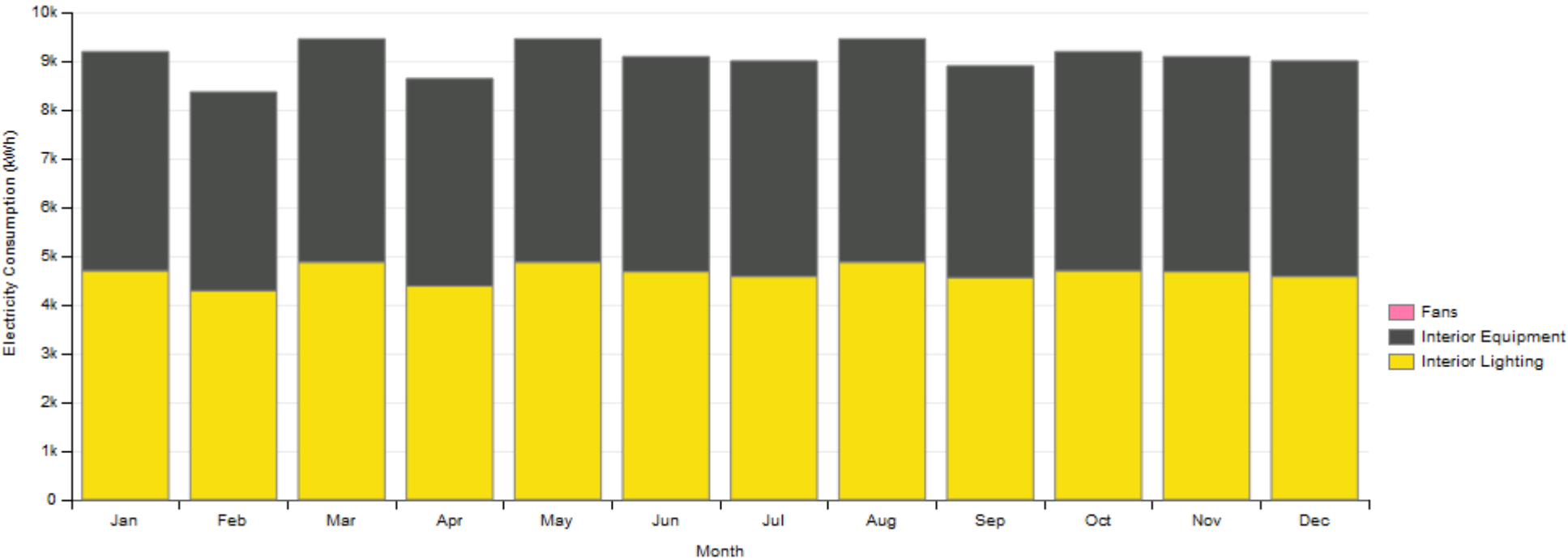


End Use	Consumption (kWh)
Heating	0
Cooling	0
Interior Lighting	55,775
Exterior Lighting	0
Interior Equipment	53,075



