EPC RECAST: paving the way for the next generation of EPCs

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The EPC RECAST project developed an innovative protocol to facilitate the work of EPC assessors in their daily activities and improve renovation recommendations for building owners. It provides an integrated workflow, from the on-site visit to the delivery of the certificate. Extensive testing with professional EPC assessors in six countries allowed to prepare technical and policy recommendations for an EU-wide EPC framework in line with the EPBD IV directive [1].

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Towards a new generation of Energy Performance Assessment and Certification:

Many EPC assessors, energy consultants and stakeholders agree on the need to reduce the time needed for a comprehensive data collection on the building geometry and technical characteristics (envelope, energy systems). Most professionals do not use advanced digital tools They often rely on default thermal parameters from reference tables to evaluate thermal characteristics of walls, windows, roofs (eg: France, Italy, Spain). Values are often obtained from proxies like the estimated year of construction or basic assumptions about wall compositions.

Most EPC simulation software rely also on static modelling methods of the energy balance and performance of energy systems. Dynamic energy simulation models better represent several key thermal and energy phenomena: daily and seasonal variations of HVAC system efficiency, electricity production from PV panels, thermal inertia of the building.

EPC simulation results rarely correspond to real energy consumptions. Asset ratings are not aimed at representing the reality, rather the intrinsic quality of the building envelope and energy systems. However, the parameters of the model are never verified with simulations under real conditions (weather data from nearby weather stations, realistic heating system use, etc), which would enable to compare the model with measured real consumptions.

EPCs must also contain renovation recommendations for owners. Most of the time, recommendations are basic and unreliable due to the low cost of EPCs and lack of time to define tailored renovation scenarios.

To tackle these challenges, EPC RECAST created a well-structured process and toolbox supporting a new generation of Energy Performance Assessment and Certification, with a focus on residential buildings.

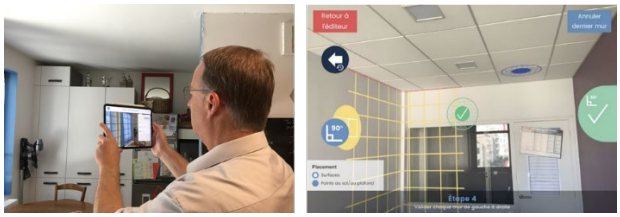
The EPC RECAST protocol

- Step 1: On-Site Visit and Diagnosis for data collection
- Step 2: Energy model calibration and energy simulations
- Step 3: Renovation roadmap and new generation certificate.

The digital implementation is based on a common data ecosystem relying on a software-neutral data model of the building (XML format) and a digital platform, which interconnect several applications. A detailed review of all technology components is provided in [2].

Step 1 – On-Site Visit and Diagnosis for data collection

The EPC assessor uses on-site the BIMEO augmented reality application on a tablet [3] to assess the precise dimensions of the dwelling, measuring the surface area of the walls, floors, ceilings and windows to create a 3D model and floor plans of each level. The model can be enriched with geolocated photos, notes, and by answering questionnaires to characterize the thermal performance of the building's components.



BIMEO app for the on-site visit.

Step 2 – Energy model calibration and Simulations

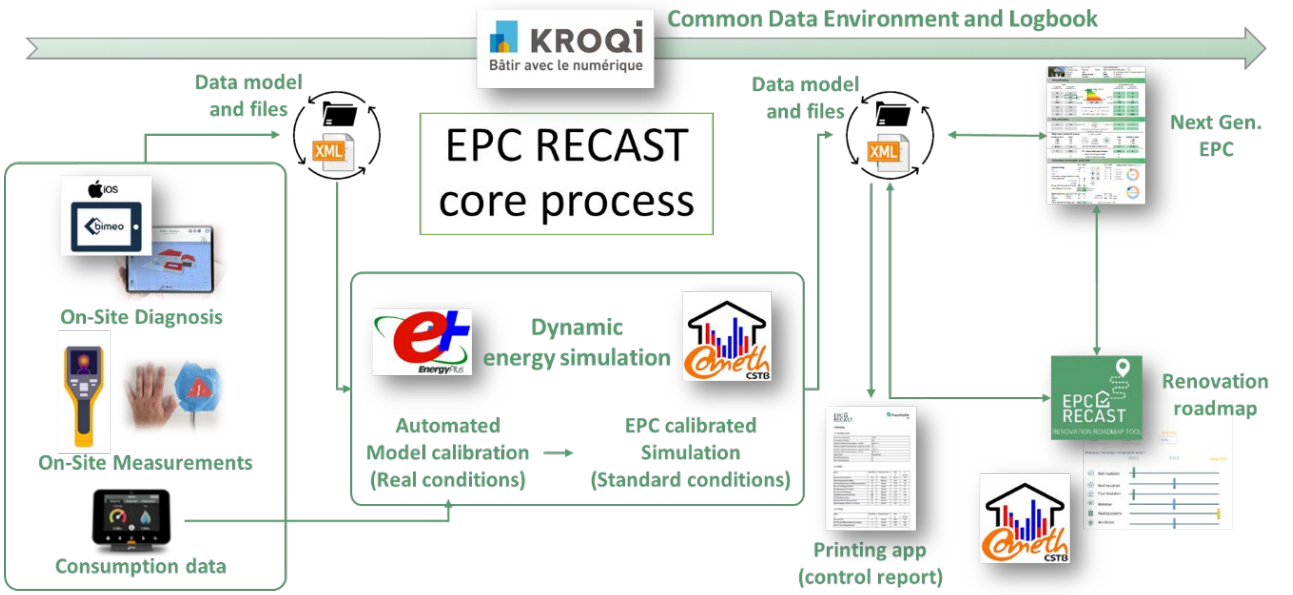
Information from Step 1 is used to generate automatically the building data model in XML format. This standardized file is stored in a secure digital logbook based on the KROQI technology. Both the owner and assessor can update it at any time by uploading files such as photos, invoices, estimates of past renovation works.

