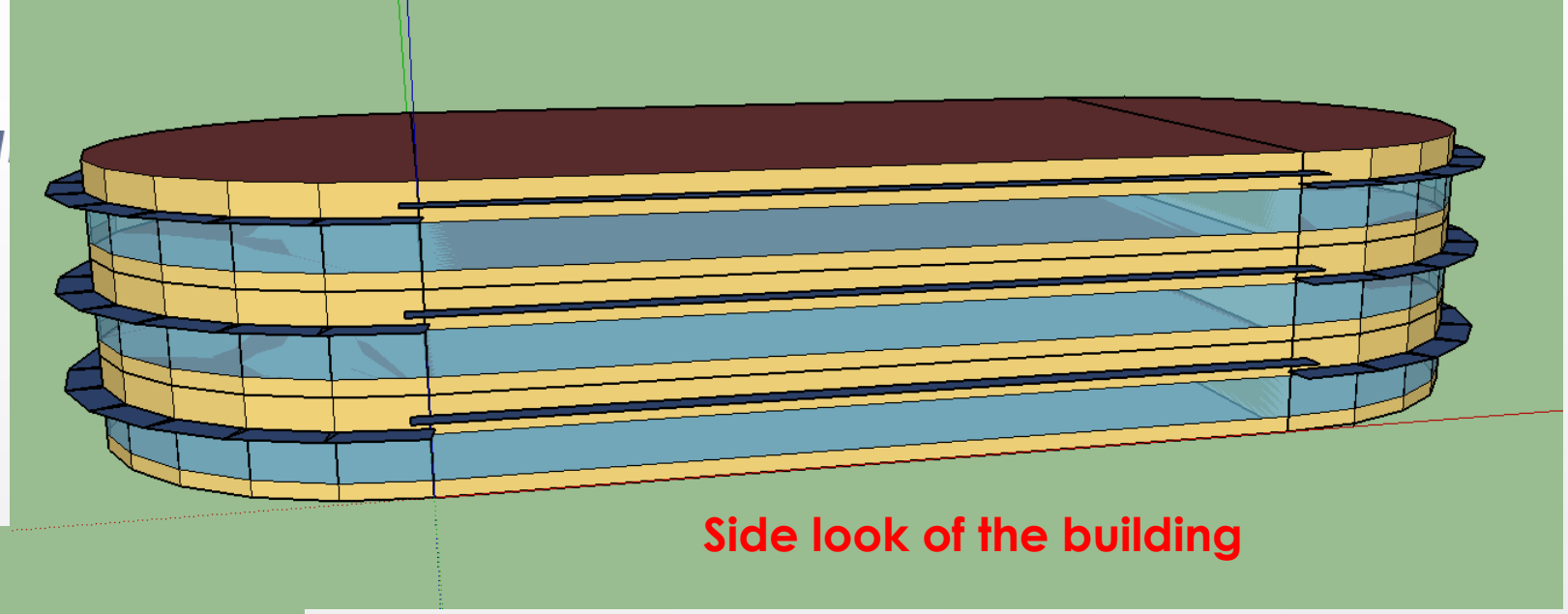
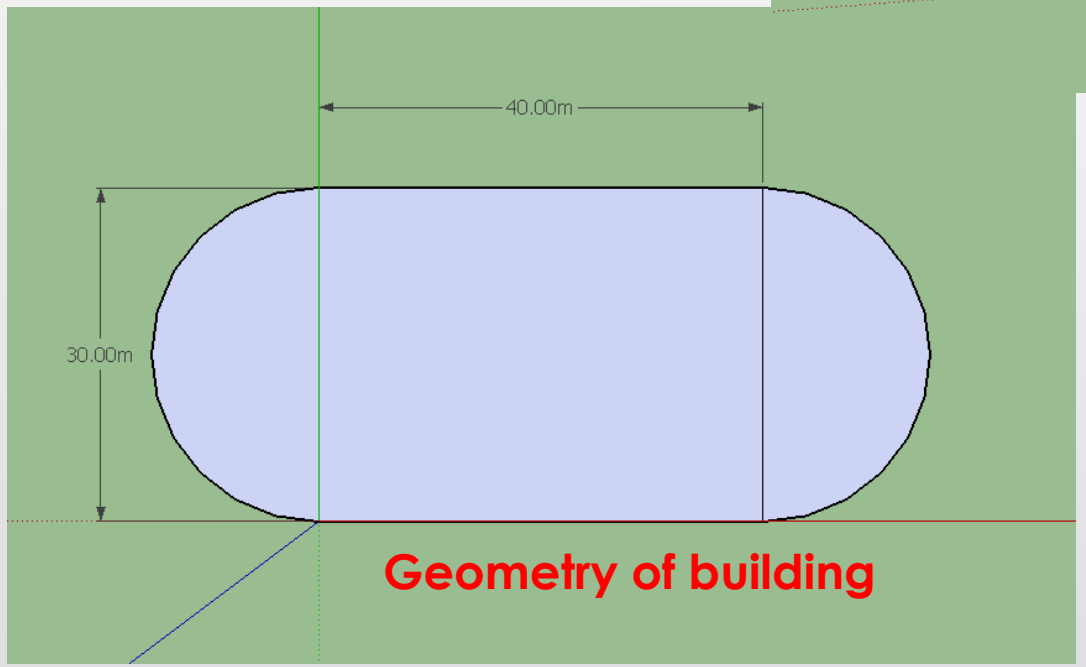
Open studio project

Course: EETBS, Politecnico di Milano, campus Piacenza



Side look of the building



Geometry of building

- Height of floor = 4.5 m
- Window/wall ratio = 0.45
- South shadowing: ratio=0.45 offset=0.5
- East/West shadowing: ratio=0.7 offset=0.1
- No shadowing on north side
- 6 thermal zones : 2 on every floor, one of them is IT_Room-CZ1-3, other is OpenOffice-CZ1-3

- Three different cities, calculated with default simulation given by OpenStudio for:

1. Piacenza (45.0526° N, 9.6930° E)
2. Shanghai (31.2304° N, 121.4737° E)
3. Thessaloniki (40.6401° N, 22.9444° E)

Piacenza – base case

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File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results

Open ResultsViewer for Detailed Reports

End Uses By Subcategory

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	628.50	0.00
Cooling	General	0.00	0.00	0.00	740.19	0.00	0.00
Interior Lighting	General	704.80	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	1303.98	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00
Fans	Ventilation (simple)	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	General	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	General	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	General	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	General	0.00	0.00	0.00	0.00	0.00	0.00
Generators	General	0.00	0.00	0.00	0.00	0.00	0.00

Normalized Metrics

Utility Use Per Conditioned Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]
Lighting	123.73	0.00	0.00	0.00	0.00	0.00
HVAC	0.00	0.00	0.00	129.94	110.33	0.00
Other	228.91	0.00	0.00	0.00	0.00	0.00
Total	352.64	0.00	0.00	129.94	110.33	0.00

Utility Use Per Total Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]

搜索 Windows

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Shanghai – base case

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File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results

Open ResultsViewer for Detailed Reports

End Uses By Subcategory

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	318.64	0.00
Cooling	General	0.00	0.00	0.00	1361.72	0.00	0.00
Interior Lighting	General	704.80	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	1303.98	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00
Fans	Ventilation (simple)	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	General	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	General	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	General	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	General	0.00	0.00	0.00	0.00	0.00	0.00
Generators	General	0.00	0.00	0.00	0.00	0.00	0.00

