RIBuild WP5 LCA/LCC software database

Data inputs for the LCA and LCC assessments are organized in four data tables (*.csv*), named *materials*, *insulation systems*, *case studies*, and *energy sources*, which can eventually be manually modified and must be included in the software folder.

The data frames are filed according to the following general instructions:

1. Cells contain texts or numbers, according to the specific instructions here below.
2. Point is used as decimal separator.
3. LCA/LCC input parameters are entered as "deterministic" values or "probability distributions", among the available PDFs typologies included in the software, reported in Table 1. Informations on input PDFs are reported in 4 columns of the data frame for each input:
   - The first column is filled with a text (the distribution name in Table 1) and indicates if the parameter is entered as a single deterministic value ("det") or a distribution (from line 2 to line 7 in the table).

Table 1 Name of PDFs typologies included in the software tool

	Distribution name for the data frame	Distribution typology
1	det	= deterministic value
2	rnorm	= normal distribution
3	runif	= uniform distribution
4	rgamma	= gamma distribution
5	rweibull	= weibull distribution
6	rlnorm	= lognormal distribution
7	rtriangle	= triangle distribution

   - The other three columns are filled with numbers, which represent the single deterministic value or the specific parameters characterizing the PDFs (their description in *italic* in Table 2). For deterministic values or for distributions characterized by only two values, a 0 (zero) is inserted in the empty columns.

Table 2 Input parameters characterizing the PDFs

Distribution name for the data frame	Parameter characterizing the PDF: 1	Parameter characterizing the PDF: 2	Parameter characterizing the PDF: 3
det	*value*	*0*	*0*
rnorm	*mean*	*sd*	*0*
runif	*min*	*max*	*0*
rgamma	*shape*	*scale*	*0*
rweibull	*shape*	*scale*	*0*
rlnorm	*meanlog*	*sdlog*	*0*
rtriangle	*min*	*max*	*mode*

The following sections provide further details on input data included in each data frame.

materials.csv

This file contains the list of all possible materials composing the systems included in the case studies to be assessed. Each line identifies a material, and the following informations are provided:

- **ID** = identifier. It is s three-digit number. It can be conventionally set to be a number starting from 101 for a Country (101, 102, 103…….), from 201 for another one (201, 202, 203, …), etc…
- **Name** = univocal name of the material.
- **Country** = Country name, e.g. Italy, Belgium, Denmark, Germany, Latvia, Sweden, Switzerland, etc…
- **de** = material's density [kg/m^3]. This is a single deterministic value**.**
- **sl** = material's service life [years]. It can be entered as a deterministic value or a PDF, so it is represented by four columns, as explained: sl_DISTR (distribution name), **sl_1**, **sl_2**, **sl_3** (deterministic value or distribution parameters expressed by numbers according to the description in Table 2).
- **UI** = Unitary production impact of the material. Three different types of impact can be entered, identified by a number which ranges from 1 to 3 (**UI_1**, **UI_2**, **UI_3**). UI data can be entered as deterministic values or PDFs, so they are represented by four columns, as explained.
- **EOL** = Unitary end of life impact of the specific material. As for the UI, three different types of impact can be assessed, consistently with those of UI (and in the same order). EOL data are also represented by four columns, as explained. If EOL data are not available (or the user does not want to assess this LCA phase), 0 (zero) can be used for the parameters' values, but a text is always indicated in the distribution type **EOL_DISTR** (e.g. rnorm).

insulation_systems.csv

This file contains the informations on the insulation systems included in the case studies. For each line, identifying an insulation system, the following data are included:

- **ID** = insulation systems identifier. It is a number starting from 1 (1,2,3,4…).
- **Name** = univocal name of the insulation system. It is provided in the form: Comp_1, Comp_2, Comp_3 etc., according on the number of systems to assess in the case studies.
- **Country** = Country name, e.g. Italy, Belgium, Denmark, Germany, Latvia, Sweden, Switzerland, etc…
- **CI** = insulation system investment cost. It is entered as a deterministic value or a PDF, so it is represented by four columns, as explained: CI_DISTR (distribution name), CI_1, CI_2, CI_3 (deterministic value or distribution parameters expressed by numbers according to the description in Table 2). This part is mandatory for the LCC assessment, for the only LCA assessment, the user can write 0 (zero) in the parameters' values, but always a text in the distribution type (e.g. rnorm).
- **CM =** insulation system maintenance cost. It is represented by four columns, as explained. This part is mandatory for the LCC assessment, for the only LCA assessment, the user can write 0 (zero) in the parameters' values, but always a text in the distribution type (e.g. rnorm).
- **SL** = the service life of the whole insulation system. It is represented by four columns, as explained.
- **n_mater** = number of materials (layers) composing the system.
- **materials** = list of the materials identifiers included in the data frame *materials.csv*, composing the system. Identifiers must be entered separated by a single space, e.g.:101 102 103 etc. This part is mandatory for the LCA assessment, in case of only LCC assessment, the user should write a material identifier number, even if this will not be considered for the assessment.
- **m_mater** = mass [kg] of the materials composing the insulation system. The mass can be entered as a deterministic value or a PDF. In the column **m_mater_DISTR** enter the PDF typology for each material listed in the column **materials**, separated by a single space, e.g.: rtriangle rnorm rtriangle det etc… Even if the distribution type is the same for all the listed materials, enter the text several times according to the material numbers, e.g.: rtriangle rtriangle rtriangle rtriangle rtriangle rtriangle, for six materials composing the insulation system. In the columns **m_mater_1**, **m_mater_2**, **m_mater_3**, enter the deterministic values or PDFs parameters values, according to the instructions included in Table 2, as numbers separated by a single space. This part is

