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SPREADSHEET SUPPORTING THE CASE STUDY ON

EN ISO 52000-1

ENERGY PERFORMANCE OF BUILDINGS
"OVERARCHING STANDARD"

SIMPLIFIED DEMONSTRATION OF DELIVERED AND EXPORTED ENERGY WEIGHTING

This spreadsheet:	
This spreadsheet is part of a series, to support the implementation and use of the set of (CEN, ISO) EPB standards	
(see below)	
Main related standard(s):	**ISO 52000-1, Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures**
Spreadsheet created by:	Laurent Socal (EPB Center expert)
Contact:	https://epb.center/contact/
Date:	2022-02-14
	Replaces file: --
Detailed info:	See sheet "Explanation"

The series of spreadsheets to support the implementation and use of the set of EPB standards:

EPB spreadsheets:	This spreadsheet is part of a series of spreadsheets to support the implementation and use of the set of (CEN, ISO) EPB standards
	Each of these spreadsheets complies with a specific template and follows specific rules

Main purpose:	The main purpose of these EPB spreadsheets is to support the implementation and use of the standards.
	They aim to demonstrate the validity of the calculation procedures and the required input and provided output data defined in the standard.
	They support the expert user of the standards, in particular those who want to review the content of the standard and those who want to translate the standard into software, to understand the correct interpretation of the formulae and calculation steps in the standard, or e.g. to explore the sensitivity for variations in input values.
	Some spreadsheets have been further developed to include more advanced features or to become more user friendly (see sheet "Explanation")

Limitations:	In general, these spreadsheets do not cover the full range of calculation options that are possible according to the standard to which it applies. This concerns e.g. the number of instances of a variable, the number of time intervals and/or special calculation cases.
	These spreadsheets cover only a single or a cluster of EPB standards and are not meant to perform a full energy performance calculation.
	Note also that these spreadsheets are mainly intended for testing and demonstration and therefore not aiming to be user friendly or to be protected against wrong or improper use.
	The spreadsheets related to the EPB standards are provided to demonstrate specific elements of the calculation procedures in the relevant standard(s). Consequently, they do not replace the EPB standards, but they shall be used along with the EPB standards.

Responsible:	In general, the preparation of the spreadsheet is a collective process in which several experts (including main developers of the standard) are involved
	See "Background" below for information on the first versions of (most of) these spreadsheets

Acknowledgement:	The EPB spreadsheets produced or upgraded after 2018 have been prepared under a contract with the European Union, represented by the European Commission (Service contract ENER/C3/2017-437/SI2-785.185). Start: 21 September 2018 for 3 years. See "Background" for information on previous (2012-2017) versions of many of these spreadsheets

Disclaimer:	Although these spreadsheets have been developed with care, neither the authors or contributors warrant that the calculations and procedures in this spreadsheet are free of errors. The EPB Center expressly disclaims any liability or responsibility arising from use of this spreadsheet, or any consequences thereof. Any responsibility arising from the use of this spreadsheet lies with the user.
	The information and views set out in this document are those of the author(s) and do not necessarily reflect the official opinion of the European Union. Neither the European Union institutions and bodies nor any person acting on their behalf may be held responsible for the use which may be made of the information contained therein.

Terms of use:	The user is not allowed to redistribute a modified version of this spreadsheet.
	The author(s) would appreciate your feed back on the spreadsheet (see **Contact** above)

More information:	www.epb.center

Background:	First published versions of these spreadsheets were developed during 2012-2017, in the framework of the preparation and revision of the set of EN or ISO standards on the energy performance of buildings, to support the European "Energy Performance of Buildings Directive" recast 2010, under Mandate M/480 of the European Commission to CEN.
	These first versions were meant for use by CEN and ISO Technical Committee(s) and the Working Group(s) working on the preparation or revision of the EPB-standard to which this spreadsheet applies.
	These first public versions of the spreadsheets were mainly intended to support checking that all formulae in the standard under development were consistent and could be linked with other relevant (EPB) standards.
	Many of these spreadsheets have been developed parallel to the preparation of the set of EPB standards under the M/480 mandate from the European Commission (2012 - 2017) and do not necessarily reflect the final status of the standard.
	More information: https://epb.center/epb-standards/background/

EPB standard:	(EN) ISO 52000-1: 2017	Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures
Responsible in ISO and/or CEN:		CEN/TC 371 in collaboration with ISO/TC 163 and TC 205 Joint Working Group on EPB standards
Use	These spreadsheets allow to experiment the effect of changing values for typical situations Please input the desired values in the yellow cellsa and areas: - either by typing a value in the cells with a yellow background - or by pressing the up/down arrows of the selectors - or by clicking on the tick-boxes Specific instruction is provided on the right of the diagrams, in the grey area, where applicable	**10** **50** **FALSE**
Color codes:	GREEN: renewable primary energy RED: non-renewable primary energy	
Main features:	This spreadsheet demonstrates the impacts of exported energy on energy performance - impact of the choice about Kexp = 0,0 or 1,0 - impact and effects of the change of the calculation interval - potential cross compensation between energy carriers - effect of time mismatch between production and use of electric energy See the accompanying short videos for more details (see links below)	
Time intervals and period:	These are demonstrations showing seasonal/yearly values A couple of sheets are specifically dedicated to the effect of the calculation interval	

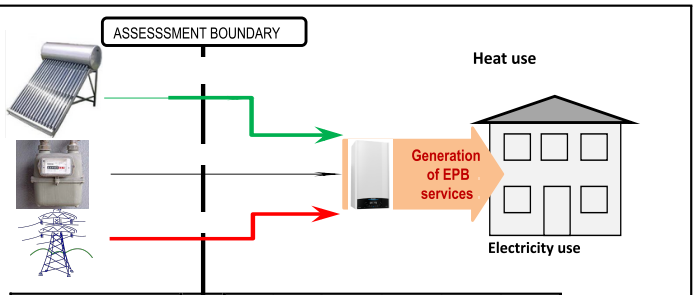
Sheets		
	Gas-Tsolar	Demonstration of the evaluation of delivered energy
	PV	Demonstration of the evaluation of exported energy
	HP-PV	Demonstration of the case with a heat pump
	Chiller-PV	Demonstration of the case with a chiller
	Gas-PV	Demonstration of the potential influence between energy carriers
	Boil-CGN	Demonstration of the case with a cogenerator
	PV-District	Demonstration of the case of a district heating
	HP-PV-match	Demonstration of the use of a matching factor
	Light-PV-match	Demonstration of the effect of time mismatch between production and use of electricity
	Free-cooling	Demonstration of the case of free heat extraction to the environment
	Free-heating	Demonstration of the case of free heat supply from the environment
	Multi-weight	Demonstration of the several weighting possibilities

Main limitations:	This spreadsheet is intended to demonstrate specific features of EN ISO 52000-1 without the noise of all the details. For a complete demonstration of the calculation procedure of EN ISO 52000-1, please refer to "Spreadsheets" section at https://epb.center/documents/
Protection:	The sheets are protected without password to prevent unintentional disruption of the calculation chain. If you desire to modify the sheets, please remove the protection.
More information:	CEN ISO/TR 52000-2, *Energy performance of buildings — Energy performance of buildings — Overarching EPB assessment — Part 2: Explanation and justification of ISO 52000-1* Published June 2017
Links:	https://epb.center/support/documents/iso-52000-1/ https://epb.center/support/documents/isotr-52000-2/ https://epb.center/support/short-videos/ https://epb.center/support/case-studies/

History of this spreadsheet

Status: **Published**

Date	**Developer**	**Description**
2020-04-25	Laurent Socal	First public version
2021-09-25	Laurent Socal	Revision for case studies
2021-10-31	Laurent Socal	Deliverable for case studies
2022-02-14	Laurent Socal	Free cooling and free heating added



		E	f_{Pnren}	f_{Pren}	E_{Pnren}	E_{Pren}	Eptot	RER
		kWh			kWh	kWh	kWh	tot
+ Delivered energy	TS	200	0,00	1,00	0	200	200	
+ Delivered energy	Grid	50	1,95	0,47	98	24	121	
+ Delivered energy	Gas	800	1,05	0,00	840	0	840	
TOTAL STEP A					***938***	***224***	***1.161***	***0,19***

STEP "A"

Kexp	**1,0**							
TOTAL STEP A					**938**	**224**	**1.161**	
+ Exported energy								
- Avoided grid gen		**0**	1,95	0,47	0	0	0	
Energy performance					**938**	**224**	**1.161**	**0,19**
Energy available ext.								