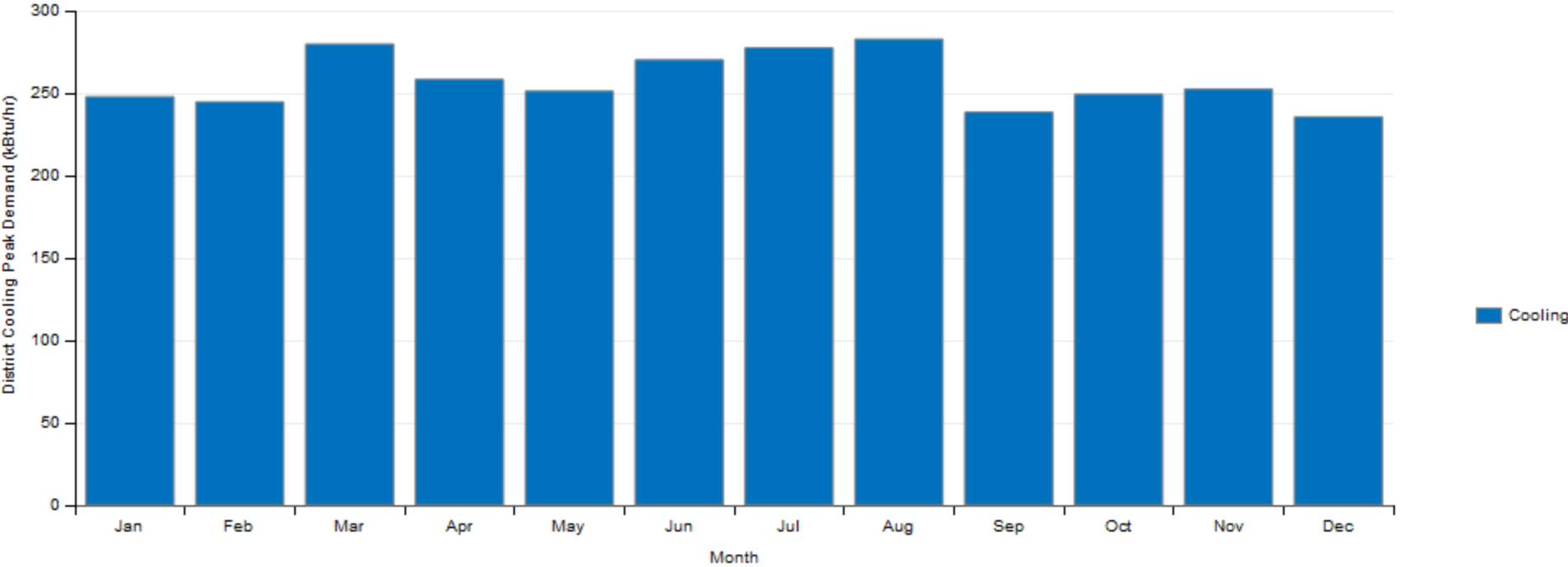
Monthly Electricity Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating													
Cooling													
Interior Lighting	4700.28	4288.72	4874.94	4383.83	4874.94	4679.53	4579.25	4874.94	4558.47	4700.28	4679.53	4579.25	55773.97
Interior Equipment	4493.25	4076.42	4580.67	4255.14	4580.67	4412.58	4423.22	4580.67	4342.56	4493.25	4412.58	4423.22	53074.22
Total	9193.53	8365.14	9455.61	8638.97	9455.61	9092.11	9002.47	9455.61	8901.03	9193.53	9092.11	9002.47	108848.19



