EERAdata

DATA-DRIVEN DECISION-SUPPORT TO INCREASE ENERGY EFFICIENCY THROUGH RENOVATION IN EUROPEAN BUILDING STOCK

D3.1 – Elements of building performance and impact assessment methodologies which are suitable to be integrated in the EERAdata methodology

[WP3 – Development of the EERAdata methodology]

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About the project

The EERAdata project will develop and test a decision-support tool to help local administrations in the collection and processing of their building and demographic data towards an assessment and prioritisation of Energy Efficiency measures in planning, renovating and constructing buildings.

While EU policy assigns a primary role to Energy Efficiency (EE), the lack of a holistic understanding of the impact of EE investments has hindered its integration in the policy-making process. Coordination between demand and supply side of energy policy is not targeted, and there is need to gather the evidence on the benefits of EE in ecological and socio-economic terms as well as on its interactions with the broader policy context and energy market.

Project's goals

The project aims to develop:

- Guidelines and roadmaps for the advancement of the clean energy transition
- Joint thematic studies and analyses reports on territorial needs and decarbonisation pathways
- A fully developed and tested decision-support tool to help local administrations in the collection and processing of their building and demographic data towards an assessment and prioritization of EE measures in planning, renovating and constructing buildings

Introduction

The objective of WP 3 is to develop the impact assessment methodology that will be operationalized by the EERAdata decision-support tool. To meet the objective, task 3.1 Detailed analysis of methodologies initially was carried out to review, analyse and implement methodologies for building performance simulation and impact of energy efficiency and supply side investment. The review will be used as input to the later implementation of the EERAdata methodology.

This report reviews methods that are considered suitable to be included in the EERAdata methodology.

Based on the review, a list of selected methodologies was elaborated. To provide an easy and structured overview, the list was compiled into an Excel spreadsheet, which is available on the project's Sharepoint server. The list provides an initial status of potential relevant methodologies and as such is not exhaustive. Additional methodologies will be included in upcoming deliverables.

Method

An initial screening of methodologies applied in related, earlier research projects was carried out. A list of these was included in the project proposal. Additional input was obtained from other projects that were identified during the review. The purpose of the screening was to describe and adopt useful elements from existing knowledge and to avoid re-inventing existing methodologies, procedures and algorithms

Outcome

The screened projects and other methodology are described in an excel sheet: "Task 3.1 Overview of existing tools.xlsx" which can be found at EERAdata Sharepoint.

The following describes the main findings from the listed projects.

ABRACADABRA

The project suggests renovation strategies based on AdoRES (Add-ons and Renewable Energy Sources) intended as one or several assistant units that adapt an existing building to achieve a nearly zero energy target. The AdoRES suggests renovation measures to building sections towards the ground, top, side and façade. The suggested procedure aims to explain and attract interest of deep renovation to financial stakeholders and decision makers to overcome obstacles to deep renovation and define a European common solution to overcome them.

Technical, financial and regulatory toolkits were developed to serve as guidelines for stakeholders in the renovation process. The toolkits are implemented in a web based application to guide users in simulating results of the ABRA strategy applied on their own apartments or buildings. The technical toolkit consists of two parts: A simplified energy model (SEM) for the calculation of the energy performance of the building at

the initial state and after application of the renovation solutions; A technical toolkit catalogue that includes packages and solutions for energy retrofit and add-on options.

In particular, the SEM seems relevant for EERAdata. The model focuses on energy use for space heating, cooling, domestic hot water, lighting and electric appliances of residential buildings, both at the design stage and for existing buildings. The SEM is implemented in an Excel spreadsheet format. The calculation procedure is defined in accordance with the relevant CEN standards and takes into account standard values for the utilization as well as national or regional climatic data. The energy needs for space heating and cooling are calculated on monthly bases according to EN ISO 13790 and ISO EN 52016-1 on the basis of a one-zone model.