STEP "B"

Primary energy factors	f_{Pnren}	f_{Pren}	f_{Ptot}
Thermal solar	0,00	1,00	1,00
Grid electricity	1,95	0,47	2,42
Gas	1,05	0,00	1,05

Intended use of this sheet

Demonstrate the potential contribution of thermal solar to the energy performance

Exported energy is not possibile in this case, no difference between step "A" and step "B", no influence of K_{exp}

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

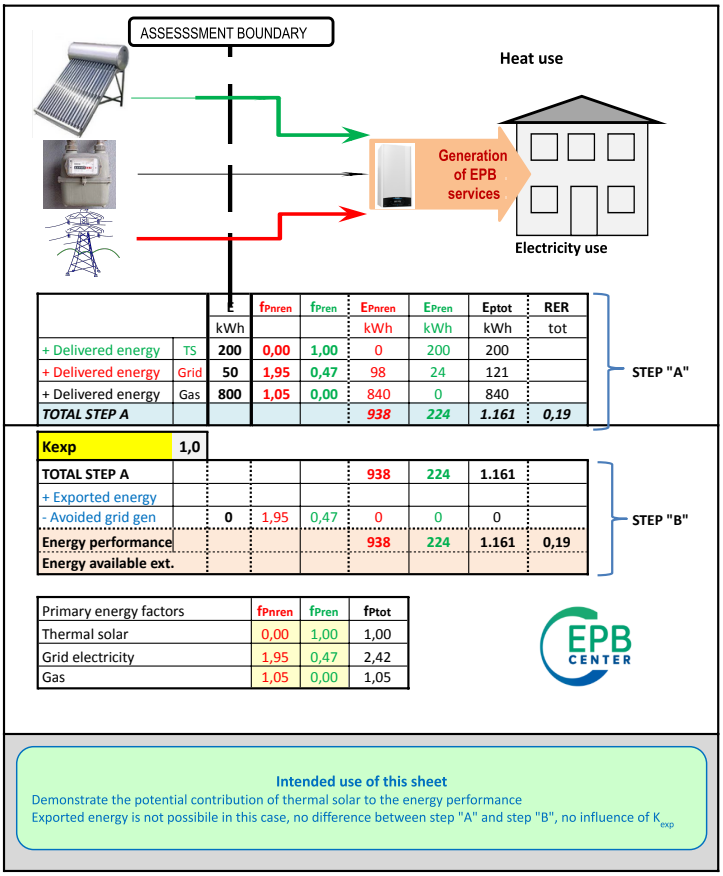
<-- input the desired kexp value

<-- input the desired weighting factor
<-- input the desired weighting factor
<-- input the desired weighting factor

ONLY CALCULATION BELOW, DO NOT MODIFY

Heat use		1000	1000 kWh
Electric energy use	kWh	50	50 kWh
Thermal solar production	kWh	200	200 kWh
Gas use		800	800 kWh
Grid supply		50	

K exp selection	TRUE



		E	f_{Pnren}	f_{Pren}	E_{Pnren}	E_{Pren}	Eptot	RER
		kWh			kWh	kWh	kWh	tot
+ Delivered energy	TS	200	0,00	1,00	0	200	200	
+ Delivered energy	Grid	50	1,95	0,47	98	24	121	
+ Delivered energy	Gas	800	1,05	0,00	840	0	840	
TOTAL STEP A					***938***	***224***	***1.161***	***0,19***

STEP "A"

Kexp	**1,0**							
TOTAL STEP A					**938**	**224**	**1.161**	
+ Exported energy								
- Avoided grid gen		**0**	1,95	0,47	0	0	0	
Energy performance					**938**	**224**	**1.161**	**0,19**
Energy available ext.								

STEP "B"

Primary energy factors	f_{Pnren}	f_{Pren}	fPtot
Thermal solar	0,00	1,00	1,00
Grid electricity	1,95	0,47	2,42
Gas	1,05	0,00	1,05

Intended use of this sheet

Demonstrate the potential contribution of thermal solar to the energy performance

Exported energy is not possibile in this case, no difference between step "A" and step "B", no influence of K_{exp}

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

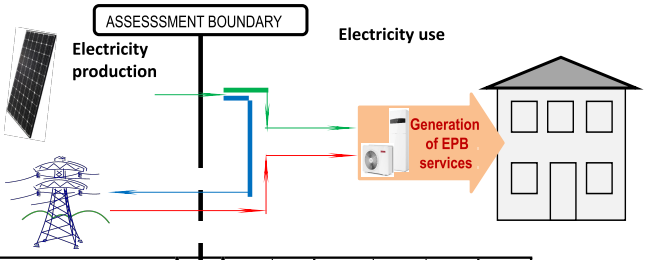
<-- input the desired kexp value

<-- input the desired weighting factor
<-- input the desired weighting factor
<-- input the desired weighting factor

ONLY CALCULATION BELOW, DO NOT MODIFY

Heat use		1000	1000 kWh
Electric energy use	kWh	50	50 kWh
Thermal solar production	kWh	200	200 kWh
Gas use		800	800 kWh
Grid supply		50	

K exp selection	TRUE



		E	fPnren	fPren	EPnren	Epren on-site	EPtot	RER
		kWh			kWh	kWh	kWh	nrb-os
+ Delivered energy	PV	**50**	**0,0**	**1,0**	0	50	50	
- Exported energy	PV	**30**	0,0	1,0	0	-30	-30	
+ Delivered energy	Grid	**0**	**2,0**	**0,0**	0	0	0	
TOTAL STEP A					***0***	***20***	***20***	***1,00***

STEP "A"

Kexp	**1,0**							
TOTAL STEP A					**0**	**20**	**20**	**1,00**
+ Exported energy	PV	**30**	0,0	1,0	0	30	30	
- Avoided grid gen	Grid	**30**	2,0	0,0	-60	0	-60	
Energy performance					**-60**	**50**	**-10**	**-5,00**
Energy available ext.		0	0,0	1,0	**0**	**0**	**0**	**n.a.**

STEP "B"

Primary energy factors	fPnren	fPren	fPtot
Photovoltaic	0,00	1,00	1,00
Grid electricity	2,00	0,00	2,00

Intended use of this sheet

Demonstrate the basic option about exported energy of EN ISO 52000-1 (Step A --> Step B, Kexp)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as K_{exp} and primary energy conversion factors

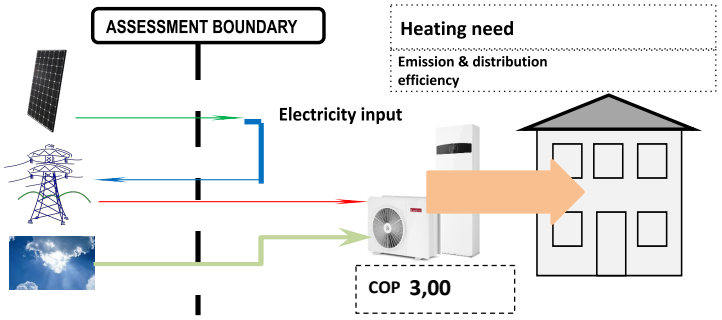
<-- Click on the selection arrows to increase/decrease values

<-- Please check to select Kexp=1, uncheck for Kexp=0

<-- input the desired primary energy weighting factor
<-- input the desired primary energy weighting factor

ONLY CALCULATION BELOW, DO NOT MODIFY

Electric energy use	kWh	20	20 kWh
Electric energy production	kWh	50	50 kWh
Exported energy	kWh	30	30 kWh
Grid supply	kWh	0	0 kWh
PV used in the building	kWh	20	20 kWh
Kexp = 1,0 ?		TRUE	



<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

		E	fPnren	fPren	EPnren	EPren	EPtot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	0	0,00	1,00	0	0	0	
- Exported energy	PV	0	0,00	1,00	0	0	0	
+ Environment heat	HP	3.333	0,00	1,00	0	3.333	3.333	
+ Delivered energy	Grid	1.667	1,95	0,47	3.251	783	4.034	
TOTAL STEP A					*3.251*	*4.116*	*7.367*	*0,56*

STEP "A"

Kexp	1,0							
TOTAL STEP A					3.251	4.116	7.367	
+ Exported energy	PV	0	0,00	1,00	0	0	0	
- Avoided grid gen	Grid	0	1,95	0,47	0	0	0	
Energy performance					3.251	4.116	7.367	0,56
Energy available ext.		0	0,0	1,0	0	0	0	n.a.

STEP "B"

<-- Please check to select Kexp=1, uncheck for Kexp=0

Primary energy factors		fPnren	fPren	fPtot
Photovoltaic	PV	0,00	1,00	1,00
Environment heat	HP	0,00	1,00	1,00
Grid electricity	Grid	1,95	0,47	2,42

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

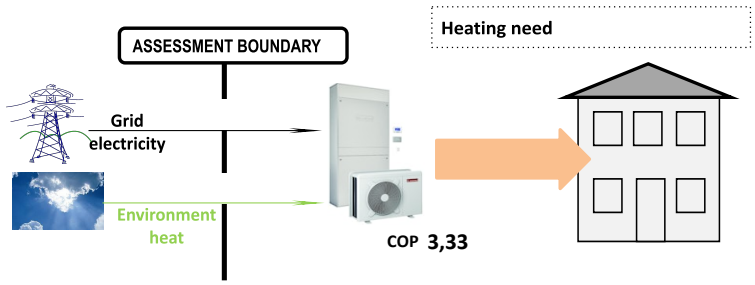
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate the basic calculation chain: energy needs --> technical systems --> delivered energy --> weighted energy (primary energy, non renewable, renewable and total + RER)
Demonstrate the basic structure of weighting procedure of EN ISO 52000-1 (Step A --> Step B)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as Kexp and primary energy conversion factors

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp = 1		TRUE	
COP	3,00	300	
Heating need	kWh	4.500	4500,0 kWh
Efficiency	0,90	90	90 %
HP output	kWh	5.000	Heat 5000,0 kWh
Electric energy use	kWh	1.667	1667,0 kWh
Heat from envirenment	kWh	3.333	3333,0 kWh
Electric energy production	kWh	0	0 kWh
Exported energy	kWh	0	0 kWh
PV used for the building	kWh	0	0 kWh
Grid supply	kWh	1.667	1667 kWh



<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

Energy carriers		Edel	fPnren	fPren	fPtot	EPnren	EPren	EPtot	RER
		kWh	-	-	-	kWh	kWh	kWh	
+ Environment heat	HP	7.000	0,00	1,00	1,00	0	7.000	7.000	
+ Grid electricity	Grid	3.000	1,95	0,47	2,42	5.850	1.410	7.260	
				Primary energy		*5.850*	*8.410*	*14.260*	*0,59*

Primary energy factors		fPnren	fPren	fPtot
Environment heat	HP	0,00	1,00	1,00
Grid electricity	Grid	1,95	0,47	2,42

