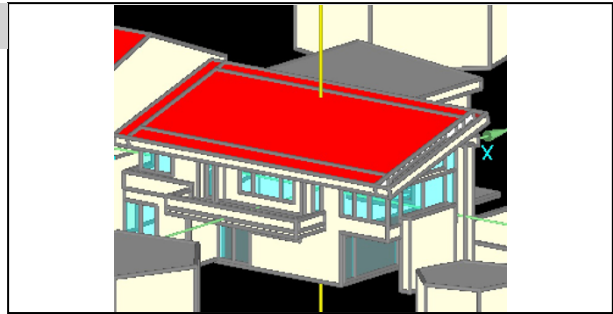


BUILDING INFORMATION

Category: **Residential**
 Status: **In planning**
 Building type: **New construction**
 Year of construction: **2021**
 Units: **1**
 Number of occupants: **4 (Design)**
 Occupant density: **778.1 ft²/Person**



Boundary conditions

Climate: **WA - SEATTLE BOEING FIELD [ISIS] (Monthly)**
 Internal heat gains: **0.8 Btu/hr ft²**
 Interior temperature: **68 °F**
 Overheat temperature: **77 °F**

Building geometry

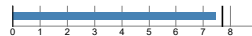
Enclosed volume: **39,629.8 ft³**
 Net-volume: **30,525.6 ft³**
 Total area envelope: **8,416.1 ft²**
 Area/Volume Ratio: **0.2 1/ft**
 Floor area: **3,112.5 ft²**
 Envelope area/iCFA: **2.704**

PASSIVEHOUSE REQUIREMENTS

Certificate criteria: PHIUS+ 2018

Heating demand

specific: **7.46 kBtu/ft²yr**
 target: **7.7 kBtu/ft²yr**
 total: **23,211.83 kBtu/yr**



Cooling demand

sensible: **1.14 kBtu/ft²yr**
 latent: **0.01 kBtu/ft²yr**
 specific: **1.15 kBtu/ft²yr**
 target: **5.6 kBtu/ft²yr**
 total: **3,563.95 kBtu/yr**



Heating load

specific: **4.71 Btu/hr ft²**
 target: **5.9 Btu/hr ft²**
 total: **14,672 Btu/hr**



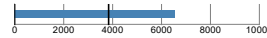
Cooling load

specific: **1.44 Btu/hr ft²**
 target: **3.4 Btu/hr ft²**
 total: **4,466.79 Btu/hr**



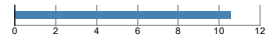
Source energy

total: **26,222.58** kWh/yr
 specific: **6,556** kWh/Person yr
 target: **3,840** kWh/Person yr
 total: **89,466.33** kBtu/yr
 specific: **28.75** kBtu/ft²yr



Site energy

total: **32,987.99** kBtu/yr
 specific: **10.6** kBtu/ft²yr
 total: **9,668.78** kWh/yr
 specific: **3.11** kWh/ft²



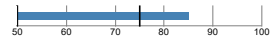
Air tightness

ACH50: **0.83** 1/hr
 CFM50 per envelope area: **0.05** cfm/ft²
 target: **0.99** 1/hr
 target CFM50: **0.06** cfm/ft²

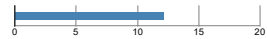


PASSIVEHOUSE RECOMMENDATIONS

Sensible recovery efficiency: **85 %**



Frequency of overheating:
 Cooling system is required **12.1 %**

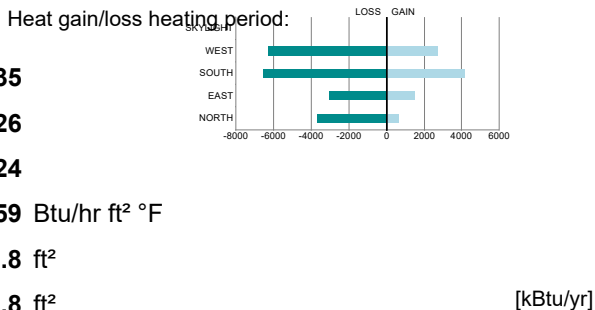


Frequency of overheating only applies if there is not a [properly sized] cooling system installed.

BUILDING ELEMENTS

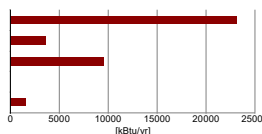
Windows

Average SHGC:	0.35
Average solar reduction factor heating:	0.26
Average solar reduction factor cooling:	0.24
Average U-value:	0.159 Btu/hr ft² °F
Total glazing area:	877.8 ft²
Total window area:	1,132.8 ft²



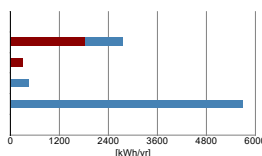
HVAC

Total heating demand:	23,212 kBtu/yr
Total cooling demand:	3,564 kBtu/yr
Total DHW energy demand:	9,571 kBtu/yr
Solar DHW contribution:	0 kBtu/yr
Auxiliary electricity:	1,509 kBtu/yr



Electricity

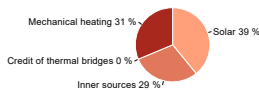
Direct heating / DHW:	0 kWh/yr
Heatpump heating:	2,758 kWh/yr
Cooling:	284 kWh/yr
HVAC auxiliary energy:	442 kWh/yr
Appliances:	5,684 kWh/yr
Renewable generation, coincident production and use:	0 kWh/yr
Total electricity demand:	9,169 kWh/yr



HEAT FLOW - HEATING PERIOD

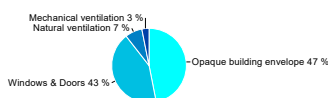
Heat gains

Solar:	21,273 kBtu/yr
Inner sources:	16,028 kBtu/yr
Credit of thermal bridges:	0 kBtu/yr
Mechanical heating:	23,212 kBtu/yr



Heat losses

Opaque building envelope:	28,400 kBtu/yr
Windows & Doors:	25,749 kBtu/yr
Natural ventilation:	4,486 kBtu/yr
Mechanical ventilation:	1,880 kBtu/yr

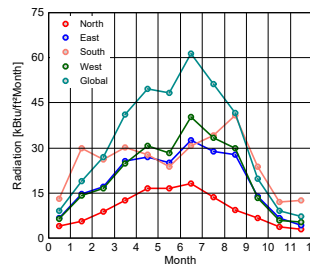
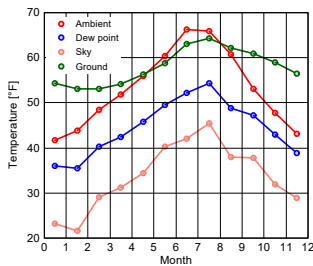