Additionally, a checklist was developed to enable users to self-assess the feasibility of a renovation project. The checklist covers topics such as building codes and regulations, urban conditions, infrastructures and site characteristics, environmental and societal conditions, and financial, tax and fiscal incentive schemes. A checklist of this nature could be relevant also for the EERAdata project.

ALDREN

The ALDREN project (Alliance for deep renovation in buildings) focuses on the development and implementation of a common European voluntary certification scheme for non-residential buildings based on the EPBD Art. 11 (9) and CEN and ISO standards to track deep renovation processes. The main goal of ALDREN is to motivate the construction sector to undertake deep renovation projects on their properties. The ALDREN project has suggested an index to evaluate at the same time all the domains of the indoor environment.

The ALDREN project interfaces EERAdata and some of the applied methodologies may be relevant also for EERAdata, although other of the listed projects seem more central.

BAMB

The mission of BAMB (Buildings As Material Banks) was to enable a systemic shift in the building sector by creating circular solutions. The project developed tools that can enable a systemic shift where dynamically and flexibly designed buildings can be incorporated into a circular economy. In particular, the Materials Passports and the Reversible Building Design Tool seem relevant for potential LCA calculations in the Eeradata project. The Materials Passports are sets of data describing characteristics of materials in products that give them value for recovery and reuse. The Reversible Building Design Tool is a design protocol that informs designers and decision makers about the transformation capacity and reuse potential of the design. The tool is used to assess the impacts on the reuse potential of design solutions during the conceptual design phase.

CEN 16798 Performance of buildings

The CEN 16798 series of standards aims at international harmonization of the methodology for the assessment of the energy performance of buildings called the "set of EPBD standards". The series of standards describe criteria to the indoor

environment and methodologies used to evaluate building energy use and design of cooling, heating and ventilation systems. May be used to specify desired indoor environment conditions aimed at after energy refurbishment of the EERAdata buildings.

COMBI

The COMBI project (Calculating and Operationalising the Multiple Benefits of Energy Efficiency) aimed at quantifying different multiple impacts of energy efficiency improvement actions. The project developed a methodology with data on different benefits such as effects on emissions with derived effects on health, ecosystems, crops and the built environment; resources related to biotic/abiotic and energy/non-energy effects; social welfare related to effects on disposable income and health; macro-economy with effects on labor market, public finance and GDP; the energy system, which affects grid, supply-side factors and energy security. All project outcomes are available online and can be analyzed via a graphic online-visualisation tool.

The project was built around a series of literature reviews addressing multiple impact quantification, avoided air pollution impacts of energy efficiency measures, resource benefits, social welfare impacts of energy efficiency improvement actions, macroeconomic effects of energy efficiency improvement actions, and energy efficiency and energy security. More than 35 individual impacts were quantified, following individual cause-effect chains from energy efficiency improvement actions to the impacts.

The method established in the COMBI project and the project outcome is highly relevant for EERAdata. The details regarding the methodological framework including technical details and cost benefit calculations are carefully described and can be adapted to EERAdata.

ENTRANZE

ENTRANZE (Policies to enforce the transition to nearly zero energy buildings in the EU-27) aimed to support policy making by providing the required data, analysis and guidelines to achieve a fast penetration of nZEB within the existing national building stocks. The core part of the project was the dialogue with policy makers and experts. The project recommendations are well aligned with EERAdata by suggesting that instruments are needed to properly address the heterogeneous target groups and technology-specific barriers of the transition to nearly zero energy buildings. Also, one conclusion of the project was that there is lack of data regarding renovation activities and the energy performance of buildings. Except for the lack of focus on multiple benefits, the project that was completed in 2014 supports well the demand of the projected EERAdata outcome.

eeEmbedded

The eeEmbedded project focused on developing optimized design methodologies for energy-efficient buildings integrated in neighbourhood energy systems. A new ICT (Information and Communications Technology) based methodology was developed to design energy efficient buildings integrated in their neighbourhood. The

methodology uses a multi-model approach for analyzing building architecture and services and seeks via simulations to optimize energy, costs and environmental impact during the building lifetime. The methodology focuses on design and evaluation of building shape and energy supply concepts taking in consideration the integration into the neighbourhood and the use of renewable or conventional resources on site and on district level. It comprises project setup, design cubature, CFD wind simulation, energy concept, lifecycle costing, energy simulations and overall decision making. Although focus is on design, several of the methodology steps may be relevant for the EERAdata methodology.

