Politecnico di Milano
Scuola di Architettura Urbanistica e Ingegneria delle Costruzioni
Master's Degree of Sustainable Architecture and Landscape Design
Course of Technical Environmental Systems A.Y. 2017/2018
Prof. Marchesi Renzo

Assignment: Project Report, 3 insulations in 3 Cities

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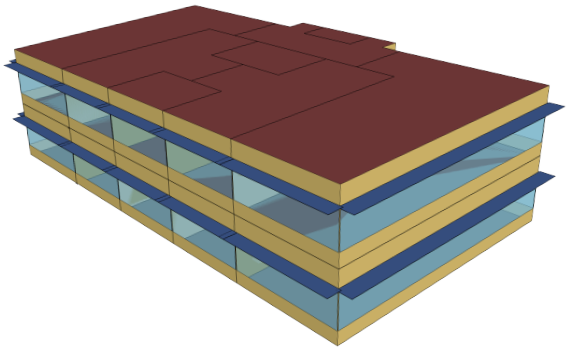
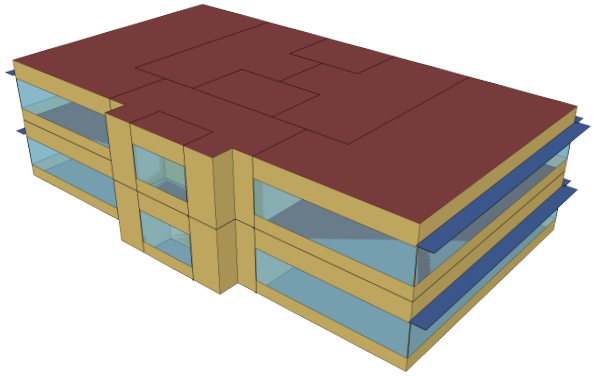
Introduction

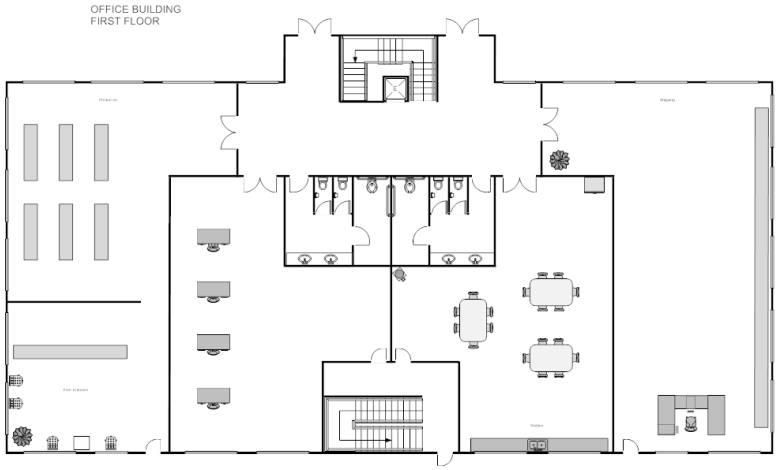
The project took under inspection is an office building, with two floors with ribbon windows. We settled the first observation in Bari (Italy) taking these datas as base for the comparison to other two geographic positions: Prague (Cz. Rep.) and Oslo (Norway).



South-East perspective



North-West perspective



In addition to compare three cities, the report analyses three different types of walls: without insulation, with 3 cm insulation and with 11 cm insulation.

ANALYSIS 1: BARI (Italy)

BARI - WALL 1

MIDDLE INSULATION

In this condition, the annual energy consumption is about 120655,556 kWh. From the fan chart, we know that 50% of the energy is used in the form of electricity. At the same time, district cooling is 32% and heating is around 18%.