CLIMATE

Latitude: **47.7 °**
 Longitude: **-122.3 °**
 Elevation of weather station: **65.6 ft**
 Elevation of building site: **283 ft**
 Heat capacity air: **0.018 Btu/ft³F**
 Daily temperature swing summer: **16.6 °F**
 Average wind speed: **4 ft/s**

Ground

Average ground surface temperature: **54.4 °F**
 Amplitude ground surface temperature: **44.2 °F**
 Ground thermal conductivity: **1.2 Btu/hr ft °F**
 Ground heat capacity: **29.8 Btu/ft³F**
 Depth below grade of groundwater: **9.8 ft**
 Flow rate groundwater: **0.2 ft/d**



Calculation parameters

Length of heating period **365 days/yr**
 Heating degree hours **109 kFh/a**
 Phase shift months **1.3 mths**
 Time constant heating demand **74 hr**
 Time constant cooling demand **0 hr**
 Time constant cooling demand with night ventilation **0 hr**

Climate for	Heating load 1	Heating load 2	Cooling
Temperature [°F]	28	36.1	72
Solar radiation North [Btu/hr ft²]	5.4	4.4	26.6
Solar radiation East [Btu/hr ft²]	11.1	7.3	62.4
Solar radiation South [Btu/hr ft²]	24.1	9.5	52
Solar radiation West [Btu/hr ft²]	8.6	4.8	65.9
Solar radiation Global [Btu/hr ft²]	12.4	8.2	102.4

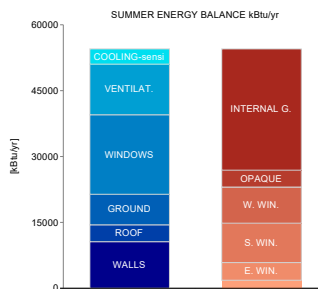
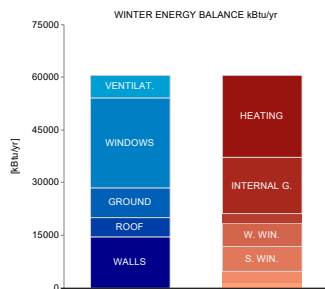
Relevant boundary conditions for heating load calculation: Heating load 1

ANNUAL HEAT DEMAND

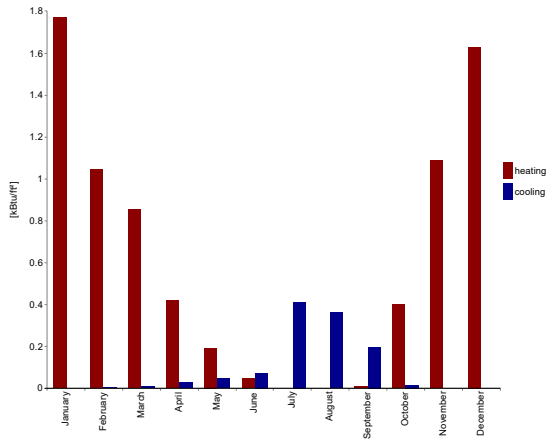
Transmission losses :	54,148 kBtu/yr
Ventilation losses:	6,365 kBtu/yr
Total heat losses:	60,514 kBtu/yr
Solar heat gains:	28,967 kBtu/yr
Internal heat gains:	21,825 kBtu/yr
Total heat gains:	50,792 kBtu/yr
Utilization factor:	73.4 %
Useful heat gains:	37,302 kBtu/yr
Annual heat demand:	23,212 kBtu/yr
Specific annual heat demand:	7,458.5 Btu/ft ² /yr

ANNUAL COOLING DEMAND

Solar heat gains:	26,859 kBtu/yr
Internal heat gains:	27,603 kBtu/yr
Total heat gains:	54,462 kBtu/yr
Transmission losses :	87,157 kBtu/yr
Ventilation losses:	25,366 kBtu/yr
Total heat losses:	112,523 kBtu/yr
Utilization factor:	45.3 %
Useful heat losses:	50,918 kBtu/yr
Cooling demand - sensible:	3,544 kBtu/yr
Cooling demand - latent:	20 kBtu/yr
Annual cooling demand:	3,564 kBtu/yr
Specific annual cooling demand:	1.1 kBtu/ft ² /yr



SPECIFIC HEAT/COOLING DEMAND MONTHLY

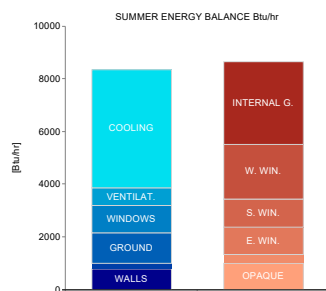
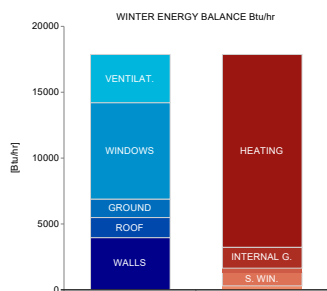


Month	Heating [kBtu/ft²]	Cooling [kBtu/ft²]
January	1.8	0
February	1	0
March	0.9	0
April	0.4	0
May	0.2	0
June	0	0.1
July	0	0.4
August	0	0.4
September	0	0.2
October	0.4	0
November	1.1	0
December	1.6	0

HEATING LOAD

COOLING LOAD

	First climate	Second climate		
Transmission heat losses:	14,154.5 Btu/hr	11,669.6 Btu/hr	Solar heat gain:	5,493.6 Btu/hr
Ventilation heat losses:	3,714.5 Btu/hr	2,974.8 Btu/hr	Internal heat gain:	3,151.3 Btu/hr
Total heat loss:	17,869 Btu/hr	14,644.4 Btu/hr	Total heat gains cooling:	8,645 Btu/hr
Solar heat gain:	1,618.4 Btu/hr	779.2 Btu/hr	Transmission heat losses:	3,494.8 Btu/hr
Internal heat gain:	1,578.6 Btu/hr	1,578.6 Btu/hr	Ventilation heat losses:	683.4 Btu/hr
Total heat gains heating:	3,197 Btu/hr	2,357.8 Btu/hr	Total heat loss:	4,178.2 Btu/hr
Heating load:	14,672 Btu/hr	12,286.6 Btu/hr	Cooling load - sensible:	4,466.8 Btu/hr
			Cooling load - latent:	0 Btu/hr
Relevant heating load:	14,672 Btu/hr		Relevant cooling load:	4,466.8 Btu/hr
Specific heating load:	4.7 Btu/hr ft ²		Specific maximum cooling load:	1.4 Btu/hr ft ²