EmBuild

EmBuild was carried out to support public authorities in SouthEast European countries to prepare a long-term strategy for mobilising investment in energy renovation of the building stock. The project objectives correspond well to those of EERAdata as they aim to increase the capacity of public authorities at regional or municipal level to collect the necessary data to prepare sustainable and realistic renovation strategies for public buildings, analyse and identify cost effective approaches to renovations, guide investment decisions and facilitate private sector involvement. EmBuild prepared a structured questionnaire to conduct a preliminary analysis of the existing building stock. The questionnaire includes existing tools and standards and assesses all energy types referred to by the EPBD (heating, ventilation, cooling, lighting, etc.). EmBuild also analysed existing methods to include wider benefits in the assessment of energy renovation.

EU Building Stock Observatory

The EU Building Stock Observatory offers comprehensive knowledge on Europe's building stock. The observatory contains a database, a data mapper and factsheets for monitoring and statistics on the energy performance of buildings across Europe. It also assesses improvements in the energy efficiency of buildings and the impact this has on the actual energy consumption of the buildings sector. The database of building stock characteristics is highly relevant and useful for EERAdata.

Healthvent

The Healthvent project developed a framework for reducing the burden of disease from residential indoor air exposures in Europe. In particular, the efficiency of control policies to health effects caused by residential indoor exposures was estimated. The modelling showed that a combination of controlling the indoor air pollution sources and selecting an appropriate ventilation rate was the most effective to reduce health risks. The project is highly relevant to EERAdata as it includes a very transparent and detailed description of the methods that were used to evaluate consequences for people of being exposed to the indoor environment in buildings.

Heron

The Heron project was targeted barriers caused by end-user behavior towards EU energy efficiency goals in the building and transport sectors. The project developed a decision support tool to transform qualitative information about barriers into numerical inputs for the development of energy efficiency scenarios. The aim of the Heron project differs somewhat from EERAdata, although the overall methodology and the developed decision support tool are compatible. In particular, the mapping of

barriers, which hamper the implementation of energy efficiency policies at regional and local levels seem relevant.

IEE Project TABULA

One of the outcomes of the TABULA (Typology Approach for BUiLding stock energy Assessment) project is a definition of typical building typologies in 13 European countries. For each country and region, buildings are grouped in three main categories: Single-family houses, row houses and multi-family buildings and nine generations representing periods with uniform construction technique and insulation levels. The tool enables cross-country comparisons of typical building typologies and energy related features. It is also possible to calculate potential energy savings by implementation of certain refurbishment measures. In an Eeradata perspective, the tool can be used to gain information about construction materials and energy systems in the building stock, for potential LCA calculations.

INSPIRE Geoportal

The INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which may have an impact on the environment. As part of the directive, the INSPIRE Geoportal offers access to country specific datasets for environmental reporting within the domains air and noise, industry, waste, nature and biodiversity, water, and marine. For some domains, the data available in the Geoportal may be relevant for the EERAdata methodology.

M-Benefits

The M-Benefits project (Valuing and Communicating Multiple Benefits of Energy-Efficiency Measures) runs until 2021 and will during this period develop a training platform and create tools to analyse and propose energy-saving projects. The project is targeted companies that do not consider energy use as contributing to their competitive advantage. Investments in energy efficiency may therefore be neglected compared to other investments. The multiple-benefits in the M-Benefits project target mostly issues related with industrial production and investment decision in companies and as such may be somewhat peripheral to EERAdata.

