Energy consumption

INDEX

1. ENERGY CONSUMPTION CALCULATION RESULTS

1.1. Monthly results.

1.1.1. Annual energy consumption of the building.

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh/year)	Year (kWh/m²·year)
BUILDING (S_u = 441.10 m²; V = 1546.78 m³)															
Energy demand	Heating	617.1	347.4	2.6	0.1	--	--	--	--	--	1.6	14.2	198.5	1181.5	2.7
	Cooling	22.2	311.6	914.0	1572.8	2399.5	3011.5	3403.6	3500.1	2389.0	1422.5	571.3	180.3	19698.5	44.7
	TOTAL	639.4	659.1	916.6	1572.9	2399.5	3011.5	3403.6	3500.1	2389.0	1424.1	585.5	378.8	20880.0	47.3
Electricity (f_{cep} = 1.954)	EF_{heat}	0.1	0.1	--	--	--	--	--	--	--	--	--	--	0.1	
	EP_{heat}	0.1	0.2	--	--	--	--	--	--	--	--	--	0.0	0.3	
	$EP_{nr,heat}$	0.1	0.1	--	--	--	--	--	--	--	--	--	0.0	0.2	
	EF_{cool}	5.1	89.3	284.4	530.9	858.9	1194.6	1383.8	1468.9	910.9	511.1	164.6	49.4	7451.9	16.9
	EP_{cool}	12.2	211.4	673.5	1257.3	2033.8	2828.8	3276.7	3478.3	2157.0	1210.3	389.9	117.1	17646.2	40.0
	$EP_{nr,cool}$	10.0	174.4	555.8	1037.5	1678.3	2334.3	2704.0	2870.3	1779.9	998.8	321.7	96.6	14561.6	33.0
	EF_{dhw}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP_{dhw}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	$EP_{nr,dhw}$	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EF_{light}	596.9	519.1	571.0	545.0	596.9	545.0	571.0	596.9	519.1	596.9	571.0	545.0	6773.7	15.4
	EP_{light}	1413.5	1229.1	1352.0	1290.6	1413.5	1290.6	1352.0	1413.5	1229.1	1413.5	1352.0	1290.6	16040.1	36.4
	$EP_{nr,light}$	1166.4	1014.3	1115.7	1065.0	1166.4	1065.0	1115.7	1166.4	1014.3	1166.4	1115.7	1065.0	13236.3	30.0
Natural gas (f_{cep} = 1.189)	EF_{heat}	749.3	417.9	3.5	0.1	--	--	--	--	--	3.0	18.1	256.7	1448.3	3.3
	EP_{heat}	895.4	499.4	4.1	0.1	--	--	--	--	--	3.6	21.6	306.7	1730.7	3.9
	$EP_{nr,heat}$	890.9	496.9	4.1	0.1	--	--	--	--	--	3.5	21.5	305.2	1722.1	3.9
	EF_{cool}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP_{cool}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	$EP_{nr,cool}$	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EF_{dhw}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP_{dhw}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	$EP_{nr,dhw}$	--	--	--	--	--	--	--	--	--	--	--	--	--	
Auto-consumed electricity (f_{cep} = 1.954)	EF	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP_{nr}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	$C_{ef,total}$	1351.4	1026.2	858.8	1076.0	1455.8	1739.6	1954.7	2065.8	1429.9	1111.0	753.7	851.1	15674.1	35.5
	C_{ep}	2321.2	1940.0	2029.7	2547.9	3447.3	4119.3	4628.8	4891.8	3386.1	2627.4	1763.5	1714.4	35417.3	80.3
	$C_{ep,nr}$	2067.4	1685.7	1675.6	2102.5	2844.7	3399.3	3819.7	4036.7	2794.2	2168.7	1458.9	1466.8	29520.3	66.9

where:

