TIMEPAC

Towards Innovative Methods
for Energy Performance Assessment and Certification of Buildings

Deliverable 2.5

Procedures and services to undertake large-scale statistical analysis of EPCs databases

Transversal Deployment Scenario 5

Lead Beneficiary: Politecnico di Torino (POLITO)

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Executive Summary

This report summarizes to the work performed in Task 2.5 “TDS 5 - Large scale statistical analysis of EPC databases” of Work Package 2 “Transversal Deployment Scenarios”. This work package is concerned with the creation of future scenarios with the aim of deploying and delivering new methods to implement enhanced EPCs schemas. Different partner profiles (e.g., certification bodies, software developers, and research groups) are involved in the deployment of these methods, which embrace the techno-scientific, operational, legislative, and standardisation levels. Task 2.5 specifically focuses on exploring the potential of EPCs to conduct large-scale analyses, ultimately enhancing the energy performance of building stocks.

TDS5 objectives mainly address the EPC data analysis and exploitation in the framework of the holistic EPC enhancement of TIMEPAC. In fact, TDS5 aims (i) to check and improve quality of the EPC data, (ii) to exploit the EPCs to carry out energy balances of the building stock by means of the definition of building archetypes, and (iii) to provide targeted stakeholders with a methodology to perform reliable refurbishment scenario analyses of their building stocks. A common methodology to achieve the objectives was developed and applied by the TIMEPAC participating countries in each own EPC database, i.e., Austria-Province of Salzburg, Croatia, Cyprus, Italy-Piemonte region, Spain-Catalonia, and Slovenia. The three TDS5 goals are interconnected and begin with the data clustering and quality checking in the EPC database. The quality checking consists of assessing the reliability of the EPC data by means of a scoring method, and defining different levels of controls (i.e., data type checks, physical impossibility checks, and consistency checks). After removing inconsistent EPCs, some building archetypes, which embed the mean technology of a specific building stock, have been created by statistical analysis. These ‘virtual’ representative buildings, generated from the exploitation of the energy certificates, have been utilised as input to determine the building stock energy (in-)efficiency and to encourage the improvement of the energy *status* of the built environment. Finally, confidence intervals on selected EPC data have been identified, and would become a helpful instrument for the certifier in the EPC generation phase.

The shared, harmonised, and flexible methodology for the creation of the archetypes has been delivered in *Guidelines* that constitute an Annex within the Deliverable. Moreover, the *Guidelines* provide a detailed description of the building archetype schema, highlighting the key performance indicators (KPIs) representative of the energy *status* of the building stock, grouped in geometric data, thermo-physical properties of the building envelope, technical building system characteristics, and energy indicators.

Besides the *Guidelines*, a building stock energy model tool has been developed and applied by the country partners; it adopts the datasets of the representative buildings to perform large-scale energy balances and to evaluate the effectiveness of the energy refurbishment scenarios of the building stock.

In a cross-country comparison, the methodology developed in TDS5 proved to be easily applicable and upgradable, adaptable to country-specific needs and tasks to be performed. In the experience of all partners, the numerical results of TDS5 are undeniably affected by the quality and the paucity of the current EPC dataset; a higher effectiveness and reliability of the outcomes will be achieved with the enhanced EPC being developed in TIMEPAC, which will constitute the future EPC databases in EU.

The main target groups of TDS5 are energy certifiers, research bodies (e.g., energy agencies), local and national energy authorities (e.g., policymakers), and validation and control bodies.

The outcomes of the study carried out in TDS5 will be validated in WP3 “Verification Scenarios” with specific target groups, evaluating the applicability of the implemented approaches. Moreover, the results of this task will be delivered in the programme of the TIMEPAC Academy in the context of WP4 “EPC Standardisation, Training and Capacity Building”.

1 Introduction

1.1 Purpose and target group

According to the European Commission, the building sector today is the largest consumer of energy in the EU; it is responsible for 40 percent of energy consumption and 36 percent of greenhouse gas emissions, and approximately 75 percent of the building stock is energy inefficient. Concerning the above-mentioned data, the European Union intervenes through political actions aimed at the realisation of deep renovation and energy requalification interventions. Proposed policy actions include the European Green Deal, the Renovation Wave, and the proposed revision of the Energy Performance of Buildings Directive (EPBD), all aimed at achieving the political and environmental targets set for 2050.

From this perspective, the Energy Performance Certificate (EPC) represents an essential document to identify the buildings that need to be upgraded, the interventions to be performed, and the best methodology to be applied. The project “Towards Innovative Methods for Energy Performance Assessment and Certification of Buildings” (TIMEPAC) aims to identify faults in the current energy performance certificates and to improve current energy certification processes from single, static certification to more holistic and dynamic approaches.

The aim of WP2 “Transversal Deployment Scenarios” (TDSs) is to deploy and deliver new methods to implement enhanced EPCs schemas, which will be then implemented in the Verification Scenarios (VSs) to be carried out in WP3. Different partner profiles — certification bodies, software developers, research groups — have been involved in the deployment of these methods, which embrace the technical, scientific, operational, legislative, and standardisation levels.

WP2 includes five TDSs:

- TDS1 – Generating enhanced EPCs with BIM data,
- TDS2 – Enhancing EPC schemas through operational data integration,
- TDS3 – Creating Building Renovation Passports from data repositories,
- TDS4 – Integration of Smart Readiness Indicators and sustainability indicators in EPC, and
- TDS5 – Large scale statistical analysis of EPC databases.

Each TDS has been developed in a different task in WP2 (from Task 2.1 to Task 2.5).

The TDSs provide methods and tools to apply a holistic approach to EPC by considering:

a) the overall cycle of EPC related data, from generation to storage, to analysis and exploitation, throughout all the building lifecycle, from design, to construction and operation,
b) that buildings are part of a larger ecosystem which includes energy and transport networks, and the built environment, and
c) that buildings are dynamic entities, continuously changing over time.

The present deliverable focuses on TDS5 and presents the work that has been carried out in the related Task 2.5 of the TIMEPAC project. The main objectives of TDS5 are:

- to check and improve quality of the EPC data,
- to exploit the EPCs to carry out energy balances of the building stock using representative buildings (archetypes), and
- to provide targeted stakeholders with a methodology to perform reliable refurbishment scenario analyses of their building stocks.

In the context of the holistic approach devised in TIMEPAC, TDS5 addresses each of the above-mentioned aspects (see also Figure 1), as follows.

a) The enhancement of the EPC data analysis and exploitation are the main focus, as TDS5 provides procedures and services to analyse EPC data and exploit them to increase data quality and to perform energy modelling of building stocks, respectively. Indirectly, TDS5 also addresses data generation and storage, as it provides a methodology to create confidence intervals on input data useful to the energy certifier in the EPC creation, as well as it works on different databases to assess the energy performance of building stocks.
b) In TDS5, the buildings are considered not just alone, but part of a larger system that is evaluated using the EPC as a source of information to assess building portfolios on the basis of several indicators, including energy, environmental, economic and social aspects.
c) Finally, the dynamism of buildings that is taken into account in the enhanced EPC is also reflected in the EPC database, as a reliable data source to carry out the analysis and the exploitation; building stock energy models inherit the status of dynamic entities, continuously changing over time.

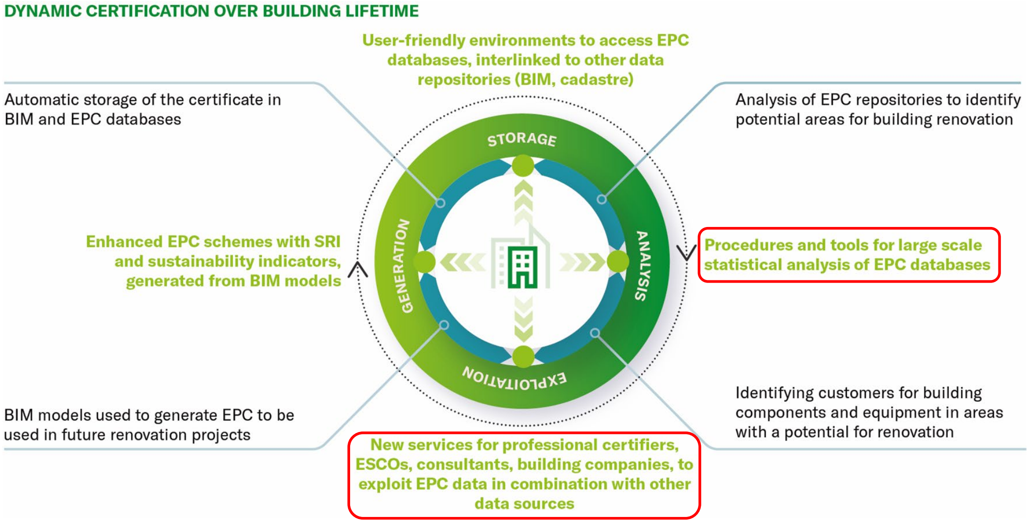

Figure 1. TDS5 in the overall framework of TIMEPAC. The main axes addressed in TDS5 are highlighted by the red boxes

The starting point of TDS5 is the EPC database, which is the main data source to address the three objectives of this scenario (Figure 2). The objectives are not considered as separate goals, rather they are interconnected: the quality of the EPC data is the pre-condition to create reliable building archetypes useful, in turn, to develop building stock energy models and to perform reliable refurbishment scenario analyses.

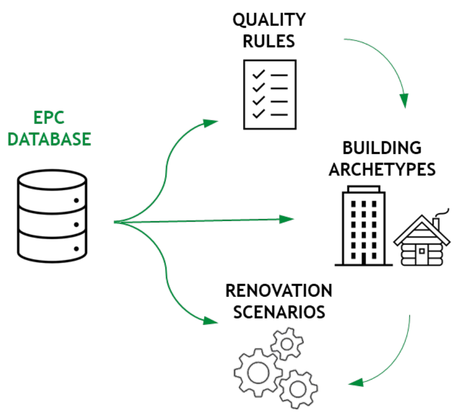

Figure 2. Interrelationship between the TDS5 objectives

The Energy Performance Certificates databases of the TIMEPAC participating countries have been used to set-up a methodology that allowed to demonstrate the potential of EPCs as a data source to develop energy models of the building stock. Models based on data analytics have been formulated on the EPCs database. The models are able to predict the building energy demand at different scales: either at the building stock scale (*bottom-up* approach) or at the single building scale (*top-down* approach).

Benchmarks were identified through the statistical analysis and clustering of building categories and construction periods in the EPC databases. For each cluster, a representative building (archetype) was identified; it represents the average features of the stock (from the point of view of the geometry, the thermo-physical parameters of the envelope, the technical building systems, etc.). A *bottom-up* approach has been implemented in a MS Excel tool to assess the energy performance of (sub-)sets of building stocks in the TIMEPAC participating countries/regions, starting from the energy intensity of the representative buildings derived from each EPC database.

In addition, the EPC database has been used to develop a proper methodology to check the quality of EPC data and − from the statistical analysis of the building clusters − inference rules were set to identify distribution functions and to define confidence intervals of the main input data that affect the energy performance of buildings. The latter is meant to be adopted in the future release of the enhanced EPC, in such a way to increase the data quality in the EPC generation.

Being TIMEPAC a *Coordination and Support Actions* (CSA) project, in the development of TDS5 not new methodologies have been introduced, but methods already established have been applied, like for instance those developed in previous EU research projects, such as TABULA (IEE, 2009) and EPISCOPE (IEE, 2013), which provided a common approach to facilitate the convergence of EPC practices and tools across Europe.

The adopted approach has been devised in such a way to be applied not only to the project partner countries, but even exploited at European level; in this sense, the TDS5 outputs will contribute to demonstrate the potential of a Europe-wide uptake of the proposed assessment scheme.

The outcomes produced by TDS5 can be summarised by the following.

- **Representative buildings**, i.e. a library of regional or national residential and non-residential buildings archetypes generated by the EPC data to fully reproduce the representativeness of building stock clusters, for each TIMEPAC participating country.
- **Building stock energy model tool** that adopts the datasets of the representative buildings to perform large-scale energy balances and to evaluate the effectiveness of the energy refurbishment scenarios of the building stock.
- **Semi-empirical models**, which deliver confidence intervals and distribution functions of the main input data of the EPC.

The generation of the representative buildings follows a procedure described by means of *Guidelines* ("Guidelines to create archetypes of the building stock from EPC data"), which constitute Annex A of the present deliverable. The procedure aims to meet two main objectives: (1) to check the data quality in the EPCs by setting rules − that is the pre-condition to carry out accurate analysis, and (2) to demonstrate the feasibility of exploiting EPC data for scenario analysis that will be provided to stakeholders.

The main target groups of TDS5 are energy certifiers, research bodies (e.g., energy agencies), local and national energy authorities (e.g., policymakers), and validation and control bodies. The exploitation of the EPC databases by means of procedures and services developed in TDS5 will enable target groups to perform energy refurbishment scenarios on a regional and/or national level at different timespans, as to address policies towards the promotion of effective energy efficiency measures for the renovation of the existing buildings. The *Guidelines* are meant to provide a plain structure to be followed also by non-energy experts. They also specify modelling assumptions and boundary conditions, and can be adaptable for their implementation in different tools or procedures.

1.2 Deliverable structure

The present deliverable is made of six sections. In the Introduction (Section 1), the purpose and the target groups of TDS5 (Section 1.1), the deliverable structure (this section), the contribution of partners (Section 1.3), and the relations of Task 2.5 with other project work packages and tasks (Section 1.4) are described.

In Section 2, the vision of the TDS5 in the proposal is discussed, pointing out the context issues that this scenario is going to overcome, the current works related to this vision, the innovation introduced by this scenario.

The methodology followed for the development of Task 2.5 is presented in Section 3, which is divided into three sub-sections mirroring the main topics of TDS5, i.e., data quality checking and building archetypes, building stock energy model, and confidence intervals on input data.

Considerations on the application of the methodology and the results are provided and discussed in Section 4 and Section 5, respectively, for each region/country involved in the analysis. A cross country comparison is also carried out. In Section 6, the conclusions and future challenges are presented.

The following Annexes are attached to this report:

- Annex A, providing the “Guidelines to create archetypes of the building stock from EPC data” (also referred in this report as the *Guidelines*),
- Annex B, presenting tables summarising the features of the archetypes created from the EPC databases for each country/region involved in TIMEPAC,
- Annex C, providing confidence intervals and kernel density distribution of input data.

1.3 Contribution of partners

Politecnico di Torino (POLITO), as leader of Task 2.5, coordinated the work by setting up the methodology for TDS5 and providing the *Guidelines* (Annex A). Each TIMEPAC country partner(s) applied the methodology in its own region or country, supported by POLITO, as follows.

- Slovenia: JSI performed large-scale statistical analysis of the entire EPC database in Slovenia and developed refurbishment scenarios on a regional level (North Primorska Region).
- Italy: POLITO, in cooperation with Regione Piemonte, performed large-scale statistical analysis of the entire EPC database of Piemonte, and developed refurbishment scenarios on the same territory.
- Spain: FUNITEC, in cooperation with ICEAN, performed large-scale statistical analysis of the entire EPC database of Catalonia.
- Austria: SERA performed large-scale statistical analysis of the EPC database of Austria for the province of Salzburg.
- Croatia: EIHP performed large-scale statistical analysis of the EPC database of Croatia.
- Cyprus: CUT performed large-scale statistical analysis of the EPC database of Cyprus.

The deliverable has been written by POLITO with contributions by the partners involved. The inputs to Sections 4 and 5, and Annex B have been provided by each country partner, in the country/region dedicated sub-section.

1.4 Relations to other project activities

TDS5 aims to address the issues raised in the context analysis carried out in WP1 “Context Analysis to Support EPC Workflow” of TIMEPAC. The work done in Task 2.5 took into account the following aspects with the final goal to overcome the limits related to the current EPC:

- Identification of factors that affect the quality of EPC
- Implementation of validity checks and controls on input data
- Increase of the exploitation of EPC data

Relationships between TDS5 and the other TDSs in WP2 concern both the building selection performed to carry out the TDSs and to the common goal of achieving the EPC enhancement (Figure 3). More specifically, the building typology definition that has been set in TDS5 informed the case studies selected to perform TDS2. The data quality addressed in TDS5 is a central aspect that will affect – even beyond TIMEPAC – the accuracy of the input data used to generated EPCs from BIM models (TDS1), as well as the new indicators devised in TDS2. The transversality of TDS5 among the TDSs of WP2 is also shown in Figure 4. TDS5 works on the current EPC databases as useful source of information to set and apply methods for the improvement of data quality in the future; the effect of the data quality enhancement will be measured in the long term when the so called “TIMED EPC” (Tailored, Improved, Enhanced and Dynamic EPC) will be issued.

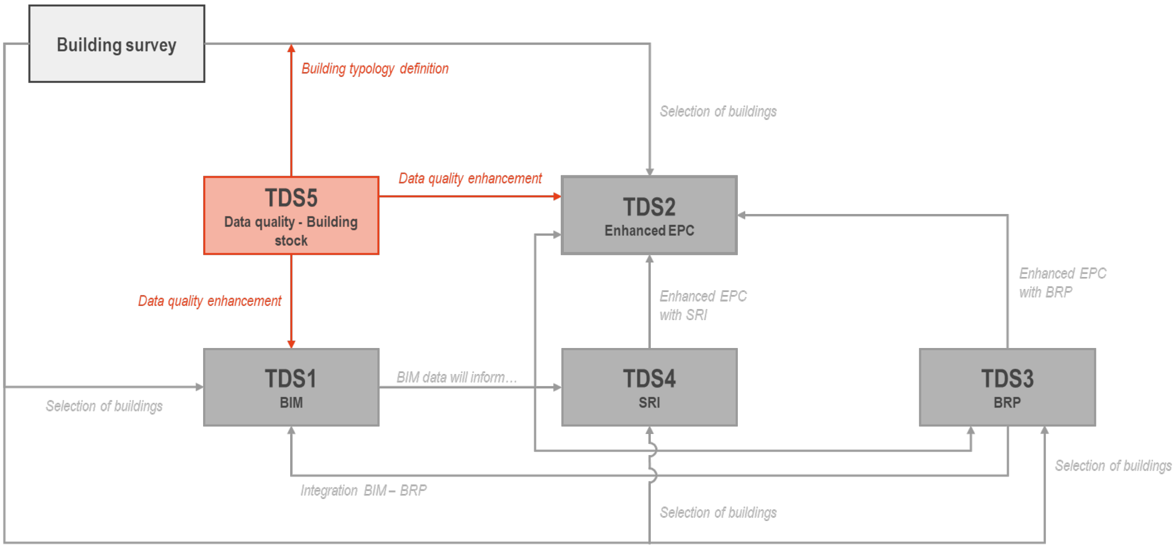

Figure 3. Relationship between TDS5 and the other Transversal Deployment Scenarios

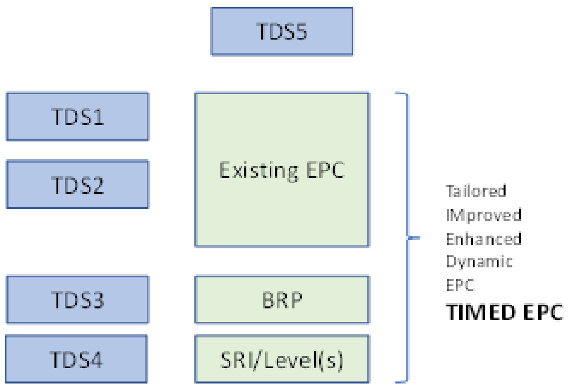

Figure 4. The transversality of TDS5 in WP2

The methods developed in TDS5 will be implemented and validated in some VSs to be carried out in WP3 of TIMEPAC. In VS1 “Improving certification with enhanced EPCs”, in which the main target groups are energy certifiers, energy agencies and validation bodies, the enhanced EPC will be generated applying confidence intervals/distribution functions of the main input data, and verified applying data quality checks set up in TDS5.

