PHPP

BRIEF INSTRUCTIONS

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Passive House
Institute, Darmstadt,
Version 9.0 beta

For use in EuroPHit, c

Place your mouse here to see the PHPP help.

If no help appears when the mouse passes over cell B4, you can activate it by going into the Menu Bar Tools/Options/View, and under "Comments", select "Comment Indicator Only".

Passive House Verification: Meaning of Field Formats

Example	Field Format	Meaning
78,8	Courier New, blue, bold on yellow background	Input Field: Please enter the required value here
01ud tripple-low-e-cr08	Arial Narrow, blue, bold on brown	Data entry field with drop down list
6619	Arial, black, standard on white background	Calculation field; please do not change
78,8	Courier New, purple, bold on white background	Field with references to another sheet - should not be changed.
126,0	Arial, black, large & bold on green background	Important result

Passive House Planning: Worksheet Directory

Worksheet name (to show/hide worksheets please use the separate 'Profile settings' tool)	Function	Brief Description	Required for the certification?
Verification	Building data; summary of results	Building description, selection of the calculation method, summary of results	yes
Overview	Overview of the specific data of the project entered	In-depth project description, overview of all results and input variables, specific details on building envelope, building services systems as well as general information.	no
Variants	Variant calculation	Input parameters and results for the variant calculations. Predefined fields for frequent entries, as well as user-defined area.	no
Comparison	Comparison between two variants	Comparison between two variants under the energy demand and economic viability perspective. Input of comparison configurations.	no
Climate	Climate Region Selection or Definition of User Data	Climate data for: Annual Heating, Windows, Heating Load, Heating, Summer, Cooling, Cooling Units, Cooling Load worksheets	yes
U-Values	Calculation of Standard building assembly U-Values	Heat transmission coefficient calculations in accordance with DIN EN ISO 6946.	yes
Areas	Areas summary	Building assembly Areas, Thermal Bridges, Treated Floor Area. Use exterior dimension references!	yes
Ground	Calculation of reduction factors against ground	More precise calculation of heat losses through the ground	if applicable
Components	Building component database	Database of certified, Passive House suitable components and entry of user-defined components	yes
Windows	U_W-Value Determination	Input of geometry, orientation, frame lengths, frame widths, U_g and U-values of the frame, and the thermal bridge heat loss coefficients of the connections; from these inputs, determine U_W and total radiation.	yes
Shading	Determination of shading coefficients	Input of shading parameters, e.g. balcony, neighbouring building, window reveal and calculating the shading factors	yes
Ventilation	Air Flow Rates, Exhaust/Supply Air Balancing, Pressurization Test Results	Sizing the ventilation system from extract and supply air requirements, infiltration air change rate and actual efficiency of heat recovery, input of pressurization test results	yes
Additional Vent	Design and planning of ventilation systems with diverse ventilation units	Extension of the Ventilation worksheet for dimensioning air flows, for special building uses and systems with various ventilation units	if used
Annual heating	Annual heating demand / Annual Method	Calculation of the annual space heating demand according to the energy balance method following EN 13790: Transmission + Ventilation - h (Solar Gains + Internal Gains)	no
Heating	Space heating demand calculation Monthly method according to EN 13790	Calculation procedure for the monthly method following EN 13790. Make appropriate selection in the Verification worksheet, if calculations should be performed following this procedure	yes
Heating Load	Building Heating Load Calculation	Calculation of the nominal heating load using a balance procedure for the design day: max transmission + max ventilation - η (minimum solar gains + internal heat gains)	yes
SummVent	Determination of Summer Ventilation	Ventilation in cooling case and estimation of air flow rates for natural ventilation during the summer period	yes
Summer	Assessment of Summer Climate	Calculation of the frequency of overheating as a measure of summer comfort	yes
Cooling	Monthly Method for Cooling Demand	Annual useful cooling demand calculation	if present
Cooling units	Latent Cooling Energy	Calculation of the energy demand for dehumidification and choice of cooling method	if present
Cooling load	Building Cooling Load Calculation	Calculation of the daily average cooling load of the building	no
DHW+Distribution	Distribution losses; DHW Requirement and Losses	Heat loss calculation of the distribution systems (heating; DHW); calculation of the useful heat requirement of DHW and storage losses	yes
SolarDHW	Solar DHW Heating	Solar contribution calculation for DHW and space heating contribution	if solar panels are used
PV	Electricity generation by photovoltaic	Electricity generation calculation of PV system	no
Electricity	Electricity Demand for Dwellings	Calculation of the electricity demand of Passive Houses with residential use	yes
Use non-res	Patterns of non-residential Utilisation	Input or selection of utilisation patterns for planning of electricity demand and internal heat gains	no
Electricity non-res	Electricity Demand for non-residential Use	Calculation of the electricity demand for lighting, electric devices and kitchens for non-residential buildings	no
Aux Electricity	Auxiliary Electricity Demand	Calculation of auxiliary electricity and corresponding primary energy demand	yes
IHG	Internal Heat Gains in Dwellings	Calculation of the internal heat gains based on the Electricity and Aux Electricity sheets.	no
IHG non-res	Internal Heat Gains for non-residential Use	Calculation of the internal heat gains for non-residential buildings based on the Electricity non-res worksheet and the occupancy	no
PE-Value	Specific Primary Energy and CO_2 Demands	Selection of heat generators, calculation of the specific primary energy and CO2 demands from the present results	yes
Compact	Efficiency of Heat Generator Compact Heat Pump Unit	Calculation of combined heat generation efficiency for heating and DHW only by means of a electric heat pump compact unit, considering the specific project boundary conditions.	if present
HP	Heat generation efficiency of the heat pump	Calculation of heat generation efficiency for one to two electric-run heat pumps, considering the specific project boundary conditions.	if present
HP Ground	Ground probe or ground collector in combination with a heat pump	Heat source calculation for a ground probe or horizontal subsoil heat exchanger for ground-coupled heat pumps, considering the specific project boundary conditions.	if present
Boiler	Efficiency of Heat Generator Boiler	For the calculation of the efficiency of heat generation with standard boilers (NT and calorific boilers) for the project given boundary conditions.	if present
District Heating	District Heat Transfer Station	Calculation of the final and primary energy demands (heat)	if present
Data	Database	Table of primary energy factors following [GEMIS] and database of EnEV (German energy efficiency regulation).	no

EnerPHit verification

Building:	Primary School 3 "Tzanko Diustabanov" -
Street:	25 Hristo Smirnenski blv.
Postcode/City:	Gabrovo
Country:	Bulgaria
Building type:	School
Climate:	Велико Търнов PHI
Altitude of building site (in [m] above sea level):	382
Home owner/client:	Municipality of Gabrovo
Street:	3 Vazrazhdane square
Postcode/City:	Gabrovo

Architecture:		Mechanical System:	
Street:		Street:	
Postcode/City:		Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	2014	Interior temperature winter [C°]	18,0	Interior temp. summer [C°]	24,0
Number of dwelling units:	1	Internal heat gains winter [W/m²]	2,8	IHG summer [W/m²]	2,8
Number of Occupants:	50,0			Spec. capacity [Wh/K per m² TFA]	204
Exterior vol. V_e:	6224,4 m³			Mechanical cooling:	x

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	848,4	m²		
Space heating	Annual heating demand	**46**	**kWh/(m²a)**	25 kWh/(m²a)	**no**
	Heating load	**26**	**W/m²**	-	**-**
Space cooling	Overall specific space cooling demand	**0**	**kWh/(m²a)**	-	**-**
	Cooling load	**14**	**W/m²**	-	**-**
	Frequency of overheating (> 24 °C)		%	-	**-**
Primary Energy	Heating, cooling, dehumidifying, DHW, auxiliary electricity, lighting, elect.	**128**	**kWh/(m²a)**	158 kWh/(m²a)	**yes**
	DHW, space heating and auxiliary electricity	100	kWh/(m²a)	-	**-**
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	**-**
Airtightness	Pressurization test result n_{50}	**2,0**	**1/h**	1 1/h	**no**

* empty field: data missing; '-': no requirement

EnerPHit building retrofit (acc. to heating demand)? **no**

I confirm that the values given herein have been determined following the PHPP methodology and were determined based on the characteristics of the building. The PHPP calculations are attached to this application.

Name:	Company:	Registration number PHPP:
Surname:	Issued on:	
		Signature

EnerPHit planning:

PROJECT OVERVIEW

Basic data

Building, name of the object	Primary School 3 "Tzanko Diustabanov" - Section		
Street:	25 Hristo Smirnenski blv.		
Postcode/City:	Gabrovo		
Country:	Bulgaria		
Building type:			
Climate: region / climate data set	User Data		User data - Вел
Climate: degree days / altitude	74	kKh/a	382
Building type / building status			
Context of urban development			
Building type / construction			
Building category, in terms of energy			
Year of construction / year of construction of existing building	2014		
Amount of dwelling units for residential use / non-residential use		Dwelling units	8
Number of occupants standard / planned		P	50
Standard / design occupancy rate		m²/P	17
Home owner / client	Municipality of Gabrovo		
Architect			
Building services			
PHPP/Energy balance			
Building physics			
Structural engineering			
Contractor / tradesperson / other (max. 5000 characters)			
Interior temperatures winter/summer	18	°C	24
IHG winter / summer	2,8	W/m²	2,8
Type of certification	EnerPHit building retrofit (acc. to heating dem		
Project certification / Certificate ID			
Certification body			
PHPP-version / PHPP-registration number	Version 9.0 beta		

Characteristic value according to EnerPHit verification

Treated floor area A_{TFA} / exterior volume V_e	848,4	m²	6224,4
	Specific Demand		Requirement
Space heating demand	46	kWh/(m²a)	25
Heating load residential		kWh/(m²a)	-
Heating load Non-residential	26	kWh/(m²a)	-
Frequency of overheating		%	-
Overall specific space cooling demand	0	kWh/(m²a)	-
Cooling load residential		kWh/(m²a)	-
Cooling load non-residential	26	kWh/(m²a)	-
Airtightness pressure air exchange rate test n_{50}	2,0	1/h	1
Total PE Value	128	kWh/(m²a)	158
Heating, cooling, DHW, auxiliary electricity, lighting, electrical appliances			
Specific PE Demand - Mechanical System / CO_2-Equivalent	100	kWh/(m²a)	27
Heating, DHW, auxiliary electricity (no lighting and electrical appliances)			
Solar power: Primary energy savings / CO2 emissions		kWh/(m²a)	

Average building quality

	Specific Demand		Requirement
Average U-value of external insulation to outside air	0,12	W/(m²K)	-
Average U-value of external insulation to ground	1,98	W/(m²K)	-
Average U-value interior insulation to outside air	0,11	W/(m²K)	-
Average U-value interior insulation to ground		W/(m²K)	-
Average U-value of thermal bridges ΔU	0,01	W/(m²K)	-
Average U-value windows	2,64	W/(m²K)	-
Average U-value of exterior doors	0,80	W/(m²K)	-
Ventilation system eff. heat recovery efficiency	81,00	%	-

Building envelope and site

Building envelope area A_{total} / treated floor area A_{TFA}	2606	m²	848
A/V-ratio / Envelope area use (A_{total}/A_{TFA})	0,42		3,07
Window area / Window area percentage	198	m²	7,6%
Specific solar aperture / Passive solar heating mode	1,6%		11409
Building site area / built-up area		m²	
Gross floor area BGF / Gross external volume BRI		m²	
Floor space ratio / Amount of complete storeys			

Building description (max.5000 characters)

Opaque building components			
Exterior wall: U-value (average value) / area	0,13	W/(m²K)	539,24
Standard exterior wall: U-value / thickness		W/(m²K)	0,0
Standard exterior wall: total area / area fraction		W/(m²K)	
Standard exterior wall: name / certified?			
Standard exterior wall: short description (materials, manufacturer, product name, special features)			
Exterior wall against ground: U-value (average value) / area		W/(m²K)	
Standard exterior wall against ground: U-value / thickness		W/(m²K)	0,0
Standard exterior wall against ground: area / area fraction		W/(m²K)	
Standard exterior wall against ground: name / certified?			
Standard exterior wall against ground: short description (materials, manufacturer, product name, special features)			
Roof / top floor ceiling: U-value (average value) / area	0,11	W/(m²K)	955,36
Standard roof / top floor ceiling: U-value / thickness		W/(m²K)	0,0
Standard roof / top floor ceiling: area / area percentage		W/(m²K)	
Standard roof / top floor ceiling: name / certified?			
Standard roof / top floor ceiling: short description (materials, manufacturer, product name, special features)			

Floor slab / basement ceiling: U-value (average value) / area	1,98	W/(m²K)	910,21
Standard floor slab / basement ceiling: U-value / thickness		W/(m²K)	0,0
Floor slab / basement ceiling standard: area / area fraction		W/(m²K)	
Standard floor slab / basement ceiling: name / certified?			
Standard floor slab / basement ceiling: short description (materials, manufacturer, product name, special features)			
Thermal bridges: Y-value (Average value) / length	0,037	W/(mK)	327,07
Thermal bridge free limit value / Complied?	0,01	W/(mK)	no
Thermal bridges: short description (max.5000 letters) (additional notices, manufacturer, product name, materials, others)			

Windows / doors / shading systems

windows/facades: U-value (average value) / area	2,64	W/(m²K)	197,98
window/facade frames: U-value (average value) / area	2,25	W/(m²K)	95,25
Glazing: U-value (Average value) / areas	2,55	W/(m²K)	102,73
Ψ-Value Glazing edge (average) / Ψ-Value Installation (average)	0,039	W/(mK)	0,076
Standard window frame: U-value / frame width		W/(m²K)	
Standard window frame: window area / area percentage		W/(m²K)	
Standard window frame: glass edge Ψ-value / installation Ψ-value		W/(mK)	
Standard window frame: name, certified?			
Standard window frame: Short description (materials, manufacturer, product name, installation)			
Standard curtain wall facade: U-value / Frame width		W/(m²K)	
Standard curtain wall facade: Facade area / Total area percentage		W/(m²K)	
Standard curtain wall facade:Ψ-value glazing edge / Ψ-value installation		W/(mK)	
Standard curtain wall facade: Description / Certified?			
Standard curtain wall facade: short description (materials, manufacturer, product name, installation)			
Standard glazing: U-value / g-value		W/(m²K)	
Standard glazing: Facade area / Area ratio		W/(m²K)	
Standard glazing: Description / Certified?			
Standard glazing: short description (description, manufacturer, product name, installation)			
Standard glazing 2: U-value / g-value		W/(m²K)	
Standard glazing 2: Facade area / Area percentage		W/(m²K)	
Standard glazing 2: Description / Certified?			
Standard glazing 2: short description (description, manufacturer, product name, installation)			
Roof lights / light domes: U-value / frame width		W/(m²K)	
Roof lights / light domes: window area / area section		W/(m²K)	
Roof lights / light domes: glazing U-value / g-value		W/(m²K)	
Roof lights / light domes: Y-value glass edge / Installation Y-value		W/(mK)	
Roof lights / light domes: name / certified?			
Roof lights / light domes: short description (materials, manufacturer, product name, installation situation)			
Exterior door: U-value (average value) / Area	0,80	W/(m²K)	3,00
Standard exterior door: door U-value / door U-value installed		W/(m²K)	
Standard exterior door: frame U-value / door leaf U-value		W/(m²K)	
Standard exterior door: door leaf thickness / frame width		mm	
Standard exterior door: panel border Y-value / installation Y-value		W/(mK)	
Standard exterior door: Name / certified?			
Standard exterior door: Short description (materials, manufacturer, product name, installation situation)			
Temporary sun protection: Type / Add. Reduction factor		W/(m²K)	7,29
Temporary sun protection: Area / Area ratio		W/(m²K)	

Shading reduction factors: orientation	Reduction factor winter		Summer reduction factor
North	68	%	78
East	70	%	39
South	67	%	41
West	60	%	48
Horizontal	100	%	100

Ventilation

Ventilation: Type of ventilation	Balanced PH-Ventilation with HR		
Calculated supply air demand / supply air per person	1500	m³/h	30
Calculated extract air demand / Amount extract air rooms	0	m³/h	
Design air flow rate (maximum) / Average value reference to maximum		m³/h	77
Average flow rate / Average air exchange		m³/h	
Airtightness test pressure at n_{50} / Air permeability q_{50}	2,00	1/h	
Net air flow for pressurization test / Infiltration flow $n_{V,Rest}$		m³	
Ventilation unit: Description / Certified?			
Ventilation system: effective heat recovery efficiency / electrical efficiency		%	
Ventilation system: Description (type of heat recovery, manufacturer, product name)			
Ventilation system: installation site / Temperature of mechanical services room	Inside the thermal envelope		
Nominal width exterior or supply air / exhaust or extract air ducts		mm	
Conductance ambient- or supply air duct / exhaust- or extract air duct		W/(mK)	
Length ambient- or supply air duct / exhaust- or extract air duct		m	
SHX: efficiency / effective heat recovery efficiency		%	0,00
HE defrosting / Defrosting at a minimum temperature of	yes		2,00
Effective energy recovery efficiency ventilation / Humidity recovery		%	0,0
Ventilation system: Short description (installation site, ducts, silencers, others)			

Summer ventilation

Summer base ventilation: ventilation type		
Air exchange via ventilation system with supply air:	Without heat recovery	0,63
Air exchange via extract air system		0,00
Window ventilation air exchange		0,19
Night summer ventilation: Type of ventilation		
Night air exchange Window Night Ventilation, Manual		0,19
Night air exchange mechanical, automatically Controlled ventilation	Humidity differenceregulated	0,63
Summer ventilation: short description (window opening profiles, night ventilation concepts, others)		

Cooling

Max. indoor absolute humidity / Internal humidity sources	12,0	g/kg	2,0
Mechanical cooling: sensible / latent	0,3	kWh/(m²a)	0,1
Mechanical cooling: Applied cooling units			
Supply Air Cooling: max. cooling capacity / energy efficiency ratio	5,0	kW	3,0
Supply Air Cooling:cyclical operation			
		kW	
	0,0		
		kWh/(m²a)	
Mechanical cooling: Average annual coefficient of performance / Electricity demand	2,0		0,2
Mechanical cooling: Short description (unit, manufacturer, product name, installation site, installation)			

Heating and DHW				
DHW Demand	30,11	kWh/(m²a)	25541
Annual heating demand	46,47	kWh/(m²a)	39424
Direct electricity: contribution to space heating / domestic hot water		%	
PE value energy carrier / CO_2-emission factor		kWh/kWh	
Direct electric heating / domestic hot water			
Final energy demand		kWh/(m²a)	
Direct electricity: short description (description, manufacturer, product name)			
Heat pump: covered fraction of space heating / domestic hot water	70	%	60
PE value energy carrier / CO_2-emission factor	2,6	kWh/kWh	680
COP heat pump for heating / heat pump for DHW	1,9		
Final energy demand	23,5	kWh/(m²a)	
Compact unit: Short description (description, manufacturer, product name)			
Compact unit: covered fraction of space heating / domestic hot water		%	
PE value energy carrier / CO_2-emission factor		kWh/kWh	
COP heat pump for heating / heat pump for DHW			
Final energy demand		kWh/(m²a)	
Compact unit: Short description (description, manufacturer, product name)			
Boiler: covered fraction of space heating / domestic hot water		%	
PE value energy carrier / CO_2-emission factor		kWh/kWh	
Heat generator: building type / COP			
Final energy demand		kWh/(m²a)	
Boiler: short description (description, manufacturer, product name)			
District heating: Covered fraction of space heating / domestic hot water	30	%	40
PE value energy carrier / CO_2-emission factor	0,8	kWh/kWh	240
Heat source / Performance of heat generator	Hard Coal CGS 70% PHC		105,0
Final energy demand	20,4	kWh/(m²a)	
Compact unit: Short description (description, manufacturer, product name)			

Solarthermics			
Collector	7 Improved flat plate collector		
Collector area / Specific collector area	28,00	m²	0,56
Deviation from north / Angle of inclination from the horizontal	180	°	26
Solarthermics: Short description (description, manufacturer, product name, installation location)			
Solar contribution to DHW	11,65	kWh/(m²a)	39
Solar contribution to space heating	6,25	kWh/(m²a)	13
Solar contribution total	17,90	kWh/(m²a)	23
Solar Storage	9 Simple solar storage		

PHOTOVOLTAIC			
Module technology	Amorph-Si		
Nominal current / Nominal voltage		A	
Nominal power / Number of modules	0,00	Wp	
Deviation from north / Angle of inclination from the horizontal		°	
Solarthermics: Short description (description, manufacturer, product name, installation location)			
Annual yield of PV modules		kWh/(m²a)	

Aux. electricity / Household electricity

Aux Electricity

Ventilation units / Electricity demand		5870
Heating system Devices / Electricity demand		973
DHW-system units / Electricity demand		321
Aux. Electricity solar devices / electr. demand		227
Total aux. Electricity	**8,71** kWh/(m²a)	**7391,52**

Household electricity

Dishwasher / useful energy demand		3575
Washing machine units / Energy demand		3135
Clothes dryer unit / Energy demand		8728
Refrigerator, Freezer or combination unit / Useful energy demand		574
Cooking unit / energy demand		6250
Lighting		8700
Consumer Electronics		2200
Small appliances, etc.		2500
Other		
Total household electricity	**42,03** kWh/(m²a)	**35661,91**

Economic data

Total gross construction costs / contained VAT	€	
Building costs (cost group 300+400) / (cost group 200-700)	€	
Total gross construction costs per m² BGF / per m³ BRI	€/m²	
Explanation building costs		
Fostering (Passivhaus, refurbishment, etc.)		
Explanation fostering		

Other

Ecological aspects: rainwater utilization, etc.	
Material used: Regional products / Natural products	
Special features: first project in the country / first project used as	
Building awards	
Research project / funded project	
Description of research / funded project	
Other	

EnerPHit planning:

select active variants
>>

Results	Units
Annual heating demand	kwh/(m²a)
Heating Load	W/m²
Overall specific space cooling demand	kwh/(m²a)
Cooling load	W/m²
Frequency of overheating	%
Total primary energy demand	kwh/(m²a)
Certifiable as EnerPHit building retrofit (acc. to heating demand)?	yes / no
<< User defined	Units

Input variables	Units
<< Assembly layers ('U-value')	
<< Radiation balance ('Areas')	
<< Thermal bridges ('Areas')	
<< Glazing and frames ('Window', 'Shading')	
<< Ventilation ('Ventilation', 'SummVent')	
<< Heat generator ('PE-value')	
Direct electricity	Fraction of annual heating demand
	Fraction of domestic warm water
Heat pump	Selection HP
	Fraction of annual heating demand
	Fraction of domestic warm water
Passive House compact unit with supply air ventilation pump	Selection of device
	Fraction of annual heating demand
	Fraction of domestic warm water

Boiler (gas, oil & wood)	Selection of boiler
	Fraction of annual heating demand
	Fraction of domestic warm water
District Heating	Selection of heat source
	Fraction of annual heating demand
	Fraction of domestic warm water
Other	Efficiency
	Fraction of annual heating demand
	Fraction of domestic warm water

<< Compressor cooling unit ('Cooling units')

<< User defined

	Description	Units
1	Door U-Value	W/m2K
2	Heat Loss Coefficient heating	W/mK
3	Heat Loss Coefficient DHW	W/mK
4	Average Heat Released from storage	W
5	Solar Collector Area	m2
6	Utilisation factor of heat transfer station	%
7	Summer Ventilation, additional ventilation summer	0/1
8	Defroster HX	0/1
9	Lighting (Changing MHL to LED)	W/m2
10	Mechanical cooling:	x
11	Perimeter Insulation Width/Depth	m
12	Perimeter Insulation Thickness	m
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		

CALCULATION OF VARIANTS

Active

4-New energy source (only Block C), DHW solar panels, LED lightings	No measures	Block C: Wall ins. Block C1: wall ins. windows changing HVAC: ventilation	Roof ins.	New energy source (only Block C), DHW solar panels, LED lightings
4	1	2	3	4
46,3	121,3	96,4	46,3	46,3
26,1	68,6	47,6	26,1	26,1
0,4				0,4
14,0				14,0
	7,9	0,9	0,1	
127,9	196,5	193,9	151,9	127,9
no	no	no	no	no
Link	Link	Link	Link	Link

Value	1	2	3	4
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
Daikin Altherma 16 kW	None	None	None	Daikin Altherma 16 kW
70%	0%	0%	0%	70%
60%	0%	0%	0%	60%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

None	None	None	None	None
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

Hard Coal CGS 70% PHC	Hard Coal CGS 70% PHC	Hard Coal CGS 70% PHC	Hard Coal CGS 70% PHC	Hard Coal CGS 70% PHC
30%	100%	100%	100%	30%
40%	100%	100%	100%	40%

0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

0,800	5,8	0,8	0,8	0,8
0,192	0,362	0,362	0,362	0,192
0,153	0,78	0,78	0,78	0,153
49,000	150	150	150	49
28,000	0	0	0	28
1,050	105%	105%	105%	105%
1,000	0	0	0	1
1,000	0	0	0	1
2,600	8,7	8,7	8,7	2,6
x				x
0,400		0,4	0,4	0,4
0,200		0,2	0,2	0,2

Change aluminium windows (15 years)				
5	6	7	8	9
22,5				
15,7		52,5	52,5	
0,3				
11,6				
93,4				
yes				
Link	Link	Link	Link	

5	6	7	8	9

0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

Daikin Altherma 16 kW	Daikin Altherma 16 kW	None	None	None
70%	70%	0%	0%	0%
60%	60%	0%	0%	0%

0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

None	None	None	None	None
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

Hard Coal CGS 70% PHC	Hard Coal CGS 70% PHC	None	None	None
30%	30%	0%	0%	0%
40%	40%	0%	0%	0%

0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

0,8	0,8			
0,192	0,192			
0,153	0,153			
49	49			
28	28			
105%	105%			
1	1			
1	1			
2,6	2,6			
x	x			
0,4	0,4			
0,2	0,2			

EnerPHit planning: **C O M P A R I S O N B**

Selection of comparison configuration

Description	4-S1: Windows
Component type	Windows ('Window')
Component	f-PVC frame North

Calculation of selected configuration

	Lower Efficiency	Hig Effici
Design according to variant	1-No measures	2-Block C:
Uw--Value	2,523	1,0
Minimal interior surface temperature	-	-
	Uncomfortable!	