To evaluate the asset rating (A to G), the assessor runs a dynamic energy simulation from a simplified web form [4] that connects, through data conversion algorithms, the data model to an advanced simulation engines (COMETH or Energy Plus) compatible with ISO/CEN Standards (M/480 Mandate) [5].

When specific energy consumption and temperature measurements are available, the simulations can be refined with a calibration module. Some physical input parameters are then automatically readjusted (U-values, ventilation flow rates or infiltration rates, etc) [6]. The assessor can also generate a pdf report containing the key input and output data of the simulation. This allows additional checks of the EP assessment in an easy-to-read format.

Step 3 – Certificate and Renovation Recommendations

The assessor can finally use a Renovation Roadmap web service to define renovation scenarios in one or more steps with just a few clicks, relying on the same data model as the EPC [4][7][8].



The EPC RECAST core process.

The assessor fills in a EPC new template that was developed following the requirements of EPBD IV [7]. It contains numerous indicators about the building's performance before and after renovation like simulated and actual energy consumptions, energy costs, summer thermal comfort and CO_2 emissions. Renovation recommendations are a summary of the Renovation roadmap, ensuring consistency between both tools.

Testing on pilot cases and preliminary results

The process was tested on 80 pilot dwellings in six pilot countries (France, Germany, Italy, Luxembourg, Slovakia, Spain), in collaboration with professional EPC assessors. Half of the pilots were subjected to Long-Term Monitoring of the energy consumption, indoor and outdoor conditions. Standard EPCs and EPC RECAST EPCs were issued for each dwelling and compared in terms of working process, input datasets and simulation results. Additional technology components were tested some pilots, including:

- evaluation of the walls' U-values with heat-flux meters
- operational rating procedure (EN 15378-3:2017 standard) [5].

More information is available in deliverables [10] and [2][6].

The studies demonstrated the integrated process was feasible and could lead to reliable simulation results. This proves innovative digital services can be used to evaluate the energy performance if built around software-neutral data models as the foundation of data ecosystems. The ecosystem allows automatic connections and conversions between different datasets, file formats, simulation engines, digital tools, avoiding data duplication and inconsistencies.

However, such developments will take time with key elements needed:

- Strong and continuous support from public authorities, regulations and policy provisions
- Collaborative standardization processes at national and European levels, leveraging or improving existing sets of ISO and CEN standards
- Effective IT development and marketing strategies from R&D to market

