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Abstract. European Directive (EU) 2018/844 amending Directives 2010/31/EU (EPBD) and 2012/27/EU (EED) aims at decarbonizing the European building stock. Energy efficiency measures and renewable energy use play an important role, especially regarding retrofit of existing buildings. Identification of retrofit opportunities and aggregation of projects to benefit from economy of scale are a precondition for the implementation of large-scale renovation projects. The ENERFUND project, funded by the HORIZON 2020 programme, provides data from Energy Performance Certificates according to EPBD publicly available in the form of a map and combines them with other geo-referenced data and general information to allow for the rating of deep renovation and carbon reduction opportunities. In this way, the tool assists in identifying retrofit opportunities and aggregation of projects for financing. It also assists in supply-side energy spatial planning, because it shows where energy consumption is likely to decrease due to economic renovation potentials. This contribution shows an overview of data available for thirteen European Member States. Data sources and differences regarding the type of data are explained, and challenges such as data quality issues and data protection concerns are discussed. It is demonstrated that the ENERFUND tool certainly assists in decarbonizing the European building stock, although some improvements are still necessary.

1. Introduction

The Energy Roadmap 2050 is the European Union's long-term strategy to achieve the goal of securing sustainable energy supplies. This effort builds on the first package of climate and energy policies adopted in 2008 and on the framework for climate and energy policy until 2030 agreed upon in 2014, representing the so called Energy Union. Among other important aspects such as research, innovation and competitiveness needed for the transformation of the energy system, climate protection and the conversion to a low-carbon economy, the priority for energy efficiency is explicitly stated.

On 30 November 2016, the European Commission presented several documents intended to achieve the transition to a sustainable energy system. Among others, there were proposals for the revision of Directive 2012/27/EU (Energy Efficiency Directive EED), Directive 2009/28/EC

(Renewable Energy Directive) and Directive 2010/31/EU (Energy Performance of Buildings Directive EPBD), as well as the proposal for a regulation on governance, in order to ensure Member States' coordinated reporting on compliance, particularly with the EU Energy and Climate Targets by 2030.

In this article, the focus is on the building sector and especially on improving the energy efficiency of existing buildings. The amending Directive (EU) 2018/844 resulting from the proposals for revisions of the EPBD and the EED, transfers the long-term renovation strategy from the EED to the EPBD and introduces the obligation to specify detailed targets and milestones. Furthermore, the progress achieved shall be reported thoroughly. The new EPBD article 2a "Long-term Renovation Strategy" stipulates that each Member State must ensure a highly energy-efficient and decarbonized national building stock, with a roadmap of indicative milestones for 2030, 2040 and 2050. In order to support the mobilization of investments in renovation, Member States shall, inter alia, facilitate access to appropriate mechanisms. For example, the bundling of projects provides a possibility for small and medium-sized enterprises to gain easier access to financing (article 2a number 3 (EU) 2018/844). The goal is to develop large-scale renovation projects that can be implemented more cost-effectively than many small individual renovation projects. The new article 2a is a reaction to the fact that the 3% renovation rate has not been achieved despite years of effort (see also rec. 10 (EU) 2018/844).

With regard to energy performance certificate (EPC) databases, Directive (EU) 2018/844 introduces two new paragraphs 6a and 6b into Article 10 (6) of Directive 2010/31/EU, stating that EPC databases allow the collection of measured or calculated energy consumption of the buildings covered. At the minimum, the anonymized data collected in accordance with the data protection requirements of the Union and its Member States, shall then be made available for statistical and research purposes. These data will also be at the building owner's disposal.

The ENERFUND project explicitly aims at making use of EPC databases having been established in many EU Member States in the process of implementing the independent control system according to article 18 EPBD. A tool was developed to display energy related building data in a geo-referenced way by means of a Geographical Information System (GIS), in order to allow for identifying areas of interest for large scale and deep building renovations.

This article explains the development process of this instrument, describes encountered challenges, and shows an overview of selected country results. It concludes with a presentation of lessons learnt and future outlook.