<-- input the desired primary energy weighting factor

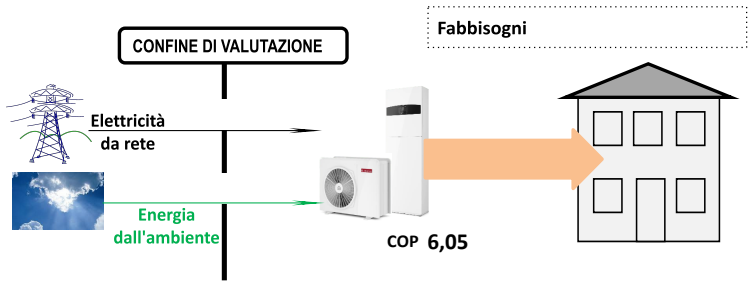
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate the basic calculation chain: energy needs --> technical systems --> delivered energy --> weighted energy (primary energy, non renewable, renewable and total + RER)
Demonstrate the basic structure of weighting procedure of EN ISO 52000-1 (Step A --> Step B)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as Kexp and primary energy conversion factors

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp = 1		TRUE	
COP	3,33	33,333333	
Heating need	kWh	10.000	10000,0 kWh
Efficiency	1,00	100	100 %
HP output	kWh	10.000	Heat 10000,0 kWh
Electric energy use	kWh	3.000	3000,0 kWh
Heat from envirenment	kWh	7.000	7000,0 kWh
Electric energy production	kWh	0	0 kWh
Exported energy	kWh	0	0 kWh
PV used for the building	kWh	0	0 kWh
Grid supply	kWh	3.000	3000 kWh



Vettori energetici		Edel	fPnren	fPren	fPtot	EPnren	EPren	EPtot	QR
		kWh	-	-	-	kWh	kWh	kWh	
+ Energia ambiente	PdC	2.504	0,00	1,00	1,00	0	2.504	2.504	
+ Energia elettrica	Rete	496	1,95	0,47	2,42	967	233	1.200	
				Energia primaria		*967*	*2.737*	*3.704*	*0,739*

Fattori di conversione		fPnren	fPren	fPtot
Energia dall'ambiente		0,00	1,00	1,00
Energia elettrica	Rete	1,95	0,47	2,42

Obbiettivi formativi di questo foglio di calcolo

Illustrare il procedimento di calcolo : fabbisogno energetico --> sistemi tecnici --> energia erogata --> energia ponderata (energia primaria, non rinnovabile, rinnovabile e totale + RER)
Dimostrare la struttura di base della procedura di ponderazione di EN ISO 52000-1 (Fase A --> Fase B)
Dimostrare l'impatto dell'energia esportata sulla prestazione energetica di un edificio.
Dimostrare l'impatto di scelte come Kexp e fattori di conversione dell'energia primaria

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

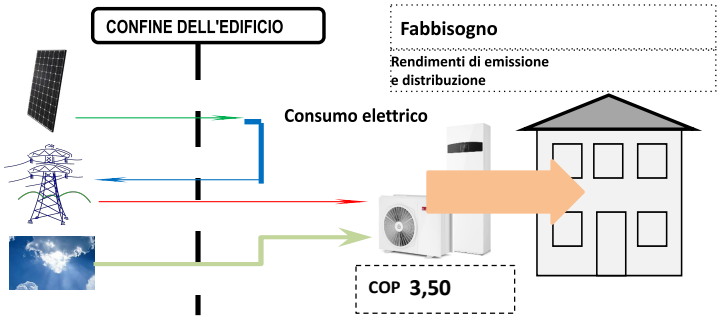
<-- Click on the selection arrows to increase/decrease values

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp = 1		TRUE	
COP	6,05	605	
Heating need	kWh	3.000	3000,0 kWh
Efficiency	1,00	100	100 %
HP output	kWh	3.000	Calore 3000,0 kWh
Electric energy use	kWh	496	496,0 kWh
Heat from envirenment	kWh	2.504	2504,0 kWh
Electric energy production	kWh	0	0 kWh
Exported energy	kWh	0	0 kWh
PV used for the building	kWh	0	0 kWh
Grid supply	kWh	496	496 kWh



<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

		E	fPnren	fPren	EPnren	EPren	EPtot	QR
		kWh			kWh	kWh	kWh	
+ Energia consegnata	PV	600	0,0	1,0	0	600	600	
- Energia esportata	PV	0	0,0	1,0	0	0	0	
+ Calore ambiente	HP	2.357	0,0	1,0	0	2.357	2.357	
+ Energia consegnata	Rete	343	2,0	0,5	669	161	830	
TOTALE PASSO A					***669***	***3.118***	***3.787***	***0,82***

PASSO "A"

Kexp	**0,0**

<-- Please check to select Kexp=1, uncheck for Kexp=0

TOTALE PASSO A					**669**	**3.118**	**3.787**	
+ Energia esportata	PV	0	0,0	1,0	0	0	0	
- Evitata da gen rete	Rete	0	2,0	0,5	0	0	0	
Prestazione energetica					**669**	**3.118**	**3.787**	**0,82**
Energia disponibile		0	0,0	1,0	**0**	**0**	**0**	**n.a.**

PASSO "B"

Fattori di conversione		fPnren	fPren	fPtot
Fotovoltaico	PV	0,00	1,00	1,00
Calore ambiente	HP	0,00	1,00	1,00
Elettricità da rete	Rete	1,95	0,47	2,42

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

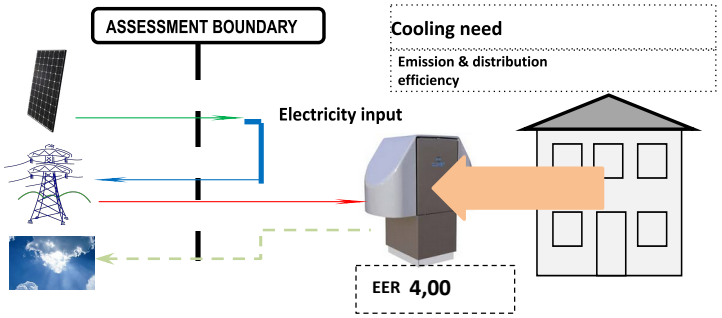
<-- input the desired primary energy weighting factor

Intended use of this sheet

Dimostrare la catena di calcolo di base: fabbisogno energetico --> sistemi tecnici --> energia erogata --> energia ponderata (energia primaria, non rinnovabile, rinnovabile e totale + RER)
Dimostrare la struttura di base della procedura di ponderazione di EN ISO 52000-1 (Fase A --> Fase B)
Dimostrare l'impatto dell'energia esportata sulla prestazione energetica di un edificio.
Dimostrare l'impatto di scelte come Kexp e fattori di conversione dell'energia primaria

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp = 1		FALSE	
COP	3,50	350	
Fabbisogno	kWh	3.300	3300,0 kWh
Efficienza	1,00	100	100 %
HP output	kWh	3.300	3300,0 kWh
Electric energy use	kWh	943	943,0 kWh
Heat from envirenment	kWh	2.357	2357,0 kWh
Electric energy production	kWh	600	600 kWh
Exported energy	kWh	0	0 kWh
PV used for the building	kWh	600	600 kWh
Grid supply	kWh	343	343 kWh



<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

		E	fPnren	fPren	EPnren	EPren	EPtot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	800	0,0	1,0	0	800	800	
- Exported energy	PV	300	0,0	1,0	0	-300	-300	
- Rejected heat		2.500						
+ Delivered energy	Grid	0	2,3	0,2	0	0	0	
TOTAL STEP A					***0***	***500***	***500***	***1,00***

STEP "A"

Kexp	**1,0**							
TOTAL STEP A					**0**	**500**	**500**	
+ Exported energy	PV	300	0,0	1,0	0	300	300	
- Avoided grid gen	Grid	300	2,3	0,2	-690	-60	-750	
Energy performance					**-690**	**740**	**50**	**14,80**
Energy available ext.		0	0,0	1,0	**0**	**0**	**0**	**n.a.**

STEP "B"

<-- Please check to select Kexp=1, uncheck for Kexp=0

Primary energy factors		fPnren	fPren	fPtot
Photovoltaic	PV	0,00	1,00	1,00
Rejected heat				
Grid electricity	Grid	2,30	0,20	2,50

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

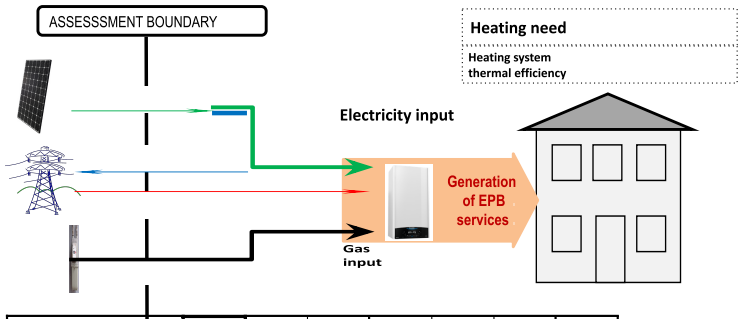
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate the basic calculation chain: energy needs --> technical systems --> delivered energy --> weighted energy (primary energy, non renewable, renewable and total + RER)
Demonstrate the basic structure of weighting procedure of EN ISO 52000-1 (Step A --> Step B)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as Kexp and primary energy conversion factors

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp = 1		TRUE	
COP	4,00	400	
Heating need	kWh	2.000	2000,0 kWh
Efficiency	1,00	100	100 %
HP output	kWh	2.000	Heat 2000,0 kWh
Electric energy use	kWh	500	500,0 kWh
Heat from envirenment	kWh	2.500	2500,0 kWh
Electric energy production	kWh	800	800 kWh
Exported energy	kWh	300	300 kWh
PV used for the building	kWh	500	500 kWh
Grid supply	kWh	0	0 kWh



		E	f_{Pnren}	f_{Pren}	E_{Pnren}	E_{Pren}	E_{Ptot}	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	**900**	**0,00**	**1,00**	0	900	900	*1,00*
- Exported energy	PV	**700**	0,00	1,00	0	-700	-700	*1,00*
+ Delivered energy	Grid	**0**	**1,95**	**0,47**	0	0	0	*n.a.*
+ Delivered energy	Gas	**1.250**	**1,05**	**0,00**	1.313	0	1.313	*0,00*
TOTAL STEP A					***1.313***	***200***	***1.513***	***0,13***

Step "A"

Kexp	**1,0**							
TOTAL STEP A					**1.313**	**200**	**1.513**	
+ Exported energy	PV	**700**	0,00	1,00	0	700	700	
- Avoided grid gen	Grid	**700**	1,95	0,47	-1.365	-329	-1.694	
Energy performance					**-53**	**571**	**519**	**1,10**
Energy available ext.		0	0,00	1,00	**0**	**0**	**0**	

Step "B"

Primary energy factors	f_{Pnren}	f_{Pren}	f_{Ptot}
Photovoltaic	0,00	1,00	1,00
Grid electricity	1,95	0,47	2,42
Gas *(or any other fuel)*	1,05	0,00	1,05

Intended use of this sheet

Demonstrate the potential interaction between different delivered and exported energy carriers
(electricity and natural gas) depending on the choices about evaluation of exported energy (Kexp value)
May also be used to demonstrate the effect of using biofuels, especially on RER.