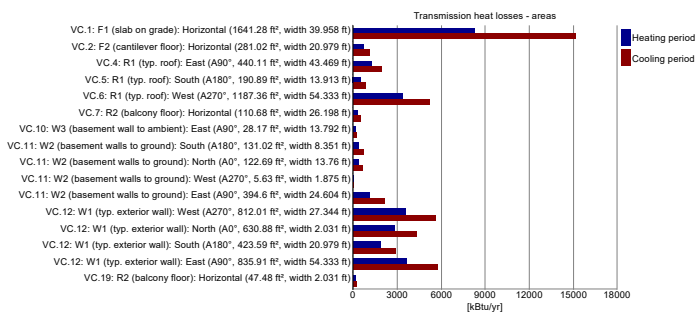
AREAS

Transmission heat losses - areas

Name	Area [ft²]	Average U-value [Btu/hr ft² °F]	Absorption coefficient	Emission coefficient	Reduction factor shading [%]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC.1: F1 (slab on grade): Horizontal (1641.28 ft², width 39.958 ft)	1641.3	0.055	0	0	0	8264.2	15144.3
VC.2: F2 (cantilever floor): Horizontal (281.02 ft², width 20.979 ft)	281	0.017	0.4	0.9	100	691	1076.7
VC.4: R1 (typ. roof): East (A90°, 440.11 ft², width 43.469 ft)	440.1	0.02	0.4	0.9	100	1233.4	1921.8
VC.5: R1 (typ. roof): South (A180°, 190.89 ft², width 13.913 ft)	190.9	0.02	0.4	0.9	100	535	833.6
VC.6: R1 (typ. roof): West (A270°, 1187.36 ft², width 54.333 ft)	1187.4	0.02	0.4	0.9	100	3327.7	5184.8
VC.7: R2 (balcony floor): Horizontal (110.68 ft², width 26.198 ft)	110.7	0.02	0.4	0.9	100	310.2	483.3
VC.10: W3 (basement wall to ambient): East (A90°, 28.17 ft², width 13.792 ft)	28.2	0.032	0.4	0.9	100	128.1	199.6
VC.11: W2 (basement walls to ground): South (A180°, 131.02 ft², width 8.351 ft)	131	0.032	0	0	0	380.4	697.1
VC.11: W2 (basement walls to ground): North (A0°, 122.69 ft², width 13.76 ft)	122.7	0.032	0	0	0	356.2	652.7
VC.11: W2 (basement walls to ground): West (A270°, 5.63 ft², width 1.875 ft)	5.6	0.032	0	0	0	16.3	29.9
VC.11: W2 (basement walls to ground): East (A90°, 394.6 ft², width 24.604 ft)	394.6	0.032	0	0	0	1145.6	2099.4
VC.12: W1 (typ. exterior wall): West (A270°, 812.01 ft², width 27.344 ft)	812	0.031	0.4	0.9	100	3569.2	5561.1
VC.12: W1 (typ. exterior wall): North (A0°, 630.88 ft², width 2.031 ft)	630.9	0.031	0.4	0.9	100	2773	4320.6
VC.12: W1 (typ. exterior wall): South (A180°, 423.59 ft², width 20.979 ft)	423.6	0.031	0.4	0.9	100	1861.9	2901
VC.12: W1 (typ. exterior wall): East (A90°, 835.91 ft², width 54.333 ft)	835.9	0.031	0.4	0.9	100	3674.2	5724.7
VC.19: R2 (balcony floor): Horizontal (47.48 ft², width 2.031 ft)	47.5	0.02	0.4	0.9	100	133.1	207.3

Degree hours [kFh/a]

	Heating	Cooling
Ambient heating	79.7	124.1
Ground heating	50.5	92.5



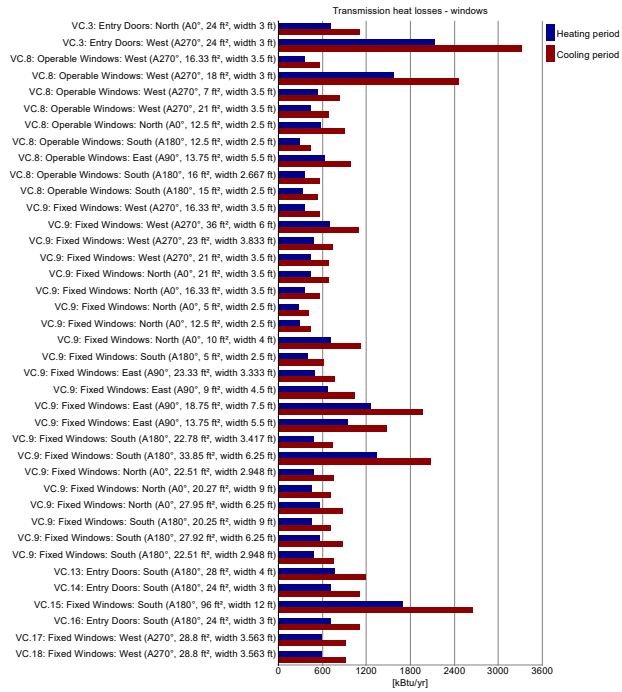
THERMAL BRIDGES**Transmission heat losses - thermal bridges**

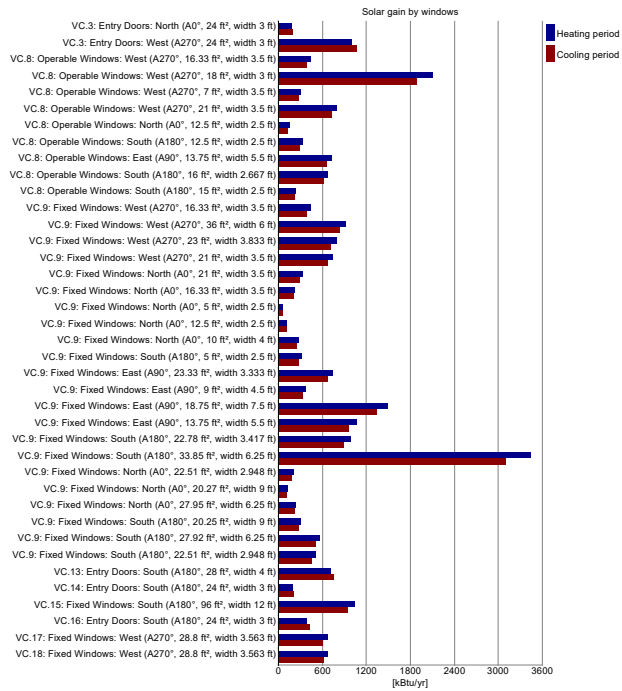
Name	Length [ft]	Psi-value [Btu/hr ft °F]	Transmission losses [kBtu/yr]	Transmission losses cooling [kBtu/yr]
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WINDOWS

