





CRREM – Carbon Risk Real Estate Monitor

CRREM Tool: Guidance for application of the CRREM Risk Assessment Tool outside the EU

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(1) BACKGROUND

The CRREM Risk Assessment tool has been implemented within the framework of an EU funded Horizon 2020 Framework Programme and is therefore applicable for the analysis of commercial real estate for all 27 EU member states including the UK. Due to the great success of the project and the tool itself, there have been repeated enquiries about the applicability of the tool outside the EU and for residential use. This request was expressed intensively, especially in the wake of the publication of the global decarbonisation pathways for the real estate industry (sponsored by PGGM, APG and Norges Bank, see the "Global downscaling pathways" via www.crrem.org/pathways/).

This document takes up the request and explains in detail which adaptations have to be undertaken by the users in order to make all functions in the EU-version usable for other regions to obtain regional specific and reliable results.

In principle, the tool can also be used outside the EU and also applicable for other building types. The excel-based solution is flexible and not limited to the EU or commercial real estate. Nevertheless, the following aspects have to be considered, which are automatically selected (default-values) by the tool starting from the data in the backend and included in the calculation:

- Climatic conditions: The tool performs an adjustment of the input data based on the climatic conditions of the selected location (HDD & CDD). Based on climate forecasts, the software also makes specific regional adjustments in order to align with the heating and cooling requirements. For both aspects, current and future developments of the HDD and CDD at the selected location need to be defined and entered in the back-end. Currently, only the European values are entered in the tool.
- **Decarbonisation pathways:** currently, only the decarbonisation pathways for energy and carbon intensity for all European member states are provided in the tool. The international pathways based on the CRREM data (available via www.crrem.org) must be entered manually.
- Emission factors (EF): the grid emission factors and the development of these until 2050 are also entered in the back-end. Country specific EF need to be entered in the back-end for the analysis of a country outside the FII
- Energy and carbon prices: Country specific average energy and carbon prices are entered in the back-end of the tool for all European countries. For an analysis of assets outside the EU, the respective energy and carbon prices must be entered.

The following sections explain the necessary manual adjustments in detail. The adjustments should always be made on the basis of the current version of the tool (latest version V1.13 available on www.crrem.eu/tool) and the corresponding reference guide/user manual (available via www.crrem.eu/reference guide/).







(2) DATA INPUT FOR BUILDINGS OUTSIDE THE EU

The CRREM- tool has a front-end, which users typically use. This part is differentiated in Input- and Output-Sheets. Following the idea of a transparent tool and reliable output, all calculations to derive results are carried out in the "Back-end sheet" (please note: the HDD&CDD data is located in back-end sheets 2-4 that can be accessed by clicking "unhide"), enabling users to easily understand the overall structure and mathematical equations. Country specific default values can be viewed in this back-end sheet of the tool. The user has the option to either adjust to user-specific input data in the "Setting sheet" - which is part of the Front-end - or even overwrite the default data in the back-end sheet. The latter option will be especially applicable if the user intends to analyse a country outside the EU (since no default-data is available for those countries in the back-end).

The user can select a specific country in the Back-end and overwrite all default values in order to create output for a "new" country (outside the EU) which has not yet been included in the tool. The CRREM-tool incorporates default data (which can be overwritten in the back-end) which impacts energy and carbon emission normalisation over time; (1), energy prices and their development over time (2), climate transition pathway/sector and country specific decarbonization pathways (3) and emission factors (EF) for various energy sources and the evolution of EF over time (4) and location specific heating & cooling degree days (HDD /CDD) and their development over time.

Note: Once the "new" default data in the back-end has been integrated the user can apply the front-end functions without any further changes (see <u>reference Guide</u> for more details).

Input guidance for default data in the back-end:

The user can select a country which is not of interest (e.g. France) and input data for the new country that shall be analysed (e.g. Switzerland). Please change the country name in the "back-end" sheet E108-E136 (only change the row for the country in question – in this case France). The French pathways and all other default values can now be replaced with the pathways and country-specific default values for Switzerland. After completion the user can now select Switzerland in the Input sheet instead of France and perform the analysis as described in the reference guide.