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

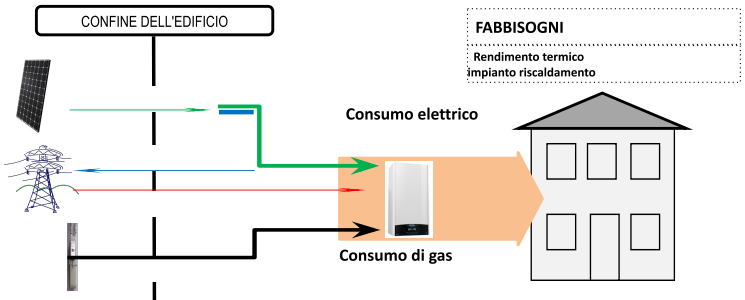
"Thermal efficiency" of the heating system means here ratio between needs and fuel input
"System efficiency" would include also the effect of auxiliary energy

<-- Click on the selection arrows to increase/decrease values

<-- Please check to select Kexp=1, uncheck for Kexp=0

<-- input the desired weighting factor for PV
<-- input the desired weighting factor for grid electricity
<-- input the desired weighting factor for gas
Note: you may also test the effect of using biofuels by adapting the fuel weighting factor

ONLY CALCULATION BELOW, DO NOT MODIFY			
Heating needs	kWh	1000	1000,0 kWh
Efficiency	0,80	80	80 %
Heat use	kWh	1250	1250,0 kWh
Electric energy use	kWh	200	200,0 kWh
Electric energy production	kWh	900	900,0 kWh
Exported energy	kWh	700	700 kWh
Grid supply	kWh	0	0 kWh
PV used for the building	kWh	200	200 kWh
Kexp = 1?		TRUE	



		E	fPnren	fPren	EPnren	EPren	EPtot	QR
		kWh			kWh	kWh	kWh	
+ Energia consegnata	PV	**1.400**	**0,0**	**1,0**	0	1.400	1.400	*1,00*
- Energia esportata	PV	**1.200**	0,0	1,0	0	-1.200	-1.200	*1,00*
+ Calore ambiente	Rete	**0**	**2,0**	**0,5**	0	0	0	*n.a.*
+ Energia consegnata	Gas	**1.389**	**1,1**	**0,0**	1.458	0	1.458	*0,00*
TOTAL STEP A					***1.458***	***200***	***1.658***	***0,12***

Step "A"

Kexp	**1,0**							
TOTAL STEP A					**1.458**	**200**	**1.658**	
+ Energia esportata	PV	**1.200**	0,0	1,0	0	1.200	1.200	
- Evitata da gen rete	Rete	**1.200**	2,0	0,5	-2.340	-564	-2.904	
Prestazione enrgetica					**-882**	**836**	**-46**	**-18,31**
Energia disponibile		0	0,0	1,0	**0**	**0**	**0**	

Step "B"

4

Fattori di conversione	fPnren	fPren	fPtot
Fotovoltaico	0,00	1,00	1,00
Eletricità da rete	1,95	0,47	2,42
Gas *(o altro combustibile)*	1,05	0,00	1,05

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

"Thermal efficiency" of the heating system means here ratio between needs and fuel input
"System efficiency" would include also the effect of auxiliary energy

<-- Click on the selection arrows to increase/decrease values

<-- Please check to select Kexp=1, uncheck for Kexp=0

<-- input the desired weighting factor for PV

<-- input the desired weighting factor for grid electricity

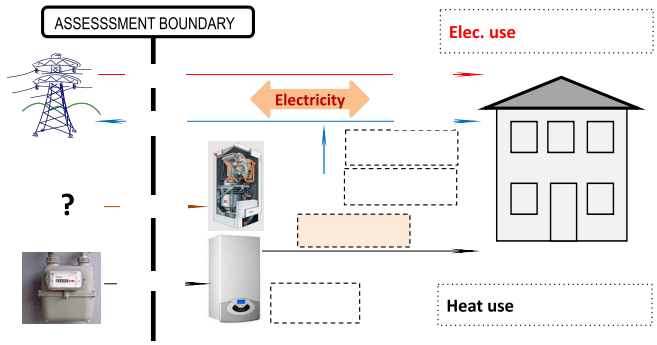
<-- input the desired weighting factor for gas

Note: you may also test the effect of using biofuels by adapting the fuel weighting factor

Obiettivi didattici di questo foglio

Dimostrare la potenziale interazione tra diversi vettori energetici consegnati ed esportati (elettricità e gas naturale) a seconda delle scelte sulla valutazione dell'energia esportata (valore Kexp)
Può anche essere utilizzato per dimostrare l'effetto dell'uso di biocarburanti, in particolare sul QR

ONLY CALCULATION BELOW, DO NOT MODIFY			
Heating needs	kWh	1000	1000,0 kWh
Efficiency	0,80	80	80 %
Calore prodotto dalla caldaia	kWh	1250	
Rendimento caldaia	%	90	
Heat use	kWh	1389	1388,889 kWh
Electric energy use	kWh	200	200,0 kWh
Electric energy production	kWh	1400	1400,0 kWh
Exported energy	kWh	1200	1200 kWh
Grid supply	kWh	0	0 kWh
PV used for the building	kWh	200	200 kWh
Kexp = 1?		TRUE	



Allocation factors according to power bonus method

			aw	aq
Grid efficiency	%	44		
Cogen electric efficiency	%	45	1,02	-0,02
Cogen thermal efficiency	%	45		

Cogenerator conversion factors	fPnren	fPren	fPtot
Fuel conversion factor	0,20	1,00	1,20
Cogen heat weighting	-0,01	-0,05	-0,06
Cogen electricity weighting	0,45	2,27	2,73

		E	fPnren	fPren	EPnren	EPren1	EPren2	EPtot	RER	RER
		kWh			kWh	kWh	kWh	kWh	tot	nrb-os
+ Delivered energy	Blr	**0**	1,1	0,0	0		0	0		
+ Delivered energy	Cgn	**1.111**	0,2	1,0	222		1.111	1.333		
- Exported energy	Cgn	**450**	0,5	2,3	-205		-1.023	-1.227		
+ Delivered energy	Grid	**0**	2,0	0,5	0	0		0		
TOTAL STEP A					***18***	***0***	***88***	***106***	***0,83***	***0,83***

Kexp	**1,0**

TOTAL STEP A					**18**	**0**	**88**	**106**		
+ Exported energy	Cgn	**450**	0,5	2,3	205		1.023	1.227		
- Avoided grid gen	Grid	**450**	2,0	0,5	-900	-225		-1.125		
Energy performance					**-678**	**-225**	**1.111**	**208**	**4,25**	**5,33**
Energy available ext.		0	0,5	2,3	**0**		**0**	**0**	**n.a.**	**n.a.**

Primary energy factors	fPnren	fPren	fPtot
Cogen input	0,20	1,00	1,20
Boiler input	1,10	0,00	1,10
Grid electricity	2,00	0,50	2,50

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

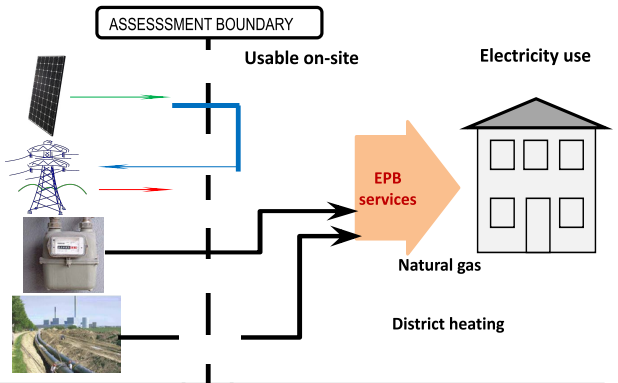
<-- input the desired kexp value

<-- input the desired weighting factor
<-- input the desired weighting factor
<-- input the desired weighting factor

ONLY CALCULATION BELOW, DO NOT MODIFY

Electric efficiency	45	ηel 45%
Total efficiency	90	ηtot 90%
Thermal efficiency	45	
part from cogen	100	100% cog

Heat from cogen	500	500 kWh
Heat from boiler	0	0 kWh
boiler input	0	0 kWh
Cogen input	1.111	1111 kWh
Electricity output	500	500 kWh
Cogen to house	50	50 kWh
Cogen to grid	450	450 kWh
Grid to house	0	0 kWh
Boiler efficiency	92	92%
Heat use kWh	500	500 kWh
Electric energy use kWh	50	50 kWh
	TRUE	



		E	fPnren	fPren	EPnren	EPren	Eptot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	**290**	**0,0**	**1,0**	0,0	290,0	290,0	
- Exported energy	PV	**190**	0,0	1,0	0,0	-190,0	-190,0	
+ Delivered energy	Grid	**0**	**2,0**	**0,5**	0,0	0,0	0,0	
+ Delivered energy	Gas	**100**	**1,1**	**0,0**	110,0	0,0	110,0	
+ Delivered energy	DH	**100**	**0,3**	**0,7**	28,0	72,0	100,0	
TOTAL STEP A					***138,0***	***172,0***	***310,0***	***0,55***