mandatory for the LCA assessment, in case of only LCC assessment, the user can also write 0 (zero).

- **M_selection** = identifies the material of the insulation system which needs periodic maintenance (for instance the periodic replacement of the internal painting). If data are not available, or the user does not want to include this LCA phase in the assessment, write 0 (zero). This part is mandatory for the LCA assessment, in case of only LCC assessment, the user can also write 0 (zero).
- **DU** = Thermal resistance of the insulation system (m^2K/W), surfaces resistances excluded. It is considered as a single deterministic value. This information is necessary only if the pre-processing module for the calculation of the heat loss of the insulation systems based on the annual HDD method is used.

case_studies.csv

This file defines the case studies to assess. For each line, identifying a case study, the the following data are included:

- **ID** = case study identifier. It is a number starting from 1 (1,2,3,4…).
- **Name** = the name of the case study. It is provided in the form: C_S_Test1, C_S_Test2, C_S_Test3, etc…, depending on the number of case studies considered.
- **Country** = Country name, e.g. Italy, Belgium, Denmark, Germany, Latvia, Sweden, Switzerland, etc…
- **Qhpost** = Heat transmission loss through the wall after renovation (kWh/year). It can be a deterministic value or a PDF, so it is represented by four columns, as explained.
- **Qhpre** = Heat transmission loss through the wall before renovation (kWh/year). It can be a deterministic value or a PDF, so it is represented by four columns, as explained.
- **CN** = number of systems included in the case study[1].
- **C1** = system identifiers (1,2,3 etc..) in the dataframe "insulation_systems", that represents the system that is assessed in the specific case study.
- **sur** = the surface (m^2) of the insulated façade area[2].

Note that data on Qh_{post} and Qh_{pre} must be filled if the user wants to use an external software for their assessment. If the user wants to use the calculation method included into the tool, he can write 0 (zero) in the columns related to PDFs parameters' values, but always a text in the column related to distribution type (e.g. rnorm).

energy_sources.csv

This file contains the informations on the energy scenarios for the LCA assessment. For each line, identifying an energy scenario, the following data are included:

- **ID** = energy source identifier. It is a number starting from 1 (1,2,3,4…).
- **Name** = univocal name of the energy scenario. It is provided in the form: Tar_1, Tar_2, Tar_3 etc, according on the number of scenarios considered.
- **Country** = Country name, e.g.: Italy, Belgium, Denmark, Germany, Latvia, Sweden, Switzerland, etc…
- **En_S** = Energy source name, e.g.: natural gas, oil, electricity, etc…

[1] Within RIBuild project, which only addresses the internal insulation, this parameter must be set = 1. If the software is used to assess several renovation measures applied to a case-study (e.g. internal insulation, heating equipment, etc…), this number will correspond to the number of renovation measures included in the case-study assessment.

[2] Within RIBuild project this parameter must be set = 1, as the functional unit selected for WP5 LCA and LCC methodology refers to 1 m^2. If the functional unit is different, e.g. at building level, when several renovation measures are addressed for the same case study, this number must be understood as a multiplicative factor of the unitary impacts and costs of the systems.

- **EnT** = Energy tariff for the source concerned. As for other input parameters, it is represented by four columns, as explained. For the only LCA assessment, the user can write 0 (zero) in the parameters' values, but always a text in the distribution type (e.g. rnorm).
- **EnFc** = the conversion factor from delivered to primary energy, which depends on the energy source typology, established at national level for some European Country. As for other input parameters, it is represented by four columns, as explained. If not used, the user can write 0 (zero) in the parameters' values, but always a text in the distribution type (e.g. rnorm)
- **ETAh** = the overall system efficiency for heating. As for other input parameters, it is represented by four columns, as explained.
- **EI** = Unitary impact of the energy vector. As for the UI, three different types of impact can be assessed, consistently with those of UI (and in the same order), and each UI is represented by four columns.