

Eracobuild

INSPIRE Tool Documentation

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1 THE INSPIRE TOOL

The INSPIRE (**I**ntegrated **S**trategy and **P**roject Development Instrument – **R**educe primary **E**nergy Use and Greenhouse Gas Emissions) Tool is a multiple-sheet Microsoft Excel based calculation tool. The individual spreadsheets are labelled “Condition”, “Measures”, “Energy price”, “Factors”, “Climate”, “Output”, “Output Summary”, and “Impressum”. The most important sheets for the user, “Condition”, “Measures” and “Output” or “Output Summary” are used by inputting data and viewing the results. The calculated sheet “Energy price” is used to define energy price scenarios. The “Factors” and “Climate” sheets are used to make further country-specific or case-specific adjustments.

The basic data are contained in a *.dat file that must be placed in the same folder as the tool’s Excel file in order for it to be used. If necessary, the tool file and database file (INSP11000en.dat) should be extracted from their parent ZIP file. The tool has been successfully tested with Windows 7 and is compatible with Microsoft Office Excel 2007 and 2010. Other versions of the operating system are not supported.

The tool’s output is affected by the cost inputs such as energy price or base price data/ These data can, however, be individually adjusted by the user.

1.1 Steps to take before launching the tool

Take the following into account in order for the INSPIRE tool to function properly:

- Files in the downloaded version of the tool are compressed in a ZIP file. To ensure full functionality, the Excel file and the associated data file (INSP11000en.dat) must both be extracted and saved in a parent folder.
- Optimal performance will result if the folder is located on a local directory or a high speed network.
- Depending on processor speed, some calculations may take up to 30 seconds to complete. The progress of these calculations is displayed in the lower right corner of the Excel screen.
- The *.dat file cannot be renamed and must always be stored in the same folder as the tool’s Excel file.
- The Excel file can be copied as needed; one for each application of the tool. For example, one case study can be represented by results in the Excel file as follows:
 - Two reference cases
 - Eight variant strategies

- Avoid accessing multiple versions of the database file simultaneously. These same base files are used by different versions of the Excel file in different case studies, for example.
- **For the INSPIRE tool to work properly, all Excel macros and links within the INSPIRE files (both database and tool) must be permanently activated.** The method to do this varies with different versions of Excel. The following is a partial list of variations on how Excel macro and link settings can be adjusted (source: www.office.microsoft.com). Whenever possible, the first method is recommended (saving INSPIRE files in a *trusted location*).

Based on your system configuration, some additional or complementary steps may be required to enable Excel macros and links. Certain network setups (i.e. in many organisations) may restrict users from adjusting these settings. Refer to your system administrator for assistance.

Method 1: saving INSPIRE files in a trusted location

In order to activate Excel macros and links for only INSPIRE tool files, save them in a “trusted location”. Documents in trusted locations are allowed to run without being checked by the security system and macros and/or links are enabled in a standard way. The user can identify any folder as a trusted location. Search for corresponding settings in the Trust Centre or in the security options (Excel 2007 and 2010).

- Click on the File menu (Excel 2010) or on the Microsoft Office Button (Excel 2007)
- Select Options.
- Click on Trust Center and then Trust Center Settings.
- Add the selected folder path in the “Trusted Locations” tab. Select the “Allow Trusted Locations on my network” if necessary.
- Add location of INSPIRE files to the list of trusted locations (Figure 1).

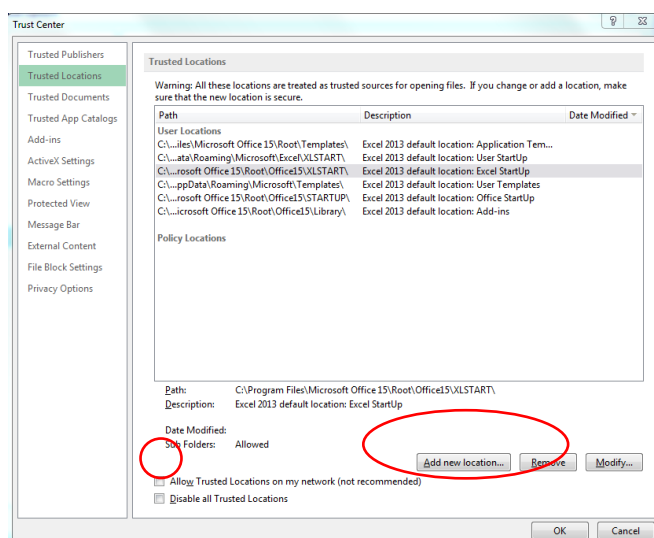


Figure 1 Trust Center Settings for Excel 2010.

Method 2: general activation of macros

The macro options can be found in the Trust Center Settings (Excel 2007 and 2010).

Note: in this method, macros are enabled for all files, not just those associated with the INSPIRE tool. This can result in a security risk if some of your Excel files are from insecure sources.