			Inves
	Per m² of component	Whole component	Per m² of component
Area of component	1,00	18	1,00
Investment costs less sum of financial support	0,00	0	329,95
Annuity (capital costs)	0,00	0	21,21

			Energy (Space heating + c
	Per m² of TFA	Entire building	Per m² of TFA
Area	1	848	1
Annual heating demand	98,30	83396	96,40
Cooling + dehumidification demand			
Electricity demand:			
Auxiliary electricity for Heating	1,15	973	1,15
Auxiliary electricity ventilation winter	1,73	1467	1,73
Direct electric	0,00	0	0,00
HP	0,00	0	0,00
Compact heat pump unit	0,00	0	0,00
Auxiliary electricity ventilation summer	2,66	2256	2,66
Compressor cooling unit	0,00	0	0,00
Final energy demand:			
Total electricity demand	5,53	4696	5,53
Gas	0,00	0	0,00
Oil	0,00	0	0,00

Logs	0,00	0	0,00
Pellet	0,00	0	0,00
District Heat	103,54	87843	101,54
Others	0,00	0	0,00

CO2-Emissions:

Total electricity demand	3,76	3193	3,76
Gas	0,00	0	0,00
Oil	0,00	0	0,00
Logs	0,00	0	0,00
Pellet	0,00	0	0,00
District Heat	21082,38	17886292	20675,59
Others	0,00	0	0,00

PE-demand

Total electricity	14,39	12209	14,39
Gas	0,00	0	0,00
Oil	0,00	0	0,00
Logs	0,00	0	0,00
Pellet	0,00	0	0,00
District Heat	82,83	102	39,16
Others	0,00	0	0,00

Costs:

Total electricity	1,38	1174	1,38
Gas	0,00	0	0,00
Oil	0,00	0	0,00
Logs	0,00	0	0,00
Pellet	0,00	0	0,00
District Heat	13,46	11420	13,20
Others	0,00	0	0,00
Total energy costs	14,84	12594	14,58
Maintenance costs	0,00	0	0,00

Final energy demand	114,61	97234	112,61
CO_2-Emissions	21086,14	17889485	20679,36
Primary energy demand	97,22	12311	53,55
Total cost space conditioning	14,84	12594	14,58

			Economi
Total annual costs	14,84	12594	15,04

Maximal economically viable additional i

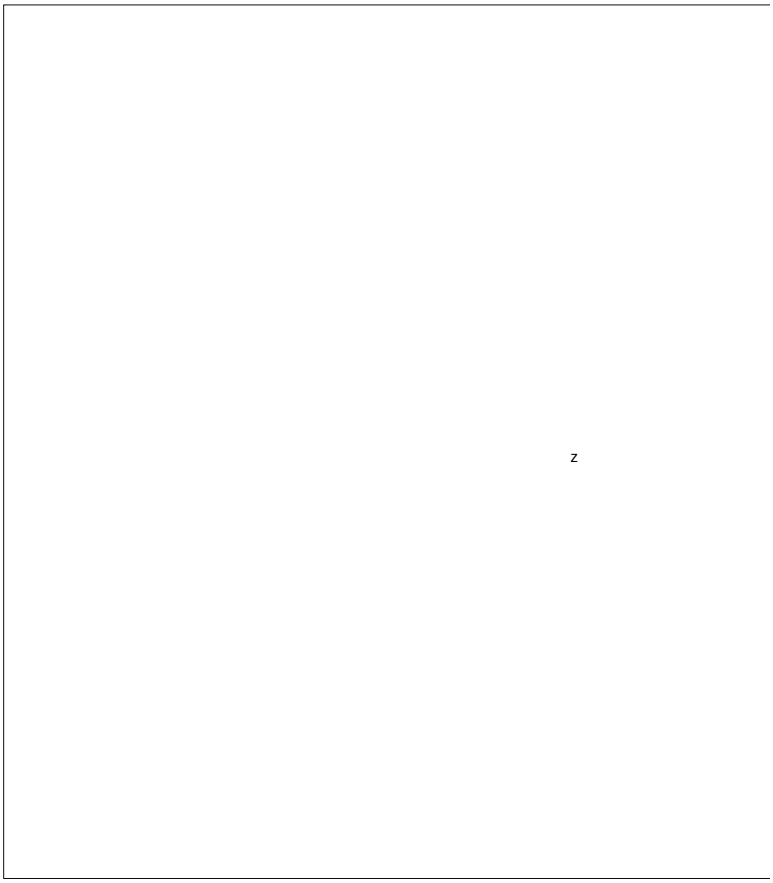
Cost per kWh of sa

<< Boundary conditions

	Boundary
Interest rate + Inflation	**Energy price**

Nominal interest rate	6,50%
Inflation	1,53%
Period under consideration [a]	20

Electricity
Gas/Oil
Logs
Pellet
District heating
Others



E T W E E N T W O V A R I A N T S

her iency	Difference / Savings / Profit		
Wall ins.			
037			W/(m²K)
-			°C
Uncomfortable!			

tment			
Whole component	Per m² of component	Whole component	
18	1,00	18	m²
6015	329,95	6015	€
387	**21,21**	**387**	€/a

ooling + mech. ventilation)			
Entire building	Per m² of component	Whole component	
848	1	18	m²
81782	**88,55**	**1614**	kWh/a
			kWh/a

973	0,00	0	kWh/a
1467	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
2256	0,00	0	kWh/a
0	0,00	0	kWh/a

4696	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a

0	0,00	0	kWh/a
0	0,00	0	kWh/a
86148	92,97	1695	kWh/a
0	0,00	0	kWh/a

3193	0,00	0	kg/a
0	0,00	0	kg/a
0	0,00	0	kg/a
0	0,00	0	kg/a
0	0,00	0	kg/a
17541173	18930,31	345118	kg/a
0	0,00	0	kg/a

12209	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
0	0,00	0	kWh/a
10	5,05	92	kWh/a
0	0,00	0	kWh/a

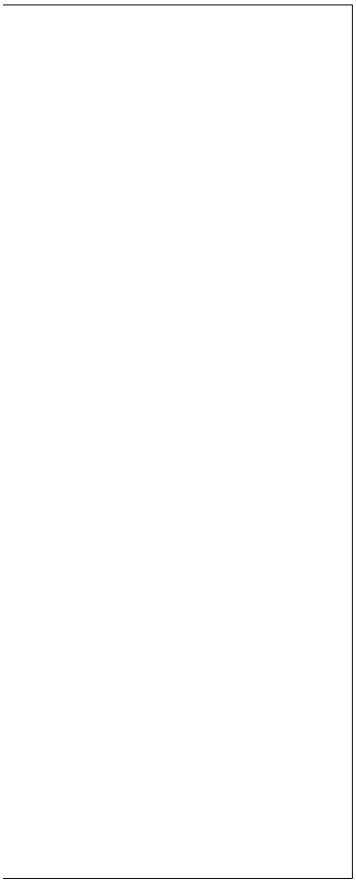
1174	0,00	0	€/a
0	0,00	0	€/a
0	0,00	0	€/a
0	0,00	0	€/a
0	0,00	0	€/a
11199	12,09	220	€/a
0	0,00	0	€/a
12373	12,09	220	€/a
0	0,00	0	€/a

95539	92,97	1695	kWh/a
17544366	18930,31	345118	kg/a
12219	5,05	92	kWh/a
12373	**0,26**	**220**	€/a

c viability			
12760	**-9,12**	**-166**	€/a
investment costs	**188,04**	**3428**	€
aved final energy	**22,8**		Cent/kWh

conditions	
s [cent/kWh]	**Period of use**

25	Build. assemblies	50	a
9	Vent. system	25	a
5	Thermal bridges	50	a
7	Complete building	35	a
13	Windows	30	a
20			



Input: comparison configuration

	1	2
Description	S1:Building	S1: Walls C
Component type	Complete building	Building assemblies ('U-Value')
Component	- No additional input	01ud Block C - plaster
"Lower Efficiency" variant	1-No measures	1-No measures
Investment costs [€]	8340,03	4176,73
Annual maintenance costs [€/a]		
"Higher Efficiency" variant	2-Block C: Wall ins. Block C1: w	2-Block C: Wall ins. Block C1: w
Investment costs [€]	45262,71	17575,70
Annual maintenance costs [€/a]		
Financial support (present value) [€]		

Results (manual transfer)

Description		
Investmant costs (BGN)	88526,16	34375,09
Reconstruction costs(BGN)	16311,68	8168,98
Maintenance costs (BGN)		

3	4	5
S1: Walls C1	S1: Windows	S1:Ventilation
Building assemblies ('U-Value')	Windows ('Window')	Ventilation system ('Ventilation'
02ud Block C - plaster external i	f-PVC frame North	- No additional input
1-No measures	1-No measures	1-No measures
1241,08	0,00	2922,22
2-Block C: Wall ins. Block C1: w	2-Block C: Wall ins. Block C1: w	2-Block C: Wall ins. Block C1: w
4227,51	6015,25	14747,38
		400
8268,29	11764,8	28843,36
2427,34		5715,36

6	7	8
S2:Roof C	S2:Roof C1	S3:Building
Building assemblies ('U-Value')	Building assemblies ('U-Value')	Complete building
11ud Roof Gym direct to externa	10ud Roof dressingrooms direc	- No additional input
2-Block C: Wall ins. Block C1: w	2-Block C: Wall ins. Block C1: w	3-Roof ins.
4214,16	3782,54	0,00
3-Roof ins.	3-Roof ins.	4-New energy source (only Bloc
45754,92	10041,80	34026,47
89488,85	19640,06	66550,00
8242,18	7398,00	

9	10
Comp.Renovation	S4:Alumin.wind
Complete building	Complete building
- No additional input	- No additional input

1-No measures	4-New energy source (only Block C), DHW solar panels, LED lightings
16336,73	0,00

5-Change aluminium windows (1	5-Change aluminium windows (15 years)
184086,73	48489,53

360042,34	94837,27
31951,86	

EnerPHit planning:

CLIMATE DATA

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Region: User Data

Climate data set: User data - Велико Търнов PHI

Weather station (altitude): 137,0 m

Building location (height above sea level): 382 m

Climate Building: Велико Търнов PHI

Monthly Data: User data - Велико Търнов PHI

Annual Data:

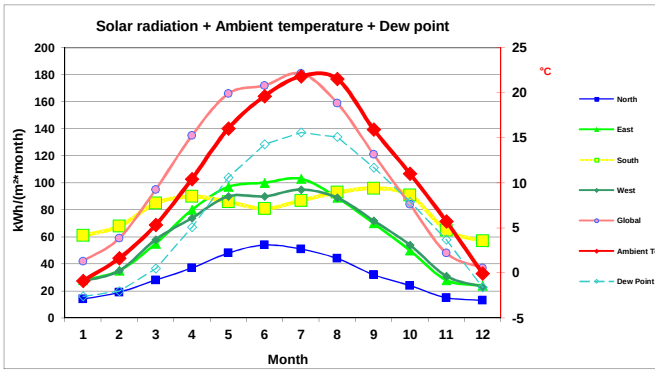
Use Annual Climate Data Set: no

Results:

Annual heating demand	46,3	kWh/(m²a)
Heating load	26,1	W/m²
Primary Energy	127,9	kWh/(m²a)

Transfer to annual method (Annual Heating)

H_T	189	d/a
G_t	74	kKh/a
North	122	kWh/(m²a)
East	240	kWh/(m²a)
South	432	kWh/(m²a)
West	243	kWh/(m²a)
Horizontal	400	kWh/(m²a)



Month	1	2	3	4	5	6	7	8	9	10	11	12	Heating load		Cooling
Days	31	28	31	30	31	30	31	31	30	31	30	31	Weather 1	Weather 2	Weather 1
Parameters for PHPP Calculated Ground Temperatures:	User data - Велико Търнов PHI	Latitude:	43,1	Longitude °	25,7	Altitude m	137	Daily Temperature Swing Summer (K)			11,2	Radiation Data:	kWh/(m²month)	Radiation: W/m²		Radiatio
Phase shift months	Ambient Temp	-0,9	1,6	5,3	10,4	16,0	19,6	21,8	21,5	15,9	11,0	5,7	-0,1	-9,1	-4,6	28,1
0,60	North	14	19	28	37	48	54	51	44	32	24	15	13	19	16	92
Damping	East	28	35	55	80	97	100	103	89	70	50	28	24	39	23	197
-0,31	South	61	68	85	90	86	81	87	93	96	91	65	57	82	40	185
Depth m	West	27	35	58	74	90	90	95	89	72	54	31	23	35	24	197
1,00	Global	42	59	95	135	166	172	181	159	121	84	48	37	56	36	349
User data - Example	Dew Point	-2,6	-2,0	0,5	5,1	10,6	14,3	15,6	15,1	11,7	7,9	3,7	-1,6			18,6
1,00	Sky Temp	-11,1	-9,3	-6,3	-1,1	5,3	9,4	11,4	10,9	6,3	1,9	-2,6	-9,3			16,5
	Ground Temp	16,6	16,5	16,6	16,8	17,1	17,5	17,7	17,8	17,7	17,4	17,1	16,8	16,5	16,5	22,9

DHW solar panels, LED lightings

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Wedge-shaped building assemblies (tapered insulation), unventilated air layers and unheated attics

-> Auxiliary calculation to the right

Assembly No. 01ud | Building assembly description: Block C - plaster | Interior insulation?

Heat transfer resistance [m²K/W] — interior Rsi: 0,13 — exterior R_{se}: 0,04

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster in	0,700					20
2.	Aereted consrete	0,210					250
3.	Plaster outside	0,870					20
4.	EPS-F	0,032					200
5.	Plaster	0,870					20
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 51,0 cm

U-value supplement: W/(m²K) | **U-Value: 0,130** W/(m²K)

Assembly No. 02ud | Building assembly description: Block C - plaster external insulation | Interior insulation?

Heat transfer resistance [m²K/W] — interior Rsi: 0,13 — exterior R_{se}: 0,04

	Area section 2	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster in	0,700					20
2.	Aereted consrete	0,210					250
3.	Plaster outside	0,870					20
4.	EPS-F	0,032					200
5.	Plaster	0,870					20
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 51,0 cm

U-value supplement: W/(m²K) | **U-Value: 0,130** W/(m²K)

Assembly No. 03ud | Building assembly description: | Interior insulation?

Heat transfer resistance [m²K/W] — interior Rsi: 0,13 — exterior R_{se}:

	Area section 3	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: cm

U-value supplement: W/(m²K) | **U-Value:** W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
04ud		

Heat transfer resistance [m²K/W] interior Rsi : **0,13**
exterior R_{se} :

	Area section 4	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
05ud		

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 5	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
06ud		

Heat transfer resistance [m²K/W] interior Rsi : **0,17**
exterior R_{se} : **0,17**

	Area section 6	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
07ud	Floor slab on grade (tiles)	

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} :

	Area section 7	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Tiles	3,490					20
2.	Cement	0,930					50
3.	Concrete	2,100					150
4.	Stone embankment	3,500					300
5.	Floor insulation	0,000					0
6.	New flooring	0,000					0
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 52,0 cm

U-value supplement: W/(m²K) **U-Value:** 2,586 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
08ud	Floor slab on grade (Gym)	

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} :

	Area section 8	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Wood	0,350					20
2.	Air closed	0,160					30
3.	Cement	0,930					30
4.	Concrete	2,100					100
5.	Stone embankment	3,500					250
6.	Mineral wool	0,000					0
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 43,0 cm

U-value supplement: W/(m²K) **U-Value:** 1,767 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
09ud		

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,10

	Area section 9	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
10ud	Roof dressingrooms direct to external air	

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,04

	Area section 10	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster	0,700					20
2.	Concrete	2,100					200
3.	Cement	0,930					30
4.	Bitum	0,170					5
5.	Mineral woow	0,041					40
6.	XPS	0,035					300
7.	Hydroinsulation	0,170					5
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 60,0 cm

U-value supplement: W/(m²K) **U-Value:** 0,101 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
11ud	Roof Gym direct to external air	yes

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,04

	Area section 11	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Sandwich panel (poliur	0,041					50
2.	Wood	0,350					30
3.	Hydroinsulation	0,170					5
4.	Tiles	0,990					30
5.	Mineral wool	0,041					300
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 41,5 cm

U-value supplement: W/(m²K) **U-Value:** 0,113 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
12ud	Under unheated basement floor	

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} :

	Area section 12	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Cement	0,930					20
2.	Concrete	1,450					150
3.	Stone embankment	3,500					250
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 42,0 cm

U-value supplement: W/(m²K) **U-Value:** 2,729 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
13ud	Block A - stone façade	yes

Heat transfer resistance [m²K/W] interior Rsi : 0,13

exterior R_{se} : 0,04

	Area section 13	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster in	0,700					20
2.	Bricks	0,790					500
3.	Plaster outside	0,870					20
4.	Stone facede	1,060					40
5.	EPS-F	0,000					0
6.	Plaster	0,000					0
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 58,0 cm

U-value supplement: W/(m²K) **U-Value:** 1,121 W/(m²K)

Assembly No. 14ud | Building assembly description: Block A connection roof direct to external air | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,04

	Area section 14	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Plaster	0,700					20
2.	Concrete	1,630					200
3.	Cement	0,930					30
4.	Bitum	0,170					5
5.	Closed air	0,870					20
6.	Mineral wool	0,032					200
7.	Suspended ceiling	0,032					200
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: 67,5 cm

U-value supplement: W/(m²K) **U-Value:** 0,078 W/(m²K)

Assembly No. 15ud | Building assembly description: | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 15	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No. 16ud | Building assembly description: | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 16	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]

1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No. 17ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

Area section 17	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No. 18ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

Area section 18	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No. 19ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

Area section 19	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.						
2.						
3.						
4.						

5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No. | Building assembly description | Interior insulation?

20ud

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 20	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Secondary Calculation: Equivalent Thermal Conductivity of Still Air Spaces

Air Layer Thickness	50	mm	Convective heat transfer	
Direction of the thermal flow:	x	Upwards	h_a	1,95 W/(m²K)
		Horizontal	Radiation heat transfer	
		Downwards	h_r	4,17 W/(m²K)
Emissivity of surface 1	0,90		equivalent thermal conductivity	
Emissivity of surface 2	0,90		λ	0,31 W/(mK)

Secondary Calculation: Equivalent Thermal Conductivity of Still Air Spaces

Air Layer Thickness	30	mm	Convective heat transfer	
of the		Upwards	h_a	0,833333 W/(m²K)
		Horizontal	Radiation heat transfer	
	x	Downwards	h_r	4,34 W/(m²K)
Emissivity of surface 1	0,92		equivalent thermal conductivity	
Emissivity of surface 3	0,92		λ	0,16 W/(mK)

Wedge-shaped layers (at an inclination of max. 5%)

(Calculation following EN 6946 Appendix C)

Assembly No.	Building assembly description
1a	Exemplary flat roof with wedge-shaped insulation

Heat transfer resistance [m²K/W]

interior Rsi :	0,10
exterior R_{se} :	0,04

A parallel assemblies layer

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Total Width Thickness d_0 [mm]
1.	Concrete Ceiling	2,100					160
2.	PS Rigid Foam	0,040					200
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			36,0 cm

U_0:	0,192	W/(m²K)
R_0:	5,216	(m²K)/W

B Wedge-Shaped Assembly Layer

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_1 [mm]
PS rigid foam insulation	0,040					150

Percentage of sec. 2	Percentage of sec. 3	Thickness d_1 [cm]
		15,0 cm

U_1:	0,267	W/(m²K)
R_1:	3,750	(m²K)/W
Rectangular Area U-Value:	**0,144**	W/(m²K)
U-value of triangular area with the thickest point at the apex:	**0,157**	W/(m²K)
U-value of triangular area with the thinnest point at the apex:	**0,131**	W/(m²K)

Wedge-shaped layers (at an inclination of max. 5%)

(Calculation following EN 6946 Appendix C)

Assembly No. | Building assembly description

2a

Heat transfer resistance [m²K/W] interior Rsi :

exterior R_{se} :

A parallel assemblies layer

Total Width

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_0 [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			cm

U_0: W/(m²K)

R_0: (m²K)/W

B Wedge-Shaped Assembly Layer

		Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_1 [mm]

Percentage of sec. 2	Percentage of sec. 3	Thickness d_1 [cm]
		cm

U_1: W/(m²K)

R_1: (m²K)/W

Rectangular Area U-Value: W/(m²K)

U-value of triangular area with the thickest point at the apex: W/(m²K)

U-value of triangular area with the thinnest point at the apex: W/(m²K)

Non-conditioned attic

Building assembly description

Roof

Heat transfer resistance [m²K/W] interior Rsi : 0,17 Exterior absorption coefficient **0,80**

exterior R_{se} : 0,04 Exterior emissivity **0,93**

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Corrugated galvanised iro	60,000					3
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			0,3 cm

U-value supplement W/(m²K) **U-Value:** **4,761** W/(m²K)

Building assembly description

Exterior attic wall

Heat transfer resistance [m²K/W] interior Rsi : 0,13 Exterior absorption coefficient 0,80

exterior R_{se} : 0,04 Exterior emissivity 0,93

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Interior plaster	0,350					15
2.	Masonry	1,100					175
3.	Exterior Render	0,800					20
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			21,0 cm

U-value supplement W/(m²K) **U-Value:** **2,519** W/(m²K)

Building assembly description

Intermediate ceiling

Heat transfer resistance [m²K/W] interior Rsi : 0,17

exterior R_{se} : 0,17

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Wooden floor	0,130					22
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
83%	16,7%		2,2 cm

U-value supplement W/(m²K)

U-Value: 1,964 W/(m²K)

Attic area

Roof area	200,0	m²
Area of exterior walls and attic	200,0	m²
Area of intermediate ceiling	100,0	m²

emissivity in the attic

Inner side of the roof / exterior wall	0,93
Upper side of the interior ceiling	0,93

Air exchange in the attic

Air change rate	0,20	1/h
Volume	200,0	m³

Equivalent value for the intermediate ceiling (to be linked to worksheets "Components" and "Areas"')

U-Value: 2,732 **Absorptivity: 0,780** **Emissivity: 0,907**

Total solar energy transmittance (informative): 0,085

EnerPHit planning: # AREAS DETERMINATION

Building: Primary School 3 "Tzanko Diustabanov" - Section A Heating demand: 46 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment	Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
1	Treated Floor Area		848,40	m²	Treated floor area according to PHPP manual			9 months	8 months
2	North Windows	A	58,20	m²	Results come from the 'Windows' worksheet.	North Windows	2,390	3416	6098
3	East Windows	A	12,52	m²	Window areas are subtracted from individual opaque areas.	East Windows	2,353	1546	1046
4	South Windows	A	100,80	m²	which is displayed in the "Windows" worksheet.	South Windows	2,818	13898	10153
5	West Windows	A	26,46	m²		West Windows	2,618	1231	1467
6	Horizontal Windows	A	0,00	m²		Horizontal Windows			
7	Exterior Door	A	3,00	m²	Please subtract area of door from respective building assembly	Exterior Door	0,800		
8	Exterior Wall - Ambient	A	539,24	m²	Temperature Zone "A" is ambient air.	Exterior Wall - Ambient	0,130	75	207
9	Exterior Wall - Ground	B	0,00	m²	Temperature zone "B" is the ground.	Exterior Wall - Ground			
10	Roof/Ceiling - Ambient	A	955,36	m²		Roof/Ceiling - Ambient	0,110	782	1413
11	Floor slab / basement ceiling	B	910,21	m²		Floor slab / basement ceiling	1,977		
12			0,00	m²	Temperature zones "A", "B","P" and "X" may be used. NOT "I"				
13			0,00	m²	Temperature zones "A", "B","P" and "X" may be used. NOT "I" Factor for X				
14		X	0,00	m²	Temperature zone "X": Please provide user-defined reduction factor (0 < f_i < 1): 75%				
						Thermal bridges - Overview	Ψ [W/(mK)]		
15	Thermal Bridges Ambient	A	203,27	m	Units in m	Thermal Bridges Ambient	0,081		
16	Perimeter Thermal Bridges	P	123,80	m	Units in m; temperature zone "P" is perimeter (see Ground worksheet).	Perimeter Thermal Bridges	-0,036		
17	Thermal bridges FS/BC	B	0,00	m	Units in m	Thermal bridges FS/BC			
18	Partition Wall to Neighbour	I	0,00	m²	No heat losses, only considered for the heating load calculation.	Partition Wall to Neighbour			
Total thermal envelope			2605,79	m²		Average Therm. Envelope	0,964		

Go to building components list

Area input

Sort: AS LIST

Area Nr.	Building assembly description	Group Nr.	Assigned to group	Quantity	x (	a [m]	x	b [m]	+	User-Determined [m²]	-	User Subtraction [m²]	-	Subtraction window areas [m²]	) =	Area [m²]	Selection of building element assembly / certified building system	U-Value [W/(m²K)]	Deviation from North	Angle of inclination from the horizontal	Orientation	Reduction factor shading	Exterior absorptivity	Exterior emissivity
	Treated floor area	1	Treated Floor Area	1	x (		x		+	848,40	-				) =	848,4									
	North Windows	2	North Windows													58,2	From 'Windows' worksheet	2,390						
	East Windows	3	East Windows													12,5	From 'Windows' worksheet	2,353						
	South Windows	4	South Windows			Please complete in Windows worksheet only!										100,8	From 'Windows' worksheet	2,818						
	West Windows	5	West Windows													26,5	From 'Windows' worksheet	2,618						
	Horizontal Windows	6	Horizontal Windows													0,0	From 'Windows' worksheet	0,000						
	Exterior Door	7	Exterior Door	1	x (	1,20	x	2,50	+		-		) -		=	3,0	U-value exterior door:	0,80						
1	North facade 1	8	Exterior Wall - Ambient	1	x (	6,50	x	3,30	+		-		) -	4,3	=	17,2	02ud Block C - plaster external insul	0,130	0	90	North	0,70	0,40	0,90
2	East facade 1	8	Exterior Wall - Ambient	1	x (	1,50	x	3,30	+		-		) -	0,0	=	5,0	02ud Block C - plaster external insul	0,130	90	90	East	0,70	0,40	0,90
3	North facade 2	8	Exterior Wall - Ambient	1	x (	12,60	x	3,30	+		-		) -	10,0	=	31,6	02ud Block C - plaster external insul	0,130	0	90	North	0,70	0,40	0,90
4	North-west façade 1	8	Exterior Wall - Ambient	1	x (	6,40	x	3,30	+		-		) -	4,0	=	17,1	02ud Block C - plaster external insul	0,130	315	90	West	0,70	0,40	0,90
5	North-east façade 1	8	Exterior Wall - Ambient	1	x (	10,90	x	6,00	+		-		) -	33,6	=	31,8	01ud Block C - plaster	0,130	45	90	North	0,70	0,40	0,90
6	North-west façade 2	8	Exterior Wall - Ambient	1	x (	18,15	x	6,00	+		-		) -	0,0	=	108,9	01ud Block C - plaster	0,130	315	90	West	0,70	0,40	0,90
7	South-west façade 1	8	Exterior Wall - Ambient	1	x (	36,35	x	6,00	+		-		) -	100,8	=	117,3	01ud Block C - plaster	0,130	225	90	South	0,70	0,40	0,90
8	South-east façade 1	8	Exterior Wall - Ambient	1	x (	18,15	x	6,00	+		-		) -	0,0	=	108,9	01ud Block C - plaster	0,130	135	90	East	0,70	0,40	0,90
9	North-east façade 2	8	Exterior Wall - Ambient	1	x (	6,05	x	6,00	+		-		) -	10,4	=	25,9	02ud Block C - plaster external insul	0,130	45	90	North	0,70	0,40	0,90
10	South-east façade 2	8	Exterior Wall - Ambient	1	x (	1,00	x	2,70	+		-		) -	3,6	=	-0,9	01ud Block C - plaster	0,130	135	90	East	0,70	0,40	0,90
11	Circle south part	8	Exterior Wall - Ambient	1	x (	2,70	x	2,70	+		-		) -	0,0	=	7,3	01ud Block C - plaster	0,130	180	90	South	0,70	0,40	0,90
12	Circle east part	8	Exterior Wall - Ambient	1	x (	2,70	x	2,70	+		-		) -	0,0	=	7,3	01ud Block C - plaster	0,130	90	90	East	0,70	0,40	0,90
13	Circle north pasrt	8	Exterior Wall - Ambient	1	x (	2,70	x	2,70	+		-		) -	0,0	=	7,3	01ud Block C - plaster	0,130	0	90	North	0,70	0,40	0,90
14	North-east façade 3	8	Exterior Wall - Ambient	1	x (	15,90	x	2,70	+		-		) -	0,0	=	42,9	01ud Block C - plaster	0,130	45	90	North	0,70	0,40	0,90
15	North-west façade 3	8	Exterior Wall - Ambient	1	x (	2,80	x	2,70	+		-		) -	0,0	=	7,6	01ud Block C - plaster	0,130	315	90	West	0,70	0,40	0,90
16	South-west façade 2	8	Exterior Wall - Ambient	1	x (	23,00	x	1,00	+		-		) -	21,9	=	1,1	01ud Block C - plaster	0,130	315	90	West	0,70	0,40	0,90
17	Roof 1	10	Roof/Ceiling - Ambient	1	x (	19,70	x	18,93	+	335,92	-		) -	0,0	=	708,7	11ud Roof Gym direct to external air	0,113	0	0	Hor	0,40	0,80	0,90
18	Roof 2	10	Roof/Ceiling - Ambient	1	x (		x		+	262,88	-	16,26	) -	0,0	=	246,6	10ud Roof dressingrooms direct to e	0,101	0	0	Hor	0,40	0,95	0,90
19	Floor 1	11	Floor slab / basement ceiling	1	x (	18,15	x	36,35	+	17,63	-		) -	0,0	=	677,4	08ud Floor slab on grade (Gym)	1,767						
20	Floor 2	11	Floor slab / basement ceiling	1	x (		x		+	250,46	-	17,63	) -	0,0	=	232,8	07ud Floor slab on grade (tiles)	2,586						
21	South-east façade 2	8	Exterior Wall - Ambient	1	x (	2,00	x	0,48	+		-		) -	0,5	=	0,4	01ud Block C - plaster	0,130	135	90	East	0,70	0,40	0,90
22	North-west façade 2	8	Exterior Wall - Ambient	1	x (	2,00	x	0,48	+		-		) -	0,5	=	0,4	01ud Block C - plaster	0,130	315	90	West	0,70	0,40	0,90
23	South-east façade 3	8	Exterior Wall - Ambient	1	x (	3,20	x	3,30	+		-		) -	8,4	=	2,2	02ud Block C - plaster external insul	0,130	135	90	East	0,70	0,40	0,90
24					x (		x		+		-		) -	0,0	=									
25					x (		x		+		-		) -	0,0	=									
26					x (		x		+		-		) -	0,0	=									
27					x (		x		+		-		) -	0,0	=									