I. BUILDING SUMMARY

Data	**Value**	**Units**
Building Name	Building 1	
Net Site Energy	440,21	GJ
Total Building Area	540	m^2
EUI	0,815	GJ/m^2
Open Studio Standards Building Type		

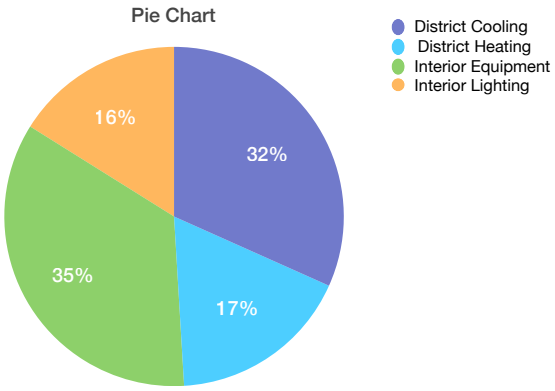
II. WEATHER SUMMARY

Data	**Value**
Weather File	**Bari-Palese Macchie - ITA IGDG WMO#=162700**
Latitute	41,13
Longitude	16,78
Elevation	49 m
Time Zone	1,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

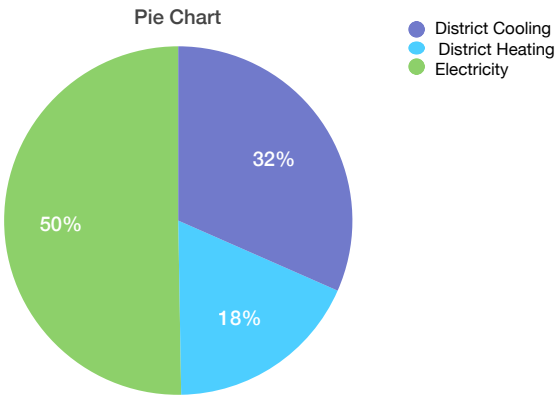
End Uses-Normal

CATEGORY	VALUE
District Cooling	137,64
District Heating	75,43
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-Normal

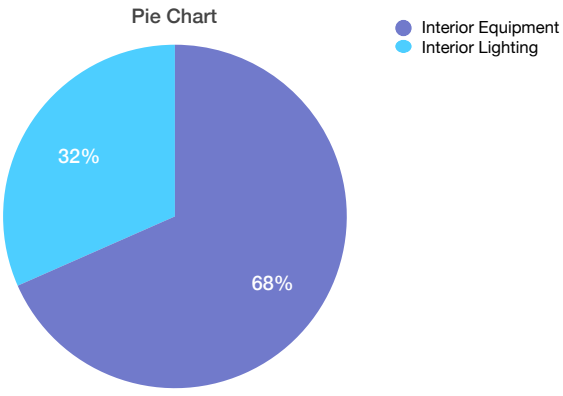
CATEGORY	VALUE
District Cooling	257,51
District Heating	147,9
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-Normal

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



BARI - WALL 2

NO INSULATION

In this condition, the annual energy consumption is about 127272,222 kWh. From the fan chart, we know that 48% of the energy is used in the form of electricity. At the same time, district cooling is 31% and heating is around 20%.

I. BUILDING SUMMARY

Data	**Value**	**Units**
Building Name	Building 1	
Net Site Energy	458,18	GJ
Total Building Area	540	m^2
EUI	0,848	GJ/m^2
Open Studio Standards Building Type		

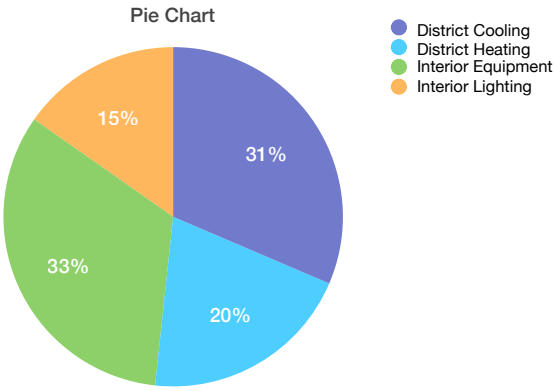
II. WEATHER SUMMARY

Data	**Value**
Weather File	Bari-Palese Macchie - ITA IGDG WMO#=162700
Latitute	41,13
Longitude	16,78
Elevation	49 m
Time Zone	1,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