Kexp	**1,0**

TOTAL STEP A					**138**	**172**	**310**	
+ Exported energy	PV	**190**	0,0	1,0	0	190	190	
- Avoided grid gen	Grid	**190**	2,0	0,5	-380	-95	-475	
Energy performance					**-242,0**	**267,0**	**25,0**	**10,7**
Energy available ext.		0	0,0	1,0	**0,0**	**0,0**	**0,0**	

Primary energy factors	fPnren	fPren	fPtot
Photovoltaic	0,00	1,00	1,00
Grid electricity	2,00	0,50	2,50
Gas	1,10	0,00	1,10
District heating	0,28	0,72	1,00

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

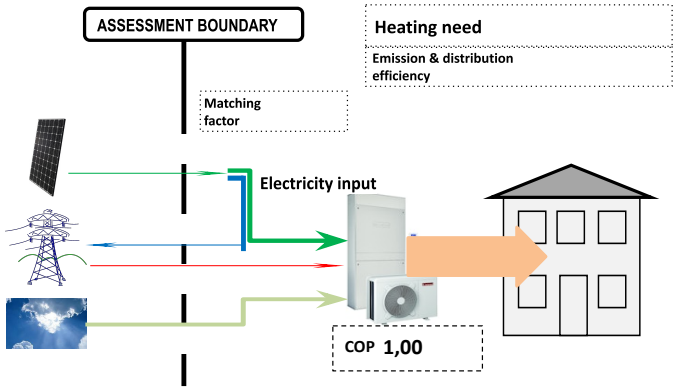
<-- input the desired kexp value

<-- input the desired weighting factor
<-- input the desired weighting factor

<-- input the desired weighting factor

ONLY CALCULATION BELOW, DO NOT MODIFY

District heating			100	100 kWh
Gas use			100	100 kWh
Electric energy use		kWh	100	100 kWh
PV production		kWh	290	290 kWh
	%		60	60%
PV Used on site	kWh	174	100	100 kWh
Kexp			TRUE	
Exported energy	kWh	190	190 kWh	
Grid supply	kWh	0	0 kWh	
PV used for the building	kWh	100	100 kWh	



<-- Click on the selection arrows to increase/decrease needs

<-- Click on the selection arrows to increase/decrease efficiency

0

<-- Click on the selection arrows to increase/decrease matching factor

<-- Click on the selection arrows to increase/decrease COP

		E	fPnren	fPren	EPnren	EPren	EPtot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	500	0,0	2,5	0	1.250	1.250	
- Exported energy	PV	200	0,0	2,5	0	-500	-500	
+ Environment heat	HP	0	0,0	1,0	0	0	0	
+ Delivered energy	Grid	500	2,0	0,5	1.000	250	1.250	
TOTAL STEP A					*1.000*	*1.000*	*2.000*	*0,50*

STEP "A"

Kexp	1,0							
TOTAL STEP A					1.000	1.000	2.000	
+ Exported energy	PV	200	0,0	2,5	0	500	500	
- Avoided grid gen	Grid	200	2,0	0,5	-400	-100	-500	
Energy performance					600	1.400	2.000	0,70
Energy available ext.		0	0,0	2,5	0	0	0	n.a.

STEP "B"

<-- Please check to select Kexp=1, uncheck for Kexp=0

Primary energy factors		fPnren	fPren	fPtot
Photovoltaic	PV	0,00	2,50	2,50
Environment heat	HP	0,00	1,00	1,00
Grid electricity	Grid	2,00	0,50	2,50

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

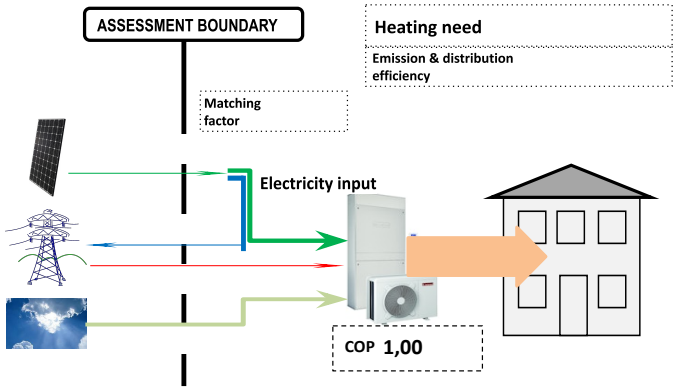
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate the basic calculation chain: energy needs --> technical systems --> delivered energy --> weighted energy (primary energy, non renewable, renewable and total + RER)
Demonstrate the basic structure of weighting procedure of EN ISO 52000-1 (Step A --> Step B)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as Kexp and primary energy conversion factors
Demonstrate the use of a matching factor to take into account the difference between a seasonal energy balance and the sum of the independent energy balances for each calculation interval

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp=1			TRUE	1,0
COP		1,00	100	
Heating need		kWh	800	800,0 kWh
Efficiency	1,00	%	100	100 %
HP output		kWh	800	Heat 800,0 kWh
Electric energy use		kWh	800	800,0 kWh
Heat from envirenment		kWh	0	,0 kWh
Electric energy production		kWh	500	500 kWh
Potential use of PV		kWh	500	
Matching factor		%	60	60 %
PV used for the building		kWh	300	300 kWh
Exported energy		kWh	200	200 kWh
Grid supply		kWh	500	500 kWh



<-- Click on the selection arrows to increase/decrease needs

<-- Click on the selection arrows to increase/decrease efficiency

0

<-- Click on the selection arrows to increase/decrease matching factor

<-- Click on the selection arrows to increase/decrease COP

		E	fPnren	fPren	EPnren	EPren	EPtot	RER	
		kWh			kWh	kWh	kWh		
+ Delivered energy	PV	**0**	**0,0**	**2,5**	0	0	0		STEP "A"
- Exported energy	PV	**0**	0,0	2,5	0	0	0		
+ Environment heat	HP	**0**	0,0	1,0	0	0	0		
+ Delivered energy	Grid	**800**	**2,0**	**0,5**	1.600	400	2.000		
TOTAL STEP A					***1.600***	***400***	***2.000***	***0,20***	

Kexp **1,0**

<-- Please check to select Kexp=1, uncheck for Kexp=0

TOTAL STEP A					**1.600**	**400**	**2.000**		STEP "B"
+ Exported energy	PV	**0**	0,0	2,5	0	0	0		
- Avoided grid gen	Grid	**0**	2,0	0,5	0	0	0		
Energy performance					**1.600**	**400**	**2.000**	**0,20**	
Energy available ext.		0	0,0	2,5	**0**	**0**	**0**	**n.a.**	

Primary energy factors		fPnren	fPren	fPtot
Photovoltaic	PV	**0,00**	**2,50**	**2,50**
Environment heat	HP	**0,00**	**1,00**	**1,00**
Grid electricity	Grid	**2,00**	**0,50**	**2,50**

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

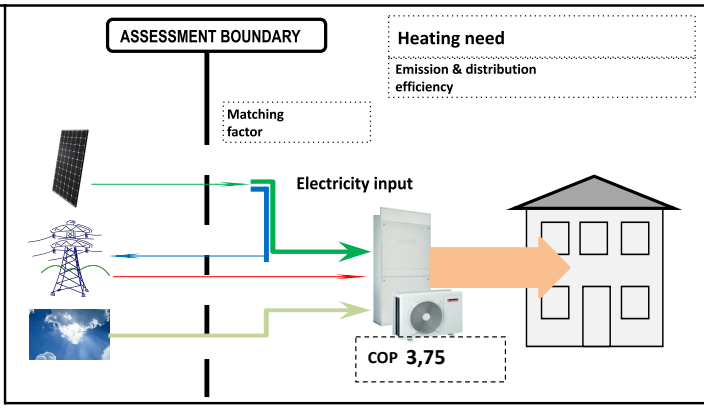
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate the basic calculation chain: energy needs --> technical systems --> delivered energy --> weighted energy (primary energy, non renewable, renewable and total + RER)
Demonstrate the basic structure of weighting procedure of EN ISO 52000-1 (Step A --> Step B)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as Kexp and primary energy conversion factors
Demonstrate the use of a matching factor to take into account the difference between a seasonal energy balance and the sum of the independent energy balances for each calculation interval

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp=1			TRUE	1,0
COP	1,00		100	
Heating need		kWh	800	800,0 kWh
Efficiency	1,00	%	100	100 %
HP output		kWh	800	Heat 800,0 kWh
Electric energy use		kWh	800	800,0 kWh
Heat from envirenment		kWh	0	,0 kWh
Electric energy production		kWh	0	0 kWh
Potential use of PV		kWh	0	
Matching factor		%	60	60 %
PV used for the building		kWh	0	0 kWh
Exported energy		kWh	0	0 kWh
Grid supply		kWh	800	800 kWh



<-- Click on the selection arrows to increase/decrease needs

<-- Click on the selection arrows to increase/decrease efficiency

0

<-- Click on the selection arrows to increase/decrease matching factor

<-- Click on the selection arrows to increase/decrease COP

		E	fPnren	fPren	EPnren	EPren	EPtot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	1.200	0,0	1,0	0	1.200	1.200	
- Exported energy	PV	800	0,0	1,0	0	-800	-800	
+ Environment heat	HP	2.750	0,0	1,0	0	2.750	2.750	
+ Delivered energy	Grid	600	2,0	0,5	1.200	300	1.500	
TOTAL STEP A					***1.200***	***3.450***	***4.650***	***0,74***

STEP "A"

Kexp	**1,0**							
TOTAL STEP A					**1.200**	**3.450**	**4.650**	
+ Exported energy	PV	**800**	0,0	1,0	0	800	800	
- Avoided grid gen	Grid	**800**	2,0	0,5	-1.600	-400	-2.000	
Energy performance					**-400**	**3.850**	**3.450**	**1,12**
Energy available ext.		0	0,0	1,0	**0**	**0**	**0**	**n.a.**