EnerPHit planning: **AREAS DETERMINATION**

Building: Primary School 3 "Tzanko Diustabanov" - Section A Heating demand 46 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment	Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
1	**Treated Floor Area**		**848,40**	m²	*Treated floor area according to PHPP manual*			9 months	8 months
2	**North Windows**	**A**	**58,20**	m²	Results come from the 'Windows' worksheet.	**North Windows**	**2,390**	**3416**	**6098**
3	**East Windows**	**A**	**12,52**	m²	Window areas are subtracted from individual opaque areas.	**East Windows**	**2,353**	**1546**	**1046**
4	**South Windows**	**A**	**100,80**	m²	which is displayed in the "Windows" worksheet.	**South Windows**	**2,818**	**13898**	**10153**
5	**West Windows**	**A**	**26,46**	m²		**West Windows**	**2,618**	**1231**	**1467**
6	**Horizontal Windows**	**A**	**0,00**	m²		**Horizontal Windows**			
7	**Exterior Door**	**A**	**3,00**	m²	*Please subtract area of door from respective building assembly*	**Exterior Door**	**0,800**		
8	**Exterior Wall - Ambient**	**A**	**539,24**	m²	*Temperature Zone "A" is ambient air.*	**Exterior Wall - Ambient**	**0,130**	**75**	**207**
9	**Exterior Wall - Ground**	**B**	**0,00**	m²	*Temperature zone "B" is the ground.*	**Exterior Wall - Ground**			
10	**Roof/Ceiling - Ambient**	**A**	**955,36**	m²		**Roof/Ceiling - Ambient**	**0,110**	**782**	**1413**
11	**Floor slab / basement ceiling**	**B**	**910,21**	m²		**Floor slab / basement ceiling**	**1,977**		
12			**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*				
13			**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"* Factor for X				
14		**X**	**0,00**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f_i < 1):* **75%**				
						Thermal bridges - Overview	**Ψ [W/(mK)]**		
15	**Thermal Bridges Ambient**	**A**	**203,27**	m	*Units in m*	**Thermal Bridges Ambient**	**0,081**		
16	**Perimeter Thermal Bridges**	**P**	**123,80**	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*	**Perimeter Thermal Bridges**	**-0,036**		
17	**Thermal bridges FS/BC**	**B**	**0,00**	m	*Units in m*	**Thermal bridges FS/BC**			
18	**Partition Wall to Neighbour**	**I**	**0,00**	m²	*No heat losses, only considered for the heating load calculation.*	**Partition Wall to Neighbour**			
Total thermal envelope			**2605,79**	**m²**		**Average Therm. Envelope**	**0,964**		

Go to building components list

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																								

EnerPHit planning: **AREAS DETERMINATION**

Building: Primary School 3 "Tzanko Diustabanov" - Section A Heating demand 46 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment		Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
1	Treated Floor Area		848,40	m²	*Treated floor area according to PHPP manual*				9 months	8 months
2	North Windows	A	58,20	m²	Results come from the 'Windows' worksheet.		North Windows	2,390	3416	6098
3	East Windows	A	12,52	m²	Window areas are subtracted from individual opaque areas.		East Windows	2,353	1546	1046
4	South Windows	A	100,80	m²	which is displayed in the "Windows" worksheet.		South Windows	2,818	13898	10153
5	West Windows	A	26,46	m²			West Windows	2,618	1231	1467
6	Horizontal Windows	A	0,00	m²			Horizontal Windows			
7	Exterior Door	A	3,00	m²	*Please subtract area of door from respective building assembly*		Exterior Door	0,800		
8	Exterior Wall - Ambient	A	539,24	m²	*Temperature Zone "A" is ambient air.*		Exterior Wall - Ambient	0,130	75	207
9	Exterior Wall - Ground	B	0,00	m²	*Temperature zone "B" is the ground.*		Exterior Wall - Ground			
10	Roof/Ceiling - Ambient	A	955,36	m²			Roof/Ceiling - Ambient	0,110	782	1413
11	Floor slab / basement ceiling	B	910,21	m²			Floor slab / basement ceiling	1,977		
12			0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*					
13			0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*	Factor for X				
14		X	0,00	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f_i < 1):*	75%				
							Thermal bridges - Overview	Ψ [W/(mK)]		
15	Thermal Bridges Ambient	A	203,27	m	*Units in m*		Thermal Bridges Ambient	0,081		
16	Perimeter Thermal Bridges	P	123,80	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*		Perimeter Thermal Bridges	-0,036		
17	Thermal bridges FS/BC	B	0,00	m	*Units in m*		Thermal bridges FS/BC			
18	Partition Wall to Neighbour	I	0,00	m²	*No heat losses, only considered for the heating load calculation.*		Partition Wall to Neighbour			
Total thermal envelope			2605,79	m²			Average Therm. Envelope	0,964		

Go to building components list

Thermal Bridge Inputs

Nr.	Thermal bridge description	Group Nr.	Assigned to group	Quantity	x (	User determined length [m]	-	Subtraction user-determined length [m]	)=	Length ℓ [m]	Input of thermal bridge heat loss coefficient W/(mK)	Ψ W/(mK)
1	Roof_connection	15	Thermal Bridges Ambient	1	x (	34,13	-		) =	34,13	Roof_connection	0,072
2	Roof_con.-wall_Gym	15	Thermal Bridges Ambient	1	x (	33,37	-		) =	33,37	Roof_con.-wall_Gym	0,025
3	Roof_to_wall_Gym	15	Thermal Bridges Ambient	1	x (	112,77	-		) =	112,77	Roof_to_wall_Gym	0,097
4	Roof_to_roof_windows	15	Thermal Bridges Ambient	1	x (	23,00	-		) =	23,00	Roof_to_roof_windows	0,097
5	Floor_Gym	16	Perimeter Thermal Bridges	1	x (	90,20	-		) =	90,20	Floor_Gym	-0,036
6	Floor_Dressrooms	16	Perimeter Thermal Bridges	1	x (	33,60	-		) =	33,60	Floor_Dressrooms	-0,036
7					x (		-		) =			
8					x (		-		) =			
9					x (		-		) =			
10					x (		-		) =			
11					x (		-		) =			
12					x (		-		) =			
13					x (		-		) =			
14					x (		-		) =			
15					x (		-		) =			
16					x (		-		) =			
17					x (		-		) =			
18					x (		-		) =			
19					x (		-		) =			
20					x (		-		) =			
21					x (		-		) =			
22					x (		-		) =			
23					x (		-		) =			
24					x (		-		) =			
25					x (		-		) =			
26					x (		-		) =			
27					x (		-		) =			
28					x (		-		) =			
29					x (		-		) =			
30					x (		-		) =			
31					x (		-		) =			

EnerPHit planning: **AREAS DETERMINATION**

Building: Primary School 3 "Tzanko Diustabanov" - Section A — Heating demand 46 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment		Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
1	**Treated Floor Area**		**848,40**	m²	*Treated floor area according to PHPP manual*				**9 months**	**8 months**
2	**North Windows**	**A**	**58,20**	m²	Results come from the 'Windows' worksheet.		**North Windows**	**2,390**	**3416**	**6098**
3	**East Windows**	**A**	**12,52**	m²	Window areas are subtracted from individual opaque areas.		**East Windows**	**2,353**	**1546**	**1046**
4	**South Windows**	**A**	**100,80**	m²	which is displayed in the "Windows" worksheet.		**South Windows**	**2,818**	**13898**	**10153**
5	**West Windows**	**A**	**26,46**	m²			**West Windows**	**2,618**	**1231**	**1467**
6	**Horizontal Windows**	**A**	**0,00**	m²			**Horizontal Windows**			
7	**Exterior Door**	**A**	**3,00**	m²	*Please subtract area of door from respective building assembly*		**Exterior Door**	**0,800**		
8	**Exterior Wall - Ambient**	**A**	**539,24**	m²	*Temperature Zone "A" is ambient air.*		**Exterior Wall - Ambient**	**0,130**	**75**	**207**
9	**Exterior Wall - Ground**	**B**	**0,00**	m²	*Temperature zone "B" is the ground.*		**Exterior Wall - Ground**			
10	**Roof/Ceiling - Ambient**	**A**	**955,36**	m²			**Roof/Ceiling - Ambient**	**0,110**	**782**	**1413**
11	**Floor slab / basement ceiling**	**B**	**910,21**	m²			**Floor slab / basement ceiling**	**1,977**		
12			**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*					
13			**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*	Factor for X				
14		**X**	**0,00**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f_i < 1):*	**75%**				
							Thermal bridges - Overview	**Ψ [W/(mK)]**		
15	**Thermal Bridges Ambient**	**A**	**203,27**	m	*Units in m*		**Thermal Bridges Ambient**	**0,081**		
16	**Perimeter Thermal Bridges**	**P**	**123,80**	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*		**Perimeter Thermal Bridges**	**-0,036**		
17	**Thermal bridges FS/BC**	**B**	**0,00**	m	*Units in m*		**Thermal bridges FS/BC**			
18	**Partition Wall to Neighbour**	**I**	**0,00**	m²	*No heat losses, only considered for the heating load calculation.*		**Partition Wall to Neighbour**			
Total thermal envelope			**2605,79**	**m²**			**Average Therm. Envelope**	**0,964**		

Go to building components list

32					x (		-		) =			
33					x (		-		) =			
34					x (		-		) =			
35					x (		-		) =			
36					x (		-		) =			
37					x (		-		) =			
38					x (		-		) =			
39					x (		-		) =			
40					x (		-		) =			
41					x (		-		) =			
42					x (		-		) =			
43					x (		-		) =			
44					x (		-		) =			
45					x (		-		) =			
46					x (		-		) =			
47					x (		-		) =			
48					x (		-		) =			
49					x (		-		) =			
50					x (		-		) =			

TBend

A tool for thermal bridge conversion to exterior dimensions					
Description		Units	Example		
	Ψ Interior Dimensions	W/(mK)	0,027		
	Temperature Diff. TB	K	30,000		
Adjacent Aarea I	Temperature Diff. Δϑ I	K	30,000		
	Exterior - Interior Dim. I	m	0,400		
	U-Value building assembly I	W/(m²K)	0,138		
Adjacent Area II	Temperature Diff. Δϑ II	K	30,000		
	Exterior - Interior Dim. II	m	0,300		
	U-Value building assembly II	W/(m²K)	0,110		
	Ψ Exterior Dimensions	W/(mK)	-0,061		

EnerPHit planning:

HEAT LOSSES THROUGH THE GROUND

Building part 1

Ground characteristics			
Thermal conductivity	λ	2,0	W/(mK)
Heat capacity	ρc	2,0	MJ/(m³K)
Periodic Penetration Depth	δ	3,17	m

Climate data			
Av. Indoor Temp. Winter	T_i	18,0	°C
Av. Indoor Temp. Summer	T_i	24,0	°C
Average Ground Surface Temperature	$T_{g,ave}$	11,7	°C
Amplitude of $T_{g,ave}$	$T_{g,\wedge}$	11,4	°C
Phase shifting of $T_{e,m}$	τ	1,0	Months
Length of the Heating Period	n	6,2	Months
Heating Degree Hours - Exterior	G_t	65,3	kKh/a

Building data							
Area of ground floor slab / basement ceiling	A	910,2	m²	U-value floor slab/basement ceiling	U_f	1,977	W/(m²K)
Perimeter length	P	123,8	m	Thermal bridges floor slab/basement ceiling	Ψ_B*l	0,00	W/K
Charact. Dimension of floor slab	B'	14,71	m	U-value floor slab / basement ceiling incl. TB	U_f'	1,977	W/(m²K)
				Eq. Thickness Floor	d_t	1,01	m

Floor Slab Type (select only one)

x **Slab on Grade**

Perimeter Insulation Width/Depth	D	0,40	m	Orientation of the Perimeter Ins.	horizontal		
Perimeter Insulation Thickness	d_n	0,20	m	(check only one field)	vertical	x	
Conductivity perimeter insulation	λ_n	0,033	W/(mK)				

Heated basement or floor slab completely / partially below ground level

Basement wall height below ground level	z		m	U-Value below ground wall	U_{wB}		W/(m²K)

Unheated basement

Height aboveground wall	h		m	U-Value above ground wall	U_W		W/(m²K)
Basement wall height below ground level	z		m	U-Value below ground wall	U_{wB}		W/(m²K)
Air Change Unheated Basement	n		h^{-1}	U-Value Basement Floor Slab	U_{fB}		W/(m²K)
Air flow basement	V		m³				

Suspended Floor Above a Ventilated Crawl Space (at max. 0.5 m Below Ground)

U-Value Crawl Space	U_{Crawl}		W/(m²K)	Area of Ventilation Openings	εP		m²
Height of crawl space wall	h		m	Wind Velocity at 10 m Height	v	4,0	m/s
U-Value crawl space wall	U_W		W/(m²K)	Wind Shield factor	f_W	0,05	-

Additional Thermal Bridge Heat Losses at Perimeter							
				Steady-State Fraction	$\Psi_{P,stat}$*l	-4,457	W/K
Phase shift	β		Months	Harmonic Fraction	$\Psi_{P,harm}$*l	-4,457	W/K

Groundwater correction							
Depth of the Groundwater Table	z_w	3,0	m	Groundwater Correction Factor	G_w	#DIV/0!	-
Groundwater flow rate	q_w	0,05	m/d				

Interim Results

Phase shift	β	0,90	Months	Steady-state heat flow	Φ_{stat}	1586,8	W
Steady-state transmittance	L_S	251,07	W/K	Periodic Heat Flow	Φ_{harm}	625,2	W
Exterior Periodic transmittance	L_{pe}	100,94	W/K	Heat Losses During Heating Period	Q_{tot}	10042	kWh
Transmittance building	L_0	1794,63	W/K				

Monthly Average temperatures in the ground for monthly method (building assembly 1)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Average value
Winter	16,6	16,5	16,6	16,8	17,1	17,5	17,7	17,8	17,7	17,4	17,1	16,8	17,1
Summer	21,7	21,6	21,7	22,0	22,3	22,6	22,8	22,9	22,8	22,6	22,3	21,9	22,3

Design ground temperature for 'Heating load' worksheet 16,5 **For 'Cooling load' worksheet** 22,9

Reduction factor for 'Annual heating' worksheet 0,09

Total result (all building parts)

Phase shift	β	0,90	Months	Steady-state heat flow	Φ_{stat}	1586,8	W
Steady-state transmittance	L_S	251,07	W/K	Periodic Heat Flow	Φ_{harm}	625,2	W
Exterior Periodic transmittance	L_{pe}	100,94	W/K	Heat Losses During Heating Period	Q_{tot}	10042	kWh
Transmittance building	L_0	1794,63	W/K	Charact. Dimension of floor slab	B'	14,71	m

Monthly Average temperatures in the ground for monthly method (all building assemblies)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Average value
Winter	16,6	16,5	16,6	16,8	17,1	17,5	17,7	17,8	17,7	17,4	17,1	16,8	17,1
Summer	21,7	21,6	21,7	22,0	22,3	22,6	22,8	22,9	22,8	22,6	22,3	21,9	22,3

Design ground temperature for 'Heating load' worksheet 16,5 **For 'Cooling load' worksheet** 22,9

Reduction factor for 'Annual heating' worksheet 0,09

Go to: 'AREAS'
Glazing
Window frame
http://www.passiv.de/komponentendatenbank/en-EN
Ventilation units
Compact units

Building assemblies (U-values)

		1			
ID	**Building system**	**Building assembly**	**Total thickness**	**U-Value**	**Interior insulation**
	Summary of the constructions calculated in 'U values' worksheet		m	W/(m²K)	-
01ud	Block C - plaster	Block C - plaster	0,510	0,130	
02ud	Block C - plaster external insulation	Block C - plaster external insulation	0,510	0,130	
03ud					
04ud					
05ud					
06ud					
07ud	Floor slab on grade (tiles)	Floor slab on grade (tiles)	0,520	2,586	
08ud	Floor slab on grade (Gym)	Floor slab on grade (Gym)	0,430	1,767	
09ud					
10ud	Roof dressingrooms direct to external a	Roof dressingrooms direct to external a	0,600	0,101	

Glazing

Glazing

ID	Description	g-Value	U_g-Value
			W/(m²K)
01ud	44 mm. triple glazing, 2 Low-E, air, alum.spacer	0,51	0,70
02ud			
03ud			
04ud			
05ud			
06ud			
07ud			
08ud			
09ud			
10ud			

Window frames

Window frames

		U_f-Value				Frame Width				Glazing edge thermal bridge				Installation thermal bridge				Curtain wall facades:
ID	Description	left	right	bottom	above	left	right	bottom	above	$\Psi_{Glazing\ edge}$ left	$\Psi_{Glazing\ edge}$ right	$\Psi_{Glazing\ edge}$ bottom	$\Psi_{Glazing\ edge}$ top	$\Psi_{Installation}$ left	$\Psi_{Installation}$ right	$\Psi_{Installation}$ bottom	$\Psi_{Installation}$ top	χ_{GC} -value Glass carrier
		W/(m²K)	W/(m²K)	W/(m²K)	W/(m²K)	m	m	m	m	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/K
01ud	EXISTING: metal, thermal break	2,40	2,40	2,40	2,40	0,140	0,140	0,140	0,140	0,040	0,040	0,040	0,040	0,088	0,088	0,088	0,088	
02ud	EXISTING: synthetic before 1998	1,80	1,80	1,80	1,80	0,140	0,140	0,140	0,140	0,050	0,050	0,050	0,050	0,088	0,088	0,088	0,088	
03ud	VEKA AG ALPHALINE 90 MD	0,97	0,97	0,97	0,97	0,118	0,118	0,118	0,118	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	
04ud																		
05ud																		
06ud																		
07ud																		
08ud																		
09ud																		
10ud																		

Ventilation units with heat recovery

Ventilation units with heat recovery

					Additional Device Data								
ID	Description	Heat recovery efficiency	Energy recovery value η_{FRG}	Electric efficiency	Entry area		External pressure per line	Fittings Δp_{intern}	Frost protection required	Noise protection			Additional info
	User defined area	%	%	Wh/m³	m³/h	m³/h	Pa	Pa		35 dB(A)	Supply air dB(A)	Extract air dB(A)	
01ud	Tangra ventilation unit EVB 04 HiE	82%	0%	0,40	150	400	100	incl.	yes	–	57	57	
02ud	Tangra ventilation unit EVB 06 HiE	82%	0%	0,40	250	600	100	incl.	yes	–	61	61	
03ud	Tangra ventilation unit EVB 08 HiE	82%	0%	0,40	400	800			yes	–	61	61	
04ud	Tangra ventilation unit EVB 10 HiE	82%	0%	0,40	500	1000			yes	–	61	61	
05ud	Tangra ventilation unit EVB 12 HiE	82%	0%	0,40	750	1200			yes	–	68	68	
06ud	Tangra ventilation unit EVB 16 HiE	82%	0%	0,40	800	1600			yes	–	68	68	
07ud	Tangra ventilation unit EVB 20 HiE	82%	0%	0,40	1000	2000			yes	–	68	68	
08ud													
09ud													
10ud													

REDUCTION FACTOR SOLAR RADIATION, WINDOW U-VALUE

Building: primary School 3 "Tzanko Diustabanov" - Section A

Annual heating demand: 46 kWh/(m²a)

Heating degree hours: 65,3

Climate: User data - Велико Търнов PHI

Window area orientation	Global radiation (cardinal points)	Shading	Dirt	Non-perpendicular incident radiation	Glazing fraction	g-Value	Solar radiation reduction factor	Window area	Window U-Value	Glazing area	Average global radiation	Transmission losses	Heat gains solar radiation
maximum:	kWh/(m²a)	0,75	0,95	0,85				m²	W/(m²K)	m²	kWh/(m²a)	kWh/a	kWh/a
North	122	0,68	0,95	0,85	0,541	0,70	0,30	58,20	2,39	31,48	142	9085	1718
East	240	0,70	0,95	0,85	0,495	0,70	0,28	12,52	2,35	6,20	368	1924	901
South	432	0,67	0,95	0,85	0,529	0,77	0,28	100,80	2,82	53,29	370	18547	8168
West	243	0,60	0,95	0,85	0,445	0,72	0,22	26,46	2,62	11,76	151	4524	622
htin Horizontal	400	1,00	0,95	0,85	0,000	0,00	0,00	0,00	0,00	0,00	400	0	0
Total or Average Value for All Windows.						0,74	0,28	197,98	2,64	102,73		34080	11409

Go to glazing list Go to window frames list

Quantity	Description	Deviation from North	Angle of inclination from the horizontal	Orientation	Window rough openings Width	Window rough openings Height	installed in: Selection from worksheet 'Areas'	Glazing: Selection from worksheet 'Components'	Frame: Selection from worksheet 'Components'	g-Value: Perpendicular Radiation	U-Value: Glazing	U-Value: Frames (centre)	Ψ Glazing edge: Ψspacer (centre)	Installation situation: left	right	bottom	above	Ψinstallation (Average)	Results: Window Area	Glazing Area	U-Value Window	Glazed fraction per window	Transmission losses	Solar gains
		Degrees	Degrees		m	m		Sort: AS LIST	Sort: AS LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%	kWh/a	kWh/a
2	Type 1 North	0	90	North	0,600	1,440	1-North facade 1	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	1	0	1	1	0,040	1,7	0,88	1,06	51%	120	36
2		0	90	North	0,600	1,440	1-North facade 1	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	0	1	1	1	0,040	1,7	0,88	1,06	51%	120	36
1	Type 2 North	0	90	North	0,900	0,900	1-North facade 1	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	1	1	1	1	0,040	0,8	0,44	1,10	54%	58	18
5	Type 3 North	0	90	North	1,050	0,950	3-North facade 2	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	1	0	1	1	0,040	5,0	2,91	1,03	58%	334	122
5		0	90	North	1,050	0,950	3-North facade 2	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	0	1	1	1	0,040	5,0	2,91	1,03	58%	334	122
2	Type 3 North-wes	315	90	West	1,050	0,950	4-North-west façade 1	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	1	0	1	1	0,040	2,0	1,16	1,03	58%	134	59
2		315	90	West	1,050	0,950	4-North-west façade 1	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	0	1	1	1	0,040	2,0	1,16	1,03	58%	134	59
2	Type 4 North-eas	45	90	North	0,800	1,500	5-North-east façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	0	1	0,088	2,4	1,27	2,90	53%	454	76
2		45	90	North	0,800	1,500	5-North-east façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	0	1	0,088	2,4	1,27	2,90	53%	454	76
2		45	90	North	0,800	1,500	5-North-east façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	1	0	0,088	2,4	1,27	2,90	53%	454	76
2		45	90	North	0,800	1,500	5-North-east façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	1	0	0,088	2,4	1,27	2,90	53%	454	76
10		45	90	North	0,800	1,500	5-North-east façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	0	1	0	0,088	12,0	6,34	2,79	53%	2183	378
10		45	90	North	0,800	1,500	5-North-east façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	0	0	1	0,088	12,0	6,34	2,79	53%	2183	378
6	Type 4 South-wes	225	90	South	0,800	1,500	7-South-west façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	0	1	0,088	7,2	3,81	2,90	53%	1362	583
6		225	90	South	0,800	1,500	7-South-west façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	0	1	0,088	7,2	3,81	2,90	53%	1362	583
6		225	90	South	0,800	1,500	7-South-west façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	1	0	0,088	7,2	3,81	2,90	53%	1362	583
6		225	90	South	0,800	1,500	7-South-west façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	1	0	0,088	7,2	3,81	2,90	53%	1362	583
30		225	90	South	0,800	1,500	7-South-west façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	0	1	0	0,088	36,0	19,03	2,79	53%	6550	2917
30		225	90	South	0,800	1,500	7-South-west façade 1	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	0	0	1	0,088	36,0	19,03	2,79	53%	6550	2917
1	Type 5 South-wes	45	90	North	0,800	1,850	9-North-east façade 2	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	1	1	0,088	1,5	0,82	2,94	55%	284	50
5		45	90	North	0,800	1,850	9-North-east façade 2	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	0	1	1	0,088	7,4	4,08	2,83	55%	1367	249
1		45	90	North	0,800	1,850	9-North-east façade 2	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	1	1	0,088	1,5	0,82	2,94	55%	284	50
1	Door	135	90	East	0,800	1,800	23-South-east façade 3	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	0	1	0,088	1,4	0,79	2,89	55%	272	123
1		135	90	East	0,800	1,000	23-South-east façade 3	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	0	1	0,088	0,8	0,37	2,91	47%	152	54
1		135	90	East	1,600	0,900	23-South-east façade 3	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	0	0	0,088	1,4	0,82	2,79	57%	262	133
1		135	90	East	1,600	0,900	23-South-east façade 3	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	0	0	0	0,000	1,4	0,82	2,74	57%	257	133
1		135	90	East	1,600	1,000	23-South-east façade 3	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	0	0	0,088	1,6	0,95	2,79	59%	292	158
1		135	90	East	0,600	0,900	23-South-east façade 3	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	1	0	0,088	0,5	0,20	2,93	37%	103	25
1		135	90	East	0,600	0,900	23-South-east façade 3	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	0	1	0	0,088	0,5	0,20	2,78	37%	98	25
1		135	90	East	0,600	1,000	23-South-east façade 3	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	1	0	0,088	0,6	0,23	2,93	38%	115	30
2	Type 6 South eas	135	90	East	0,600	0,800	10-South-east façade 2	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	1	1	0	1	0,040	1,0	0,41	1,15	43%	72	48
2		135	90	East	0,600	1,600	10-South-east façade 2	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	1	1	0	0	0,040	1,9	0,99	1,07	52%	134	122
2		135	90	East	0,600	0,600	10-South-east façade 2	01ud 44 mm. triple glazing, 2 Low-E, air, al	03ud VEKA AG ALPHALINE 90 MD	0,51	0,70	0,97	0,030	1	1	1	0	0,040	0,7	0,26	1,19	37%	56	30
1	Roof triangle	135	90	East	1,160	0,450	21-South-east façade 2	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	1	1	1	0,088	0,5	0,15	3,22	29%	110	19
1	Roof triangle	315	90	West	1,160	0,450	22-North-west façade 2	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	1	1	1	0,088	0,5	0,15	3,22	29%	110	7
1	Roof	315	90	West	0,700	0,950	16-South-west façade 2	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	1	0	1	1	0,088	0,7	0,28	3,01	42%	131	15
31	Roof	315	90	West	0,700	0,950	16-South-west façade 2	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	0	1	1	0,088	20,6	8,72	2,89	42%	3885	466
1	Roof	315	90	West	0,700	0,950	16-South-west façade 2	97ud Double glazing 4/30mm air/7	01ud EXISTING: metal, thermal break	0,77	2,80	2,40	0,040	0	1	1	1	0,088	0,7	0,28	3,01	42%	131	15