In VS3 “Building renovation scenarios from the analysis of enhanced EPC data”, the archetypes identified in TDS5 and the tool developed to assess *bottom-up* building stock energy models will be applied to design building energy renovation plans in potential areas to be renovated. In this case, the main target groups are municipalities and local energy authorities. More detail on the relationship between TDS5 and VSs, as well as the related Training Scenarios (TSs) and Training Modules (TMs) of WP4, are provided in Figure 5.

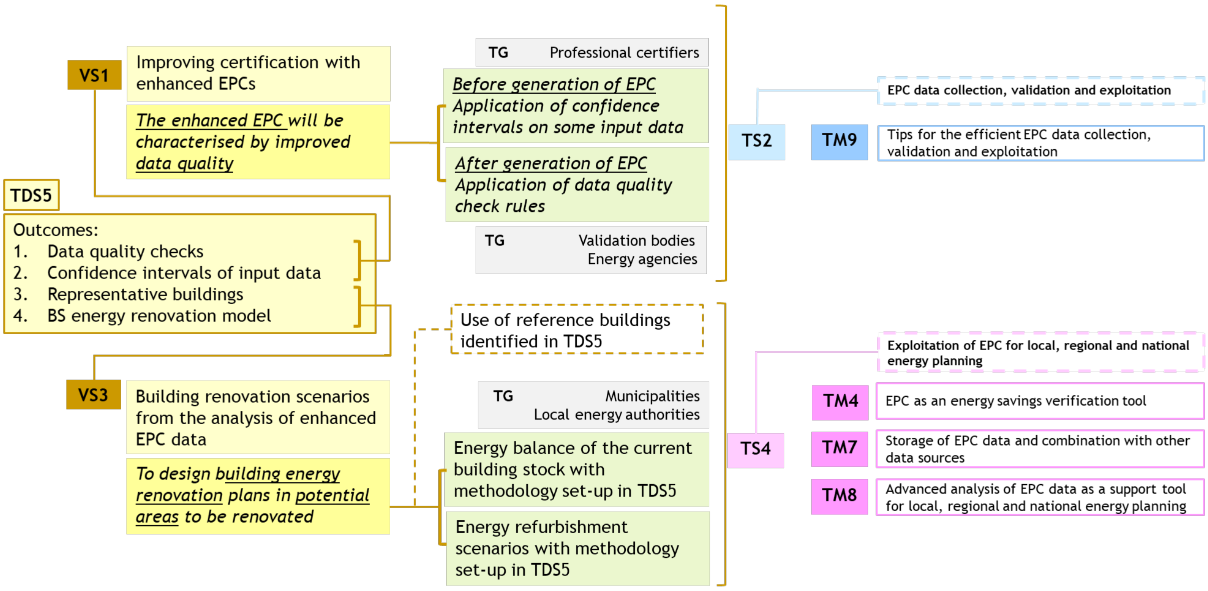

Figure 5. Relationship between TDS5, Verification Scenarios (VSs), Training Scenarios (TSs) and related Training Modules (TMs)

The main outcomes of TDS5 have been configured as exploitable assets in WP5 (D5.11), namely, "Exploitable asset 11: Guidelines to create archetypes of the building stock from EPC data", "Exploitable asset 12: Library of buildings' archetypes", and "Exploitable asset 13: Building stock energy modelling tool".

2 Recent developments and TIMEPAC vision

The EPC, introduced by the European Directive 2002/91/EC (European Parliament, 2002), is a mandatory document for newly constructed, sold, or leased buildings or building units. Its purpose is to provide crucial information regarding the energy performance of the building stock, fuel poverty levels, and the effectiveness of national or regional energy renovation initiatives (Hardy & Glew, 2019). The quality of EPC data is primarily influenced by factors such as the accuracy of input data, the methodology and software utilised, and the qualifications of energy assessors (Li et al., 2019). In this respect, D1.3 (“Report on EPC data analysis”) developed under Task 1.3 of the TIMEPAC project has proposed a qualitative classification of the EPC data as a function of the source type and way of determination. According to the Task 1.3 outcomes, an investigation on the EPC data characterised by the lowest quality level should be carried out. The inclusion of checks and rules (Marinosci & Morini, 2014) within the process of generating the EPC, either through the energy simulation program or during the uploading phase into local, regional, or national EPC databases, would play a crucial role in addressing uncertainties in the input data. This is important not only at the building scale, but also at the city level, whereas energy certificates are a crucial source of information to rank the overall energy performance of the building stock. The low quality of EPC, in fact, negatively affects the use of the energy certificates for single-building or large-scale analysis.

In literature, several works focused on the exploitation of EPC can be found. Capozzoli et al. (2015) used data mining techniques to classify EPCs in order to predict categorical variables that influence the primary energy demand, setting threshold values for quantitative parameters. Ballarini et al. (2011) defined benchmark values, investigating the EPC issued in Piemonte Region, for key indicators of representative buildings in the context of the TABULA project. Droutsa et al. (2015) with the exploitation of the certificates ranked the energy performance of the residential building stock in the Hellenic territory. Pagliaro et al. (2021), instead, examined the energy performance levels of buildings evaluating the influence of energy policies by conducting a comprehensive analysis of EPCs. The proposed studies reflect the importance of having reliable energy certificates to conduct single-building and large-scale analyses.

In this context, the ongoing research studies carried out in the context of the EU projects funded under the program “Next-generation of Energy Performance Assessment and Certification” should be mentioned; in Table 1, the sister projects that have a relation with TDS5 of TIMEPAC are identified. They address different type of actions, *Coordination and Support Actions* (CSA) and *Innovation Actions* (IA). The implementation of the strategies proposed in the cluster is aimed at enhancing the effectiveness of the certificate. Currently, the EPC is an energy-related document considered from the end-user’s vision as an administrative obstacle necessary for constructed, sold, or leased buildings or building units. The enhanced EPC, which is envisioned through the five TDSs, will have multiple functions becoming a central document for different target groups (e.g., end-users, energy certifiers, local, regional, and national authorities, etc.) and with various purposes.

The highlighted sister projects are connected with the TDS5 objectives mainly to determine which EU countries already have their procedure to verify the reliability of data and to establish the quality level of the existing EPC.

The sister project crossCert explores EPC data quality aspects related to providing transparency of data and information (i.e., transparent calculation method providing functional and user-friendly EPC databases) and ensuring the reliability of the information, developing EPC protocols and requirements that demand frequent updates to existing EPCs, improving the certification user-experience also for EPC assessors (crossCert, 2022a). Moreover, the crossCert project summarises the EPC control and verification framework around EU countries (crossCert, 2022b).

EUB SuperHub (EUB SuperHub, 2021) introduces measures for ensuring and monitoring the quality mechanism within the Consortium countries. The analysis provided encompasses various elements including the quality control of EPC, the auditing procedures, and the origin and nature of the input data for EPCs.

The EPC quality control of the X-tendo project is focused on two control levels and the EPC flagging, i.e., an indication related to the certificate inconsistencies that require manual modification by the energy assessors. The first threshold check can be considered as a data type and physical impossibility check. The second check, on the other hand, is applied directly to the clustered building archetypes. The EPC data quality checking approach developed in TDS5 draws inspiration from the X-tendo methodology (X-tendo, 2022).

Table 1. Next generation Energy Performance Certificates H2020 cluster and relation with TDS5

Funding Scheme	Topic(s)	Sister project name	Relation with TDS5
CSA*, 2019	H2020_LC-SC3-EE-5-2019	QualDeEPC[1]	
		U-CERT[2]	
		X-tendo[3]	●
IA, 2020	H2020_LC-SC3-EE-5-2019	D^2EPC[4]	
		EDYCE[5]	
		ePANACEA[6]	
		EPC RECAST[7]	
CSA, 2021	LC-SC3-B4E-4-2020	crossCert[8]	●
		EUB SuperHub[9]	●
		iBRoad2EPC[10]	
		TIMEPAC[11]	
IA, 2021	LC-SC3-B4E-3-2020	COLLECTiEF[12]	
CSA, 2021	LC-SC3-B4E-11-2020	SER[13]	
* CSA = Coordination and Support Actions; IA = Innovation Actions			

[1] qualdeepc.eu.

[2] u-certproject.eu.

[3] x-tendo.eu.

[4] d2epc.eu.

[5] edyce.eu.

[6] epanacea.eu.

[7] epc-recast.eu.

[8] crosscert.eu.

[9] eubsuperhub.eu.

[10] ibroad2epc.eu.

[11] timepac.eu.

[12] collectief-project.eu.

[13] ser4impact.eu.

The outcomes of some recognised past projects can be useful to achieve the TDS5 objectives. The primary source guiding the development of the representative buildings is the successful EU project TABULA (Ballarini et al., 2014). TABULA served as a significant point of reference to establish national building typologies. In numerous European countries, the building type matrix was formulated to summarise residential buildings based on the climatic zone, construction year class, size and shape. Another valuable resource is BUILD_ME (BUILD_ME, 2018), which constructed a building typology database reflecting the distinctive architectural and technical building systems of Egypt, Jordan, and Lebanon. In addition, the Prototype Building Models (PBM) created by the U.S. Department of Energy (DOE, 2013) served as the final point of reference. Each PBM is associated with a scorecard that contains essential modelling input information. Another relevant example is the Urban Reference Buildings for Energy Modelling (URBEM, 2022) project. URBEM is an Italian on-going research project centred on the creation of a comprehensive database of reference buildings, representing with adequate accuracy the national building stock to reduce uncertainty of the Urban Building Energy Models (UBEMs).

The objectives of TDS5 are multiple and are mainly based on the exploitation of EPCs to perform large-scale energy analyses. TDS5 is founded on three innovation pillars indicated as follows:

- The use of EPCs for benchmarking, planning, and assessing the improvement of the building stock energy performance,
- The definition of standardised rules to verify the EPC quality, and
- The set-up of controls on EPC input data to increase reliability.

The first innovation deals with building benchmarking, i.e., the practice of comparing the calculated building energy performance with those referring to a reference building that embeds the mean technologies of a climatic zone, building use category, construction period, and building size. The second innovation is based on a quantitative EPC data quality-checking procedure focused on tailored rules and scores to evaluate the reliability of the EPC data. Standardised, harmonised, and flexible rules malleable to country-specificities allow the reproducibility of the proposed methodology. This approach compares the assigned EPC overall score against an acceptability threshold value beyond which the certificate is considered unreliable. Finally, the confidence intervals association with EPC input data allows to evaluate the plausibility of the desired data against the benchmarking value for that specific cluster. The potential of this approach is to estimate the real value of a parameter based on a sample quantifying the deviation associated with that estimated.

The TDS5 objectives are in line with the current EPBD-recast proposal (European Commission, 2023). Firstly, Member States are required to ensure the complete interoperability of the energy performance of buildings database with other administrative databases. This aspect determines an enhancement of the EPC data quality, due to information centralisation to a proprietary informative system. Moreover, building archetypes represent useful instruments for national building renovation plan development. The national building renovation plan is a four-step procedure that encompasses: (a) the assessment of the energy performance of the building stock, (b) the refurbishment roadmap to achieve the decarbonisation target, (c) an overview of implemented and planned energy policies, and (d) the financing sources for building stock renovation. Especially for the first step of the national building renovation plan, reference buildings play a crucial role.

The intended audience to whom the innovations are addressed are presented in Table 2, in which the needs, the market, social, and technical constraints, as well as the TDS5 contribution are provided. The TDS5 outcomes impact on the following key actors macro-categories: managers of real estate assets, policymakers, researchers and technicians. In Section 1.1, the key actors have been identified into the following target groups: energy certifiers, research bodies, local and national energy authorities, and validation and control bodies.

Table 2. Needs and constraints matrix of actors involved in TDS5

Target group	Needs	Constraints	TDS5 contribution
Energy certifiers	Lack of warnings in EPC generation to increase the reliability of the document	Energy assessor's qualification and low value of current EPC	Introduction of confidence intervals to reduce inconsistencies
Research bodies	Residential and non-residential building benchmark per climatic zone	Uncertainty gap in Urban Building Energy Model creation	Guidelines to create archetypes of the building stock from EPC data. Library of representative buildings for large-scale energy analysis for the participating countries
Local/national energy authorities	Assessment of the energy performance of the building stock to boost the deep renovation in energy-inefficient urbanised areas	Lacking of large-scale energy analysis tools without the Urban Building Energy Model complexity	Simplified building stock energy modelling tool based on energy performance indicators from EPCs
Validation and control bodies	Controls and rules framework to supervise the reliability of EPCs	Lacking of EPC data quality controls in the EPC generation phase and in Regional and National EPC database	EPC data quality checking procedure

The methodology proposed in TDS5 is the core of this deliverable. Due to the specificities of each country, a common, flexible, and harmonised methodology is proposed, adaptable to specific configurations of the EPC database. By working on the current available EPC datasets, the numerical results of the TDS5 objectives (see also Figure 2) are affected by the quality and the paucity of the current EPC data. As mentioned above, the accuracy and reliability of the EPC are strongly dependent on the quality of the input data, the methodology and applied tools, and the energy assessors' expertise (Li et al., 2019). By changing the starting dataset and the assumptions made, the final results may vary. But by adopting a fully well-established methodology, the outcomes available in the future – thanks to the next-generation EPC founded on the pillars of information enrichment and improvement – will be enhanced. As shown in Figure 6, the increase of data quality foreseen in TDS5 will improve data in the future enhanced EPC database that, in turn, will improve the building stock model for subsequent scenario analyses.

In conclusion, the development of TDS5 should be seen not as a static workflow, but rather a dynamic mechanism that in subsequent states of advancement, which will be characterised by adding new and improved EPCs, will lead to increasingly accurate, reliable and representative results.

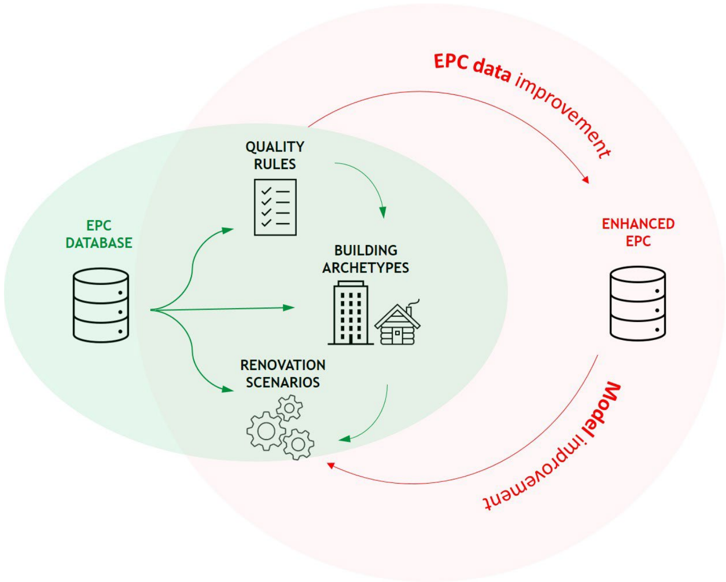

Figure 6. TDS5 objectives in the view of the enhanced EPC

3 Methodology

The methodology for the development of TDS5 is structured into different steps, as shown in Figure 7. Three main groups of the methodology workflow are identified; they mirror the main topics of TDS5, i.e., data quality checking and building archetypes, building stock energy model, and confidence intervals on input data. Each group is meant to address one of the main aspects of the enhanced EPC workflow in TIMEPAC, namely the EPC analysis, the EPC exploitation, and the EPC generation, respectively. Each group is described in a different sub-section of this section.

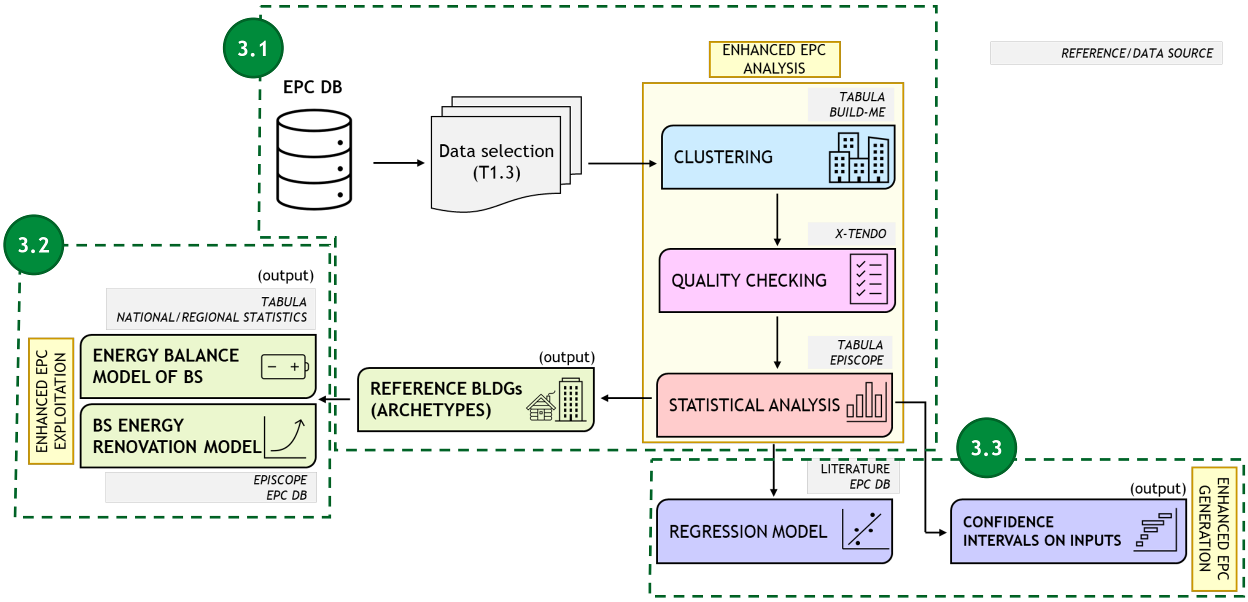

Figure 7. Methodology flowchart of TDS5. Three shaped areas identify the topics addressed in the related sub-sections of Section 3.