Normalized Metrics

Utility Use Per Conditioned Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]
Lighting	123.73	0.00	0.00	0.00	0.00	0.00
HVAC	0.00	0.00	0.00	239.05	55.94	0.00
Other	228.91	0.00	0.00	0.00	0.00	0.00
Total	352.64	0.00	0.00	239.05	55.94	0.00

Utility Use Per Total Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]

搜索 Windows

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Thessaloniki – base case

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File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results

Open ResultsViewer for Detailed Reports

End Uses By Subcategory

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	311.66	0.00
Cooling	General	0.00	0.00	0.00	988.42	0.00	0.00
Interior Lighting	General	704.80	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	1303.98	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00
Fans	Ventilation (simple)	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	General	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	General	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	General	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	General	0.00	0.00	0.00	0.00	0.00	0.00
Generators	General	0.00	0.00	0.00	0.00	0.00	0.00

Normalized Metrics

Utility Use Per Conditioned Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]
Lighting	123.73	0.00	0.00	0.00	0.00	0.00
HVAC	0.00	0.00	0.00	173.52	54.71	0.00
Other	228.91	0.00	0.00	0.00	0.00	0.00
Total	352.64	0.00	0.00	173.52	54.71	0.00

Utility Use Per Total Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]

搜索 Windows

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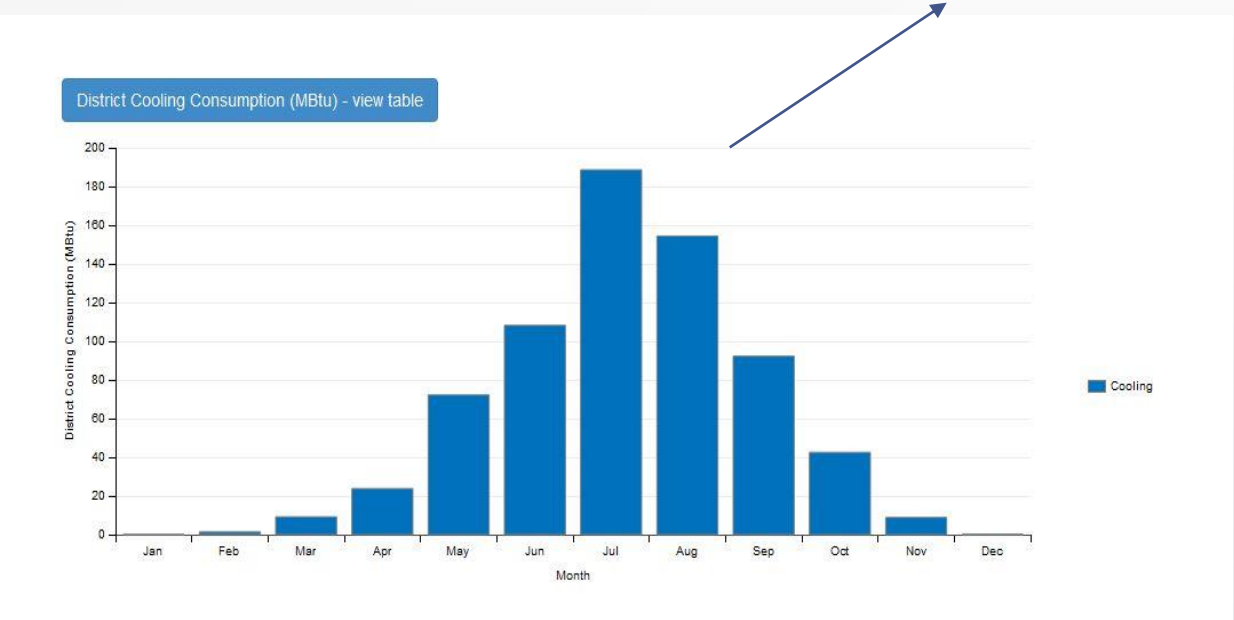
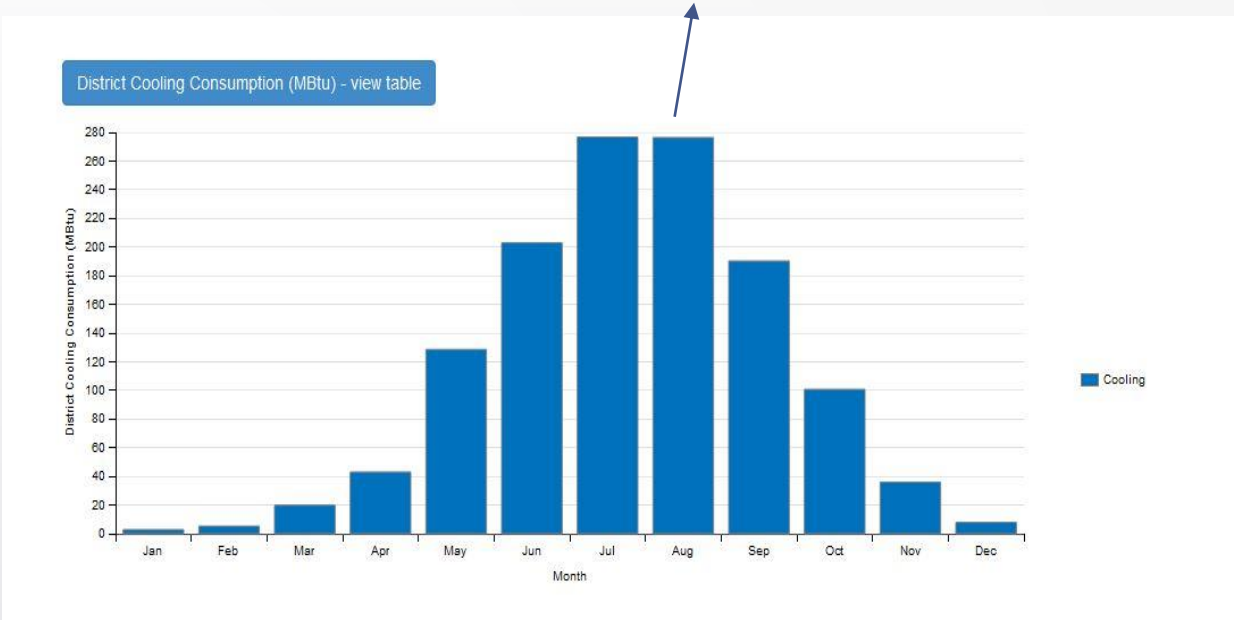
Comparison (district cooling/heating consumption)