• Country name: CRREM "Back-end" Sheet: B108-M136. Note: Please do **NOT** change any input in C108-C136.

М le exported 2051 NUTS 0 Type of use Austria AT OFFICE RETAIL -Belgium Bulgaria BG RETAIL -WAREHO Croatia HR RESTAUR Cyprus Czech Repulcz HOTEL Legend dummy nate and grid corrected asset pe Denmark DK Estonia EE EDUCATI 16.874295 Start x: 1 Start y: INDUSTR FR OTHER UK Government GHG Conversion Factors for Company Reporting EL Activity Unit kg CO2e per unit Greece 1.5°C Hungary HU Gas kWh 0.18396 Italy INDC Heat/StearkWh Lithuania LT Other energ Unit kg CO2e per unit Luxembour 0.00022 Malta Biogas 0.01506 Netherland NL Yes Office Wood logs kWh 0.01506 Poland Wood chi Retail, Hig RHS Portugal Wood pell kWh 0.01506 Retail, Sho RSM RO Grass/stra kWh 0.01314 Slovakia Gross floo 2019 Isk kWh 0.3447 ndustrial. DWH 2020 Landfill ga kWh Gross asse Slovenia 2021 0.21448 Healthcare HEC 2022 Sweder SE United King UK Mixed Use MIX 2023 Biogas

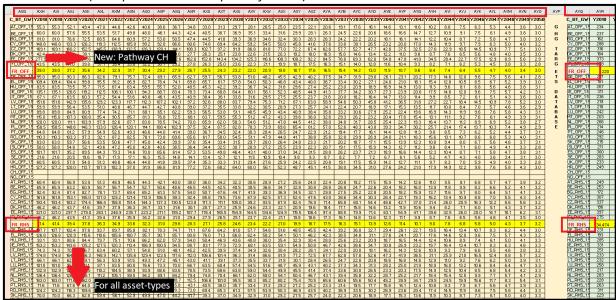
Back-End Sheet (Example Switzerland in place of France):





Decarbonisation pathways: CRREM "Back-end" Sheet: AXG & AYQ - The user can now exchange the GHG & kWh pathways for the 1.5 & 2°C targets for the respective country selected.

Back-End Sheet (Example Switzerland in place of France):



• Other default data: The user should also overwrite all areas that refer to country & asset-type specific default values. Please find the complete list below:

Default values to be changed in the "Back-end" sheet:

Pathway: AXG & AYQ (country & asset-type specific for 1.5 & 2°C).

You may find the global pathways for all asset-types <u>here</u>.

Electricity EF & development until 2050: Back-end A 22-A 51

District Heating EF: Back-end ratio J 123 to Electricity EF UK is used

The default emission factors evolve dynamically over time, with the district heating emission factor being coupled to the development of the electricity emission factor of the selected country. User-defined emission factors and the development can be entered in the settings sheet.

Electricity Price & development until 2050: Back-end AVH 33 Gas Price & development until 2050: Back-end AVH 96 Oil Price & development until 2050: Back-end AVH 127 Coal Price & development until 2050: Back-end AVH 344 Wood Chip Price & development until 2050: Back-end AVH 187 Pellets Price & development until 2050: Back-end AVH 253 District Heating Price & development until 2050: Back-end AVH 344 Carbon Price (€/Kg) & development until 2050: Back-end AVH 439 Back-end CVQ Carbon Price Development:

HDD/CDD in respective year: Back end 4 (please blend in this sheet ("unhide")

HDD/CDD development until 2050: Back end AXD

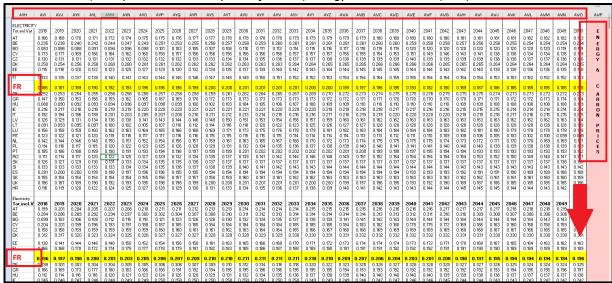




Back-End Sheet (Example Switzerland in place of France) Electricity EF development:

4 A	В	С	D	E	F	G	н	1	J	К	L	М	N	0	Р	Q
Electricity (trade adjusted)																
3	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
AT .				0.252	0.254	0.256	0.257	0.259	0.260	0.259	0.258	0.255	0.252	0.247	0.242	0.236
BE				0.274	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.274	0.274	0.273	0.273
BG				0.599	0.589	0.575	0.558	0.539	0.520	0.503	0.486	0.471	0.458	0.447	0.438	0.431
HR				0.613	0.555	0.509	0.472	0.443	0.421	0.405	0.394	0.387	0.382	0.379	0.378	0.377
B CY				0.531	0.487	0.450	0.419	0.394	0.374	0.358	0.346	0.337	0.331	0.327	0.324	0.323
e CZ				0.644	0.640	0.638	0.637	0.637	0.638	0.638	0.638	0.635	0.629	0.620	0.607	0.590
DK DK				0.245	0.225	0.207	0.191	0.178	0.168	0.161	0.157	0.155	0.155	0.158	0.162	0.167
EE				0.920	0.920	0.920	0.920	0.920	0.920	0.920	0.920	0.916	0.888	0.849	0.804	0.758
				0.164	0.163	0.163	0.164	0.166	0.167	0.168	0.168	0.167	0.164	0.160	0.155	0.149
FR				0.182	0.185	0.187	0.189	0.190	0.191	0.192	0.192	0.191	0.190	0.189	0.187	0.185
105				0.517	0.517	0.522	0.524	0.526	0.525	0.522	0.516	0.508	0.498	0.486	0.473	0.463
5 EL				0.663	0.641	0.619	0.588	0.560	0.532	0.506	0.481	0.447	0.416	0.386	0.359	0.342
HU				0.352	0.344	0.320	0.295	0.259	0.227	0.200	0.184	0.173	0.166	0.160	0.154	0.148
7 IE				0.513	0.491	0.475	0.464	0.459	0.453	0.447	0.442	0.433	0.424	0.416	0.407	0.399
B [IT				0.316	0.318	0.314	0.307	0.294	0.283	0.271	0.263	0.256	0.252	0.248	0.244	0.240
LV				0.850	0.839	0.850	0.901	0.948	0.991	1.034	1.077	1.036	1.096	1.092	1.073	1.046
LT				0.302	0.293	0.290	0.297	0.311	0.330	0.350	0.355	0.305	0.262	0.225	0.193	0.175
LU				0.430	0.415	0.401	0.411	0.423	0.434	0.446	0.454	0.458	0.458	0.458	0.458	0.458
MT				0.618	0.553	0.494	0.485	0.475	0.466	0.457	0.448	0.445	0.442	0.439	0.436	0.433
NL.				0.534	0.499	0.482	0.475	0.472	0.472	0.471	0.465	0.463	0.454	0.441	0.427	0.414
PL				0.914	0.896	0.879	0.870	0.861	0.852	0.843	0.834	0.815	0.797	0.779	0.762	0.745
5 PT				0.274	0.245	0.219	0.196	0.176	0.158	0.142	0.129	0.117	0.106	0.097	0.089	0.082
RO RO				0.437	0.431	0.415	0.395	0.369	0.342	0.315	0.289	0.263	0.243	0.223	0.207	0.192
OV				0.227	0.220	0.240	0.222	0.240	0.240	0.244	0.202	0.207	0.271	0.251	0.225	0.247

Back-End Sheet (Example Switzerland in place of France) Energy & Carbon Prices (AVH):









(3) RESIDENTIAL BUILDING DATA INPUT

The default decarbonisation pathways within the tool include commercial real estate for Europe.

Nevertheless, users can always enter "User-Defined Decarbonisation Pathways", this includes entering country-specific residential pathways. The global pathways, including asset-type specific pathways for multi-family and single-family buildings can be downloaded here.