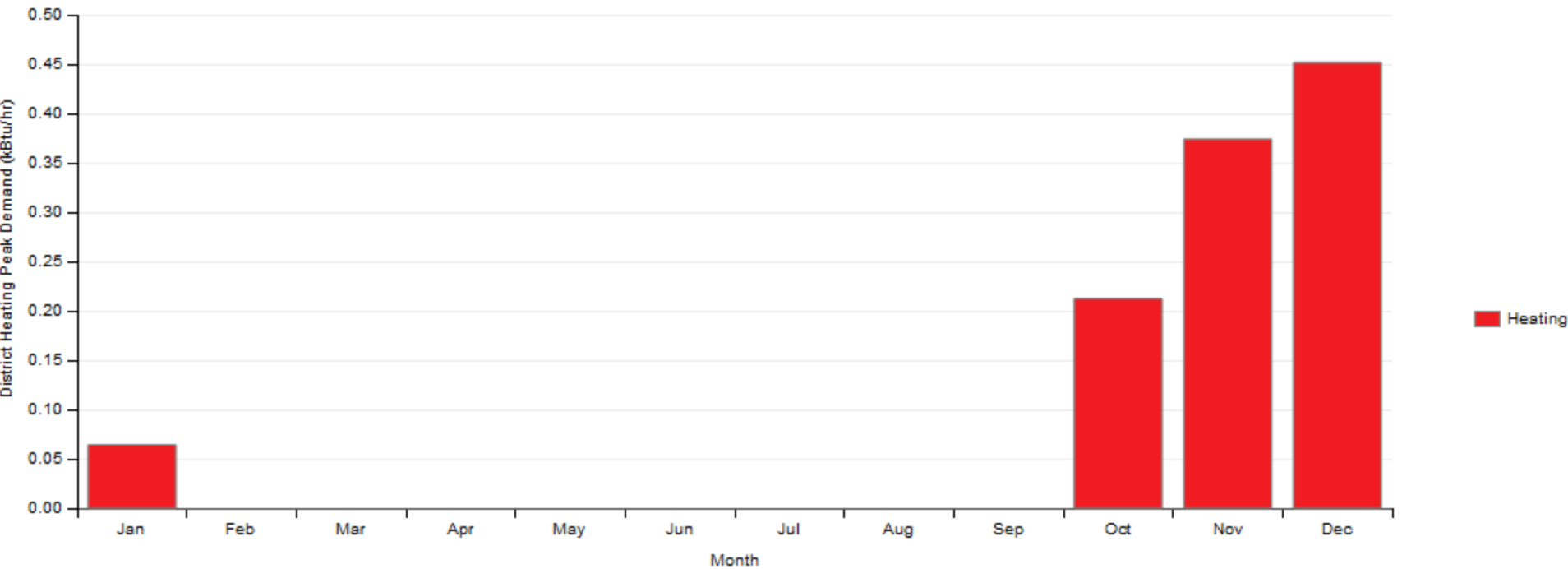
Monthly Cooling Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating												
Cooling	247.8255	244.6609	279.8071	258.3102	251.2169	270.1726	277.4874	282.788	238.44	249.2565	252.3676	235.6066



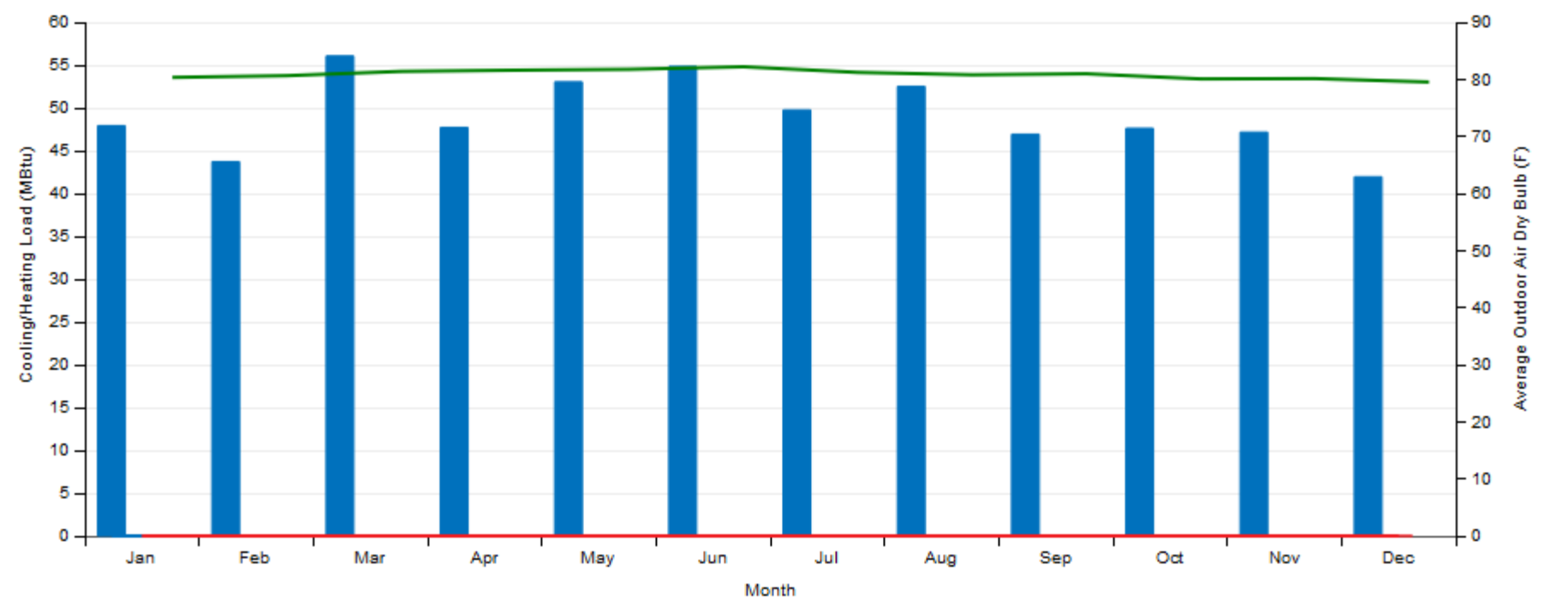
Monthly Heating Consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating	0.0642									0.2123	0.3738	0.4515
Cooling												