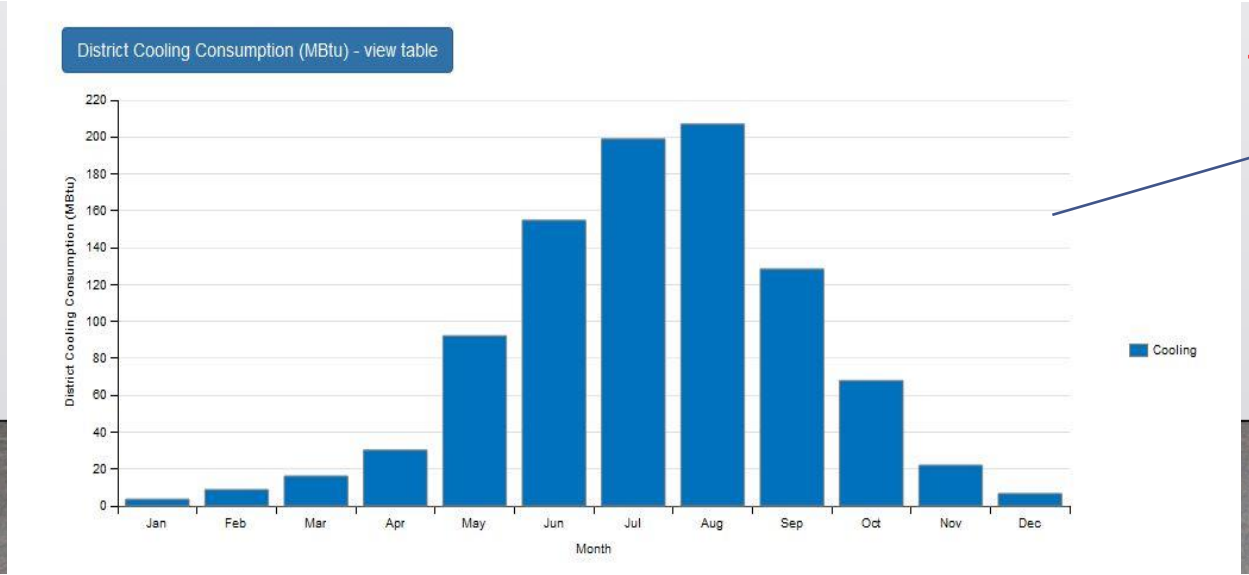
Piacenza (740,19 GJ –total cooling consumption)



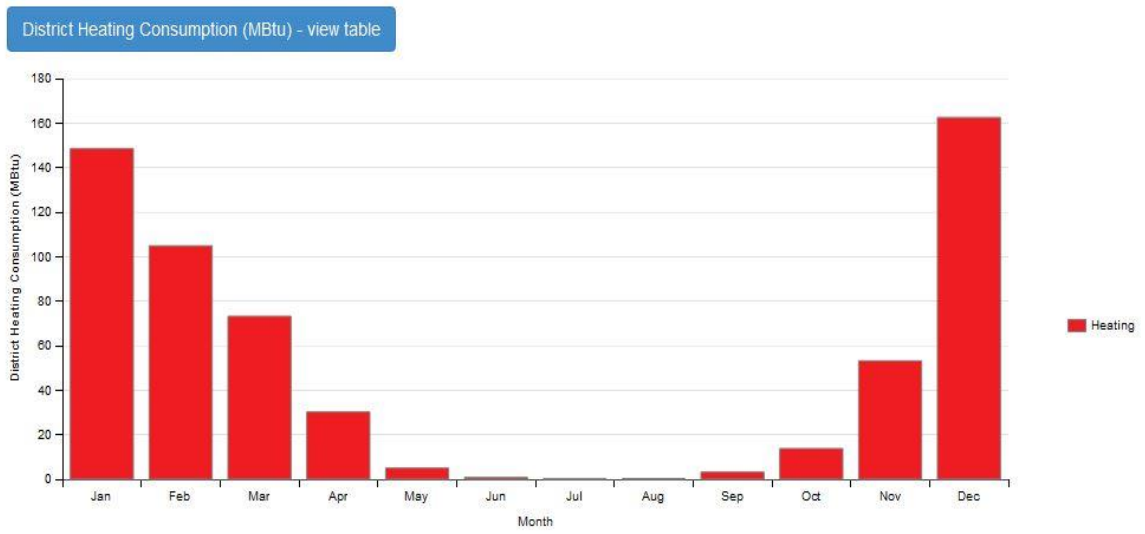
Shanghai (1361.72 GJ –total cooling consumption)



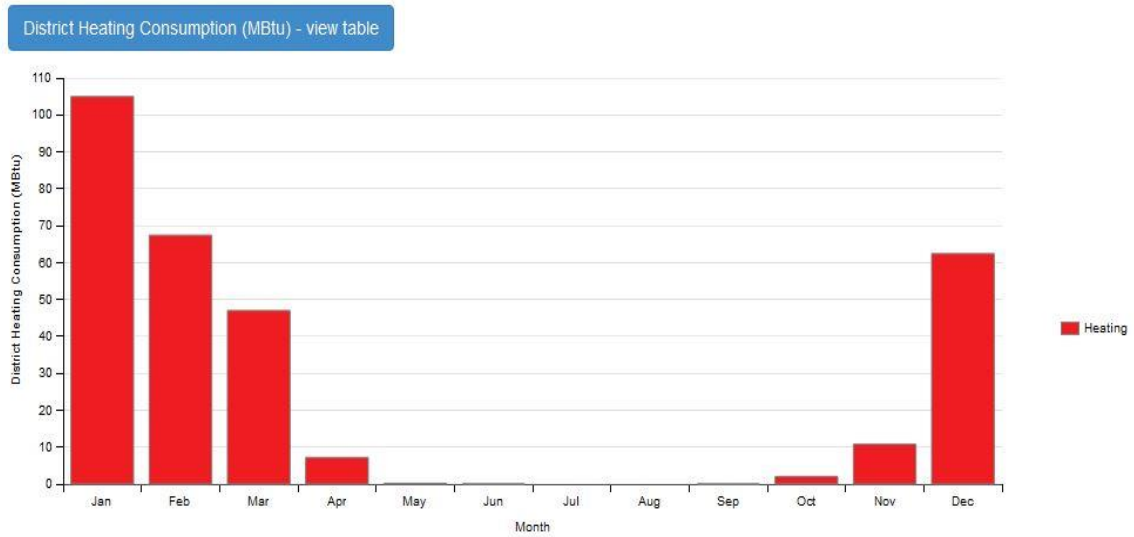
Thessaloniki (988,42 GJ –total cooling consumption)



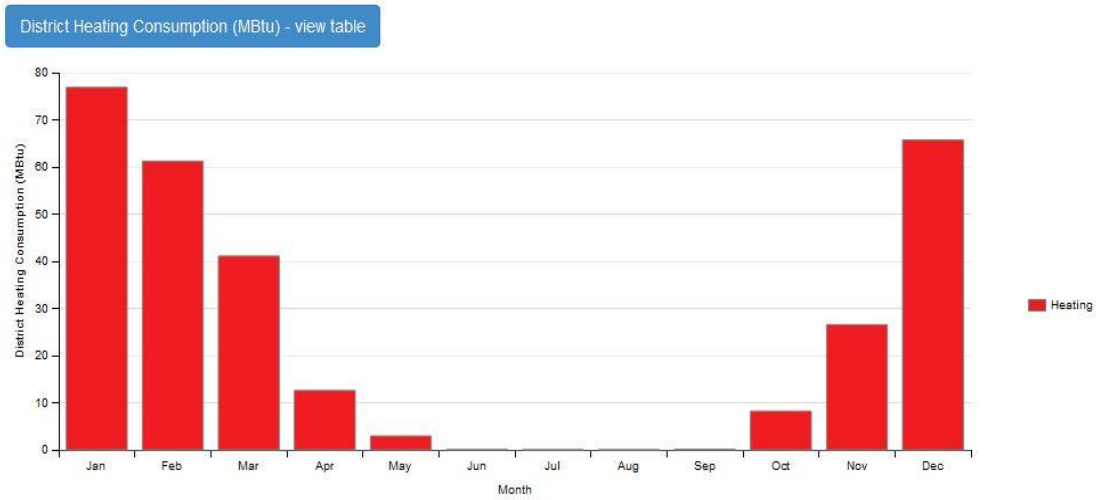
Piacenza (628.5 GJ –total heating consumption)



