Passive House-Verification

10.4a EN

PHPP

Photo or drawing

Building:	Wunderhaus
Street:	
Postcode/City:	
Province/Country:	Sussex / GB-United Kingdom/ Britain
Building type:	
Climate data set:	GB0003a-London Gatwick, Altitude corrected
Climate zone:	3: Cool-temperate — Altitude of location: 56 m
Home owner / Client:	
Street:	
Postcode/City:	
Province/Country:	

Architecture:	
Street:	
Postcode/City:	
Province/Country:	
Mechanical engineer:	
Street:	
Postcode/City:	
Province/Country:	
Energy consultancy:	
Street:	
Postcode/City:	
Province/Country:	
Certification:	
Street:	
Postcode/City:	
Province/Country:	

Year of construction:	2023	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) winter [W/m²]:	2.4	IHG summer [W/m²]:	2.8
No. of occupants:	2.9	Specific heat capacity [Wh/K per m² TFA]:	60	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	155.8				
Space heating	Heating demand	kWh/(m²a)	**16**	≤	15	-	**No**
	Heating load	W/m²	**11**	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	**4**	≤	15		**Yes**
	Frequency of overheating (> 25 °C)	%	**-**	≤	-		**-**
	Frequency of excessively high humidity (> 12 g/kg)	%	**0**	≤	10		**Yes**
Airtightness	Pressurisation test result n_{50}	1/h	**0.6**	≤	0.6		**Yes**
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	**72**	≤	-		**-**
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	**59**	≤	60	60	**Yes**
	Renew. energy generation (in rel. to projected building footprint area)	kWh/(m²a)	**182**	≥	-	-	

I confirm that the values given here have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive house Classic? **No**

Task: | First name: | Surname: | Signature:

Certificate-ID | Issued on: | City:

Areas determination

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Summary

Temp.-zone	Thermal envelope Areas [m²]	Area group	Group no.	Average U-value [W/(m²K)]	Radiation gains Heating period [kWh/a]	Radiation load Cooling period [kWh/a]
	155.78	**Treated floor area**	1		10 months	11 months
A	**9.00**	**North windows**	2	**0.888**	**397**	**625**
A	**0.00**	**East windows**	3			
A	**26.82**	**South windows**	4	**0.848**	**4378**	**3849**
A	**0.00**	**West windows**	5			
A	**0.00**	**Horizontal windows**	6			
A	**2.49**	**Exterior door**	7	**1.200**		
A	**195.00**	**External wall - ambient**	8	**0.126**	**91**	**149**
B	**0.00**	**External wall ground/basement**	9			
A	**158.49**	**Roof / ceiling - ambient**	10	**0.156**	**107**	**206**
B	**118.19**	**Floor slab / basement ceiling**	11	**0.154**		
	0.00		12			
	0.00		13			
	0.00		14			
	Thermal bridges, length [m]			Ψ [W/(mK)]		
A	**145.93**	**Thermal bridges ambient**	15	**0.016**		
P	**48.66**	**Perimeter thermal bridges**	16	**-0.040**		
B	**0.00**	**Thermal bridges FS/BC**	17			
	Building element towards neighbour, [m²]			[W/(m²K)]		
I	**0.00**	**Building element towards neighbour**	18			
	Total thermal envelope [m²]			[W/(m²K)]		
	509.99	Average U-value of thermal envelope:		**0.199**		

User-defined temperature reduction factors					
Zone	Heating-demand	Heating load	Cooling demand	Cooling load	Passive cooling
X					
Y					
Z					
Auxiliary calculation for the determination of temperature reduction factors					
		Temperature of the adjacent zone [°C]:			

Go to building components list

Area input

Area no.	Building assembly description	Assigned to group	Quantity	x (	a [m]	x	b [m]	+	User-defined calculation [m²]	-	User-defined subtraction [m²]	-	Subtraction window areas [m²]	) =	Area [m²]	Building assembly selection: Selection building assembly / Building system	Building assembly selection: U-value [W/(m²K)]	Radiation balance input: Deviation from North	Radiation balance input: Angle of inclination from the horizontal	Radiation balance input: Orientation	Radiation balance input: Reduction factor shading	Radiation balance input: Exterior absorptivity	Radiation balance input: Exterior emissivity
	Projected building footprint	0-Projected building footprint:	1	x (		x		+	118.19	-		)		=	118.2	2-Sort by ID							
	Treated floor area	1-Treated floor area	1	x (		x		+	155.78	-		)		=	155.8								
	Exterior door	7-Exterior door	1	x (	2.26	x	1.10	+		-		) -		=	2.5	Exterior door	1.20		Radiation balance window frames:			0.60	0.90
1				x (		x		+		-		) -	0.0	=									
2				x (		x		+		-		) -	0.0	=									
3				x (		x		+		-		) -	0.0	=									
4				x (		x		+		-		) -	0.0	=									
5	slab	11-Floor slab / basement ceiling	1	x (		x		+	118.19	-		) -	0.0	=	118.2	01ud-FT01	**0.154**	0	180	Hor	0.70	0.60	0.90
6				x (		x		+		-		) -	0.0	=									
7	East	8-External wall - ambient	1	x (		x		+	59.45	-	4.40	) -	0.0	=	55.1	02ud-WT01	**0.126**	90	90	East	0.70	0.60	0.90
8	South	8-External wall - ambient	1	x (		x		+	57.21	-	0.00	) -	26.8	=	30.4	02ud-WT01	**0.126**	180	90	South	0.70	0.60	0.90
9	West	8-External wall - ambient	1	x (		x		+	59.45	-	4.40	) -	0.0	=	55.1	02ud-WT01	**0.126**	270	90	West	0.70	0.60	0.90
10	North	8-External wall - ambient	1	x (		x		+	57.21	-	2.50	) -	9.0	=	45.7	02ud-WT01	**0.126**	0	90	North	0.70	0.60	0.90
11				x (		x		+		-		) -	0.0	=									
12	East Pitch	10-Roof / ceiling - ambient	1	x (		x		+	69.60	-		) -	0.0	=	69.6	04ud-RT01	**0.160**	90	45	East	0.70	0.60	0.90
13	West Pitch	10-Roof / ceiling - ambient	1	x (		x		+	69.60	-		) -	0.0	=	69.6	04ud-RT01	**0.160**	270	45	West	0.70	0.60	0.90
14	Flat	10-Roof / ceiling - ambient	1	x (		x		+	19.29	-		) -	0.0	=	19.3	05ud-RT02	**0.128**	0	5	Hor	0.70	0.60	0.90
15				x (		x		+		-		) -	0.0	=									
16	East sip connection	8-External wall - ambient	11	x (	4.00	x	0.10	+		-		) -	0.0	=	4.4	03ud-WT02	**0.138**	90	90	East	0.70	0.60	0.90
17	West sip connection	8-External wall - ambient	11	x (	4.00	x	0.10	+		-		) -	0.0	=	4.4	03ud-WT02	**0.138**	270	90	West	0.70	0.60	0.90
18				x (		x		+		-		) -	0.0	=									
19				x (		x		+		-		) -	0.0	=									
20				x (		x		+		-		) -	0.0	=									
21				x (		x		+		-		) -	0.0	=									
22				x (		x		+		-		) -	0.0	=									
23				x (		x		+		-		) -	0.0	=									
24				x (		x		+		-		) -	0.0	=									
25				x (		x		+		-		) -	0.0	=									
26				x (		x		+		-		) -	0.0	=									
27				x (		x		+		-		) -	0.0	=									
28				x (		x		+		-		) -	0.0	=									
29				x (		x		+		-		) -	0.0	=									
30				x (		x		+		-		) -	0.0	=									
31				x (		x		+		-		) -	0.0	=									
32				x (		x		+		-		) -	0.0	=									
33				x (		x		+		-		) -	0.0	=									
34				x (		x		+		-		) -	0.0	=									
35				x (		x		+		-		) -	0.0	=									
36				x (		x		+		-		) -	0.0	=									
37				x (		x		+		-		) -	0.0	=									
38				x (		x		+		-		) -	0.0	=									
39				x (		x		+		-		) -	0.0	=									
40				x (		x		+		-		) -	0.0	=									
41				x (		x		+		-		) -	0.0	=									
42				x (		x		+		-		) -	0.0	=									
43				x (		x		+		-		) -	0.0	=									
44				x (		x		+		-		) -	0.0	=									
45				x (		x		+		-		) -	0.0	=									
46				x (		x		+		-		) -	0.0	=									
47				x (		x		+		-		) -	0.0	=									
48				x (		x		+		-		) -	0.0	=									
49				x (		x		+		-		) -	0.0	=									
50				x (		x		+		-		) -	0.0	=									