The methodology originates from the analysis of the regional or national EPC databases of the TIMEPAC country partners and the *Data collection sheet*, which is an outcome of Task 1.3 (see Deliverable 1.3 “Report on EPC data analysis”) and allows to identify the common set of information in the EPCs of the different countries. Once a common dataset is selected, the subsequent work encompasses (1) the clustering of energy performance certificates, (2) the EPC quality checking, and (3) the statistical analysis. The statistical analysis is then the crossroad between (4) the definition of the reference buildings (i.e., archetypes of the building stock) – which in turn allows both (5) to benchmark the energy status of the building stock and (6) to set up refurbishment scenarios to renovate the urbanised area – and (7) the development of a regression model *plus* (8) the generation of confidence intervals on some EPC input data.

The clustering approach, which has been derived from the outcomes of the TABULA and EPISCOPE projects (IEE, 2009; IEE, 2013), plays an important role in grouping buildings with similar thermo-physical properties of the opaque and transparent building envelope, as well as comparable technical building system characteristics. Once the clustering is performed, the EPC data quality-checking procedure is carried out. The procedure is based on a score attribution system that ensures the reliability of EPCs with a limited overall score error. This methodology draws inspiration from the X-tendo sister project, especially for the EPC data score attribution. The subsequent statistical analysis is carried out including only the EPCs with an acceptable scoring.

The statistical analysis is conducted for two important following phases, namely:

- the generation of the building archetypes – addressed in Section 3.1,
- the generation of the semi-empirical models that deliver confidence intervals and distribution functions of the main input data of the EPC – detailed in Section 3.3.

In turn, the archetypes are adopted in the building stock energy model presented in Section 3.2. This model encompasses the current energy balance of the building stock and the renovation scenarios performed by means of a dedicated tool.

3.1 Data quality checking and building archetypes

The first part of the methodology developed in TDS5 includes the EPC data quality checking by means of the establishing of rules and scores, and the generation of the representative buildings (archetypes) from the EPC data. The description of the methodology and an example of application are provided in Annex A – *Guidelines to create archetypes of the building stock from EPC data.*

3.2 Building stock energy model

The growing interest of municipalities and public administrations in evaluating the energy performance of their building stock for energy renovation policies has led to the adoption of Urban Building Energy Models (UBEMs). These models serve as a means to assess the energy performance of a group of buildings. To do so, UBEMs rely on reference buildings, which are average theoretical or virtual buildings representing the overall characteristics of the building stock.

In TDS5, the building stock energy model is tailored for the primary target groups, who are municipalities interested in assessing the energy performance *status* of the building stock and implementing effective refurbishment strategies to achieve climate-neutral buildings.

The building stock energy model is based on the energy performance indicators extracted from the EPCs. Utilising the information available in the library of building archetypes, the model enables the assessment of the energy performance of the entire building stock through a *bottom-up* approach.

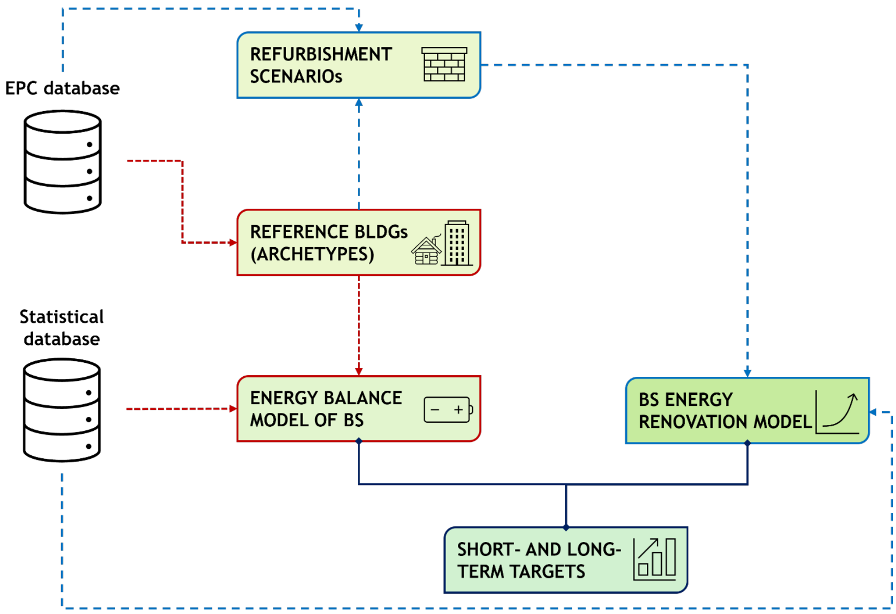

Figure 8. Building stock energy model flowchart

The flowchart that describes the logic behind the building stock energy modelling is illustrated in Figure 8. The energy intensity of the reference buildings (archetypes), developed in the previous task of TDS5 (Section 3.1), is applied as input to determine the energy performance of the building stock considered (*energy balance model of bs* in Figure 8). The energy intensity is multiplied by the building stock consistency, i.e., the total conditioned floor area for each building category (cluster). This information can be deduced from local, regional, or national statistical databases (e.g., census data), depending on the reference scale of analysis. In addition, the model allows evaluation of the impact of refurbishment scenarios to renovate the building stock (*bs energy renovation model* in Figure 8). The impact of the recommendations (*refurbishment scenarios* in Figure 8) is evaluated as a percentage energy saving on the EP indicators included in the building archetype schema.

The building stock energy model allows for a preliminary evaluation of the achievement of *short- and long-term targets*. It could be affected by the limitations of the existing EPCs, and the low quality of the information stored in the certificates. At the moment, only the residential building stock is addressed.

The building stock energy model has been implemented in a tool, as described later in Section 4.2.

3.3 Confidence intervals on input data

In this step, in order to provide a range of plausible values for the main input data from the regional or national EPC databases that affect the energy performance of buildings, Confidence Intervals (CI) are calculated. The building EPC generation process can incorporate these inferential values in the form of rules. By using confidence intervals, we can estimate the real value of a parameter based on a sample and quantify the uncertainty associated with that estimate. This enables us to draw conclusions about the population based on sample data. CI is calculated according to the following formula:

$$CI = \bar{x} \pm z_{cl} \frac{s}{\sqrt{n}}$$

Where $\bar{x}$ is the sample mean, *s* is the sample standard deviation, *n* is the sample size, and z_{cl} is the z-score for the selected confidence level. A confidence interval is calculated at a certain level, reflecting the likelihood that the estimation of a statistical parameter's location in a sample survey is also true for the population. In this case, the 95% confidence level, which is the most common one, is selected. Accordingly, the z_{95} is equal to 1,96.

Additionally, identifying distribution functions for the input data is valuable in minimising inconsistencies. This study employed kernel density estimation due to its reliability in estimating probability density functions and its potential to overcome the limitation of histograms, particularly in cases where the underlying distribution is unknown. Kernel density estimators are non-parametric density estimators, a subclass of estimation techniques. Non-parametric estimators have no pre-defined structure and rely on all data points to arrive at an estimate, unlike parametric estimators with a fixed functional form (structure). The histograms exhibit limitations that can be overcome using kernel density estimators. More detailed, the width of the bins — equal sub-intervals into which the entire data interval is divided — and the end points of the bins — where each bin begins — are important factors to consider while creating a histogram. Therefore, the histograms lack smoothness and rely on the bins' width and endpoints. Kernel density estimators can be used to solve these issues. Kernel estimators align a kernel function at each data point to eliminate dependence on the bin ends. Accordingly, we will have a smooth density estimate using a smooth kernel function. This way, we have eliminated two of the problems associated with histograms.

Furthermore, when the sample is suitable, multiple regression is performed for output and correlated input data. Regression analysis is useful for investigating interactions between variables, forecasting outcomes, and finding key components. The basic model for multiple linear regression is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p$$

Where *Y* is the dependent variable (output data), *p* is the number of independent variables (input data), and β is the regression coefficient.

Testing the null hypothesis is an important step in completing regression analysis. The null hypothesis suggests that there is no statistical significance between the two variables in the investigation. This test is carried out by calculating the *P*-value. *P*-value, in other words, assesses the degree of evidence against the null hypothesis and aids in determining the statistical significance of an observed effect. Here, the *P*-value is 0,05, a common threshold for this value. It indicates that we accept the possibility that we may have concluded an incorrect relationship 5% of the time.

The application of these theory aspects is provided in Section 4.3.

4 Application

4.1 Data quality checking and building archetypes

In the following subsections, the application of the methodology addressed in Section 3.1 and Annex A (*Guidelines*) is described for each country or region involved in TIMEPAC.

4.1.1 Austria

It was the objective to model a set of reference buildings based on the statistical analysis of EPC data that represents the energy efficiency of a subset of the Austrian building stock. The *Guidelines* provided were applied, but adjustments were made to improve the usability in the Austrian context. For this purpose, Python 3 with the statistical analysis package “Pandas” and “NumPy” for numerical computation are used.

EPC data were retrieved from the so called “ZEUS” database which is the EPC database for the Austrian province of Salzburg. For this project, ZEUS provided an anonymised data export containing data from 46.156 EPCs (applied filter: construction status completed) in the form of an Excel file. This is suitable, because Pandas is able to handle Excel sheets very well.

The produced dataframe from ZEUS contains 356 variables from which 48 were used for the analysis, as can be seen in the table below. Variables were chosen as far as possibly in accordance with the TDS5 *Guidelines*, and based on the first screening of the ZEUS data export. It is noted that an the EPC database export contains all EPC versions based on the EPBD 2002, 2010, and 2018, and the related transposition at national and regional levels. Data fields have changed, and data fields have been added, resulting in incomplete EPC records when compared to the latest EPC version transposing the amending Directive (EU) 2018/844.

Common data types are numeric (integer or float) and datetime. A Pandas-specific data type is category, which is used for variables containing repeating descriptive strings.

Table 3. Variables used in the energy efficiency analysis of the Austrian building stock; variables apply to each building

Variable	English description	Data type	Unit
Typ	Construction status completed (new buildings and renovations)	category	
Uploaddatum	Upload date of EPC	datetime	
Letztgültiger EA (entspricht umgesetzten Gebäude)	Last valid EPC	boolean	
Ganzes Gebäude	Whole building	boolean	
Nutzungsprofil	Usage profile (residential, non-residential; categories within residential and non-residential)	category	
Nutzungseinheiten im Energieausweis	Number of building units in the EPC	numeric	
Baujahr	Year of construction	numeric	
Bauweise	Construction method (building construction typology)	category	

Variable	English description	Data type	Unit
Klimaregion	Climatic region	category	
Heizgradtage 20/12	Heating degree days	numerical	kd
Heizungstyp	Heating type space heating	category	
Energieträger	Energy carrier space heating	category	
Art der Warmwasserbereitung	Water heating centralised or decentralised	category	
Typ.2	Water heating separate or combined with space heating	category	
HWB Standortklima spezifisch	Heating energy need, site-climate-specific	numeric	kWh/m²a
Warmwasserwärmebedarf Standortklima spezifisch	Hot water energy heating need, site-climate-specific	numeric	kWh/m²a
Heizenergiebedarf Standortklima spezifisch	Heating energy use, site-climate-specific (space heating + hot water + conversion losses; final energy indicator for heating)	numeric	kWh/m²a
Energieaufwandszahl Heizen	Energy expenditure number heating (efficiency of the heating system; indicator for conversion loss)	numeric	
Endenergiebedarf Standortklima spezifisch	Final energy use, site-climate-specific (heating + other uses)	numeric	kWh/m²a
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch	Non-renewable primary energy use, site-climate-specific	numeric	kWh/m²a
Primärenergiebedarf erneuerbar Standortklima spezifisch	Renewable primary energy use, site-climate-specific	numeric	kWh/m²a
Mittlerer U-Wert	Average U-value (Mean thermal transmittance of the total/opaque/transparent building envelope)	numeric	W/m²K
Kompaktheit	Compactness	numeric	1/m
Bruttovolumen konditioniert	Gross volume conditioned (Thermally heated/cooled)	numeric	m³
Gebäudehüllfläche	Thermal building envelope area	numeric	m²
Bruttogrundfläche	Gross floor area	numeric	m²

Table 4. Variables used in the energy efficiency analysis of the Austrian building stock; variables apply to a subset of buildings

	Variable	English translation	Data type	Unit
	NWG: Kühlbedarf Standortklima spezifisch	Non-residential: Cooling demand site climate specific	numeric	kWh/m²a
	NWG: Kühlenergiebedarf Standortklima spezifisch	Non-residential: Cooling energy demand site climate specific	numeric	kWh/m²a
Boiler	Nennwärmeleistung	Nominal heat output	numeric	kW
	Wirkungsgrad Vollast	Efficiency full load	numeric	%
	Wirkungsgrad Teillast	Efficiency part load	numeric	%
	Bereitschaftsverlust	Loss of readiness	numeric	%
Heat pump	Typ.1	Type of heat pump	category	
	Betriebsart	Operating mode	category	
	Anlagentyp	Plant type	category	
	Nennleistung beim Normpunkt	Nominal power at standard point	numeric	kW
	Jahresarbeitszahl	Annual performance factor	numeric	
	Leistungszahl	Coefficient Of Performance	numeric	
Solar thermal	Kollektorentyp	Collector type	category	
	Verlustfaktor	Loss factor	numeric	
	Konversionsrate	Conversion rate	numeric	
	Hilfsenergie	Auxiliary energy	numeric	W
Photovoltaic	Typ.4	Photovoltaic type	category	
	Kollektorfläche	Collector area	numeric	m²
	Maximalleistung der gesamten Anlage	Maximum power of the entire plant	numeric	kW
	Wirkungsgrad	Efficiency	numeric	%
	PV-Export Standortklima zonenbezogen	PV export, site-climate-zonal	numeric	kWh/a
	PV-Export Standortklima spezifisch	PV export, site-climate-specific	numeric	kWh/m²a

Note: The naming of the variables with unit in the ZEUS database and data analysis algorithm is "variable [unit]" e.g. "Bruttogrundfläche [m²]". For better reading the naming of the variables has been changed in this document by separating the unit from the variable.

There are conditions every dataset must fulfil, to qualify as a valid dataset that will be used. In this first step all records that do not meet these conditions are filtered out.

1. Each dataset must contain a value for the variables shown in the table below.
2. The value of “Ganzes Gebäude” (whole building) has to be True. If the value is False, the dataset would only contain information about a building zone and thus is excluded.

For further understanding of the data an investigation on which percentage of the buildings contain a value for each variable has been made.

Table 5. Percentage of existing data for mandatory variables (for the meaning of the terms, see Table 3 and Table 4)

Variable	Percentage of existing data
Typ	100,0
Uploaddatum	100,0
Letztgültiger EA (entspricht umgesetzten Gebäude)	100,0
Ganzes Gebäude	53,4
Nutzungsprofil	100,0
Nutzungseinheiten im Energieausweis	91,5
Baujahr	100,0
Bauweise	93,4
Klimaregion	100,0
Heizgradtage 20/12	99,4
Heizungstyp	99,4
Energieträger	99,1
Art der Warmwasserbereitung	92,8
Typ.2	92,8
HWB Standortklima spezifisch	99,4
Warmwasserwärmebedarf Standortklima spezifisch	52,8
Heizenergiebedarf Standortklima spezifisch	92,6
Energieaufwandszahl Heizen	52,8
Endenergiebedarf Standortklima spezifisch	92,7
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch	52,8
Primärenergiebedarf erneuerbar Standortklima spezifisch	52,8
Mittlerer U-Wert	100,0
Kompaktheit	93,4
Bruttovolumen konditioniert	100,0
Gebäudehüllfläche	100,0
Bruttogrundfläche	100,0

On a first glance, the four variables containing 52,8% existing data could appear together. This was confirmed by looking at the intersection of the datasets with existing entries for these variables (it also contains 52,8% of the original data). These data fields were only introduced in a later phase of the implementation of the EPBD.

As these are mandatory variables, all the datasets which do not hold this information must be filtered out. This concerns half of all datasets, so it is important to look at the effects this kind of filter will have on the remaining data. For this task, a binary / filtering variable was introduced, that indicates the existence of the four variables. Then a measure for the correlation between the other variables and the binary variable was calculated. For numerical variables, the Pearson method was used and for categorical variables a Chi-squared test has been performed.

Table 6. Correlation of mandatory variables with the main filtering variable (for the meaning of the terms, see Table 3 and Table 4)

Variable	Method	r value	Cramér's V	p value
Uploaddatum	Pearson	0,834		0,0
Heizenergiebedarf Standortklima spezifisch	Pearson	-0,088		0,0
Endenergiebedarf Standortklima spezifisch	Pearson	-0,049		0,0
Baujahr	Pearson	0,046		0,0
Mittlerer U-Wert	Pearson	-0,026		0,0
Heizgradtage 20/12	Pearson	0,016		0,001
Gebäudehüllfläche	Pearson	-0,016		0,001
Bruttovolumen konditioniert	Pearson	-0,015		0,002
Bruttogrundfläche	Pearson	-0,005		0,254
Kompaktheit	Pearson	0,005		0,291
Nutzungseinheiten im Energieausweis	Pearson	0,002		0,684
HWB Standortklima spezifisch	Pearson	0,002		0,631
Energieträger	Chi-squared test		0,549	0,0
Heizungstyp	Chi-squared test		0,431	0,0
Nutzungsprofil	Chi-squared test		0,309	0,0
Klimaregion	Chi-squared test		0,282	0,0
Art der Warmwasserbereitung	Chi-squared test		0,072	0,0
Bauweise	Chi-squared test		0,07	0,0
Typ.2	Chi-squared test		0,014	0,003

Firstly, the upload date strongly correlates with the filtering variable. This is expected, as it is most likely related to the introduction of a new version for the data structure in the ZEUS database. The majority of the other variables hardly correlate with the filtering variable, which is good, because this indicates that the main filtering process does not affect them.

Still there are four variables which are indeed affected, including "Energy carrier", "Heating type", "Usage profile" and "Climate region" (marked yellow in the above table). This is important for the discussion of the resulting reference buildings that should represent the energy efficiency of the building stock after a statistical analysis. Nevertheless, these effects should wear out as more and more buildings are being added to the database.

This detailed investigation was only performed for the main filtering process with the introduced filtering variable. Of course, data is also filtered out by a few other data entries missing from mandatory variables. But as it can be seen in Table 5, these effects on the data should be minor.

After all the filtering done, 37,8% of the original data remains.

The buildings are clustered into groups by using the following columns:

Column	English translation
Baujahr	Year of construction
Nutzungsprofil	Usage profile
Klimaregion	Climate region

For each column except for the climate region there are multiple possible values to belong to a certain cluster. The buildings are clustered as described in the chapters below, in accordance with the TDS5 *Guidelines*.

The year of construction is categorised according to the following construction periods:

1601-1918; 1919-1944; 1945-1960; 1961-1980; 1981-1990; 1991-2000; 2001-2010; >2010.

The values the usage profile could contain are firstly differentiated between residential and non-residential buildings. Then they are clustered into smaller categories as shown in Table 7.