Transmission heat losses - windows

Name	Quantity	Inclination [°]	U-value total [Btu/hr ft² F]	SHGC (perpendicular)	Reduction factor shading [%]	Reduction factor shading summer [%]	Solar gain heating [kBtu/yr]	Solar gain cooling [kBtu/yr]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC.3: Entry Doors: North (A0°, 24 ft², width 3 ft)	1	90	0.207	0.3	41.4	39.8	185.5	196.4	711.6	1,108.7
VC.3: Entry Doors: West (A270°, 24 ft², width 3 ft)	3	90	0.207	0.3	35.6	37.8	1,001.6	1,060.6	2,134.8	3,326.2
VC.8: Operable Windows: West (A270°, 16.33 ft², width 3.5 ft)	1	90	0.153	0.3	48	39.4	439.6	395.6	357.5	557
VC.8: Operable Windows: West (A270°, 18 ft², width 3 ft)	4	90	0.153	0.3	52	43.8	2,102	1,891.8	1,580.3	2,462.2
VC.8: Operable Windows: West (A270°, 7 ft², width 3.5 ft)	3	90	0.179	0.3	30.5	25.1	309.8	278.9	538.1	838.4
VC.8: Operable Windows: West (A270°, 21 ft², width 3.5 ft)	1	90	0.148	0.3	66.7	58.3	803.7	723.3	446.5	695.7
VC.8: Operable Windows: North (A0°, 12.5 ft², width 2.5 ft)	2	90	0.163	0.3	23.4	19.6	149.9	134.9	582.9	908.2
VC.8: Operable Windows: South (A180°, 12.5 ft², width 2.5 ft)	1	90	0.163	0.3	39.8	28.8	327.1	294.4	291.5	454.1
VC.8: Operable Windows: East (A90°, 13.75 ft², width 5.5 ft)	2	90	0.16	0.3	53.8	45.1	731.8	658.6	632.3	985.2
VC.8: Operable Windows: South (A180°, 16 ft², width 2.667 ft)	1	90	0.157	0.3	63.1	48.1	681.7	613.6	360.8	562.1
VC.8: Operable Windows: South (A180°, 15 ft², width 2.5 ft)	1	90	0.16	0.3	24.7	19.1	247	222.3	343.6	535.4
VC.9: Fixed Windows: West (A270°, 16.33 ft², width 3.5 ft)	1	90	0.153	0.3	48.1	39.3	440	396	357.5	557
VC.9: Fixed Windows: West (A270°, 36 ft², width 6 ft)	1	90	0.136	0.3	42.5	35	923.1	830.8	703.7	1,096.5
VC.9: Fixed Windows: West (A270°, 23 ft², width 3.833 ft)	1	90	0.146	0.3	59.8	49.9	797.5	717.8	480.8	749.1
VC.9: Fixed Windows: West (A270°, 21 ft², width 3.5 ft)	1	90	0.148	0.3	62.2	51.7	748.4	673.6	446.5	695.7
VC.9: Fixed Windows: North (A0°, 21 ft², width 3.5 ft)	1	90	0.148	0.3	56.4	45.1	324.6	292.2	446.5	695.7
VC.9: Fixed Windows: North (A0°, 16.33 ft², width 3.5 ft)	1	90	0.153	0.3	53.3	43.1	232.9	209.6	357.5	557
VC.9: Fixed Windows: North (A0°, 5 ft², width 2.5 ft)	2	90	0.188	0.3	30.8	25.9	67.4	60.7	270	420.6
VC.9: Fixed Windows: North (A0°, 12.5 ft², width 2.5 ft)	1	90	0.163	0.3	39.5	32.8	126.3	113.6	291.5	454.1
VC.9: Fixed Windows: North (A0°, 10 ft², width 4 ft)	3	90	0.166	0.3	37.7	31.5	280.1	252.1	715.8	1,115.3
VC.9: Fixed Windows: South (A180°, 5 ft², width 2.5 ft)	3	90	0.188	0.3	37.9	29.6	320.2	288.2	404.9	630.9
VC.9: Fixed Windows: East (A90°, 23.33 ft², width 3.333 ft)	1	90	0.148	0.3	59.8	56.4	744.3	669.9	493.7	769.2
VC.9: Fixed Windows: East (A90°, 9 ft², width 4.5 ft)	3	90	0.173	0.3	29.9	26.3	372.3	335.1	671.3	1,045.9
VC.9: Fixed Windows: East (A90°, 18.75 ft², width 7.5 ft)	3	90	0.156	0.3	52.7	43.9	1,497.9	1,348.1	1,258.7	1,961.2
VC.9: Fixed Windows: East (A90°, 13.75 ft², width 5.5 ft)	3	90	0.16	0.3	52.4	43.1	1,068.6	961.8	948.5	1,477.8
VC.9: Fixed Windows: South (A180°, 22.78 ft², width 3.417 ft)	1	90	0.147	0.3	61.2	41	985.5	887	481.6	750.4
VC.9: Fixed Windows: South (A180°, 33.85 ft², width 6.25 ft)	2	90	0.137	0.3	69.2	49.2	3,450.8	3,105.7	1,334.1	2,078.6
VC.9: Fixed Windows: North (A0°, 22.51 ft², width 2.948 ft)	1	90	0.151	0.3	33.4	27.3	204.3	183.9	485.8	757
VC.9: Fixed Windows: North (A0°, 20.27 ft², width 9 ft)	1	90	0.158	0.3	24.7	20.6	128.6	115.8	460.7	717.7
VC.9: Fixed Windows: North (A0°, 27.95 ft², width 6.25 ft)	1	90	0.141	0.3	31.1	25.4	244.4	220	566	881.9
VC.9: Fixed Windows: South (A180°, 20.25 ft², width 9 ft)	1	90	0.159	0.3	23.3	17.6	311.1	280	460.3	717.3
VC.9: Fixed Windows: South (A180°, 27.92 ft², width 6.25 ft)	1	90	0.141	0.3	28.6	17	576.4	518.7	565.4	880.9
VC.9: Fixed Windows: South (A180°, 22.51 ft², width 2.948 ft)	1	90	0.151	0.3	33	21.1	518.5	466.7	485.8	757
VC.13: Entry Doors: South (A180°, 28 ft², width 4 ft)	1	90	0.191	0.3	47.5	39.8	717.8	760	767.9	1,196.4
VC.14: Entry Doors: South (A180°, 24 ft², width 3 ft)	1	90	0.207	0.3	17.5	15.9	202.1	214	711.6	1,108.7
VC.15: Fixed Windows: South (A180°, 96 ft², width 12 ft)	1	90	0.124	0.3	13.9	9.6	1,046.9	942.2	1,703.3	2,653.8
VC.16: Entry Doors: South (A180°, 24 ft², width 3 ft)	1	90	0.207	0.3	34.7	30.6	400	423.5	711.6	1,108.7
VC.17: Fixed Windows: West (A270°, 28.8 ft², width 3.563 ft)	1	90	0.144	0.3	39.5	33.2	666.6	599.9	594	925.5
VC.18: Fixed Windows: West (A270°, 28.8 ft², width 3.563 ft)	1	90	0.144	0.3	40.4	34.4	681.8	613.6	594	925.5