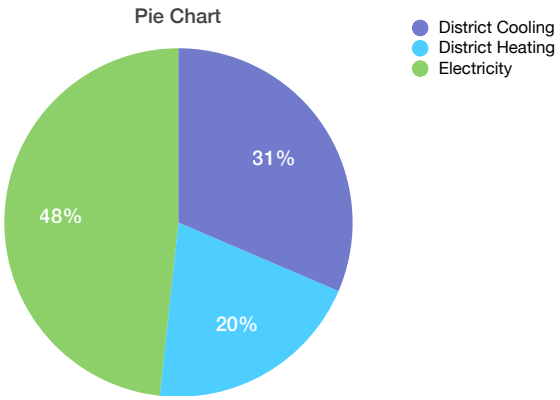
End Uses-No Insulation

CATEGORY	VALUE
District Cooling	144
District Heating	92,89
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-No Insulation

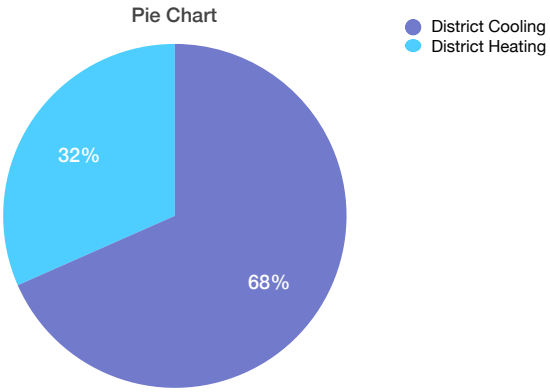
CATEGORY	VALUE
District Cooling	266,68
District Heating	172,01
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-No Insulation

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



BARI - WALL 3

HIGH INSULATION

In this condition, the annual energy consumption is about 122280,556 kWh. From the fan chart, we know that more than 50% of the energy is used in the form of electricity. At the same time, district cooling is 32% and heating is around 17%.

I. BUILDING SUMMARY

Data	Value	Units
Building Name	Building 1	
Net Site Energy	434,36	GJ
Total Building Area	540	m^2
EUI	0,804	GJ/m^2
Open Studio Standards Building Type		

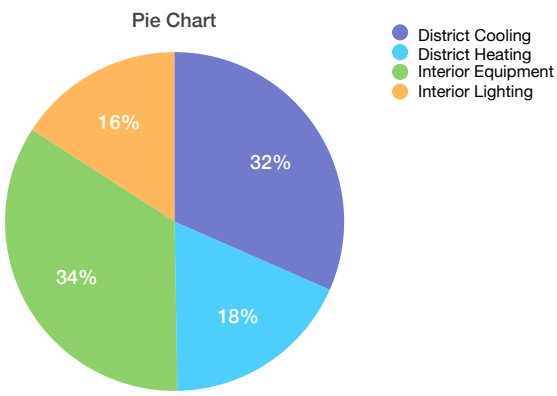
II. WEATHER SUMMARY

Data	Value
Weather File	Bari-Palese Macchie - ITA IGDG WMO#=162700
Latitute	41,13
Longitude	16,78
Elevation	49 m
Time Zone	1,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

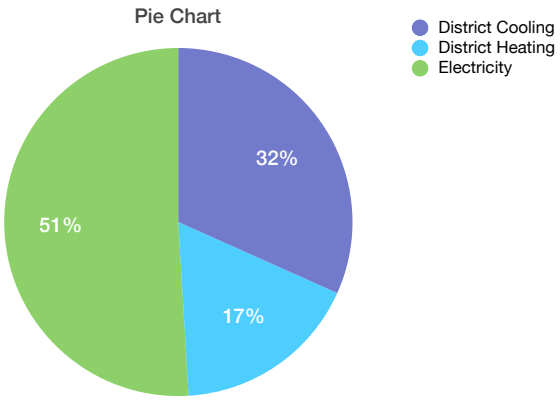
End Uses-High Insulation

CATEGORY	VALUE
District Cooling	139,06
District Heating	79,86
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-High Insulation

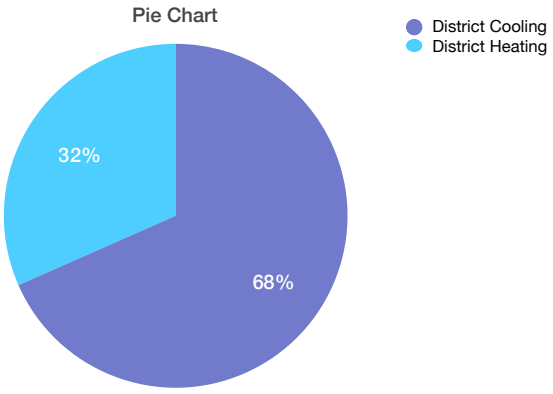
CATEGORY	VALUE
District Cooling	254,9
District Heating	139,69
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-High Insulation

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



ANALYSIS 2: OSLO (Norway)

OSLO - WALL 1

NORMAL INSULATION

In this condition, the annual energy consumption is about 301661,1111 kWh. From the fan chart, we know that 56% of the energy is used in the form of heating.
At the same time, district cooling is 6% and energy is around 38%.