- Click on the File menu (Excel 2010) or on the Microsoft Office Button in Excel 2007.
- Select Options.
- Click on Trust Center and then Trust Center Settings.
- Select Macro Settings.
- Select “Enable all macros (not recommended; potentially dangerous code can run)”.
- Activate «Trust access to the VBA project object model » under Developer Macro Settings.
- Click on OK.

Note: this method does not activate data links.

Method 3: enable contents on the message bar

When the Excel file is opened, a message bar appears with the option to “Enable Content”. The appearance of this message bar varies in different versions of Excel (Figure 2, Figure 3).

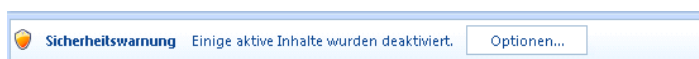


Figure 2 “Enable Content” security warning in Excel 2007.

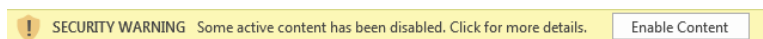


Figure 3 “Enable Content” security warning in Excel 2010

Click “Enable Content” on the message bar or on “Options” followed by “Enable Content” and “Yes”. The file is now open as a trusted document.

Note: Excel 2007 doesn’t save this setting while Excel 2010 does. This can lead to problems and computational errors. We therefore do not recommend this method for use with Excel 2007.

1.2 Welcome message

A message displaying the current version of the INSPIRE Tool appears on the start screen once it is launched successfully (Figure 4).

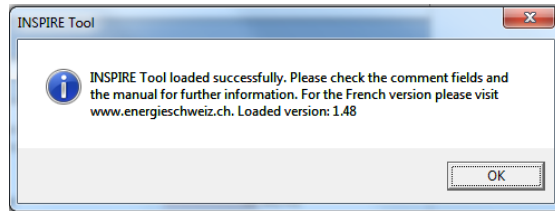


Figure 4 Welcome message displayed once the INSPIRE Tool is correctly launched.

Since some data are loaded from the data file when the Excel file is started, the tool cannot be accessed until this message appears. If this message does not display, then the macro settings have not been properly adjusted (see above).

1.3 Notes on updates

When the tool launches, it checks for new versions of the tool and associated data files. If an update is possible, a message indicating the website from which it can be downloaded is displayed. When required, a message displaying new functionalities or errors appears (Figure 5)

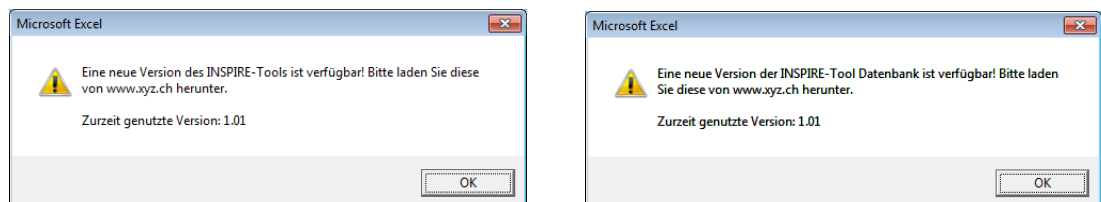


Figure 5 Warning message for new version update.

Although use of the tool itself does not require a functioning Internet connection, it can only check for updates when online. Make sure your organisation has not blocked your Internet connectivity so that this important step is not missed

If a new version of the tool is used, data entered in the old version must be transferred to the new one.

1.4 INSPIRE Tool spreadsheet description

1.4.1 “Condition”

The current state of a building is defined using the “Condition” sheet. Building-specific information related to building data, occupancy, and energetic requirements for the building envelope as well as automation are inputted by the user.

1.4.2 “Measure”

Variations in energetic retrofits along with various reference values are inserted into the “Measure” sheet. The possible installed measures relate mainly to the building envelope, follow-up measures affecting this envelope, building automation, heating systems, internally-generated electricity, lighting, building technology, appliances, and to follow-up measures of building automation.

1.4.3 “Energy price”

The energy price and the evolution of these prices over time are fixed in the “Energy price” spreadsheet.

1.4.4 “Factors”

In this sheet, the GHGE factors as well as primary energy use factors stored in the tool can be modified for different energy carriers.

1.4.5 “Climate”

The standard climate data in the tool can be changed in this spreadsheet.

1.4.6 “Output”

The results of the calculated values are summarised in the “Output” sheet. The main results are specific annual costs, yearly greenhouse gas emissions (GHGE) and annual primary energy consumption. Two graphs comparing the GHGE and primary energy consumption to the costs over the life cycle of renovation measures are also generated. All indicators are calculated and displayed for all sets of measures.

1.4.7 “Output Summary”

The “Output” sheet is summarised in the “Output Summary” sheet.

2 Functionality

This section outlines the functional possibilities of the INSPIRE Tool by describing its component spreadsheets.

2.1 “Condition” spreadsheet

The current state of the assessed building is defined by the user in the “Condition” sheet. Several dropdown menus are available for this step.