The CRREM Tool <u>"Settings"</u> sheet enables users to enter individual decarbonisation pathways for each asset. This enables the user to either make own assumptions or benchmark individual assets of the portfolio against the country specific residential pathways for the 1.5°C/2°C targets.

Input Guide - Option 1:

- CRREM "Settings" Sheet: Column KM-LT
- User-defined decarbonisation pathway from 2018-2050 in terms of GHG for residential real estate

Input Guide - Option 2:

The user also has the option to overwrite data in the Back-end sheet and input the residential pathways e.g. instead of the asset-type "e.g. Leisure". This results in a change in the drop-down "Property-type" list in the Input sheet. The user can now select "Residential" instead of "Leisure" in the Input sheet.

- CRREM "Back-end" Sheet: M128-M135. Note: Please do NOT change any input in N128-N135.
- CRREM "Back-end" Sheet: AXG & AYQ The user can now exchange the (e.g. Leisure 'LEI') GHG & kWh pathways for the 1.5 & 2°C residential targets for the respective country selected.
- CRREM "Back-end" Sheet: EF can be changed in E23-E51.







(4) DATA INPUT FROM THE GRESB DATA SHEET

The CRREM asset data input is fully aligned with GRESB. Should you use / already have the GRESB data input sheet available, you may input the GRESB parameters into the CRREM tool using the following GRESB/CRREM mapping:

Asset ID: Input data from the GRESB "Asset Characteristics" sheet (name GRESB Asset ID).

General Information

- Asset name: GRESB Sheet "Asset Characteristics".
- Reporting year: GRESB Sheet "Reporting Characteristics".
- GAV: GRESB Sheet "Asset Characteristics".
- Reporting period: GRESB Sheet "Energy Consumption".
- Entity: GRESB does not report entity name, this can be completed additionally.

Building Characteristics

- Location: GRESB Sheet "Asset Characteristics" (F, H, G, I).
- Property Type: GRESB Sheet "Asset Characteristics" (E).
- Air conditioning: GRESB does not air conditioning, this can be completed additionally.
- Asset size: GRESB Sheet "Asset Characteristics" (L).
- Vacancy: GRESB Sheet "Reporting Characteristics" (F).

Energy Consumption

- Energy consumption Grid: GRESB "Energy Consumption" ((S or AB/AK + AT/BC)-BJ).
- Data Coverage Grid: GRESB "Energy Consumption" (T or AC/AL + AU/BD).
- Max Coverage Grid: GRESB "Energy Consumption" (U or AD/AM + AV/BE).
- Energy consumption Gas: GRESB "Energy Consumption" (M or V/AE + AN/AW).
- Data Coverage Gas: GRESB "Energy Consumption" (N or W/AF + AO/AX).
- Max Coverage Gas: GRESB "Energy Consumption" (O or X/AG + AP/AY).
- Energy consumption District Heating: GRESB "Energy Consumption" (P or Y/AH + AQ/AZ).
- Data Coverage District Heating: GRESB "Energy Consumption" (Q or Z/AI & AR/BA).
- Max Coverage District Heating: GRESB "Energy Consumption" (R or AA/AJ & AS/BB).
- Other energy consumption: Please fill in this section separately, GRESB does not record this data.

Fugitive Emissions

Please fill in this section separately, GRESB does not record this data.

Renewable Energy

- Onsite renewable (generated & consumed on-site for PV & Wind): GRESB "Energy consumption" (BJ).
- Onsite renewable (generated & exported for PV & Wind): GRESB "Energy consumption" (BK).
- Generated off-site & consumed on-site: GRESB "Energy consumption" (BM + BN).
- Heat-pump & solar: GRESB does not differentiate, therefore energy consumption is included in the GRESB sheet "Energy consumption" (BJ + BL and BM & BN).

Retrofit actions

Please fill in this section separately, GRESB does not record this data.

For further information on GRESB & CRREM data output please see the <u>CRREM Tool Risk Assessment Reference</u> Guide.