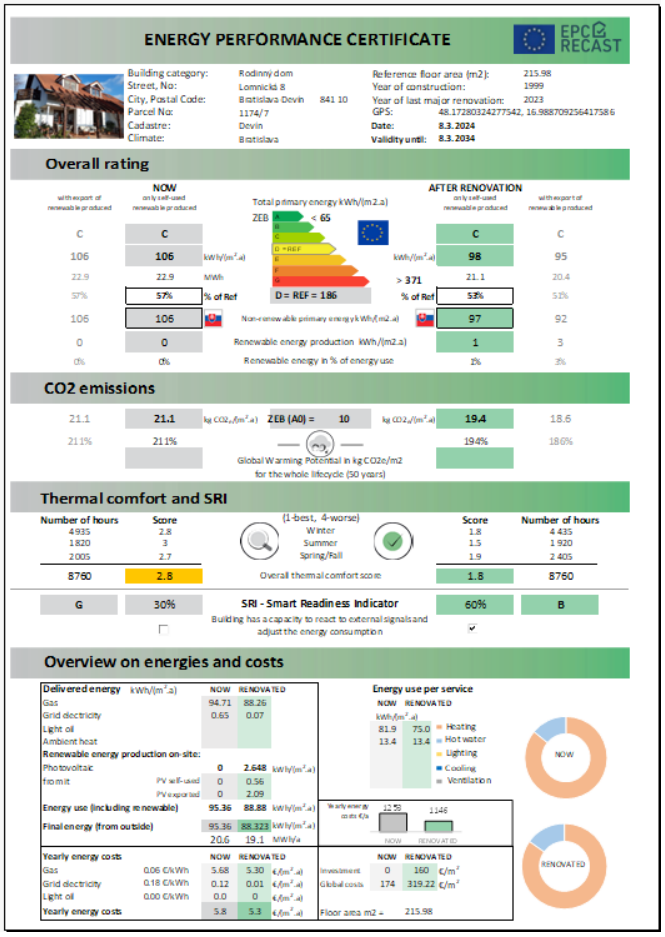


Figure 4. New EPC template compliant with EPBD IV.

Figure 3. Dynamic energy simulation process.

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Project website: https://epc-recast.eu/

References

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[7] EPC RECAST – EPC RECAST Certificate and Renovation Roadmap.

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[9] EN 15378-3:2017 – Energy performance of buildings - Heating and DHW systems in buildings - Part 3: Measured energy performance, Module M3-10, M8-10.

[10] EPC RECAST – Lessons learned from the demonstration.

[11] EPC RECAST – Policy recommendation paper for an EU wide deployment of EPC RECAST. ■

EPC RECAST's final policy recommendations

The project's final outcome and perspectives [2] was compared with the EPBD IV to prepare final policy recommendations [11]. The main recommendations are summarized here.

R1 - Developing common data ecosystems and standardized building data models
EPC RECAST recommends establishing standardized and simulation software-neutral digital models of buildings at national and European level to facilitate the development of data ecosystems. This would foster interoperability between digital tools through a common digital description of building elements, technical systems and KPIs.

R2 - Ensuring compatibility between data ecosystems and national implementations of the EPBD
Data ecosystems for EP assessment can be designed as collaborative digital environments involving several software companies and application providers. Alternatively, they can be designed as integrated software maintained by the same organization. Common data ecosystems must be compatible and interoperable with national implementations of the EPBD and EP assessments calculated in this way.

R3 - Supporting the development and use of digital tools for on-site visits and data collection
Mature innovative digital technologies for on-site visits and automated connections to product database could reduce the EPC assessment process by 20-30%. Full interoperability with simulation tools could further reduce working times by up to 50% if the collected data automatically fills in the input dataset of the simulation model.

R4 - Collecting high-quality metered consumption and climate data for quality checks
Operational rating procedures based on EN 15378-3:2017 could be used to compare simulated heating and DHW consumptions with metered consumptions normalized against weather data and operating conditions. This would allow to detect major inconsistencies in EPC simulations or help confirm the energy model is valid. High-quality metered data is needed at a monthly time step.

R5 - Encouraging the use of calibration procedures for quality checks
As a longer-term perspective, independent EPC verifiers and EPC assessors could use calibration algorithms to run automated quality checks of the input data and heating/cooling simulation results, to detect potential inconsistencies. Anonymized and automated collection of metered energy uses from smart meters will be necessary.

R6 - Positioning the target cost of EPCs and BRPs compared to energy audits
The target cost of EPCs and Building Renovation Passports is a key question for public authorities: how much should an owner pay? This will strongly influence evolutions of working practices and design of software interfaces. Comprehensive on-site visits, careful adjustments of simulations and renovation roadmaps can be time-consuming: should EPCs and BRPs become closer to energy audits?

R7 - Getting the most in the EPC for its price
Building owners should get as much information as possible from the EPC for the price they pay. The EPC's content could be enriched with information collected digitally during the on-site visit and from remote metering: blueprints, photos, observations (eg: potential sources of good/bad IEQ, mould, wall cracks), operational rating, etc.

R8 - Specifying minimum requirements of software interfaces for BRPs
More discussions are needed at European and national scale on the levels of standardization and simplification of building renovation passport interfaces. Should the definition of renovation actions for energy simulations be highly flexible and the input data highly tweakable or should the user rely on default values and limited sets of options?

R9 - Leveraging synergies between Articles 9 and 12 of the EPBD IV
Renovation Passport and Roadmap tools could be used by Member States on sampled buildings representative of the national building stock to fine-tune their national renovation trajectories and strategies. Complementarily, a building renovation scenario should be comparable to the objectives set in the national trajectory: would the renovation project participate to targets set for 2030, 2040, 2050?

R10 - Developing digital logbooks as digital hubs for regulatory tools
Digital logbooks can constitute the basis of building data ecosystems by combining secure storage and management of datasets and files. They could become digital hubs that interconnect software and tools required by the EPBD IV: EPC and BRP software, national databases for the EP of buildings (Article 22), building product database.