Aend

Thermal bridge input

Change sorting

No.	Thermal bridge - description	Group No.	Quantity	x (	Length [m]	-	Subtraction length [m]	)=	Length ℓ [m]	User-defined psi value [W/(mK)]	User defined f_{Rsi}=0.25 (optional)	or	Selection building system	**Ψ-value [W/(mK)]**	f_{Rsi}-value Evaluation
	Interior drain pipes pipes	15-Thermal Bridges Ambient	1	x	6.00			=	6.00	0.108				**0.108**	
1	E5 GF/wall	16-Perimeter thermal bridges	1	x (	48.66	-		) =	48.66	-0.040		or		**-0.040**	
2				x (		-		) =				or			
3				x (		-		) =				or			
4				x (		-		) =				or			
5	E16 Corner not glu	15-Thermal bridges ambient	1	x (	15.14	-		) =	15.14	-0.040		or		**-0.040**	
6	E16 Corner glu	15-Thermal bridges ambient	1	x (	8.86	-		) =	8.86	0.040		or		**0.040**	
7	E17 invert	15-Thermal bridges ambient	2	x (	3.14	-		) =	6.28	-0.120		or		**-0.120**	
8	E13 Wall/Roof	15-Thermal bridges ambient	1	x (	20.75	-		) =	20.75	0.040		or		**0.040**	
9	E11 Wall/Roof	15-Thermal bridges ambient	1	x (	26.84	-		) =	26.84	0.040		or		**0.040**	
10	E14 Wall/Roof	15-Thermal bridges ambient	1	x (	12.53	-		) =	12.53	-0.040		or		**-0.040**	
11	E24	15-Thermal bridges ambient	1	x (	5.45	-		) =	5.45	-0.120		or		**-0.120**	
12	R04 Apex	15-Thermal bridges ambient	1	x (	13.42	-		) =	13.42	-0.040		or		**-0.040**	
13				x (		-		) =				or			
14	glu windposts	15-Thermal bridges ambient	3	x (	6.26	-		) =	18.78	0.080		or		**0.080**	
15	glu lintels	15-Thermal bridges ambient	1	x (	11.88	-		) =	11.88	0.080		or		**0.080**	
16				x (		-		) =				or			
17				x (		-		) =				or			
18				x (		-		) =				or			
19				x (		-		) =				or			
20				x (		-		) =				or			
21				x (		-		) =				or			
22				x (		-		) =				or			
23				x (		-		) =				or			
24				x (		-		) =				or			
25				x (		-		) =				or			
26				x (		-		) =				or			
27				x (		-		) =				or			
28				x (		-		) =				or			
29				x (		-		) =				or			
30				x (		-		) =				or			
31				x (		-		) =				or			
32				x (		-		) =				or			
33				x (		-		) =				or			
34				x (		-		) =				or			
35				x (		-		) =				or			
36				x (		-		) =				or			
37				x (		-		) =				or			
38				x (		-		) =				or			
39				x (		-		) =				or			
40				x (		-		) =				or			
41				x (		-		) =				or			
42				x (		-		) =				or			
43				x (		-		) =				or			
44				x (		-		) =				or			
45				x (		-		) =				or			
46				x (		-		) =				or			
47				x (		-		) =				or			
48				x (		-		) =				or			
49				x (		-		) =				or			
50				x (		-		) =				or			

TBend

Tool for conversion of thermal bridges to exterior dimensions

		Example	
	Ψ Interior dimensions	0.027	W/(mK)
	Temperature difference TB	30.000	K
Adjacent area I	Temperature difference $\Delta\vartheta$ I	30.000	K
	Exterior - Interior dimensions I	0.400	m
	U-value building assembly I	0.138	W/(m²K)
Adjacent area II	Temperature difference $\Delta\vartheta$ II	30.000	K
	Exterior - interior dimensions II	0.300	m
	U-value building assembly II	0.110	W/(m²K)
	Ψ Exterior dimensions	**-0.061**	**W/(mK)**

Auxiliary calculation for interior drain pipes that are ventilated through the roof

Climate		Nominal width: mm	λ W/(mK)	Insulation thickness mm	Reflective coating?	Ψ-value W/(mK)	Length m	Ψ*ℓ W/K
Room temperature °C	20.0	100	0.035	100	x	0.172	6.00	1.029
Ground temperature °C	11.7							
Ambient temperature heating period °C	7.5							
							m	W/K
Limitation of airflow rate in the pipe system:						Total	6.00	1.029
Nominal width mm	100							
Number of parallel pipes	1					Reduction factor sewer temperature		0.666
Capacitance rate W/K	9.3					Reduction factor warming of air		0.947
						Spec. loss with respect to ambient air [W/K]		**0.649**

This result is automatically transferred to the energy balance

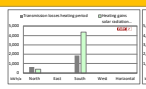
Windows and entrance doors

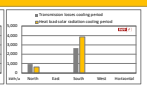
Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Window orientation	Global radiation (main direction)	Shading	Dirt	Non-perpendicular radiation (w=1/effective w)	Glazing fraction	g-value	Solar irradiation reduction factor	Window area	Window U_w installed	Glazing area	Average global radiation
Standard values →	kWh/(m²a)	0.75	0.95	0.85				A_w	W/(m²K)	A_g	kWh/(m²a)
North	97	0.69	0.95	0.85	0.70	0.53	0.39	9.0	0.89	6.33	97
East	208	1.00	0.95	0.85	0.00	0.00	0.00	0.0	0.00	0.00	208
South	384	0.76	0.95	0.85	0.77	0.52	0.47	26.8	0.85	20.68	384
West	221	1.00	0.95	0.85	0.00	0.00	0.00	0.0	0.00	0.00	221
Horizontal	326	1.00	0.95	0.85	0.00	0.00	0.00	0.0	0.00	0.00	326
Total or average value for all windows						**0.52**	**0.45**	**35.82**	**0.86**	**27.01**	**317**

	Transmission losses heating period	Heating gains solar radiation heating period
	kWh/a	kWh/a
North	655	397
East	0	0
South	1863	4378
West	0	0
Horizontal	0	0
Total	**2518**	**4776**

	Transmission losses cooling period	Heat load solar radiation cooling period
	kWh/a	kWh/a
North	930	625
East	0	0
South	2645	3949
West	0	0
Horizontal	0	0
Total	**3574**	**4475**





Frame absorptivity: 0.60
Frame emissivity: 0.90

Heating degree hours [kKh/a]: 82

Cooling degree hours [kKh/a]: 116

Recommendation for $U_{w,installed}$: Horizontal 1.10, Inclined 1.00, Vertical 0.85

Exterior temperature: -3.9 °C (°C) User-defined

Quantity	Description	Deviation from north	Angle of inclination from the horizontal	Orientation	Dimensions windows, doors etc. Width	Height	Installed in: Selection from 'Areas' worksheet	Glazing/panel: Selection list in 'Components' worksheet	Frame: Selection list in 'Components' worksheet	Opening casement: length of outer frame Left	Right	Top	Bottom	Threshold	Fixed glazing: length of outer frame Left fixed	Right fixed	Top fixed	Bottom fixed	Mullion length fm	m2	m1	m	Transom length q2	t1	t	Number of glass carriers	Installation: over value for $\Psi_{installed}$ or 1 = $\Psi_{installed}$ from 'Components' worksheet; 0 = adjacent to other window Left	Right	Top	Bottom	Thermal parameters U_f frame (mean)	g-value glazing	U_g glazing	$\Psi_{Glazing\ edge}$	$\Psi_{Installation}$ (Avg.)	Results Window area	Glazing area	Glazing fraction per window	U_w	U_w installed	Ener-PHit	Window surface temperature assessment Comfort	Heat gains heating period	Heat loads cooling period
	Pos. -m-	-	-		m	m				m					m				m				m			Pieces					W/(m²K) or 1/0		W/(mK)	W/(mK)		m²	m²	%	W/(m²K)	W/(m²K)	Exemption	Exemption		kWh/a	kWh/a
										0.00	0.00	0.00	0.00													1	1	1	1																
1	w1	180	90	South	0.73	1.46	6-South	01ab-Pilkington 4/18/4/18/4	01ab-Wirtec	1.46	1.46	0.73	0.73													1	1	1	1	1.10	0.53	0.50	0.038	0.040	**1.1**	**0.6**	**59%**	**0.869**	**1.034**				27	-77
1	w2	180	90	South	1.60	2.25	6-South	02ab-Pilkington 6/16/6/16/6	01ab-Wirtec	2.25	2.25	1.60	1.60													1	1	1	1	1.10	0.51	0.60	0.038	0.040	**3.6**	**2.8**	**78%**	**0.783**	**0.869**				300	-52
1	w3	180	90	South	1.60	2.25	6-South	02ab-Pilkington 6/16/6/16/6	01ab-Wirtec	2.25	2.25	1.60	1.60													1	1	1	1	1.10	0.51	0.60	0.038	0.040	**3.6**	**2.8**	**78%**	**0.783**	**0.869**				300	-52
1	w4	180	90	South	1.60	3.05	6-South	02ab-Pilkington 6/16/6/16/6	01ab-Wirtec	3.05	3.05	1.60	1.60													1	1	1	1	1.10	0.51	0.60	0.038	0.040	**4.9**	**3.9**	**80%**	**0.766**	**0.842**				475	60
1	w5.1	180	90	South	1.60	2.25	6-South	01ab-Pilkington 4/18/4/18/4	01ab-Wirtec	2.25	2.25	1.60	1.60													1	0	1	1	1.10	0.53	0.50	0.038	0.040	**3.6**	**2.8**	**78%**	**0.795**	**0.766**				438	419
1	w5.2	180	90	South	1.60	2.25	6-South	01ab-Pilkington 4/18/4/18/4	01ab-Wirtec	2.25	2.25	1.60	1.60													0	1	1	1	1.10	0.53	0.50	0.038	0.040	**3.6**	**2.8**	**78%**	**0.795**	**0.766**				437	417
1	w6	180	90	South	1.60	2.55	6-South	02ab-Pilkington 6/16/6/16/6	01ab-Wirtec	2.55	2.55	1.60	1.60													1	1	1	1	1.10	0.51	0.60	0.038	0.040	**4.1**	**3.2**	**79%**	**0.775**	**0.857**				447	416
1	w7	180	90	South	1.10	2.25	6-South	02ab-Pilkington 6/16/6/16/6	01ab-Wirtec	2.25	2.25	1.10	1.10													1	1	1	1	1.10	0.51	0.60	0.038	0.040	**2.5**	**1.8**	**72%**	**0.828**	**0.937**				91	55
										0.00	0.00	0.00	0.00													1	1	1	1																
1	w8	0	90	North	1.00	2.25	10-North	01ab-Pilkington 4/18/4/18/4	01ab-Wirtec	2.25	2.25	1.00	1.00													1	1	1	1	1.10	0.53	0.50	0.038	0.040	**2.3**	**1.6**	**70%**	**0.773**	**0.889**				-64	-76
1	w9	0	90	North	1.00	2.25	10-North	01ab-Pilkington 4/18/4/18/4	01ab-Wirtec	2.25	2.25	1.00	1.00													1	1	1	1	1.10	0.53	0.50	0.038	0.040	**2.3**	**1.6**	**70%**	**0.773**	**0.889**				-64	-76
1	w10	0	90	North	1.00	2.25	10-North	01ab-Pilkington 4/18/4/18/4	01ab-Wirtec	2.25	2.25	1.00	1.00													1	1	1	1	1.10	0.53	0.50	0.038	0.040	**2.3**	**1.6**	**70%**	**0.773**	**0.889**				-64	-76
1	w11	0	90	North	1.00	2.25	10-North	01ab-Pilkington 4/18/4/18/4	01ab-Wirtec	2.25	2.25	1.00	1.00													1	1	1	1	1.10	0.53	0.50	0.038	0.040	**2.3**	**1.6**	**70%**	**0.773**	**0.889**				-64	-76
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																
										0.00	0.00	0.00	0.00													1	1	1	1																