A dropdown menu is used, for example, to select the building type (Figure 6). When a user selects an option from this list, predefined default values contained in the database file are automatically inserted throughout parts of the sheet. Figure 6 shows how to select a multifamily building and which predetermined database values can then be changed if needed (occupancy and hot water use per person).

Building data		Building occupancy and use	
Gross heated floor area	500 m ²	Residential building: Number of units	1
SIA building type	Single-family building	Number of heated levels (not including the cellar)	1
Construction type	Multi-family building	Cellar heating	yes
Construction period	Single-family building	Occupancy (AE per person)	60 m ²
Is the house free-standing?	Office	Hot water use per m ² per year	50 MJ/m ²
Roof type	School		
Conversion of attic to living space	Pitched roof		
	non-extensible to heated area		

Figure 6: Dropdown menu used to select a single family building.

Some dropdown menu items require further user input once they are selected.

For example, in Figure 7, an energetic renovation measure previously applied to the building envelope is selected from the dropdown menu in the section describing the current state of the building. Additional information specifying what portion of the building is affected by this measure is to be supplied by the user based on the selection.

Insulated surface area and installed measures (building envelope)					
Default values for areas	Insulated surface area [m ²]	Measure	Portion of area [%]	Year	U-value [W/(m ² *K)]
Roof adjacent to exterior	268	No measure / overhaul only			0.800
Attic floor adjacent to unheated space	0	No measure / overhaul only			1.000
Wall adjacent to exterior	484	No measure / overhaul only			1.000
Wall adjacent to unheated space	121	No measure / overhaul only			1.000
Wall adjacent to ground	73	No measure / overhaul only			1.000
Floor adjacent to exterior	0	No measure / overhaul only			1.000
Floor adjacent to ground	0	No measure / overhaul only			1.000
Floor adjacent to unheated space	189	No measure / overhaul only			1.000
South windows	48	Energy efficient retrofit	input	choose	error
East windows	40	No measure / overhaul only			0.700 3.500
West windows	40	No measure / overhaul only			0.700 3.500
North windows	24	No measure / overhaul only			0.700 3.500
Skylights, roof windows	8	No measure / overhaul only			0.700 3.500
All windows	160	Energy efficient retrofit	0%		0.450 2.450

Figure 7: Dropdown menu example with further required user input.

The user can also select from different buttons in the “Condition” sheet. For example, a photo of the building can be added and displayed in the upper section of the sheet by clicking on the “Load picture” button (Figure 8).

Model building

Project description

Location: Place name

Load picture

Delete picture

Colour code of legend	Select from list	User-defined	Default value or derived from input; can be replaced	derived value; cannot be replaced
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Figure 8: Buttons allowing uploading and deletion of a photo.

The user has the option of using predefined standard values for the insulated surface area of the building envelope (“Default values for areas” button, Figure 9) or to use his or her own data values. If the standard values are used, gross heated floor area (AE) must be user defined. The standard values are then calculated based on the specified building type and age.

Insulated surface area and installed measures (building envelope)					
Default values for areas	Insulated surface area [m2]	Measure	Portion of area [%]	Year	U-value [W/(m2*K)]
Roof adjacent to exterior	268	No measure / overhaul only			0.800
Attic floor adjacent to unheated space	0	No measure / overhaul only			1.000
Wall adjacent to exterior	484	No measure / overhaul only			1.000
Wall adjacent to unheated space	121	No measure / overhaul only			1.000
Wall adjacent to ground	73	No measure / overhaul only			1.000
Floor adjacent to exterior	0	No measure / overhaul only			1.000
Floor adjacent to ground	0	No measure / overhaul only			1.000
Floor adjacent to unheated space	189	No measure / overhaul only			1.000

Figure 9: “Default values for areas” button.

Care must be taken when indicating surface areas of the building so that they include only those within the *insulated surface area*. These are defined as the surfaces surrounding the heated spaces within a building. Special attention must be given to the insulated surface area in the case of a roof with attic:

- If the building includes a heated attic, the insulated surface area of the roof is the surface area adjacent to the building exterior (“Roof adjacent to exterior”). In this case, the surface area of the attic floor is *not* considered part of the insulated surface area.
- If the building includes a non-heated attic, then only the attic floor is to be considered as an insulated surface area (“Attic floor adjacent to unheated space”). The roof surface area is not to be included in the analysis as it is not, by definition, part of the insulated surface areas.

If the same energetic renovation measures were previously applied to all windows on a building, the user can simply enter the relevant values for the south facing windows and use the “All windows like south window” button to auto-fill the other window fields (Figure 10).

	All windows like south window	Portion of area [%]	Year	solar heat gain coefficient	U-value [W/(m2*K)]
South windows	48	Energy efficient retrofit	Input	choose	error
East windows	40	No measure / overhaul only		0.700	3.500
West windows	40	No measure / overhaul only		0.700	3.500
North windows	24	No measure / overhaul only		0.700	3.500
Skylights, roof windows	8	No measure / overhaul only		0.700	3.500
All windows	160		0%	0.490	2.450

Figure 10: The “All windows like south window” button.