Summary building envelope

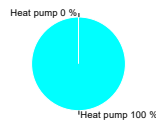
	Total area / length	Average U-value / Psi value	Transmission losses
Exterior wall ambient:	3,011.6 ft ²	0.029 Btu/hr ft ² °F	12,697.4 kBtu/yr
Exterior wall ground:	653.9 ft ²	0.032 Btu/hr ft ² °F	1,898.6 kBtu/yr
Basement:	1,641.3 ft ²	0.055 Btu/hr ft ² °F	8,264.2 kBtu/yr
Roof:	1,976.5 ft ²	0.02 Btu/hr ft ² °F	5,539.3 kBtu/yr
Windows:	1,132.8 ft ²	0.159 Btu/hr ft ² °F	25,748.8 kBtu/yr
Doors:	0 ft ²	0 Btu/hr ft ² °F	0 kBtu/yr
Thermal bridge ambient:	0 ft	0 Btu/hr ft °F	0 kBtu/yr
Thermal bridge perimeter:	0 ft	0 Btu/hr ft °F	0 kBtu/yr
Thermal bridge floor slab:	0 ft	0 Btu/hr ft °F	0 kBtu/yr

Shading

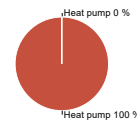
	Heating	Cooling
Reduction factor North:	36.7 %	30.6 %
Reduction factor East:	50.6 %	43.2 %
Reduction factor South:	36.8 %	26.6 %
Reduction factor West:	46.9 %	40.5 %
Reduction factor Horizontal:	100 %	100 %

System	DHW			Heating			Total		
	Covered DHW demand [%]	Estimated solar fraction [%]	Final energy demand [kBtu/yr]	Covered heating demand [%]	Estimated solar fraction [%]	Final energy demand [kBtu/yr]	Performance ratio	CO2 equivalent emissions [lb/yr]	Source energy demand [kBtu/yr]
Heat pump, MITSUBISHI MXZ-3C24NAHZ (Ducted) SEER 15.5 FFD 10	100	0	3,158.3	0	0	0	0.3	1,387.8	8,843.2
Heat pump, MITSUBISHI MXZ-3C24NAHZ (Ducted) SEER 15.5 FFD 10	0	0	0	100	0	6,251.4	0	2,746.9	17,503.9
Σ	100	0	3,158.3	100	0	6,251.4		4,134.6	26,347.1

DHW - final energy



Heating - final energy



COOLING UNITS

	sensible	latent
Air cooling:	0 kBtu/ft²yr	0 kBtu/ft²yr
Recirculation cooling:	1.1 kBtu/ft²yr	0 kBtu/ft²yr
Additional dehumidification:		0 kBtu/ft²yr
Panel cooling:	0 kBtu/ft²yr	
Sum:	1.1 kBtu/ft²yr	0 kBtu/ft²yr

VENTILATION

Energy transportable by supply air

Heating energy

transportable: **0.52 W/ft²**
 load: **1.38 W/ft²**



Cooling energy

transportable: **0.28 W/ft²**
 load: **0.42 W/ft²**



Infiltration pressure test ACH50: **0.83 1/hr**
 Total extract air demand: **80 cfm**
 Supply air per person: **18 cfm**
 Occupancy: **4**

Average air flow rate: **82.28 cfm**
 Average air change rate: **0.16 1/hr**
 Effective ACH ambient: **0.08 1/hr**
 Effective ACH ground: **0 1/hr**
 Energetically effective air exchange: **0.08 1/hr**
 Infiltration air change rate: **0.06 1/hr**
 Infiltration air change rate (heating load): **0.14 1/hr**

Type of ventilation system: **Balanced PH ventilation**
 Wind screening coefficient (e): **0.07**
 Wind exposure factor: **15**
 Wind shield factor: **0.05**

Ventilation heat losses: **4,838.64 kBtu/yr**

Devices

Name	Sensible recovery efficiency [-]	Electric efficiency [W/cfm]	Heat recovery efficiency SHX [-]	Effective recovery efficiency [-]
HRV Zehnder Q350 HRV	0.9	0.02	0	0.9
Altogether	0.9	0.02	0	0.9

Ducts

Name	Length (total) [ft]	Clear cross-section [ft²]	U-value [Btu/hr ft² °F]	Assigned ventilation units
Supply	6	0.1963	1.29	HRV Zehnder Q350 HRV
Ex	6	0.1963	1.29	HRV Zehnder Q350 HRV
Σ	12			

*length * quantity

** thermal conductivity / thickness

SUMMER VENTILATION

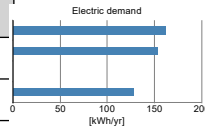
ACH night ventilation: **0 1/hr**
 ACH natural summer: **0 1/hr**

Overheating temperature:

77 °F

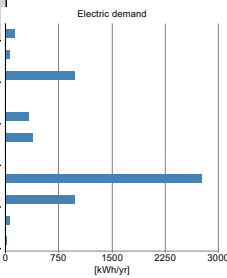
ELECTRICITY DEMAND - AUXILIARY ELECTRICITY

Type	Quantity	Indoor	Norm demand	Electric demand [kWh/yr]	Source energy [kBtu/yr]
DHW circulating pump	1	yes	30 W	161.8	1546
Ventilation winter	1	yes	0.4 W/cfm	153	1461.3
Ventilation Defrost	1	yes	23.3 W	0.2	1.5
Ventilation summer	1	yes	0.4 W/cfm	127.4	1216.6
Σ				442.3	4225.4



