eXTENDing the energy performance assessment and certification schemes via a mOdular approach

Guidelines for

"Enhanced recommendations" spread sheet (Feature 8)

Beta version 5.0

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FOREWORD

This document aims to guide the tool user through the spread sheets and calculations exclusively for the X-tendo F8 "**Enhanced recommendations**". The main software required is Excel. Additionally, other tools can be used to automatically extract the EPC data from the XML file.

This document is complementary to the project report (below), that explains the methodology in detail:

D4.4 Description of methodologies and concepts for the technical implementation of each feature regarding improved handling and use of EPC data in selected implementing countries.

1 SPREAD SHEET OVERVIEW

Content of files and explanation of the terms, can be found in the sheets:

1. Title
2. File Content

Building relevant information, as well required input data for the calculation and targeted energy standards in the sheet:

3. Building input data (current building information)
4. Targeted standards (for recommendations)

Required databases:

5. Insulation material database
6. Window and door database
7. Heating system database
8. Solar radiation information (average monthly radiation)
9. PV system Database
10. Pre-fabricated recommendations

Calculation sheets:

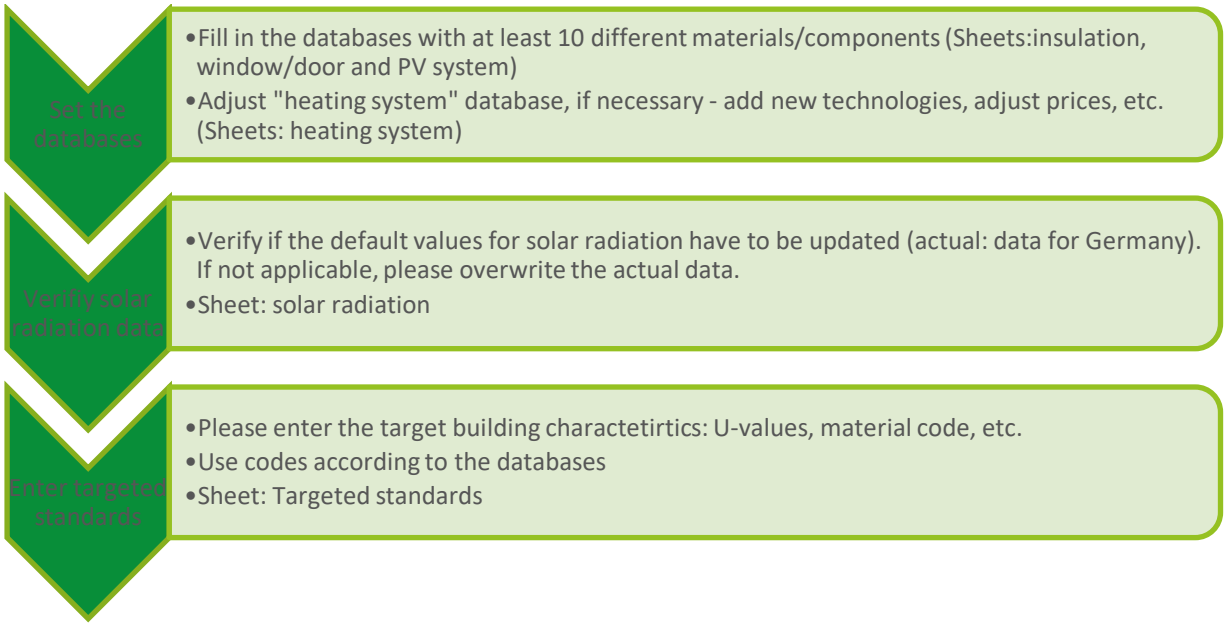
11. External wall
12. Floor (or cellar ceiling)
13. Roof (or upper ground ceiling)
14. PV production

Results sheets:

15. Recommendation summary (building category, criteria check, parameters, co-benefits and explanation of benefits)
16. Recommendation explanation (building category, co-benefits and explanation of benefits)
17. Recommendation costs (including cost ranges estimation)

2 PREPARATION OF THE BACKGROUND INFORMATION AND DATABASES (FOR ALL BUILDINGS)

Setting the background information and databases can be done one time, before the calculation per building. Following activities should be performed:



2.1 Set the databases and solar radiation information

The spread sheets (in grey) provide the structure for different databases: insulation material, window/door, heating system, solar radiation and PV system. Also, weather information regarding solar radiation can be entered. These sheets should be filled in by the tool user before the calculation procedures start. And, can be used to all testing cases.

Figure 1: Spread sheets for databases

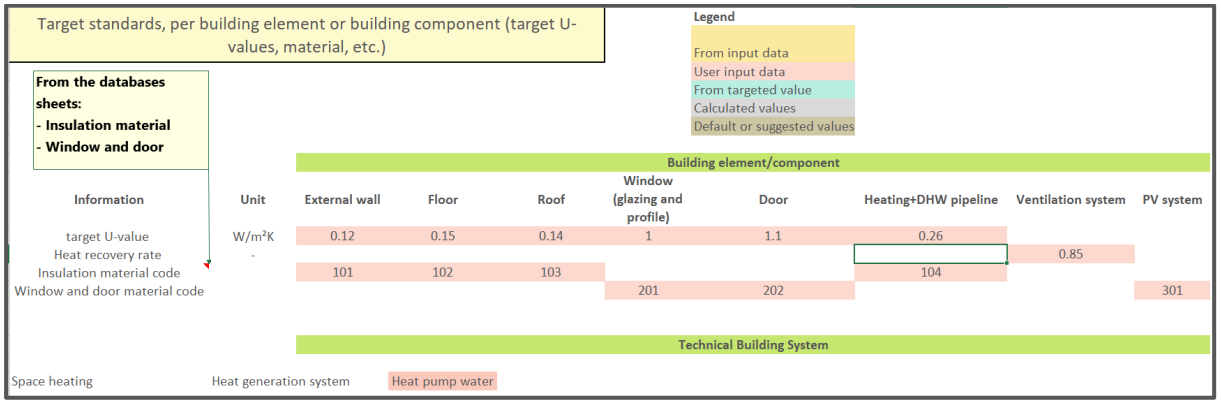
2.2 Targeted standards

In this spread sheet the building user has to input the specifications of the targeted building, which is aimed to be achieved due to the recommendations. These "targeted building standards" should be derived either from national building codes or long-term building renovation targets as well as from decarbonisation targets.

Here, the tool user can enter U-values, efficiency rates, etc. Also, after choosing the materials (according to the databases in Figure 1) for providing the recommendations, tool user have to enter their codes here as well.

Targeted standards

Figure 2: Spread sheet for target buildings



Target standards, per building element or building component (target U-values, material, etc.)

Legend
From input data
User input data
From targeted value
Calculated values
Default or suggested values

From the databases sheets:
- Insulation material
- Window and door

Information	Unit	Building element/component: External wall	Floor	Roof	Window (glazing and profile)	Door	Heating+DHW pipeline	Ventilation system	PV system
target U-value	W/m²K	0.12	0.15	0.14	1	1.1	0.26		
Heat recovery rate	-							0.85	
Insulation material code		101	102	103			104		
Window and door material code					201	202			301

Technical Building System

Space heating	Heat generation system	Heat pump water

Figure 3: Required target building information

3 CALCULATION STEPS (PER BUILDING)

3.1 Building input data

This spread sheet contains the all the input data required by the calculation procedures. Here, it is possible to provide an interface with EPC xml file. For example, extracting the EPC data from the xml file automatically. For that, a Pyhton script (or other code) is necessary as additional tool. In the context of the project, a code was written for the Danish EPC scheme and the automatised data extraction will be tested in during the testing phase.