The colour of the cells are used to categorise data entry methods in the “Condition” sheet.

- Blue indicates where the user must select an option from a dropdown list.
- Turquoise cells indicate where values are user-defined (i.e. “Gross heated floor area” in Figure 6).
- Pink cells indicate standardised values contained in the database or those calculated based on the user’s relevant dropdown menu selections. These values can be overridden by the user by inserting their own values in the indicated cells (the cell colour will then change to turquoise). To revert back to pre-determined values in these pink cells, the inserted values can simply be deleted or the cell contents cleared.
- Cells become orange if a dropdown list requires additional information to be user-defined (see Figure 7).
- Standard values that require additional input before they can be calculated are indicated by red cells. In Figure 7, the “Portion of area” and the “Year” must both be entered before the standardised U-value can be displayed by the program.
- Values in white cells cannot be changed by the user (see Figure 11). These values are derived from calculations based on previous input into other cells. As this is the case, it is recommended that the form be filled out from top to bottom.

Heating		
Heating demand in accordance with SIA 380/1	402'162 MJ/a	Heating power demand in accordance with SIA 380/1
Heating demand in accordance with SIA 380/1 by m ² of ERA	804 MJ/a/m ²	51 kW

Figure 11: Example of a derived value in a white cell.

2.2 “Measure” spreadsheet

The “Measure” sheet allows for the specification of energy efficiency measures that were indicated in the “Condition” sheet. The colour coding of cells is the same as in this first sheet.

The starting point for the “Measure” sheet is displayed in Figure 12. The building components that are to be retrofitted are listed by category in the leftmost column (“Building envelope” comprises “Window” and “Façade”, among others, whereas “Building technology” includes “Ventilation system”, “Heating”, etc.). Next, the grey columns are used to select different measure packages.

INSPIRE Tool		Abbreviation	CRB code	Explanation								
Copy selected measure(s) up to the final option		No measure		No measure								
		Overhaul masonry	E.2.1	Overhaul masonry								
		Compact overhaul	E.2.2	Overhaul compound façade								
		Overhaul ventilation	E.2.3	Overhaul ventilated façade								
		Compound insulation	E.2.4	Compound insulation								
		Insulation with ventilated façade	E.2.5	Insulation with ventilated façade								
		Interior insulation	E.2.6	Interior insulation								
2. Efficiency measures		Ref1	Ref2	Var 1	Var 2	Var 3	Var 4	Var 5	Var 6	Var 7	Var 8	
Building envelope												
Façade measures		No measure	Overhaul masonry	Compact overhaul	Overhaul ventilation	Compound insulation	No measure	No measure	No measure	No measure	No measure	100%
Partial energy efficiency measure			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Type of insulation material					Wood	Mixture						
Type of material					Wood	Rock wool						
Insulation thickness (cm)						16						
U-value of entire façade		1.00	1.00	1.00	1.00	0.20	1.00	1.00	1.00	1.00	1.00	1.00
Cost indicator (CHF/m ²)			38	67	105	145	0	0	0	0	0	1
Portion of cost for energy measure			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Window												
Window measures		No measure	New windows	Overhaul windows	Overhaul windows	New windows	New windows	Overhaul windows	Overhaul windows	New windows	New windows	100%
Partial energy efficiency measure			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Type of window			Standard conversion	Standard conversion	Metal	Standard conversion	Standard conversion	Standard conversion	Standard conversion	Standard conversion	Standard conversion	100%
Frame material			Wood-metal	Standard wood	Metal	Wood-metal	Wood-metal	Wood-metal	Wood-metal	Wood-metal	Wood-metal	100%
Window with sun protection			no	no	no	no	no	no	no	no	no	100%
U-value of all windows		0.69	0.72	0.72	0.69	0.72	0.72	0.69	0.69	0.69	0.72	0.7
U-value of new windows [W/m ² K]			1.31	1.31		1.31	1.31				1.31	1.3
Average U-value of windows [W/m ² K]		3.34	1.31	1.31	3.34	1.31	1.31	3.34	3.34	1.31	1.31	1.3
Cost indicator for windows (CHF/m ²)			98	20	98	20	98	40	40	98	98	98
Portion of cost for window energy measure			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Figure 12: Starting point for the “Measure” sheet.

The user can indicate the following for each building component:

- No measure implementation.
- Overhaul of certain building elements to re-establish functionality without providing energetic improvements.
- Measures that provide energy efficiency improvements: various options are available based on the relevant building component.

In using this part of the tool, only building energy efficiency measures that affect elements of the building envelope included in the insulated surface area are to be included. This assures that the same building envelope surfaces are considered for the “Condition” and “Measure” sheets.