Calculation of reduction factors for shading

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Latitude: 51.2 °

Orientation	Glazing area [m²]	Reduction factor winter F_3	Reduction factor cooling $F_{3,1}$	Reduction factor cooling load $F_{3,2}$	Solar load [kWh/(m²$_{Glass/a}$)]
North	6.33	69%	75%	75%	99
East	0.00	100%	100%	100%	0
South	20.68	76%	52%	52%	186
West	0.00	100%	100%	100%	0
Horizontal	0.00	100%	100%	100%	0

								Horizon		Lateral reveal		Reveal / Overhang						Reduction factors for shading in winter				Reduction factors for shading in summer			
Quantity	Description	Deviation from North	Angle of inclination from the horizontal	Orientation	Glazing width	Glazing height	Glazing area	Height of the shading object	Distance of horizon	Window reveal depth	Distance from glazing edge to reveal	Overhang depth	Distance from upper glazing edge to overhang	Additional shading reduction factor, winter	Additional shading reduction factor, summer	Reduction factor z for temporary sun protection	Regulated / temporary use	Horizon	Reveal	Overhang	Total for winter	Horizon	Reveal	Overhang	Total for summer	Total for cooling load
		[Degrees]	[Degrees]		w_{G} [m]	h_{G} [m]	A_{w} [m²]	h_{Hor} [m]	d_{Hor} [m]	o_{Reveal} [m]	d_{Reveal} [m]	o_{over} [m]	d_{over} [m]	$r_{other,w}$ [%]	$r_{other,s}$ [%]	z [%]		r_{H} [%]	r_{R} [%]	r_{O} [%]	r_{3} [%]	r_{H} [%]	r_{R} [%]	r_{O} [%]	$r_{3,1}$ [%]	$r_{3,2}$ [%]
1	w1	180	90	South	0.51	1.24	0.6			2.00	2.610	2.00	0.27						86%	76%	65%		82%	26%	22%	22%
1	w2	180	90	South	1.38	2.03	2.8			2.00	2.610	2.00	0.27						88%	83%	73%		84%	37%	31%	31%
1	w3	180	90	South	1.38	2.03	2.8			2.00	2.610	2.00	0.27						88%	83%	73%		84%	37%	31%	31%
1	w4	180	90	South	1.38	2.83	3.9			2.00	2.610	2.00	0.27						88%	86%	76%		84%	48%	40%	40%
1	w5 l	180	90	South	1.38	2.03	2.8			2.00	2.660	2.00	3.41						88%	95%	83%		85%	85%	72%	72%
1	w5 r	180	90	South	1.38	2.03	2.8			2.00	2.610	2.00	3.41						88%	95%	83%		84%	85%	71%	71%
1	w6	180	90	South	1.38	2.33	3.2			2.00	2.610	2.00	3.41						88%	95%	83%		84%	85%	72%	72%
1	w7	180	90	South	0.88	2.03	1.8			4.66	1.270	0.11	0.60						58%	99%	57%		51%	100%	51%	51%
1	w8	0	90	North	0.78	2.03	1.6			0.91	1.150	0.91	0.26						84%	82%	69%		86%	87%	75%	75%
1	w9	0	90	North	0.78	2.03	1.6			0.91	1.150	0.91	0.26						84%	82%	69%		86%	87%	75%	75%
1	w10	0	90	North	0.78	2.03	1.6			0.91	1.150	0.91	0.26						84%	82%	69%		86%	87%	75%	75%
1	w11	0	90	North	0.78	2.03	1.6			0.91	1.150	0.91	0.26						84%	82%	69%		86%	87%	75%	75%

Ventilation data

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Treated floor area A_{TFA}		156	m²		
Room height h		2.50	m	Used	2.50 m
Reference volume for the ventilation system (A_{TFA}*h) =	V_V	389	m³		

Selection of ventilation input

Type of ventilation	1-Balanced PH ventilation with HR	
'Ventilation' worksheet	x	Standard project design for residential buildings
'Addl vent' worksheet		Multiple ventilation units, non-res

Infiltration air change rate

		For annual demand:	For heating load:	
Wind protection coefficient, e	2-Moderate protection	0.07	0.18	
Wind protection coefficient, f		15	15	
Net air volume for pressurisation test	V_{n50}	439		m³
Air change rate from pressurisation test	n_{50}	0.64		1/h
Air permeability	q_{50}	0.55		m³/(hm²)
		For annual demand:	For heating load:	
Excess extract air		0.00	0.00	1/h
Infiltration air change rate	$n_{V,Rest}$	0.051	0.126	1/h

Results

Average airflow rate	Average air change rate heating period	Excess air (extract air system)	Effective heat recovery efficiency	Humidity recovery efficiency	Heat recovery efficiency, cooling	Humidity recovery efficiency	Specific electric efficiency	SHX Heat recovery efficiency
m³/h	1/h	1/h	[-]	[-]	[-]	[-]	Wh/m³	[-]
117	**0.30**	**0.00**	**87.2%**	**0.0%**	**77.2%**	**N/A**	**0.24**	**0.0%**

Transfer

Efficiency SHX η^*_{SHX} 0%

Average interior humidity during winter operation

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
45%	44%	47%	49%	58%	67%	-	-	68%	60%	51%	45%

Summary: multiple ventilation units, non-res

Passive House with PHPP Version 10.4a EN

Ventilation data

Dimensioning of a ventilation system with only one ventilation unit

Occupant density	m²/P	53			
Number of occupants	P	2.9			
Supply air per person	m³/(P*h)	30			
Supply air demand	m³/h	**88**		Bathroom	
Extract air rooms		Kitchen	Bathroom	(shower only)	WC
Quantity		1	0	3	1
Extract air demand per room	m³/h	60	40	20	20
Total extract air demand	m³/h	**140**			

Design airflow rate (maximum) m³/h 152 Recommended: 152 m³/h

Calculation of the average air change rate

Type of operation	Daily operation hours h/d	Factors referenced to maximum	Airflow rate m³/h	Air change rate 1/h
Maximum		1.00	152	0.39
Standard	24.0	0.77	117	0.30
Basic ventilation		0.54	82	0.21
Minimum		0.40	61	0.16
			Average airflow rate (m³/h)	Average air change rate (1/h)
	Average value	0.77	**117**	**0.30**

Selection of ventilation unit with heat recovery

Location of ventilation unit: 1-Inside thermal envelope

		$T_{room} > T_{outdoor}$		$T_{room} < T_{outdoor}$				
Go to ventilation units list 1-Sort as list		Heat recovery efficiency Unit η_{HR}	Energy recovery efficiency	Cool recovery rate Unit η_{HR}	Energy recovery efficiency	Specific power input [Wh/m³]	Airflow range [m³/h]	Frost protection necessary
Selection of ventilation unit	0956vs03-Zehnder Group Nederland B.V. - ComfoAir Q35	0.91	0.00	N/A	N/A	0.24	70 - 270	yes

Implementation of frost protection: 2-Electr.

Conductivity of outdoor air duct	Ψ	W/(mK)	0.577	HR efficiency, cooling	
Length of outdoor air duct		m	1.5	0.77	
Conductivity of exhaust air duct	Ψ	W/(mK)	0.577		
Length of exhaust air duct		m	1.5		
Temperature of mechanical room (enter only if the unit is outside of the thermal envelope)		°C			

Limit temperature [°C]: -8
Useful energy [kWh/a]: 0

Room temperature (°C): 20
Avg. ambient temp. heating period (°C): 7.5
Avg. ground temp (°C): 11.7

Effective heat recovery efficiency $\eta_{HR,eff}$ **87.2%**

Effective heat recovery efficiency subsoil heat exchanger

SHX efficiency	η^*_{SHX}	
Heat recovery efficiency SHX	η_{SHX}	0%

Secondary calculation
Ψ-value supply or outdoor air duct

Nominal width:	286	mm
Insulation thickness:	43	mm
Reflective coating?		
Thermal conductivity	0.035	W/(mK)
Nominal airflow rate	117	m³/h
Δϑ	12	K
Exterior duct diameter	0.286	m
Exterior diameter	0.372	m
α–Interior	2.87	W/(m²K)
α-Surface	5.74	W/(m²K)
Ψ–value	**0.577**	**W/(mK)**
Surface temperature difference	1.075	K

Secondary calculation
Ψ-value extract or exhaust air duct

Nominal width:	286	mm
Insulation thickness:	43	mm
Reflective coating?		
Thermal conductivity	0.035	W/(mK)
Nominal airflow rate	117	m³/h
Δϑ	12	K
Exterior duct diameter	0.286	m
Exterior diameter	0.372	m
α–Interior	2.87	W/(m²K)
α-Surface	5.74	W/(m²K)
Ψ–value	**0.577**	**W/(mK)**
Surface temperature difference	1.075	K

Specific energy demand for heating (monthly method)

Passive House with PHPP Version 10.4a EN

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

The sum of the heating periods calculated through the monthly method is presented on this worksheet.

