Quick-start guidelines on
Climate and Energy Assessment of Museums (CEAM) software

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CEAM OVERVIEW

The **C**limate and **E**nergy **A**ssessment for **M**useums (**CEAM**) was developed to allow its users a valuable and constructive energy- and climate-related overview of the examined heritage buildings. CEAM aims to help Federal Institutions preserve heritage. The developed decision-making support software provides information to building/collection owners on how to adapt sustainable solutions to their buildings, utilizing indoor climate management. CEAM is an open-source, data-driven tool scripted using Python and consists of a modular structure. This user-friendly tool allows for a comprehensive multicriteria analysis considering heritage preservation, indoor climate management, and energy efficiency improvement. The tool uses raw input data (records of the measured energy consumption and indoor/outdoor climate conditions) to provide useful outputs. The obtained outputs allow for a better understanding of the current building management and provide a helpful guide on how to, and to what extent, improve the energy efficiency of the examined case. The tool employs AI-based optimization methods to evaluate potential energy savings through short-term management strategies, with predicted savings ranging from 10-50% depending on the scenario and selected interventions.

This document provides compact information on the quick start for the CEAM software. All the details on required inputs, definition process, capabilities, applications, and limitations of the tool, as well as how to review the received results, can be found in the CEAM manuals available here. The software is available here as a stand-alone Windows app, as well as raw scripts, in the GitHub repository.

CEAM was developed by Marcin Zygmunt as a part of the Climate2Preserv (C2P) project, founded by the Belgian Science Policy Office. The C2P project is the combined effort of project partners: KU Leuven, KIK-IRPA, and ULiège.

Please address all the comments related to the CEAM software via the contact email: **climate2preserv@gmail.com**.

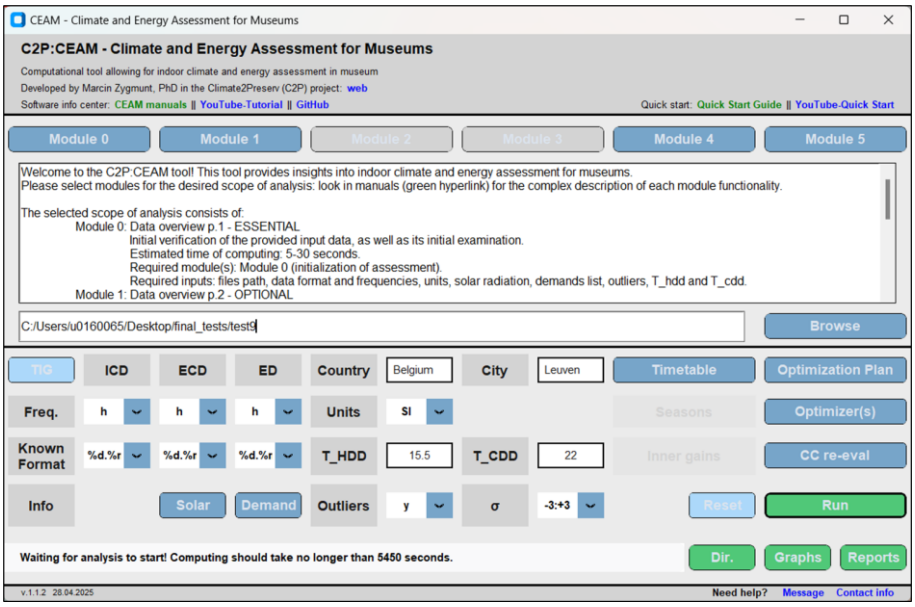
GETTING STARTED WITH CEAM

CEAM software can be downloaded from here as a ready-to-use executable file (no need to install any additional software if the updated version of Windows is used). It is also suggested to run the software via the '*run as administrator*' option. The GitHub repository is given for users who prefer to run the tool from a Python environment (additional libraries and packages are obligatory for a successful operation). The tutorials on how to use the CEAM software are given on the YouTube channel.

The tool has no specific requirements: once downloaded, only the input files are required. Three main input files in the csv format are necessary, particularly the *Exterior Climate Data* (ECD.csv), *Indoor Climate Data* (ICD.csv), and *Energy Data* (ED.csv). A certain input data structure is required: some exemplary input files are available here, with a full introduction in the manuals. Input files with hourly frequencies of records are recommended, yet CEAM also supports daily and monthly granularities. The goal is the use your own data input, and thus a precise definition process is recommended.

RUNNING CEAM

CEAM provides a user-friendly GUI for easy definition and computation. The exemplary filled-in GUI is shown below.



CEAM GUI with exemplary inputs.

The scope of computing is adjustable by the user: the required modules should be selected at the top of the window. When the module is selected, the corresponding description is also shown, with the required inputs to be provided.

The so-called working path should be selected, pointing to the folder containing three input files. Next, all the required information should be provided in the given textboxes, selected from lists, and defined in the additional windows. When all the necessary information is provided, the simulation can be performed by pressing the Run button.

The computing time is dependent on the selected scope of the assessment: a complete simulation can take as long as three hours. The predicted time computing is given before running the simulation, as well as a supporting pop-up window is visualized when calculations are in progress. Users are informed when computing is finished.

All the outputs are stored in the directory path selected before; the original input files are safely copied. The outputs consist of various valuable outputs, including input data overview, the climate and energy consumption evaluations, as well as energy optimization. A proper, predefined file management is provided. Some exemplary results from a successful analysis are available here.

A correct understanding of the obtained results is key to a successful assessment of the examined case study. Some active links to the helpful repositories (e.g., manuals or contact info) are given with hyperlinks in the upper and lower parts of the GUI. Users are also welcome to share their feedback.