The two first columns on this sheet are designed for the reference cases. It is possible to select only overhaul options for certain reference cases if necessary. It is also possible that there are no or only a few implemented measures in the reference case. There are two possible variations on these reference cases. The first column (“Ref 1”) can represent the building based on the “Condition” sheet, whereas the second column (“Ref 2”) can represent the same building with some overhaul measures applied.

Columns E1 (Variation 1) to E8 (Variation 2) represent possible variants for the modelling of energy efficient retrofitting measures that can then be compared to the reference cases. Two subsequent variants can represent a stepwise progression toward a single strategy. An example of this latter technique is shown in Figure 13. Variants can also represent unrelated strategies (Figure 14) that can then be compared to either reference case or to another variant.

2. Efficiency measures	Ref1	Ref2	Var 1	Var 2
Building envelope				
Façade				
Façade measures	No measure	Overhaul masonry	Compound insulation	Compound insulation
Part of the façade affected by the measure		100%	100%	100%
Desired efficiency level			Standard conversion	Standard conversion
Type of insulation material			EPS	EPS
Façade material				
Insulation thickness [cm]				11
Façade U-value (with new insulation)			0.25	0.25
U-value of entire façade	1.00	1.00	0.25	0.25
Cost indicator [CHF/m2]		38	130	130
Portion of cost for energy measure		100%	100%	100%
Window				
Window measures	No measures	Overhaul windows	Overhaul windows	New windows
Part of windows affected by measures		100%	100%	100%
Desired efficiency level				Minergie
Frame material		Wood-metal	Standard wood	Metal
Window with sun protection				yes
g-value of new windows				0.35
g-value of all windows	0.70	0.70	0.70	0.35
U-value of new windows [W/(m2·K)]				0.95
Average U-value of windows [W/(m2·K)]	3.50	3.50	3.50	0.95
Cost indicator for windows [CHF/m2]		40	40	1187
Portion of cost for window energy measure		100%	100%	100%

Figure 13: Example of variants showing a two-step strategy.

2. Efficiency measures	Ref1	Ref2	Var 1	Var 2
Building envelope				
Façade				
Façade measures	No measure	Overhaul masonry	Compound insulation	No measure
Part of the façade affected by the measure		100%	100%	
Desired efficiency level			Standard conversion	
Type of insulation material			EPS	
Façade material				
Insulation thickness [cm]				11
Façade U-value (with new insulation)			0.25	
U-value of entire façade	1.00	1.00	0.25	1.00
Cost indicator [CHF/m2]		38	130	
Portion of cost for energy measure		100%	100%	
Window				
Window measures	No measures	Overhaul windows	No measures	New windows
Part of windows affected by measures		100%		100%
Desired efficiency level				Minergie
Frame material		Wood-metal		Metal
Window with sun protection				yes
g-value of new windows				0.35
g-value of all windows	0.70	0.70	0.70	0.35
U-value of new windows [W/(m2·K)]				0.95
Average U-value of windows [W/(m2·K)]	3.50	3.50	3.50	0.95
Cost indicator for windows [CHF/m2]		40		1187
Portion of cost for window energy measure		100%		100%

Figure 14: Example of variants showing a series of unrelated applied measures.

Relevant abbreviations and the CRB code along with a brief explanation of different measures are displayed at the top of the “Measure” sheet whenever a particular variety of measure is selected (Figure 15).

INSPIRE Tool				
Abbreviation		CRB code	Explanation	
No measure			No measures	
Overhaul masonry		E 2.1	Overhaul masonry	
Compact overhaul		E 2.2	Overhaul compound façade	
Overhaul ventilation		E 2.3	Overhaul ventilated façade	
Compound insulation		E 2.2	Compound insulation	
Insulation with ventilated		E 2.3	Insulation with ventilated façade	
Interior insulation		G 3.2	Interior insulation	

Copy selected measure(s) up to the final option				
-------------------------------------------------	--	--	--	--

2. Efficiency measures	Ref1	Ref2	Var 1	Var 2
Building envelope				
Façade				
Façade measures	No measure	No measure	Compound insulation	No measure
Part of the façade affected by the measure			100%	
Desired efficiency level			Standard conversion	
Type of insulation material			EPS	
Façade material				
Insulation thickness [cm]			11	

Figure 15: Abbreviation, CRB code and explanation of measures.

As shown in Figure 16, the button labelled “Copy selected measure(s) up to the final option” [2] can be used to copy all of the modified options within the selected variant [1] to all of the variants in columns to the right.