I. BUILDING SUMMARY

Data	Value	Units
Building Name	Building 1	
Net Site Energy	586,43	GJ
Total Building Area	540	m^2
EUI	1,085	GJ/m^2
Open Studio Standards Building Type		

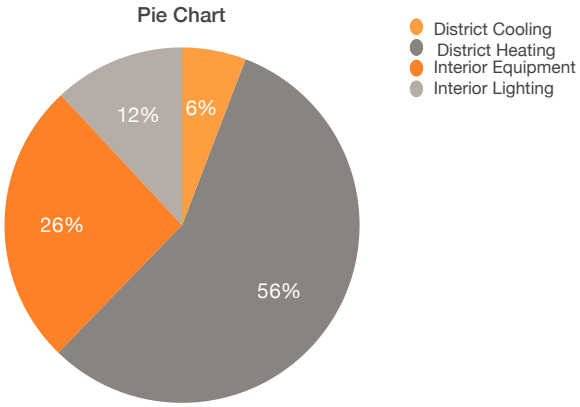
II. WEATHER SUMMARY

Data	Value
Weather File	OSLO/FORNEBU - NOR IWEC Data WMO#=014880
Latitute	59,90
Longitude	10,62
Elevation	17 m
Time Zone	1,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

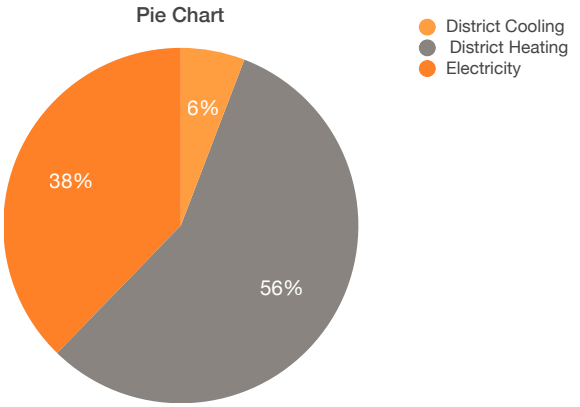
End Uses-Normal

CATEGORY	VALUE
District Cooling	34,17
District Heating	330,98
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-Normal

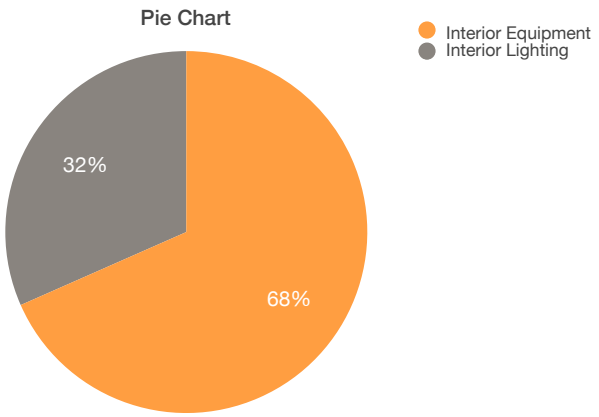
CATEGORY	VALUE
District Cooling	63,27
District Heating	612,92
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-Normal

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



OSLO - WALL 2

NO INSULATION

In this condition, the annual energy consumption is about 332677,7778 kWh. From the fan charts, we know that 61% of the energy is used in the form of heating. At the same time, district cooling is 5% and energy is around 34%.