STEP "B"

<-- Please check to select Kexp=1, uncheck for Kexp=0

Primary energy factors		fPnren	fPren	fPtot
Photovoltaic	PV	0,00	1,00	1,00
Environment heat	HP	0,00	1,00	1,00
Grid electricity	Grid	2,00	0,50	2,50

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

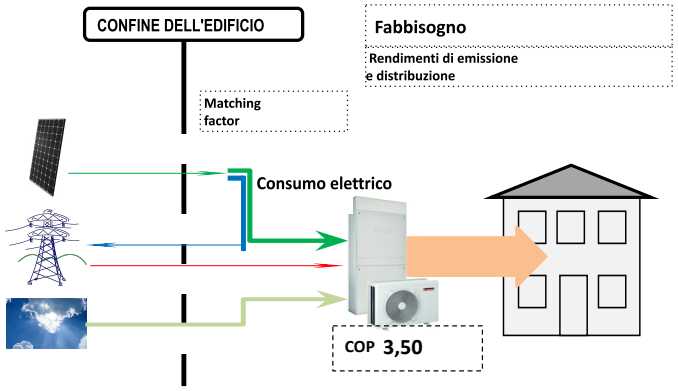
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate the basic calculation chain: energy needs --> technical systems --> delivered energy --> weighted energy (primary energy, non renewable, renewable and total + RER)
Demonstrate the basic structure of weighting procedure of EN ISO 52000-1 (Step A --> Step B)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as Kexp and primary energy conversion factors
Demonstrate the use of a matching factor to take into account the difference between a seasonal energy balance and the sum of the independent energy balances for each calculation interval

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp=1			TRUE	1,0
COP		3,75	375	
Heating need		kWh	3.000	3000,0 kWh
Efficiency	0,80	%	80	80 %
HP output		kWh	3.750	Heat 3750,0 kWh
Electric energy use		kWh	1.000	1000,0 kWh
Heat from envirenment		kWh	2.750	2750,0 kWh
Electric energy production		kWh	1.200	1200 kWh
Potential use of PV		kWh	1.000	
Matching factor		%	40	40 %
PV used for the building		kWh	400	400 kWh
Exported energy		kWh	800	800 kWh
Grid supply		kWh	600	600 kWh



<-- Click on the selection arrows to increase/decrease needs

<-- Click on the selection arrows to increase/decrease efficiency

0

<-- Click on the selection arrows to increase/decrease matching factor

<-- Click on the selection arrows to increase/decrease COP

		E	fPnren	fPren	EPnren	EPren	EPtot	RER	
		kWh			kWh	kWh	kWh		
+ Delivered energy	PV	**5.000**	**0,0**	**1,0**	0	5.000	5.000		
- Exported energy	PV	**4.428**	0,0	1,0	0	-4.428	-4.428		
+ Environment heat	HP	**3.571**	0,0	1,0	0	3.571	3.571		
+ Delivered energy	Grid	**857**	**2,0**	**0,5**	1.672	403	2.075		
TOTAL STEP A					***1.672***	***4.546***	***6.218***	***0,73***	STEP "A"

Kexp	**1,0**								
TOTAL STEP A					**1.672**	**4.546**	**6.218**		
+ Exported energy	PV	**4.428**	0,0	1,0	0	4.428	4.428		
- Avoided grid gen	Grid	**4.428**	2,0	0,5	-8.635	-2.081	-10.717		STEP "B"
Energy performance					**-6.963**	**6.893**	**-71**	**-97,33**	
Energy available ext.		0	0,0	1,0	**0**	**0**	**0**	**n.a.**	

<-- Please check to select Kexp=1, uncheck for Kexp=0

Primary energy factors		fPnren	fPren	fPtot
Photovoltaic	PV	**0,00**	**1,00**	**1,00**
Environment heat	HP	**0,00**	**1,00**	**1,00**
Grid electricity	Grid	**1,95**	**0,47**	**2,42**

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

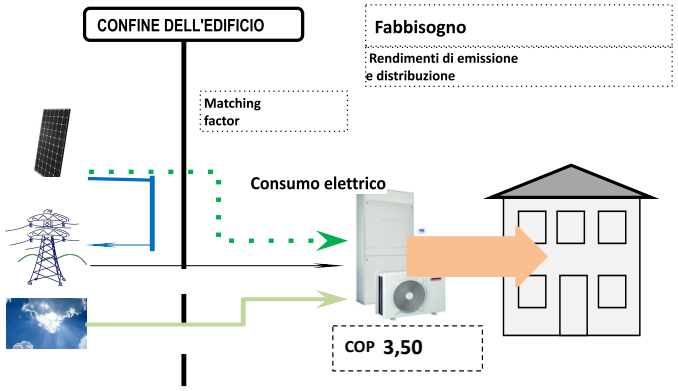
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate the basic calculation chain: energy needs --> technical systems --> delivered energy --> weighted energy (primary energy, non renewable, renewable and total + RER)
Demonstrate the basic structure of weighting procedure of EN ISO 52000-1 (Step A --> Step B)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as Kexp and primary energy conversion factors
Demonstrate the use of a matching factor to take into account the difference between a seasonal energy balance and the sum of the independent energy balances for each calculation interval

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp=1			TRUE	1,0
COP		3,50	350	
Heating need		kWh	4.500	4500,0 kWh
Efficiency	0,90	%	90	90 %
HP output		kWh	5.000	Heat 5000,0 kWh
Electric energy use		kWh	1.429	1429,0 kWh
Heat from envirenment		kWh	3.571	3571,0 kWh
Electric energy production		kWh	5.000	5000 kWh
Potential use of PV		kWh	1.429	
Matching factor		%	40	40 %
PV used for the building		kWh	572	571,6 kWh
Exported energy		kWh	4.428	4428,4 kWh
Grid supply		kWh	857	857,4 kWh



<-- Click on the selection arrows to increase/decrease needs

<-- Click on the selection arrows to increase/decrease efficiency

0

<-- Click on the selection arrows to increase/decrease matching factor

<-- Click on the selection arrows to increase/decrease COP

		E	fPnren	fPren	EPnren	EPren	EPtot	RER	
		kWh			kWh	kWh	kWh		
+ Delivered energy	PV	**5.000**	**0,0**	**1,0**	0	5.000	5.000		
- Exported energy	PV	**4.428**	0,0	1,0	0	-4.428	-4.428		
+ Environment heat	HP	**3.571**	0,0	1,0	0	3.571	3.571		
+ Delivered energy	Grid	**857**	**2,0**	**0,5**	1.715	429	2.144		
TOTAL STEP A					***1.715***	***4.571***	***6.286***	***0,73***	STEP "A"
Kexp	**1,0**								<-- Please check to select Kexp=1, uncheck for Kexp=0
TOTAL STEP A					**1.715**	**4.571**	**6.286**		
+ Exported energy	PV	**4.428**	0,0	1,0	0	4.428	4.428		
- Avoided grid gen	Grid	**4.428**	2,0	0,5	-8.857	-2.214	-11.071		STEP "B"
Energy performance					**-7.142**	**6.786**	**-356**	**-19,03**	
Energy available ext.		0	0,0	1,0	**0**	**0**	**0**	**n.a.**	

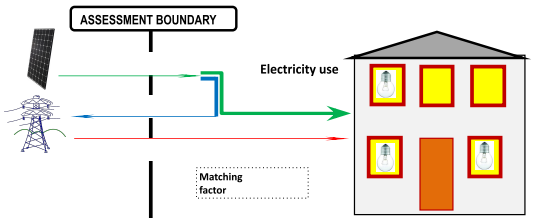
Primary energy factors		fPnren	fPren	fPtot	
Photovoltaic	PV	**0,00**	**1,00**	**1,00**	<-- input the desired primary energy weighting factor
Environment heat	HP	**0,00**	**1,00**	**1,00**	<-- input the desired primary energy weighting factor
Grid electricity	Grid	**2,00**	**0,50**	**2,50**	<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate the basic calculation chain: energy needs --> technical systems --> delivered energy --> weighted energy (primary energy, non renewable, renewable and total + RER)
Demonstrate the basic structure of weighting procedure of EN ISO 52000-1 (Step A --> Step B)
Demonstrate the impact of exported energy on the energy performance of a building.
Demonstrate the impact of choices such as Kexp and primary energy conversion factors
Demonstrate the use of a matching factor to take into account the difference between a seasonal energy balance and the sum of the independent energy balances for each calculation interval

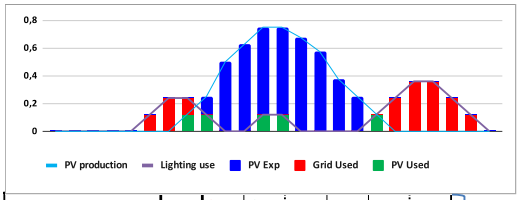
ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp=1			TRUE	1,0	
COP		3,50	350		
Heating need		kWh	4.500	4500,0 kWh	
Efficiency	0,90	%	90	90 %	
HP output		kWh	5.000	Heat 5000,0 kWh	
Electric energy use		kWh	1.429	1429,0 kWh	
Heat from envirenment		kWh	3.571	3571,0 kWh	
Electric energy production		kWh	5.000	5000 kWh	
Potential use of PV		kWh	1.429		
Matching factor		%	40	40 %	
PV used for the building		kWh	572	571,6 kWh	
Exported energy		kWh	4.428	4428,4 kWh	
Grid supply		kWh	857	857,4 kWh	



<-- Click on the selection arrows to increase/decrease values of the total daily PV generation and electricity use

<-- Resulting matching factor



<-- Daily lighting use and PV production profile
Total daily values are set in the diagram above
Daily profiles can be modified in the table below