- S_u: *Residential area of the building, m².*
- V: *Net residential area of the building, m³.*
- f_{cep}: *Conversion factor for final energy to primary energy obtained from non-renewable sources.*
- EF: *Final energy consumed by the system at consumption point, kWh.*
- EP: *Primary energy consumption, kWh.*
- EP_{nr}: *Non-renewable primary energy consumption, kWh.*
- $C_{ef,total}$: *Energy consumption at consumption point (final energy), kWh/m²·year.*
- C_{ep}: *Total primary energy consumption, kWh/m²·year.*
- $C_{ep,nr}$: *Non-renewable primary energy consumption, kWh/m²·year.*

1.1.2. Results by occupied zone and month

Offices - South (S_u = 189.33 m²; V = 643.14 m³)

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh/year)	Year (kWh/m²·year)
Energy demand	Heating	235.9	132.1	0.5	--	--	--	--	--	--	0.3	1.8	60.2	430.9	2.3
	Cooling	17.0	202.5	516.5	768.1	1115.8	1408.7	1613.3	1691.4	1206.4	805.4	405.9	140.3	9891.3	52.2
	TOTAL	252.9	334.6	517.0	768.1	1115.8	1408.7	1613.3	1691.4	1206.4	805.8	407.7	200.5	10322.2	54.5

		Jan (h)	Feb (h)	Mar (h)	Apr (h)	May (h)	Jun (h)	Jul (h)	Aug (h)	Sep (h)	Oct (h)	Nov (h)	Dec (h)	Year (h)
Unmet load hours*	Heating	4	2	--	--	--	--	--	--	--	--	--	2	9
	Cooling	--	--	--	0	2	16	45	42	6	--	--	--	112

**Number of hours in which the air temperature of the spaces of the zone lies outside the range of the setpoint heating or cooling temperatures, with a margin greater than 0.2 °C for heating and 0.2 °C for cooling.*

Energy consumption

where:

- S_u: *Useful surface area of the habitable zone, m².*
- V: *Net volume of the occupied zone, m³.*
- DHW_{sol}: *Solar net energy provided, kWh.*
- DHW_{sis}: *Net energy provided by the system, kWh.*

Offices - North (S_u = 143.72 m²; V = 485.51 m³)

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh/year)	Year (kWh/m²·year)
Energy demand	Heating	343.9	194.0	0.9	--	--	--	--	--	--	0.5	9.3	124.6	673.2	4.7
	Cooling	--	74.2	303.4	638.3	1032.7	1296.8	1456.8	1464.5	946.7	471.1	107.4	21.8	7813.6	54.4
	TOTAL	343.9	268.2	304.3	638.3	1032.7	1296.8	1456.8	1464.5	946.7	471.6	116.7	146.4	8486.8	59.0

		Jan (h)	Feb (h)	Mar (h)	Apr (h)	May (h)	Jun (h)	Jul (h)	Aug (h)	Sep (h)	Oct (h)	Nov (h)	Dec (h)	Year (h)
Unmet load hours*	Heating	5	3	--	--	--	--	--	--	--	--	0	3	11
	Cooling	--	--	--	0	4	18	42	32	5	--	--	--	100

**Number of hours in which the air temperature of the spaces of the zone lies outside the range of the setpoint heating or cooling temperatures, with a margin greater than 0.2 °C for heating and 0.2 °C for cooling.*

where:

- S_u: *Useful surface area of the habitable zone, m².*
- V: *Net volume of the occupied zone, m³.*
- DHW_{sol}: *Solar net energy provided, kWh.*
- DHW_{sis}: *Net energy provided by the system, kWh.*

Cafeteria (S_u = 50.51 m²; V = 171.90 m³)

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh/year)	Year (kWh/m²·year)
Energy demand	Heating	37.3	21.4	1.2	0.1	--	--	--	--	--	0.8	3.1	13.6	77.5	1.5
	Cooling	5.3	34.9	94.1	166.4	251.0	306.0	333.5	344.2	235.9	145.9	58.1	18.2	1993.5	39.5
	TOTAL	42.6	56.2	95.3	166.5	251.0	306.0	333.5	344.2	235.9	146.7	61.2	31.8	2071.0	41.0