Interior temperature:	20	°C
Building type:		
Treated floor area A_{TFA}:	155.8	m²
Spec. Capacity:	60	Wh/(m²K)

Transmission heat losses Q_T

Building assembly	Temperature zone	Area m²		U-value W/(m²K)		Temperature reduction factor		G_t kKh/a		kWh/a	Per m² of TFA
External wall - ambient	A	195.0	*	0.126	*	1.00	*	82	=	2016	12.94
External wall ground/basement	B		*		*	1.00	*		=		
Roof / ceiling - ambient	A	158.5	*	0.156	*	1.00	*	82	=	2021	12.97
Floor slab / basement ceiling	B	118.2	*	0.154	*	1.00	*	61	=	1121	7.20
	A		*		*	1.00	*		=		
	A		*		*	1.00	*		=		
	A		*		*	1.00	*		=		
Windows	A	35.8	*	0.858	*	1.00	*	82	=	2518	16.16
Exterior door	A	2.5	*	1.200	*	1.00	*	82	=	244	1.57
Thermal bridges ambient (length/m)	A	145.9	*	0.016	*	1.00	*	82	=	189	1.21
Perimeter thermal bridges (length/m)	P	48.7	*	-0.040	*	1.00	*	61	=	-119	-0.77
Thermal bridges ground (length/m)	B		*		*	1.00	*		=		0.00
											kWh/(m²a)
Sum of all areas of the building envelope		510.0						**Total transmission heat losses Q_T**	=	**7989**	**51.3**

Ventilation heat losses Q_V

						m² 156	*	m 2.50	=	m³ 389	
Reference volume for the ventilation system, V_V (A_{TFA}*h)											
	$n_{V,system}$ 1/h		η*$_{SHX}$		η_{HR}		$n_{V,Res}$ 1/h		$n_{V,equi,fraction}$ 1/h		
Effective air change rate Ambient $n_{V,e}$	0.300	*(1-	0%	)*(1-	0.87	)+	0.051	=	0.089		
Effective air change rate Ground $n_{V,g}$	0.300	*	0%	*(1-	0.87	)		=	0.000		
	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)	
Ventilation losses ambient Q_V	389	*	0.089	*	0.33	*	82	=	936	6.0	
Ventilation losses ground $Q_{V,e}$	389	*	0.000	*	0.33	*	60	=	0	0.0	
							Total ventilation heat losses Q_V	=	**936**	**6.0**	

Total heat losses Q_L	(	7989	+	936	) *	1.0	=	8925	**57.3**	
		Q_T kWh/a		Q_V kWh/a		Reduction factor night/weekend lowering		kWh/a	kWh/(m²a)	

Available solar heat gains Q_S

Orientation of the area	Reduction factor see 'Windows' worksheet		g-value (perp. radiation)		Area m²		Global radiation kWh/(m²a)		kWh/a
North	0.39	*	0.53	*	9.0	*	213	=	397
East	0.00	*	0.00	*	0.0	*	448	=	0
South	0.47	*	0.52	*	26.8	*	666	=	4378
West	0.00	*	0.00	*	0.0	*	458	=	0
Horizontal	0.00	*	0.00	*	0.0	*	712	=	0
Sum opaque areas									745
									kWh/(m²a)
							Total available solar heat gains Q_S	=	**5521**	**35.4**

Internal heat gains Q_I

	Length Heat. Period		Spec. Power q_I		A_{TFA}			
kh/d	d/a		W/m²		m²		kWh/a	kWh/(m²a)
0.024	* 303	*	2.4	*	155.8	=	**2743**	**17.6**

Utilisation factor heat gains η_G

			kWh/a	kWh/(m²a)
Free heat Q_F	Q_S + Q_I	=	8263	53.0
Ratio free heat to losses	Q_F / Q_L	=	0.93	
Utilisation factor heat gains h_G		=	78%	
Total heat gains Q_G	η_G * Q_F	=	6469	**41.5**
			kWh/a	kWh/(m²a)

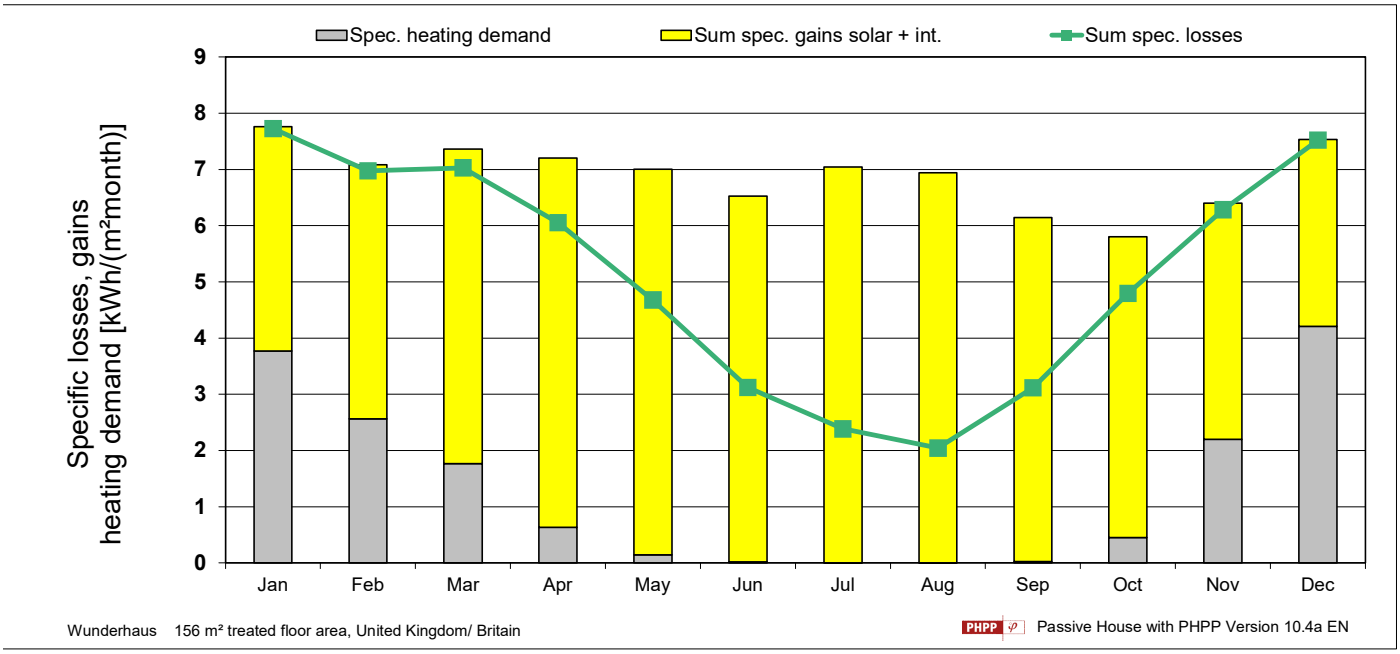
			kWh/a	kWh/(m²a)
Annual heating demand Q_H	Q_L - Q_G	=	2456	**15.8**
	kWh/(m²*a)			
Limit value	15	**Requirement met?**		**No**

Specific energy for heating (monthly method)

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Interior temperature:	20	°C
Building type:		
Treated floor area A_{TFA}:	156	m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating degree hours - exterior	11.5	10.2	10.1	8.4	6.2	3.8	2.7	2.3	4.2	7.0	9.4	11.3	87	kKh
Heating degree hours - ground	5.6	6.0	7.5	7.8	8.2	7.5	7.0	6.0	5.0	4.6	4.3	4.9	74	kKh
Losses - exterior	1112	989	973	815	595	363	257	219	404	672	908	1093	8400	kWh
Losses - ground	92	97	122	127	134	123	114	99	81	75	71	79	1215	kWh
Sum spec. losses	7.7	7.0	7.0	6.1	4.7	3.1	2.4	2.0	3.1	4.8	6.3	7.5	61.7	kWh/m²
Solar gains - North	13	22	37	56	77	90	88	69	45	30	17	11	554	kWh
Solar gains - East	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - South	296	381	480	585	579	519	585	605	546	460	329	204	5568	kWh
Solar gains - West	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - Opaque	32	47	74	111	133	134	143	126	91	63	37	22	1015	kWh
Internal heat gains	281	253	281	272	281	272	281	281	272	281	272	281	3304	kWh
Sum spec. gains solar + int.	4.0	4.5	5.6	6.6	6.9	6.5	7.0	6.9	6.1	5.4	4.2	3.3	67.0	kWh/m²
Utilisation factor	99%	98%	94%	82%	66%	48%	34%	29%	51%	81%	97%	100%	69%	
Annual heating demand	587	399	275	98	22	2	0	0	3	70	343	656	2456	kWh
Spec. heating demand	**3.8**	**2.6**	**1.8**	**0.6**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**2.2**	**4.2**	**15.8**	kWh/m²



Wunderhaus 156 m² treated floor area, United Kingdom/ Britain

Passive House with PHPP Version 10.4a EN

Annual heating demand: Comparison

Monthly method	*('Heating')*	**2456**	**kWh/a**	**15.8**	**kWh/(m²a)** reference to treated floor area according to PHPP
Annual method	*('Annual heating')*	**2630**	**kWh/a**	**16.9**	**kWh/(m²a)** reference to treated floor area according to PHPP

Cooling: specific energy demand for useful cooling

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

The sum of the cooling periods calculated through the monthly method is presented on this worksheet.