		E	fPnren	fPren	EPnren	EPren	EPtot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	5	0,0	1,0	0	5	5	
- Exported energy	PV	4	0,0	1,0	0	-4	-4	
+ Delivered energy	Grid	2	2,0	0,5	4	1	4	
TOTAL STEP A					*4*	*2*	*5*	*0,30*

STEP "A"

Kexp	1,0							
TOTAL STEP A					**4**	**2**	**5**	
+ Exported energy	PV	**4**	0,0	1,0	0	4	4	
- Avoided grid gen	Grid	**4**	2,0	0,5	-9	-2	-11	
Energy performance					**-5**	**4**	**-2**	**-2,47**
Energy available ext.		0	0,0	1,0	**0**	**0**	**0**	**n.a.**

STEP "B"

<-- Please check to select Kexp=1, uncheck for Kexp=0
See that selecting Kexp=1 cancels the effect of time mismatch

Primary energy factors	fPnren	fPren	fPtot
Photovoltaic	0,00	1,00	1,00
Grid electricity	2,00	0,50	2,50

<-- input the desired weighting factor
<-- input the desired weighting factor

Daily PV generation and electricity use profile

Time of day	PV production %	PV production kWh	Lighting use %	Lighting use kWh	PV Exp kWh	PV Used kWh	Grid Used kWh
1	0,0	0,00	0,0	0,00	0,00	0,00	0,00
2	0,0	0,00	0,0	0,00	0,00	0,00	0,00
3	0,0	0,00	0,0	0,00	0,00	0,00	0,00
4	0,0	0,00	0,0	0,00	0,00	0,00	0,00
5	0,0	0,00	0,0	0,00	0,00	0,00	0,00
6	0,0	0,00	5,0	0,12	0,00	0,00	0,12
7	0,0	0,00	10,0	0,24	0,00	0,00	0,24
8	2,5	0,13	10,0	0,24	0,00	0,13	0,12
9	5,0	0,25	5,0	0,12	0,13	0,12	0,00
10	10,0	0,50	0,0	0,00	0,50	0,00	0,00
11	12,5	0,63	0,0	0,00	0,63	0,00	0,00
12	15,0	0,75	5,0	0,12	0,63	0,12	0,00
13	15,0	0,75	5,0	0,12	0,63	0,12	0,00
14	13,5	0,68	0,0	0,00	0,68	0,00	0,00
15	11,5	0,58	0,0	0,00	0,58	0,00	0,00
16	7,5	0,38	0,0	0,00	0,38	0,00	0,00
17	5,0	0,25	0,0	0,00	0,25	0,00	0,00
18	2,5	0,13	5,0	0,12	0,01	0,12	0,00
19	0,0	0,00	10,0	0,24	0,00	0,00	0,24
20	0,0	0,00	15,0	0,36	0,00	0,00	0,36
21	0,0	0,00	15,0	0,36	0,00	0,00	0,36
22	0,0	0,00	10,0	0,24	0,00	0,00	0,24
23	0,0	0,00	5,0	0,12	0,00	0,00	0,12
24	0,0	0,00	0,0	0,00	0,00	0,00	0,00
TOTAL	100,0	5,00	100,0	2,40	4,40	0,61	1,80

<-- Input the percentage value for each hour to modify the profile
See the result on the chart above
Set the total daily value on the diagram above

<-- Daily totals from the profile

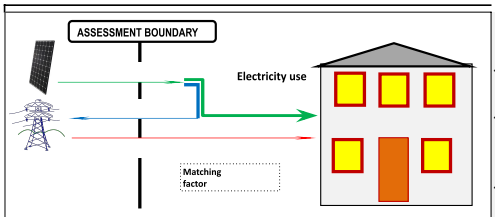
Could be used, based on daily total	D	2,40
Is used, based on sum of hourly balance	H	0,61
Matching factor, from daily to hourly	H/D	0,25

<-- Minimum of daily PV production and daily electricity use
<-- Sum of minimum of hourly PV production and hourly electricity use

Intended use of this sheet

Demonstrate the concept of time mismatch between (electric) energy production and use
Demonstrate the concept of matching factor
Demonstrate the effect of the choices such as Kexp and primary energy conversion factors on the consequence of time mismatch between energy production and use.

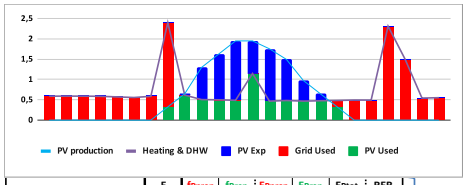
Kexp	TRUE		1,0	
Electric energy use	24	kWh	2,4	02 kWh
Electric energy production		kWh	5	05 kWh
PV used for the building		kWh	0,6	001 kWh
Grid supply		kWh	1,8	002 kWh
Exported energy		kWh	4,4	004 kWh
Matching factor		%	0,25	25 %



<-- Click on the selection arrows to increase/decrease values of the total daily PV generation and electricity use

<-- Select a typical profile for EPB electricity use

<-- Resulting matching factor



<-- Daily lighting use and PV production profile
Total daily values are set in the diagram above
Daily profiles can be modified in the table below

		E	fPnren	fPren	EPnren	EPren	EPtot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	13	0,0	1,0	0	13	13	
- Exported energy	PV	7	0,0	1,0	0	-7	-7	
+ Delivered energy	Grid	12	2,0	0,5	24	6	31	
TOTAL STEP A					*24*	*12*	*36*	*0,33*

STEP "A"

Kexp	**0,0**							
TOTAL STEP A					**24**	**12**	**36**	
- Exported energy	PV	0	0,0	1,0	0	0	0	
- Exported energy	Grid	0	0,0	0,5	0	0	0	
Energy performance					**24**	**12**	**36**	**0,33**
Energy available ext.		7	0,0	1,0	**0**	**7**	**7**	**1,00**

STEP "B"

<-- Please check to select Kexp=1, uncheck for Kexp=0
See that selecting Kexp=1 cancels the effect of time mismatch

Primary energy factors	fPnren	fPren	fPtot
Photovoltaic	0,00	1,00	1,00
Grid electricity	2,00	0,50	2,50

<-- input the desired weighting factor
<-- input the desired weighting factor

Lighting
Heating & DHW
DHW only
Cooling & DHW

Daily PV generation and electricity use profile

Time of day	PV production %	PV production kWh	Heating & DHW %	Heating & DHW kWh	PV Exp kWh	PV Used kWh	Grid Used kWh
1	0,0	0,00	3,4	0,59	0,00	0,00	0,59
2	0,0	0,00	3,4	0,59	0,00	0,00	0,59
3	0,0	0,00	3,4	0,59	0,00	0,00	0,59
4	0,0	0,00	3,4	0,59	0,00	0,00	0,59
5	0,0	0,00	3,3	0,57	0,00	0,00	0,57
6	0,0	0,00	3,2	0,56	0,00	0,00	0,56
7	0,0	0,00	3,4	0,59	0,00	0,00	0,59
8	2,5	0,33	13,9	2,40	0,00	0,33	2,08
9	5,0	0,65	3,6	0,62	0,03	0,62	0,00
10	10,0	1,30	2,9	0,51	0,79	0,51	0,00
11	12,5	1,63	2,9	0,50	1,12	0,50	0,00
12	15,0	1,95	2,8	0,49	1,46	0,49	0,00
13	15,0	1,95	6,6	1,15	0,80	1,15	0,00
14	13,5	1,76	2,7	0,47	1,29	0,47	0,00
15	11,5	1,50	2,8	0,48	1,01	0,48	0,00
16	7,5	0,98	2,7	0,47	0,51	0,47	0,00
17	5,0	0,65	2,8	0,48	0,17	0,48	0,00
18	2,5	0,33	2,8	0,48	0,00	0,33	0,16
19	0,0	0,00	2,9	0,49	0,00	0,00	0,49
20	0,0	0,00	2,9	0,49	0,00	0,00	0,49
21	0,0	0,00	13,4	2,31	0,00	0,00	2,31
22	0,0	0,00	8,7	1,50	0,00	0,00	1,50
23	0,0	0,00	3,1	0,54	0,00	0,00	0,54
24	0,0	0,00	3,2	0,55	0,00	0,00	0,55
TOTAL	100,0	13,00	104,3	18,00	7,20	5,80	12,20

<-- Input the percentage value for each hour to modify the profile
See the result on the chart above
Set the total daily value on the diagram above

<-- Daily totals from the profile

Could be used, based on daily total	D	13,00
Is used, based on sum of hourly balance	H	5,80
Matching factor, from daily to hourly	H/D	0,45

<-- Minimum of daily PV production and daily electricity use
<-- Sum of minimum of hourly PV production and hourly electricity use
<-- Resulting matching factor

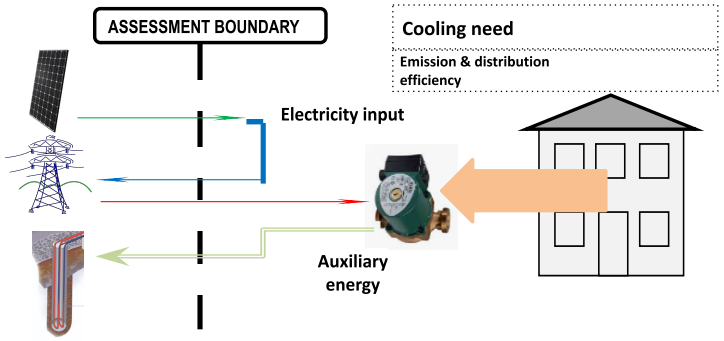
Intended use of this sheet

Demonstrate the concept of time mismatch between (electric) energy production and use
Demonstrate the concept of matching factor
Demonstrate the effect of the choices such as Kexp and primary energy conversion factors on the consequence of time mismatch between energy production and use.