ELECTRICITY DEMAND RESIDENTIAL BUILDING

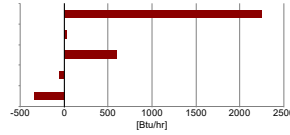
Type	Quantity	Indoor	Norm demand	Electric demand [kWh/yr]	Non-electric demand [kWh/yr]	Source energy [kBtu/yr]
Kitchen dishwasher	1	yes	1.2	129.9	0	1241.4
Laundry - washer	1	yes	0.3	57.4	0	548.3
Laundry - dryer	1	yes	4.5	981.4	0	9375.2
Energy consumed by evaporation	0	yes	3.1	0	45.8	437.7
Kitchen refrigerator	1	yes	0.9	325	0	3104.7
Kitchen freezer	1	yes	1	377	0	3601.5
Kitchen cooking	1	yes	0.3	0	500	1876.5
PHIUS+ Misc Electric Loads	1	yes	2,761.9	2761.9	0	26384.2
PHIUS+ Interior Lighting	1	yes	980.6	980.6	0	9367.6
PHIUS+ Exterior Lighting	1	no	51.1	51.1	0	488.4
PHIUS+ Garage Lighting	1	no	20	20	0	191.1
Σ	10			5684.3	545.8	56616.7



INTERNAL HEAT GAINS

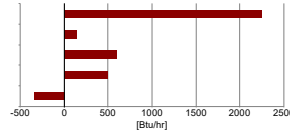
Heating season

Electricity total:	2,247.9 Btu/hr
Auxiliary electricity:	34.5 Btu/hr
People:	600.5 Btu/hr
Cold water:	-50 Btu/hr
Evaporation:	-341.2 Btu/hr
Σ:	2,491.7 Btu/hr
Specific internal heat gains:	0.8 Btu/hr ft ²



Cooling season

Electricity total:	2,247.9 Btu/hr
Auxiliary electricity:	143.6 Btu/hr
People:	600.5 Btu/hr
Cold and hot water:	500.5 Btu/hr
Evaporation:	-341.2 Btu/hr
Σ:	2,491.7 Btu/hr
Specific internal heat gains:	0.8 Btu/hr ft ²



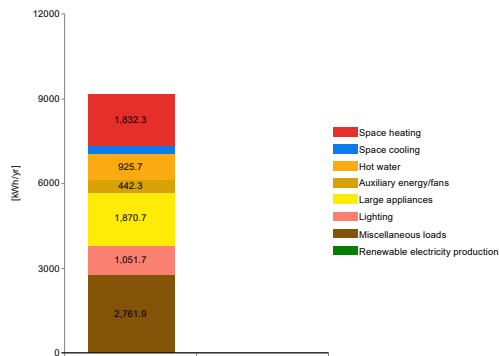
DHW AND DISTRIBUTION

DHW consumption per person per day:	6.6 gal/Person/day
Average cold water temperature supply:	50 °F
Useful heat DHW:	7,218.1 kBtu/yr
Specific useful heat DHW:	2,319.3 Btu/ft ² yr
Total heat losses of the DHW system:	2,352.5 kBtu/yr
Specific losses of the DHW system:	755.9 Btu/ft ² yr
Performance ratio DHW distribution system and storage:	1.3
Utilization ratio DHW distribution system and storage:	0.8
Total heat demand of DHW system:	9,570.6 kBtu/yr
Total specific heat demand of DHW system:	3,075.2 Btu/ft ² yr
Total heat losses of the hydronic heating distribution:	0 kBtu/yr
Specific losses of the hydronic heating distribution:	0 Btu/ft ² yr
Performance ratio of heat distribution:	100 %

Region	Length [ft]	Annual heat loss [kBtu/yr]
Hydronic heating distribution pipes		
Σ	0	0
DHW circulation pipes		
In conditioned space	0	0
Σ	0	0
Individual pipes		
In conditioned space	213.9	2352.5
Σ	213.9	2352.5
Water storage		
Σ		0

Project name	Zahr Residence
Climate	WA - SEATTLE BOEING FIELD [ISIS] (Monthly)
Type	Residential
Interior conditioned floor area	3,112.5 ft²
Number of units	1
Occupants	4
Site energy use	32,988 kBtu/yr
Specific site energy use	10.6 kBtu/ft²yr
Site energy use	9,668.8 kWh/yr
Specific site energy use	3.1 kWh/ft²yr
Site energy use per person	2,417.2 kWh/Person yr
Net site energy use (with 100% renewables)	32,988 kBtu/yr
Specific net site energy use (with 100% renewables)	10.6 kBtu/ft²yr
Net site energy use (with 100% renewables)	9,668.8 kWh/yr
Specific net site energy use (with 100% renewables)	3.1 kWh/ft²yr
Net site energy use per person (with 100% renewables)	2,417.2 kWh/Person yr

OVERVIEW

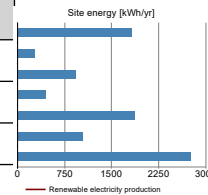


Not renewable

Renewable

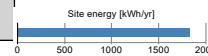
TOTAL USE BY TYPE

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
Space heating	1,832.3	0.6	6,251.4	2
Space cooling	284.2	0.1	969.6	0.3
Hot water	925.7	0.3	3,158.3	1
Auxiliary energy/fans	442.3	0.1	1,509.1	0.5
Large appliances	1,870.7	0.6	6,382.5	2.1
Lighting	1,051.7	0.3	3,588.3	1.2
Miscellaneous loads	2,761.9	0.9	9,422.9	3
Renewable electricity production	0	0	0	0
Total	9,168.8	2.9	31,282.1	10.1



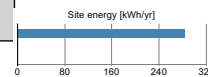
SPACE HEATING

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
Heat pump	1,832.3	0.6	6,251.4	2
Total	1,832.3	0.6	6,251.4	2



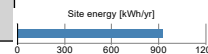
SPACE COOLING

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
Recirculation Cooling	284.2	0.1	969.6	0.3
Dehumidification	0	0	0	0
Total	284.2	0.1	969.6	0.3



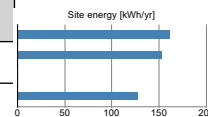
DHW

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
Heat pump	925.7	0.3	3,158.3	1
Total	925.7	0.3	3,158.3	1



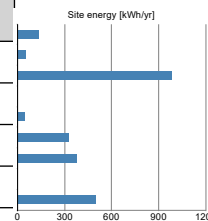
AUXILIARY ENERGY/FANS

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
DHW circulating pump	161.8	0.1	552.1	0.2
Ventilation winter	153	0	521.9	0.2
Ventilation Defrost	0.2	0	0.5	0
Ventilation summer	127.4	0	434.5	0.1
Total	442.3	0.1	1,509.1	0.5



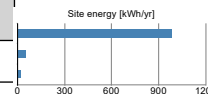
LARGE APPLIANCES

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
Kitchen dishwasher	129.9	0	443.4	0.1
Laundry - washer	57.4	0	195.8	0.1
Laundry - dryer	981.4	0.3	3,348.3	1.1
Energy consumed by evaporation	0	0	0	0
	(45.8)	(0)	(156.3)	(0.1)
Kitchen refrigerator	325	0.1	1,108.8	0.4
Kitchen freezer	377	0.1	1,286.3	0.4
Kitchen cooking	0	0	0	0
	(500)	(0.2)	(1,705.9)	(0.5)
Total	1,870.7	0.6	6,382.5	2.1