I. BUILDING SUMMARY

Data	**Value**	**Units**
Building Name	Building 1	
Net Site Energy	646,72	GJ
Total Building Area	540	m^2
EUI	1,197	GJ/m^2
Open Studio Standards Building Type		

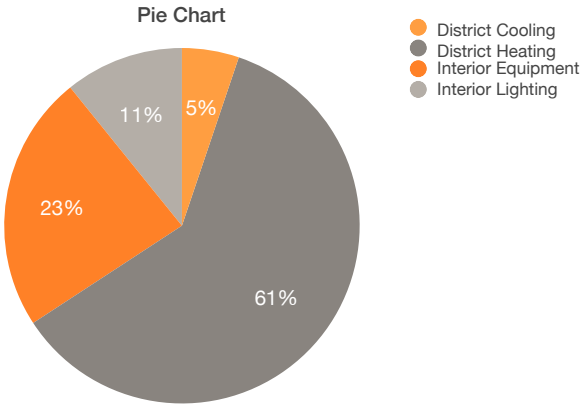
II. WEATHER SUMMARY

Data	**Value**
Weather File	OSLO/FORNEBU - NOR IWEC Data WMO#=014880
Latitute	59,90
Longitude	10,62
Elevation	17 m
Time Zone	1,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

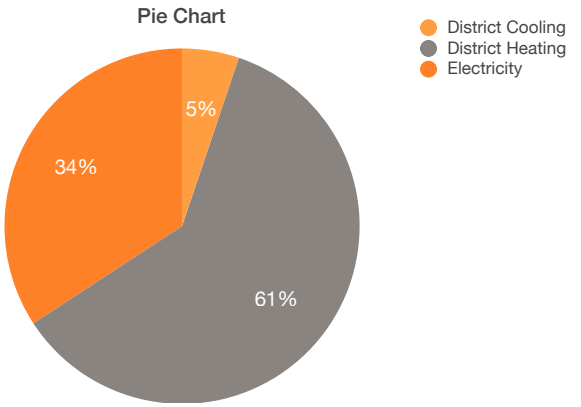
End Uses-No Insulation

CATEGORY	VALUE
District Cooling	33,54
District Heating	391,9
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-No Insulation

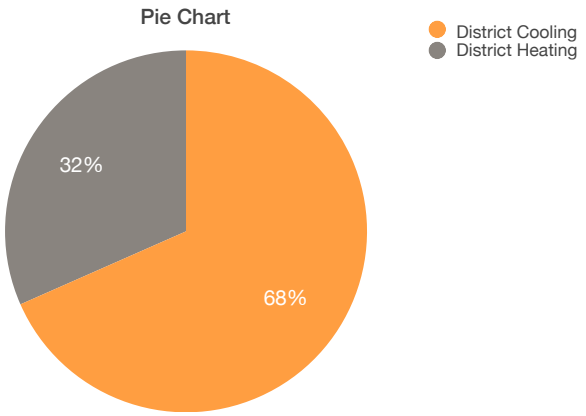
CATEGORY	VALUE
District Cooling	62,11
District Heating	725,74
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-No Insulation

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



OSLO - WALL 3

HIGH INSULATION

In this condition, the annual energy consumption is about 290827,7778 kWh. From the fan chart, we know that 55% of the energy is used in the form of heating. At the same time, district cooling is 6% and energy is around 39%.

I. BUILDING SUMMARY

Data	**Value**	**Units**
Building Name	Building 1	
Net Site Energy	565,37	GJ
Total Building Area	540	m^2
EUI	1,046	GJ/m^2
Open Studio Standards Building Type		

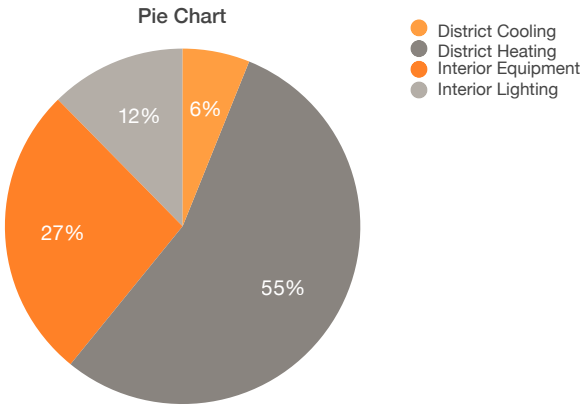
II. WEATHER SUMMARY

Data	**Value**
Weather File	OSLO/FORNEBU - NOR IWEC Data WMO#=014880
Latitute	59,90
Longitude	10,62
Elevation	17 m
Time Zone	1,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