2. Developing the ENERFUND Tool

2.1 Objectives and technical solution

The aim of the ENERFUND tool is to be a quick evaluation instrument, assisting financial institutions, owners and ESCOs interested in examining the feasibility or usefulness of deep energy renovation of commercial and other buildings in a thorough way. Therefore, identified open source databases with significant information about building energy performance were integrated in the tool in a user-friendly manner. The interface of the tool is a European map which displays buildings and building units with coloured dots, in accordance to their energy label and with several filtering options in order to assist the user to narrow the range of screening buildings according to his or her preferences. At the home page of the ENERFUND tool, a drop-down list with all countries involved is available, in order to minimise the processing duration due to the large amount of integrated data. Additionally, after selecting the country of interest, the user can compare buildings and view detailed information regarding their energy performance along with other information for the building. Furthermore, the tool provides the ENERFUND score per building or building unit on a per cent scale. This score can be used to compare buildings of any country, since the score formula used is common for all countries. Finally, the user can produce a report based on the selection criteria. As a future development of the tool, in order to increase the tool's functionality and accuracy, user inputs regarding the selected buildings will be enabled.

2.2 Available data source

In order to identify the most important data and parameters for the development of the ENERFUND tool, several key elements and criteria were initially examined according to previous studies, expert's opinions and surveys conducted in the framework of the ENERFUND project. EPC databases were identified as the major databases for the ENERFUND tool since they include a variety of important information for the energy performance of the buildings [1]. Nevertheless, additional available databases, including significant data for the energy renovation decision making process, such as Noise Databases and Building Price Databases were embedded. The level of publicly available information in EPC databases varies between Member States. In some cases, open access to EPC data is provided directly from the database of the competent authorities (such as Denmark, Bulgaria, the Netherlands, the United Kingdom); whereas in others, only aggregated results are made publicly available (such as Greece, France and Romania). However, in most of the countries studied (i.e. Cyprus, Austria), there is no publicly available access to the EPC database. Complete access to the core of the database, meaning access to all raw data, is not provided by most Member States [2]. Furthermore, in none of the studied cases data were geocoded in a way that would allow automatic mapping on the ENERFUND map.

2.3 ENERFUND score

The ENERFUND score assists the decision-making process for the energy renovation of buildings and is based on a Multi Criteria Analysis methodology. It is a result of an equation that uses eight main parameters, with different weight factors, which have been selected as key parameters for building energy retrofitting: Total Area and Energy Saving Potential (Mandatory Parameters), Construction Year, Average Building Sale Price, Occupancy Level, Own Contribution (to financing renovation), Noise Levels and Building Ownership Status. ENERFUND score uses data only from open databases available in the EU, in order to maintain up to date data. In case that any of the above parameters are not available, default values have been used. The highest score that can be granted is hundred.

3. Member States data embedded in the tool

3.1 Overview of country data

In February 2019, approximately eight million EPCs were mapped across thirteen Member States. In total more than seventy million unique data entries (such us wall energy efficiency, construction year, etc.) are available in the context of this tool, but still availability differs from country to country. For example in Slovakia, only the EPC rating and the building type are available in the tool, while for the UK, ten parameters per EPC are available. In the following sections, three countries, representing different situations, are described in detail by answering the next questions:

- How were the data made available for ENERFUND? What had to be discussed, agreed upon, or clarified?
- Is the full EPC data set included or only part of it?
- What are the reasons for a country-specific partial availability?
- What difficulties were encountered to get the data for ENERFUND and what were the solutions provided?
- What is the opinion regarding data quality and data protection?
- Which specific features are especially interesting for which target groups?
- What are the lessons learnt?

3.2 Denmark

Ever since the first EPC scheme was launched in 1997, all Danish EPCs issued were uploaded to one central database hosted by the Danish Energy Agency. Following EU legislation, the legal framework of the Danish EPC scheme has undergone several revisions. The last major revisions were in 2006 and 2011.

The first time the Danish EPC database was made available to the ENERFUND tool, all EPCs issued since 2006 were part of the data transfer. This first transfer was based on a 2015 copy of all Danish EPCs including domestic and non-domestic buildings. A quality filter ensured that only EPCs with reasonable data would be accepted. Therefore, by definition the full Danish EPC data based on the 2015 copy have been made available for the ENERFUND tool. Due to lack of permission to use data from the live database, all EPCs issued at a later date could not be included. This difficulty has now been overcome thanks to a direct University access to the EPC database. Put otherwise, now a new updated EPC data copy can be extracted at any time and transferred into the ENERFUND tool.

The quality of Danish EPCs has been increasing steadily. Since the revision of 2006, all EPCs are presumed high quality records. Concerning data protection, only buildings owned by the Ministry of Defence must be observed.