Building type:			Treated floor area A_{TFA}:	155.8	m²
Interior temperature summer:	25	°C	Building volume:	389	m³
Max. indoor absolute humidity:	12	g/kg	Internal humidity sources:	1.9	g/(m²h)
Spec. capacity:	60	Wh/(m²K)			

Transmission losses Q_T (negative: heat loads)

Building assembly	Temperature zone	Area m²		U-value W/(m²K)		Temperature reduction factor		G_t kKh/a		kWh/a	Per m² of TFA
External wall - ambient	A	195.0	*	0.126	*	1.00	*	116	=	2862	18.37
External wall ground/basement	B		*		*	1.00	*		=		
Roof / ceiling - ambient	A	158.5	*	0.156	*	1.00	*	116	=	2869	18.42
Floor slab / basement ceiling	B	118.2	*	0.154	*	1.00	*	62	=	1135	7.29
	A		*		*	1.00	*		=		
	A		*		*	1.00	*		=		
	A		*		*	1.00	*		=		
Windows	A	35.8	*	0.858	*	1.00	*	116	=	3574	22.95
Exterior door	A	2.5	*	1.200	*	1.00	*	116	=	347	2.23
Thermal bridges ambient (length/m)	A	145.9	*	0.016	*	1.00	*	116	=	269	1.72
Perimeter thermal bridges (length/m)	P	48.7	*	-0.040	*	1.00	*	116	=	-226	-1.45
Thermal bridges ground (length/m)	B		*		*	1.00	*		=		0.00
											kWh/(m²a)
Sum of all areas of the building envelope		510.0				**Total transmission heat losses Q_T**			=	**10830**	**69.5**

Ventilation heat losses Q_V

Information from the 'SummVent' worksheet

Ventilation conductance, vent. unit

exterior $H_{V,e}$	4.9	W/K
without HR	38.6	W/K
ground $H_{V,g}$	0.0	W/K
without HR	0.0	W/K

Ventilation conductance, others

exterior	6.5	W/K

Ventilation system

η_{HR}	87%
η_{FRV}	0%
η^*_{SHX}	0%

Ventilation parameter s

Daily temperature fluctuation in summer	8.9	K
Minimum acceptable indoor temperature	22.0	°C
Heat capacity air	0.33	Wh/(m³K)
Supply air change rate	0.30	1/h
Outdoor air change rate	0.05	1/h
Window night vent. air change rate, manual @ 1K	0.00	1/h
Air change rate due to mech., autom. controlled vent.	0.00	1/h
Specific electricity consumption for this	0.00	Wh/m³
Temperature increase	0.0	K

Summer ventilation control

HRV/ERV in summer	
None	
Temperature controlled	x
Enthalpy controlled	
Always	
Additional ventilation	
Temperature controlled	x
Humidity controlled	

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR} (considers bypass)		$n_{V,Rest}$ 1/h		$n_{V,equi,fraction}$ 1/h
Hygienic change rate:									
Effective air change rate ambient $n_{V,e}$	0.300	*(1-	0%	)*(1-	0.00	)+	0.051	=	0.351
Effective air change rate ground $n_{V,g}$	0.300	*	0%	*(1-	0.00	)		=	0.000

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation losses ambient Q_V	389	*	0.351	*	0.33	*	110	=	4977	31.9
Ventilation losses ground $Q_{V,e}$	389	*	0.000	*	0.33	*	0	=	0	0.0
Heat losses summer ventilation	389	*	0.000	*	0.33	*	0	=	0	0.0
							Total ventilation heat losses Q_V	=	**4977**	**31.9**

Total heat losses Q_L	10830 (Q_T kWh/a)	+	4977 (Q_V kWh/a)	=	**15806** kWh/a	**101.5** kWh/(m²a)

Available solar heat gains Q_S

Orientation of the area	Reduction factor		g-value (perp. radiation)		Area m²		Global radiation kWh/(m²a)		kWh/a	kWh/(m²a)
North	0.45	*	0.53	*	9.0	*	291	=	625	4.0
East	0.40	*	0.00	*	0.0	*	612	=	0	0.0
South	0.34	*	0.52	*	26.8	*	816	=	3849	24.7
West	0.40	*	0.00	*	0.0	*	620	=	0	0.0
Horizontal	0.40	*	0.00	*	0.0	*	982	=	0	0.0
Sum opaque areas									939	6.0
										kWh/(m²a)
								Total	**5414**	**34.8**

Internal heat gains Q_I

kh/d		Length cooling period d/a		Spec. power q_I W/m²		A_{TFA} m²		kWh/a	kWh/(m²a)
0.024	*	334	*	2.8	*	155.8	=	**3514**	**22.6**

Sum heat loads Q_F	Q_S + Q_I	=	**8928** kWh/a	**57.3** kWh/(m²a)

Utilisation factor heat losses η_L

Ratio of losses to free heat gains	Q_L / Q_F	=	1.77	
Utilisation factor heat losses η_L		=	52%	
			kWh/a	kWh/(m²a)
Useful heat losses $Q_{L,n}$	η_L * Q_L	=	**8247**	**52.9**
			kWh/a	kWh/(m²a)
Useful cooling demand Q_K	Q_F - $Q_{L,n}$	=	**681**	**4.4**

kWh/(m²a)		
Recommendation	15	**Target value reached?** **Yes**

Dehumidification demand Q_{Dr}

	Q_{Tr}	=	**3**	**0.0**

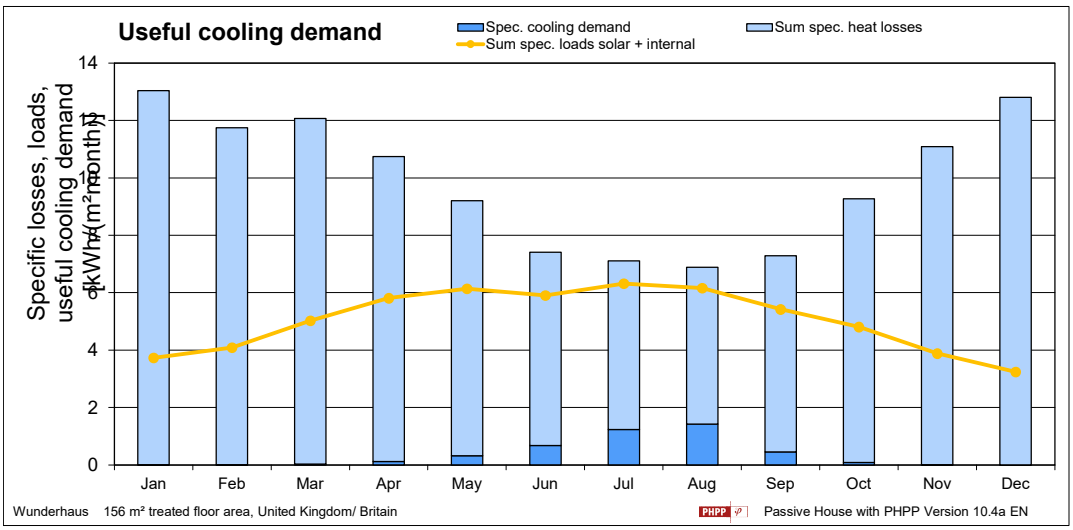
kWh/(m²a)		
Recommendation	0	**Target value reached?** **Yes**

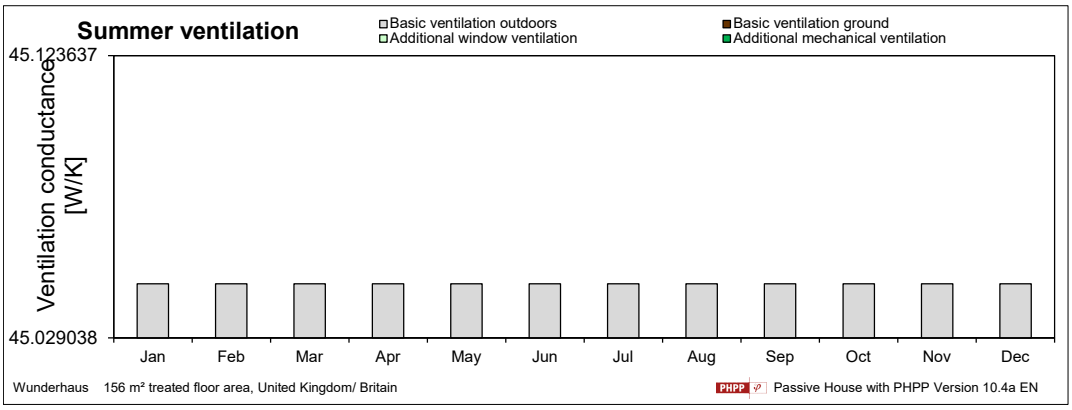
Cooling: specific energy demand for useful cooling

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Building type:
Interior Temperature: 25 °C
Treated floor area A_{TFA}: 156 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating degree hours - Exterior	15.3	13.6	13.8	12.1	9.9	7.4	6.4	6.1	7.8	10.7	13.0	15.1	131	kKh
Heating degree hours - Ground	5.0	5.3	6.7	7.0	7.3	6.7	6.3	5.4	4.5	4.1	3.9	4.3	67	kKh
Losses - Exterior	1939	1730	1753	1527	1251	926	801	752	983	1356	1654	1915	16586	kWh
Losses - Ground	92	97	122	127	134	123	114	99	81	75	71	79	1215	kWh
Losses summer ventilation	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Sum spec. heat losses	13.0	11.7	12.0	10.6	8.9	6.7	5.9	5.5	6.8	9.2	11.1	12.8	114.3	kWh/m²
Solar load North	15	26	43	64	88	103	101	80	52	34	19	13	638	kWh
Solar load East	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load South	212	274	344	420	415	373	420	434	392	330	236	146	3996	kWh
Solar load West	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load Opaque	29	44	70	105	127	129	138	120	86	58	34	20	959	kWh
Internal heat gains	326	295	326	316	326	316	326	326	316	326	316	326	3840	kWh
Sum spec. loads solar + internal	3.7	4.1	5.0	5.8	6.1	5.9	6.3	6.2	5.4	4.8	3.9	3.2	60.6	kWh/m²
Utilisation factor losses	29%	35%	41%	54%	66%	78%	87%	87%	73%	51%	35%	25%	49%	
Useful cooling energy demand	1	2	5	19	50	105	192	222	70	13	2	0	681	kWh
Spec. cooling demand	**0.0**	**0.0**	**0.0**	**0.1**	**0.3**	**0.7**	**1.2**	**1.4**	**0.5**	**0.1**	**0.0**	**0.0**	**4.4**	kWh/m²
Specif. dehumidification demand	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	kWh/m²
Sensible fraction	100%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	