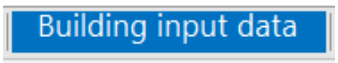


Figure 4: Spread sheet for building input data

The number of the parameters (column A) follows the same structure as the X-tendo internal file for documenting EPC data.[1] The columns on the right should be filled by the implementing partner as too. It indicates if the parameter is in the current EPC or it the data should be gathered through other sources, as for example, on-site visit.

Building input data necessary in the calculation, and its availability in the country specific EPCs

Input data (Level 1)	Input data (Level 2)	Input data (Level 3)	Unit	Value	Linked sheet
Envelope	External wall	U-value	W/m2K	3.71	External wall, Recommendations_summary
Envelope	External wall	Thickness layer 1	m	0.02	External wall
Envelope	External wall	Thickness layer 2	m	0.18	External wall
Envelope	External wall	Thickness layer 3	m	0.00	External wall
Envelope	External wall	Thickness layer 4	m		External wall
Envelope	External wall	Thickness layer 5	m		External wall
Envelope	External wall	Thickness layer 6	m		External wall
Envelope	External wall	Thickness layer 7	m		External wall
Envelope	External wall	Thickness layer 8	m		External wall
Envelope	External wall	Thickness layer 9	m		External wall
Envelope	External wall	Thermal conductivity layer 1	W/mK	0.81	External wall
Envelope	External wall	Thermal conductivity layer 2	W/mK	2.30	External wall
Envelope	External wall	Thermal conductivity layer 3	W/mK	0.80	External wall
Envelope	External wall	Thermal conductivity layer 4	W/mK		External wall
Envelope	External wall	Thermal conductivity layer 5	W/mK		External wall
Envelope	External wall	Thermal conductivity layer 6	W/mK		External wall
Envelope	External wall	Thermal conductivity layer 7	W/mK		External wall
Envelope	External wall	Thermal conductivity layer 8	W/mK		External wall
Envelope	External wall	Thermal conductivity layer 9	W/mK		External wall

Figure 5: Spread sheet for building input data

3.2 Calculation procedures

The calculation procedures are carried out in the following sheets:

External wall | Floor_Cellar ceiling | Roof_Upper ground ceiling | PV production

Figure 6: Spread sheets with the calculations

[1] https://tuwienacat.sharepoint.com/sites/X-tendo2/_layouts/15/Doc.aspx?OR=teams&action=edit&sourcedoc={142D3119-9435-4C28-9A70-0034D36CA7D7}

The tool user should follow the legend, to understand the origin of the values, which one should be entered, which are referenced and linked to other cells, etc.

Legend

From input data
User input data
From targeted value
Calculated values
Default or suggested values

Figure 7: Spread sheet data input legend

In general all fields can be modified by the user. Some are automatically linked with other sheets or default values are suggested.

The Figure 8 below shows the spread sheet for external walls insulation thickness calculation. The same structure is followed in the other sheets roof (or upper ceiling) and floor (or cellar ceiling). However, the input data (building element layers, thermal resistance, and material thermal conductivity) should be specific for each building element.