Table 7. Categories of residential buildings

Residential clusters	Nutzungsprofil (usage profile)	English translation
Single-family houses of different types	EINFAMILIENHAUS_V40	One-family house
	ZWEIFAMILIENHAUS_V40	Two-family house
	REIHENHAUS_V40	Row house
	DOPPELHAUS_V40	Semi-detached house
Apartment blocks	MEHRGESCHOSSIGER_WOHNBAU_V31	Multi story housing
	MEHRFAMILIENHAUS_V40	Multifamily house

Table 8. Categories of non-residential buildings

Non-residential clusters	Nutzungsprofil (usage profile)	English translation
Offices	BUEROGEBAEUDE	Offices
Educational buildings	SCHULEN_UNBEKANNT_V2	Schools
	KINDERGARTEN	Kindergarten
	HOEHERESCHULE_HOCHSCHULE_V40	Secondary school, College
	KINDERGARTEN_PFLICHTSCHULE_V40	Kindergarten, Compulsory school
Hospitals	KRANKENHAUS	Hospital

Non-residential clusters	Nutzungsprofil (usage profile)	English translation
	PFLEGEHEIM_V40	Care home
Sports facilities	SPORTSTAETTE	Sports facility
	HALLENBAD_V40	Indoor swimming pool
	VERANSTALTUNGSSTAETTE	Event site

The climate region column holds the values "ZA" (Region Alpine Zentrallage - region alpine central location) or "NF" (Region Nord Föhngebiet - region north foehn area). These are also the values a cluster is identified with.

The clustering process also works as a kind of filtering, as only datasets with the right values get clustered. The number of datasets which hold a value that does not fall into one of the clusters corresponds to 0,61% of the remaining data after the initial filtering process.

It is stated in the *Guidelines "The aim of the EPC data quality procedure is to derive only the reliable energy certificates, whose information will be processed in the subsequent phase of the analysis*" (e.g., statistical analysis and definition of representative buildings per country/region). To accomplish this goal, the *Guidelines* present three methods of data quality check:

1. Data type checks
2. Physical impossibility checks
3. Consistency checks

In this work on the ZEUS database of the province of Salzburg, data type checks have been implemented automatically by the usage of Pandas which assigns every value a certain data type depending on its variable. For example, values which do not hold a floating point number in a numerical variable are considered NaN (not a number) and therefore discarded from the calculation of reference buildings.

Also, for some variables there have been entries with strings like "Unknown" or other meaningless values. In the clustering process, date entries with such values have been automatically removed for the climate region and usage profile variable.

Physical impossibility checks and consistency checks have not been implemented at this stage, as they are done by the calculation software and by the ZEUS database.

4.1.2 Croatia

The Ministry of Physical Planning, Construction and State Assets provided EPC database access as publicly available data represents only basic data. Overall, there are 129.281 EPCs in the database. Buildings in Croatia are divided in two climatic regions, Continental and Costal. The share is represented in Figure 9.

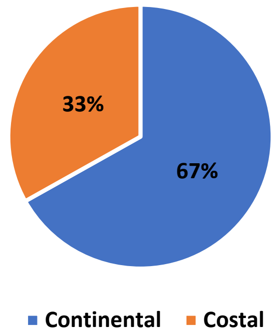

Figure 9. Share of EPCs in Croatian database according to climatic regions

Additionally, the database provides information about building category, with shares represented in Figure 10.

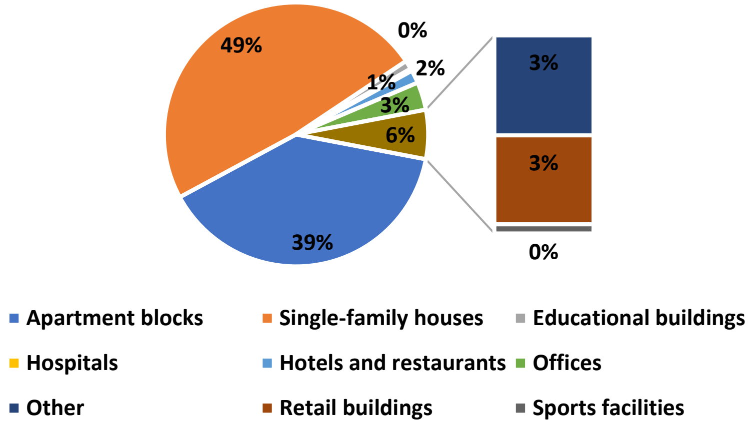

Figure 10. Share of EPCs in Croatian database according to building category

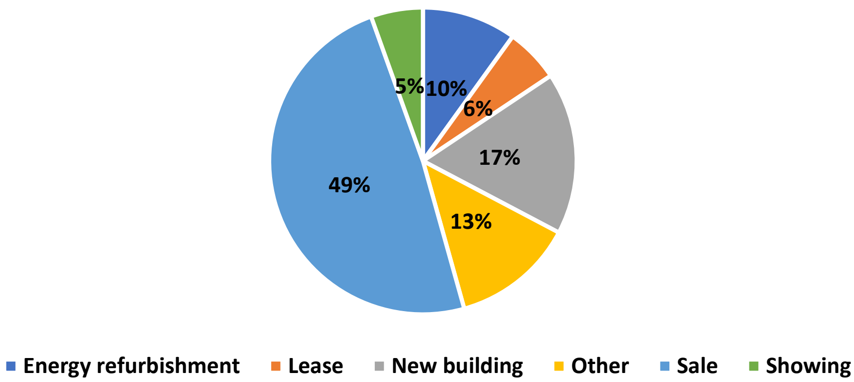

Figure 11. Share of EPCs in Croatian database according to application type

Most of the EPCs in Croatia are issued because of property sale (49%) (Figure 11) with most of thermally heated floor area below 1.000 m^2 (96%) (Figure 12). 98% of properties have space heating and 62% have space cooling service (Figure 13). Domestic hot water service is present in 97% of EPCs.

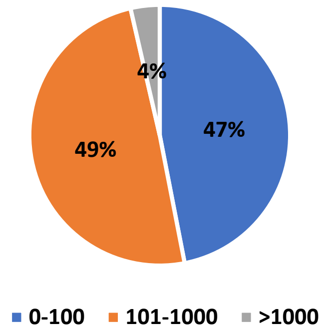

Figure 12. Share of EPCs in Croatian database according to thermally heated floor area in m^2

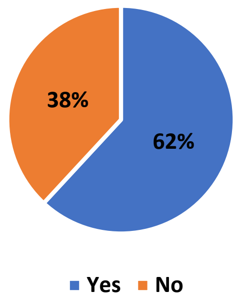

Figure 13. Share of EPCs in Croatian database according to presence of space cooling energy service

Available data from EPC database was compared to the TDS5 common methodology of EPC data selection. From 57 requested sets of data for individual EPC, the Croatian database contains 24, adding additional 6 where assumptions can be taken. It has to be emphasised that the Croatian database contains 80 sets of data for individual EPCs, but most of them cannot be linked to data in databases in other countries. The methodology for EPC quality assessment provided in the TDS5 *Guidelines* was followed closely, using the same rules, eliminating only segments that were not present in Croatian database. Unrespected rules were penalised with the same score of 0,026 for non-critical parameters, and 1 for critical parameters. The acceptability threshold was calculated for the Croatian database size, amounting to 0,50. All EPCs with acceptability threshold scores over 0,5 were discarded.

EPCs were separated according to two climate zones – Costal and Continental. In addition, another segmentation was done according to building category – residential buildings, offices, educational buildings, hospitals, sport facilities, hotels and restaurants, and retail. Buildings were then divided into 3 construction periods – till 1970, from 1971 to 2006 and 2007 and afterwards (Figure 14), making it 42 combinations.

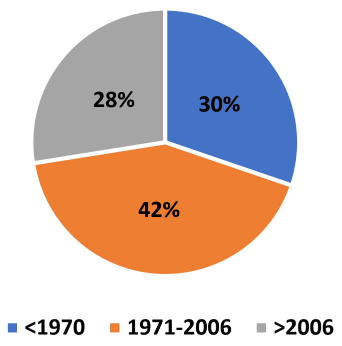

Figure 14. Share of EPCs in Croatian database according to construction period

4.1.3 Cyprus

In Cyprus, applying the methodology for data quality checking and the generation of building archetypes was conducted considering the specific context and circumstances of the country. It is important to note that while there is an obligation to issue Energy Performance Certificates in Cyprus, their widespread usage is still limited, and the sample size available for analysis was relatively small. However, it is worth mentioning that as of 2021, EPCs have become compulsory for new buildings in Cyprus, which is expected to increase data availability for future analyses.

To ensure the application of the methodology, the guidelines provided in the project proposal were followed. The available EPC data were clustered and analysed according to the proposed methodology, which involved examining various energy efficiency parameters and characteristics of the buildings. By utilizing the available data and following the proposed methodology, we generated building archetypes representative of the energy performance characteristics in Cyprus.

Given the limited sample size, it is important to note that the generated building archetypes and the resulting interquartile ranges should be interpreted cautiously. However, they provide valuable insights into the energy performance trends and characteristics of the buildings analysed in Cyprus. As shown in Annex B (Section B3), the interquartile ranges demonstrate the distribution of energy performance indicators within the available dataset.

4.1.4 Italy

For the Piemonte Region case, the procedure applied for EPC data quality checking and the building archetypes definition is faithful to the methodology provided in the *Guidelines* (Annex A). The EPC database analysed was made available by Regione Piemonte (RP).

According to Italian legislation (Italian Republic, 1993), the Piemonte Region is divided into two climatic zones: zone E (heating degree day, *HDD* – 2101 ≤ *HDD* ≤ 3000) and zone F (*HDD* ≥ 3001). Zone F, defined as the alpine and pre-alpine climatic area, encompasses the Regions with the coldest weather. On the other hand, the majority of the cities belonging to the Piemonte Region (Figure 15) are in zone climatic E (i.e., the Po Valley). For this reason, climatic zone E has been chosen as the most representative to summarise and describe the building technologies of the Piemonte Region. Therefore, the EPC data quality checking procedure and building archetype creation has been applied just to the buildings located in the Po Valley area (i.e., climatic zone E).

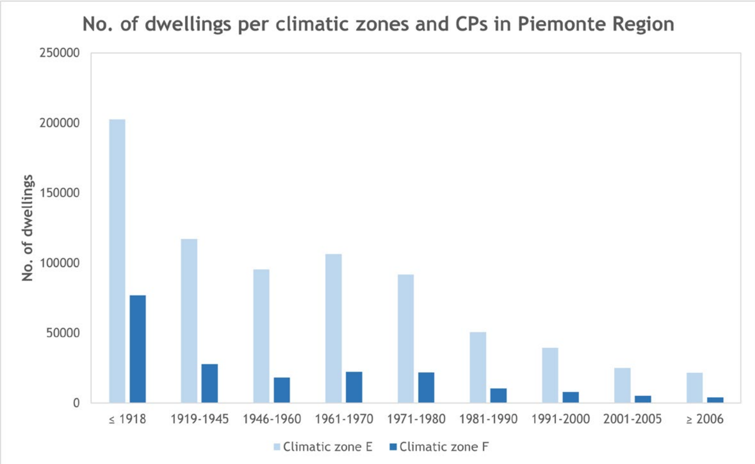

Figure 15. No. of dwellings per climatic zones and CPs in Piemonte Region (ISTAT, 2011)

The TABULA (TABULA, 2012) eight construction periods (CPs) to cluster the EPCs have been utilised (see Table 9).

Table 9. Construction period ranges (Piemonte Region)

CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
≤ 1900	1901-1920	1921-1945	1946-1960	1961-1975	1976-1990	1991-2005	> 2005

The EPCs in climatic zone E stored in the Informative System for the Energy Performance of Buildings ("Sistema Informativo per la Prestazione Energetica degli Edifici") of the Piemonte Region are just over half a million documents. The totality of EPCs divided into CPs and building use categories, according to the Italian legislation (Italian Republic, 1993) classification, have been reported in Table 10. According to this classification, the residential buildings with continuous use (i.e., code "E1(1)") are 88% of the total number of EPCs.

Table 10. Total no. of EPCs per climatic zone E in Piemonte Region

Building classif.*	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
	≤ 1900	1901-1920	1921-1945	1946-1960	1961-1975	1976-1990	1991-2005	> 2005
E1(1)	61684	18241	48306	95117	141198	48038	34650	39868
E1(1) bis	117	9	57	35	60	18	15	21

Building classif.*	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
	≤ 1900	1901-1920	1921-1945	1946-1960	1961-1975	1976-1990	1991-2005	> 2005
E1(2)	1524	225	473	404	556	361	195	272
E1(3)	225	38	76	85	81	63	61	95
E2	2733	672	1513	2367	3140	1815	2037	1503
E3	153	25	58	128	125	101	89	138
E4(1)	81	20	34	57	40	42	33	36
E4(2)	125	9	26	40	40	12	12	21
E4(3)	1018	211	446	711	655	334	322	346
E5	5624	1268	2987	5831	6633	2140	2021	2029
E6(1)	8	3	6	4	20	9	15	19
E6(2)	35	13	23	92	141	104	93	68
E6(3)	14	3	8	19	38	61	32	54
E7	178	49	112	170	340	262	83	102
E8	627	172	627	1942	2745	2588	2410	1423
* Building use categories according with the Italian legislation (Italian Republic, 1993)								

The building use categories considered in the EPC data quality checking procedure and building archetypes definition have been reported in Table 11.

Table 11. Building use categories considered (Piemonte Region)

Intended use	Bldg classif.*	Bldg type	Description
Residential	E1(1)	*BLDNGCAT_RES_SINGLE*	Single-family houses (SFHs)
	E1(1)	*BLDNGCAT_RES_BU(AB)*	Building units in multi-family houses or apartment blocks
Non-residential	E1(3)	*BLDNGCAT_HOTEL*	Hotels
	E2	*BLDNGCAT_OFF*	Offices
	E3	*BLDNGCAT_HOSP*	Hospitals
	E6(2)	*BLDNGCAT_SPORT*	Sports facilities (i.e., gyms)
	E7	*BLDNGCAT_EDUC*	Educational buildings
* Building use categories according with the Italian legislation (Italian Republic, 1993)			

In the EPC data quality checking procedure, 48 EPC parameters have been considered in the analysis. The EPC data considered are those reported in the *Guidelines* (Table A.4) to which the additional non-critical parameters in Table 12 have been added.

Moreover, compared to the critical parameters presented in Table A.4, the thermal transmittances (i.e., mean thermal transmittance of the total/opaque/transparent building envelope) were also made critical. This choice was made to lead reliable U-values to the subsequent phase of the TDS5 (i.e., confidence intervals on input data). Therefore, considering 48 EPC parameters, of which 13 are deemed as critical, results in $s = 0{,}029$ as the score for the non-critical parameter and $e = 0{,}686$ as the score for the acceptability threshold value beyond which an energy certificate, and all data contained therein, is considered rejected. As far as the database configuration of the Piemonte Region is concerned, mainly an EPC is discarded if at least one critical error is detected.

The rules associated with the EPC data and applied to the Piemonte Region are in line with the *Guidelines* (Table A.8 and Table A.9), regarding the additional consistency checks.

Table 12. EPC data rules and scores for addition EPC parameters (Piemonte Region)

Data name	Typology of rules	Rule	Respected rule (score)	Unrespected rule (score)
Year of last renovation	D, P*	string not null *or* integer ≥ 0	0,000	0,029
No. of floor	D, P	string not null *or* integer ≥ 0	0,000	0,029
Mean overall heat transfer coefficient by thermal transmission (H'_T)	D, P	decimal > 0	0,000	0,029
Energy need for domestic hot water	D, P	decimal ≥ 0	0,000	0,029
Non-renewable energy performance indicator per space cooling	D, P	decimal ≥ 0	0,000	0,029
Non-renewable energy performance indicator per domestic hot water	D, P	decimal ≥ 0	0,000	0,029
Overall renewable energy performance indicator	D, P	decimal ≥ 0	0,000	0,029
* D = data types of checks; P = physical impossibility checks				

The parameters considered in the building archetype schema are listed in Table 13. The selected data have been grouped into the following clusters: geometry, building envelope, technical building system, and energy performance indicators. Each parameter is identified by its description, symbol, and unit of measure. Moreover, the dependency of the datum on the variability of the construction period (CP) is outlined. If the independency on the CP is defined means that the parameter is the same for that building typology (i.e., offices, SFH, BU(AB), etc.). Furthermore, the two mean seasonal efficiencies of the heating generation sub-system ($\eta_{H;gn}$) are referred to as the two most used energy carriers of the analysed sample.

Table 13. Data in the building archetype schema and dependence on the construction period (CP)

	Data	Symbol	Unit of measure	Dependent on CP	Independent on CP
Geometry	Compactness ratio	CR	m^{-1}	●	
	Thermally heated gross volume	$V_{H;g}$	m^3	●	
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	●	

	Data	Symbol	Unit of measure	Dependent on CP	Independent on CP
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	●	
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	W/(m²·K)	●	
	Mean thermal transmittance of transparent building envelope	U_{wi}	W/(m²·K)	●	
Technical building system	Energy carrier per space heating				●
	Energy carrier per space cooling				●
	Energy carrier per domestic hot water				●
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 1)	$\eta_{H;gn}$	–		●
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 2)	$\eta_{H;gn}$	–		●
	Utilisation energy efficiency	$\eta_{H;u}$	–		●
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	●	
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	●	
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m²	●	
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	●	
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	●	
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	●	
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m²	●	
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m²	●	
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m²	●	
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	●	
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	●	
	Renewable Energy Ratio	*RER*	%	●	

4.1.5 Slovenia

The Ministry of Environment, climate and energy provides EPC database access, as publicly available data represents only basic data (location, energy class, age of construction, and primary energy). For research purposes additional data can be gained as well. There are two basic types of EPCs in Slovenia:

- Calculated EPC (cEPC) for either the entire building or apartment only, and
- Measured EPC (mEPC) for the entire building, which is issued based on actual data on energy consumption.

Overall, there are 85.581 EPCs in the database, 79.946 (93%) of which are cEPCs and the rest are mEPCs (7%). A consistent and complete EPC database in Slovenia does not yet exist. The current database was first established in 2013 when first EPCs were issued. Later on it was twice restructured and upgraded, which means the range of data collected was different and changed twice. Furthermore, the same datum might have a different name at different periods of database. National regulation for EPC calculation was updated in mid-2022 and the EPC database has not been updated up to today (summer 2023). The latest regulation finally adopts new indicators with consistent naming of the parameters as the latest standards, so at the moment EPC database does not collect indicators such as renewable and non-renewable primary energy.

This inconsistent data capture is the main reason why data quality checking was not done entirely by the proposed methodology. At first stage, all relevant data from EPC databases had to be extracted and put in a new database in order to establish a complete set of data for all EPCs. The methodology for quality check was the same, but calculated separately. The statistical analysis was done partially in Excel and partially in SPSS software for observed parameters.

The database provides information about building categories, with shares represented in Figure 16. It can be seen that the majority of issued EPCs are for residential buildings (92%), which comes as no surprise since this sector represents 70% of the entire building stock and the EPC is obligatory for new buildings and in real estate transactions.