Heat distribution and domestic hot water (DHW) system

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Interior temperature:	20	°C	Interior temperature summer:	25	°C
Building type:					
Treated floor area A_{TFA}:	156	m²			
Number or occupants per day:	2.9	Pers			
Number of dwelling units:	1				
Annual heating demand $q_{heating}$:	2456	kWh/a	Annual useful cooling dem. q_{Cool}:	681	kWh/a
Length of heating period:	303	d/a	Length cooling period:	334	d/a
Average heating load $P_{average}$:	0.5	kW	Average cooling load $P_{Average}$:	0.1	kW
Marginal usability of additional heat gains:	49%		Marginal usability of additional heat losses:	6%	

Heat delivery:

	Supply air
	Radiators
x	Underfloor heating or other panel heating
	Concrete core activation
	Split unit or similar
	Wood stove with direct heat emission
	Other

Space heat distribution

			Inside thermal envelope					Outside thermal envelope					Total values	
			1	2	3	4	5	1	2	3	4	5	Absolute	Specific
Length of distribution pipes (forward + return flows)	L_H	m												
Nominal width of pipe		mm												
Insulation thickness		mm												
Reflective coating?		-												
Thermal conductivity of insulation		W/(mK)												
Heat loss coefficient		W/(mK)												
Insulation quality of mountings, pipe suspensions, etc.		-	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None		
Thermal bridging of pipework		W/K												
Total heat loss coefficient	Ψ	W/(mK)												
Room temperature	θ_R	°C	20	20	20	20	20							
Forward flow temperature	θ_V	°C	55	55	55	55	55	55	55	55	55	55		
System heating load	$P_{heating}$	kW	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8		
Flow temperature control?														
Common pipe Heating + DHW?														
Return flow temperature	θ_R	°C												
Heat emission pipe	q'_{HL}	kWh/(m·a)												
Utilisation factor of released heat	η_G	-												
Heat losses of heating distribution	Q_{HL}	kWh/a											0	0.0
Heat losses of heating storage		kWh/a											0	0.0
Total heat losses of heating		kWh/a											0	0.0
Performance ratio of space heating distribution	ea_{HL}	-											100%	

DHW useful heat

DHW demand for showers, per person and day (with 60 °C)		litre/person/d	16.0
DHW demand others, per person and day (with 60 °C)		litre/person/d	9.0
Performance of drain water heat recovery (shower)		-	0%
Effective DHW demand	V_{DHW}	litre/person/d	25
Average cold water temperature of the supply	θ_{TW}	°C	11.7
DHW demand for washing machines & dishwashers		kWh/a	0
Useful heat of DHW	Q_{DHW}		kWh/a: 1508 / kWh/(m²a): 9.7

Secondary calculation for determining the DHW requirements (for non-res)

Secondary calculation: drain water heat recovery (shower)

DHW distribution

			Inside thermal envelope					Outside thermal envelope					Total values	
			1	2	3	4	5	1	2	3	4	5	Absolute	Specific
Room temperature	θ_R	°C						11.0	11.0	11.0	11.0	11.0		
DHW circulation pipes or, for heat interface units, forward and return flows														
Common pipe heating + DHW?														
Length of pipes (forward + return flows)	L_{HS}	m												
Nominal width of pipe		mm												
Insulation thickness		mm												
Reflective coating?		-												
Thermal conductivity of insulation		W/(mK)												
Heat loss coefficient		W/(mK)												
Insulation quality of mountings, pipe suspensions, etc.		-	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None	1 - None		
Thermal bridge surcharge mountings		W/K												
Total heat loss coefficient	Ψ	W/(mK)												
Daily operating time of circulation	td_{Circ}	h/d	24	24	24	24	24	24	24	24	24	24		
Forward flow temperature	θ_V	°C												
Pipes to heat interface unit?														
Return flow temperature	θ_R	°C												
Operating time of the circulation in winter	t_{Circ}	h/a												
Operating time of the circulation in summer	t_{Circ}	h/a												
Heat loss circulation pipes in winter	QZ	kWh/a												
Heat loss circulation pipes in summer	QZ	kWh/a											0	0.0
DHW stub pipes / individual pipes														
DHW temperature	θ_V	°C	60	60	60	60	60	60	60	60	60	60		
Exterior pipe diameter	$d_{U,Pipe}$	mm	15											
Total length of individual pipes	L_U	m	160.00											
Number of tapping points in building	$n_{basins\,occ}$	-	8	8	8	8	8	8	8	8	8	8		
Average pipe length per tapping point	$L_{U,average}$	m	20.0											
Tap openings per person per day		-	6	6	6	6	6	6	6	6	6	6		
Utilisation days per year		d	365	365	365	365	365	365	365	365	365	365		
Number of tap openings per year and person	n_{Tap}	Openings/a	2190											
Heat emission per tap opening in winter	$q_{individual}$	kWh/Opening	0.1204											
Heat emission per tap opening in summer	$q_{individual}$	kWh/Opening	0.1053											
Heat emission from single pipes in winter	Q_U	kWh/a	**439**											
Heat emission from single pipes in summer	Q_U	kWh/a	**296**											
													kWh/a: 735	kWh/(m²a): 4.7
Total heat losses of DHW distribution	Q_{WL}												kWh/a: 735	kWh/(m²a): 4.7
Performance ratio of DHW distribution pipes	ea_{HL}	-											149%	

Storage heat losses

			Storage type 1	Storage type 2	Buffer storage tank (only heating)	Compact unit
Selection of storage tank			1-DHW and heating	0-No storage tank	0-No storage tank	0-No
Storage necessary for HP				----------	----------	----------
Solar DHW connection					----------	
Heat loss rate		W/K	0.8			
Storage volume		litre	212			----------
Standby fraction		-	35%		----------	----------
Location of storage tank, inside or outside of thermal envelope			1-Inside	1-Inside	1-Inside	
Temperature of mechanical room		°C	20.0			
Typical storage tank temperature		°C	55.0			
Manual entry of storage temperature		°C				----------
Average standby heat losses storage tank		W	9			
Additional heat loss storage, solar system operation		W			----------	----------
Possible utilisation factor of heat losses			----------	----------		----------
Annual heat losses DHW storage tank		kWh/a	83			----------
Annual heat losses buffer storage tank		kWh/a				
						kWh/a: 83 / kWh/(m²a): 0.5

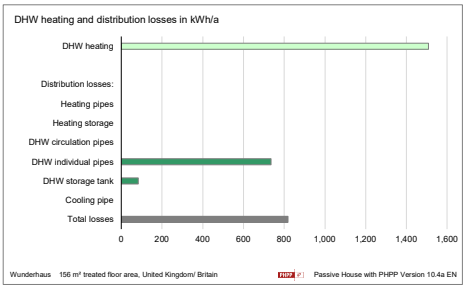
Auxiliary calculation - heat losses through storage tank according to EU efficiency classes

Total energy demand of DHW

Heat losses of DHW distribution and storage	Q_{WL}	kWh/a: 818	kWh/(m²a): 5.2
Performance ratio DHW distribution + storage	$e_{a,WL}$	154%	
Total heat demand of DHW system including storage tank	Q_{DHW}	kWh/a: 2326	kWh/(m²a): 14.9

Cooling distribution

			Inside thermal envelope					Outside thermal envelope					Total values	
			1	2	3	4	5	1	2	3	4	5	Absolute	Specific
Length of distribution pipes	L_H	m												
Nominal width of pipe		mm												
Insulation thickness		mm												
Reflective coating?		-												
Thermal conductivity of insulation		W/(mK)												
Heat loss coefficient per m pipe	Ψ	W/(mK)												
Temp. of room through which the pipes pass	θ_R	°C	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0		
Design flow temperature	θ_V	°C	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		
System cooling load	P_{Cool}	kW												
Flow temperature control ('x' if appropriate)														
Design return temperature	θ_R	°C												
Annual heat absorption per m of pipe	q'_{HL}	kWh/(m·a)												
Possible utilisation factor of this heat absorption	η_G	-												
Annual losses of cooling distribution	Q_{HL}	kWh/a											0	0.0
Performance ratio cold water distribution pipes	ea_{HL}	-											100%	



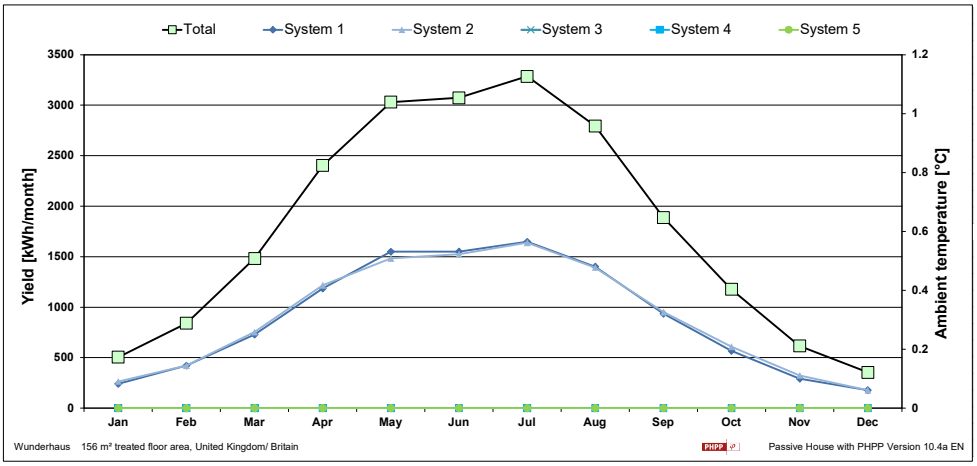
Photovoltaic systems

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Climate data set: GB0003a-London Gatwick, Altitude corrected
Building type:
Projected building footprint: 118.2 m²