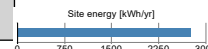
LIGHTING

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
PHIUS+ Interior Lighting	980.6	0.3	3,345.6	1.1
PHIUS+ Exterior Lighting	51.1	0	174.4	0.1
PHIUS+ Garage Lighting	20	0	68.2	0
Total	1,051.7	0.3	3,588.3	1.2



MISC LOADS

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
PHIUS+ Misc Electric Loads	2,761.9	0.9	9,422.9	3
Total	2,761.9	0.9	9,422.9	3



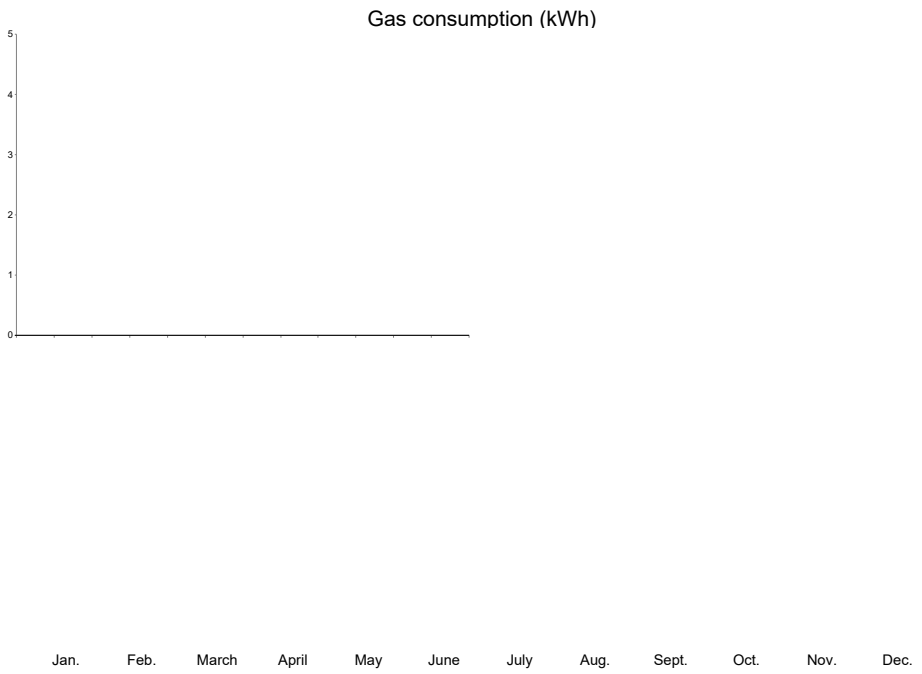
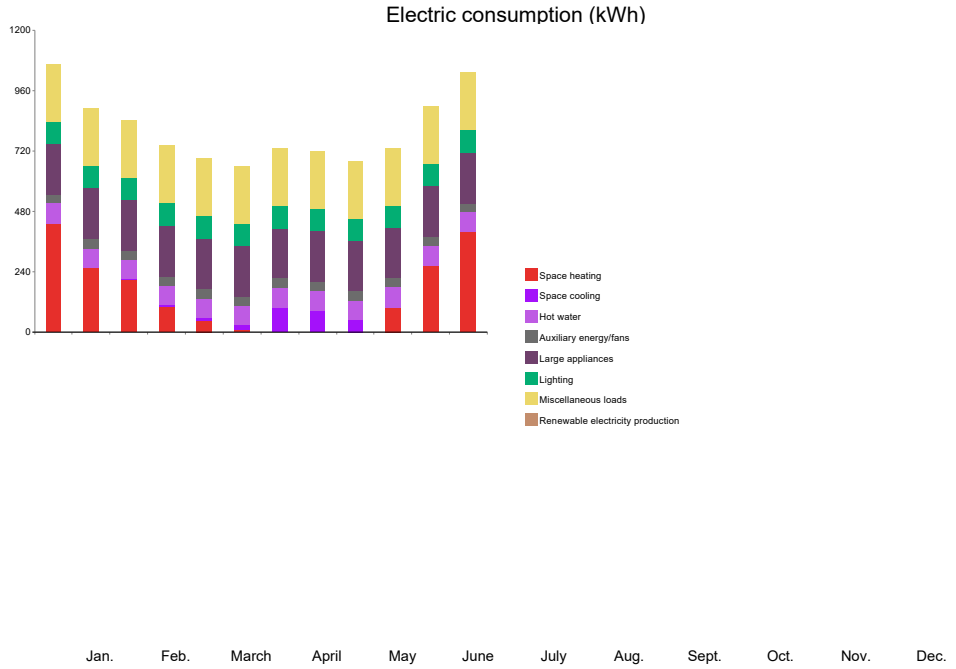
SITE ENERGY MONTHLY REPORT

ELECTRICITY USE [kWh]

Type	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Space heating	434.68	256.38	210.03	103.36	47.76	11.2	0.09	0.07	2.32	98.36	267.47	400.55
Space cooling	0.19	1.49	2.11	6.33	11.01	17.82	100.18	87.95	48.13	3.65	0.44	0.18
Hot water	77.14	77.14	77.14	77.14	77.14	77.14	77.14	77.14	77.14	77.14	77.14	77.14
Auxiliary energy/fans	36.86	36.86	36.86	36.86	36.86	36.86	36.86	36.86	36.86	36.86	36.86	36.86
Large appliances	201.38	201.38	201.38	201.38	201.38	201.38	201.38	201.38	201.38	201.38	201.38	201.38
Lighting	87.64	87.64	87.64	87.64	87.64	87.64	87.64	87.64	87.64	87.64	87.64	87.64
Miscellaneous loads	230.16	230.16	230.16	230.16	230.16	230.16	230.16	230.16	230.16	230.16	230.16	230.16
Renewable electricity production	0	0	0	0	0	0	0	0	0	0	0	0

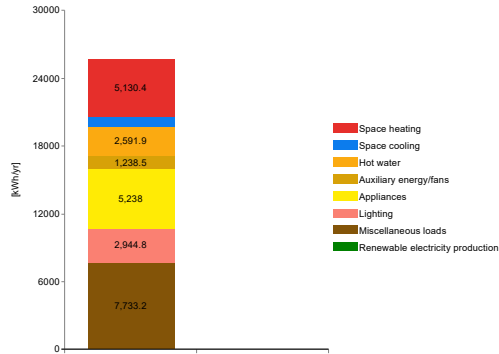
GAS USE [kWh]