CALCULATING SHADING FACTORS

Climate: User data - Велико Търнов PHI

Building: primary School 3 "Tzanko Diustabanov" - Section A

Latitude: 43,086 °

s

Orientation	Glazing area	Reduction factor winter	Summer reduction factor
	m²	r_S	r_S
North	31,48	68%	78%
East	6,20	70%	39%
South	53,29	67%	41%
West	11,76	60%	48%
Horizontal	0,00	100%	100%

Space heating demand:	46,3	kWh/(m²a)
Useful Cooling Demand:	0,3	kWh/(m²a)
Frequency of overheating:	0,1%	

								Horizon		Reveal		Overhang					Winter				Summer			
Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Glazing width	Glazing height	Glazing area	Height of the shading object	Horizontal distance	Window reveal depth	Distance from glazing edge to reveal	Overhang depth	Distance from upper glazing edge to overhang	Additional reduction factor winter shading	Additional reduction factor summer shading	Reduction factor z for temporary sun protection	Horizontal shading reduction factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor
		Degrees	Degrees		m	m		m	m	m	m	m	m	%	%	%	%	%	%	%	%	%	%	%
					w_G	h_G	A_G	h_{Hori}	d_{Hori}	o_{Reveal}	d_{Reveal}	o_{over}	d_{over}	$r_{other,w}$	$r_{other,s}$	z	r_H	r_R	r_O	r_S	r_H	r_R	r_O	r_S
2	Type 1 North	0	90	North	0,36	1,20	0,9			0,16	0,131	0,16	0,13				100%	86%	94%	81%	100%	86%	98%	85%
2		0	90	North	0,36	1,20	0,9			0,16	0,13	0,16	0,13				100%	86%	94%	81%	100%	86%	98%	85%
1	Type 2 North	0	90	North	0,66	0,66	0,4			0,16	0,131	0,16	0,13				100%	90%	91%	82%	100%	90%	96%	86%
5	Type 3 North	0	90	North	0,81	0,71	2,9			0,16	0,131	0,16	0,13				100%	92%	91%	84%	100%	92%	96%	88%
5		0	90	North	0,81	0,71	2,9			0,16	0,131	0,16	0,13				100%	92%	91%	84%	100%	92%	96%	88%
2	Type 3 North-w	315	90	West	0,81	0,71	1,2			0,16	0,131	0,16	0,13				100%	90%	91%	82%	100%	94%	96%	90%
2		315	90	West	0,81	0,71	1,2			0,16	0,131	0,16	0,13				100%	90%	91%	82%	100%	94%	96%	90%
2	Type 4 North-e	45	90	North	0,52	1,22	1,3			0,35	0,120	0,35	0,12				100%	74%	87%	64%	100%	83%	92%	76%
2		45	90	North	0,52	1,22	1,3			0,35	0,120	0,35	0,12				100%	74%	87%	64%	100%	83%	92%	76%
2		45	90	North	0,52	1,22	1,3			0,35	0,120	0,35	0,12				100%	74%	87%	64%	100%	83%	92%	76%
2		45	90	North	0,52	1,22	1,3			0,35	0,120	0,35	0,12				100%	74%	87%	64%	100%	83%	92%	76%
10		45	90	North	0,52	1,22	6,3			0,35	0,120	0,35	0,12				100%	74%	87%	64%	100%	83%	92%	76%
10		45	90	North	0,52	1,22	6,3			0,35	0,120	0,35	0,12				100%	74%	87%	64%	100%	83%	92%	76%
6	Type 4 South-w	225	90	South	0,52	1,22	3,8			0,35	0,120	0,35	0,12			60%	100%	75%	89%	67%	100%	82%	84%	41%
6		225	90	South	0,52	1,22	3,8			0,35	0,120	0,35	0,12			60%	100%	75%	89%	67%	100%	82%	84%	41%
6		225	90	South	0,52	1,22	3,8			0,35	0,120	0,35	0,12			60%	100%	75%	89%	67%	100%	82%	84%	41%
6		225	90	South	0,52	1,22	3,8			0,35	0,120	0,35	0,12			60%	100%	75%	89%	67%	100%	82%	84%	41%
30		225	90	South	0,52	1,22	19,0			0,35	0,120	0,35	0,12			60%	100%	75%	89%	67%	100%	82%	84%	41%
30		225	90	South	0,52	1,22	19,0			0,35	0,120	0,35	0,12			60%	100%	75%	89%	67%	100%	82%	84%	41%
1	Type 5 South-w	45	90	North	0,52	1,57	0,8			0,35	0,120	0,35	0,12				100%	74%	90%	66%	100%	83%	94%	78%
5		45	90	North	0,52	1,57	4,1			0,35	0,120	0,35	0,12				100%	74%	90%	66%	100%	83%	94%	78%
1		45	90	North	0,52	1,57	0,8			0,35	0,120	0,35	0,12				100%	74%	90%	66%	100%	83%	94%	78%
1	Door	135	90	East	0,52	1,52	0,8			0,35	0,120	0,35	0,12			60%	100%	75%	91%	68%	100%	82%	88%	43%
1		135	90	East	0,52	0,72	0,4			0,35	0,120	0,35	0,12			60%	100%	75%	84%	63%	100%	82%	71%	35%
1		135	90	East	1,32	0,62	0,8			0,35	0,120	0,35	0,12			60%	100%	86%	82%	71%	100%	90%	67%	36%
1		135	90	East	1,32	0,62	0,8			0,35	0,120	0,35	0,12			60%	100%	86%	82%	71%	100%	90%	67%	36%
1		135	90	East	1,32	0,72	1,0			0,35	0,120	0,35	0,12			60%	100%	86%	84%	73%	100%	90%	71%	39%
1		135	90	East	0,32	0,62	0,2			0,35	0,120	0,35	0,12			60%	100%	68%	82%	56%	100%	77%	67%	31%
1		135	90	East	0,32	0,62	0,2			0,35	0,120	0,35	0,12			60%	100%	68%	82%	56%	100%	77%	67%	31%
1		135	90	East	0,32	0,72	0,2			0,35	0,120	0,35	0,12			60%	100%	68%	84%	57%	100%	77%	71%	33%
2	Type 6 South e	135	90	East	0,36	0,56	0,4			0,16	0,131	0,16	0,13			60%	100%	85%	91%	77%	100%	89%	89%	47%
2		135	90	East	0,36	1,36	1,0			0,16	0,131	0,16	0,13			60%	100%	85%	95%	81%	100%	89%	97%	52%
2		135	90	East	0,36	0,36	0,3			0,16	0,131	0,16	0,13			60%	100%	85%	88%	75%	100%	89%	82%	44%
1	Roof triangle	135	90	East	0,88	0,17	0,1			0,35	0,120	0,35	0,12			60%	100%	82%	67%	55%	100%	87%	42%	22%
1	Roof triangle	315	90	West	0,88	0,17	0,1			0,35	0,120	0,35	0,12				100%	81%	64%	52%	100%	88%	60%	53%
1	Roof	315	90	West	0,42	0,67	0,3			0,35	0,120	0,35	0,12			60%	100%	71%	81%	57%	100%	81%	83%	40%
31	Roof	315	90	West	0,42	0,67	8,7			0,35	0,120	0,35	0,12			60%	100%	71%	81%	57%	100%	81%	83%	40%
1	Roof	315	90	West	0,42	0,67	0,3			0,35	0,120	0,35	0,12			60%	100%	71%	81%	57%	100%	81%	83%	40%

EnerPHit planning: **V E N T I L A T I O N D A T A**

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Treated floor area A_{TFA}		m²	848	*(Areas worksheet)*
Room Height h		m	2,50	
Room ventilation volume (A_{TFA}*h) =	V_V	m³	2121	*(Worksheet Annual heating)*

Ventilation type

Please select: **Balanced PH-Ventilation with HR**

Infiltration air change rate

Wind protection coefficients e and f	Several sides exposed	One side exposed
Coefficient e for screening class		
No screening	0,10	0,03
Moderate screening	0,07	0,02
High screening	0,04	0,01
Coefficient f	15	20

			for annual demand:	for Heating Load:				
Wind protection coefficient, e			0,07	0,18				
Wind protection coefficient, f			15	15	Net Air Volume for Press. Test	V_{n50}	Air permeability	q_{50}
Air Change Rate at Press. Test	n_{50}	1/h	2,00	2,00		m³		m³/(hm²)

			for annual demand:	for Heating Load:
Excess extract air		1/h	0,00	0,00
Infiltration air change rate	$n_{V,Rest}$	1/h		

Selection of ventilation data input - Results

The PHPP offers two methods for dimensioning the air quantities and choosing the ventilation unit. Fresh air or extract air quantities for residential buildings and parameters for ventilation system can be determined using the standard planning option in the 'Ventilation' sheet. The 'Additional Vent' sheet has been created for more complex ventilation systems and allows up to 10 different ve Furthermore, air quantities can be determined on a room-by-room or zone-by-zone basis. Please select your design method here.

	Ventilation unit / Heat recovery efficiency design		Average Air Exchange m³/h	Average Air Change Rate 1/h	Extract air excess (Extract air system) 1/h	Effective heat recovery efficiency Unit [-]	Energy recovery value [-]	Specific power input Wh/m³	Heat recovery efficiency SHX [-]
	Standard design	*(Ventilation worksheet see below)*							
x	Various vent. units, non residential	*(Worksheet Additional vent)*	808	0,38	0,00	81,0%	0,0%	0,40	0,0%

SHX efficiency η^*_{SHX} 0%

STANDARD INPUT FOR BALANCED VENTILATION

Ventilation dimensioning for systems with one ventilation unit

Calculation in sheet 'Additional Vent': Extended data input for balanced ventilation

Occupancy	m²/P	17				
Number of occupants	P	50,0				
Supply air per person	m³/(P*h)	30				
Supply air requirement	m³/h	1500				
Extract air rooms		Kitchen	Bathroom	Bathroom (shower only)	WC	
Quantity						
Extract air requirement per room	m³/h	60	40	20	20	
Total Extract Air Requirement	m³/h	0				

Design air flow rate (maximum) m³/h

Average air change rate calculation

Type of operation	Daily operation duration h/d	Factors referenced to maximum	Air flow rate m³/h	Air change rate 1/h
maximum		1,00	#WERT!	#WERT!
Standard	24,0	0,77	#WERT!	#WERT!
Basic		0,54	#WERT!	#WERT!
Minimum		0,40	#WERT!	#WERT!
			Average air flow rate (m³/h)	Average air change rate (1/h)
	Average value	0,77		

Selection of ventilation unit with heat recovery

Installation site of ventilation unit: Inside the thermal envelope

Heat recovery?

Ventilation unit selection (Sort: BY ID)	Heat recovery efficiency Unit η_{HR}	Energy recovery η_{ERV}	Specific power input [Wh/m³]	Application range [m³/h]	Frost required

Go to ventilation units list

Conductance value of exterior air duct Ψ	W/(mK)	0,000	See calculation below
Length of exterior air duct	m		
Conductance value of exhaust air duct Ψ	W/(mK)	0,000	See calculation below
Length of exhaust air duct	m		
Temperature of mechanical services room (Enter only if the central unit is outside of the thermal envelope.)	°C		

Room temperature (°C)	18
Av. Ambient Temp. Heating P. (°C)	4,3
Av. Ground Temp (°C)	11,7

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

Effective heat recovery efficiency subsoil heat exchanger

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

Secondary calculation

Ψ-value supply or ambient air duct

Nominal width:		mm
Insul. Thickness:		mm
Reflective?		Yes
	x	No
Thermal conductivity		W/(mK)
Nominal air flow rate		m³/h
Δϑ	14	K
Exterior duct diameter	0,000	m
Exterior diameter	0,000	m
α-Interior	0,00	W/(m²K)
α–Surface		W/(m²K)
Ψ-value		**W/(mK)**
Surface temperature difference		K

Secondary calculation

Ψ-value extract or exhaust air duct

Nominal width:		mm
Insul. Thickness:		mm
Reflective?		yes
	x	no
Thermal conductivity		W/(mK)
Nominal air flow rate		m³/h
Δϑ	14	K
Exterior duct diameter	0,000	m
Exterior diameter	0,000	m
α-Interior	0,00	W/(m²K)
α–Surface		W/(m²K)
Ψ-value		**W/(mK)**
Surface temperature difference		K

EnerPHit planning: # EXTENDED DATA INPUT FOR BALANCED VENTILATION

Planning ventilation systems with multiple ventilation units

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Ventilation unit / Heat recovery efficiency design

In Ventilation worksheet (standard design)			*(Ventilation worksheet)*
In Additional Vent (this worksheet)		x	*(Additional vent)*
Treated Floor Area A_{TFA}	m²	848	*(Areas worksheet)*
Room Height h	m	2,50	*(Worksheet Annual heating)*
Room air volume for ventilation (A_{TFA}*h) = V_v	m³	2121	*(Worksheet Annual heating)*
Number of Occupants	P	50,0	*(Ventilation worksheet)*
Room temperature	°C	18	*(Worksheet Annual heating)*
Average external temp. heating period	°C	4,3	*(Ventilation worksheet)*
Average ground temp.	°C	11,7	*(Ground worksheet)*
Ventilation type		Balanced PH-Ventilation with HR	*(Ventilation worksheet)*

Results of ventilation design and unit selection:

Venti-lation Unit no.	Description of the unit	Design V_{SUP} m³/h	Design V_{ETA} m³/h	Average value / yr. V_{SUP} m³/h	Average value / yr. V_{ETA} m³/h	Average value / yr. Air ch.rt. 1/h	Effective heat recovery efficiency	Energy recovery value	spec. Input power	Heat recov. efficiency SHX	Cross check
1	Floor 1	420	420	63	63	---	77%	0%	0,40	0%	
2	Floor 2	2000	2000	745	745	---	81%	0%	0,40	0%	
3						---					
4						---					
5						---					
6						---					
7						---					
8						---					
9						---					
10						---					
Result for overall vent. syst.		**2420**	**2420**	**808**	**808**	**0,38**	**81%**	**0%**	**0,40**	**0%**	

Recommendations for dimensioning air quantities

Use of low odour and low-emission building materials/ furnishings:
It is strongly recommended to use building materials that cause no or only little pollution instead of increasing the outdoor air volume flow in order to reduce preventable pollution.
This holds true independently from the chosen approach for the air quality determination; emissions of all sources in the room should be considered, e.g. furniture, carpets and ventilation or air-conditioning unit.

Assessment of volume flow rates according to the number of persons
Also in non-residential buildings, the number of persons is fundamentally important for assessing the volume air flow rates. For good indoor air quality the amounts of 20 to 30 m³/h/person are completely sufficient.
Higher outdoor air amounts may lead to excessively dry indoor air in winter. The air flow rates are specified by classification according to EN 13779. The classification must be agreed with the client in advance.
IDA 3 is adequate for office buildings. IDA 4 has proven satisfactory for school buildings as purge ventilation is carried out during breaks anyway. For typical external air CO_2 concentrations of around 400-500 ppm, it is possible to comply even with 1500 ppm. Exceeding this figure temporarily is permissible.

Fresh air flow rates per person:
- Recommended for residential buildings: around 30 m³/(h person)
- Recommended for offices and similar uses: around 30 m³/(h person) (AMEV: 28 m³/(h person); EN 13779 / IDA 3: at least 24 m³/(h person))
- Recommended for schools and day care centres: 15 to 20 m³/(h person) (Source: Guidelines for energy-efficient educational buildings, Passive House Institute, 2010)
- Recommendation for sport halls: 60 m³/(h person) (DIN 18032-1)

Purging phase for intermittent ventilation operation
Due to the purge ventilation phase, the ventilation operation period is extended accordingly (utilisation time + purge ventilation phase). Please consider this for the ventilation design.
Emissions have to be removed. Flushing the building prolongs the utilization time of the ventilation system (utilization time + flushing phase). Please consider this at design stage.

Design of air quantities

When designing the air quantities, please consider the design recommendations given above.
The ventilation operation period can be determined on the basis of the daily utilisation hours including purging phase if applicable. In addition, time periods with reduced ventilation requirements (operation modes) can be
Taken into account by means of reduction factors.

Room Nr.	Amount a	Room name	Asignment to ventilation unit	Area A m²	Clear height h m	Room vol. A x h m³	Volume flow per room V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h	Air change rate per room n 1/h	Utilisation times h/d h	d/week d	weeks/yr Weeks	Reduction Red.1	Operation Red. 1	Reduction Red.2	Operation Red.2	Reduction Red.3	Operation Red. 3	Cross check	Average volume flows V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h	Average air change rate 1/h
1	2	Teacher offic	1	13,5	3,00	41	50	10		1,23	12	7	32	100%	15%	60%	15%	35%	70%		15	3		0,18
2	1	Dressing room	1	36	3,00	108	160			1,48	12	7	32	100%	15%	60%	15%	35%	70%		24			0,22
3	1	Dressing room	1	27	3,00	81	140			1,73	12	7	32	100%	15%	60%	15%	35%	70%		21			0,26
4	2	Showders, batl	1	9	3,00	27		100		3,70	12	7	32	100%	15%	60%	15%	35%	70%			30		0,55
5	1	Corridor	1	62,87	3,00	189	20	150		0,80	12	7	32	100%	15%	60%	15%	35%	70%		3	22		0,12
6	1	Gym-storage	1	25,47	3,00	76		50		0,65	12	7	32	100%	15%	60%	15%	35%	70%			7		0,10
7	1	Gym	2	630,76	8,00	5046	1600	2000		0,40	15	7	50	100%	30%	60%	30%	35%	40%		596	745		0,15
8	1	Tribune	2	46,79	3,00	140	400			2,85	15	7	50	100%	30%	60%	30%	35%	40%		149			1,06
9	1	Stairs	1	9,08	8,00	73			50	0,69	12	7	32	100%	15%	60%	15%	35%	70%				7	0,10
10														100%	100%									
11														100%	100%									
12														100%	100%									
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Ventilation unit selection

Up to 10 different ventilation units are considered. By changing the amount, identical units can be considered. The data from PHI certified ventilation units
as well as the entry data lines for user data for other ventilation units can also be found in the worksheet "Components". When choosing to use a compact unit the standard design in the Ventilation worksheet has to be used.

Go to ventilation units list

Venti-lation Unit no.	Quan-tity [-]	Description Ventilation units	Selection Unit type	Design vol. flow per unit m³/h	Entry area for volume flow rate from m³/h	to m³/h	Electrical efficiency Wh/m³	Pressure loss calculation ODA-SUP Δp_{duct} Pa	ETA-EHA Δp_{duct} Pa	Additional Δp_{intern} Pa	Entry area per line $\Delta p_{external}$ Pa	Subtraction Δp_{intern} Pa	Cross check ---------- Pressure loss assessment duct network	Interior location (x)	Exterior location (x)	Heat recovery efficiency Unit [-]	effective [-]	Energy recovery value [-]	Frost protection necessary	Subsoil HX Effective-efficiency degree	Efficiency of heat recovery	Noise protecti U noise level < 35dB(A)	adapter Supply air db(A)
1	1	Floor 1	02ud Tangra ventilation unit EVB 06 Hi	420	250	600	0,40	65	65	75	100	-	Probably too high	x		0,82	77%	0%	yes		0%	n.a.	61
2	1	Floor 2	07ud Tangra ventilation unit EVB 20 Hi	2000	1000	2000	0,40	60	60	70	-	-	ok	x		0,82	81%	0%	yes		0%	n.a.	68
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

Data entries for duct sections between the ventilation unit and the thermal envelope

The duct sections between the ventilation unit and the thermal envelope should be as short as possible and should be well insulated, both for interior as for exterior location of the ventilation unit. These duct sections can be entered here. The heat losses of the overlying duct section will be considered for the effective heat recovery efficiency.
An entered duct section can also be used for multiple ventilation units.
If in the section "Ventilation unit - selection" in one line a ventilation unit is selected as multiple units (amount larger than 1 for identical units), then the corresponding duct sections may simply be entered (duct sections for one ventilation unit).

Temperature of the location of installation (only enter when at least one unit is installed outside of the thermal envelope)

Quan-tity	Cross check	Round duct ins. diameter mm	Rectangular duct Width mm	Height mm	Insulation Thickness mm	Thermal conducti-vity W/(m K)	Reflective insulation duct (x)	Transmittance duct W/(m K)	Length of Supply air m	Ambient or Extract air Duct (1)	Exhaust or flow Duct (1)	Duct type	Design Volume rate	Allocation to ventilation units (when central unit applicable enter "1") Vent. Unit 1	Vent. Unit 2	Vent. Unit 3	Vent. Unit 4	Vent. Unit 5	Vent. Unit 6	Vent. Unit 7	Vent. Unit 8	Vent. Unit 9	Vent. Unit 10
1		315			150	0,033		0,278	6	1		Ambient air	420	1									
1		315			150	0,033		0,278	12,2		1	Fortluft	420	1									
1		315			150	0,033		0,295	3	1		Ambient air	2000		1								
1		315			150	0,033		0,295	8,6		1	Fortluft	2000		1								
1		315			150	0,033			3	1		Ambient air	0			1							
1		315			150	0,033			5		1	Fortluft	0			1							
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EnerPHit planning: # SPECIFIC ANNUAL HEATING DEMAND (annual method)

Climate: User data - Велико Търнов PHI
Building: Primary School 3 "Tzanko Diustabanov" - Section A

Interior Temperature: 18,0 °C
Building type: School
Treated Floor Area A_{TFA}: 848,4 m²

Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Temp. Factor f_t		G_t kKh/a		kWh/a	per m² Treated Floor Area
Exterior Wall - Ambient	A	539,2	*	0,130	*	1,00	*	65,3	=	4580	5,40
Exterior Wall - Ground	B		*		*	0,09	*		=		
Roof/Ceiling - Ambient	A	955,4	*	0,110	*	1,00	*	65,3	=	6873	8,10
Floor slab / basement ceiling	B	910,2	*	1,977	*	0,09	*	65,3	=	10067	11,87
	A		*		*	1,00	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,75	*		=		
Windows	A	198,0	*	2,636	*	1,00	*	65,3	=	34080	40,17
Exterior Door	A	3,0	*	0,800	*	1,00	*	65,3	=	157	0,18
Exterior TB (length/m)	A	203,3	*	0,081	*	1,00	*	65,3	=	1075	1,27
Perimeter TB (length/m)	P	123,8	*	-0,036	*	0,09	*	65,3	=	-25	-0,03
Ground TB (length/m)	B		*		*	0,09	*		=		0,00
Total of all building envelope areas		2605,8									kWh/(m²a)
Transmission heat losses Q_T									Total	56807	67,0

		A_{TFA} m²		Clear Room Height m	=	m^3
Ventilation System:	Effective Air Volume, V_V	848,4	*	2,50	=	2121,0
Effective heat recovery efficiency of heat recovery	η_{eff} 81%					
Efficiency of Subsoil Heat Exchanger	η_{SHX} 0%					

	$n_{V,system}$ 1/h		η_{HR}		$n_{V,Res}$ 1/h	=	1/h
Energetically Effective Air Exchange n_v	0,381	* (1 -	0,81	) +	0,046	=	0,119

	V_V m³		n_V 1/h		c_{Air} Wh/(m³K)		G_t kKh/a	=	kWh/a	kWh/(m²a)
Ventilation heat losses Q_V	2121,0	*	0,119	*	0,33	*	65,3	=	5419	6,4

	Q_T kWh/a		Q_V kWh/a		Reduction Factor Night/Weekend Saving	=	kWh/a	kWh/(m²a)
Total heat losses Q_L	(56807	+	5419	)	1,0	=	62226	73,3

Orientation of the area	Reduction Factor See 'Windows' worksheet		g-Value (perp. radiation)		Area m²		Radiation HP kWh/(m²a)	=	kWh/a
1. North	0,30	*	0,70	*	58,20	*	142	=	1718
2. East	0,28	*	0,70	*	12,52	*	368	=	901
3. South	0,28	*	0,77	*	100,80	*	370	=	8168
4. West	0,22	*	0,72	*	26,46	*	151	=	622
5. Horizontal	0,00	*	0,00	*	0,00	*	400	=	0
Available Solar Heat Gains Q_S								Total	11409

	kh/d		Length heating period d/a		Spec. Power q_i W/m²		A_{TFA} m²	=	kWh/a	kWh/(m²a)
Internal Heat Gains Q_I	0,024	*	189	*	2,80	*	848,4	=	10785	12,7

			kWh/a	kWh/(m²a)
Free Heat Q_F	Q_S + Q_I	=	22194	26,2
Ratio of Free Heat to Losses	Q_F / Q_L	=	0,36	
Utilisation Factor Heat Gains η_G	(1 - (Q_F / Q_L)^5) / (1 - (Q_F / Q_L)^6)	=	100%	
Heat Gains Q_G	η_G * Q_F	=	22111	26,1

			kWh/a	kWh/(m²a)
Annual heating demand QH	Q_L - Q_G	=	40115	47

	kWh/(m²a)	(Yes/No)
Limiting value	25	**Requirement met?** no

EnerPHit planning: **SPECIFIC ANNUAL HEATING DEMAND (monthly method)**

(This page displays the sums of the monthly method over the heating period)

Climate: Велико Търнов PHI — Interior Temperature: 18 °C

Building: primary School 3 "Tzanko Diustabanov" - Section A — Building type: School

Spec. Capacity: 204 Wh/(m²K) — Treated Floor Area A_{TFA}: 848,4 m²

Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Month. Red. Fac.		G_t kKh/a		kWh/a	per m² Treated Floor Area
Exterior Wall - Ambient	A	539,2	*	0,130	*	1,00	*	72	=	5022	5,92
Exterior Wall - Ground	B		*		*	1,00	*		=		
Roof/Ceiling - Ambient	A	955,4	*	0,110	*	1,00	*	72	=	7535	8,88
Floor slab / basement ceiling	B	910,2	*	1,977	*	1,00	*	7	=	12411	14,63
	A		*		*	1,00	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,75	*		=		
Windows	A	198,0	*	2,636	*	1,00	*	72	=	37362	44,04
Exterior Door	A	3,0	*	0,800	*	1,00	*	72	=	172	0,20
Exterior TB (length/m)	A	203,3	*	0,081	*	1,00	*	72	=	1179	1,39
Perimeter TB (length/m)	P	123,8	*	-0,036	*	1,00	*	7	=	-31	-0,04
Ground TB (length/m)	B		*		*	1,00	*		=		0,00

Transmission heat losses Q_T — Total 63650 kWh/a — 75,0 kWh/(m²a)

Effective Air Volume V_V: A_{TFA} 848 m² * Clear Room Height 2,50 m = 2121 m³

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR}		$n_{V,Res}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective Air Change Rate Ambient $n_{V,e}$	0,381	*(1-	0%	)*(1-	0,81	)+	0,046	=	0,119
Effective Air Change Rate Ground $n_{V,g}$	0,381	*	0%	*(1-	0,81	)		=	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	2121	*	0,119	*	0,33	*	72	=	5941	7,0
Ventilation losses ground $Q_{V,e}$	2121	*	0,000	*	0,33	*	41	=	0	0,0

Ventilation heat losses Q_V — Total 5941 kWh/a — 7,0 kWh/(m²a)

Total heat losses Q_L = (Q_T 63650 kWh/a + Q_V 5941 kWh/a) * Reduction Factor Night/Weekend Saving 1,0 = 69591 kWh/a — 82,0 kWh/(m²a)

Orientation of the area	Reduction Factor See 'Windows' worksheet		g-Value (perp. radiation)		Area m²		Global Radiation kWh/(m²a)		kWh/a
North	0,30	*	0,70	*	58,2	*	282	=	3416
East	0,28	*	0,70	*	12,5	*	632	=	1546
South	0,28	*	0,77	*	100,8	*	630	=	13898
West	0,22	*	0,72	*	26,5	*	298	=	1231
Horizontal	0,00	*	0,00	*	0,0	*	787	=	0
Sum opaque areas									1862