2	Lighting %	ating & DH %	DHW only %	oling & DHW %			
	0,0	3,4	0,0	2,0	0,3429881	0	0,3
	0,0	3,4	0,0	1,3	0,3442073	0	0,2
	0,0	3,4	0,0	0,0	0,3436209	0	0
	0,0	3,4	0,0	0,0	0,3412266	0	0
	0,0	3,3	0,0	0,0	0,3330114	0	0
	5,0	3,2	0,0	0,0	0,3242250	0	0
	10,0	3,4	0,0	2,0	0,3410627	0	0,3
	10,0	13,9	34,8	11,0	1,3976661	1,1971373	1,6233721
	5,0	3,6	0,0	4,5	0,3587059	0	0,6609087
	0,0	2,9	0,0	4,6	0,2942113	0	0,6826816
	0,0	2,9	0,0	4,8	0,2912327	0	0,7086213
	5,0	2,8	0,0	4,9	0,2840422	0	0,7254493
	5,0	6,6	13,8	7,6	0,6679061	0,4732812	1,1331860
	0,0	2,7	0,0	5,2	0,0597583	0	0,7702033
	0,0	2,8	0,0	5,1	0,0597583	0	0,7578963
	0,0	2,7	0,0	4,9	0,2721066	0	0,7251180
	0,0	2,8	0,0	4,9	0,2778306	0	0,7209791
	5,0	2,8	0,0	4,7	0,2815774	0	0,6964018
	10,0	2,9	0,0	4,4	0,2878524	0	0,6580294
	15,0	2,9	0,0	4,3	0,2870453	0	0,6408688
	15,0	13,4	33,4	10,3	1,3467590	1,1482674	1,5210426
	10,0	8,7	18,1	7,4	0,8751628	0,6219569	1,0919188
	5,0	3,1	0,0	3,4	0,3158408	0	0,5
	0,0	3,2	0,0	2,7	0,3214695	0	0,4
	100,0	104,3	100,0	100,0	10,049268	3,4406430	14,816677
					9,9509729	29,064334	6,7491512

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp	FALSE		0,0	
Electric energy use	27	kWh	18	18 kWh
Electric energy production		kWh	13	13 kWh
PV used for the building		kWh	5,8	006 kWh
Grid supply		kWh	12,2	012 kWh
Exported energy		kWh	7,2	007 kWh
Matching factor		%	0,45	45 %



<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

		E	fPnren	fPren	EPnren	EPren	EPtot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	5	0,0	1,0	0	5	5	
- Exported energy	PV	0	0,0	1,0	0	0	0	
+ Free cooling	FC	338	0,0	1,0	0	338		
+ Delivered energy	Grid	0	2,3	0,2	0	0	0	
TOTAL STEP A					***0***	***343***	***343***	***1,00***

STEP "A"

Kexp	**1,0**							
TOTAL STEP A					**0**	343	343	
+ Exported energy	PV	0	0,0	1,0	0	0	0	
- Avoided grid gen	Grid	0	2,3	0,2	0	0	0	
Energy performance					**0**	343	343	1,00
Energy available ext.		0	0,0	1,0	**0**	0	**0**	**n.a.**

STEP "B"

<-- Please check to select Kexp=1, uncheck for Kexp=0

Primary energy factors		fPnren	fPren	fPtot
Photovoltaic	PV	0,00	1,00	1,00
Free cooling	FC	0,00	1,00	1,00
Grid electricity	Grid	2,30	0,20	2,50

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

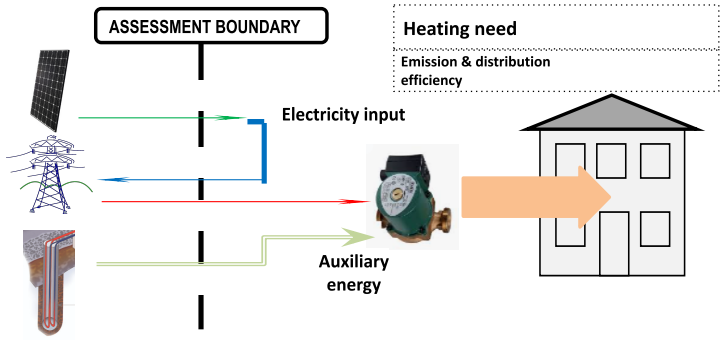
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate how to deal with free cooling energy flows.
Free cooling (free heat extraction): spontaneous heat extraction thanks to a source (external environment in this case) at a lower temperature than the space or object to be cooled.

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp = 1		TRUE	
Auxiliary energy	5	50	
Heating need	kWh	300	300,0 kWh
Efficiency	0,90	90	90 %
Required heat extraction	kWh	333	Heat 333,333 kWh
Electric energy use	kWh	5	5,0 kWh
Cooling from envirenment	kWh	338	338,333 kWh
Electric energy production	kWh	5	5 kWh
Exported energy	kWh	0	0 kWh
PV used for the building	kWh	5	5 kWh
Grid supply	kWh	0	0 kWh



<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

		E	fPnren	fPren	EPnren	EPren	EPtot	RER
		kWh			kWh	kWh	kWh	
+ Delivered energy	PV	0	0,0	1,0	0	0	0	
- Exported energy	PV	0	0,0	1,0	0	0	0	
+ Free heating	FC	106	0,0	1,0	0	106		
+ Delivered energy	Grid	5	2,3	0,2	12	1	13	
TOTAL STEP A					***12***	***107***	***119***	***0,90***

STEP "A"

Kexp	**1,0**							
TOTAL STEP A					**12**	**107**	**119**	
+ Exported energy	PV	0	0,0	1,0	0	0	0	
- Avoided grid gen	Grid	0	2,3	0,2	0	0	0	
Energy performance					**12**	**107**	**119**	**0,90**
Energy available ext.		0	0,0	1,0	**0**	**0**	**0**	**n.a.**

STEP "B"

<-- Please check to select Kexp=1, uncheck for Kexp=0

Primary energy factors		fPnren	fPren	fPtot
Photovoltaic	PV	0,00	1,00	1,00
Free heating	FC	0,00	1,00	1,00
Grid electricity	Grid	2,30	0,20	2,50

<-- input the desired primary energy weighting factor

<-- input the desired primary energy weighting factor

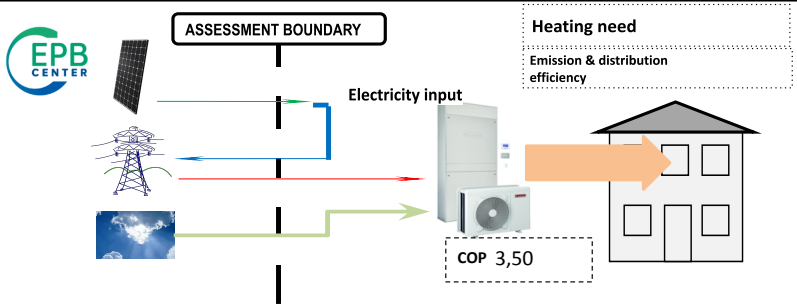
<-- input the desired primary energy weighting factor

Intended use of this sheet

Demonstrate how to deal with free heating energy flows.
Free heating (free heat supply): spontaneous heat supply thanks to a source (externla environment in this case) at a lower temperature than the space or object to be cooled.

ONLY CALCULATION BELOW, DO NOT MODIFY

Kexp = 1		TRUE	
Auxiliary energy	5	50	
Heating need	kWh	100	100,0 kWh
Efficiency	0,90	90	90 %
Required heat extraction	kWh	111	Heat 111,111 kWh
Electric energy use	kWh	5	5,0 kWh
Cooling from envirenment	kWh	106	106,111 kWh
Electric energy production	kWh	0	0 kWh
Exported energy	kWh	0	0 kWh
PV used for the building	kWh	0	0 kWh
Grid supply	kWh	5	5 kWh



<-- Click on the selection arrows to increase/decrease values

<-- Click on the selection arrows to increase/decrease values

		E	fwe	Euros
		kWh	€/kWh	€
+ Delivered energy	PV	0	0,00	0
- Exported energy	PV	0	0,00	0
+ Environment heat	HP	893	0,00	0
+ Delivered energy	Grid	357	0,30	107
TOTAL STEP A				***107***

m² 100
1,07 €/m²yr

Weighting type

<-- Please select the desired weighting type

Kexp	**1,0**			
TOTAL STEP A				**107**
+ Exported energy	PV	0	0,00	0
- Avoided grid gen	Grid	0	0,15	0
Weighted performance				**107**
Available ext.		0	0,0	**0**

<-- Please check to select Kexp=1, uncheck for Kexp=0

Weighting factors	fPnren	fC	fCO2
	kWh/kWh	€/kWh	kgCO2/kWh
Photovoltaic	0,00	0,00	0,00
Environment heat	0,00	0,00	0,00
Electricity imported from grid	2,50	0,30	0,40
Electricity exported to the grid	2,50	0,15	0,40

<-- input the desired weighting factor
<-- input the desired weighting factor

<-- input the desired weighting factor

Intended use of this sheet

Illustrate the the possibile alternative in weighting: non renewable primary energy, GHG emissions, economic cost

Illustrate how the k_{exp} factor applies to all weighting types, even independently depending on the context of the calcualtion (i.e. a different factor may be used for the different weightings)

ONLY CALCULATION BELOW, DO NOT MODIFY

			kWh		€	kgCO2	
							2
Kexp choice	0,00	0,00	0,00			kWh	Primary EPnr kWh/m²yr
TRUE	0,00	0,00	0,00		kWh/kWh	€	Cost Eurc €/m²yr
	2,50	0,30	0,40		€/kWh	kg CO2	CO2 em kg C kgco2/m²yr
	2,50	0,15	0,40	90	kgCO2/kWh		

COP		3,50	350
Heating need	kWh		1.000
Efficiency			80,00
HP output	kWh		1.250
Electric energy use	kWh		357
Heat from envirenment	kWh		893
Electric energy production	kWh		0
Exported energy	kWh		0
PV used for the building	kWh		0
Grid supply	kWh		357

1000,0 kWh
80%
Heat 1250,0 kWh
357,0 kWh
893,0 kWh

0 kWh
0 kWh
0 kWh
357 kWh