Type	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Space heating	0	0	0	0	0	0	0	0	0	0	0	0
Space cooling	0	0	0	0	0	0	0	0	0	0	0	0
Hot water	0	0	0	0	0	0	0	0	0	0	0	0
Auxiliary energy/fans	0	0	0	0	0	0	0	0	0	0	0	0
Large appliances	0	0	0	0	0	0	0	0	0	0	0	0
Lighting	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous loads	0	0	0	0	0	0	0	0	0	0	0	0
Renewable electricity production	0	0	0	0	0	0	0	0	0	0	0	0



Project name	Zahr Residence
Climate	WA - SEATTLE BOEING FIELD [ISIS] (Monthly)
Type	Residential
Interior conditioned floor area	3,112.5 ft²
Number of units	1
Occupants	4
Source energy use	89,466.3 kBtu/yr
Specific source energy use	28.7 kBtu/ft²yr
Source energy use	26,222.6 kWh/yr
Source energy use per person	6,556 kWh/Person yr
Net source energy use (with 100% renewables)	89,466.3 kBtu/yr
Specific net source energy use (with 100% renewables)	28.7 kBtu/ft²yr
Net source energy use (with 100% renewables)	26,222.6 kWh/yr
Specific source energy use per person (with 100% renewables)	6,555.6 kWh/Person yr
PHIUS+ Source Zero	NO

OVERVIEW

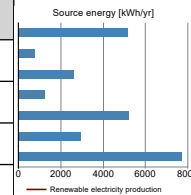


Not renewable

Renewable

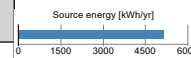
TOTAL USE BY TYPE

Type	Source energy [kWh/yr]	Specific source energy [kWh/ft ² yr]	Source energy [kBtu/yr]	Specific source energy [kBtu/ft ² yr]
Space heating	5,130.4	1.6	17,503.9	5.6
Space cooling	795.7	0.3	2,714.9	0.9
Hot water	2,591.9	0.8	8,843.2	2.8
Auxiliary energy/fans	1,238.5	0.4	4,225.4	1.4
Appliances	5,238	1.7	17,871.1	5.7
Lighting	2,944.8	0.9	10,047.1	3.2
Miscellaneous loads	7,733.2	2.5	26,384.2	8.5
Renewable electricity production	0	0	0	0
Total	25,672.6	8.2	87,589.8	28.1



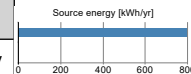
SPACE HEATING

Type	Source energy [kWh/yr]	Specific source energy [kWh/ft ² yr]	Source energy [kBtu/yr]	Specific source energy [kBtu/ft ² yr]	Source energy factor [kWh/kWh]	Source
Heat pump	5,130.4	1.6	17,503.9	5.6	2.8	Electricity
Total	5,130.4	1.6	17,503.9	5.6		



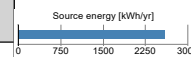
SPACE COOLING

Type	Source energy [kWh/yr]	Specific source energy [kWh/ft ² yr]	Source energy [kBtu/yr]	Specific source energy [kBtu/ft ² yr]	Source energy factor [kWh/kWh]	Source
Recirculation Cooling	795.7	0.3	2,714.9	0.9	2.8	Electricity
Dehumidification	0	0	0	0	2.8	Electricity
Total	795.7	0.3	2,714.9	0.9		



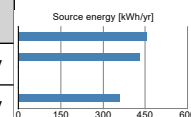
DHW

Type	Source energy [kWh/yr]	Specific source energy [kWh/ft ² yr]	Source energy [kBtu/yr]	Specific source energy [kBtu/ft ² yr]	Source energy factor [kWh/kWh]	Source
Heat pump	2,591.9	0.8	8,843.2	2.8	2.8	Electricity
Total	2,591.9	0.8	8,843.2	2.8		



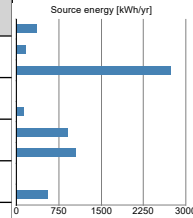
AUXILIARY ENERGY/FANS

Type	Source energy [kWh/yr]	Specific source energy [kWh/ft ² yr]	Source energy [kBtu/yr]	Specific source energy [kBtu/ft ² yr]	Source energy factor [kWh/kWh]	Source
DHW circulating pump	453.1	0.1	1,546	0.5	2.8	Electricity
Ventilation winter	428.3	0.1	1,461.3	0.5	2.8	Electricity
Ventilation Defrost	0.4	0	1.5	0	2.8	Electricity
Ventilation summer	356.6	0.1	1,216.6	0.4	2.8	Electricity
Total	1,238.5	0.4	4,225.4	1.4		



LARGE APPLIANCES

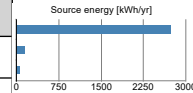
Type	Source energy [kWh/yr]	Specific source energy [kWh/ft² yr]	Source energy [kBtu/yr]	Specific source energy [kBtu/ft² yr]	Source energy factor [kWh/kWh]	Source
Kitchen dishwasher	363.9	0.1	1,241.4	0.4	2.8	Electricity
Laundry - washer	160.7	0.1	548.3	0.2	2.8	Electricity
Laundry - dryer	2,747.9	0.9	9,375.2	3	2.8	Electricity
Energy consumed by evaporation	0	0	0	0	2.8	Electricity
	(128.3)	(0.04)	(437.75)	(0.14)	2.8	HVAC System *)
Kitchen refrigerator	910	0.3	3,104.7	1	2.8	Electricity
Kitchen freezer	1,055.6	0.3	3,601.5	1.2	2.8	Electricity
Kitchen cooking	0	0	0	0	2.8	Electricity
	(550)	(0.18)	(1,876.49)	(0.6)	1.1	Natural Gas
Total	5,238	1.7	17,871.1	5.7		



*) Energy demand covered with HVAC System

LIGHTING

Type	Source energy [kWh/yr]	Specific source energy [kWh/ft² yr]	Source energy [kBtu/yr]	Specific source energy [kBtu/ft² yr]	Source energy factor [kWh/kWh]	Source
PHIUS+ Interior Lighting	2,745.7	0.9	9,367.6	3	2.8	Electricity
PHIUS+ Exterior Lighting	143.1	0	488.4	0.2	2.8	Electricity
PHIUS+ Garage Lighting	56	0	191.1	0.1	2.8	Electricity
Total	2,944.8	0.9	10,047.1	3.2		



MISC LOADS

Type	Source energy [kWh/yr]	Specific source energy [kWh/ft² yr]	Source energy [kBtu/yr]	Specific source energy [kBtu/ft² yr]	Source energy factor [kWh/kWh]	Source
PHIUS+ Misc Electric Loads	7,733.2	2.5	26,384.2	8.5	2.8	Electricity
Total	7,733.2	2.5	26,384.2	8.5		