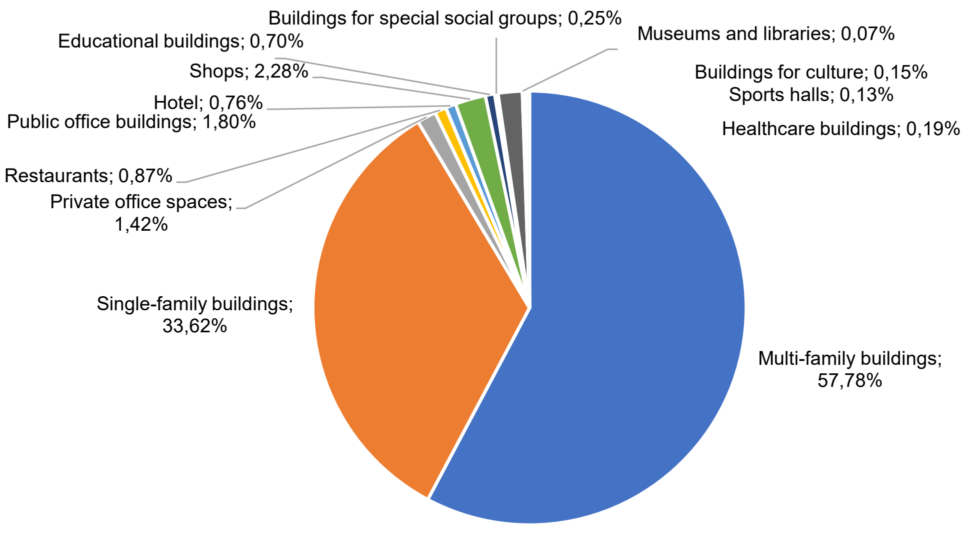

Figure 16. Share of calculated EPCs in Slovenian database according to building category

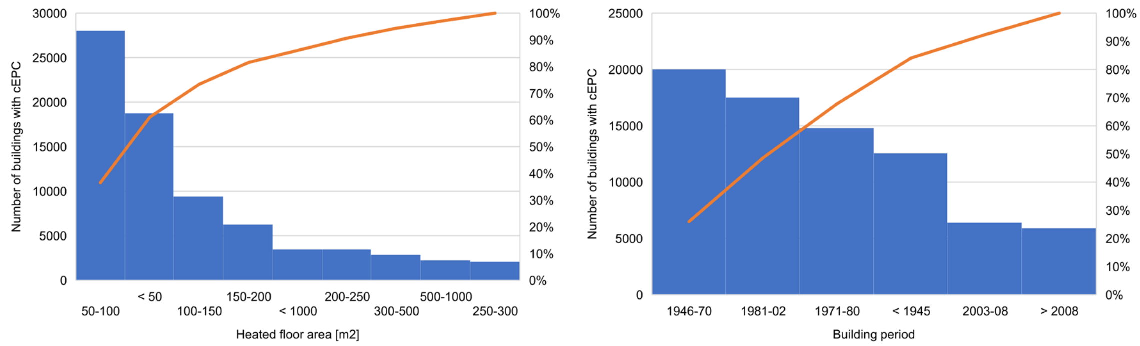

Figure 17. Share of calculated EPCs in Slovenian database according to thermally heated floor area in m^2 (left) and period of construction (right)

The results show that around 20% of the EPCs are for apartment units. The possibility to issue an EPC for an apartment only (and not for the entire building) enables an apartment owner to easily get the EPC, since the process for making an EPC for entire buildings comes with several obstacles (e.g., higher investment, more condominium owners, consents, etc.).

Around 20.000 EPCs were issued for buildings built in the period 1946-70. It can be seen from Figure 17 that the distribution of issued EPCs between individual building periods is relatively evenly weighted, except for fewer EPCs for buildings constructed since 2003.

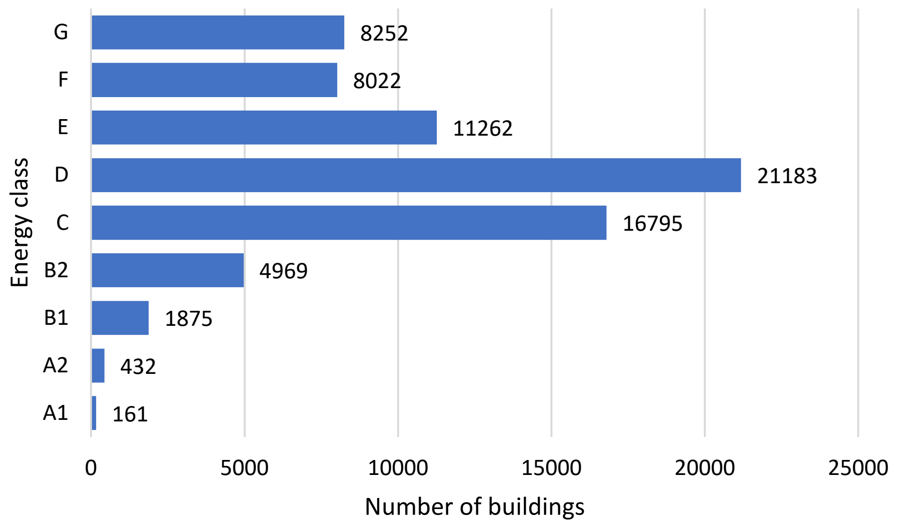

Figure 18. Number of calculated EPCs according to the energy class

National energy- and climate-related documents address the energy inefficient building stock. The analysis of an EPC database reinforces this (see Figure 19) and the vast majority of the buildings is either energy class C or lower. We analysed also the energy efficiency of 13 building types (MFH-Multi-family house, SFH - Single-family house, POS - Private office spaces, R – Restaurants, H – Hotel, SHO – Shops, EDU - Educational buildings, SSG - Buildings for special social groups, POB - Public office buildings, MUL - Museums and libraries, CUL - Buildings for culture, HCB - Healthcare buildings and SPO - Sports halls). Among the most energy-efficient building categories are EDU (kindergarten, schools) and SGG (e.g., homes for elderly people). This shows the public building owners take care of those particularly sensitive social groups.

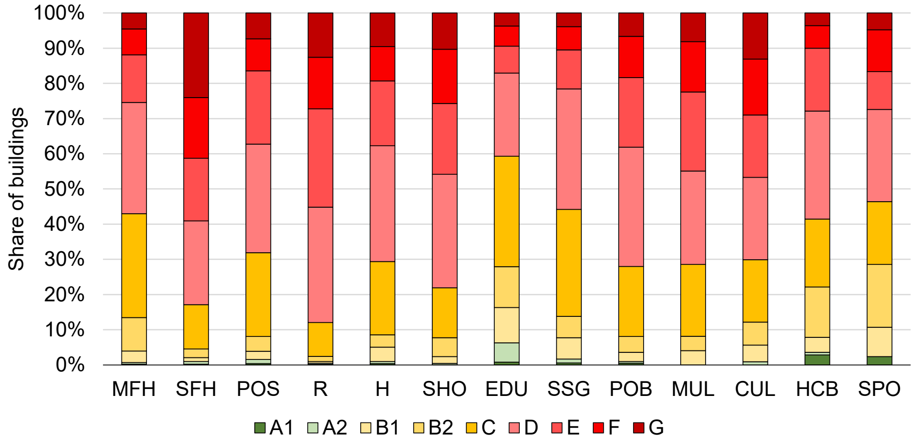

Figure 19. Share of calculated EPCs in Slovenian database according to energy class and building type

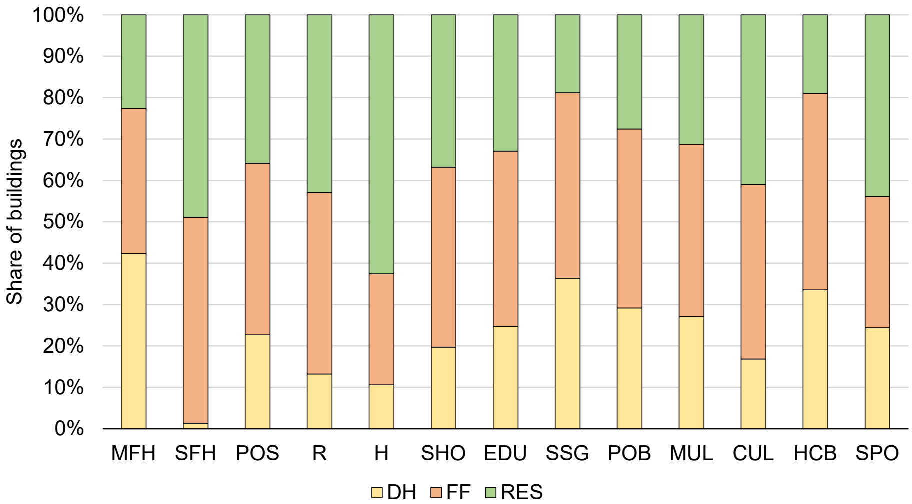

Figure 20. Share of calculated EPCs in Slovenian database according to main energy source (DH - district heating; FF - fossil fuel, RES - renewable energy source) and building type

An interesting observed indicator is the main energy source (Figure 20), which clearly shows there is still significant potential for the exploitation of technologies based on renewable energy sources. The share of DH connections on national average is around 22%, the EPC analysis shows similar results.

4.1.6 Spain

For the Catalan case, the procedure applied for EPC data quality checking and the building archetypes definition was completed according to the methodology presented in the *Guidelines* (see Annex A). The full EPC database with more than 1.400.000 EPCs has been made available by the Institut Català D'Energia (ICAEN).

The EPC data quality checking and the characterisation of the building archetypes have been carried out by using SQL commands to directly access the ICAEN's database, as the use of Microsoft Excel is not feasible due to its limitation in terms of managing the number of rows. The processes described in Annex A have been implemented through 18 query commands, out of which 17 have been employed to execute the rules for the EPC data quality checking, and one has been used to calculate the mean and interquartile values for each parameter of the archetypes. The entire processes of checking the quality of the EPCs and characterising the archetypes takes less than 10 minutes on a standard computer (Intel(R) Core (TM) i5-7500 CPU with 4 cores and 8GB RAM).

According to the Spanish legislation, the Catalonia is divided into five climatic zones: B3, C2, C3, D2, and D3. Most of the dwellings in the Catalonia are in climatic zone C2 (Figure 21).

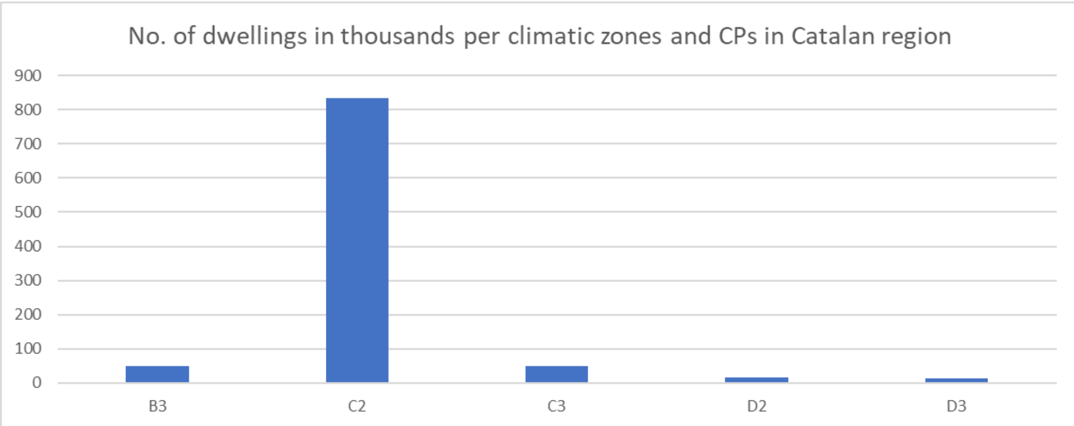

Figure 21. No. of dwellings per climatic zones and CPs in Catalan region (ICAEN, 2023)

The TABULA (TABULA, 2012) six construction periods (CPs) to cluster the EPCs have been utilised (Table 14).

Table 14. Construction period ranges (Catalan Region)

CP1	CP2	CP3	CP4	CP5	CP6
≤ 1900	1901-1936	1937-1960	1961-1980	1981-2006	> 2007

The Catalan energy performance certificates database contains over 1.400.000 records. When analysing the data based on climatic zones and construction periods, it becomes evident that the majority of EPCs belong to climatic zone C2, with buildings falling under construction periods CP4 and CP5 (Table 15). Although these statistics are significant, it is important to highlight that a comprehensive EPC data quality checking procedure has been implemented across the entire database. Additionally, building archetype creation has been carried out for multiple climatic zones, taking into account the representativeness of each zone and its corresponding construction periods.

Table 15. Total no. of EPCs per climatic zone in Catalan region

	CP1	CP2	CP3	CP4	CP5	CP6
	≤ 1900	1901-1936	1937-1960	1961-1980	1981-2006	> 2007
B3	3.215	1.520	3.442	23.453	30.208	9.103
C2	55.396	65.325	94.429	411.425	245.289	69.024
C3	3.351	1.261	2.752	20.136	31.077	9.117
D2	1.750	1.955	5.016	16.247	18.490	7.597
D3	1.895	1.245	4.147	12.869	14.004	7.930

Table 16 provides an overview of the building use categories that has been considered during the EPC data quality checking procedure and the definition of building archetypes. However, it is unfortunate that the database lacks specific information regarding tertiary buildings.

Table 16. Building use categories considered (Catalan region)

Intended use	Bldg type	Description
Residential	SFH	Single-family houses
	AB	Building units in multi-family houses or apartment blocks
Non-residential	TRY	Tertiary buildings such as offices, hospitals, hotels, …

In the EPC data quality checking procedure, 33 EPC parameters have been considered in the analysis. The EPC data have been reported in Table A.4 to which the additional parameters in Table 17 have been added.

Energy consumption for space heating, natural gas consumption, and electricity consumption have been considered as additional non-critical parameters because we had access to that data and might reveal errors in the EPC calculation. Thus, three critical parameters with specific rules have been added:

- Overall efficiency of the heating system: it must be a decimal value between 0 and 6. This range is significant because an efficiency over 6 is uncommon.
- Overall efficiency of the cooling system: it must be a decimal value between 0 and 6. This range is significant because an efficiency over 6 is uncommon.
- Ventilation rate for residential use: it must be a decimal value greater than 0.25 as this is a normative value for residential buildings.

Therefore, taking into account the 33 EPC parameters, of which 10 are deemed critical, the score for the non-critical parameter is s = 0,043, and the acceptability threshold value is e = 0,695. If the value exceeds this threshold, the energy certificate and all its data are considered rejected. In the context of the Catalan region's database configuration, an EPC is primarily discarded if at least one critical error is detected.

Table 17. EPC data rules and scores for addition EPC parameters (Catalan Region)

Data name	Typology of rules	Rule	Respected rule (score)	Unrespected rule (score)
Energy consumption for space heating	D, P	Decimal not null or decimal > 0	0,000	0,043
Natural gas consumption	D, P	Decimal not null or decimal > 0	0,000	0,043
Electricity consumption	D, P	Decimal not null or decimal > 0	0,000	0,043
Overall efficiency of the heating system	D, P, C	Decimal not null or decimal > 0 and decimal < 6	0,000	1,000
Overall efficiency of the cooling system	D, P, C	Decimal not null or decimal > 0 and decimal < 6	0,000	1,000
Ventilation rate for residential use	D, P, C	Decimal > 0,25	0,000	1,000
* D = data types of checks; P = physical impossibility checks: C= consistency checks				

The data considered in the building archetype schema are reported in Table 18. The selected data have been grouped into the following clusters: geometry, building envelope, technical building system, and energy performance indicators. Each parameter is identified by its description, symbol, and unit of measure. Moreover, the dependency of the datum on the variability of the construction period (CP) has been outlined. If the independency on the CP is defined means that the parameter is the same for that building typology (i.e., offices, SFH, BU(AB), etc.). Furthermore, the two mean seasonal efficiencies of the heating generation sub-system ($\eta_{H;gn}$) are referred to as the two most used energy carriers of the analysed sample.

Table 18. Data in building archetype schema and dependence on the construction period (CP)

	Data	Symbol	Unit of measure	Dependent on CP	Independent on CP
Geometry	Compactness ratio	CR	m^{-1}	•	
	Thermally heated gross volume	$V_{H;g}$	m^3	•	
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	•	
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	•	
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	•	
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	•	
Technical building system	Energy carrier per space heating				•
	Energy carrier per space cooling				•
	Energy carrier per domestic hot water				•
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 1)	$\eta_{H;gn}$	–		•

	Data	Symbol	Unit of measure	Dependent on CP	Independent on CP
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 2)	$\eta_{H;gn}$	–		•
	Utilisation energy efficiency	$\eta_{H;u}$	–		•
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	•	
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	•	
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	•	
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	•	
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	•	
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	•	
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	•	
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	•	
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	•	
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	•	
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	•	
	Renewable Energy Ratio	RER	%	•	

The building typology matrix for Catalan region is composed of different building use categories, construction periods, and climatic zones (Table 19). Building typologies with a representation under 10,000 EPCs have been discarded.

Table 19. Building typology matrix (Catalan region)

		CP1	CP2	CP3	CP4	CP5	CP6
		≤ 1900	1901-1936	1937-1960	1961-1980	1981-2006	> 2007
B3	AB				B3_RES_AB_CP4	B3_RES_AB_CP5	
C2	AB	C2_RES_AB_CP1	C2_RES_AB_CP2	C2_RES_AB_CP3	C2_RES_AB_CP4	C2_RES_AB_CP5	C2_RES_AB_CP6
	SFH			C2_RES_SFH_CP3	C2_RES_SFH_CP4	C2_RES_SFH_CP5	C2_RES_SFH_CP6
	TRY			C2_TRY_CP3	C2_TRY_CP4	C2_TRY_CP5	
C3	AB				C3_RES_AB_CP4	C3_RES_AB_CP5	
	SFH					C3_RES_SFH_CP5	
D2	AB				D2_RES_AB_CP4	D2_RES_AB_CP5	
D3	AB				D3_RES_AB_CP4		

4.3 Building stock energy model

In this section, the application of the building stock energy model introduced in Section 3.2 is presented firstly by describing the features of the developed tool implementing the model. Then, in the following subsections, the application of the tool is presented for each country or region involved in TIMEPAC.

The building stock energy model has been implemented in a MS Excel spreadsheet that originates from the information stored in the energy certificates. The developed tool is not intended to replace detailed UBEM simulation programs, but to exploit efficiently the energy certificates. The tool allows calculation of: (i) the energy balance of the building stock, (ii) the building stock GHG emissions, and (iii) the refurbishment scenarios.