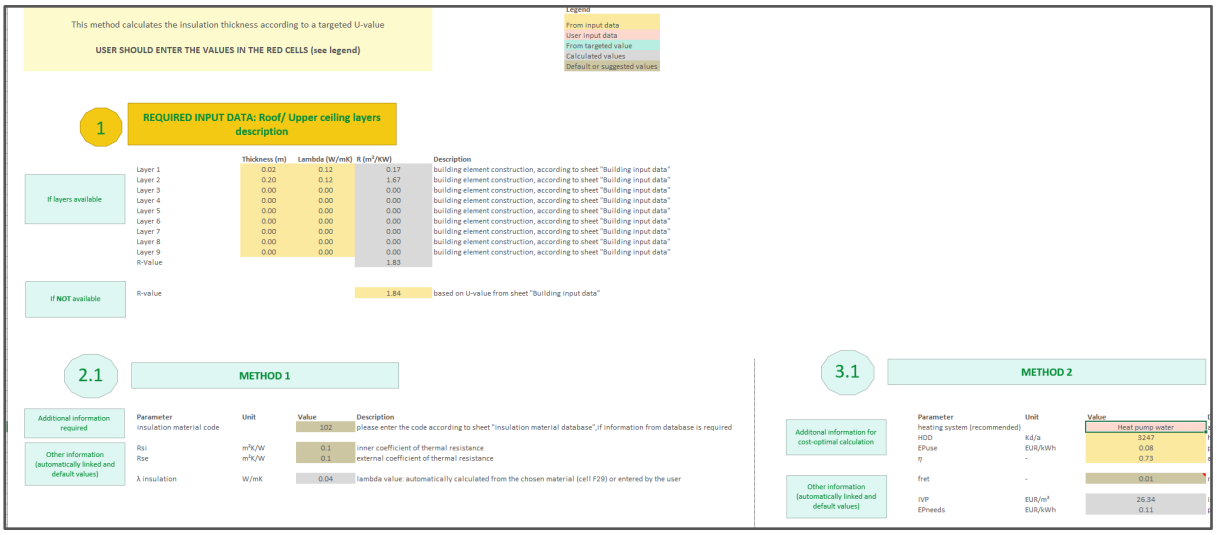


Figure 8: Calculation spread sheet "external wall" – input data

The results are provided for two different calculation methods: method 1 is a reversed U-value calculation, and method 2 a cost optimal calculation (according to the Austrian Standard ÖNORM B 8110-4[2]), as specified in the report D4.4. The results of method 1 are automatically linked to the spread sheet with the final recommendations. But, the user can change the link, according to their preference and choice. That is the reason, why both calculation methods are presented.

[2] ("ÖNORM B 8110-4:2011 07 15 - Lesesaal - Austrian Standards," 2011)

Figure 9: Calculation spread sheet "external wall" – results data

The Figure 10 below shows the spread sheet for estimating the solar energy production with PV cells. The calculation is based on the German Standard DIN 18599-9[3] .

Parameter	Unit	Value	Description
A	m2	50	By default 50% of roof area
Isol	kWh/m2yr	1217	annual solar irradiation energy
PV cell orientation		South	
PV cell inclination	degree	35	
PV cell type		monocrystalline silicon	
PV installation type		moderated ventilation	
fperf	-	0.75	system performance factor (also from table B1)
refI	kW/m2	1	reference solar irradiation intensity
specfpK	kW/m2	0.135	peak capacity (area specific) - (also from Table B2)
cpk	kW	6.75	peak capacity (PV Standard Test)
Energy_production_PV	**kWh**	**6161**	yearly PV electric energy production

Figure 10: Calculation spread sheet "PV production"

3.3 Results: enhanced recommendations

In the results are presented in following sheets:

Recommendations_summary	Recommendations_explanation	Recommendation_costs	Recommendation_indicators

Figure 11: Spread sheet for building input data

The "sheet results recommendations" contain measure-by-measure recommendations:

1) Building category
2) Building element/component
3) Criteria check
4) Need of recommendation
5) Short explanation
6) In some cases, also quantitative recommendations are provided, including energy savings
7) Co-benefits (non-energetic benefits for the measures)
8) Short explanation about the benefits of each measure

It is also suggested to perform a new calculation of the energy performance (taking into account all measures) by making use of the national calculation EPC software used by the EPC assessor and document the savings in the field:

[3] (DIN Norm, 2018)

Figure 12: Whole building assessment

The "sheet results costs" contains measure-by-measure costs estimation – material, labor, business profit and general expenditure) and VAT fees.

Here, the user can enter the values or use the suggested defaults one.