Since COP 21 and the Paris agreement, Danish target groups, especially Danish municipalities, have put special interest on the ENERFUND decarbonizing rating feature, i.e. the possibility to compare buildings concerning their carbon reduction potential. This not only applies to municipal owned buildings but also to private domestic and non-domestic buildings located on the territory of the municipality. The reason is that politicians and local authorities of a number of municipalities hold themselves responsible to meet the Paris agreement, and buildings stand for a large share of greenhouse gas emissions.

3.3 Spain

Spain follows a regional approach for the certification procedure, therefore there are no central registers, but smaller, regional ones instead. Considerable effort was necessary to transfer EPC data into the ENERFUND tool. First, it was analysed which data were available online. It was found that only ten out of nineteen registers were accessible through the internet; furthermore they use different search parameters depending on the region. The EPC rating is the only parameter all of them have in common. Secondly, the availability of geocoded data was investigated. Only two out of these ten regions displayed geocoded data, but only one presented it in such a way that it was downloadable as open data. In Royal Decree 235/2013 it was stated that the registers would allow citizens to access the information on energy performance certificates. Implementation is being realized little by little.

Finally, data for four regions are available on the tool: Comunidad Valenciana, Cataluña, Castilla La Mancha and País Vasco. Since EPC data were stored in different ways depending on regional registers, approaches to make these data available for ENERFUND vary accordingly. One region showed special interest to provide data in a quality that allows automatic updating and availability in the tool. This represents one of the ENERFUND success cases.

In Spain the full EPC dataset is not publicly available, that is the reason why only data on the EPC label is accessible within the ENERFUND tool. As a consequence, stakeholders do not consider data protection as a problem: the tool only shows data that is already public anyway. For instance, public buildings must show EPC label data.

Summarizing, the ENERFUND tool is considered to be very interesting and useful by the Spanish majority. Nevertheless, there is a need to standardize the storage and the online public availability of data among the different regions. These data should also be downloadable in a homogeneous format.

3.4 Romania

In the case of Romania, the process of implementing available EPC data in a structured format to meet the program's requirements, started also with the national EPC database.

The national EPC database was first introduced in the legal framework in 2007 and started to receive EPCs from energy auditors for buildings in 2008. Although a full structure of the database was defined in 2010 (with an xml format for making the system automatic) and another application was developed by the responsible authority in 2016 to facilitate the on-line submission of EPCs, the system is running manually, with EPCs sent by e-mail and stored by the energy auditor.

Since there is a great diversity of received (electronic) formats (pdf, doc, docx, xls, xlsm, xlsx, jpg, tiff, gif, html, etc.), either as the final draft document or scanned copy of the signed and stamped EPC, it is almost impossible to transform the gathered information into structured data that can be further processed to supply meaningful performance information about the existing building stock.

In this context, the data to be introduced into the ENERFUND app were based on about 46,000 EPCs that were entered manually into the structured database (11,300 buildings and 34,700 individual apartments in collective buildings), representing three to four percent of all issued EPCs. The data were geo-located, filtered and introduced on the map, both as individual data and in aggregated form. The first step of aggregating data at county level did not lead to useful information (area too big), so the aggregation was performed later at smaller areas (small city or district in large cities).

The difficulties encountered in entering data into ENERFUND were first in finding relevant data (except EPCs) and secondly geocoding available data. Most of the data needed to calculate the ENERFUND score were not available and thus considered from default values (same for all areas).

The public status of the EPC data is not specifically defined, however no explicit prohibition to publish the EPC information exists in the legal framework. On the other hand, the EPC does not contain any personal data related to the building owner.

The ENERFUND features are widely appreciated by all stakeholders, but without the introduction of relevant data, the tool is not of appropriate advantage for any interested party. Thus, the population of the tool with detailed EPC data together with other type of information (like social and income information aggregated at district area, availability of experts and specialised construction companies, energy and utilities map, renovated buildings etc.) could lead to an important raise in the usefulness of the tool. Moreover, all data should be geocoded in order to facilitate the integration in the tool; the new EPC template (methodology under revision) must include geo-coordinates that should be reported in the database.