The structure of the MS Excel spreadsheet can be summarised in the following parts:

- Library of representative buildings (see Figure 22): the analysis can be performed for residential buildings for the following three building types:
  - Single-family houses (SFH),
  - Building units in apartment blocks or multi-family houses (BU(AB)), and/or
  - Apartment blocks (AB).
- Library of energy carriers per building type: two energy carriers for each EP (i.e., $EP_{H;nren}$, $EP_{C;nren}$, $EP_{W;nren}$, $EP_{gl;nren}$) per building type can be contemplated. The building stock GHG emissions calculation is conducted by converting the primary energy to delivered energy and applying the GHG emission coefficient per energy carrier (K_{CO2e}) (see Figure 23).
- Library of EP indicators after energy efficiency measures: three refurbishment scenarios for the three specified building types (i.e., SFH, BU(AB), and AB) can be considered in the energy analysis. The impact of the energy efficiency measures is specified by variating the inserted EP indicators (i.e., $EP_{H/C/W;nd}$, $EP_{H/C/W;nren}$, and $EP_{gl;nren/ren}$).
- Baseline calculation: this part performs the calculation of the energy performance *status* of the building stock in the current state.
- Refurbishment scenario calculation: this part performs the calculation of the refurbishment scenarios. The user is able to specify the time frame to achieve the long-term targets.

	IT	symbol	uom	SFH	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
Geometry	Compactness ratio	CR	m^{-1}		0,75	0,75	0,75	0,79	0,82	0,79	0,75	0,79
	Thermally heated gross volume	$V_{H;g}$	m^3		457	461	464	453	497	517	522	534
	Thermally heated floor area	$A_{H;use;ztc}$	m^2		110	112	113	110	121	133	138	130
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%		5%	5%	5%	5%	6%	5%	6%	5%
Envelop	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$		1,295	1,297	1,270	1,170	1,052	0,980	0,793	0,338
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$		3,166	3,144	3,100	2,907	2,820	2,700	2,508	1,570
Technical building system	Energy carrier per space heating				Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)							
	Energy carrier per space cooling				Electricity = 100% (of the analysed sample)							
	Energy carrier per domestic hot water				Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)							
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–		0,917	0,917	0,917	0,917	0,917	0,917	0,917	0,917
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–		0,750	0,750	0,750	0,750	0,750	0,750	0,750	0,750
	Utilisation energy efficiency	$\eta_{H;u}$	–		0,875	0,875	0,875	0,875	0,875	0,875	0,875	0,875
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2		193,7	193,5	186,7	174,7	166,0	144,4	114,3	61,4
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2		7,3	6,5	7,5	9,2	8,2	6,4	6,3	11,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2		17,0	17,0	16,9	17,0	16,6	16,2	16,1	16,4
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–		0,730	0,730	0,730	0,730	0,740	0,740	0,760	0,800
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–		1,190	1,140	1,280	1,160	1,240	1,210	1,330	1,675
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–		0,580	0,610	0,630	0,670	0,690	0,700	0,720	0,720
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2		241,5	246,2	236,3	215,9	204,5	168,1	130,5	55,6
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2		6,6	7,3	5,1	7,5	6,9	5,3	4,9	6,8
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2		26,7	26,1	25,2	24,0	22,2	21,2	20,9	10,5
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2		270,8	273,8	265,9	242,8	228,6	192,4	153,7	72,2
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2		1,8	2,0	1,7	1,9	2,2	1,9	1,6	21,8
	Renewable Energy Ratio	RER	%		1%	1%	1%	1%	1%	1%	1%	24%

Figure 22. Building archetype schema input for SFH in the tool (example for Piemonte Region)

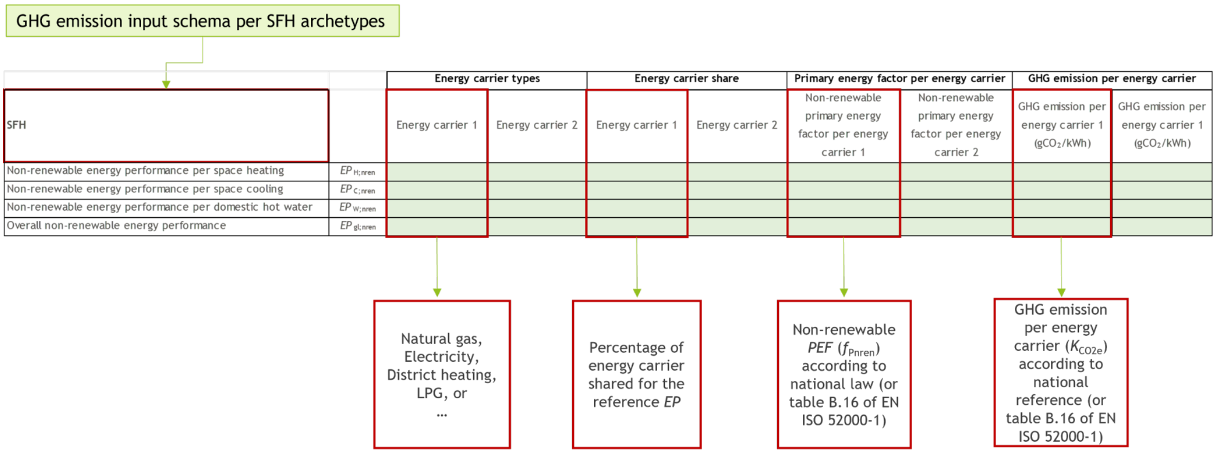

Figure 23. Building stock GHG emissions schema in the tool

The building stock energy modelling provides some limitations connected to the limitations of the current EPC data. Firstly, the calculation can be performed just for the residential building stock. The GHG emissions of the building stock are calculated from the non-renewable energy performance ($EP_{H;nren}$, $EP_{C;nren}$, and $EP_{W;nren}$) and the overall non-renewable energy performance ($EP_{gl;nren}$) indicators. So, from the primary energy index and the energy carrier typology share, the energy delivered to the generator can be estimated. Therefore, the environmental footprint of the building stock can be calculated only in the existing state and not after the application of the energy efficiency measures. This fact is due to the absence of information in the energy certificate regarding the energy carrier change after the application of the retrofit measures. In Italy, for instance, the recommendations are only evaluated through the variability of the $EP_{gl;nren}$.

The achievement of long-term targets is based on a calculation assuming the same energy savings year by year (see Figure 24).

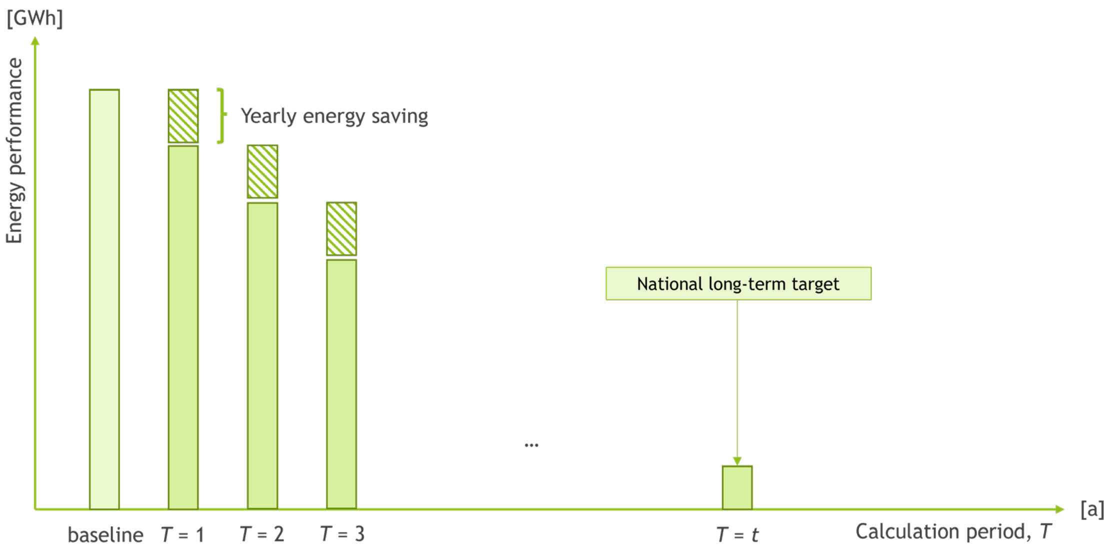

Figure 24. Assessment of long-term targets in the tool

4.3.1 Austria

The energy balance of the building stock has been calculated for residential buildings (single-family houses and apartment buildings).

This task builds on the reference buildings developed from the ZEUS EPC database as presented in Section 4.1.1.

The floor area per reference building cluster was retrieved from Statistics Austria via fee-based access to the STATcube database[14], because freely accessible publications do not contain the information in the required form. A specific query was generated and recorded as a video to simplify the subsequent application of the method.

Conversion factors (primary energy and GHG emissions) are taken from OIB Guideline 6 (OIB-330.6-026/19) (OIB, 2019), which is the official source for EPBD related calculations in Austria.

The fee-based access to the STATcube database allows for a more detailed clustering of the construction periods as shown in Table 20.

Table 20. Construction periods and code used in performing the task

Year of construction	<1919	1919-1944	1945-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2005	>2005
Construction period code	1	2	3	4	5	6	7	8	9

The energy performance indicators used to describe the building stock energy performance are presented in Table 21. This exercise is done for residential buildings only, because the sample for developing reference buildings for non-residential building types was too small.

In deviation from the guide provided for this task, cooling is not taken into account, as building regulations require residential buildings to be constructed in such a way that mechanical cooling is not necessary.

Table 21. Indicators used and English explanation

Indicator name in ZEUS	English description
Heizwärmebedarf (HWB)	Space heating energy need, site-specific
Warmwasserwärmebedarf (WWB)	Hot water heating energy need, site-specific
Heizenergiebedarf (HE)	Heating energy use, site-climate-specific (space heating + hot water + conversion losses; final energy indicator for heating)
Primärenergiebedarf Heizen (PE-HE)	Primary energy use, site-climate-specific
Primärenergiebedarf Heizen erneuerbar (PE-HE e)	Renewable primary energy use, site-climate-specific
Primärenergiebedarf Heizen nicht-erneuerbar (PE-HE ne)	Non-renewable primary energy use, site-climate-specific

While the first three indicators are given by the calculated reference building for each cluster, the primary energy indicators are calculated using the “Heizenergiebedarf” and the energy-carrier

[14] statistik.at/en/databases/statcube-statistical-database.

dependent conversion factors from the OIB Guideline (OIB, 2019). This procedure was necessary because in the EPC, the primary energy indicator is calculated based on total final energy demand which also includes electricity consumption for lighting and other uses such as appliances. The same applies to the GHG indicator in the EPC.

The GHG emissions are also calculated from the "Heizenergiebedarf" using the energy-carrier dependent conversion factors from the OIB Guideline (OIB, 2019).

Since the conversion factors of the primary energy indicators and the GHG emissions are energy-carrier dependent, the share of the "Heizenergiebedarf" per each energy carrier has to be evaluated. To achieve this, it is assumed that the average amount of the "Heizenergiebedarf" consumed of the buildings inside a cluster using different energy carriers is constant. In this case, the percentage energy carrier share can be directly applied to the percentage "Heizenergiebedarf" share of the of the different energy carriers.

Now the primary energies and the GHG emissions can be calculated for each energy carrier using the "Heizenergiebedarf" share per energy carrier and the conversion factors from OIB Guideline 6 (2019) which are presented in Table 22.

Table 22. Conversion factors according to OIB Guidleine 6 (OIB-330.6-026/19)

		f_{PE} [-]	$f_{PE,n.ern}$ [-]	$f_{PE, ern}$ [-]	$f_{CO2\ equ}$ [g/kWh]
Energy Carrier (German language in database)	**Energy Carrier (English translation)**	**Primary energy factor**	**Primary energy factor non-renewable**	**Primary energy factor renewable**	**Emission factors CO2equ**
Kohle	Coal	1,46	1,46	0,00	375
Heizöl	Domestic heating oil	1,20	1,20	0,00	310
Erdgas	Natural gas	1,10	1,10	0,00	247
Biomasse (Biobrennstoffe fest)	Biomass (solid biofuels)	1,13	0,10	1,03	17
Biobrennstoffe flüssig (Inselbetrieb)	Liquid biofuels (stand-alone operation)	1,50	0,50	1,00	70
Biobrennstoffe gasförmig (Inselbetrieb)	Gaseous biofuels (stand-alone operation)	1,40	0,40	1,00	100
Strom (Liefermix)	Electricity (supply mix)	1,63	1,02	0,61	227
Fernwärme aus Heizwerk (erneuerbar)	District heating from heating plant (renewable)	1,60	0,28	1,32	59
Fernwärme aus Heizwerk (nicht erneuerbar)	District heating from heating plant (non-renewable)	1,51	1,37	0,14	310
Fernwärme aus hocheffizienter KWK	District heating from high-efficiency CHP	0,88	0,00	0,88	75
Abwärme	Waste heat	1,00	1,00	0,00	22

Since the energy carriers described in the OIB Guideline 6 (2019) and the energy carriers from the reference buildings (originally the EPCs) do not match exactly, an allocation was made to create this match.

So far in this exercise, specific indicators for energy performance and GHG emissions have been given, e.g., [kWh/m^{2}a]. To obtain absolute values in terms of energy consumption per year, the results need to be multiplied by the total floor area of each cluster.

A reference building cluster is characterised by three variables:

- Climate region
- Construction period
- Building type (Single-family house or Apartment block)

With the database user interface named STATcube portal provided by Statistics Austria, it is possible to retrieve the following data for each municipality as shown in Table 23 for the example of City of Salzburg (not to be confused with the Province of Salzburg). This is the total net floor area (“Nutzfläche”) per construction period (“Bauperiode”), building type (“Gebäudeeigenschaft”) and municipality (Region).

Table 23. Net floor area of residential buildings according to construction period: City of Salzburg (municipality code <50101>)

Region	Gebäudeeigenschaft (überwiegende Nutzung)	Bauperiode	Nutzfläche in Quadratmetern
Municipality	**Building type**	**Construction period**	**Net floor area [m^2]**
Salzburg <50101>	Wohngebäude mit einer Wohnung (residential buildings with one apartment)	Until 1919	52508
		1919 to 1944	106629
		1945 to 1960	213854
		1961 to 1970	190669
		1971 to 1980	149345
		1981 to 1990	132892
		1991 to 2000	121603
		2001 to 2005	65611
		2006 and later	59620
	Wohngebäude mit zwei Wohnungen (residential buildings with two apartments)	Until 1919	52722
		1919 to 1944	65122
		1945 to 1960	108807
		1961 to 1970	83873
		1971 to 1980	67995
		1981 to 1990	36645
		1991 to 2000	21164
		2001 to 2005	14234
		2006 and later	11119
		Until 1919	416657

Region	Gebäudeeigenschaft (überwiegende Nutzung)	Bauperiode	Nutzfläche in Quadratmetern
Municipality	**Building type**	**Construction period**	**Net floor area [m²]**
	Wohngebäude mit drei und mehr Wohnungen (residential buildings with two or more apartments)	1919 to 1944	318491
		1945 to 1960	575121
		1961 to 1970	1029876
		1971 to 1980	884728
		1981 to 1990	435347
		1991 to 2000	356076
		2001 to 2005	224838
		2006 and later	276839
...	...	...	...

Buildings with one apartment were considered as single-family houses and buildings with two or more apartments as apartment blocks.

A closer look at the ZEUS EPC data revealed that most buildings inside a municipality belong to the same climate region, so the climate region of the majority of the buildings of a municipality was used to determine the climate region of each municipality.

Net floor areas of the municipalities in the same climate region were summarised. Then total floor area for each cluster and climate region can be calculated for the province of Salzburg. Via multiplication with the energy performance indicators and the GHG emissions, the absolute values per year were computed.

4.3.2 Croatia

The building stock energy model was developed using the tool for residential sector. Analysis was done for single family houses and apartment buildings. Median values were taken from statistical analysis of the EPC database (segmenting only residential sector). Some values were approximated according to the EPC calculation methodology (e.g., hot water energy need). The overall building stock floor area was taken from long term building renovation strategy (Croatian Republic, 2020).

4.3.3 Cyprus

In the case of Cyprus, the application of the energy balance of the building stock tool was not feasible due to the current state of EPCs in the country. The low number of available EPC samples hindered the accurate implementation of the tool, making it challenging to derive reliable and representative results.

The limited availability of EPC data posed significant constraints on sourcing the necessary numerical consistency required for the energy balance calculations. Due to the small sample size, generating statistically meaningful insights or accurately assessing the energy performance of the overall building stock in Cyprus was impossible.

Given these limitations, it was necessary to acknowledge that the application of the energy balance tool in Cyprus was not feasible during the timeframe of this project. The scarcity of available EPCs restricted the ability to make accurate assumptions and calculations necessary for the tool's implementation.

EPCs in Cyprus for buildings intended for sale or rent have been compulsory since 2010. In late 2015, the government implemented additional regulations mandating the purchase and rental of only high energy-efficient buildings by the central government, specifically those with an energy class of B or higher. Currently, the proportion of EPCs issued for existing buildings constitutes only 10,6% of the total EPCs issued (Hadjinicolaou, 2020).

It is crucial to note that the unavailability of a comprehensive dataset for the energy balance tool does not imply a lack of importance or commitment to energy efficiency in Cyprus. Efforts are underway and are included in the National Energy and Climate Action Plan which is revised in 2023, which requires the revision of sale and rental legislation and the further connection of the EPC with financial incentives.

4.3.4 Italy

The energy balance of the building stock has been calculated for residential buildings, more precisely for SFHs and BU(AB), by applying the tool.

The geometrical consistency of the residential buildings has been derived from the statistical survey of the Italian National Institute of Statistics (ISTAT). The information presented in Figure 25, Figure 26, and Figure 27 has been utilised to characterise the geometry of the residential Piemonte Region building stock. Firstly, the CPs defined by ISTAT (Figure 25) have been converted to the CPs of TABULA and adopted in TDS5. Secondly, the number of dwellings per building (Figure 26) is crucial to distinguish between SFH (i.e., the building unit corresponds with the building) and building units in multi-family houses or apartment blocks (i.e., building with more building units). Finally, in Figure 27 the percentage distribution of residential buildings per class of floor area is shown. The three clusters with the largest surface area class have been associated with SFHs.