Annual Cooling and Heating Load

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Outdoor Air Dry Bulb (F)	80.3	80.6	81.4	81.6	81.8	82.2	81.2	80.8	81.0	80.1	80.1	79.5
Cooling Load (MBtu)	47.91	43.71	56.05	47.71	53.03	54.83	49.75	52.51	46.92	47.61	47.15	41.94
Heating Load (MBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



# Conclusion

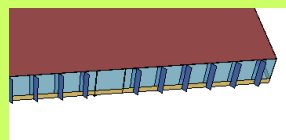
Design 3. Design with 25% Openings  
City 3. Kuala Lumpur

## Yearly Energy Consumption:

Heating : -  
Cooling : 589.12 kBtu = 0.6 MBtu  
Electricity : 108848.2 kWh = 371.4 MBtu

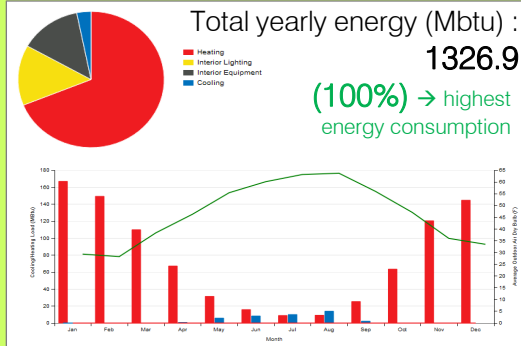
Total : 372.0 MBtu

## City 1. Prague

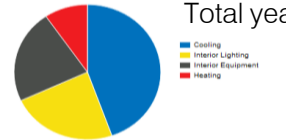


### Design 1.

- 80% opening
- South & West Vertical Shading

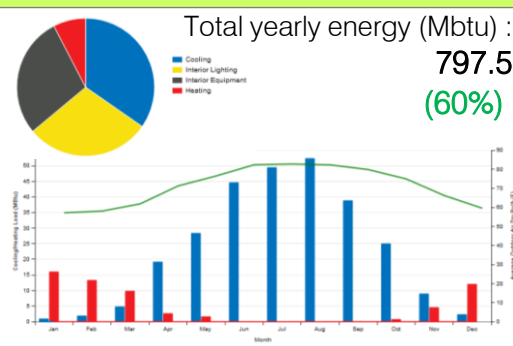
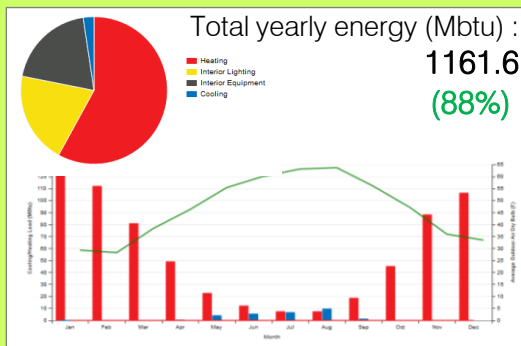