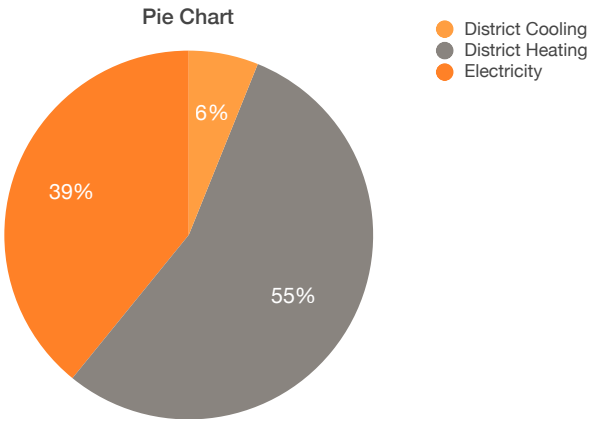
End Uses-High Insulation

CATEGORY	VALUE
District Cooling	34,54
District Heating	309,54
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-High Insulation

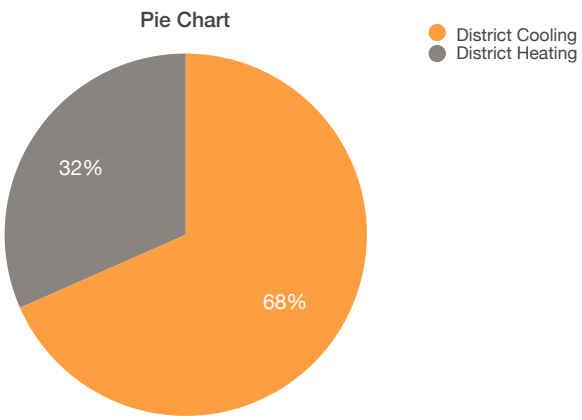
CATEGORY	VALUE
District Cooling	63,96
District Heating	573,23
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-High Insulation

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



ANALYSIS 3: PRAGUE (Czech Republic)

PRAGUE - WALL 1

NORMAL INSULATION

In this condition, the annual energy consumption is about 289891,6667 kWh. From the fan chart, we know that 52% of the energy is used in the form of heating. At the same time, district cooling is 8% and energy is around 39%.

I. BUILDING SUMMARY

Data	**Value**	**Units**
Building Name	Building 1	
Net Site Energy	563,55	GJ
Total Building Area	540	m^2
EUI	1,043	GJ/m^2
Open Studio Standards Building Type		

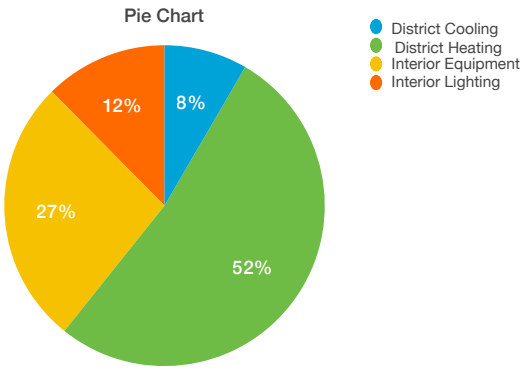
II. WEATHER SUMMARY

Data	**Value**
Weather File	PRAGUE - CZE IWEC Data WMO#=115180
Latitute	50,10
Longitude	14,28
Elevation	366 m
Time Zone	0,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

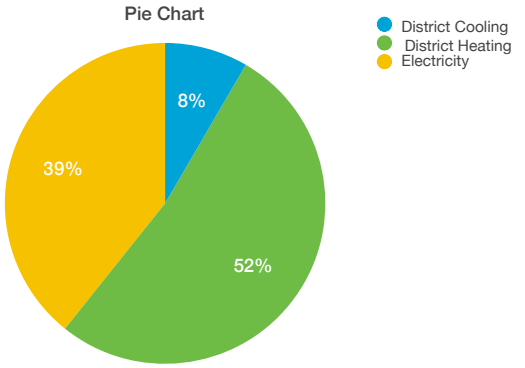
End Uses-Normal

CATEGORY	VALUE
District Cooling	47,34
District Heating	294,92
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-Normal