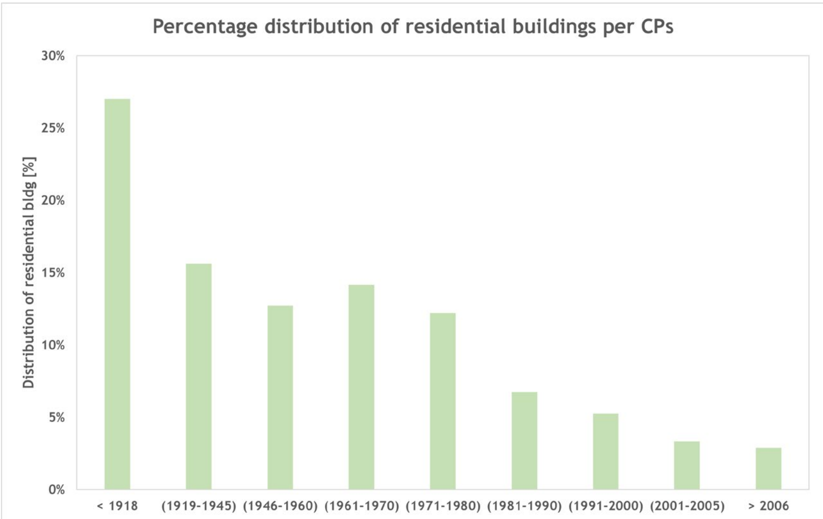

Figure 25. Distribution of residential buildings per CPs (Piemonte Region; ISTAT, 2011)

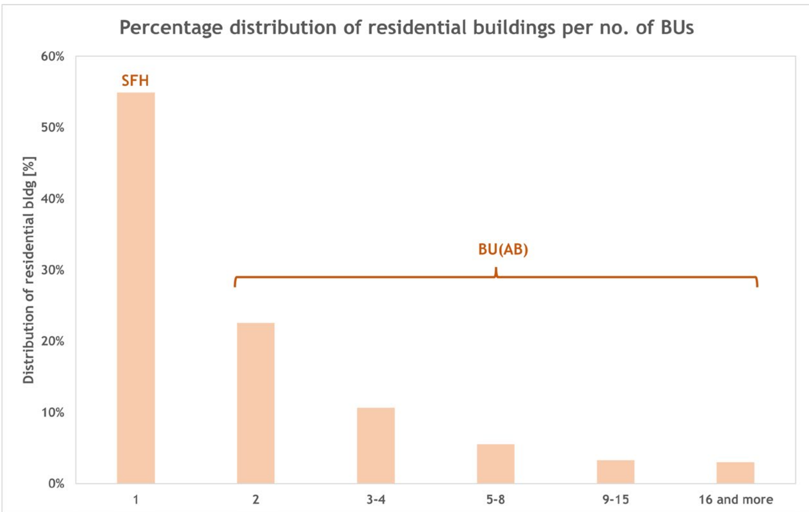

Figure 26. Distribution of residential buildings per no. of building units (Piemonte Region; ISTAT, 2011)

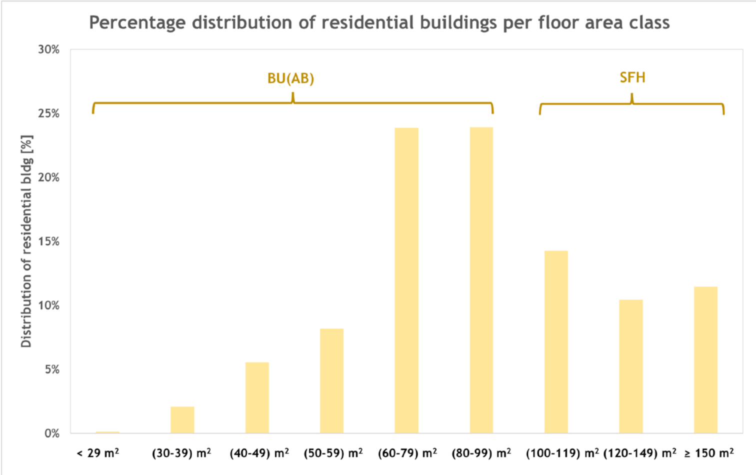

Figure 27. Distribution of residential buildings per class of floor area (Piemonte Region; ISTAT, 2011)

The *EP* indicators have been derived from the SFH and BU(AB) archetype schema of the previous task of TDS5. The energy performance *status* of the existing Piemonte Region building stock has been carried out considering every *EP* indicator (i.e., $EP_{H;nd}$, $EP_{C;nd}$, $EP_{W;nd}$, $EP_{H;nren}$, $EP_{C;nren}$, $EP_{W;nren}$, $EP_{gl;nren}$, and $EP_{gl;ren}$).

For the energy refurbishment scenarios, the analysis only relied on the information contained in the EPC. Therefore, just the variability of the overall non-renewable energy performance indicator ($EP_{gl;nren}$) has been considered in the analysis. That is because, in the recommendation section of the Piemonte Region EPC schema, the effectiveness of an energy efficiency measure is only evaluated by the variation of $EP_{gl;nren}$.

According to the Piemonte Region EPC schema, the energy efficiency measures in the recommendation section are grouped into six groups: REN1, REN2, REN3, REN4, REN5, and REN6. Each retrofit measure is referred to specific interventions (see Table 24) based on the renovation of the building fabric (from REN1 to REN2) and the technical building system (from REN3 to REN6).

Table 24. Recommendations considered in the Piemonte Region EPC schema

System	REN code	Energy efficiency measure description
Building fabric	REN1	Opaque building envelope
	REN2	Transparent building envelope
Technical building system	REN3	Space heating system
	REN4	Space cooling system
	REN5	Other systems
	REN6	Renewable plants

For each recommended energy efficiency measure (REN) in the EPC database, the frequency of prevalence of each RENs for each construction period and SFH and BU(AB) has been examined (see Figure 28). In each defined cluster, the renovation of the opaque building envelope is the prevailing measure (i.e., REN1). The second measure considered technically more feasible in Piemonte Region is the replacement of windows with more energy-efficient ones (i.e., REN2). The third most widespread retrofit measure is related to the replacement of the technical building system for space heating. The introduction of policies (Italian Republic, 2021) to encourage the promotion and exploitation of renewable energy sources can be seen in more recent CPs, especially in SFHs (Figure 28).

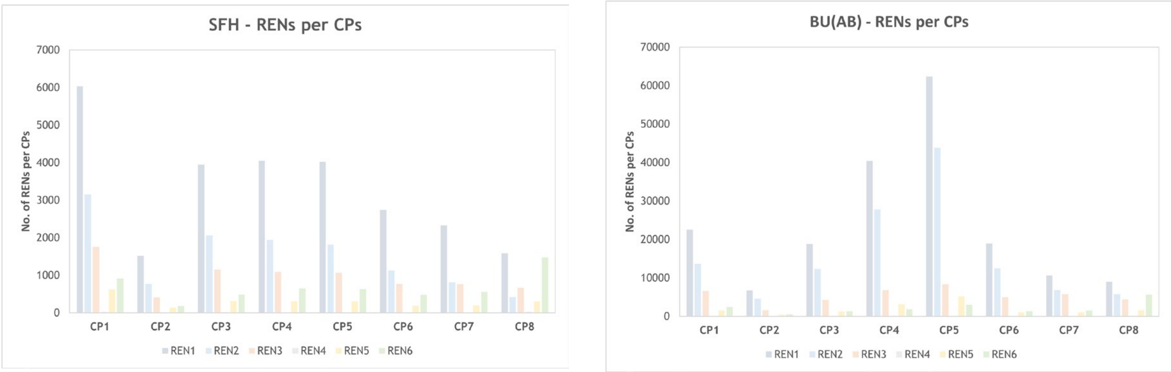

Figure 28. Recommendations frequency per CP for SFHs and BU(AB) in the Piemonte Region EPC database

The combinations of measures presented in the EPC database have been analysed to propose energy refurbishment scenarios; Figure 29 shows the single or simultaneous application of multiple energy efficiency measures on the same building. 71% of the analysed sample for SFH and 77% for BU(AB) encourages the single energy retrofit measure. Instead, about 20% proposes at least two RENs.

The majority of the applied RENs are related to the renovation of the opaque and transparent building envelope and the renovation of the technical building system for space heating. The decrease of the overall non-renewable energy performance indicator for the most widespread RENs and the combination of REN1, REN2, and REN3 are shown in Figure 30 and Figure 31.

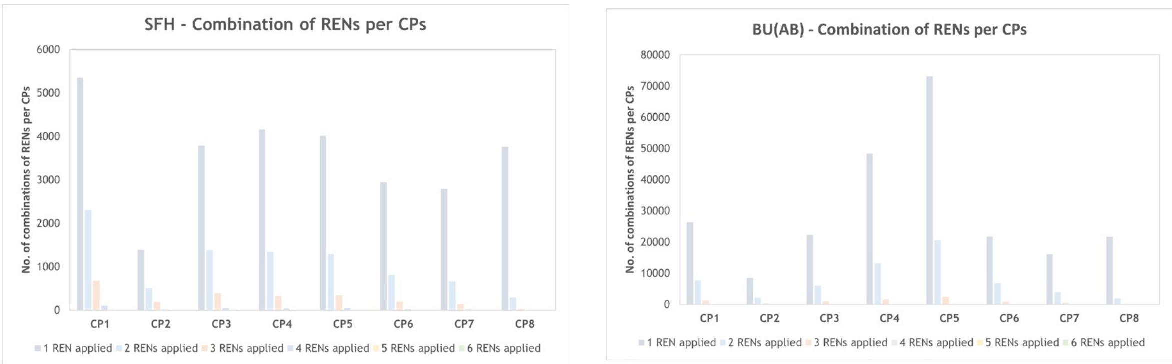

Figure 29. Combination of recommendations frequency per CP for SFHs and BU(AB) in the Piemonte Region EPC database

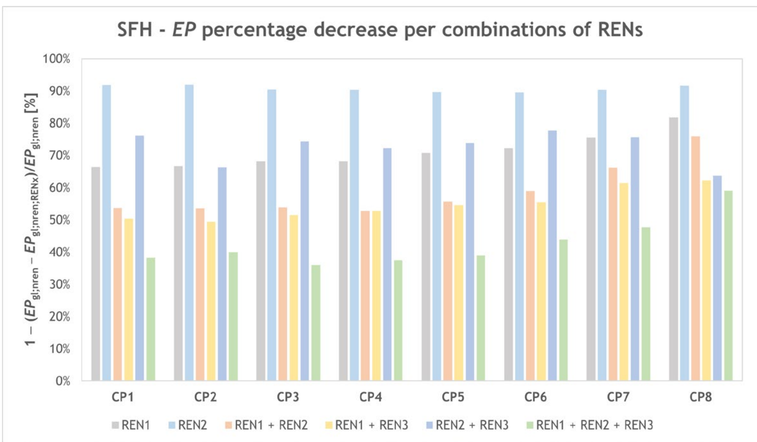

Figure 30. *EP* percentage decrease per single or combination of measures for SFH in Piemonte Region (derived from the EPC database)

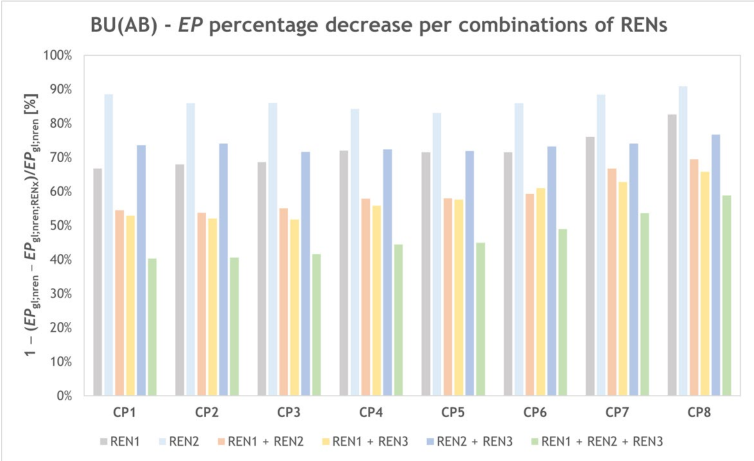

Figure 31. *EP* percentage decrease per single or combination of measures for BU(AB) in Piemonte Region (derived from the EPC database)

In light of the presented results, the retrofit measures chosen for developing the scenarios are the renovation of the opaque building envelope (i.e., REN1), the renovation of the opaque and transparent building envelope (i.e., REN1 + REN2), and the renovation of the opaque building envelope and replacement of the space heating system (i.e., REN1 + REN3).

The non-renewable primary energy factors (PEFs) per energy carrier have been extracted from Italian legislation (Italian Republic, 2015). Moreover, the CO_2 emission coefficient (K_{CO2e}) per energy carrier has been derived from the Italian National Annex of UNI EN ISO 52000-1 (CTI, 2022).

4.3.5 Slovenia

The main data source to determine the total floor area of residential buildings in North Primorska Region is the Register of Real Estate (REN), accessible at Geodetic Administration of the Republic of Slovenia (GURS). One of the biggest challenges is linking the energy performance related data of a particular building across all relevant databases, since each data source has been established separately since 2007. The REN register, managed by GURS, keeps complete (actual) data on the renovation of thermal envelope components up to 2008 with minor updates up to 2014. Moreover, the Slovenian Eco Fund keeps data of conferred national subsidies for thermal envelope components and building systems from 2008.

The EPC register was established in 2013 by the responsible Ministry and linked into the database of GURS. The EPC register stores the energy indicators and data on energy carriers per certified building. The REN database was used to determine total floor area of single-family buildings (SFH) as well as apartment blocks (AB) by the buildings period by the *bottom-up* approach. What could be further improved is disaggregation of buildings by their actual technical potential for energy renovation. If the building has not been renovated yet, it has potential for deep energy renovation. But on the other hand, if a façade and roof were previously renovated, the actual potential is smaller and such buildings present potential for only partial renovation. Such approach requires more detailed knowledge of the buildings stock and data can be derived from either EPC or institution that gives out grants for energy efficiency measures, such as the Slovenian Eco Fund.

The overall assumption is that the buildings have the same energy status in the baseline year and renovation scenarios can be applied to all of them. This might not be the actual case, so the final results can underestimate the overall energy balance. The actual condition of the building stock might be better, more efficient and thus the energy balance lower.

The baseline buildings for each building period derive from the EPC statistical analysis, but the improvement of energy performance was calculated with monthly method for each one.

The baseline energy source considered was the most dominant one that was identified in the EPC database for SFH and AB. Since the heat supply is quite diverse, the prevailing energy source for SFH is fuel oil with total share of around 40%. For the AB the prevailing energy source is district heating with total share of around 55%. Using this as the assumptions for entire building stock and conducting the energy balance calculations has several limitations that can be enhanced in the future.

4.3.6 Spain

The energy balance of the building stock has been calculated for residential buildings, more precisely for SFHs and BU(AB) of the C2 climatic zone, as it has the highest number of buildings.

Figure 32 shows the percentage distribution of residential buildings in Catalonia by construction period. The chart shows that the majority of residential buildings in Catalonia were built during CP4 and CP5, with a smaller percentage built during CP1, CP2, CP3 and CP6. The chart also shows that apartment buildings (AB) make up most residential buildings in Catalonia, followed by single-family homes (SFH).

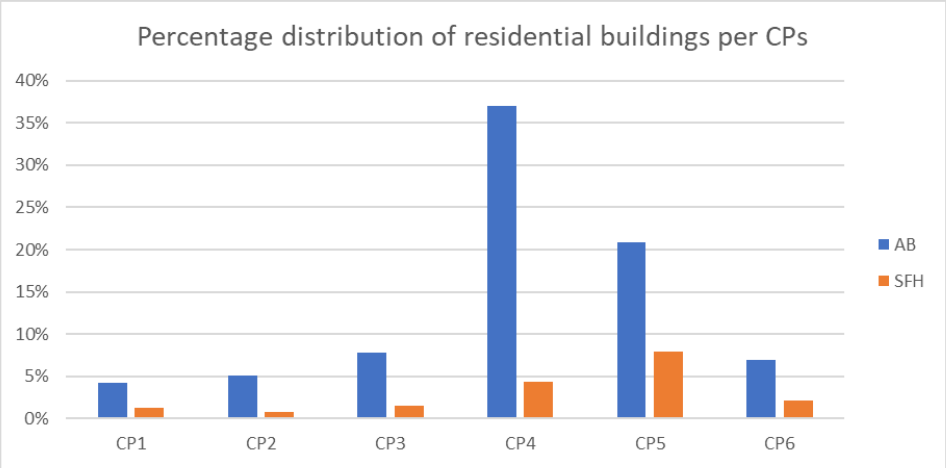

Figure 32. Distribution of residential buildings per CPs (Catalan Region; ICAEN, 2023)

The data presented in Figure 33 highlights the distribution of residential buildings in Catalonia based on their size. It reveals that a significant portion of residential buildings in Catalonia are relatively small, encompassing less than 100 square meters of floor space. Within this size range, apartment blocks are more prevalent than single-family homes, accounting for approximately 60% of all buildings.

However, as the floor space increases, there is a noticeable shift in the composition of residential buildings. The proportion of single-family homes increases relative to apartment blocks. Currently, single-family houses represent 18% of all buildings in Catalonia, with 8% of them classified as larger houses exceeding 120 square meters.

In summary, the majority of residential buildings in Catalonia are compact, with apartment blocks being more common than single-family homes in this size category.

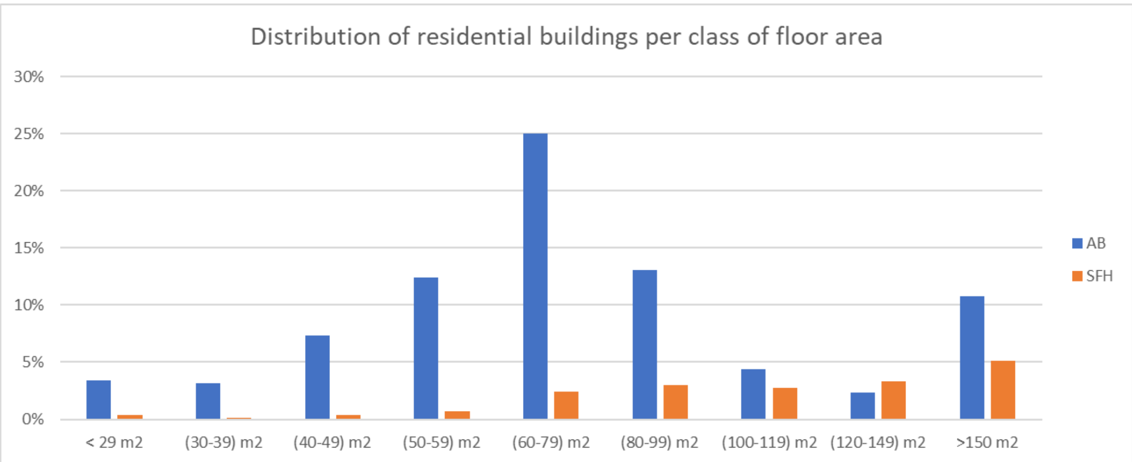

Figure 33. Distribution of residential buildings per class of floor area (Catalan Region; ICAEN, 2023)

The *EP* indicators have been derived from the SFH and BU(AB) archetype schema of the previous task of TDS5. The energy performance *status* of the existing building stock has been carried out considering every *EP* indicator (i.e., $EP_{H;nd}$, $EP_{C;nd}$, $EP_{W;nd}$, $EP_{H;nren}$, $EP_{C;nren}$, $EP_{W;nren}$, $EP_{gl;nren}$, and $EP_{gl;ren}$).