Shanghai (318.64 GJ –total heating consumption)



Thessaloniki (311.66 GJ –total heating consumption)



- Two more different walls for fixed location (Piacenza)
- Defining of our materials:

Name: Lightweight Concrete Darko & Zhang

Measure Tags (Optional):

Standard:	*Standard Source:*
Standards Category: Concrete	*Standards Identifier:* 80 lb/ft3 - 10 in.
Composite Framing Material:	*Composite Framing Configuration:*
Composite Framing Depth:	*Composite Framing Size:*
Composite Cavity Insulation:	

Roughness: Smooth	**Thickness:** 0.300000 m
Conductivity: 0.570000 W/m · K	**Density:** 1280.000000 kg/m³
Specific Heat: 900.100000 J/kg · K	**Thermal Absorptance:** 0.900000
Solar Absorptance: 0.700000	**Visible Absorptance:** 0.700000

Mineral fiber batt new

Measure Tags (Optional):

Standard:	*Standard Source:*
Standards Category: Insulation Batt	*Standards Identifier:*
Composite Framing Material:	*Composite Framing Configuration:*
Composite Framing Depth:	*Composite Framing Size:*
Composite Cavity Insulation:	

Roughness: Smooth	**Thickness:** 0.250000 m
Conductivity: 6.600000 W/m · K	**Density:** 1000.000000 kg/m³
Specific Heat: 750.000000 J/kg · K	**Thermal Absorptance:** 0.900000
Solar Absorptance: 0.500000	**Visible Absorptance:** 0.500000

Gypsum board new

Measure Tags (Optional):

Standard:	*Standard Source:*
Standards Category: Insulation Board	*Standards Identifier:* e (unfaced) - 6 in.
Composite Framing Material:	*Composite Framing Configuration:*
Composite Framing Depth:	*Composite Framing Size:*
Composite Cavity Insulation:	

Roughness: Smooth	**Thickness:** 0.100000 m
Conductivity: 0.610000 W/m · K	**Density:** 750.000000 kg/m³
Specific Heat: 1000 J/kg · K	**Thermal Absorptance:** 0.900000
Solar Absorptance: 0.4	**Visible Absorptance:** 0.4

Urethane rigid foam new

Measure Tags (Optional):

Standard:	*Standard Source:*
Standards Category: Insulation Board	*Standards Identifier:* e (unfaced) - 6 in.
Composite Framing Material:	*Composite Framing Configuration:*
Composite Framing Depth:	*Composite Framing Size:*
Composite Cavity Insulation:	

Roughness: Smooth	**Thickness:** 0.100000 m
Conductivity: 3.920000 W/m · K	**Density:** 1000.000000 kg/m³
Specific Heat: 750.000000 J/kg · K	**Thermal Absorptance:** 0.900000
Solar Absorptance: 0.500000	**Visible Absorptance:** 0.500000

wood fiberboard new

Measure Tags (Optional):

Standard:	*Standard Source:*
Standards Category: Woods	*Standards Identifier:* Wood - 1/2 in.
Composite Framing Material:	*Composite Framing Configuration:*
Composite Framing Depth:	*Composite Framing Size:*
Composite Cavity Insulation:	

Roughness: Smooth	**Thickness:** 0.013 m
Conductivity: 0.23 W/m · K	**Density:** 800 kg/m³
Specific Heat: 600 J/kg · K	**Thermal Absorptance:** 0.500000
Solar Absorptance: 0.600000	**Visible Absorptance:** 0.600000

Wood bevel lapped siding new

Measure Tags (Optional):

Standard:	*Standard Source:*
Standards Category: Woods	*Standards Identifier:* od siding - 1/2 in.
Composite Framing Material:	*Composite Framing Configuration:*
Composite Framing Depth:	*Composite Framing Size:*
Composite Cavity Insulation:	

Roughness: Smooth	**Thickness:** 0.026 m
Conductivity: 0.28 W/m · K	**Density:** 800 kg/m³
Specific Heat: 600 J/kg · K	**Thermal Absorptance:** 0.500000
Solar Absorptance: 0.600000	**Visible Absorptance:** 0.600000

- Case 2: wall is consisted of Lightweight Concrete Darko&Zhang and wood bevel lapped siding new

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File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results

Open ResultsViewer for Detailed Reports

End Uses By Subcategory

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	796.30	0.00
Cooling	General	0.00	0.00	0.00	705.52	0.00	0.00
Interior Lighting	General	704.80	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	1303.98	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00
Fans	Ventilation (simple)	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	General	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	General	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	General	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	General	0.00	0.00	0.00	0.00	0.00	0.00
Generators	General	0.00	0.00	0.00	0.00	0.00	0.00

Normalized Metrics

Utility Use Per Conditioned Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]
Lighting	123.73	0.00	0.00	0.00	0.00	0.00
HVAC	0.00	0.00	0.00	123.85	139.79	0.00
Other	228.91	0.00	0.00	0.00	0.00	0.00
Total	352.64	0.00	0.00	123.85	139.79	0.00

Utility Use Per Total Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]

搜索 Windows

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- Case 3: wall is consisted of all previously defined materials

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File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results

Open ResultsViewer for Detailed Reports

End Uses By Subcategory

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	688.42	0.00
Cooling	General	0.00	0.00	0.00	662.93	0.00	0.00
Interior Lighting	General	704.80	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	1303.98	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00
Fans	Ventilation (simple)	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	General	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	General	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	General	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	General	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	General	0.00	0.00	0.00	0.00	0.00	0.00
Generators	General	0.00	0.00	0.00	0.00	0.00	0.00

Normalized Metrics

Utility Use Per Conditioned Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]
Lighting	123.73	0.00	0.00	0.00	0.00	0.00
HVAC	0.00	0.00	0.00	116.38	120.85	0.00
Other	228.91	0.00	0.00	0.00	0.00	0.00
Total	352.64	0.00	0.00	116.38	120.85	0.00

Utility Use Per Total Floor Area

	Electricity Intensity [MJ/m2]	Natural Gas Intensity [MJ/m2]	Additional Fuel Intensity [MJ/m2]	District Cooling Intensity [MJ/m2]	District Heating Intensity [MJ/m2]	Water Intensity [m3/m2]