Copy selected measure(s) up to the final option					
Interior insulation G 3.2 Interior insulation					
2. Efficiency measures	Ref1	Ref2	Var 1	Var 2	Var 3
Building envelope					
Façade					
Façade measures	No measure	Overhaul masonry	Compound insulation	Compound insulation	No measure
Part of the façade affected by the measure			100%	100%	
Desired efficiency level			Standard conversion	Standard conversion	
Type of insulation material			EPS	EPS	
Façade material					
Insulation thickness [cm]			11	11	
Façade U-value (with new insulation)			0.25	0.25	
U-value of entire façade	1.00	1.00	0.25	0.25	1.00
Cost indicator [CHF/m ²]		38	130	130	100
Portion of cost for energy measure		100%	100%	100%	100%

Copy selected measure(s) up to the final option					
Interior insulation G 3.2 Interior insulation					
2. Efficiency measures	Ref1	Ref2	Var 1	Var 2	Var 3
Building envelope					
Façade					
Façade measures	No measure	Overhaul masonry	Compound insulation	Compound insulation	Compound insulation
Part of the façade affected by the measure			100%	100%	100%
Desired efficiency level			Standard conversion	Standard conversion	Standard conversion
Type of insulation material			EPS	EPS	EPS
Façade material					
Insulation thickness [cm]			11	11	11
Façade U-value (with new insulation)			0.25	0.25	0.25
U-value of entire façade	1.00	1.00	0.25	0.25	0.25
Cost indicator [CHF/m ²]		38	130	130	130
Portion of cost for energy measure		100%	100%	100%	100%

Figure 16: Example use of the “Copy selected measure(s) up to the final option” button. The measures that are to be copied are selected using the pointer and pushing the button then executes the action, copying all of the information until the end column.

The colour coding used in the “Measure” sheet is the same as in the “Condition” sheet, aside from one important difference: deleting or erasing values from within a cell will not automatically refill that cell with the predetermined value. To do this, the associated measure must be selected again from the dropdown menu.

2.3 “Energy price” spreadsheet

Energy prices used in calculations are contained in the “Energy price” sheet (Figure 17). The INSPIRE tool comes pre-loaded with an energy price development scenario, but the values are user-adjustable. Fields that can be modified on this sheet are coloured turquoise, whereas the white cells are used to indicate the input units and cannot be changed by the user.

The default currency used in the INSPIRE Tool is the Swiss Franc (CHF). Adjustments can be made using the “Price factor” field (Figure 17). Changing the currency does not cause any changes in the default values within the database but altering the “Price factor” will change the default values for investment and maintenance costs in the “Measure” sheet. The energy prices, while not being affected by this change, can be manually adjusted in the “Energy price” sheet.

INSPIRE Tool						
3.a) Basic setting for prices						
Basis	Einheit					
Currency	CHF					
Price factor	1.0					
The change of currency does not lead to a change in the default data. Changes may be made by adapting the price factor. Adapting the price factor leads to changes in the default values for investment costs and maintenance costs; the energy prices are not affected by the price factor, they can be directly edited in this sheet. The default values indicated here refer to Switzerland; differently from other fields with default values in this tool, the default values are not reloaded when the value is deleted.						
3.b) Development of energy prices (applies to measures)						
Energy system	Unit	2013	2020	2030	2040	2050
Heating oil	CHF/L	0.955	1.117	1.292	1.412	1.482
	CHF/kWh	0.096	0.112	0.129	0.141	0.148
Natural gas	CHF/kWh	0.10	0.12	0.14	0.15	0.16
Wood logs (1500 kWh/stère)	CHF/stère	80.0	105.0	125.0	140.0	150.0
	CHF/kWh	0.053	0.070	0.083	0.093	0.100
Wood chips (975 kWh/m3)	CHF/m2	47.50	56.00	73.00	84.00	91.00
	CHF/kWh	0.049	0.057	0.075	0.086	0.093
Wood pellets (5000 kWh/t)	CHF/t	380	415	503	563	598
	CHF/kWh	0.076	0.083	0.101	0.113	0.120
Biogas	CHF/kWh	0.186	0.205	0.225	0.239	0.247
District heating (CH-Mix)	CHF/GJ	20.28	23.00	26.00	28.00	31.00
	CHF/kWh	0.07	0.08	0.09	0.10	0.11
District heating (User-defined)	CHF/GJ	20.28	23.00	26.00	28.00	31.00
	CHF/kWh	0.07	0.08	0.09	0.10	0.11
Electricity, owner (CH-mix)	CHF/kWh	0.220	0.264	0.292	0.305	0.312
Electricity, owner (User-defined)	CHF/kWh	0.220	0.264	0.292	0.305	0.312
Electricity, tenant (CH-Mix)	CHF/kWh	0.220	0.264	0.292	0.305	0.312
Electricity, tenant (User-defined)	CHF/kWh	0.220	0.264	0.292	0.305	0.312
Internally-generated electricity compensation	CHF/kWh	0.220	0.264	0.292	0.305	0.312

Figure 17: “Energy price” sheet.

2.4 “Factors” spreadsheet

In the “Factors” sheet, GHGE factors along with the primary energy use factors used in the tool can be modified for the different energy carriers (Figure 18). The standard values refer to the case in Switzerland. In the primary energy factor, a distinction is made between factors relating to non-renewable primary energy and total primary energy.