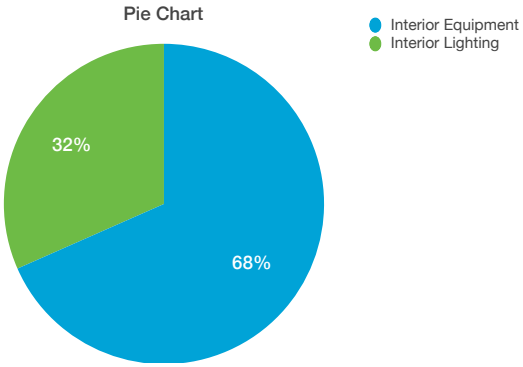
CATEGORY	VALUE
District Cooling	87,67
District Heating	546,15
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-Normal

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



PRAGUE WALL 2

NO INSULATION

In this condition, the annual energy consumption is about 318544,4444 kWh. From the fan chart, we know that 57% of the energy is used in the form of heating. At the same time, district cooling is 7% and energy is around 36%

BUILDING SUMMARY

Data	Value	Units
Building Name	Building 1	
Net Site Energy	619,25	GJ
Total Building Area	540	m^2
EUI	1,146	GJ/m^2
Open Studio Standards Building Type		

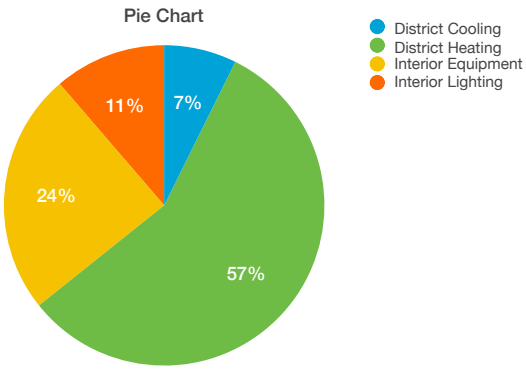
WEATHER SUMMARY

Data	Value
Weather File	PRAGUE - CZE IWEC Data WMO#=115180
Latitute	50,10
Longitude	14,28
Elevation	366 m
Time Zone	0,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

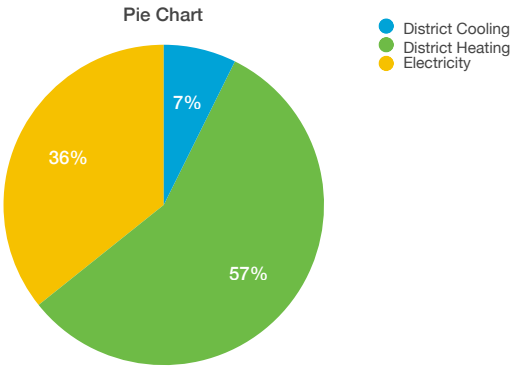
End Uses-No Insulation

CATEGORY	VALUE
District Cooling	45,34
District Heating	352,62
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-No Insulation

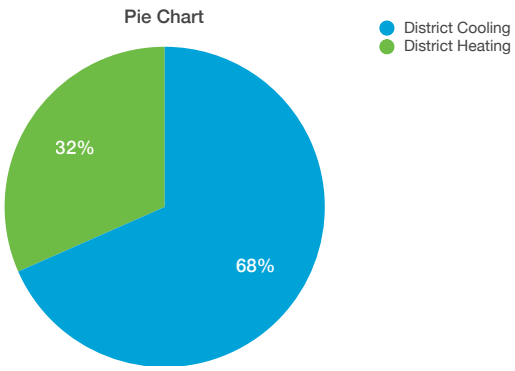
CATEGORY	VALUE
District Cooling	83,96
District Heating	653,01
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-No Insulation

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



PRAGUE - WALL 3

HIGH INSULATION

In this condition, the annual energy consumption is about 280461,1111 kWh. From the fan chart, we know that 51% of the energy is used in the form of heating. At the same time, district cooling is 9% and energy is around 41%.