搜索 Windows

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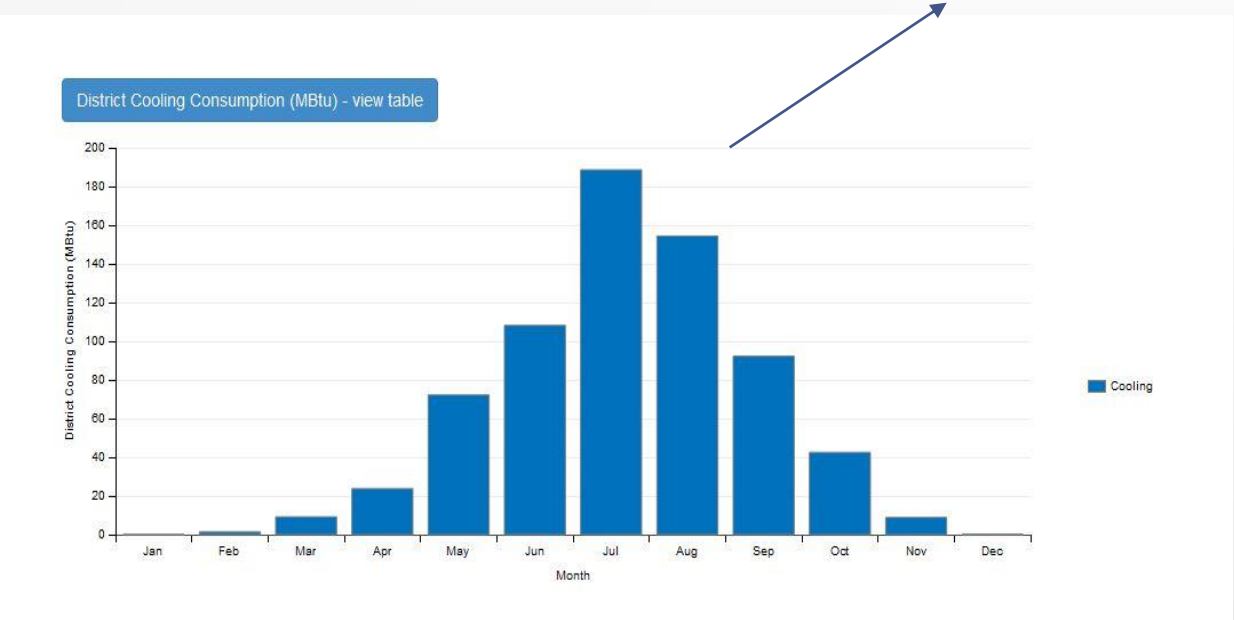
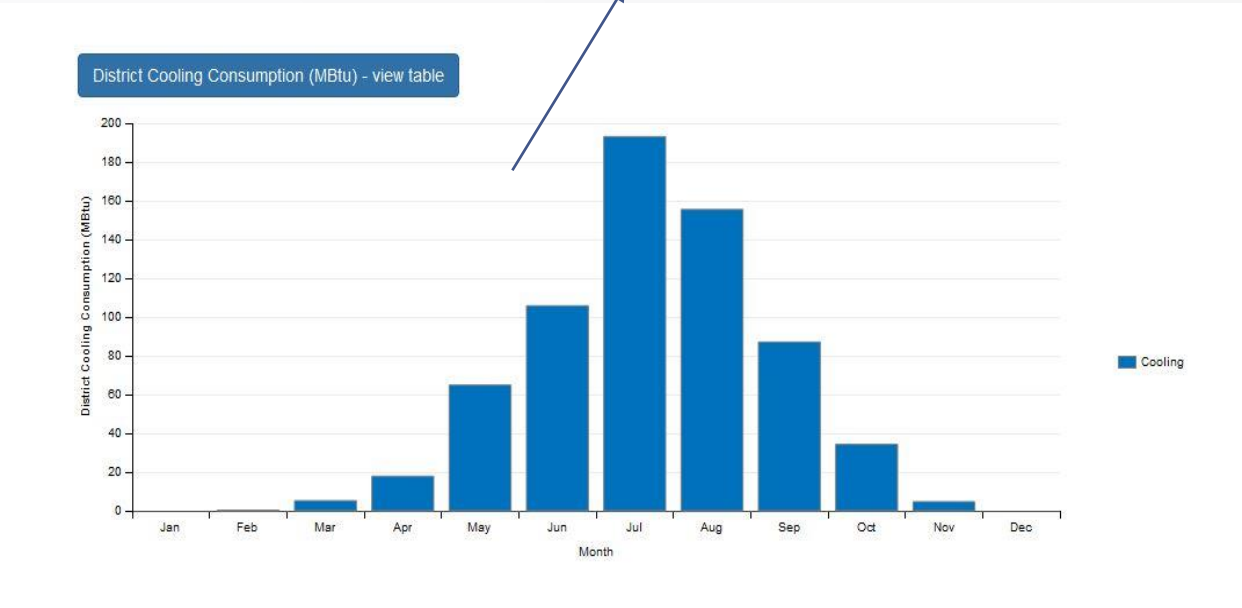
Comparison (district cooling/heating consumption)

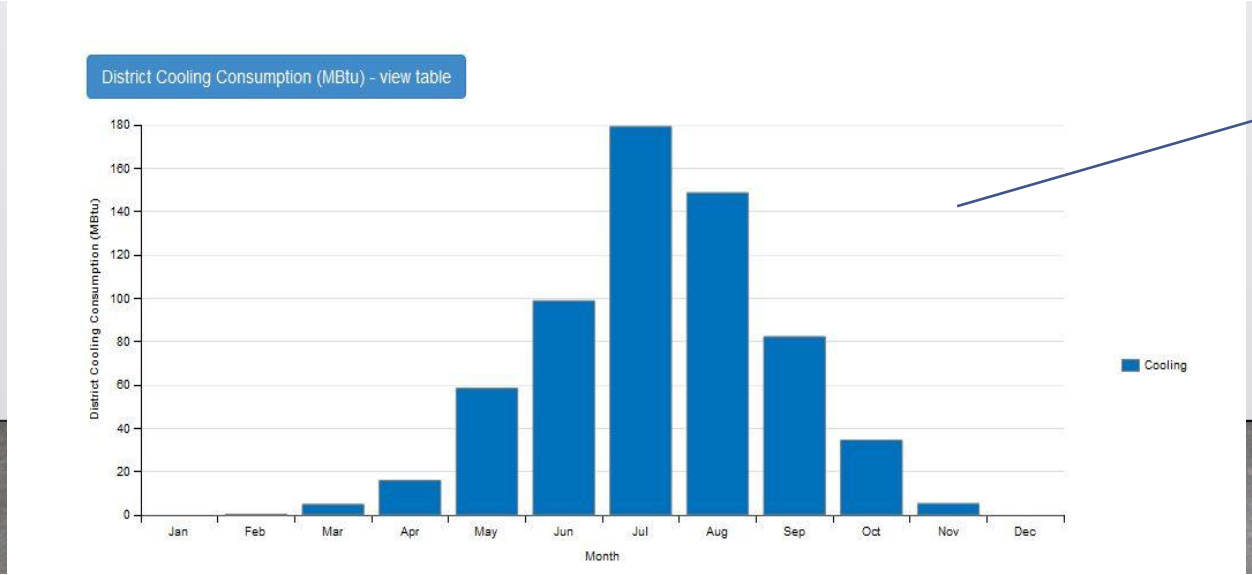
Default wall (740,19 GJ –total cooling consumption)



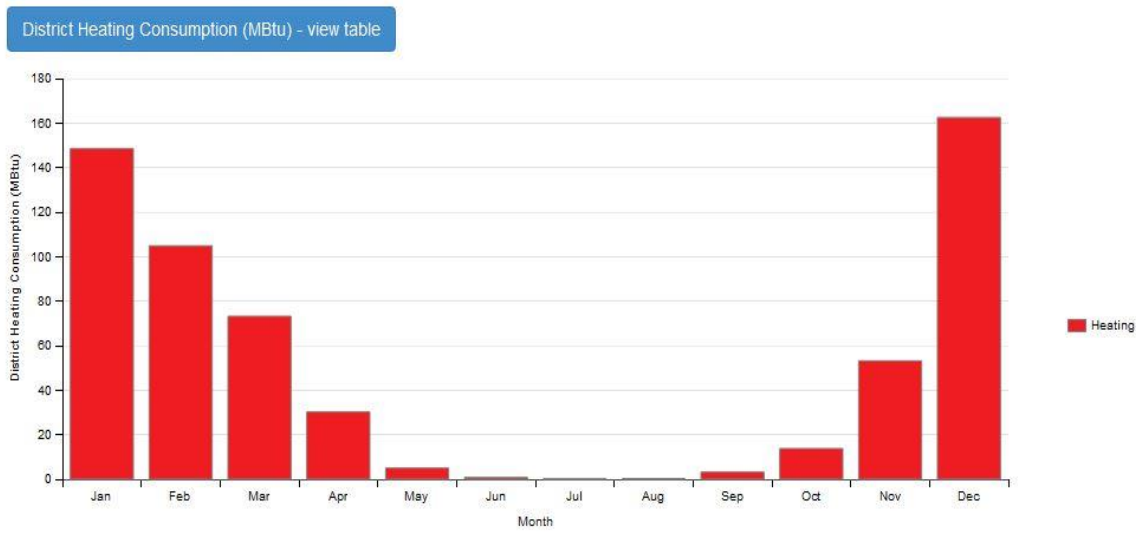
Wall 2 (705.52 GJ –total cooling consumption)