4. Challenges encountered and lessons learnt

4.1 Challenges encountered

Regarding the data necessary for a successful transfer into the ENERFUND tool, the following problems have arisen:

- EPC data is not publicly available, or in electric format that can be easily used by the public or even by the relevant authorities.
- EPC data was not geocoded and therefore it took longer than expected to display the data on the map. Geocoded addresses do exist (see for example INSPIRE directive [3]), but are not yet linked with EPC data addresses.
- In some countries, EPCs issued in the course of renting or selling a building or a building unit, are not fully trusted. The reason is that energy performance calculation is done based on default values, and often the building is not even visited.
- EPC data is not harmonised across all Member States. In some cases, all data to calculate the EPC rating is available (i.e. door surface area), while in others, only the EPC rating is available, thus making the database unusable for the needs of the ENERFUND tool. Furthermore, the classification of each data category is not standardized, therefore cross-country comparison is not always feasible.

4.2 Open Government Data (OGD) versus General Data Protection Regulation (GDPR)

Energy-related building data displayed by the EPC and describing the technical characteristics of a building can be classified as non-personal data because energy efficiency indicators are calculated using standardized usage profiles without reference to the actual users of a building. Non-personal data do not fall under the GDPR [4] but can be classified OGD if specific requirements are met, such as reliability of information, relevance for the public, and rights to publish the data. OGD are data of the administration, which are accessible to the general public for free use, distribution, and further

disposition. Legal bases are several EU directives, for example Directive 2013/37/EU (re-use of public sector information) and Directive 2003/4/EG (public access to environmental information).

Reference is made here to Directive 2007/2/EC as the basis for creating a common spatial information infrastructure in the European Union (INSPIRE). The visualization of the building address is the prerequisite for the publicly accessible, geo-referenced presentation of EPC data and the utilization of information for project developments and innovations. However, in some cases, the building address could be combined with the registry showing the principal residences and thus represent a case of identifiability of individuals according to GDPR. Under this perspective, the address of a residential building can be viewed as personal data. If the GDPR applies, rules for lawful data processing will be mandatory. Usually, lawful processing takes place according to article 6 (1) e GDPR (if there is public interest) or article 6 (1) f GDPR (if there is legitimate interest).

However, there is a range of interpretation regarding the definition of "identifiability" and also "public interest". While in some countries accessibility of EPC data is clearly regulated, there is no clear view on how to deal with it in other countries, for example in Austria: there is no agreed approach on how to define identifiability and there is no established mechanism how to balance public interest against personal rights. It must be noted that the GDPR is not about data protection as such, but about the protection of personal rights. These rights must be balanced against the public interest in accessible information needed for awareness creation and better decision-making. Public access to EPC data can be seen in the context of the INSPIRE Directive, as illustrated by a JRC report on the harmonization of EPC data for use in a common spatial information infrastructure [5]. However, this report is not strong enough to invalidate GDPR-related concerns. A guidance note issued by the European Commission on the public access to geocoded building related EPC data would be useful.

4.3 Quality of EPC data: reliability, comparability, electronic format

The main data source for the ENERFUND tool is represented by the available set of EPCs for a specific country or region. Since its definition and enforcement, the EPC was acknowledged with the potential to become an effective tool to support the implementation of building policies and incentives to upgrade the energy performance of buildings. Achieving the desired impact in the market strongly depends on the actual quality of EPCs, which can be achieved through the implementation of a clear calculation methodology with explicit procedures, the creation of effective tools for calculating or selecting inputs, and the approval of a robust compliance check frame.

The issue of quality of EPC data is twofold: on the one hand the quality of the energy performance certification process, and on the other hand the quality of EPC data to fit into the ENERFUND tool requirements in order to facilitate the decision for building renovation. Another European project, the QUALICHeCK project, confirmed that problems do exist with EPC quality and input data, as well as with compliance frameworks which are still in the development process in all countries [6]. As an example, a new field study on the assessment of quality and compliance in the EPC system in Romania [7] showed that recalculation of 25 EPCs based on field-proven input data lead to a change in energy class in almost 40% of the sample for the total energy use. Although progress can be seen in most Member States, the status on the ground needs continuous monitoring. More efforts should be put into systematic data collection and the application of validation procedures in order to assure the credibility of energy performance requirements and EPC system.

A solution for these problems could be the implementation of an on-line submission of EPC data, based on a defined electronic format as it is already used by many Member States. Developing the structure and defining the requirements for an electronic format of issued EPCs to feed the central EPC register can facilitate access in real time to building stock data together with tools for the plausibility and quality checks of relevant data. Furthermore, the application of the EPC control system will be facilitated, thus improving the quality of EPC elaboration by providing feedback to energy auditors of buildings.