Name of system		System 1	System 2	System 3	System 4	System 5	Reference PV syst.	
Location: Selection from 'Areas' worksheet		12-East Pitch	13-West Pitch					
Size of selected area		69.6	69.6					m²
Deviation from North		90	270					°
Angle of inclination from horizontal		45	45					°
Alternative input: deviation from north								°
Alternative input: angle of inclination from horizontal								°
Information from the PV module data sheet for standard test conditions (STC)								
Technology		4-Mono-Si	4-Mono-Si				4-Mono-Si	
Nominal current	I_{MPP0}	10.30	10.30				10.00	A
Nominal voltage	U_{MPP0}	41.70	41.70				34.00	V
Nominal power	P_n	430	430	0	0	0	340	Wp
Temperature coefficient short-circuit current	α						0.050	%/K
Temperature coefficient open-circuit voltage	β						-0.270	%/K
PV module dimensions: height		1.760	1.760				1.750	m
PV module dimensions: width		1.130	1.130				1.050	m
							1.8	PV module area [m²]
Further specifications								
Number of PV modules	n_M	35	35				0.0	
Height of PV module array								m
Height of horizon	h_{Hori}							m
Distance of horizon	e_{Hori}							m
Additional reduction factor shading	r_{other}							
Efficiency of the inverter	η_{Inv}	95%	95%				95%	
Results								
Area of PV module array		69.6	69.6	0.0	0.0	0.0	0.0	m²
Free area on the selected building element		0.0	0.0					m²
Used fraction of building element		100%	100%					
Annual losses due to shading		0	0					kWh

							Total	
Annual electricity yield after the inverter, absolute	**10693**	**10760**					**21452**	kWh/a
Referred to projected building footprint area	**90.5**	**91.0**					**182**	kWh/m²$A_{Projected}$*a
CO2-equivalent emissions according to 1-CO2 factors GEMIS (Germany)	1390.0	1398.7					2788.8	kg/a
PE-factor according to 1-PE factors (non-renewable) PHI Certification	0.00	0.00				0.0	0.00	kWh_{prim}/kWh_{End}



List of PV module technologies

	Technology	AEE kWh/Wp	CO_2 kg/Wp	Lifespan years	PER factor kWh/kWh	1-PE factors (non-renewable) PHI Certification kWh/kWh	1-CO2 factors GEMIS (Germany) kg/kWh
1							
2	Amorph-Si	7.955	1.141695	30	1.00	0.00	0.063
3	CIGS	5.805	0.788184	30	1.00	0.00	0.063
4	Mono-Si	11.85	1.782135	30	1.00	0.00	0.130
5	Poly-Si	8.04	1.595889	30	1.00	0.00	0.063

System 1

Electricity demand for residential buildings

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Number of dwelling units	1	dwelling units
Number of occupants	2.9	persons
Treated floor area A_{TFA}	156	m²

Solar fraction of DHW Laundry&Dish	0%
Marginal performance ratio DHW	100%
Marginal performance ratio heating	100%

	PER factors	PE factors
Electricity	1.30	1.50
Energy carrier for DHW:	1.30	1.50
Energy carrier for space heating:	1.65	1.50
Gas for cooking, drying	1.75	0.00

Applications	Quantity	Consider for IHG?	Utilisation factor	Reference value		Frequency		In operation: Average power / electricity demand of the application		Duration of use h/app.		Size of the unit		Useful energy kWh/a	When not in operation: Power W	Hours per unit h/d	Useful energy kWh/a	Total Useful energy kWh/a	Electricity demand: Electric fraction	Final energy kWh/a	Additional heating demand: Fraction additional demand	Additional/ reduced demand	Marginal performance ratio	Solar fraction	Final energy kWh/a	PER demand kWh/a	PE demand kWh/a
Column no.	1	2	3	4	5	6		7		8		9		10	11	12	13	14	15	16	17	18	19	20	21	22	23
Refrigerating																											
Refrigerator	0	1	1.00	1	dwelling unit(s)	365	d/a	0.34	kWh/d									0	100%	**0**						**0**	0
Freezer	0	1	1.00	1	dwelling unit(s)	365	d/a	0.55	kWh/d									0	100%	**0**						**0**	0
Refrigerator-freezer combination	1	1	1.00	1	dwelling unit(s)	365	d/a	0.61	kWh/d									223	100%	**223**						**289**	334
Cooking with:	1-Electricity																										
Electricity demand	1	1	1.00	2.9	person(s)	500	l/(P*a)	0.25	kWh/Use									369	100%	**369**						**479**	553
Gas demand																					0%				**0**	**0**	0
Dishwashing	2-Cold water connection																										
Electricity demand	1	1	1.00	2.9	person(s)	65	l/(P*a)	0.92	kWh/Use	3.0	12	Place settings		176	0.75	22.4	6	182	100%	**182**						**237**	274
DHW demand																					0%	* 1.30	* 1.00	*(1- 0.00	) = **0**	**0**	0
Clothes washing	2-Cold water connection							50%	Remaining moisture																		
Electricity demand	1	1	1.00	2.9	person(s)	57	l/(P*a)	0.79	kWh/Use	2.9	5	kg wash load		133	0.75	22.7	6	139	100%	**139**						**181**	209
DHW demand																					0%	* 1.05	* 1.00	*(1- 0.00	) = **0**	**0**	0
Drying with	4-Condensation dryer																										
Electricity demand	1	1	0.75	2.9	person(s)	57	l/(P*a)	2.13	kWh/Use	2.4	5	kg wash load		269	1.50	23.2	13	281	100%	**281**						**366**	422
Gas demand (for gas dryers)									kWh/Use									0			0%				**0**	**0**	0
Energy demand from evaporation	0	1	0.50	2.9	person(s)	57	l/(P*a)	3.13	kWh/Use									0			100%	* 1.00	* 1.00	*(1- 0.65	) = **0**	**0**	0
Lighting																											
Inside dwelling unit:	1	1	4.20	2.9	person(s)	1.2	lx/(P*a)	7	W/lamp	100	lm/W (efficacy)			107				107	100%	**107**						**139**	161
Outside of dwelling unit:	0	1									Nominal illuminance:							0	100%	**0**						**0**	0

Other devices:	Quantity	IHG?	Reference value	Frequency	In operation	When not in operation	kWh/a					
Total other devices	1	1.00					**622**	100%	**622**		**809**	934

Total household electricity		kWh/a	**1923**	kWh/a	**2500**	**2887**	kWh/a
		kWh/(m²a)	**12**	kWh/(m²a)	**16**	**19**	kWh/(m²a)
Electricity demand for:							
Space heating	from 'PER' worksheet, without aux. electricity	kWh/a	2456	kWh/a	4053	3687	kWh/a
Cooling + dehumidification	from 'PER' worksheet, without aux. electricity	kWh/a	628	kWh/a	628	943	kWh/a
Domestic hot water	from 'PER' worksheet, without aux. electricity	kWh/a	2326	kWh/a	3023	3491	kWh/a
Aux Electricity	from 'Aux. Electricity' worksheet	kWh/a	246	kWh/a	336	369	kWh/a
Total sum electricity demand		kWh/a	**7579**	kWh/a	**10540**	**11376**	kWh/a
		kWh/(m²a)	**49**	kWh/(m²a)	**68**	**73**	kWh/(m²a)

Additional demand transferred to other worksheets:		
DHW for washing machines and dishwashers	0	kWh/a
Additional space heating (energy demand from evaporation)	0	kWh/a
Gas demand for clothes drying / cooking	0	kWh/a

Aux Electricity

Passive House with PHPP Version 10.4a EN

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

Heating period	213	d/a	Runtime vent. syst in winter	4.94	kh/a	Treated floor area	156	m²	
Cooling period	152	d/a	Runtime vent. syst in summer	3.82	kh/a	Boiler design output	15	kW	
Dwelling units	1		Heat recovery efficiency ventilation	0.87		DHW system heat demand	2326	kWh/a	
Reference volume for the vent. system	389	m³	Air change rate	0.30	h^{-1}	Design flow temperature	55	°C	
									kWh/kWh
								PE factor for electricity	1.50