Available Solar Heat Gains Q_S — Total 21953 kWh/a — 25,9 kWh/(m²a)

Internal Heat Gains Q_I = kh/d 0,024 * Length Heat. Period 273 d/a * Spec. Power q_i 2,8 W/m² * A_{TFA} 848,4 m² = 15564 kWh/a — 18,3 kWh/(m²a)

Free Heat Q_F: Q_S + Q_I = 37517 kWh/a — 44,2 kWh/(m²a)

Ratio Free Heat to Losses: Q_F / Q_L = 0,54

Utilisation Factor Heat Gains η_G = 81%

Heat Gains Q_G: η_G * Q_F = 30313 kWh/a — 35,7 kWh/(m²a)

Annual heating demand QH: Q_L - Q_G = 39278 kWh/a — **46** kWh/(m²a)

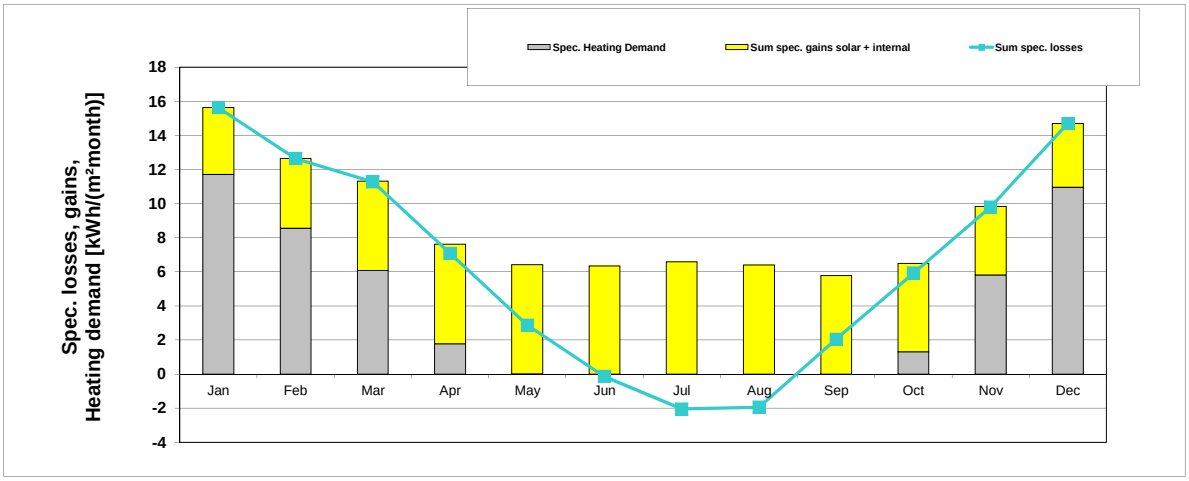
Limiting value 25 kWh/(m²a) — Requirement met? no (Yes/No)

EnerPHit planning: **SPECIFIC ANNUAL HEATING DEMAND (monthly method)**

Climate: Велико Търнов PHI
Building: Primary School 3 "Tzanko Diustabanov" - Section A

Interior Temperature: 18 °C
Building type: School
Treated Floor Area A_{TFA}: 848 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating Degree Hours - Exterior	14,2	11,1	9,6	5,6	1,6	-1,0	-2,7	-2,5	1,6	5,3	8,9	13,6	65	kKh
Heating Degree Hours - Ground	1,1	1,0	1,1	0,9	0,6	0,4	0,2	0,2	0,2	0,4	0,7	0,9	8	kKh
Losses - Exterior	11332	8901	7663	4482	1293	-824	-2157	-1977	1297	4247	7150	10845	52252	kWh
Losses - Ground	1934	1836	1903	1529	1150	705	428	329	443	781	1172	1633	13842	kWh
Sum spec. losses	15,6	12,7	11,3	7,1	2,9	-0,1	-2,0	-1,9	2,1	5,9	9,8	14,7	77,9	kWh/m²
Solar gains - North	190	256	404	598	773	845	825	690	497	341	191	167	5776	kWh
Solar gains - East	121	138	185	223	235	231	244	235	219	188	126	110	2255	kWh
Solar gains - South	1076	1249	1715	1917	2013	1926	2072	2120	2005	1762	1180	981	20017	kWh
Solar gains - West	64	91	154	204	266	281	283	254	188	134	75	55	2048	kWh
Solar gains - Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - Opaque	106	144	225	310	376	389	407	362	282	203	119	94	3020	kWh
Internal Heat Gains	1767	1596	1767	1710	1767	1710	1767	1767	1710	1767	1710	1767	20810	kWh
Sum spec. gains solar + internal	3,9	4,1	5,2	5,8	6,4	6,3	6,6	6,4	5,8	5,2	4,0	3,7	63,6	kWh/m²
Utilisation Factor	100%	100%	99%	91%	45%	100%	100%	100%	35%	89%	99%	100%	50%	
Annual heating demand	9943	7270	5161	1511	22	0	0	0	5	1121	4940	9305	39278	kWh
Spec. Heating Demand	**11,7**	**8,6**	**6,1**	**1,8**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**1,3**	**5,8**	**11,0**	**46,3**	kWh/m²



Annual heating demand: Comparison

Monthly method	*(Worksheet Heat*	**39278**	**kWh/a**	**46,3**	**kWh/(m²a) reference to treated floor area according to PHPP**
Annual method	*(Worksheet Annu*	**40115**	**kWh/a**	**47,3**	**kWh/(m²a) reference to treated floor area according to PHPP**

EnerPHit planning: # SPECIFIC SPACE HEATING LOAD

Building: primary School 3 "Tzanko Diustabanov" - Section A — Building type: School

Climate (HL): Велико Търнов PHI — Treated Floor Area A_{TFA}: 848,4 m² — Interior Temperature: 18 °C

	Design Temperature		Radiation:	North	East	South	West	Horizontal	
Weather 1:	-9,1	°C		19	39	82	35	56	W/m²
Weather 2:	-4,6	°C		16	23	40	24	36	W/m²
Ground Design Temp.	16,5	°C							

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Factor Always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		P_T 1 W		P_T 2 W
1.	Exterior Wall - Ambient	A	539,2	*	0,130	*	1,00	*	27,1	or	22,6	=	1899	or	1583
2.	Exterior Wall - Ground	B		*		*	1,00	*	1,5	or	1,5	=		or	
3.	Roof/Ceiling - Ambient	A	955,4	*	0,110	*	1,00	*	27,1	or	22,6	=	2849	or	2375
4.	Floor slab / basement ceiling	B	910,2	*	1,977	*	1,00	*	1,5	or	1,5	=	2738	or	2738
5.		A		*		*	1,00	*	27,1	or	22,6	=		or	
6.		A		*		*	1,00	*	27,1	or	22,6	=		or	
7.		X		*		*	0,75	*	27,1	or	22,6	=		or	
8.	Windows	A	198,0	*	2,636	*	1,00	*	27,1	or	22,6	=	14127	or	11778
9.	Exterior Door	A	3,0	*	0,800	*	1,00	*	27,1	or	22,6	=	65	or	54
10.	Exterior TB (length/m)	A	203,3	*	0,081	*	1,00	*	27,1	or	22,6	=	446	or	372
11.	Perimeter TB (length/m)	P	123,8	*	-0,036	*	1,00	*	1,5	or	1,5	=	-7	or	-7
12.	Ground TB (length/m)	B		*		*	1,00	*	1,5	or	1,5	=		or	
13.	House/DU Partition Wall	I		*		*	1,00	*	1,0	or	1,0	=		or	

Transmission heat load P_T

Total = 22117 or 18894

Ventilation System:

Effective Air Volume, V_v: A_{TFA} 848,4 m² * Clear Room Height 2,50 m = 2121 m³

Heat recovery efficiency of the Heat Exchanger η_{HR} 81% — Heat Recovery Efficiency SHX 0% — Efficiency SHX η_{SHX} 1: 0% or η_{SHX} 2: 0%

Energetically Effective Air Exchange n_v: $n_{V,Res}$ (Heating Load) 0,105 1/h + $n_{V,system}$ 0,381 1/h *(1- Φ_{HR} 0,81 or Φ_{HR} 0,81) = 0,177 1/h or 0,177 1/h

Ventilation heat load P_v

V_v m³		n_v 1/h		n_v 1/h	c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
2121,0	*	0,177	or	0,177	* 0,33	*	27,1	or	22,6	=	3361	or	2802

Total heating load P_L

$P_T + P_V$ = P_L 1: 25477 or P_L 2: 21696

	Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction Factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
1.	North	58,2	*	0,7	*	0,30	*	22	or	17	=	265	or	202
2.	East	12,5	*	0,7	*	0,28	*	67	or	34	=	165	or	83
3.	South	100,8	*	0,8	*	0,28	*	65	or	35	=	1426	or	763
4.	West	26,5	*	0,7	*	0,22	*	20	or	18	=	83	or	73
5.	Horizontal	0,0	*	0,0	*	0,40	*	56	or	36	=	0	or	0

Solar heating power P_S

Total = 1939 or 1121

Internal heating load P_I

Spec. Power W/m² 1,6 * A_{TFA} m² 848 = P_I 1: 1357 or P_I 2: 1357

Heating power (gains) P_G

$P_T + P_I$ = P_G 1: 3296 or P_G 2: 2478

$P_L - P_G$ = 22181 or 19218

Heating load P_H = 22181 W

Area specific space heating load PH / A_{TFA} = 26,1 W/m²

Input Max. Supply Air Temperature 52 °C

Max. Supply Air Temperature $\vartheta_{Supply,Max}$ 52 °C — Supply Air Temperature Without Heating $\vartheta_{Supply,Min}$: 12,9 °C or 13,7 °C

For comparison: heating load transportable by the supply Air. $P_{Supply\ Air,Max}$ = 10435 W specific: 12,3 W/m²

Supply Air Heating Sufficient? (Yes/No): no

EnerPHit planning:

SUMMER VENTILATION

Building:	Primary School 3 "Tzanko Diustabanov" - Section A		Building type:	School	
Building volume:	2121	m³	Heat recovery η_{HRV}:	81%	
Max. indoor absolute humidity:	12	g/kg	Energy recovery η_{ER}:	0%	
panels, Internal humidity sources:	2	g/(m²h)	Subsoil heat exchanger η^*_{SHX}:	0%	

Results passive cooling			Results active cooling		
Frequency of overheating:	0,1%	at the overheating limit ϑ_{max} = 24 °C	Useful Cooling Demand:	0,3	kWh/(m²a)
Frequency of exceeded humidity:	0,0%		Dehumidification demand:	0,1	kWh/(m²a)
max. humidity:	11,5	g/kg			

Summer background ventilation to ensure adequate air quality

Air exchange via ventilation system with supply	0,63	1/h	HRV/ERV in Summer (check only one field)	
			None	x
			automatic bypass, controlled by temperature difference	
			automatic bypass, controlled by enthalpy difference	
			always	
Air exchange via extract air system	0,00	1/h		
			Specific power consumption (for extract air system)	0,00 Wh/m³
Window ventilation air exchange	0,19	1/h		

Effective air exchange

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR}		$n_{V,equi,fraction}$ 1/h
exterior $n_{V,e}$	0,630	*(1-	0%	)*(1-	0,81	) =	0,120
without HR	0,630	*(1-	0%	)		=	0,630
Ground nL,g	0,630	*	0%	*(1-	0,81	) =	0,000
without HR	0,630	*	0%			=	0,000

Ventilation conductance

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)			
exterior $H_{V,e}$	2121	*	0,120	*	0,33	=	83,8	W/K
without HR	2121	*	0,630	*	0,33	=	441,0	W/K
Ground $H_{V,g}$	2121	*	0,000	*	0,33	=	0,0	W/K
without HR	2121	*	0,000	*	0,33	=	0,0	W/K
Infiltration, window, extract air system	2121	*	0,190	*	0,33	=	133,0	W/K

Additional Summer Ventilation for Cooling

Additional ventilation regulation

Minimum Acceptable Indoor Temperatur: 18,0 °C

Type of additional ventilation

Window Night Ventilation, Manual	Night ventilation value	0,19	1/h	
	Corresponding air change rate	0,63	1/h	Controlled by (please cl
mechanical, automatically Controlled ventilation	during operation, in addition to base air change			Temperature difference
	Specific power consumption	0,40	Wh/m³	Humidity difference x

Secondary Calculation: hygienic air exchange through window ventilation

Estimation for window air exchange to ensure sufficient air quality

Description	Day GF	Day GF	Day GF				
Open duration [h/d]	2	2	12				
Climate Boundary Conditions							
Temperature Diff Interior - Exterior	4	4	4				K
Wind Velocity	1	1	1				m/s
Window Group 1							
Quantity	2	3	6				
Clear Width	0,60	1,00	1,85				m
Clear Height	1,44	0,95	1,50				m
Tilting window (check if appropriate	x	x	x				
Opening Width (for tilting windows)	0,055	0,055	0,055				m
Window Group 2 (Cross Ventilation)							
Quantity	1	1	3				
Clear Width	1,05	1,05	1,85				m
Clear Height	2,00	2,00	1,50				m
Tilting window (check if appropriate)			x				
Opening Width (for Tilting Windows)			0,055				m
Difference in Height to Window 1							m
							Total
Result: air exchange	0,03	0,03	0,12	0,00	0,00	0,00	0,19 **1/h**

Secondary calculation: additional night ventilation for cooling

Air change value during additional window night ventilation

Description	Night	Night	Night				
Reduction Factor	100%	100%	100%				
Climate Boundary Conditions							
Temperature Diff Interior - Exterior	1	1	1	1	1	1	K
Wind Velocity	0	0	0	0	0	0	m/s
Window Group 1							
Quantity	2	1	4				
Clear Width	1,85	1,85	1,00				m
Clear Height	1,50	1,50	0,95				m
Tilting window (check if appropriate	x	x	x				
Opening Width (for Tilting Window	0,055	0,055	0,055				m
Window Group 2 (Cross Ventilation)							
Quantity	2	1	3				
Clear Width	1,85	1,85	1,85				m
Clear Height	1,50	1,50	1,50				m
Tilting window (check if appropriate	x	x	x				
Opening Width (for Tilting Window	0,055	0,055	0,055				m
Difference in Height to Window 1			3,00				m
							Total
Result: night ventilation values	0,03	0,02	0,13	0,00	0,00	0,00	0,19 **1/h**

EnerPHit planning:

SUMMER: PASSIVE COOLING

Climate:	Велико Търнов PHI	Building type:	School
Building:	Primary School 3 "Tzanko Diustabanov" - Section A	Treated Floor Area A_{TFA}:	848,4 m²
Overtemperature limit:	24 °C	Building volume:	2121 m³
Nominal humidity:	12 g/kg	Internal humidity sources:	2,0 g/(m²h)
Spec. Capacity:	204 Wh/(m²K)		

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Red. Factor $f_{T,Summer}$		H_{Summer} Heat Conductance
1.	Exterior Wall - Ambient	A	539,2	*	0,130	*	1,00	=	70,1
2.	Exterior Wall - Ground	B		*		*	1,00	=	
3.	Roof/Ceiling - Ambient	A	955,4	*	0,110	*	1,00	=	105,2
4.	Floor slab / basement ceili	B	910,2	*	1,977	*	1,00	=	1799,1
5.		A		*		*	1,00	=	
6.		A		*		*	1,00	=	
7.		X		*		*	0,75	=	
8.	Windows	A	198,0	*	2,636	*	1,00	=	521,9
9.	Exterior Door	A	3,0	*	0,800	*	1,00	=	2,4
10.	Exterior TB (length/m)	A	203,3	*	0,081	*	1,00	=	16,5
11.	Perimeter TB (length/m)	P	123,8	*	-0,036	*	1,00	=	-4,5
12.	Ground TB (length/m)	B		*		*	1,00	=	

Exterior Thermal Transmittance, $H_{T,e}$ 716,1 W/K

Ground Thermal Transmittance, $H_{T,g}$ 1794,6 W/K

Summer Ventilation

from 'SummVent' worksheet

Ventilation unit conductance

Exterior $H_{V,e}$	83,8	W/K
without HR	441,0	W/K
Ground HV,g	0,0	W/K
without HR	0,0	W/K

Ventilation conductance, others

Exterior	133,0	W/K

Ventilation parameter

Temperature amplitude summer	11,2	K
Minimum Acceptable Indoor Temperature	18,0	°C
Heat capacity air	0,33	Wh/(m³K)
Supply air exchange	0,63	1/h
Ambient air exchange	0,19	1/h
Window night ventilation air exchange rate, manual @ 1K	0,19	1/h
Air change rate due to mechanical, automatically controlled ventilation	0,63	1/h
Specific power consumption for	0,40	Wh/m³
η_{HR}	81%	
η_{ERV}	0%	
η^*_{SHX}	0%	

Summer ventilation regulation

	HRV/ERV
None	x
Controlled by temperature	
Controlled by enthalpy	
always	
	Additional ventilation
Controlled by temperature	
Controlled by humidity	x

Solar Aperture

	Orientation of the area	Angle Factor Summer		Shading Factor Summer		Loss-Dirt		g-Value (perp. radiation)		Area m²		Portion of Glazing	=	**Aperture** m²
1.	North	0,9	*	0,78	*	0,95	*	0,70	*	58,2	*	54%	=	14,8
2.	East	0,9	*	0,39	*	0,95	*	0,70	*	12,5	*	49%	=	1,5
3.	South	0,9	*	0,41	*	0,95	*	0,77	*	100,8	*	53%	=	14,4
4.	West	0,9	*	0,48	*	0,95	*	0,72	*	26,5	*	44%	=	3,4
5.	Horizontal	0,9	*	1,00	*	0,95	*	0,00	*	0,0	*	0%	=	0,0
6	Sum opaque areas													2,8

Total 37,0 m²/m² 0,04

Internal Heat Gains Q_I

Specif. Power q_I W/m²		A_{TFA} m²	=	W	W/m²
2,8	*	848	=	2376	2,8

Frequency of Overheating $h_{\vartheta \geq \vartheta max}$ **0,1%** **At the overheating limit ϑ_{max} = 24 °C**

If the "frequency over 25°C" exceeds 10%, additional measures to protect against the heat during the summer are necessary.

Daily internal temperature stroke

Transmission kWh/d		Ventilation kWh/d		Solar load kWh/d		1/k		Spec. Capacity Wh/(m²K)		A_{TFA} m²			
(96,2	+	142,6	+	150,7	) *	1000	/ (	204	*	848	) =	**2,3**	K

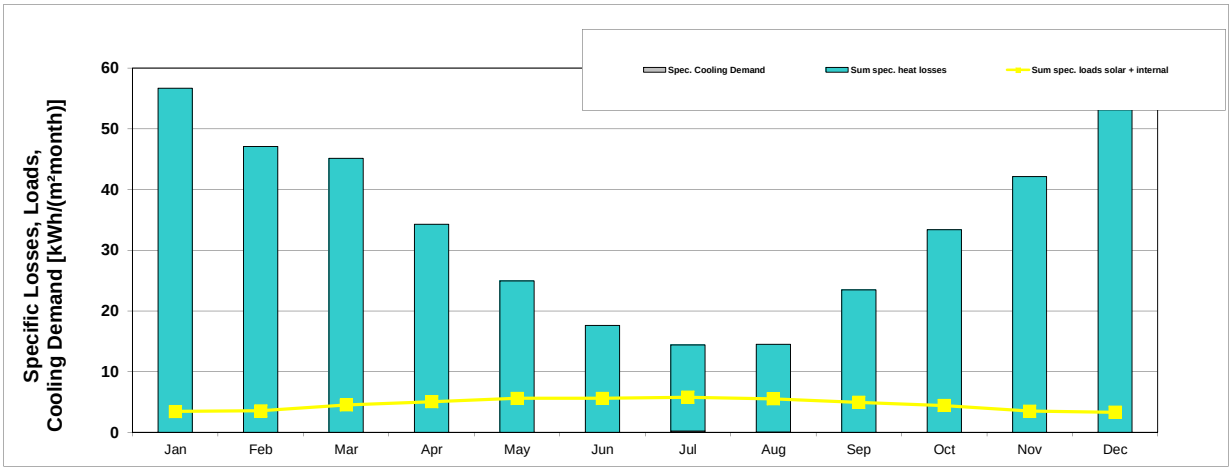
EnerPHit planning:

SPECIFIC USEFUL COOLING DEMAND

Climate: Велико Търнов PHI
Building: Primary School 3 "Tzanko Diustabanov" - Section A

Interior Temperature: 24 °C
Building type: School
Treated Floor Area A_{TFA}: 848 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating Degree Hours - Exterior	18,7	15,2	14,1	9,9	6,1	3,3	1,8	2,0	6,0	9,8	13,3	18,1	118	kKh
Heating Degree Hours - Ground	5,5	5,1	5,5	5,2	5,1	4,7	4,7	4,6	4,6	4,9	5,0	5,4	60	kKh
Losses - Exterior	23900	19435	17987	12686	7744	4157	2194	2484	7575	12508	17000	23124	150795	kWh
Losses - Ground	9969	9094	9939	9305	9184	8478	8460	8361	8217	8814	8947	9668	108436	kWh
Losses summer ventilation	14250	11432	10362	7098	4224	2293	1395	1446	4140	6990	9792	13737	87161	kWh
Sum spec. heat losses	56,7	47,1	45,1	34,3	24,9	17,6	14,2	14,5	23,5	33,4	42,1	54,8	408,3	kWh/m²
Solar load North	232	314	496	733	948	1036	1012	846	609	419	234	204	7083	kWh
Solar load East	72	82	110	133	140	137	145	140	130	112	75	66	1341	kWh
Solar load South	704	816	1121	1253	1316	1259	1355	1386	1311	1152	772	641	13086	kWh
Solar load West	53	75	128	170	221	234	235	211	156	111	62	46	1703	kWh
Solar load Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load Opaque	106	144	225	310	376	389	407	362	282	203	119	94	3020	kWh
Internal Heat Gains	1767	1596	1767	1710	1767	1710	1767	1767	1710	1767	1710	1767	20810	kWh
Sum spec. loads solar + internal	3,5	3,6	4,5	5,1	5,6	5,6	5,8	5,6	4,9	4,4	3,5	3,3	55,4	kWh/m²
Utilisation Factor Losses	6%	8%	10%	15%	23%	32%	39%	38%	21%	13%	8%	6%	14%	
Useful Cooling Energy Demand	0	0	0	1	4	19	185	39	3	0	0	0	252	kWh
Spec. Cooling Demand	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,2**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,3**	kWh/m²
specif. dehumidification demand	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,1**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,1**	kWh/m²
Sensible Fraction	100%	100%	100%	100%	100%	100%	70%	100%	100%	100%	100%	100%	76%	



EnerPHit planning:

SPECIFIC USEFUL COOLING DEMAND

(This page displays the sums of the monthly method over the cooling period))

Climate: Велико Търнов PHI
Building: primary School 3 "Tzanko Diustabanov" - Section A
Interior temperature summer: 24 °C
Nominal humidity: 12 g/kg
Spec. Capacity: 204 Wh/(m²K)

Building type: School
Treated Floor Area A_{TFA}: 848,4 m²
Building volume: 2121 m³
Internal humidity sources: 2,0 g/(m²h)

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Mon. Red. Fac.		G_t kKh/a		kWh/a	per m² Treated Floor Area
1.	Exterior Wall - Ambient	A	539,2	*	0,130	*	1,00	*	53	=	3715	4,38
2.	Exterior Wall - Ground	B		*		*	1,00	*		=		
3.	Roof/Ceiling - Ambient	A	955,4	*	0,110	*	1,00	*	53	=	5574	6,57
4.	Floor slab / basement c	B	910,2	*	1,977	*	1,00	*	39	=	70757	83,40
5.		A		*		*	1,00	*		=		
6.		A		*		*	1,00	*		=		
7.		X		*		*	0,75	*		=		
8.	Windows	A	198,0	*	2,636	*	1,00	*	53	=	27640	32,58
9.	Exterior Door	A	3,0	*	0,800	*	1,00	*	53	=	127	0,15
10.	Exterior TB (length/m)	A	203,3	*	0,081	*	1,00	*	53	=	872	1,03
11.	Perimeter TB (length/m)	P	123,8	*	-0,036	*	1,00	*	53	=	-236	-0,28
12.	Ground TB (length/m)	B		*		*	1,00	*		=		0,00

Transmission losses Q_T (negative: heat loads) — Total 108449 kWh/a — 127,8 kWh/(m²a)

Summer Ventilation from 'SummVent' worksheet

Ventilation unit conductance

Exterior $H_{V,e}$	83,8	W/K
without HR	441,0	W/K
Ground HV,g	0,0	W/K
without HR	0,0	W/K

Ventilation conductance, others

Exterior	133,0	W/K

Ventilation parameter

Temperature amplitude summer	11,2	K
Minimum Acceptable Indoor Temperature	18,0	°C
Heat capacity air	0,33	Wh/(m³K)
Supply air exchange	0,63	1/h
Ambient air exchange	0,19	1/h
Window night ventilation air exchange rate, manual @ 1K	0,19	1/h
Air change rate due to mechanical, automatically controlled v	0,63	1/h
Specific power consumption for	0,40	Wh/m³
η_{HR}	81%	
η_{ERV}	0%	
η^*_{SHX}	0%	

Summer ventilation regulation

	HRV/ERV
None	x
Controlled by temperature	
Controlled by enthalpy	
always	
	Additional ventilation
Controlled by temperature	
Controlled by humidity	x

Hygienic air change

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR} (considers bypass)		$n_{V,Rest}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective Air Change Rate Ambient $n_{V,e}$	0,630	*(1-	0%	)*(1-	0,00	)+	0,190	=	0,820
Effective Air Change Rate Ground $n_{V,g}$	0,630	*	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	2121	*	0,820	*	0,33	*	52	=	29644	34,9
Ventilation losses ground $Q_{V,e}$	2121	*	0,000	*	0,33	*	0	=	0	0,0
Heat losses summer ventilation	2121	*	0,882	*	0,33	*	61	=	37948	44,7

Ventilation heat losses Q_V — Total 67592 kWh/a — 79,7 kWh/(m²a)

Total heat losses Q_L: Q_T 108449 kWh/a + Q_V 67592 kWh/a = 176041 kWh/a — 207,5 kWh/(m²a)

	Orientation of the area	Reduction Factor		g-Value (perp. radiation)		Area m²		Global Radiation kWh/(m²a)		kWh/a
1.	North	0,36	*	0,70	*	58,2	*	411	=	6098
2.	East	0,17	*	0,70	*	12,5	*	719	=	1046
3.	South	0,19	*	0,77	*	100,8	*	704	=	10153
4.	West	0,18	*	0,72	*	26,5	*	427	=	1467
5.	Horizontal	0,40	*	0,00	*	0,0	*	1113	=	0
6.	Sum opaque areas									2556

Available Solar Heat Gains Q_S — Total 21320 kWh/a — 25,1 kWh/(m²a)

Internal Heat Gains Q_I: kh/d 0,024 * Length Heat. Period 245 d/a * Spec. Power q_I 2,8 W/m² * A_{TFA} 848,4 m² = 13968 kWh/a — 16,5 kWh/(m²a)

Sum heat loads Q_F: Q_S + Q_I = 35288 kWh/a — 41,6 kWh/(m²a)

Ratio of Losses to Free Heat Gains: Q_L / Q_F = 4,99

Utilisation Factor Heat Losses η_G = 20%

Useful heat losses $Q_{V,n}$: η_G * Q_L = 35036 kWh/a — 41,3 kWh/(m²a)

Useful Cooling Demand Q_K: Q_F - $Q_{V,n}$ = 252 kWh/a — **0** kWh/(m²a)

Limiting value: 15 kWh/(m²a)