		Jan (h)	Feb (h)	Mar (h)	Apr (h)	May (h)	Jun (h)	Jul (h)	Aug (h)	Sep (h)	Oct (h)	Nov (h)	Dec (h)	Year (h)
Unmet load hours*	Heating	1	1	--	--	--	--	--	--	--	--	--	0	3
	Cooling	--	--	--	--	2	26	37	48	3	--	--	--	116

**Number of hours in which the air temperature of the spaces of the zone lies outside the range of the setpoint heating or cooling temperatures, with a margin greater than 0.2 °C for heating and 0.2 °C for cooling.*

where:

- S_u: *Useful surface area of the habitable zone, m².*
- V: *Net volume of the occupied zone, m³.*
- DHW_{sol}: *Solar net energy provided, kWh.*
- DHW_{sis}: *Net energy provided by the system, kWh.*

Unconditioned (S_u = 57.53 m²; V = 246.23 m³)

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh/year)
Energy demand	TOTAL	--	--	--	--	--	--	--	--	--	--	--	--	--

		Jan (h)	Feb (h)	Mar (h)	Apr (h)	May (h)	Jun (h)	Jul (h)	Aug (h)	Sep (h)	Oct (h)	Nov (h)	Dec (h)	Year (h)
Unmet load hours*	Heating	--	--	--	--	--	--	--	--	--	--	--	--	--
	Cooling	--	--	--	--	--	--	--	--	--	--	--	--	--

**Number of hours in which the air temperature of the spaces of the zone lies outside the range of the setpoint heating or cooling temperatures, with a margin greater than 0.2 °C for heating and 0.2 °C for cooling.*

where:

- S_u: *Useful surface area of the habitable zone, m².*
- V: *Net volume of the occupied zone, m³.*
- DHW_{sol}: *Solar net energy provided, kWh.*
- DHW_{sis}: *Net energy provided by the system, kWh.*

2. DESIGN MODEL OF THE BUILDING.

2.1. Energy demand of the building.

2.1.1. Heating and cooling energy demand.

Habitable zones	S_u (m²)	D_{heat} (kWh/year)	D_{heat} (kWh/m²·year)	D_{cool} (kWh/year)	D_{cool} (kWh/m²·year)
Offices - South	189.33	430.86	2.28	9891.32	52.24
Offices - North	143.72	673.21	4.68	7813.63	54.37
Cafeteria	50.51	77.47	1.53	1993.52	39.47
Unconditioned	57.53	--	--	--	--
	441.10	1181.53	2.68	19698.47	44.66

where:

- S_u: *Useful surface area of the habitable zone, m².*
- D_{heat}: *Calculated value of the heating energy demand, kWh/year.*
- D_{cool}: *Calculated value of the cooling energy demand, kWh/m²·year.*

2.1.2. Domestic hot water energy demand.

The planned building does not have any domestic hot water demand.

2.2. Conversion factors

Energy vector	C_{ef} (kWh/year)	C_{ef} (kWh/m²·year)	f_{cep}	C_{ep} (kWh/year)	C_{ep} (kWh/m²·year)	$f_{cep,nr}$	$C_{ep,nr}$ (kWh/year)	$C_{ep,nr}$ (kWh/m²·year)	f_{co2}	kg CO_2 (kg CO_2/year)	kg CO_2 (kg CO_2/m²·year)
Electricity obtained from the network	14225.75	32.25	2.368	33686.58	76.37	1.954	27798.17	63.02	0.331	4708.7	10.7
Natural gas	1448.33	3.28	1.195	1730.75	3.92	1.189	1722.09	3.90	0.252	365.0	0.8

where:

- C_{ef}: *Energy consumption at consumption point (final energy), kWh/m²·year.*
- f_{cep}: *Conversion factor for final energy to primary energy.*
- C_{ep}: *Primary energy consumption, kWh/m²·year.*
- $f_{cep,nr}$: *Conversion factor for final energy to primary energy obtained from non-renewable sources.*
- $C_{ep,nr}$: *Non-renewable primary energy consumption, kWh/m²·year.*
- f_{co2}: *Final energy to CO_2 emissions conversion factor, kg CO_2/kWh.*
- kg CO_2: *CO_2 emissions, kg CO_2/m²·year.*