Multi-criteria decision-making

Multi-criteria decision-making (MCDM) is a suite of methods used to make decisions in cases with more than one criterion. Some of the most well- known methods comprise the AHP, SAW and TOPSIS. Among these, TOPSIS is widely used to rank scenarios according to their relative closeness towards an idea solution, based on a set of criteria each with its own weight of importance. The ideal solution is a theoretical solution scoring highest on all criteria. In EERAdata, MCDM may be used to evaluate and select the best among several renovation approaches.

NewTREND

The NewTREND project created a platform for evaluation of potential energy refurbishment. The platform can be used to guide decision makers in the selection of the best energy retrofitting strategy for the building in the context of the district.

The platform comprises four tools.

- In the collaborative design platform, users can simulate buildings and districts in their current state or create new scenarios. Projects are created through cityGML in combination with BIM models. Key performance indicators in the current state and different scenarios can be visualized in the 3D model of the building and district.
- The Data Manager is an application to assist the data collection process of a retrofit design project. It can be accessed on a web browser on a laptop or on mobile devices. Data from the collaborative design platform and the data manager is sent to the District Information Model Server, which stores information from the projects.
- The Simulation and Design Hub performs calculations and simulations necessary to assess the impact of different design options in terms of economy and predicted energy use and comfort. The results are displayed using the 3D models in the collaborative design platform.

In an EERAdata context, the platform could serve as an inspiration for the architecture of the Data collection, data processing and data storage modules as well as communication protocols between them.

OneClickLCA

One Click LCA is a Life Cycle Assessment tool that integrates with many design tools. The tool links with several building energy performance simulation tools and creates reports on life cycle impact. It supports calculations of all life cycle stages from Cradle to Grave as defined in EN 15978, including construction products and process, building use, maintenance, energy and water consumption, end-of-life impacts and external impacts. It is capable of performing calculations including life cycle assessment, life cycle costing, embodied carbon calculation and circularity assessment.
The tool seems highly relevant for the EERAdata project and could potentially be linked with the EERAdata tool as an LCA engine.

Smart Readiness Indicator for Buildings

The Smart Readiness Indicator (SRI) for buildings addresses the EPBD by promoting smart readiness technologies. The indicator rates the capability of buildings or building units to adapt their operation to the needs of the occupant, optimize energy efficiency and overall performance, and to enhance energy flexibility. The smart readiness indicator should raise awareness amongst building owners and occupants of the value behind building automation and electronic monitoring of technical building systems and should give confidence to occupants about the actual savings of those new enhanced functionalities. The SRI assessment procedure is based on an inventory of the smart ready services which are present in a building and an evaluation of the functionalities they can offer. The assessment indicates the functionality levels for the relevant smart ready services using a check-list approach. Such an approach could be adopted in EERAdata to evaluate the services present in a building (e.g. heating, lighting, electric vehicle charging, etc.) and it can also provide input to assessment of various impacts (energy savings, comfort improvements, flexibility towards the energy grid, etc.).

The SRI deals with a multitude of domains and impact categories and therefore a multi-criteria assessment method is proposed as the underlying methodology for

calculating the smart readiness indicator. In this multi-criteria assessment, weightings can be attributed to domains and impact criteria to reflect their relative contributions to an aggregated overall impact score. The use of multi-criteria assessment methods is equally relevant for EERAdata.

SimStadt

SimStadt is a German simulation software environment capable of managing and processing data on an urban scale. It can be used for planning of future scenarios to analyse energy demand of single buildings, city quarters, entire cities and regions. The applications span the range from simulation of heating demand and photovoltaic potential analysis to simulations for building refurbishment and renewable energy provisioning strategies. The model uses multiple linear regression to downscale aggregated energy consumption for heating to single dwellings based on a series of buildings and households descriptors. In another step, 3D models are used in combination with building construction libraries linked to typical building typologies (e.g. from the TABULA project) to define an urban thermal model. This model can be used to calibrate the regression models to achieve a model of household energy use validated on neighbourhood scale. The tool seems relevant for the Eeradata project and could be used to assess the consequences of renovations on energy use in different scales.

Annex

Task 3.1 Overview of existing tools.xlsx