Greenhouse gas emission factors and primary energy factors			
You can change the factors by editing the corresponding fields. The default values indicated here refer to Switzerland; differently from other fields with default values in this tool, the default values are not reloaded when the value is deleted.			
Energy carriers excluding electricity			
Energy carrier	Greenhouse gas emissions [kg CO ₂ eq/MJ]	Non-renewable PEF	Total PEF (Primary Energy Factor)
Heating oil	0.0827	1.23	1.24
Natural gas	0.0658	1.1	1.12
Wood logs	0.00308	0.0636	1.14
Wood chips	0.004	0.05	1.06
Wood pellets	0.0102	0.21	1.22
Biogas	0.0455	0.369	0.403
Electricity			
Energy carrier	Greenhouse gas emissions [kg CO ₂ eq/MJ]	Non-renewable PEF	Total PEF (Primary Energy Factor)
National Mix	0.0413	2.63	3.05
District heating			
Energy carrier	Greenhouse gas emissions [kg CO ₂ eq/MJ]	Non-renewable PEF	Total PEF (Primary Energy Factor)
National Mix	0.0434745	0.76596	0.8212

Figure 18: “Factors” sheet.

2.5 “Climate” spreadsheet

The climatic data stored in the tool can be adjusted using the “Climate” sheet (Figure 19Figure 20). Standard values are recorded for Switzerland.

Climate data		
Location / country:		
Switzerland		
You can change the climate data by editing the corresponding fields. The default values indicated here refer to Switzerland; differently from other fields with default values in this tool, the default values are not reloaded when the value is deleted.		
Parameter	Unit	Values
Metres above mean sea level	m	523.051

Figure 19: Standard climate data for Switzerland in the “Climate” sheet.

2.6 “Output” spreadsheet

The “Output” spreadsheet organises the resulting calculations from the tool and displays these results represented graphically and numerically. An example showing the resultant GHGE and primary energy demand calculated for each variant is shown in Figure 20.

	Ref1	Ref2	Var 1	Var 2	Var 3	Var 4	Var 5	Var 6	Var 7	Var 8
Intermediate energy values										
Electricity consumption for appliances / building infrastructure (MJ/m ² *a)	52	52	52	52	52	52	52	52	52	52
Heating demand Q _h (% of value)	292%	292%	224%	164%	158%	158%	224%	224%	158%	158%
Final energy heating and hot water (MJ/m ² *a)	1176	1176	922	697	676	676	922	922	676	676
Energy and environmental impacts										
Greenhouse gas emissions (kg/(a*m ²))	5.8	6.0	5.8	6.1	5.9	5.9	5.8	5.8	5.9	5.9
Non-renewable primary energy demand [MJ/a*m ²]	212.0	213.2	210.3	210.6	206.1	206.1	210.3	210.3	206.1	206.1
Specific annual costs										
Total (CHF/m ² /a)	30	33	31	43	40	40	32	32	40	40
of which capital costs (%)	0%	11%	21%	53%	51%	51%	23%	23%	51%	51%
of which operation and maintenance (%)	10%	9%	9%	6%	7%	7%	9%	9%	7%	7%
of which energy costs (%)	90%	80%	70%	41%	42%	42%	68%	68%	42%	42%

Figure 20: Example of numerical results from the INSPIRE Tool.

Figure 21 displays a diagram representing the costs over a model building's life cycle. In the left frame, the user can adjust additional parameters such as the interest rate, unit of primary energy production, energy-specific costs, and the degree to which grey energy is considered.

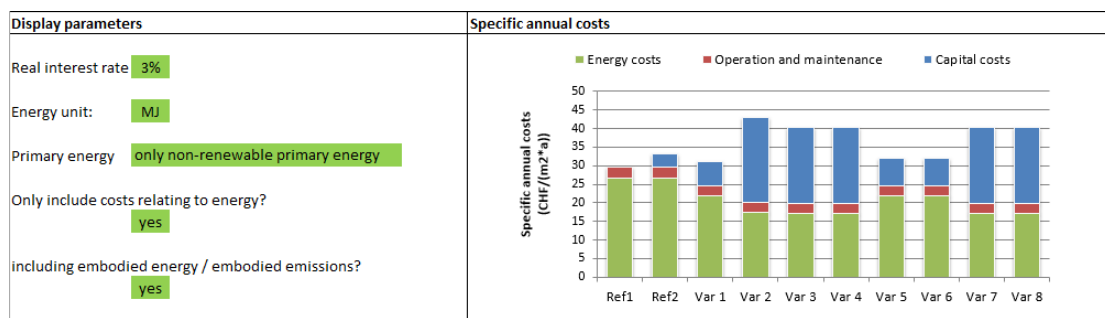


Figure 21: Costs over the building's life cycle as displayed in the “Output” sheet.

Figure 22 shows how GHGE emissions (left side) and primary energy demand (right side) are graphed versus specific annual costs. All of the measure implementation variants as well as the reference cases can be compared in this graphic representation. Target emissions and energy demand values can also be added and visualised on the resultant graphs. These standardised targets are based on the SIA 2040 values.