## City 2. Cairo

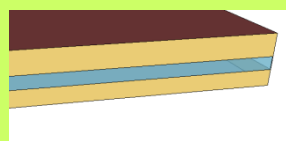


### Design 2.

- 50% opening
- Horizontal Shading on all 4 sides

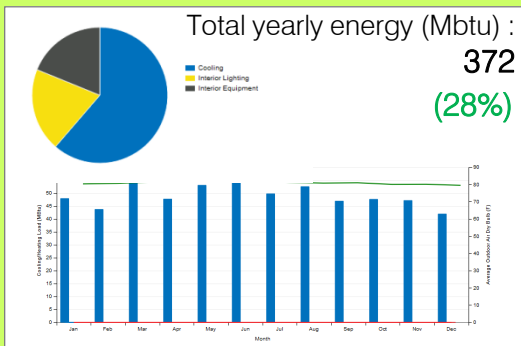
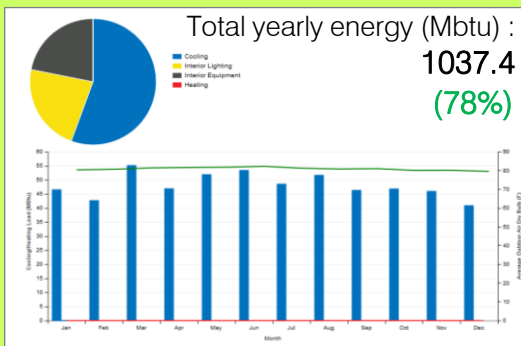
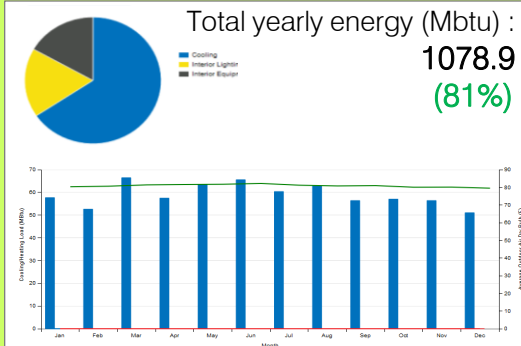
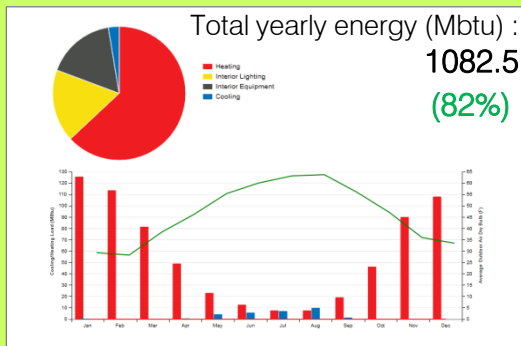


## City 3. K.L.



### Design 3.

- 25% opening





		Prague	Kairo	Kuala Lumpur
Design 1	Heating	913.6	77.4	0.0
	Cooling	41.9	360.9	707.5
	Electricity	371.4	371.4	371.4
	Total	1326.9	809.7	1078.9
Design 2	Heating	673.8	60.8	0.3
	Cooling	27.6	276.5	576.9
	Electricity	460.2	460.2	460.2
	Total	1161.6	797.5	1037.4
Design 3	Heating	682.8	61.5	0.0
	Cooling	28.3	280.7	0.6
	Electricity	371.4	371.4	371.4
	Total	1082.5	713.6	372.0

## Conclusion

*Based on the result comparison, design with 80% opening shows the largest energy consumption, while design with 25% opening shows lowest energy consumption. We conclude that the largest the opening of the building, the larger thermal load due to bigger surface of heat penetration.*

*Result of City 1 (Prague) shows largest energy consumption due to the massive needs of energy for heating. Result of City 3 (Kuala Lumpur) shows second largest energy consumption due to the massive needs of energy for cooling.*