Requirement met? (Yes/No): -

EnerPHit planning: # COMPRESSOR COOLING UNITS

Climate:	Велико Търнов PHI		Building type:	School	
DHW solar p Building:	Primary School 3 "Tzanko Diustabanov" - Section T		Treated Floor Area A_{TFA}:	848,4	m²
Interior temperature summer:	24,0	°C	Mechanical cooling:	x	
Nominal humidity:	12,0	g/kg	Air exchange via ventilation system with supply air:	0,6	
Internal humidity sources:	2,0	g/(m²h)			

x Supply Air Cooling

check as appropriate

On/Off Mode (check as appropriate)		
max. cooling capacity (sensible + latent)	5,0	kW
Temperature reduction dry	11,0	K
Seasonal energy efficiency ratio	3,0	

Recirculation Cooling

check as appropriate

On/Off Mode (check as appropriate)		
max. cooling capacity (sensible + latent)	0,0	kW
Volume flow rate at nominal power	0,0	m³/h
Temperature reduction dry		K
Variable volume flow (check if appropriate)		
Seasonal energy efficiency ratio	1,0	

Additional Dehumidification

check as appropriate

Waste heat to room (please check if applicable)		
Seasonal energy efficiency ratio	1,0	

Panel Cooling

check as appropriate

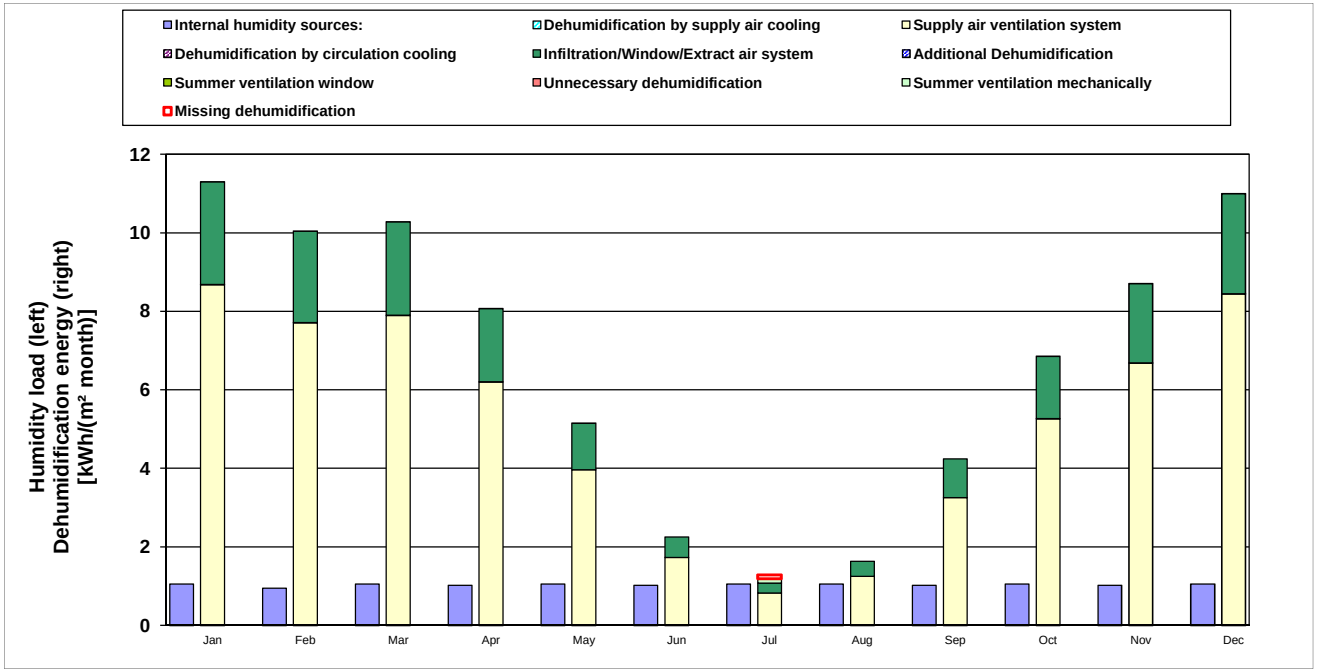
Seasonal energy efficiency ratio	1,0	

	sensible kWh/(m²a)		latent kWh/(m²a)		COP		lectricity Demand (kWh/a) kWh/(m²a)	Sensible Fraction
Useful cooling total	0,3		0,1					76%
Cooling contribution by:								
Supply Air Cooling	(0,3	+	0,0	) /	3,0	=	0,1	100%
Recirculation Cooling	(0,0	+	0,0	) /	1,0	=	0,0	0%
Dehumidification			0,1	/	1,0	=	0,1	0%
Remaining for Panel Cooling	0,0			/	1,0	=	0,0	100%
Total	(0,3	+	0,1	) /	2,0	=	0,2	76%

			(Yes/No)
Unsatisfied Demand	0,0	0,0	**Cooling demand covered?** yes

Humidity loads and humidity removal

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Internal humidity sources:	1,1	1,0	1,1	1,0	1,1	1,0	1,1	1,1	1,0	1,1	1,0	1,1	12	kWh/m²
Infiltration/Window/Extract air system	-2,6	-2,3	-2,4	-1,9	-1,2	-0,5	-0,3	-0,4	-1,0	-1,6	-2,0	-2,5	-19	kWh/m²
Supply air ventilation system	-8,7	-7,7	-7,9	-6,2	-4,0	-1,7	-0,8	-1,3	-3,3	-5,3	-6,7	-8,5	-62	kWh/m²
Summer ventilation window	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
Summer ventilation mechanically	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	0,0	0,0	0,0	0,0	0,0	0	kWh/m²
Total humidity load	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
Dehumidification by supply air cooling	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
Dehumidification by circulation cooling	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
Additional Dehumidification	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
Total dehumidification	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	
Unnecessary dehumidification	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
Missing dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0	kWh



EnerPHit planning: **COOLING LOAD**

Building: Primary School 3 "Tzanko Diustabanov" - Section A
Climate (HL): Велико Търнов PHI

Building type: School
Treated Floor Area A_{TFA}: 848,4 m²
Building volume: 2121 m³
Interior Temperature: 24 °C
Spec. Capacity: 204 Wh/(m²
Nominal humidity: 12,0 g/kg
Internal humidity sources: 2,0 g/kg

Temperature:	Ambient Air		Dew Point	Sky	
Weather 1:	28,1	°C	18,6	16,5	°C
Weather 2:	24,5	°C	18,6	18,6	°C
Ground Design Temp.	22,9	°C	SHX	11,7	°C

Radiation:	North	East	South	West	Horizontal	
	92	197	185	197	349	W/m²
	64	159	237	159	269	W/m²

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Factor Always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		P_T 1 W		P_T 2 W
1.	Exterior Wall - Ambient	A	539,2	*	0,130	*	1,00	*	4,1	or	0,5	=	290	or	37
2.	Exterior Wall - Ground	B		*		*	1,00	*	-1,1	or	-1,1	=		or	
3.	Roof/Ceiling - Ambient	A	955,4	*	0,110	*	1,00	*	4,1	or	0,5	=	435	or	56
4.	Floor slab / basement ceiling	B	910,2	*	1,977	*	1,00	*	-1,1	or	-1,1	=	-1953	or	-1953
5.		A		*		*	1,00	*	4,1	or	0,5	=		or	
6.		A		*		*	1,00	*	4,1	or	0,5	=		or	
7.		X		*		*	0,75	*	4,1	or	0,5	=		or	
8.	Windows	A	198,0	*	2,636	*	1,00	*	4,1	or	0,5	=	2155	or	277
9.	Exterior Door	A	3,0	*	0,800	*	1,00	*	4,1	or	0,5	=	10	or	1
10.	Exterior TB (length/m)	A	203,3	*	0,081	*	1,00	*	4,1	or	0,5	=	68	or	9
11.	Perimeter TB (length/m)	P	123,8	*	-0,036	*	1,00	*	-1,1	or	-1,1	=	5	or	5
12.	Ground TB (length/m)	B		*		*	1,00	*	-1,1	or	-1,1	=		or	
13.	House/DU Partition Wall	I		*		*	1,00	*	4,0	or	4,0	=		or	
14.	Radiation correction ambient air				$L_{ambient}$ W/K		-15,6	*	4,1	or	0,5	=	-64	or	-8
15.	Radiation correction sky				L_{Sky} W/K		15,4	*	-7,5	or	-5,4	=	-115	or	-83

Transmission heat load P_T Total = **830** or **-1660**

Ventilation load	V_V m³		$n_{V,equi,fraction}$ 1/h		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
Exterior $P_{V,o}$	2121	*	0,820	or	0,820	*	0,33	*	4,1	or	0,5	=	2370	or	304
Ground PL,e	2121	*	0,000	or	0,000	*	0,33	*	-12,3	or	-12,3	=	0	or	0
Summer ventilation $P_{L,S}$	2121	*	0,000	or	0,000	*	0,33	*	0,0	or	0,0	=	0	or	0

Ventilation heat load P_V Total = **2370** or **304**

	Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction Factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
1.	North	58,2	*	0,7	*	0,36	*	124	or	86	=	1839	or	1270
2.	East	12,5	*	0,7	*	0,17	*	201	or	215	=	292	or	313
3.	South	100,8	*	0,8	*	0,19	*	201	or	215	=	2895	or	3108
4.	West	26,5	*	0,7	*	0,18	*	135	or	93	=	463	or	320
5.	Horizontal	0,0	*	0,0	*	0,40	*	349	or	269	=	0	or	0
6.	Sum opaque areas											790	or	630

Solar load P_S Total = **6279** or **5641**

Internal heating load P_I Spec. Power W/m² = 2,8 * A_{TFA} m² = 848 = **2376** or **2376**

$P_T + P_V + P_S + P_I$ = **11855** or **6661**

Cooling load P_C = **11855** W

Area specific cooling load P_C / A_{TFA} = **14,0** W/m²

Please enter the minimum supply air temperature. 3 °C

Supply air temperature without cooling $\vartheta_{Supply,Min}$ °C: **28,1** or **24,5**

For comparison: cooling load, transportable through the supply air $P_{Supply;Max}$ = **11081** W or **9494** W

specific: 13,1 W/m² or 11,2 W/m²

Air conditioning over the supply air possible? (yes/no) **no**

Daily internal temperature stroke

(Transmission 830,1 W + Ventilation 2370,4 W + Solar load 6278,6 W) * Time 24 h/d / (Spec. Capacity 204 Wh/(m²K) * A_{TFA} 848 m²) = **1,3** K

Dehumidification load from 'Cooling' worksheet

Absolute humidity exterior air	13,4	or	13,4	g/kg	Absolute humidity supply air	13,4	or	13,4	g/kg
Ambient air mass flow	476	or	476	kg/h	Supply air mass flow	1577	or	1577	kg/h
Summer ventilation air mass flow	0	or	0	kg/h	**Humidity load, supply air**	2276	or	2276	g/h
Humidity load, outside air	686	or	686	g/h	**Humidity load, internal**	1697	or	1697	g/h

Enthalpy of vaporisation Wh/kg: 707,122 / 1000 g/kg * Humidity load g/h: 4659 or 4659 = **3295** W or **3295** W

Dehumidification load P_T = **3295** W

Area specific dehumidification load P_T / A_{TFA} = **3,9** W/m²

Monthly Average values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Spec. Cooling Demand	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	kWh/m²
Specif. dehumidification demand	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	kWh/m²
Sensible Fraction	100%	100%	100%	100%	100%	100%	70%	100%	100%	100%	100%	100%	

Minimum of sensible cooling load fraction occurred **100%**

HEAT DISTRIBUTION AND DHW SYSTEM

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Interior Temperature:	18	°C
Building type:	School	
Treated Floor Area A_{TFA}:	848	m²
Occupancy:	50,0	Pers
Number of dwelling units:	1	
Annual heating demand qHeating	39278	kWh/a
Length of Heating Period:	189	d
Average heating load Pave:	8,7	kW
Marginal Utilisability of Additional Heat Gains:	98%	

Parts

			Warm region	Cold Region		Total		
Space Heat Distribution			1	2	3			
Length of Distribution Pipes	L_H *(Project)*		20,00	4,00			m	
Heat Loss Coefficient per m Pipe	Ψ *(Project)*		0,192	0,192			W/(mK)	
Temperature of the Room Through Which the Pipes	ϑ_X *Mechanical Room*		18	10,0			°C	
Design Flow Temperature	ϑ_{dist} *Flow, Design Value*		55,0	55,0			°C	
Design system heating load	$P_{heating}$ *(exist./calc.)*		22,2	22,2			kW	
Flow Temperature Control (check)			x					
Design Return Temperature	ϑ_R	=0.714*(J_{dist}-20)+20	45,0	45,0			°C	
Annual Heat Emission per m of Plumbing	q^*_{HL}	= Y (J_m−ϑ_X) $t_{Heating}$*0.024	15	35			kWh/(m·a)	
Possible Utilization Factor of Released Heat	η_G		98%	0%			-	
Annual Losses	Q_{HL}	= L_H · q^*_{HL} · (1-η_G)	6	139	0	145	kWh/a	
Specif. losses	q_{HL}	= ΣQ_{HL} / A_{TFA}					kWh/(m²a)	0,2
'Performance ratio of heat distribution	$e_{a,HL}$	= (q_H + q_{HV}) / q_H				100%	-	

DHW: Standard Useful Heat

DHW Consumption per Person and Day (60 °C)	V_{DHW} *(Project or Average Value 25 Litres/P/d)*		20,0	Litre/Person/d
Average Cold Water Temperature of the Supply	ϑ_{DW} *Temperature of drinking water*		11,7	°C
DHW Non-Electric Wash and Dish	*(Electricity worksheet)*		0	kWh/a
Useful heat - DHW	Q_{DHW}		20459	kWh/a
Specif. useful heat - DHW	q_{DHW}	= Q_{DHW} / A_{TFA}		kWh/(m²a) 24,1

			Warm region	Cold Region		Total		
DHW Distribution and Storage								
Length of Circulation Pipes (Flow + Return)	L_{HS} *(Project)*		10,0				m	
Heat Loss Coefficient per m Pipe	Ψ *(Project)*		0,153				W/m/K	
Temperature of the Room Through Which the Pipes	ϑ_X *Mechanical Room*		18				°C	
Design Flow Temperature	ϑ_{dist} *Flow, Design Value*		60,0				°C	
Daily circulation period of operation.	td_{Circ} *(Project)*		10,0				h/d	
Design Return Temperature	ϑ_R	=0.875*(ϑ_{dist}-20)+20	55				°C	
Circulation period of operation per year	t_{Circ}	= 365 td_{Circ}	3650				h/a	
Annual Heat Released per m of Pipe	q^*_z	= Y (J_m−ϑ_X) t_{Circ}	22				kWh/m/a	
Possible Utilization Factor of Released Heat	η_{GDHW}	=$t_{heating}$/365d * η_G	51%				-	
Annual Heat Loss from Circulation Lines	Q_Z	= L_{HS} · q^*_z ·(1-η_{GDHW})	109			109	kWh/a	
Total length of individual pipes	L_U *(Project)*		6,00				m	
Exterior pipe diameter	d_{U_Pipe} *(Project)*		0,030				m	
Tap openings per person per day			3	3	3		-	
Utilisation days per year			365	365	365		d	
Heat loss per tap opening	$q_{Individual}$	=($c_{pH2O}V_{H2O}$+$c_{pMat}V_{Mat}$)(ϑ_{dist}-ϑ_X)	0,1767				kWh/tap opening	
Amount of tap openings per year	n_{Tap}	= n_{Pers} · n_{Tap} · d / n_{WE}	54750				Tap openings per year	
Annual Heat Loss	q_U	= n_{Tap} · $q_{Individual}$	9676				kWh/a	
Possible Utilization Factor of Released Heat	η_{G_U}	=$t_{heating}$/8760*η_G	51%				-	
Annual Heat Loss of individual pipes	Q_U	= q_U ·(1-η_{G_U})	4763			4763	kWh/a	
Average Heat Released from storage	P_S		49				W	
Possible Utilization Factor of Released Heat	η_{G_S}	=$t_{heating}$/8760*η_G	51%					
Annual Heat Losses from storage	Q_S	= P_S·8.760 kh·(1-η_{G_S})	211			211	kWh/a	
Total heat losses of the DHW system	Q_{WL}	= Q_Z+Q_U+Q_S				5083	kWh/a	
Specif. losses of the DHW system	q_{WL}	= Q_{WL} / A_{TFA}					kWh/(m²a)	6,0
Performance ratio DHW-distribution + storage	$e_{a,WL}$	= (q_{TDHW} + q_{WV}) / q_{TDHW}				125%	-	
Total heating demand of DHW system	Q_{gDHW}	= Q_{DHW}+Q_{WL}				25541	kWh/a	
Totalspec. heating demand of DHW system	q_{gDHW}	= Q_{gDHW} / A_{TFA}					kWh/(m²a)	30,1

Secondary calculation: Ψ-values of plumbing

Nominal width:	25	mm
Insulation Thickness:	50	mm
Mirrored?		Yes
	x	No
Thermal Conductivity	0,040	W/(mK)
$\Delta\vartheta$	30	K
Interior Pipe Diameter:	0,025	m
Exterior Pipe Diameter	0,027	m
Exterior Pipe Diameter	0,127	m
α–Surface	6,08	W/(m²K)
Ψ-Value	**0,153**	**W/(mK)**
Surface Temperature Difference	1,886	K

EnerPHit planning:

SOLAR THERMAL SYSTEM

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Building type: School

Treated Floor Area A_{TFA}: 848,4 m²

Solar fraction

Heating Demand DHW	q_{gDHW}	25541	kWh/a	*(DHW+Distribution)*
Annual heating demand		39424	kWh/a	*(Worksheets Heating & DHW+Distribution)*
Heating support (please check, if applicable)				
DHW priority (check if appropriate)				
Latitude:		43,1	°	*(Worksheet Climate)*

Collector: 7 Improved flat plate collector

Solar Collector Area		28,00	m²
Deviation from North		180	°
Angle of Inclination from the Horizontal		26	°
Height of the Collector Field		1,00	m
Height of Horizon	h_{Hori}		m
Horizontal Distance	a_{Hori}		m
Additional Reduction Factor Shading	r_{other}		

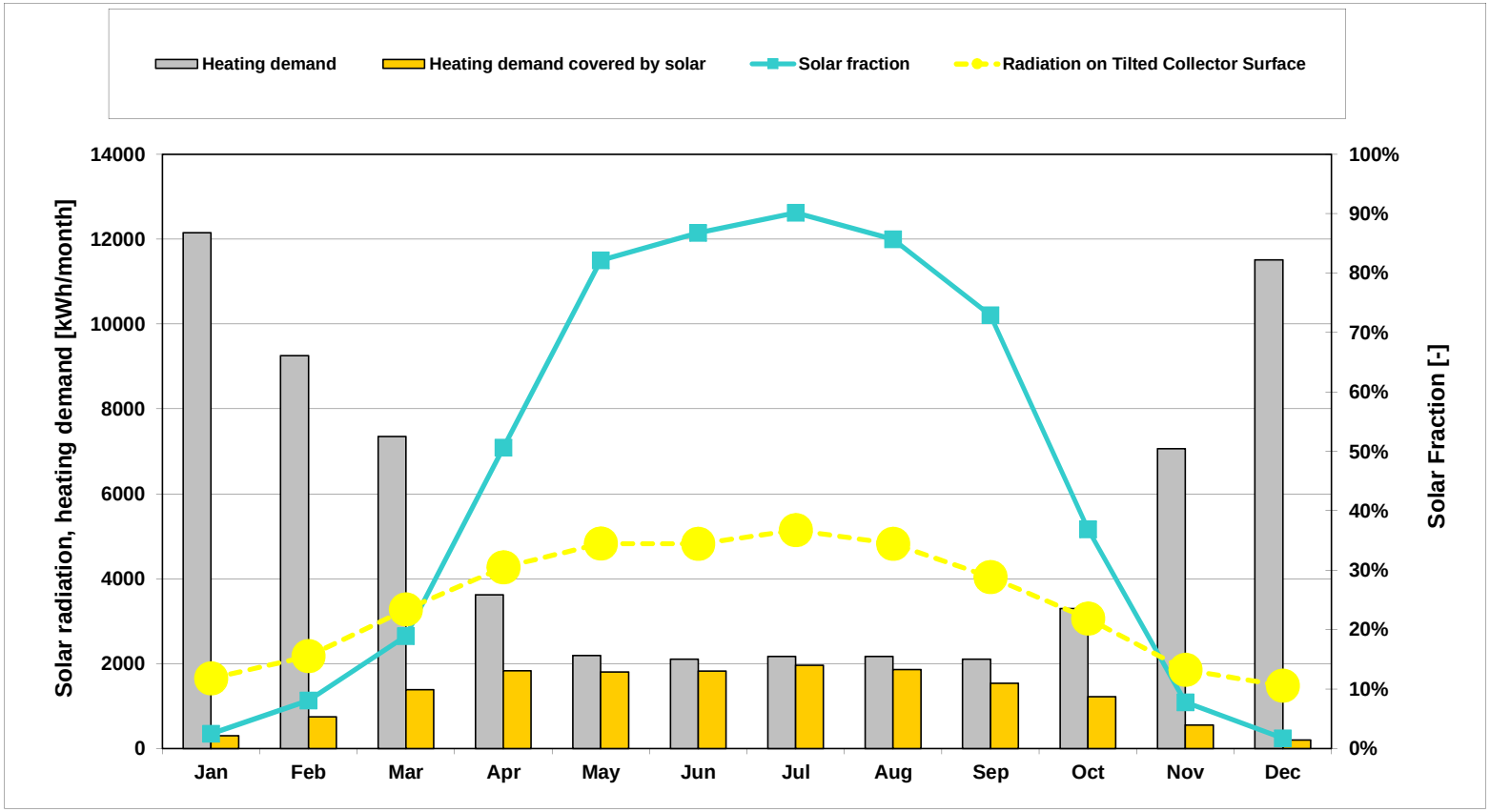
Occupancy	50,0	Persons
Specific Collector Area	0,6	m²/Pers

Estimated solar DHW fraction	**39%**	**9886**	kWh/a	**12**	kWh/(m²a)
Estimated solar coverage for heating	**13%**	**5300**	kWh/a	**6**	kWh/(m²a)
Solar heat contribution total	**23%**	**15186**	kWh/a	**18**	kWh/(m²a)

Secondary Calculation of Storage Losses

Solar Storage: 9 Simple solar storage

Total storage volume	500	litre
Volume Standby Part (above)	150	litre
Volume Solar Part (below)	350	litre
Specific heat losses storage (total)	3,6	W/K
Typical Temperature DHW	60	°C
Room Temperature	10	°C
Storage heat losses (standby part only)	**38**	W
Total storage heat losses	**180**	W



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating demand DHW-preparation	2169	1959	2169	2099	2169	2099	2169	2169	2099	2169	2099	2169	25541	kWh/month
Heating demand space heating	9980	7296	5180	1517	22	0	0	0	5	1125	4958	9340	39424	kWh/month
Heating demand	12149	9256	7349	3616	2191	2099	2169	2169	2105	3295	7058	11509	64965	kWh/month
Radiation on Tilted Collector Surface	1653	2180	3279	4273	4828	4825	5146	4822	4040	3059	1857	1477	41437	kWh/month
Please enter: Solar production for DHW													0	kWh/month
Please enter: Solar production for heating													0	kWh/month
DHW heat demand covered by solar	0	8	49	514	1778	1822	1955	1858	1529	364	9	0	9886	kWh/month
Heating demand covered by solar	298	736	1338	1317	22	0	0	0	5	851	538	196	5300	kWh/month
Heating demand covered by solar	298	744	1387	1831	1800	1822	1955	1858	1534	1215	547	196	15186	kWh/month
Solar fraction	2%	8%	19%	51%	82%	87%	90%	86%	73%	37%	8%	2%	23%	-

Hit planning:

PHOTOVOLTAIC SYSTEM

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Building type: School

Climate: Велико Търнов PHI

Information from the module data sheet

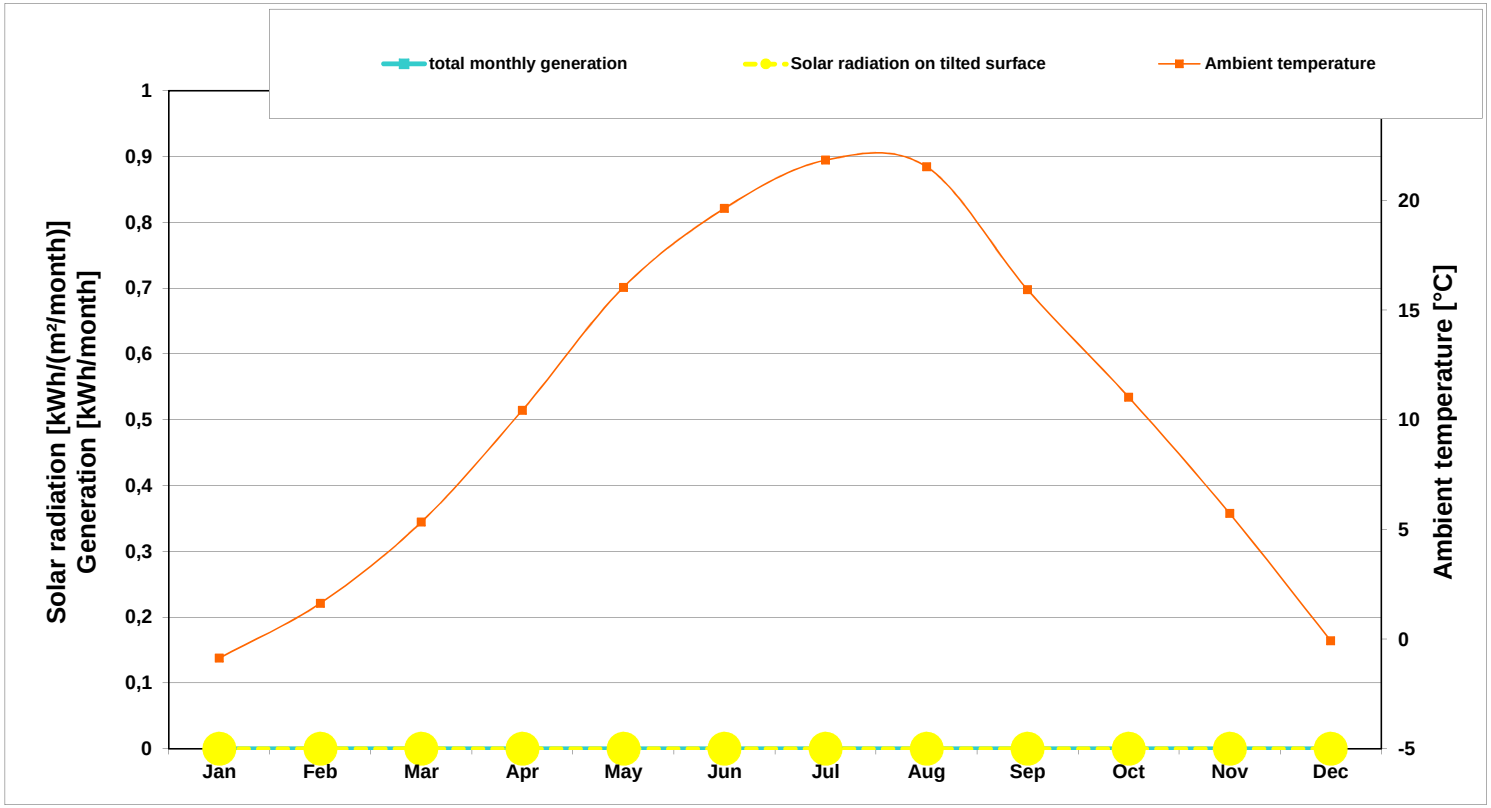
Technology: Amorph-Si

Nominal current	I_{MPP0}		A
Nominal voltage	U_{MPP0}		V
Nominal power	P_n	0	W_p
Temperature coefficient short-circuit current	α		%/K
Temperature coefficient open-circuit voltage	β		%/K