Building category	Building element/component	Parameter	Value	Unit	Material and labour costs [Euro]	Business profit and general expenditure [%]	Total costs	VAT Fees (%)	Total
Building envelope	External wall	surface area	200.00	m²	23,062.96	0.17	26,983.67	0.19	32,110.56
Building envelope	Floor or cellar ceiling	surface area	100.00	m²	37,203.56	0.17	43,528.16	0.19	51,798.51
Building envelope	Roof or upper ground ceiling	surface area	100.00	m²	10,925.16	0.17	12,782.43	0.19	15,211.09
Building envelope	Window	surface area	20.00	m²	2,729.04	0.22	3,329.43	0.19	3,962.02
Building envelope	Door	surface area	9.00	m²	691.09	0.15	794.76	0.19	945.76
Technical system	Pipeline	Pipeline Length	20.00	m	241.60	0.10	265.76	0.19	316.25
Technical system	Heating system	Heating system systen	8.25	kW	1,625.62	0.20	1,950.74	0.19	2,321.38
Renewable energy sources and CO2 emissions	RES production	Electric energy	7	kWp	9,774.00	0.22	11,924.28	0.19	14,189.89

Figure 13: Measure-by-measure cost assessment

Figure 14: Measure-by-measure cost assessment – graphs including ranges

4 AUTOMATIZED XML FILE DATA EXTRACTION

Introduction

This tool serves to analyse the structure of XML files representing building EPC data as well as to extract data from it and export the extracted details into the calculation spreadsheet. Any other different files would require an adaptation of the programming code.

Programme code information

The driving idea of this tool is to let the user define custom queries and query options that the program will consider during the XML processing. The content of the XML tags matching the specified queries will be extracted and will be exported into spreadsheets.

What computations are performed?

Stemming from the nature of the tool, the main objective of the software is purely to extract data from existing XML files. However, aggregate operations are supported in the export phase of the processing. This means the script can aggregate the extracted data to facilitate the interpretation of the generated spreadsheets without modifying the XML file.

How to run the code?

The code can be ran using Python 3.8 and a command-line interface. The available arguments are specified on the homepage of the repository. Please proceed to the next section to locate the project and its documentation.

Where is the code hosted?

The permanent repository for the code presented here may be found at:

https://eeg.tuwien.ac.at/gitlab/gyarmati/x-tendo-f8-xml-processing

Detailed description of the tool's usage can be found at:

https://eeg.tuwien.ac.at/gitlab/gyarmati/x-tendo-f8-xml-processing/-/blob/master/README.md

5 POSSIBLE Q&A DURING THE TESTING

Questions 1:

If the same building element (for example: external wall) has different U-values. Which one should be used?

A: Here you can 1) use the U-value of material with the highest share or 2) provide a weighted U-value (representative for the whole building element).

Questions 2:

If the same building element has different U-values and respective surface area. Which surface area should be used?

A: The surface area of this building element should be the sum of all areas.

Questions 3:

If the building elements layers cannot not be specified in the EPC scheme. Is it really necessary to provide each building element layer?

A: Use standardised constructions. Please verify if there are building construction databases. The project EPISCOPE provides exemplary building typologies. https://episcope.eu/welcome/

REFERENCES

DIN Norm, 2018. DIN V 18599-9 | 2018-09 Energetische Bewertung von Gebäuden - Berechnung des Nutz-, End- und Primärenergiebedarfs für Heizung, Kühlung, Lüftung, Trinkwarmwasser und Beleuchtung - Teil 9: End- und Primärenergiebedarf von stromproduzierenden Anlagen [WWW Document]. Baunormenlexikon.de. URL https://www.baunormenlexikon.de/ (accessed 4.19.21).

ÖNORM B 8110-4:2011 07 15 - Lesesaal - Austrian Standards [WWW Document], 2011. URL https://lesesaal.austrian-standards.at/action/de/private/details/396775/OENORM_B_8110-4_2011_07_15 (accessed 4.6.21).

X-tendo

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