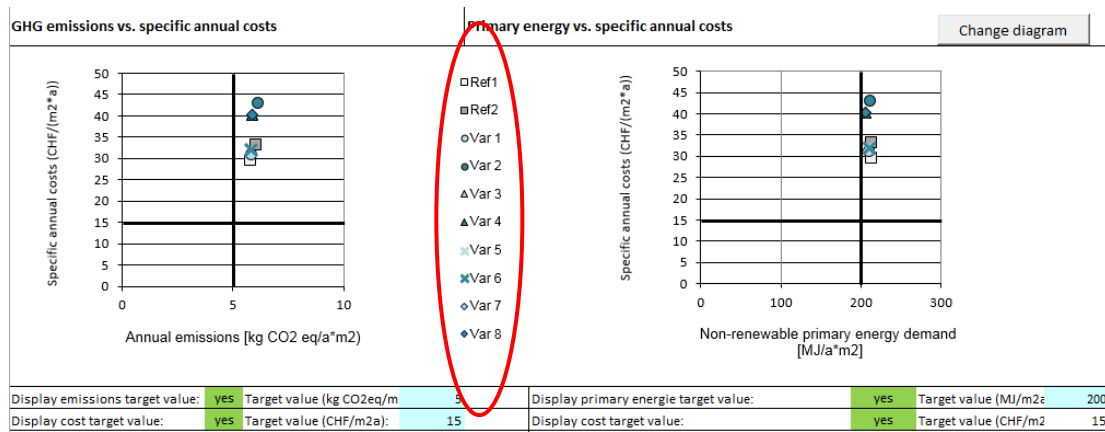


Figure 22: GHGE (left), primary energy demand (right) vs. specific annual costs.

2.7 “Output Summary” spreadsheet

The “Output Summary” again summarises the results based on the tool’s calculations displayed in the previous “Output” sheet. GHGE and costs related to the various measure implementation scenarios (E1-E8) are shown relative to the chosen reference case (Figure 23). The costs of both CO₂ and primary energy demand mitigation are also indicated. It is possible to assign a colour scheme to indicate values above or below a chosen threshold.

Value of variants vs. reference		Change in costs vs. Reference (CHF / m ² a)	Change in GHG emissions vs. reference	Costs of CO ₂ mitigation (CHF / t CO ₂ eq)	Primary energy change vs. reference	Costs of primary energy mitigation (CHF/GJ)
Chosen reference: Ref2						
Var 1	...	1.4	-99%	-11707	-101%	-7.7
Var 2	...	13.4	-94%	-82879	-101%	19.1
Var 3	...	10.5	-99%	49782	-103%	12.9
Var 4	...	10.5	-99%	49782	-103%	12.9
Var 5	...	2.4	-99%	-6242	-101%	-4.1
Var 6	...	2.4	-99%	-6242	-101%	-4.1
Var 7	...	10.5	-99%	49782	-103%	12.9
Var 8	...	10.5	-99%	49782	-103%	12.9

Colour scheme definition			
	Costs of CO ₂ mitigation (CHF / t CO ₂ eq)		Costs of primary energy mitigation (CHF/GJ)
Maximum value	300	Maximum value	50
Minimum value	0	Minimum value	0

Figure 23: Example of additional table displayed in “Output Summary”.

3 General comments and disclaimer

3.1 Comments

There are certain areas within the tool where comments have been included to assist the user. These can be identified by the small red triangle typically used in Excel and can be accessed by placing the cursor overtop the corresponding cell (Figure 24).

Insulated surface area and installed measures (building envelope)				
Default values for areas	Insulated surface area [m ²]	Indicate only the portion of the surfaces included within the insulated area		
		Measure	Portion of area [%]	U-value [W/(m ² *K)]
Roof adjacent to exterior	268	No measure / overhaul only		0.800
Attic floor adjacent to unheated space	0	No measure / overhaul only		1.000
Wall adjacent to exterior	484	No measure / overhaul only		1.000

Figure 24: Example of additional information supplied within the “Calculation” sheet.

3.2 Comments on reference values and assumptions

The standard values included in the tool have been derived using a simplified approach to assumptions and models. For example, an independent building with average dimensions and geometry was assumed for the calculation of these standard values.

As a result, the data values are approximate. The results of the tool must therefore be considered as approximations themselves. Calculations will be more accurate if specific values are inputted on a case per case basis. Further, cost calculations will rely on both the material chosen for the retrofitting as well as the labour involved in its installation. Additional follow-up measures resulting from the selected energy efficiency improvements to different building elements will also necessarily have to be considered and specifically included in an analysis.

3.3 Disclaimer

Although the utmost was done to ensure the accuracy of the database values and all calculations within the INSPIRE Tool, the authors assume no responsibility for the accuracy or correctness of the data or calculations.