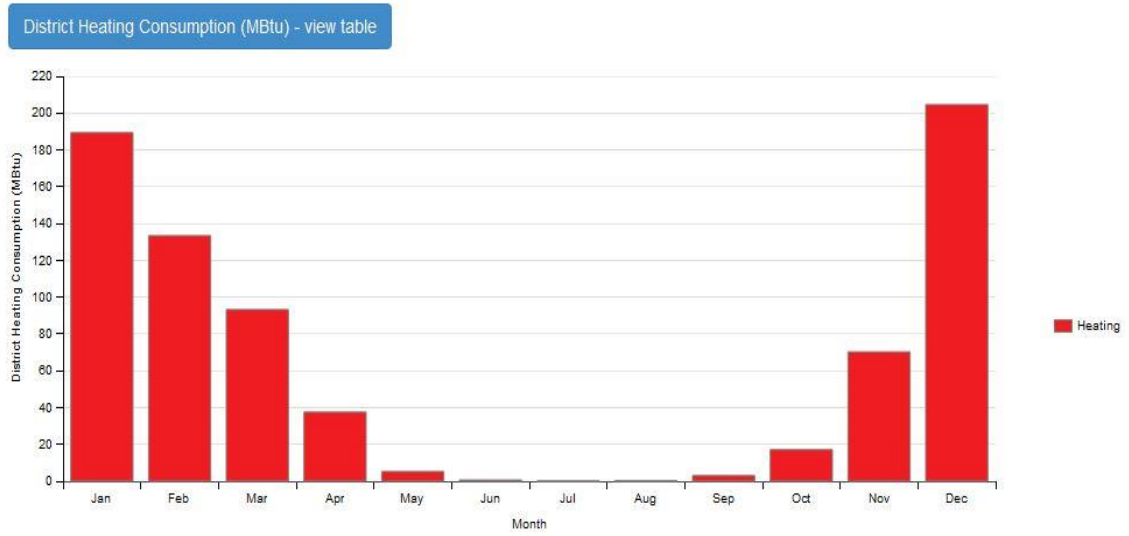
Wall 3 (662.93 GJ –total cooling consumption)



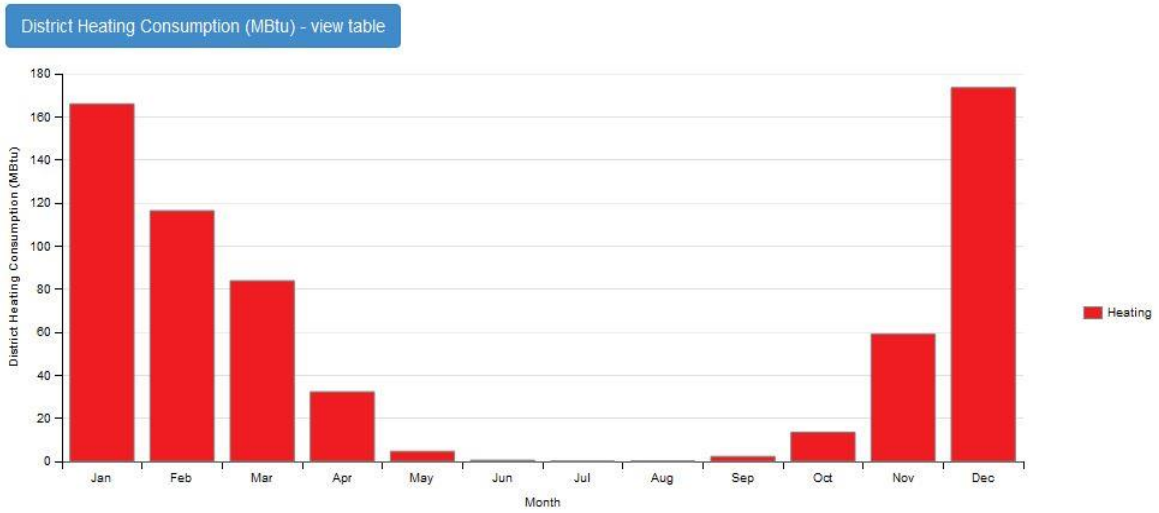
Default wall (628.5 GJ –total heating consumption)



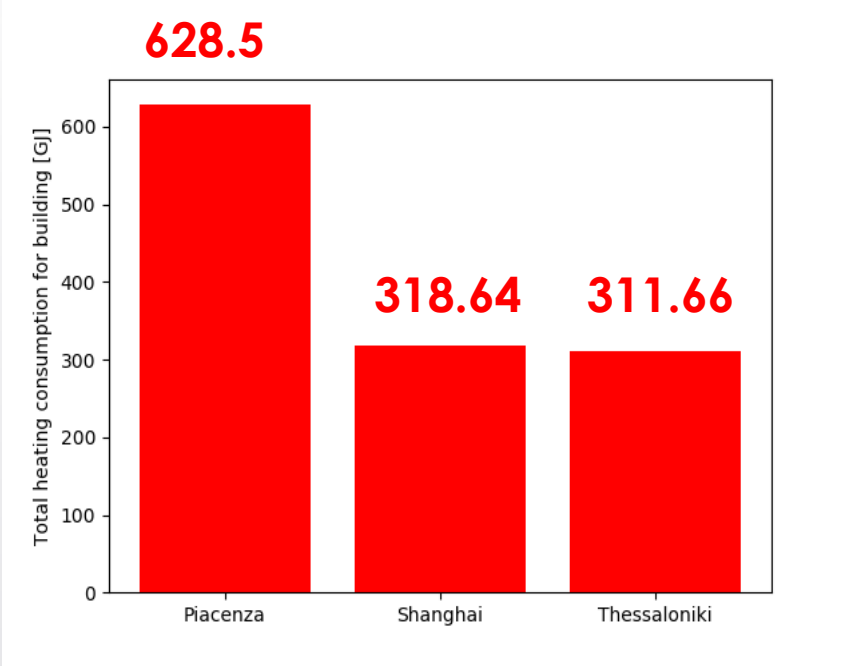
Wall 2 (796.3 GJ –total heating consumption)