Further specifications

Latitude:		43,1	°	*(Worksheet Climate)*
Number of modules	n_M			
Deviation from North			°	
Angle of inclination from the horizontal			°	
Height of module array			m	
Height of horizon	h_{Hori}		m	
Horizontal distance	a_{Hori}		m	
Additional Reduction Factor Shading	r_{other}			
Efficiency of the inverter	η_{HRV}			

Annual yield of the inverter		kWh
Annual losses due to shading		kWh
PE value (non-renewable)		
CO_2-equivalent emission value		g/kWh



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Year	
Solar radiation on tilted surface													kWh/m²/Month		kWh/m²/a
Ambient temperature	-1	2	5	10	16	20	22	22	16	11	6	0	°C	10,7	°C
total monthly generation													kWh/month		kWh/a
Losses due to shading situation													kWh/month		kWh/a

EnerPHit planning: **ELECTRICITY DEMAND**

Building: Primary School 3 "Tzanko Diustabanov" - Sectio **Calculation in worksheet 'Electricity non-res'!**

Households	1	HH
Persons	50,0	P
Living Area	848	m²
Annual heating demand	46	kWh/(m²a)

Solar fraction of DHW Laundry&Dish	
Marginal Performance Ratio DHW	74%
Marginal Performance Ratio Heating	69%

Prim. Energy Factors:	Electricity	2,6	kWh/kWh
	Natural Gas	1,1	kWh/kWh
Energy Carrier for Space Heating/DHW:		1,8	1,8

Column Nr.	1	2	3			4		5		6		7		8	8a		9		10		11		12		13		14
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand			Utilization Factor		Frequency		Reference Quantity		Useful Energy (kWh/a)		Electric Fraction	Non-Electric Fraction		**Electricity Demand (kWh/a)**		Additional demand		Marginal Performance Ratio		Solar Fraction		Non-Electric Demand (kWh/a)		**Primary Energy-Demand (kWh/a)**
Dishwashing	1	1	1,10	kWh/Use		* 1,00	*	65	/(P*a)	* 50,0	P	= 3575	*	100%		=	**3575**										**9295**
Cold water connection													*		0%			* (1+	0,30	) *	0,74	*(1-		) =			
Clothes washing	1	1	1,10	kWh/Use		* 1,00	*	57	/(P*a)	* 50,0	P	= 3135	*	100%		=	**3135**										**8151**
Cold water connection													*		0%			* (1+	0,05	) *	0,74	*(1-		) =			
Clothes drying with:	1	1	3,50	kWh/Use	Residual dampness	0,88	*	57	/(P*a)	* 50,0	P	= 8728		100%		=	**8728**										**22693**
Condensation Dryer					0,60							= 0			0%						1,00	*			**0**		**0**
Energy consumed by evaporation	0	1	3,13	kWh/Use		* 0,60	*	57	/(P*a)	* 50,0	P	= 0	*		100%			* (1+	0,00	) *	0,69	*(1-	0,55	) =	**0**		**0**
Refrigerating	1	1	0,78	kWh/d		* 1,00	*	365	d/a	* 1	HH	= 285	*	100%		=	**285**										**740**
Freezing	1	0	0,88	kWh/d		* 0,90	*	365	d/a	* 1	HH	= 289	*	100%		=	**289**										**752**
or combination	0	1	1,00	kWh/d		* 1,00	*	365	d/a	* 1	HH	= 0	*	100%		=	**0**										**0**
Cooking with:	1	1	0,25	kWh/Use		* 1,00	*	500	/(P*a)	* 50,0	P	= 6250	*	100%		=	**6250**										**16250**
Electricity					Percentage CFLs								*		0%										**0**		**0**
Lighting	1	1	60	W	0%	* 1,00	*	2,90	kh/(P*a)	* 50,0	P	= 8700	*	100%		=	**8700**										**22620**
Consumer electronics	1	1	80	W		* 1,00	*	0,55	kh/(P*a)	* 50,0	P	= 2200	*	100%		=	**2200**										**5720**
Small appliances, etc.	1	1	50	kWh		* 1,00	*	1,00	/(P*a)	* 50,0	P	= 2500	*	100%		=	**2500**										**6500**
Total aux. electricity												7392					**7392**										**19218**
Other:																											
				kWh/a								0					**0**										**0**
				kWh/a								0					**0**										**0**
				kWh/a								0					**0**										**0**
Total												**43053**	kWh				**43053**	kWh	DHW Non-Electric - Wash&Dish **0**	kWh					**0**		**111939**
Specific Demand																	**50,7**	kWh/(m²a)	Non-Renewable Non-Electric DHW Wash&Dish **0,0**	kWh/(m²a)					**0,0**		**131,9**
Recommended maximum value																	**18**										**50**

EnerPHit planning: **U T I L I S A T I O N non-residential Use**

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Latitude [°]: 43

	Utilisation Pattern	Periods of utilisation and operation	Begin Utilisation [h]	End Utilisation [h]	Daily Utilisation Hours [h/d]	Annual Utilisation Days [d/a]	Annual Utilisation Hours [h/a]	Annual Utilisation Hours During Daytime [h/a]	Annual Utilisation Hours During Nighttime [h/a]	Daily operating hours of heating	Daily operating hours of ventilation	Lighting	Illumination Level [lux]	Height of utilisation level (0.8 or 0.0 m)	Height of utilisation level (0.8 or 0.0 m)	Relative Absenteeism	Part Use Factor of Building Operating Period for Lighting	Average Occupancy [m²/Pers.]
1	**Classroom**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**300**	**0,8**	0,8	**0,25**	**0,9**	**3,0**
2	**Corridors**		**7,5**	**18**	11	**300**	3150	3004	146	13	13		**100**	**0,0**	0,0	**0,80**	**1,0**	
3	**Lobbies**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**200**	**0,0**	0,0	**0,80**	**1,0**	
4	**Computer room**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**300**	**0,8**	0,8	**0,30**	**0,4**	**2,0**
5	**Bookstore**		**9,0**	**18**	9	**180**	1620	1534	86	11	11		**300**	**0,8**	0,8	**0,90**	**1,0**	
6	**Canteen**		**10,0**	**16**	6	**180**	990	990	0	8	8		**100**	**0,8**	0,8	**0,80**	**0,4**	
7	**Kitchen**		**10,0**	**16**	6	**180**	990	990	0	8	8		**100**	**0,8**	0,8	**0,80**	**0,4**	
8	**Stairs**		**7,5**	**18**	11	**300**	3150	3004	146	13	13		**100**	**0,0**	0,0	**0,80**	**1,0**	
9	**WC, Sanitary**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**200**	**0,8**	0,8	**0,90**	**1,0**	
10	**Teacher offices**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**300**	**0,8**	0,8	**0,30**	**0,7**	**10,0**
11	**Dressing room**		**7,5**	**23**	16	**300**	4650	3156	1494	18	18		**300**	**0,8**	0,8	**0,30**	**0,7**	
12	**Bath, showers**		**7,5**	**23**	16	**300**	4650	3156	1494	18	18		**200**	**0,8**	0,8	**0,90**	**1,0**	
13					0		0	0	0	2	2				0,8			
14					0		0	0	0	2	2				0,8			
15					0		0	0	0	2	2				0,8			
16					0		0	0	0	2	2				0,8			
17					0		0	0	0	2	2				0,8			
18					0		0	0	0	2	2				0,8			
19					0		0	0	0	2	2				0,8			
20					0		0	0	0	2	2				0,8			
21	Single Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,30	0,70	10,00
22	Group Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,30	0,70	
23	Open-Plan Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,00	1,00	15,00
24	Meeting		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,50	1,00	2,00
25	Counter Area		7	18	11	250	2750	2543	207	13			200	0,8	0,8	0,00	1,00	
26	Retail		8	20	12	300	3600	2999	601	14			300	0,8	0,8	0,00	1,00	7,00
27	Classroom		8	15	7	200	1400	1398	2	9			300	0,8	0,8	0,25	0,90	2,00
28	University Auditorium		8	18	10	150	1500	1409	91	12			500	0,8	0,8	0,25	0,70	0,75
29	Bedroom		0	24	24	365	8760	4407	4353	24			300	0,8	0,8	0,00	0,50	
30	Hotel Room		21	8	11	365	4015	755	3260	24			200	0,8	0,8	0,25	0,30	
31	Canteen		8	15	7	250	1750	1748	2	9			200	0,8	0,8	0,00	1,00	
32	Restaurant		10	0	14	300	4200	2404	1796	16			200	0,8	0,8	0,00	1,00	1,50
33	Kitchen Non-Residential		10	23	13	300	3900	2404	1496	15			500	0,8	0,8	0,00	1,00	
34	Kitchen, Storage, Preparation		7	23	16	300	3900	2404	1496	15			300	0,8	0,8	0,50	1,00	
35	WC, Sanitary		7	18	11	250	2750	2543	207	13			200	0,8	0,8	0,90	1,00	
36	Other Habitable Rooms		7	18	11	250	2750	2543	207	13			300	0,8	0,8	0,50	1,00	
37	Secondary Areas		7	18	11	250	2750	2543	207	13			100	0,8	0,8	0,90	1,00	
38	Circulation Area		7	18	11	250	2750	2543	207	13			100	0,0	0,0	0,80	1,00	
39	Storage, Services		7	18	11	250	2750	2543	207	13			100	0,8	0,8	0,98	1,00	
40	Server Room		0	24	24	365	8760	4407	4353	24			500	0,8	0,8	0,50	0,50	
41	Workshop		7	16	9	250	2250	2192	58	11			500	0,8	0,8	0,00	1,00	
42	Theatre Auditorium		19	23	4	250	1001	55	946	6			200	0,8	0,8	0,00	1,00	
43	Theatre Foyer		19	23	4	250	1001	55	946	6			300	0,8	0,8	0,50	1,00	
44	Theatre Stage		13	23	10	250	2500	1253	1247	12			1000	0,8	0,8	0,00	0,60	
45	Fair, Congress		13	18	5	150	1350	1260	90	11			300	0,8	0,8	0,50	1,00	
46	Exhibition		10	18	8	250	2001	1850	151	24			200	0,8	0,8	0,00	1,00	
47	Library Reading Room		8	20	12	300	3600	2999	601	14			500	0,8	0,8	0,00	1,00	
48	Open Access Library		8	20	12	300	3600	2999	601	14			200	0,8	0,8	0,00	1,00	
49	Library Repository		8	20	12	300	3600	2999	601	14			100	0,8	0,8	0,90	1,00	
50	Gymnasium		8	23	15	300	4500	3002	1498	17			300	0,8	0,8	0,30	1,00	
51	Parking Garage		7	18	11	250	2750	2543	207	0			75	0,0	0,0	0,95	1,00	
52	Public Parking Garage		9	0	15	365	5475	3290	2185	0			75	0,0	0,0	0,80	1,00	

EnerPHit planning: **E L E C T R I C I T Y   D E M A N D Non-Residential Use**

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Treated Floor Area A_{TFA}: 848,4 m²

Auxiliary Electricity Demand: 7391,5 kWh/a

Primary Energy factors:

Electricity: 2,6 kWh/kWh

Natural gas: 1,1 kWh/kWh

Energy Carrier for DHW: kWh/kWh

Solar fraction of DHW 39%

Marginal Performance Ratio DHW:

Window Properties (from Windows worksheet):

	Shading	Dirt Factor	Non-Perpendicular Radiation	Glazing Fraction
North	0,68	0,95	0,85	0,54
East	0,70			0,49
South	0,67			0,53
West	0,60			0,44

Lighting / non-residential	Percentage of treated floor area	Room Category	Room Category	Nominal Illuminance Level	Facade with Windows: Deviation from North	Orientation	Light Transmission Glazing	Existing window	Room Geometry: Input of a Typical Room or Room by Room: Room Depth	Room Width	Room Height	Lintel Height	Window Width	Input Warning	Daylight Utilisation	User Data: Installed Lighting Power	Installed Lighting Power (Standard)	Lighting Control	With motion?	Lighting Control	Utilisation Hours per Year [h/a]	User Determined: Lighting Full Load Hours	Full Load Hours of Lighting	Electricity Demand (kWh/a)	Spec. Electricity Demand (kWh/(m²a))	Primary Energy Demand (kWh/a)
Room / Zone				Lux	Degrees		-	[x]	m	m	m	m	m			W/m²	W/m²		[x]		h/a	h/a	h/a	kWh/a	kWh/(m²a)	kWh/a
			2	15																		9				
Teacher offices	3%	10	Teacher offices	300	0	North	69%	x	4,4	2,5	3,0	2,6	1,2		none		9,8			Manual Without motion	1890		1029,0	256,7	10,1	667,3
Dressing room 1	4%	11	Dressing room	300	0	North	69%	x	6,9	2,2	3,0	2,6	2,1		low		9,8			Manual Without motion	4650	1300	1300,0	432,3	12,7	1124,1
Dressing room 2	3%	11	Dressing room	300	0	North	69%	x	3,6	5,3	3,0	2,6	4,2		low		9,8			Manual Without motion	4650	1300	1300,0	324,3	12,7	843,1
Corridor	7%	2	Corridors	100	0	North	69%		16,0	3,0	3,0	2,6			none		4,6			Manual Without motion	3150		2360,0	644,7	10,9	1676,3
Gym storage	3%	39	Storage, Services	100	0	North	69%		6,0	6,0	3,0	2,6			none		4,6			Manual Without motion	2750		1930,0	226,0	8,9	587,5
Gym	36%	50	Gymnasium	300	225	South	69%	x	8,6	35,8	8,0	5,6	15,7		low	3	2,6			Manual Without motion	4500		3390,0	2692,0	8,8	6999,2
Gym	36%	50	Gymnasium	300	225	South	69%	x	8,6	35,8	8,0	5,6	33,6		medium	3	2,6			Manual Without motion	4500		3240,0	2572,9	8,4	6689,5
Tribune	5%	50	Gymnasium	300	45	North	69%	x	10,0	11,0	4,0	3,8	10,8		low		9,8			Manual Without motion	4500		3585,0	1490,3	35,1	3874,9
Stairs	1%	8	Stairs	100	45	North	69%	x	3,4	3,4	8,0	7,9			none		4,6			Manual Without motion	3150	1500	1500,0	58,5	6,9	152,2
Bath, showders	2%	12	Bath, showers	200	45	North	69%	x	4,0	2,2	3,0	2,6	2,1		low		7,2			Manual Without motion	4650	1300	1300,0	158,8	9,4	412,9
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	
							69%								none		0,0			Manual Without motion					0,0	

Office Equipment	Room Category	Room Category	In the thermal envelope? (1/0)	Existing/Planned? (1/0)	Quantity	Power Rating (W)	Utilisation Hours per Year (h/a)	relative absenteeism	Duration of Utilisation in Energy Saving Mode (h/a)	Useful Energy (kWh/a)	Electricity Demand (kWh/a)	Primary Energy Demand (kWh/a)
		2					9	20 / 18				
PC 1	10	Teacher offices	1	1	1	55	1323	0,3		51	50,9	132
PC in Energy Saving Mode			1		1	2,0	1323	0,3		1	0,8	2
Monitor 1	10	Teacher offices	1	1	1	20	1323	0,3		19	18,5	48
Monitor in Energy Saving Mode			1		1	1,5	1323	0,3		1	0,6	2
PC 2							0	0		0	0,0	0
PC in Energy Saving Mode			0		0		0	0		0	0,0	0
Monitor 2							0	0		0	0,0	0
Monitor in Energy Saving Mode			0		0		0	0		0	0,0	0
Copier							0		0	0	0,0	0
Copier in Energy Saving Mode			0		0		0			0	0,0	0
Printer							0			0	0,0	0
Printer in Energy Saving Mode			0		0		0			0	0,0	0
Server							0			0	0,0	0
Server in Energy Saving Mode			0		0		8760		0	0	0,0	0
Telephone System							8760			0	0,0	0
Hand Dryer (WC)										0	0,0	0
										0	0,0	0
										0	0,0	0
										0	0,0	0
										0	0,0	0

Kitchen / Aux. Electricity	Room Category	Predominant Utilisation Pattern of Building	In the thermal envelope? (1/0)	Existing/Planned? (1/0)	Utilisation Days per Year (d/a)	Number of Meals per Utilisation Day	Norm Consumption	Useful Energy (kWh/a)	Non-Electric Fraction	Electric Fraction	Additional demand	Marginal Performance Ratio	Solar Fraction	Other Primary Energy Demand (kWh/a)	Electricity Demand (kWh/a)	Primary Energy Demand (kWh/a)
					8											
Cooking					0		0,25 kWh / Meal	0		100%					0,0	0
Electricity									0%					0		0
Dishwashing					0	0	0,10 kWh / Cover	0		55%					0,0	0
DHW connection									45%		0,30	1,20	0,39	0		0
Refrigerating					365		kWh/d	0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
								0		100%					0,0	0
Total Auxiliary Electricity								7392				Hot Water Non-Electric Dishwashing			7391,5	19218
Total								16319 kWh				0		0	16319 kWh/a	42429 kWh/a
Specific Demand												0,0		0,0	19 kWh/(m²a)	50 kWh/(m²a)

EnerPHit planning: # AUXILIARY ELECTRICITY

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Treated Floor Area	848	m²
Heating period	189	d
Air Volume	2121	m³
Dwelling Units	1	HH
Enclosed Volume	6224	m³

Operation Vent. System Winter	4,54	kh/a
Operation Vent. System Summer	4,22	kh/a
Air Change Rate	0,38	h^{-1}
Defrosting HX from	2,0	°C

Primary Energy factor - Electricity	2,60	kWh/kWh
Annual Space Heating Demand	46	kWh/(m²a)
Boiler Rated Power	22	kW
DHW System Heating Demand	25541	kWh/a
Design Flow Temperature	55	°C

Column Nr.	1	2	3		4		5		6		7		8		9		10		11	12
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand		Utilization Factor		Period of Operation		Reference Size		Electricity Demand (kWh/a)		Available as Interior Heat		Used During Time Period (kh/a)		Internal heat source Winter (W)		Internal heat source Summer (W)	Primary Energy Demand (kWh/a)
Ventilation System																				
Winter Ventilation	1		0,40	Wh/m³	* 0,38	h^{-1}	* 4,5	kh/a	* 2121	m³	= **1467**		considered in heat recovery efficiency							**3814**
Defroster HX	1	0	3785	W	* 1,00		* 0,6	kh/a	* 1		= **2096**	*	1,0	/	4,54	=	**0**			**5451**
Summer Ventilation	1	0,55	0,40	Wh/m³	* 0,63	h^{-1}	* 4,2	kh/a	* 2121	m³	= **2256**	*	1,0	/	4,22	=			**294**	**5864**
																			Internal heat sources ' Additional summer ventilation' 7	
Additional ventilation summer	1	0,55	0,40	Wh/m³	* 0,01	h^{-1}	* 4,2	kh/a	* 2121	m³	= **51**	*	1,0	/	4,22	=			**471**	**133**
Heating System					Controlled/UnControlled (1/0)															
Enter the Rated Power of the pump				W																
Circulation Pump	1	1	214	W	* 1,0		* 4,5	kh/a	* 1		= **973**	*	1,0	/	4,54	=	**214**			**2530**
Boiler Electricity Consumption at 30% Load				W																
Aux. Energy - Heat. Boiler	0	0	66	W	* 1,00		* 0,00	kh/a	* 1		= **0**	*	1,0	/	4,54	=	**0**			**0**
Aux. Energy - Wood fired/pellet boiler	0	0	Data entries in Boiler worksheet. Auxiliary energy demand including possible drinking water prod.								**0**	*	1,0	/	4,54	=	**0**			**0**
DHW system																				
Enter average power consumption of pump				W																
Circulation Pump	1		43	W	* 1,00		* 7,5	kh/a	* 1		= **321**	*	0,5	/	8,76	=	**0**		**0**	**836**
Enter the Rated Power of the pump				W																
Storage Load Pump DHW			162	W	* 1,00		* 1,2	kh/a	* 1		= **0**	*	1,0	/	4,54	=	**0**		**0**	**0**
Boiler Electricity Consumption at 100% Load				W																
DHW Boiler Aux. Energy	0	0	198	W	* 1,00		* 0,0	kh/a	* 1		= **0**	*	1,0	/	4,54	=	**0**		**0**	**0**
Enter the Rated Power of the Solar DHW pump				W																
Solar Aux Electricity	1		130	W	* 1,00		* 1,8	kh/a	* 1		= **227**	*	0,5	/	8,76	=	**0**		**0**	**590**
Misc. Aux. Electricity																				
Misc. Aux. Electricity				kWh/a	* 1,00		* 1,0		* 1	HH	= **0**	*	1,0	/	8,76	=	**0**		**0**	**0**
Total											**7392**						**214**		**765**	**19218**
Specific Demand	kWh/(m²a)		divided by treated floor area:								**8,7**									**22,7**

EnerPHit planning:

INTERNAL HEAT GAINS

Building: Primary School 3 "Tzanko Diustabanov" - Sectio — Calculation in worksheet 'IHG non-res'!

Utilisation Pattern: School — 2,80 W/m²

Type of Values Used: Standard — 6,59 W/m² in summer

No data input necessary — 1,34 W/m²

Go to utilisation pattern selection

Calculation Internal Heat Household

Persons 50,0 P

Living Area 848 m²

Heating Demand 46 kWh/(m²a)

Heating period 189 d/a

Column Nr.		1	2	3		4	5		6		7		8		9		10
Application		Existing (1/0), or number of people	In the Thermal Envelope (1/0)	Norm Consumption		Utilization Factor	Frequency		Useful Energy (kWh/a)		Included in Electricity Balance?		Availability		Used During Time Period (kh/a)		**Internal heat source Winter (W)**
Dishwashing		1	1	1,1	kWh/Use	1,00	65	/(P*a)	3575	*			0,30	/	8,76	=	**122**
Clothes Washing		1	1	1,1	kWh/Use	1,00	57	/(P*a)	3135	*			0,30	/	8,76	=	**107**
Clothes drying with:		1	1	3,5	kWh/Use	0,88	57	/(P*a)	8728	*			0,70	/	8,76	=	**697**
Condensation Dryer			1	0,0					0				0,80				
Energy consumed by evaporation		0	1	-3,1	kWh/Use	0,60	57	/(P*a)	0	* (1-	0	) *	0,00	/	8,76	=	**0**
Refrigerating		1	1	0,8	kWh/d	1,00	365	d/a	285	*			1,00	/	8,76	=	**33**
Freezing		1	0	0,9	kWh/d	0,90	365	d/a	289	*			1,00	/	8,76	=	**0**
or combination		0	1	1,0	kWh/d	1,00	365	d/a	0	*			1,00	/	8,76	=	**0**
Cooking		1	1	0,3	kWh/Use	1,00	500	/(P*a)	6250	*			0,50	/	8,76	=	**357**
Lighting		1	1	60,0	W	1,00	2,9	kh/(P*a)	8700	*			1,00	/	8,76	=	**993**
Consumer Electronics		1	1	80,0	W	1,00	0,55	kh/(P*a)	2200	*			1,00	/	8,76	=	**251**
Household Appliances/Other		1	1	50,0	kWh	1,00	1,0	/(P*a)	2500	*			1,00	/	8,76	=	**285**
Auxiliary Appliances (cf. Aux Electricity Sheet)																=	**214**
Other Applications (cf. Electricity Sheet)		0	0,0						0	*			0	/	8,76	=	**0**
Persons		50	1	80,0	W/P	1,00	8,76	kh/a	35040	*			0,55	/	8,76	=	**2200**
Cold Water		50	1	-3,1	W/P	1,00	8,76	kh/a								=	**-153**
DHW - circulation		1	1	25,2	W	1,00	8,76	kh/a	221	*			1,00	/	8,76	=	**25**
DHW - individual pipes		1	1	1104,5	W	1,00	8,76	kh/a	9676	*			1,00	/	8,76	=	**1105**
DHW - storage		1	1	49,0	W	1,00	8,76	kh/a	429	*			1,00	/	8,76	=	**49**
Evaporation		50	1	-25,0	W/P	1,00	8,76	kh/a	-10950	*			1,00	/	8,76	=	**-1250**
Total															W		**3858**
Specific Demand															W/m²		**4,55**
Heat Available From Internal Sources											189,2	d/a			kWh/(m²a)		**20,6**

EnerPHit planning: **INTERNAL HEAT GAINS non-residential Use**

Building: Primary School 3 "Tzanko Diustabanov" - Sectio

Utilisation Pattern: School | 2,80 W/m² |

Type of Values Used: Standard | No data input necessary |

Calculation Internal Heat

Persons: 50,0 P | Treated floor area: 848,4 m² | Heating period: 189,17 d/a | Room Temperature: 18 °C | Internal Heat Gains Aux. Electricity: 214,3 W

Column Nr.