BUILDING SUMMARY

Data	**Value**	**Units**
Building Name	Building 1	
Net Site Energy	545,22	GJ
Total Building Area	540	m^2
EUI	1,009	GJ/m^2
Open Studio Standards Building Type		

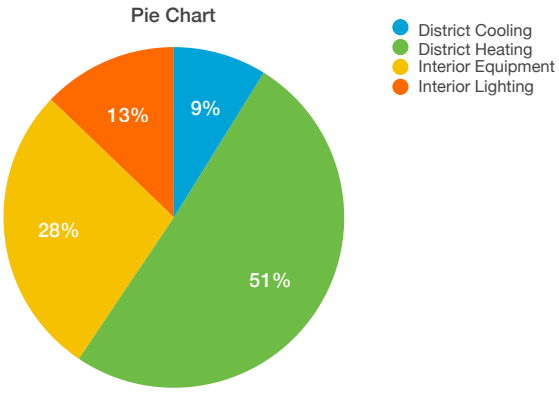
WEATHER SUMMARY

Data	**Value**
Weather File	PRAGUE - CZE IWEC Data WMO#=115180
Latitute	50,10
Longitude	14,28
Elevation	366 m
Time Zone	0,00
North Axis Angle	0,00
ASHARE Climate Zone	

III. DISTRICT COOLING AND HEATING CONSUMPTION

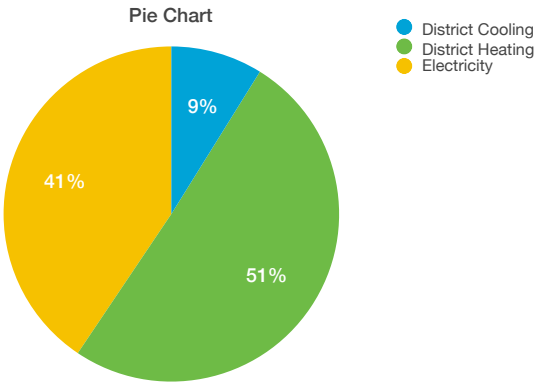
End Uses-High Insulation

CATEGORY	VALUE
District Cooling	48,26
District Heating	275,67
Interior Equipment	151,34
Interior Lighting	69,95



Utility Use Per Conditioned Floor Area-High Insulation

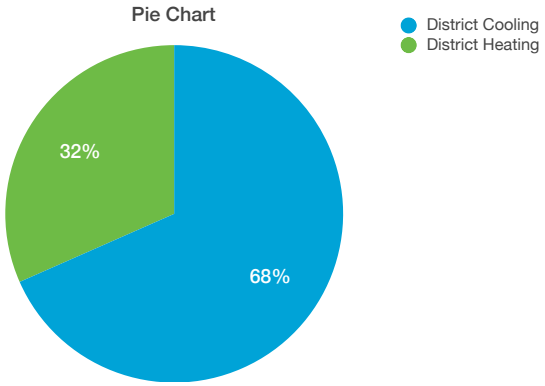
CATEGORY	VALUE
District Cooling	89,38
District Heating	510,49
Electricity	409,79



IV. ELECTRICITY

Electricity End Uses-High Insulation

CATEGORY	VALUE
Interior Equipment	151,34
Interior Lighting	69,95



COMPARISON

	WALL 1 (3cm ins.)		WALL 2 (0cm ins.)		WALL 3 (11cm ins.)	
	Net Site Energy (kW/h)	%	Net Site Energy (kW/h)	%	Net Site Energy (kW/h)	%
BARI	122280.556	%27.68	127272.222	%26.57	120655.5556	%28.11
OSLO	162897.222	%36.88	179644.444	%37.51	157047.222	%36.60
PRAGUE	156541.666	%35.44	172013.888	%35.92	151450	%35.29

	BARI		OSLO		PRAGUE	
	Net Site Energy (kW/h)	%	Net Site Energy (kW/h)	%	Net Site Energy (kW/h)	%
WALL 1 (3cm ins.)	122280.556	%33.02	162897.222	%32.60	156541.666	%32.61
WALL 2 (0cm ins.)	127272.222	%34.38	179644.444	%35.96	172013.888	%35.84
WALL 3 (11cm ins.)	120655.5556	%32.60	157047.222	%31.44	151450	%31.55

*All net site energy values are converted from Gigajoule to KiloWatt / Hour for the comparison