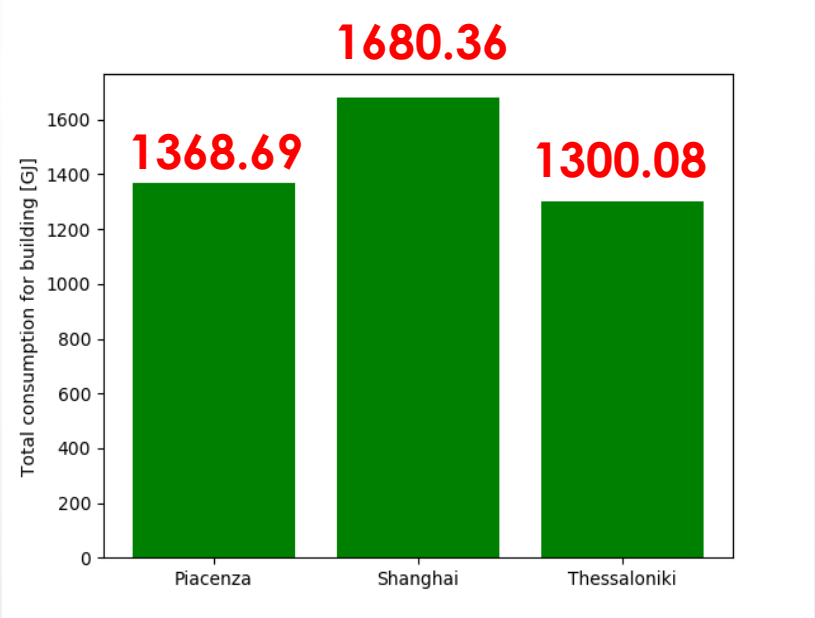


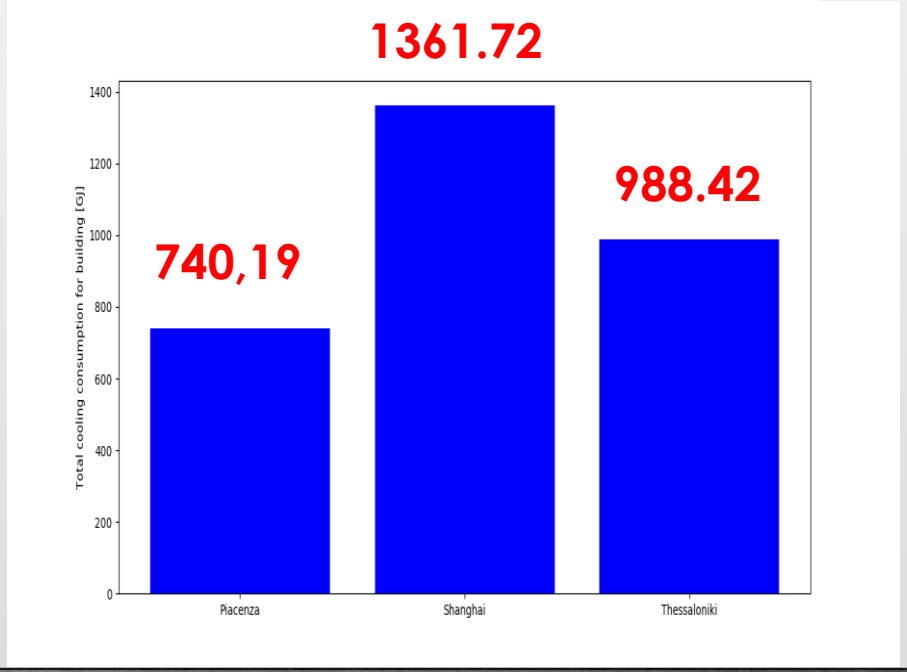
Wall 3 (688.42 GJ –total heating consumption)



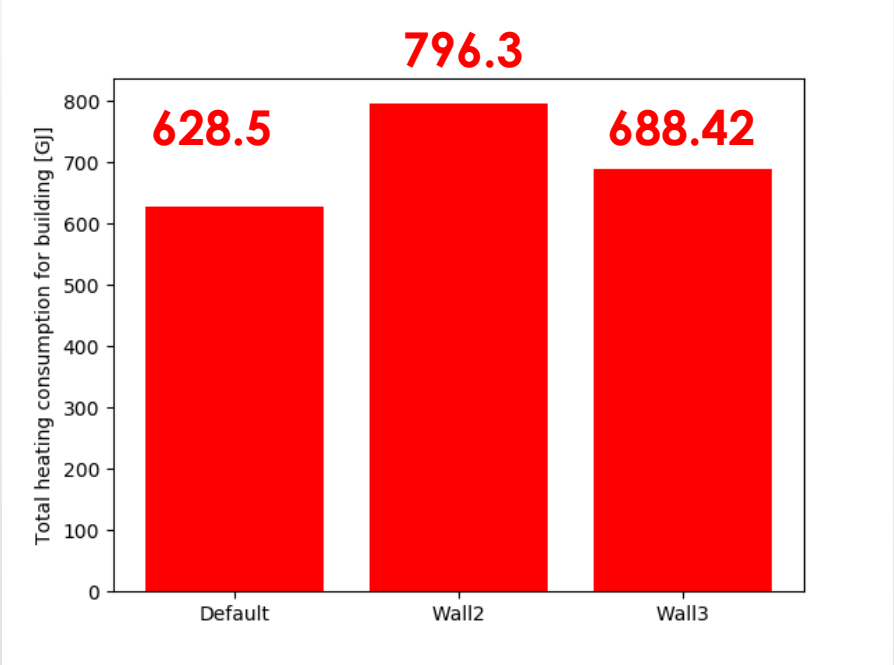
Comparison of results for different cities using bar charts