Persons	Select	Utilisation Pattern	Select	Activity of Persons	Planning with the number of persons or via floor area of utilisation zone (planning via area only if the occupancy is available for this utilisation pattern). Pers./Area (1 / 0)	Number of Occupants	Entered occupancy	Floor Area of Utilisation Zone (m²)	Average Occupancy (Persons / m²)	Heat emitted per person (W)	Utilisation Hours per Year [h/a]	Relative Presence	Used in Time Span (h/a)	Average Heat Emitted by Persons (W)
									27		9	18		
Persons A	50	Gymnasium	3	>10 yr., standing or light work	1 Planning with occupancy	{ 50 }*	or	{	* No standard value }*	100 *	4500 *	0,70 /	8760 =	1798
Persons B	11	Dressing room	3	>10 yr., standing or light work	1 Planning with occupancy	{ 50 }*	or	{	* No standard value }*	100 *	4650 *	0,70 /	8760 =	1858
Persons C	10	Teacher offices	2	> 10 yr., sitting	1 Planning with occupancy	{ 1 }*	or	{	* 0,1 }*	80 *	1890 *	0,70 /	8760 =	12
Persons D				Invalid data input	Enter occupancy or floor area	{ }*	or	{	* No standard value }*	0 *	0 *	1,00 /	8760 =	0
Persons E				Invalid data input	Enter occupancy or floor area	{ }*	or	{	* No standard value }*	0 *	0 *	1,00 /	8760 =	0
Persons F				Invalid data input	Enter occupancy or floor area	{ }*	or	{	* No standard value }*	0 *	0 *	1,00 /	8760 =	0
Persons G				Invalid data input	Enter occupancy or floor area	{ }*	or	{	* No standard value }*	0 *	0 *	1,00 /	8760 =	0
Evaporation (person specific)						99 *					4650 *	0,70 /	8760 =	0

Lighting / Equipment / Aux. Electricity	Useful Energy [kWh/a]	Availability	Used in Time Period (kh/a)	Average Heat Release
Lighting	8857	* 1,00	/ 8,76	= 1011
Office Applications (Within Therm. Envelope)	71	* 1,00	/ 8,76	= 8
Cooking (Within Therm. Envelope)	0	* 0,50	/ 8,76	= 0
Dishwashing (Within Therm. Envelope)	0	* 0,30	/ 8,76	= 0
Cooling (Within Therm. Envelope)	0	* 1,00	/ 8,76	= 0
Other (Within Therm. Envelope)	0	* 1,00	/ 8,76	= 0
Auxiliary Appliances (See Aux Electricity Worksheet)				= 214

Heat loss due to cold water (calculation from column AJ)	on/off (1 / 0)	Predominant Utilisation Pattern of Building (Data transfered from Electricity non-res worksheet; input kitchen)	Number of WCs (user data)	Amount of WCs: Standard values for schools are used (X)	Number of WCs (calculation value)	DT: Cold Water Temp. - Room Temp. [K]	Occupied Days per Year [d/a]	Loss daytime [W]	Loss Nighttime [W]	Availability	Used in Period (d/a)	Average Power Cold Water
		2					8					
Cold Water Due to Flushing WC	1	0	2	X	8	-6	0 *(	0 +	-21)*	1,00 /	365 =	0

Total	W	4901
Specific Demand	W/m²	5,8
Heat Available From Internal Sources	189 d/a	kWh/(m²a) 26

EnerPHit planning:

PRIMARY ENERGY VALUE

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Building type: School

Treated Floor Area A_{TFA}: 848 m²

Space Heating Demand incl. Distribution: 46 kWh/(m²a)

Useful cooling demand incl. dehumidification: 0 kWh/(m²a)

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			Final Energy kWh/(m²a)	Primary Energy kWh/(m²a)	Emissions CO_2-Equivalent kg/(m²a)
Electricity Demand (without Heat Pump)				PE Value	CO_2-Emissions Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	2,6	680
Direct Electric Heating	$Q_{H,de}$		0,0	0,0	0,0
Hot water, direct electric (without DHW wash&dish)	$Q_{DHW,de}$	*(DHW+Distribution, SolarDHW)*	0,0	0,0	0,0
Electric Post heating DHW Wash&Dish		*(Electricity, SolarDHW)*	0,0	0,0	0,0
Electricity demand lighting/auxiliary tools/kitchen	Q_{EHH}	*(Electricity worksheet)*	10,5	27,4	7,2
Electricity Demand - Auxiliary Electricity			8,7	22,7	5,9
Total electricity demand (without heat pump)			19,2	50,0	13,1
Heat pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*	70%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	60%	2,6	680
Energy Carrier - Supplementary Heating			Electricity	2,6	680
Annual coefficient of performance of heat pump 1 (heating / heating&DHW)	SPF_{H-1}	*(HP worksheet)*	1,9		
Annual coefficient of performance of heat pump 2 (DHW)	SPF_{H-1}	*(HP worksheet)*			
Heat generation efficiency (excl. DHW wash&dish)		*(HP worksheet)*	0,60		
Heat generation efficiency (incl. DHW wash&dish)		*(HP worksheet)*	0,60		
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}	*(HP worksheet)*	23,5	61,0	16,0
Non-Electric Demand, DHW Wash&Dish			0,0	0,0	0,0
Total electricity demand heat pump		*(HP worksheet)*	23,5	61,0	16,0
Compact Heat Pump Unit				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	2,6	680
Energy Carrier - Supplementary Heating			Electricity	2,6	680
COP Heat Pump Heating	SPF_{H-1}	*(Compact worksheet)*	0,0		
COP Heat Pump DHW	SPF_{H-1}	*(Compact worksheet)*	0,0		
Heat generation efficiency (excl. DHW wash&dish)		*(Compact worksheet)*			
Heat generation efficiency (incl. DHW wash&dish)		*(Compact worksheet)*			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}	*(Compact worksheet)*	0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish			0,0	0,0	0,0
Total Compact Unit		*(Compact worksheet)*	0,0	0,0	0,0
Boiler				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%		250
Boiler Type		*(Boiler worksheet)*			
Performance Ratio of Heat Generator		*(Boiler worksheet)*	0%		
Annual Energy Demand (without DHW Wash&Dish)		*(Boiler worksheet)*	0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Total heating oil/gas/wood			0,0	0,0	0,0
District Heat				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	30%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	40%	0,8	240
Heat source		*(District heating worksheet)*	Hard Coal CGS 70% PHC		
Performance Ratio of Heat Generator		*(District heating worksheet)*	105%		
Heating Demand District Heat (without DHW Wash&Dish)		*(District heating worksheet)*	20,4	16,3	4,9
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Total district heat			20,4	16,3	4,9
Other				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	0,2	55
Heat source		*(Project)*	Wood		
Performance Ratio of Heat Generator		*(Project)*	0%		
Annual Energy Demand, Space Heating			0,0	0,0	0,0
Annual Energy Demand, DHW (without DHW Wash&Dish)			0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Non-Electric Demand Cooking/Drying (Gas)		*(Electricity worksheet)*	0,0	0,0	0,0
Total - Other			0,0	0,0	0,0
Cooling with Electric Heat Pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
				kWh/kWh	g/kWh
Covered Fraction of Cooling Demand		*(Project)*	100%	2,6	680
Heat source			Electricity		
Seasonal energy efficiency ratio cooling			2,0		
Energy Demand Space Cooling			0,2	0,5	0,1
Heating, cooling, DHW, auxiliary electricity, lighting, electrical appliances			63,3	127,9	34,1

Total PE Value 127,9 kWh/(m²a)

Total emissions CO_2-Equivalent 34,1 kg/(m²a)

(Yes/No)

Primary Energy Requirement 158 kWh/(m²a) **yes**

Heating, DHW, auxiliary electricity (no lighting and electrical appliances)	52,6	100,0	26,8	
Specific PE Demand - Mechanical System	100,0	kWh/(m²a)		
Total emissions CO_2-Equivalent	26,8	kg/(m²a)		

Solar electricity			kWh/a	PE-Value (Generation) kWh/kWh	CO_2-Emission Factor g/kWh
Planned Annual Electricity Generation		*(Worksheet PV)*			
Specific Demand					
PE Value: conservation by solar electricity		kWh/(m²a)			
Saved CO_2 emissions through solar electricity		kg/(m²a)			

EnerPHit planning: **HEAT PUMP**

Building: Primary School 3 "Tzanko Diustabanov" - Secti | Building type: School

Climate: Велико Търнов PHI | Treated Floor Area A_{TFA}: 848 m²

C), DHW solar p

Covered fraction of space heating demand			*(PE Value worksheet)*	70%	
Space Heat Demand + Distribution Losses		Q_H+Q_{HL}:	*(DHW+Distribution)*	39424	kWh/a
Solar fraction for space heat		$\eta_{Solar,\ H}$	*(SolarDHW worksheet)*	13%	
Effective Annual Heat Demand		$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$		23886	kWh/a
Covered Fraction of DHW Demand			*(PE Value worksheet)*	60%	
Total heat demand of DHW system		Q_{gDHW}	*(DHW+Distribution)*	26644	kWh/a
Solar fraction for DHW		$\eta_{Solar,\ DHW}$	*(SolarDHW worksheet)*	37%	
Effective DHW demand		$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$		10055	kWh/a
Number of heat pumps in the system				1	
Functionality				Heating & DHW	

Heating

Selection of HP:	Daikin Altherma 16 kW	Heat source:		Ambient air	
Selection of distribution system				Radiators	
Design distribution temperature		θ_{design}	*(DHW+Distribution)*	55,00	°C
Nomimal Power of distribution system		P_{nom}		150,00	kW

Distribution system (fulfilled from expert users only)

Nominal Power of distribution system		P_{nom}		150,00	kW
Radiator exponent		n		1,30	
Heating storage				No	
Specific heat losses storage		U * $A_{storage}$			W/K
Storage location in thermal envelope	Inside or outside of the thermal envelope			Outside	
Room temperature (Storage location: outside of thermal envelope)			*(DHW+Distribution)*	10,00	°C
Sink temperature of heat pump for heating		θ_{snk}		61,50	°C

Entries in relation to the domestic hot water system

Selection of HP:	Daikin Altherma 16 kW	Heat source:		Ambient air	
DHW temperature			*(DHW+Distribution)*	60,00	°C
DHW storage location	inside or outside of the thermal envelope			Outside	
Specific heat losses storage		U * $A_{storage}$		2,5	W/K
Room temperature (Storage location: outside of thermal envelope)			*(DHW+Distribution)*	0,00	°C
Type of backup heater				Electr. immersion heater	
Δθ of Electric flow type heater				5,0	K

In case of one heat pump with functionality: Heating & DHW

Same heat pump's sink temperature for Heating and for DHW				Yes	
Heat Pump Priority			*(Manufacturer, Techn. Data)*	DHW priority	

Control

Control strategy				On / off	

Heating

Depth (horizontal / vertical) ground heat exchanger		z		50,0	m
Power of pump for ground heat exchanger		P_{pump}		0,05	kW

EnerPHit planning: **HEAT PUMP**

Daikin Altherma 16 kW

Heating

Heat pump: Daikin Altherma 16 kW

Source: Ambient air

	θ_source °C	θ_sink °C	Heating capacity kW	COP
Test Point 1	-15,0	35,0	12,9	2,0
Test Point 2	-7,0	35,0	14,9	2,6
Test Point 3	-2,0	35,0	15,4	2,9
Test Point 4	2,0	35,0	15,6	3,3
Test Point 5	7,0	35,0	16,1	4,2
Test Point 6	12,0	35,0	16,7	4,4
Test Point 7	15,0	35,0	18,2	4,8
Test Point 8	-15,0	50,0	10,6	1,6
Test Point 9	-7,0	50,0	12,4	1,9
Test Point 10	-2,0	50,0	13,6	2,1
Test Point 11	2,0	50,0	14,4	2,3
Test Point 12	7,0	50,0	14,5	2,8
Test Point 13	12,0	50,0	15,1	3,0
Test Point 14	15,0	50,0	16,4	3,2
Test Point 15				

Temperature difference in sink $\Delta\theta_{Sink}$ 8,0 K

DHW

Heat pump: Daikin Altherma 16 kW

Source: Ambient air

	θ_source °C	θ_sink °C	Heating capacity kW	COP
Test Point 1	-15,0	35,0	12,9	2,0
Test Point 2	-7,0	35,0	14,9	2,6
Test Point 3	-2,0	35,0	15,4	2,9
Test Point 4	2,0	35,0	15,6	3,3
Test Point 5	7,0	35,0	16,1	4,2
Test Point 6	12,0	35,0	16,7	4,4
Test Point 7	15,0	35,0	18,2	4,8
Test Point 8	-15,0	50,0	10,6	1,6
Test Point 9	-7,0	50,0	12,4	1,9
Test Point 10	-2,0	50,0	13,6	2,1
Test Point 11	2,0	50,0	14,4	2,3
Test Point 12	7,0	50,0	14,5	2,8
Test Point 13	12,0	50,0	15,1	3,0
Test Point 14	15,0	50,0	16,4	3,2
Test Point 15				

Temperature difference in sink $\Delta\theta_{Sink}$ 8,0 K

Electrical energy consumption of pump (groundwater / groun	Q_{pump}	0	kWh/a
Energy by Direct Electricity	$Q_{E,dir}$	3791	kWh/a
Space heat supplied by HP	$Q_{HP,Heating}$	20095	kWh/a
Winter DHW supplied by HP	$Q_{HP,DHW,Winter}$	6482	kWh/a
Summer DHW supplied by HP	$Q_{HP,DHW,Summer}$	3573	kWh/a
Space heating supplied by HP without storage losses	$Q_{HP,Heating}$	20095	kWh/a
Winter DHW supplied by HP without storage losses	$Q_{HP,DHW,Winter}$	11420	kWh/a
Summer DHW supplied by HP without storage losses	$Q_{HP,DHW,Summer}$	3104	kWh/a
Electrical consumption of HP	Qel_{HP}	16126	kWh/a

		1. HP: Heating or heating & DHW	2. HP: Domestic hot water
Seasonal performance factor of Heat Pump	SPF_{H-1}	1,87	
Seasonal Performance factor of System	SPF_{H-3}	1,66	
Heat generation efficiency DHW & heating		60%	
		kWh/a	kWh/(m²a)
Final electrical energy demand heat generation	Q_{final}	19918	23,5
Annual primary energy demand		51786	61,0
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions		13544	16,0

EnerPHit planning:

HP Ground (Ground probes / Ground collectors)

Building: Primary School 3 "Tzanko Diustabanov" - Section A
Climate: Велико Търнов PHI
Building type: School
Treated Floor Area A_{TFA}: 848 m²

Ground probes

Probe field configuration		A	Individual probe	
Length of probe	*(HP worksheet)*	H	50	m
Probes spacing/distance		B		m
Depth (z=H/2)		z	25	m
Type of probe		A	Double-U	
Borehole radius		R_b		m
Inner radius of pipe		R_i		m
Exterior pipe radius		R_a		m
Distance between pipes		BU		m
Inner radius of pipe casing (only coaxial)		R_{i2}		m
Exterior radius casing pipe (only coaxial)		R_{a2}		m
Thermal conductivity of pipe		λ_R		W/(mK)
Thermal conductivity of back fill		λ_F		W/(mK)
Probe time constant		t_p	#DIV/0!	d
Internal borehole resistance		R_a		Km/W
Borehole resistance		R_b		Km/W

Ground

Soil type	J	0	
Density of the ground	ρ_E	0	kg/m³
Thermal capacity of ground	cp_E	0	J/(kgK)
Thermal conductivity of ground	λ_E	0,0	W/(mK)
Soil temperature conductivity	a_E	#DIV/0!	m/s²
Ground temperature gradient	ΔT_G	0,022	K/m

Brine

Brine (characteristics at 2 °C)	E	0	
Density of the brine	ρ_S	0	kg/m³
dynamic viscosity of the brine	η_S	0	kg/(ms)
Heat capacity brine	cp_S	0	J/(kgK)
Thermal conductivity of brine	λ_S	0	W/(mK)
Brine - mass flow	m_S		kg/s

Operation type

Waste heat of active cooling to ground probe? Please check, if applicable.			
Heat pump operation duration			h/a
Specific heat extraction rate as an annual average	q_{ex}		W/m
	H/R_b		W/K

Ground collectors

Inner radius of pipe	r_i	0,013	m
Exterior pipe radius	r_a	0,016	m
Thermal conductivity of pipe	λ_r	0,420	W/(mK)
Pipe depth	z_{pipe}	50	m
Ground water depth	z_{gw}		m
Pipe spacing	D	0,4	m
Base area		80	m²
Pipe outer surface		20,1	m²
Pipe length	L	200,0	m

Brine

Brine (characteristics at 2 °C)	E	0	
Density of the brine	ρ_S	0	kg/m³
dynamic viscosity of the brine	η_S	0	kg/(ms)
Heat capacity brine	cp_S	0	J/(kgK)
Thermal conductivity of brine	λ_S	0	W/(mK)
Brine - mass flow	m_S	0,5	kg/s
Specific heat extraction rate	q_{ex}		W/m²
U * A			W/K

Climate

Period duration		365	d
Average ground surface temperature	T_{m0}	11,7	°C
Surface temperature amplitude	T1	11,4	°C
Phase shifting surface	t_{02}	31	d

HP Ground (Ground probes / Ground collectors)

Ground characteristics		Thermal conductivity [W/(mK)]	Density [kg/m³]	Heat capacity [J/(kg K)]	Heat capacity [MJ/(m³ K)]	Temperature conductivity [10-7 m²/s]	Source
A	Sand, 9% moisture	0,980	1440	1507	2,170	4,520	[Neiß 1977]
B	Sand, 13% moisture	1,500	1600	1800	2,880	5,210	[Neiß 1977]
C	Ground, coarse gravel	0,520	2000	1840	3,680	1,410	[VDI 1984]
D	Loam, 36% moisture	2,300	1650	2847	4,700	4,900	[Neiß 1977]
E	Clay	1,280	1500	880	1,320	9,700	[VDI 1984]
F	Clay / Silt	2,200	2550	882	2,250	9,780	[VDI 2000]
G	Slate	2,100	2700	870	2,350	8,940	[VDI 2000]
H	Silt	1,500	1920	2938	5,640	2,660	[ISO 13370]
I	Rock	3,500	2500	2500	6,250	5,600	[ISO 13370]
J							

Properties of the brine		Temperature [°C]	Density [kg/m³]	Heat capacity [J/(kg K)]	Thermal conductivity [W/(mK)]	Dynamic viscosity [kg/(ms)]
A	Ethylene glycol 25%	2	1052	3950	0,480	0,0052
B	Potassium carbonate	2	1265	2941	0,544	0,0031
C	Potassium formate	2	1226	3190	0,534	0,00237
D	Water	2	997	4190	0,590	0,001307
E						

Result ground probe calculation

Month	Borehole Temperature °C
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

EnerPHit planning: **COMPACT UNIT WITH EXHAUST AIR HEAT PUMP**

Calculation based on measured values of the laboratory evaluation for component certification

Building: primary School 3 "Tzanko Diustabanov" - Section A | Building type: School

Treated Floor Area A_{TFA}: 848 m²

				incl. DHW Connection for Washing Machines & Dishwashers	
Covered fraction of space heating demand	*(PE Value worksheet)*	0%			
Space Heating Demand + Distribution Losses	Q_H+Q_{HL} *(DHW+Distribution)*	39424	kWh		
Solar contribution for space heaing	$\eta_{Solar,\ H}$ *(SolarDHW worksheet)*	13%			
Effective Annual heating demand	$Q_{H,WI}=Q_H*(1-\eta_{Solar,\ H})$	0	kWh		
Covered Fraction of DHW Demand	*(PE Value worksheet)*	0%			
Total Heating Demand of DHW system	Q_{gDHW} *(DHW+Distribution)*	25541	kWh	25541	kWh
Solar contribution for DHW	$\eta_{Solar,\ DHW}$ *(SolarDHW worksheet)*	39%		39%	
Effective DHW Demand	$Q_{DHW,WI}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$	0	kWh	0	kWh

Sort: AS LIST

Compact unit selection: Go to list of compact units

Measured Values from Laboratory Test Invalid selection: for the time being compact HP units or combined HPs can ONLY be considered as single units, meaning they can ONLY be calculated with the 'Ventilation' worksheet (please check the

Ventilation

Effective heat recovery efficiency	η_{eff} *(Test stand)*		
Electric Efficiency	*(Test stand)*		Wh/m³

Heating

		Test point 1	Test point 2	Test point 3	Test point 4	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power Heat Pump Heating	$P_{HP,Heating}$					kW
Measured COP Heating	$COP_{Heating}$					-

Domestic Hot Water

		Test point 1	Test point 2	Test point 3	Test point 4	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power DHW Storage Heating-Up	$P_{DHW,Heating-Up}$					kW
Measured Thermal Power DHW Storage Reload	$P_{DHW,Reload}$					kW
Measured COP DHW Storage Heating-Up	$COP_{DHW,Heating-Up}$					-
Measured COP DHW Storage Reload	$COP_{DHW,Reload}$					-

Standby (Inputs required only if different from storage reload)

		Test point 1	Test point 2	Test point 3	Test point 4	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power Heat Pump Standby	$P_{HP,Standby}$					kW
Measured COP Standby	$COP_{Standby}$					-

0%

Specific heat loss storage incl. connections	$U * A_{Storage}$ *(Test stand)*		W/K	
Average Storage Temperature in Standby Mode	$T_{DHW,Standby}$ *(Test stand)*		°C	
Heat pump priority	separate heat pumps	DHW Priority		Heating priority
	Room temperature (°C)	18		
	Av. Ambient Temp. Heating P. (°C)	4		
	Av. Ground Temp (°C)	12		
Efficiency SHX Exhaust Air Mixing	η^*_{SHX}			
Heat Recovery Efficiency SHX Exhaust Air Mixing (if applicable)	$\eta_{SHX,add}$ *(Design Value)*	0%		
Volume Flow Rate of Added Exhaust Air (if applicable)	V_{add} *(Test stand)*		m³/h	
Hydraulic frost protection				

Heat supplied by direct electricity	$Q_{E,dir}$		kWh/a			kWh/a	
Space heat supplied by HP	$Q_{HP,Heating}$		kWh/a			kWh/a	
Winter DHW supplied by HP	$Q_{HP,DHW,Winter}$	0	kWh/a		0	kWh/a	
Winter standby heat supplied by HP	$Q_{HP,Standby,Winter}$		kWh/a			kWh/a	
Summer DHW supplied by HP	$Q_{HP,DHW,Summer}$	0	kWh/a		0	kWh/a	
Summer standby heat supplied by HP	$Q_{HP,Standby,Summer}$		kWh/a			kWh/a	
Performance Ratio of Heat Generator, DHW & Space Heating							
Annual Coefficient of Performance	SPF_{H-3}						
		kWh/a		kWh/(m²a)	kWh/a		kWh/(m²a)
Final energy demand heat generation	Q_{final}						
Annual primary energy demand							
		kg/a		kg/(m²a)	kg/a		kg/(m²a)
Annual CO_2-Equivalent Emissions							

EFFICIENCY OF HEAT GENERATION (gas, oil & wood)

Building: Primary School 3 "Tzanko Diustabanov" - Section A

Building type: School

Treated Floor Area A_{TFA}: 848 m²

Covered fraction of space heating demand	*(PE Value worksheet)*	0%	
Space Heating Demand + Distribution Losses	$Q_H+Q_{HS;}$ *(DHW+Distribution)*	39424	kWh
Solar contribution for space heaing	$\eta_{Solar,\ H}$ *(SolarDHW worksheet)*	13%	
Effective Annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$	**0**	kWh
Space Heating Demand without Distribution Losses	Q_H *(Verification sheet)*	39278	kWh
Covered Fraction of DHW Demand	*(PE Value worksheet)*	0%	
Total Heating Demand of DHW system	Q_{gDHW} *(DHW+Distribution)*	25541	kWh
Solar contribution for DHW	$\eta_{Solar,\ DHW}$ *(SolarDHW worksheet)*	39%	
Effective DHW Demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$	**0**	kWh

Additional selection only in the case of Natural Gas

Boiler Type	*(Project)*	None	
Primary Energy factor	*(Data worksheet)*		kWh/kWh
CO_2-Emissions Factor (CO_2-Equivalent)		250	g/kWh
Useful heat provided	Q_{Use}		kWh/a
Max. Heating Power Required for Heating the Building	P_{BH} *(Heating load worksheet)*	22,18	kW
Length of the Heating Period	t_{HP}	4540	h
Length of DHW Heating Period	t_{DHW}	8760	h

Use characteristic values entered (check if appropriate)?

		Project Data		Standard Values		Input field	
Design Output	P_{Nom} *(Rating Plate)*	22	kW	22	kW		
Installation of Boiler (Outdoor: 0, Indoor: 1)		0		0			
Input Values (Oil and Gas Boiler)		Project Data		Standard Values		Input field	
Boiler Efficiency at 30% Load	$\eta_{30\%}$ *(Manufacturer)*						
Boiler Efficiency at Nominal Output	$\eta_{100\%}$ *(Manufacturer)*						
Standby Heat Loss Boiler at 70 °C	$q_{B,70}$ *(Manufacturer)*						
Average Return Temperature Measured at 30% Load	$\vartheta_{30\%}$ *(Manufacturer)*		°C				
Input Values (Biomass Heat Generator)		Project Data		Standard Values		Input field	
Efficiency of Heat Generator in Basic Cycle	η_{GZ} *(Manufacturer)*			60%			
Efficiency of Heat Generator in Constant Operation	η_{SO} *(Manufacturer)*			70%			
Average Fraction of Heat Output Released to Heating Circuit	$z_{HC,m}$ *(Manufacturer)*			0,4			
Temperature Difference Betw. Power-On and Power-Off	$\Delta\vartheta$ *(Manufacturer)*		K	30	K		
For Interior Installations: Area of Mechanical Room	$A_{install}$ *(Project)*		m²	0	m²		
Useful heat output per basic cycle	$Q_{N,GZ}$ *(Manufacturer)*		kWh	33,0	kWh		
Average Power Output of the Heat Generator	$Q_{N,m}$ *(Manufacturer)*		kW	22,0	kW		
Heat generator without pellets conveyor							
Unit with regulation (no fan / no starting aid)							
Heating energy demand for a basic machine cycle	$Q_{HE,GZ}$ *(Manufacturer)*		kWh		kWh		kWh
Power consumption in steady state operation	$P_{el,SB}$ *(Manufacturer)*		W		W		W

Utilisation factor heat generator heating run	$h_{H,g,K}$ $=f_\varphi*\eta_{K;}$	0%
Utilisation factor heat generator DHW run	$h_{TW,g,K}$ $=\eta_{100\%}/f_{\varphi,TW}$	0%
Utilisation factor heat generator DHW & heating	$h_{g,K}$	0%

		kWh/a	kWh/(m²a)
Final energy demand space heating	$Q_{Final,\ HE}$ $= Q_{H,wi}* e_{H,g,K}$	0	
Final energy demand DHW	$Q_{Final,\ DHW}$ $= Q_{DHW,wi}* e_{TW,g,K}$	0	
Total final energy demand	Q_{Final} $= Q_{Final,DHW} + Q_{Final,HE}$	0	0,0
Annual primary energy demand			
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions		0	0,0

Building:	Primary School 3 "Tzanko Diustabanov" - Section A	Building type:	School	
		Treated Floor Area A_{TFA}:	848	m²
Covered fraction of space heating demand		*(PE Value worksheet)*	30%	
Annual heating demand kWh/a	Q_H	*(DHW+Distribution)*	39424	kWh
Solar contribution for space heaing	$\eta_{Solar, H}$	*(SolarDHW worksheet)*	13%	
Effective Annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar, H})$		**10237**	kWh
Covered Fraction of DHW Demand		*(PE Value worksheet)*	40%	
DHW Demand	Q_{DHW}	*(DHW+Distribution)*	25541	kWh
Solar contribution for DHW	$\eta_{Solar, DHW}$	*(SolarDHW worksheet)*	39%	
Effective DHW Demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar, DHW})$		**6262**	kWh
Heat source			Hard Coal CGS 70% PHC	
Primary Energy factor		*(Data worksheet)*	0,8	kWh/kWh
CO_2-Emissions factor (CO_2-Equivalent)		*(Data worksheet)*	240	g/kWh
Utilisation factor of heat transfer station	ha,HX		105%	

		kWh/a	kWh/(m²a)
Final energy demand heat generation	$Q_{final} = Q_{Use} * e_{a,DH}$	17324	20,4
Annual primary energy demand		13859	16,3
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions		4158	4,9

Table of Primary Energy Factors and CO_2-Equivalent Emissions Factors of Various Energy Carriers

Energy Type		Energy Carrier	PE (non-regenerative) kWh_{Prim}/kWh_{Final}	CO_2 GEMIS 3.0 kg/kWh_{Final}
	1	None		
Fuel Source	2	Oil	1,1	0,31
	3	Natural Gas	1,1	0,25
	4	LPG	1,1	0,27
	5	Hard Coal	1,1	0,44
	6	Wood	0,2	0,05
Electricity	7	Electricity-Mix	2,6	0,68
	8	Electricity from Photovoltaics	0,7	0,25
	1	None	0	0
District Heat	2	Hard Coal CGS 70% PHC	0,8	0,24
	3	Hard Coal CGS 35% PHC	1,1	0,32
	4	Hard Coal HS 0% PHC	1,5	0,41
Gas CGS	5	Gas CGS 70% PHC	0,7	-0,07
	6	Gas CGS 35% PHC	1,1	0,13
	7	Gas HS 0% PHC	1,5	0,32
Heating Oil-EL CGS	8	Oil CGS 70% PHC	0,8	0,1
	9	Oil CGS 35% PHC	1,1	0,25
	10	Oil HS 0% PHC	1,5	0,41

Data Source: DIN V 4701-10/GEMIS 4.14

Heat Generator		Selection of gas type	
Nr.	Type	Nr.	Type
1	None	1	Natural Gas
2	Improved gas condensing boi-ler	2	LPG
3	Improved oil condensing boi-ler	3	
4	Condensing boiler gas		
5	Condensing boiler oil		
6	Low Temperature Boi-ler Gas		
7	Low Temperature Boi-ler Oil		
8	Wood Log Burning (Direct and Indirect Release of Heat)		
9	Wood Pellet Burning (Direct and Indirect Release of Heat)		
10	Wood Pellet Burning (Only Indirect Release of Heat)		
11	Reserve		

Dishwashing	Washing
1	DHW Connection
2	Cold water connection

Clothes Drying		Availability Electricity	Availability Evaporation
1	Clothesline	1	1
2	Drying Closet (cold!)	1	1
3	Drying Closet (cold!) in Exhaust Air	0,9	0,9
4	Condensation Dryer	0,7	0
5	Electric Exhaust Air Dryer	1	1
6	Gas Exhaust Air Dryer	1	1

Cooking		Electric Fraction	Primärenergiefaktor	CO_2 factor
1	Electricity	100%	2,6	0,68
2	Natural Gas	0%	1,1	0,25
3	LPG	0%	1,1	0,27