Application	Used?	Consider for IHG?	Final energy demand: Norm demand or power	Utilisation factor	Period of operation kh/a	Reference value	Electricity demand kWh/a	Internal heat gains (IHG): Availability	Utilisation period kh/a	Winter W	Summer W	PER: PER factor kWh/kWh	PER demand kWh/a	PE demand kWh/a
Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Heating, ventilation winter														
Ventilation system														
Ventilation in winter	1		0.24 Wh/m³	0.30 h^{-1}	4.94	389 m³	**139**	IHG included in heat recovery efficiency				1.65	**229**	208
Defroster HX	0	1	From worksheet 'Ventilation/Addl. Vent'				**0**	0.1	5.11	**0**		1.65	**0**	0
Heating system														
Circulation pump heating	0	1	62 W	1.00	5.11		**0**	1.0	5.11	**0**		1.65	**0**	0
Regulated?			W user-defined pump nominal power											
Aux. energy - Heat. boiler	0	0	55 W	1.00	0.00		**0**	0.0	5.11	**0**		1.65	**0**	0
			W user-defined el. power at 30% load											
Aux. energy - wood-burning/pellet boiler	0	0	from 'Boiler' worksheet, incl. aux. energy for DHW				**0**	0.0	5.11	**0**		1.65	**0**	0
Fan coils		1	W	0.19	5.11		**0**	1.0	5.11	**0**		1.65	**0**	0
			kWh/a				**0**	0.0	5.11	**0**		1.65	**0**	0
			kWh/a				**0**	0.0	5.11	**0**		1.65	**0**	0
			kWh/a				**0**	0.0	5.11	**0**		1.65	**0**	0
			kWh/a				**0**	0.0	5.11	**0**		1.65	**0**	0
			kWh/a				**0**	0.0	5.11	**0**		1.65	**0**	0
Total aux. electricity heating, ventilation winter							**139**			**0**			**229**	**208**
Cooling, ventilation in summer														
Ventilation system														
Ventilation in summer	1		0.24 Wh/m³	0.30 h^{-1}	3.82	389 m³	**107**	IHG included in recovery efficiency for cooling				1.00	**107**	161
Additional vent. summer	0		0.00 Wh/m³	0.00 h^{-1}	3.82	389 m³	**0**	IHG included in the worksheets 'Summer' + 'Cooling'				1.00	**0**	0
Cooling system														
Circulation pump cooling		1	W	0.0	3.6		**0**	1.0	3.6		**0**	1.00	**0**	0
Fan coils (recirculation cooling)		1	W	0.0	3.6		**0**	1.0	3.6		**0**	1.00	**0**	0
Cooling server rooms		0	kWh/a				**0**					1.00	**0**	0
			kWh/a				**0**	0.0	3.82		**0**	1.00	**0**	0
			kWh/a				**0**	0.0	3.82		**0**	1.00	**0**	0
			kWh/a				**0**	0.0	3.82		**0**	1.00	**0**	0
			kWh/a				**0**	0.0	3.82		**0**	1.00	**0**	0
			kWh/a				**0**	0.0	3.82		**0**	1.00	**0**	0
Total aux. electricity cooling, ventilation summer							**107**				**0**		**107**	**161**
Dehumidification														
			kWh/a				**0**	0.0	3.82		**0**	1.15	**0**	0
			kWh/a				**0**	0.0	3.82		**0**	1.15	**0**	0
			kWh/a				**0**	0.0	3.82		**0**	1.15	**0**	0
Total aux. electricity dehumidification							**0**				**0**		**0**	**0**
DHW system														
Circulation pump DHW	0	0	29 W		8.76 kh/a		**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
			W user-defined nominal power of the pump											
Storage load pump DHW		0	56 W		0.00 kh/a		**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
			W user-defined nominal power of the pump											
DHW boiler aux. energy	0	0	165 W		0.00 kh/a		**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
			W user-defined nominal power of the pump											
Solar aux. electricity		0	40 W		1.75 kh/a		**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
			W user-defined nominal power of the pump											
Total aux. electricity DHW+Solar							**0**			**0**	**0**		**0**	**0**
Other														
Inverter	1	1	82 W in winter		190 W in summer			1.0		**82**	**190**			
Elevator			kWh/a				**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
			kWh/a				**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
			kWh/a				**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
			kWh/a				**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
			kWh/a				**0**	0.0	8.76	**0**	**0**	1.30	**0**	0
Total aux. electricity other							**0**			**82**	**190**		**0**	**0**

	Winter	Summer	
Total internal heat gains	**82**	**190**	W
	0.5	**1.2**	W/m²

	Final energy		PER	PE
Total auxiliary electricity	**246**	kWh/a	**336**	**369**
	1.58	kWh/(m²$_{TFA}$ a)	**2.2**	**2.4**

Primary Energy Renewable PER

Passive House with PHPP Version 10.4a EN

Wunderhaus / Climate: London Gatwick / TFA: 156 m² / Heating: 15.8 kWh/(m²a) / Cooling: 4.4 kWh/(m²a) / PER: 59.1 kWh/(m²a)

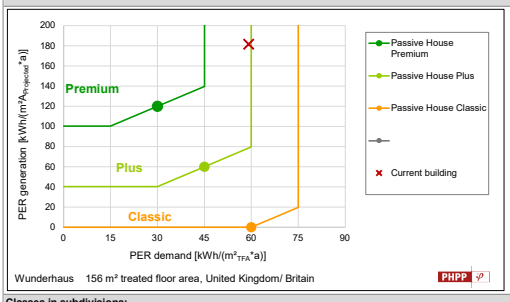
Selection of the heat generation system	Contribution (useful energy) Heating	DHW
5-Direct electricity	100%	100%
-		
-		
-		
Additionally:		
Solar thermal	0.0	0.0 kWh/(m²a)

Building type:		
Treated floor area A_{TFA}:	156	m²
Projected building footprint $A_{Projected}$:	118	m²
Heating demand incl. distribution & hydr. frost protection	15.8	kWh/(m²a)
Cooling energy demand incl. dehumidification	5	kWh/(m²a)
DHW demand including distribution:	14.9	kWh/(m²a)
Biomass contingent (PER):	20	kWh/(m²a)

Energy demand referred to treated floor area	Efficiency: Calculation -	Efficiency: User defined -	Useful energy: Covered fraction	Final energy demand kWh/(m²a)	PER factor kWh/kWh	PER demand kWh/(m²a)	PE factor kWh/kWh	PE demand kWh/(m²a)	CO_2: Emission factor (CO_2-eq) kg/kWh	CO_2: CO_2eq emissions kg/a
							1-PE factors (non-renewable) PHI Certificatio		1-CO2 factors GEMIS (Germany)	
Heating			100%							
Electricity (HP compact unit)					1.65		1.50		0.363	
Electricity (heat pump)					1.65		1.50		0.363	
Other (heating)	1.00	1.00	100%	15.8	1.65	26.0	1.50	23.7	0.363	892
Boiler					0.00					
District heating					0.91		0.30		0.000	
Solar thermal system										
Aux. electricity (heating, wintertime ventilation)				0.9	1.65	1.5	1.50	1.3	0.363	50
Total heating						**27.5**		**25.0**		**942**
Cooling and dehumidification					**PER**		**PE**		**CO_2**	
Electricity cooling (HP)	1.47			3.3	1.00	3.3	1.50	5.0	0.363	189.2
Electricity dehumidification (HP)					1.15		1.50		0.363	
Auxiliary electricity cooling, ventilation summer				0.7	1.00	0.7	1.50	1.0	0.363	38.9
Auxiliary electricity (dehumidification)					1.15		1.50		0.363	
Total cooling and dehumidification						**4.03**		**6.05**		**228.09**
DHW generation			100%		**PER**		**PE**		**CO_2**	
Electricity (HP compact unit)					1.30		1.50		0.363	
Electricity (heat pump)					1.30		1.50		0.363	
Electricity (direct)	1.00	1.00	100%	14.9	1.30	19.4	1.50	22.4	0.363	844
Boiler					0.00					
District heating					0.86		0.30		0.000	
Solar thermal system										
Aux. electricity (DHW + solar DHW)					1.30		1.50		0.363	
Total DHW						**19.4**		**22.4**		**844**
Household electricity + Auxiliary electricity (other)					**PER**		**PE**		**CO_2**	
Household electricity (lighting, electrical devices, etc.)				12.3	1.30	16.0	1.50	18.5	0.363	698
Auxiliary electricity (other)					1.30		1.50		0.363	
Total household electricity and auxiliary electricity						**16.0**		**18.5**		**698**
Additional gas demand					**PER**		**PE**		**CO_2**	
Drying/Cooking				0.0	1.75	0.0	0.00	0.0	0.000	
Total additional gas demand						**0.00**		**0.00**		**0**
Total PER demand without bioenergy budget						**67.0**				
Bioenergy utilisation						**-7.9**		The bioenergy budget will be used with 13.3 kWh/(m²a).		
Total energy demand kWh/(m^2_{TFA} a)					**PER:**	**59.1**	**PE:**	**72.0**	**CO_2:**	**2712** kg/a

Energy generation referred to projected building footprint	Final energy: Final energy generation kWh/a	Final energy: Final energy generation kWh/($m^2_{Projected}$*a)	PER: PER factor kWh/kWh	PER: PER generation kWh/($m^2_{Projected}$a)	PE: PE factor kWh/kWh	PE: PE generation kWh/($m^2_{Projected}$a)	CO_2: Emission factor (CO_2-eq) kg/kWh	CO_2: Emissions generated kg/a	CO_2: Emissions saved kg/a
PV electricity	21452	181.5	1.00	181.5	0.00	0.0	0.13 | 0.363	2789	4998
Solar thermal system	0	0.0	-	0.0	0.00	0.0			
		0.0							
Total energy production kWh/($m^2_{Projected\ building\ footprint}$ a)			**PER:**	**181.51**	**PE:**	**0.00**	**CO_2:**	**2789**	**4998**

Verification Passive House/EnerPHit standard



Classes in subdivisions:	Current value:		PHI Criteria Low Energy Building	Criteria Passive House: Classic	Plus	Premium	Achieved class
Heating demand referred to TFA	**16** kWh/(m²a)	≤	30		15		Not achieved
Heating load referred to TFA	**11** W/m²	≤	-		10		
Cooling and dehumidification demand referred to TFA	**4** kWh/(m²a)	≤	30		15		Premium
Airtightness n_{50}	**0.6** 1/h	≤	1		0.6		Premium
PER demand referred to TFA	**59** kWh/(m²a)	≤	75	60	45	30	Plus
PER generation referred to projected building footprint	**182** kWh/(m²a)	≥	-	0	60	120	
PE demand (non-renewable primary energy)	**72** kWh/(m²a)	≤	85		85		Classic
Energy standard of the whole building			**With the selected verification method PER (renewable) the following class can be reached:**				**Not achieved**

Standard criteria

Summary: Different final energy sources are added up here. Though this is not scientifically correct, it is required by other single verifications.	Final energy MWh/a	PER (renewable primary energy) MWh/a	PE (non-renewable primary energy) 1-PE factors (non-renewable) PHI Certification MWh/a	CO_2eq emissions 1-CO2 factors GEMIS (Germany) kg/a	CO_2eq substitution 1-CO2 factors GEMIS (Germany) kg/a
Demand	**7.5**	**9.2**	11.22	2712	2712
Generation	**-21.5**	**-21.5**	0.00	2789	-4998
Cumulated demand and generation (annual balance)	**-13.98**	**-12.24**	11.22	5501	-2286
Demand without occupant electricity consumption	5.55	6.71	8.33	-106035	-106035
Demand without occupant electricity consumption, accumulated generation	-15.90	-14.74	8.33	-103246	-111033