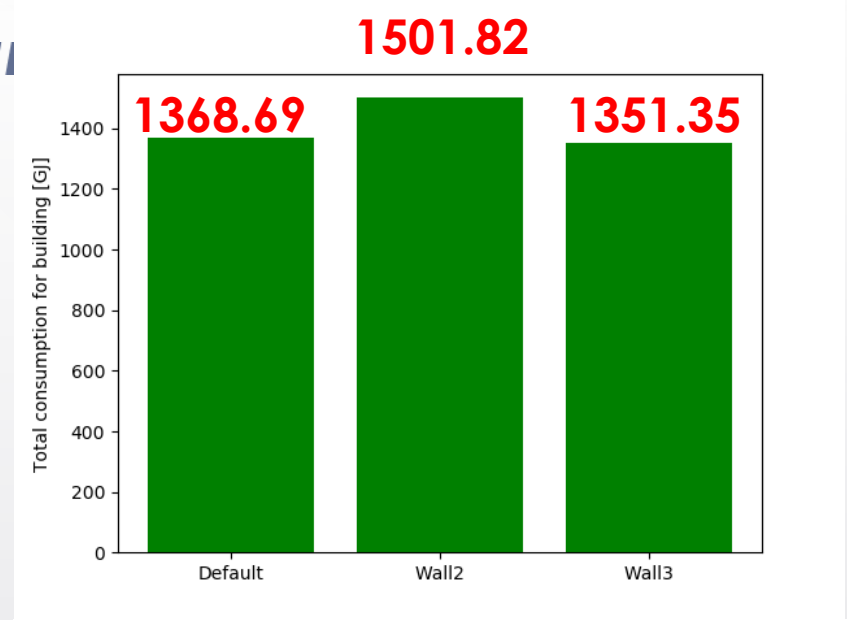


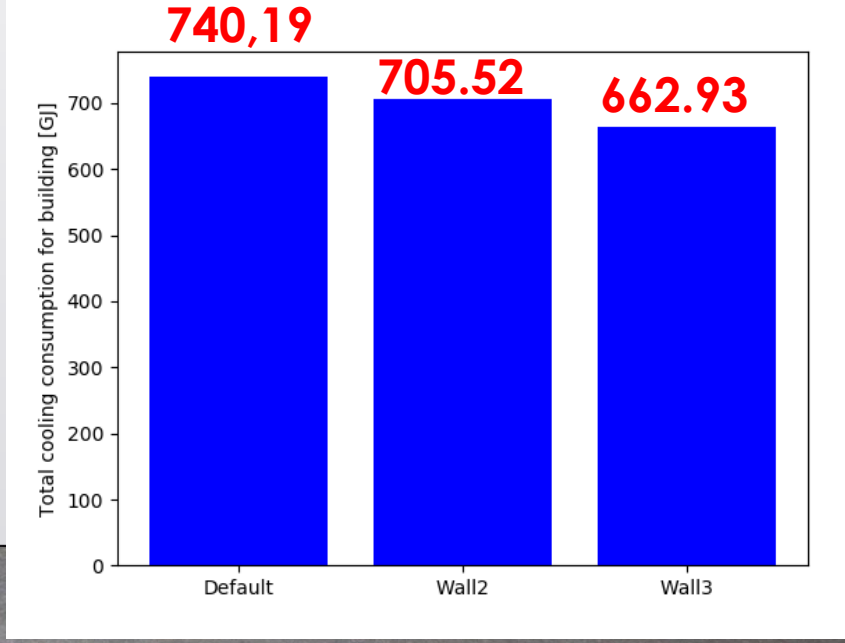
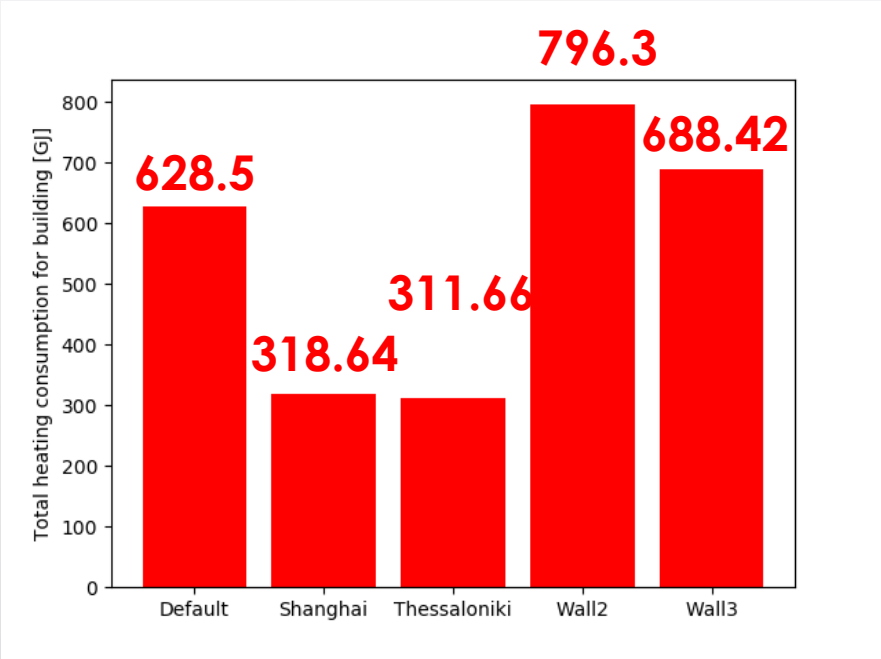
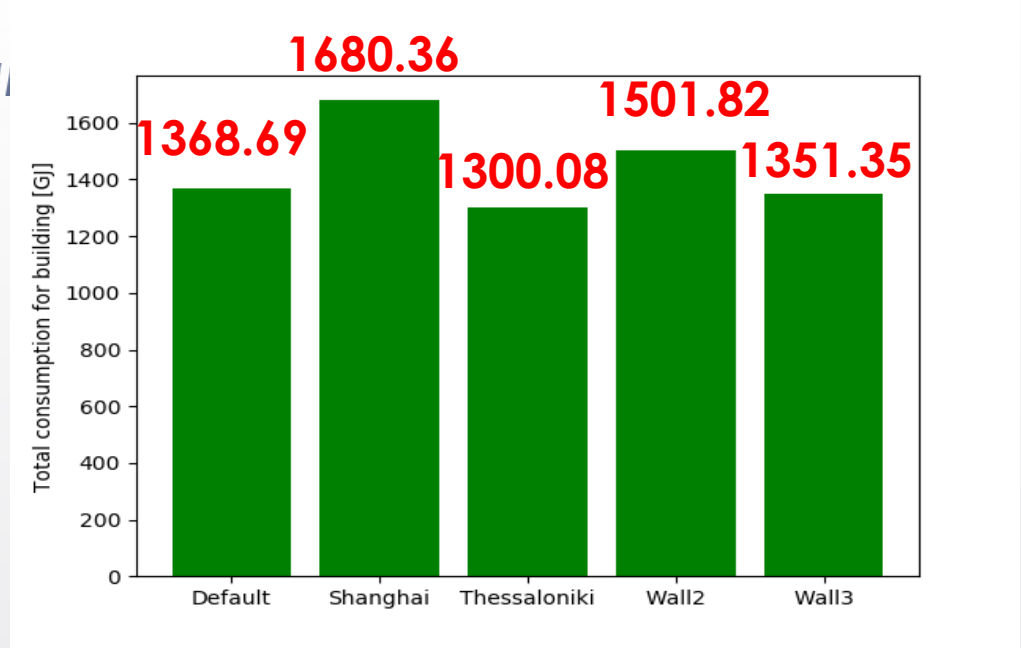
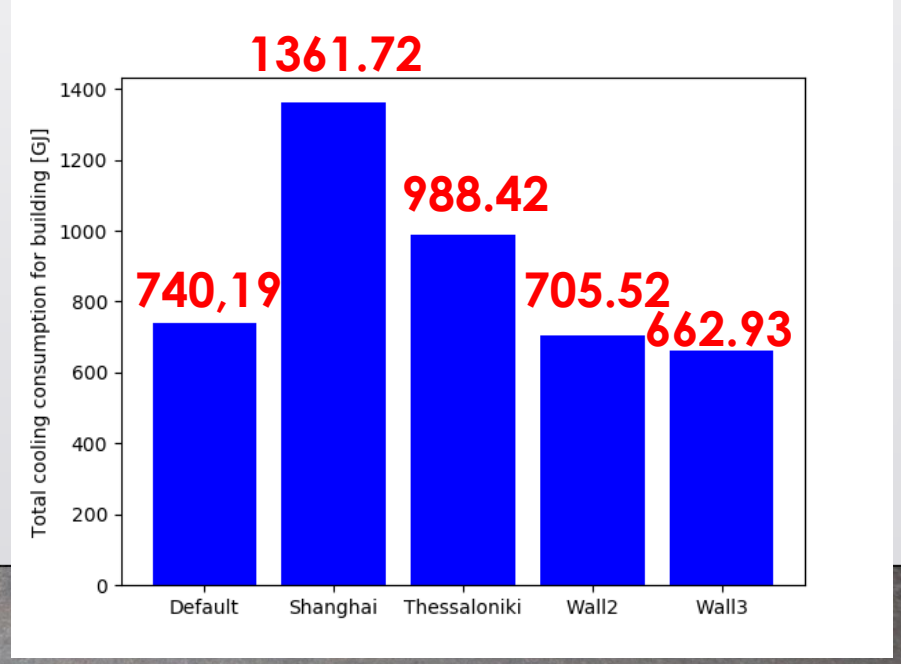




Comparison of results for different walls using bar charts







Comparison of all results