However, even if country specific information is publicly available in a format easy to display by means of GIS, the problem of lacking comparability remains when data from different countries

should be assessed. Energy performance category B of a building in Denmark does not imply the same primary energy demand compared with energy performance category B of a building in Greece. Energy performance requirements of building components such as U-values of windows are different in Austria and Spain, for example. Nevertheless, the purpose of the ENERFUND tool is to present the building data in the most possible coherent way to help the user identifying opportunities for businesses related with deep renovation of buildings. Some information is necessarily specific to a country or even region, due to climatic reasons. Therefore the method of introducing a qualitative scale ranging from "very good" to "very poor" was introduced. However, it will be useful to specify a minimum number of data fields for geo-referenced presentation in a uniform way, such as year of construction, type of building use, m^2 useful area, type of fuel used, year of EPC issuance, overall energy performance rating, rating of energy efficiency of the walls, windows, roofs, and heating system. This format should be made mandatory for all EU Member States, as well as the obligation to make this information publicly accessible.

5. Conclusions and Outlook

5.1 Future tool development

An update of the ENERFUND tool will include a carbon-reduction benchmark. Thereby, the decarbonizing potential of any building or whatever selection of buildings can be benchmarked against any other building or selection of buildings. The carbon emission feature will be based on the actual and potential energy consumption, and in case this information is missing, the actual and potential EPC rating values. Combined with knowledge about the national energy mix or preferentially the energy supply labelling of each building, the buildings can be furnished with a carbon emission reduction benchmark. Moreover, this information can be used for a decarbonizing score.

The first countries are in preparation for GIS visualization of their carbon emission benchmarks. Among these is Denmark with an EPC data set containing the buildings' actual and potential energy demand, and - in addition - the sort of energy supply for each building like electricity, natural gas, district heating and fuel oil. A list of carbon emission factors of each fuel and regarding electricity and district heating, the actual kg of carbon emission per kWh delivered, completes the data set.

In other words, with these features in place, the ENERFUND tool definitely will be able to contribute to the decarbonizing of the European building stock.

5.2 Recommendations

The EPBD does not require an electronic EPC database to be used as the basis for the establishment and operation of the independent EPC control system. However, many Member States or regions have chosen this approach because effective control is otherwise difficult in a cost-effective way. It also implies the possibility of using the data for energy-related purposes other than the control of energy performance certificates. The EPC is thus not only used for information on the energetic state of the building, but the underlying calculations and technical documentations are also valuable to build up databases for different purposes: for strategic investigations, project developments, and statistical analyses.

Public access to geo-referenced EPC data plays an important role in raising awareness and participation as part of the Long Term Renovation Strategy, and also in strengthening innovation in the development of products and services for greater energy efficiency and reduction of CO_2 emissions. The analysis presented here shows that harmonization across Europe is urgently needed in two ways: first, regarding energy data as such, and second, regarding geo-coding and public accessibility.

Therefore, the ENERFUND project will conclude with a recommendation to the European Commission and DG Energy in particular, that harmonisation of all energy data, not only EPC data, - and their geocoding - should become mandatory across all Member States.

References

[1] Arcipowska A, Anagnostopoulos F, Mariottini F and Kunkel S 2014 *Energy Performance Certificates across the EU, A mapping of national approaches* (Brussels: BPIE)

[2] Charalambides A G, Maxoulis C N, Kyriacou O, Blakeley E and Soto Frances L 2019 The impact of Energy Performance Certificates on building deep energy renovation targets, *International Journal of Sustainable Energy*, 38:1, pp 1-12, DOI:10.1080/14786451.2018.1448399

[3] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), OJEU L.108

[4] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), OJEU L.119

[5] Pignatelli F and Martirano G 2016 *INSPIRE Harmonisation of existing Energy Performance Certificate datasets: European Union Location Framework Energy Pilot,* JRC Technical Reports (Luxembourg: Publications Office of the European Union)

[6] Durier F, Geissler S and Wouters P 2017 *Source book for improved compliance of Energy Performance Certificates (EPCs) of buildings*, QUALICHeCK project (www.qualicheck-platform.eu)

[7] Petran H, Petcu C and Mladin E-C 2016 *Romania: Assessment of Quality and Compliance in the Certification of Energy Performance of Buildings*, QUALICHeCK project (www.qualicheck-platform.eu)

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