4.4 Confidence intervals on input data

According to the EPC data availability comparison table of Task 1.3 (see Deliverable 1.3 "Report on EPC data analysis"), the energy need for space heating ($EP_{H;nd;ztc;an}$) is the only energy output given in all EPC databases of the six TIMEPAC countries. By reviewing the literature (Goudarzi, 2019; Sun, 2020; Seyedzadeh, 2020), the most correlated input data to $EP_{H;nd;ztc;an}$ are: the mean thermal transmittance of the opaque building envelope (U_{op}), the mean thermal transmittance of the transparent building envelope (U_{wi}), the ratio between transparent thermal envelope area and thermal envelope area (A_{wi}/A_{env}), and compactness ratio (CR). These input data are reported for the building archetypes identification as well.

In this case, confidence intervals were calculated for the input data obtained from the Piemonte Region energy certificates database taken as an example. These intervals were computed separately for each building typology and construction period. Furthermore, RStudio was utilised to plot the kernel density functions for the same input data to identify their distribution.

To complete the statistical analysis, it is essential to have accurate input data from reliable energy certificates. Hence, the same data quality checking method used to create archetypes addressed in Section 3.1 is applied before calculating the confidence intervals.

In the next step, multiple regression is applied to explore the relationship between the dependent variable ($EP_{H;nd;ztc;an}$), normalised to the heating degree days (HDD), and independent variables (U_{op}, U_{wi}, A_{wi}/A_{env}, CR). To check data quality, in contrast to calculating the CI, EPCs with an overall score greater than zero are excluded from the regression analysis. This is because, in regression, all the input and output data of an EPC, treated as a sample, need to be reliable. The analysis was performed using MS Excel.

5 Results and discussion

5.1 Data quality checking and building archetypes

In the following subsections, the results of the data quality checking and the creation of the building archetypes are presented for each country or region involved in TIMEPAC.

5.1.1 Austria

In this sub-section, the construction periods will be referred to as shown in Table 25. Also, the climate region will be indicated by NF (region north foehn area) and ZA (region alpine central location), the building type single family house as SFH and apartment blocks as MUH.

Table 25. Designation of the construction periods

Year of construction	1601-1918	1919-1944	1945-1960	1961-1980	1981-1990	1991-2000	2001-2010	>2010
Construction period	1	2	3	4	5	6	7	8

For a visual representation of the filtered data, three different types of diagrams are used.

1. **Grouped Boxplot**

Every basic boxplot contains three key elements:

- the first quartile Q_1, i.e., the first 25% of the statistical distribution
- the second quartile Q_2, i.e., the median value
- the third quartile Q_3, i.e., 75% of the data falls below the third quartile

The majority of boxplots also contain additional information which can differ. As we used the Pandas package for plotting the plots contain the so-called whiskers and outliers. From the official Pandas documentation:

*The whiskers extend from the edges of box to show the range of the data. By default, they extend no more than 1,5 * IQR ($IQR = Q_3 – Q_1$) from the edges of the box, ending at the farthest data point within that interval. Outliers are plotted as separate dots.*

To better understand how certain variables evolved over time, the data represented in boxplots is grouped by the construction periods, as can be seen in Figure 34 as example plot.

To get a better feeling for the data, we also experimented with visualising the actual datapoints as scattered dots inside the boxplots. The result is shown in Figure 35.

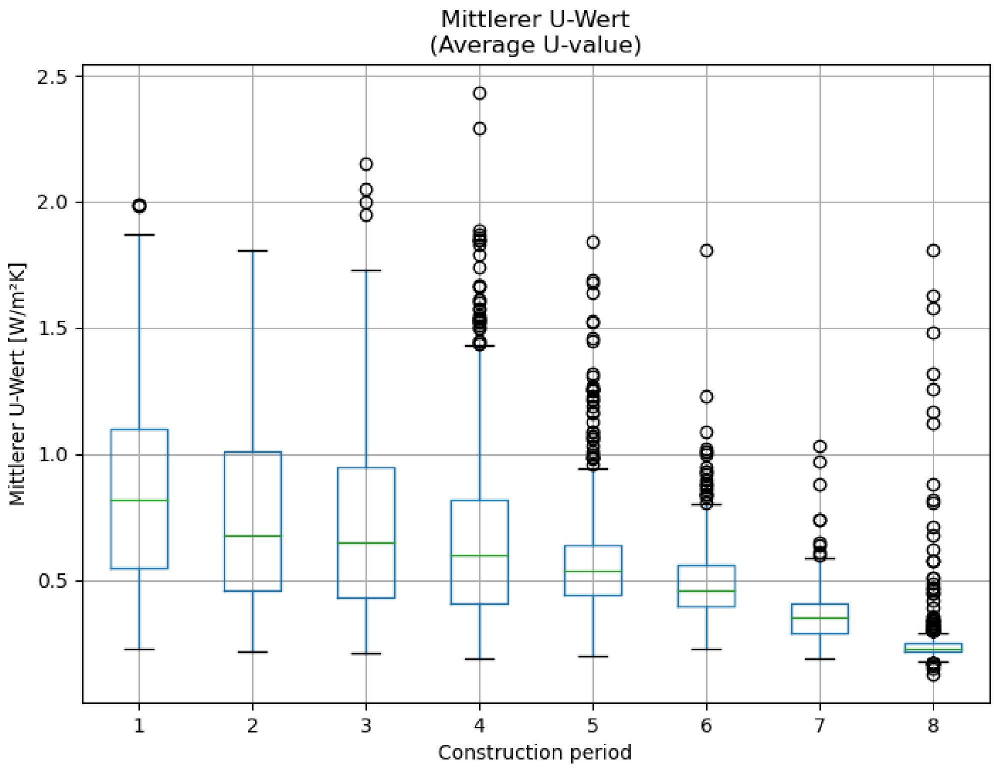

Figure 34. NF; SFH; Boxplot of the average *U*-value grouped by construction periods

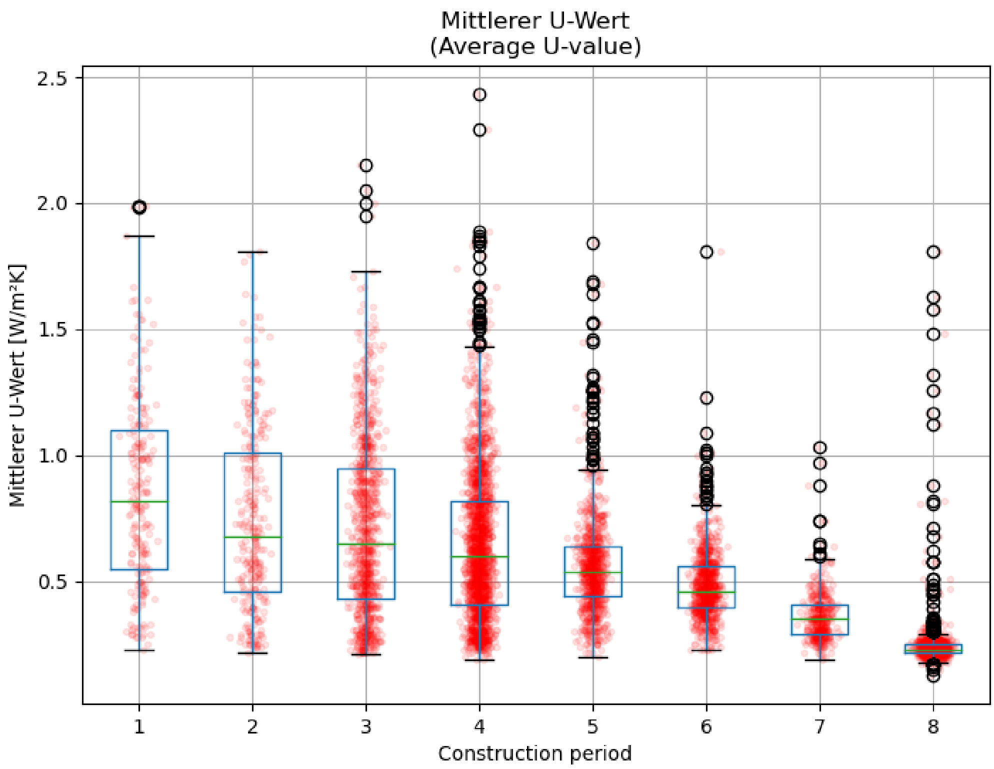

Figure 35. NF; SFH; Boxplot and datapoints of the average *U*-value grouped by construction periods

2. Grouped relative frequency plot

Many variables of the main technical building system are not mandatory to exist but relevant if existent. The percentage of buildings containing a variable, e.g., indicating a photovoltaic system, is visualised in a frequency plot. In this case the percentages are grouped by the construction periods, so the percentage of buildings containing a technical system build in a certain year is represented.

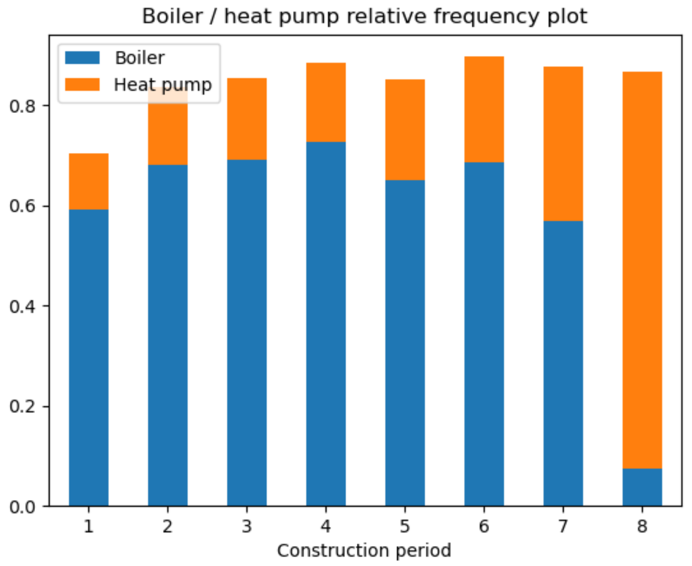

Figure 36. NF; SFH; Grouped frequency plot of the buildings percentage containing a boiler / heat pump

3. Relative frequency plot

Many important variables are categorical and the percentage of buildings containing a certain category is the interesting information visualised in a relative frequency plot. This time the buildings are not grouped into construction periods, but it could be done in future versions. An example plot can be seen in Figure 37.

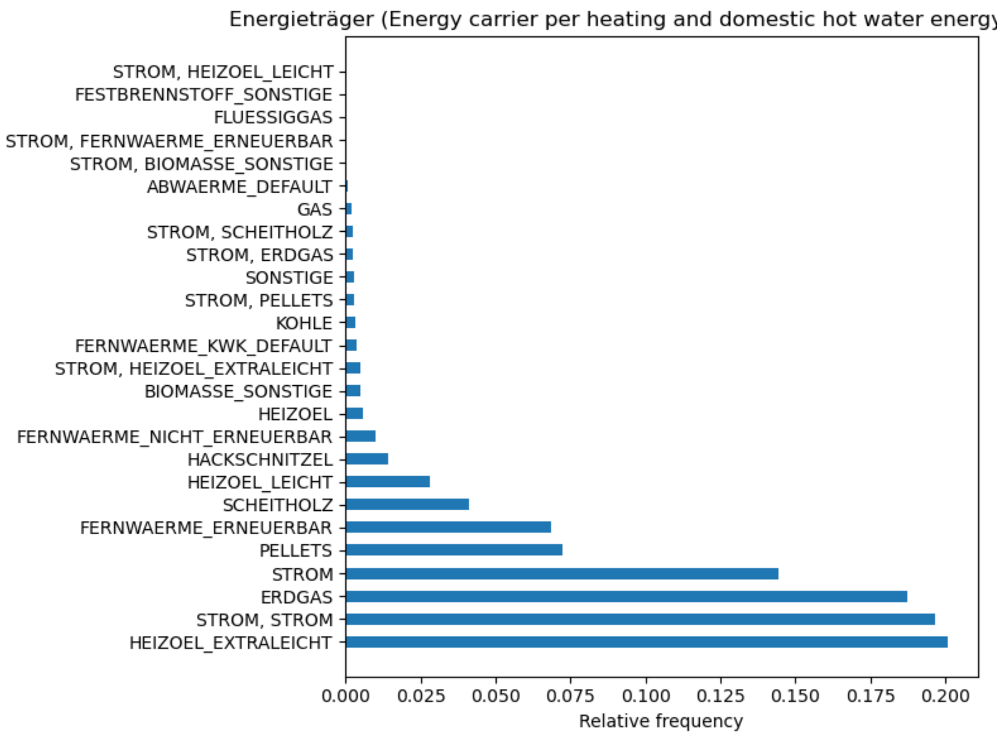

Figure 37. NF; SFH; Relative frequency plot of the energy carrier categories (for the meaning of the terms, see Table 22)

The variables on which a statistical analysis and plotting has been performed are listed in Table 26. The colours indicate the type of diagram that has been plotted for the variable:

- Relative frequency plot
- Grouped Boxplot
- Grouped relative frequency plot

The variables are named exactly as they appear in ZEUS to allow for future use of the results. For information and comparison in the TIMEPAC project, the English description is given once in the table below.

Table 26. Variables for statistical analysis and plotting

Variable (presented as defined in the database)	English description	Data type	Unit
Nutzungsprofil	Usage profile (residential, non-residential; categories within residential and non-residential)	category	
Nutzungseinheiten im Energieausweis	Number of building units in the EPC	numeric	
Bauweise	Construction method (building construction typology)	category	
Heizungstyp	Heating type space heating	category	
Energieträger	Energy carrier space heating	category	
Art der Warmwasserbereitung	Water heating, centralised or decentralised	category	
Typ.2	Water heating, separate or combined with space heating	category	
HWB Standortklima spezifisch	Space heating energy need, site-climate-specific	numeric	kWh/m^2a
Warmwasserwärmebedarf Standortklima spezifisch	Hot water heating energy need, site-climate-specific	numeric	kWh/m^2a
Heizenergiebedarf Standortklima spezifisch	Heating energy use, site-climate-specific (space heating + hot water + conversion losses; final energy indicator for heating)	numeric	kWh/m^2a
Energieaufwandszahl Heizen	Energy expenditure number, heating (efficiency of the heating system; indicator for conversion loss)	numeric	
Endenergiebedarf Standortklima spezifisch	Final energy use, site-climate-specific (heating + other uses)	numeric	kWh/m^2a
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch	Non-renewable primary energy use, site-climate-specific	numeric	kWh/m^2a
Primärenergiebedarf erneuerbar Standortklima spezifisch	Renewable primary energy use, site-climate-specific	numeric	kWh/m^2a
Mittlerer U-Wert	Average U-value (Mean thermal transmittance of the total/opaque/transparent building envelope)	numeric	W/m^2K
Kompaktheit	Compactness	numeric	1/m

	Variable (presented as defined in the database)	English description	Data type	Unit
	Bruttovolumen konditioniert	Gross volume conditioned (Thermally heated/cooled)	numeric	m^3
	Gebäudehüllfläche	Thermal building envelope area	numeric	m^2
	Bruttogrundfläche	Gross floor area	numeric	m^2
Boiler	Nennwärmeleistung	Nominal heat output	numeric	kW
Boiler	Bereitschaftsverlust	Loss of readiness	numeric	%
Heat pump	Typ.1	Type of heat pump	category	
Heat pump	Betriebsart	Operating mode	category	
Heat pump	Anlagentyp	Plant type	category	
Heat pump	Nennleistung beim Normpunkt	Nominal power at standard point	numeric	kW
Heat pump	Jahresarbeitszahl	Annual performance factor	numeric	
Heat pump	Leistungszahl	Coefficient Of Performance	numeric	
Solar thermal	Kollektorentyp	Collector type	category	
Solar thermal	Verlustfaktor	Loss factor	numeric	
Solar thermal	Konversionsrate	Conversion rate	numeric	
Solar thermal	Hilfsenergie	Auxiliary energy	numeric	W
Photovoltaic	Typ.4	Photovoltaic type	category	
Photovoltaic	Kollektorfläche	Collector area	numeric	m^2
Photovoltaic	Maximalleistung der gesamten Anlage	Maximum power of the entire plant	numeric	kW
Photovoltaic	Wirkungsgrad	Efficiency	numeric	%
Photovoltaic	PV-Export Standortklima zonenbezogen	PV export, site-climate-zonal	numeric	kWh/a
Photovoltaic	PV-Export Standortklima spezifisch	PV export, site-climate-specific	numeric	kWh/m^2a

A reference building contains the statistical results of the relevant variables for its assigned cluster. Until now, only numeric variables have been evaluated.

In this step it is important to differentiate between mandatory variables and not mandatory but relevant variables. Every dataset contains all mandatory, but not necessarily all relevant variables. For example, not every building has a solar energy system on the roof. So the number of buildings containing an optional variable is as important, as statistical results such as the median. When using the median it is necessary to only consider datasets containing the evaluated variable, or else the result will be unusable. So to say, numerical variables containing “0” as a value, meaning there is no value, have been filtered out.

An example reference building can be seen in Table 27, Table 28 and Table 29. The variables are named as they appear in ZEUS to allow for future use of the results. In the example below, the English description is given once, for information and comparison in the TIMEPAC project.

Table 27. Reference building for single family house from 1961-1980 in the climate region NF. Numeric variables

Variables	English description	Unit	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	Usage profile (residential, non-residential; categories within residential and non-residential)		1	1	0	1864
Baujahr	Construction year		1972	4	5	1864
Heizgradtage 20/12	Heating degree days	kd	3651	345	30	1864
HWB Standortklima spezifisch	Space heating energy need, site-climate-specific	kWh/m²a	113,7	53,425	39,075	1864
Warmwasserwärmebedarf Standortklima spezifisch	Hot water heating energy need, site-climate-specific	kWh/m²a	12,8	0	0	1864
Heizenergiebedarf Standortklima spezifisch	Heating energy use, site-climate-specific (space heating + hot water + conversion losses; final energy indicator for heating)	kWh/m²a	172,6	85	63,875	1864
Energieaufwandszahl Heizen	Energy expenditure number, heating (efficiency of the heating system; indicator for conversion loss)		1,36	0,17	0,2	1864
Endenergiebedarf Standortklima spezifisch	Final energy use, site-climate-specific (heating + other uses)	kWh/m²a	188,55	85,275	63,9	1864
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch	Non-renewable primary energy use, site-climate-specific	kWh/m²a	189,4	122,3	133,825	1864
Primärenergiebedarf erneuerbar Standortklima spezifisch	Renewable primary energy use, site-climate-specific	kWh/m²a	15	44,975	3,4	1864
Mittlerer U-Wert	Average U-value (Mean thermal transmittance of the total/ opaque/ transparent building envelope)	W/m²K	0,6	0,22	0,19	1864
Kompaktheit	Compactness	1/m	0,71	0,06	0,0525	1864

Variables	English description	Unit	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Bruttovolumen konditioniert	Gross volume conditioned (Thermally heated/ cooled)	m^3	744,24	207,96	170,6175	1864
Gebäudehüllfläche	Thermal building envelope area	m^2	533,81	108,79	92,48	1864
# Kessel	Boiler					
Nennwärmeleistung	Nominal heat output	kW	20	5	4,35	1357
Wirkungsgrad Volllast	Efficiency full load	%	86,57	4,33	1,92	1357
Wirkungsgrad Teillast	Efficiency part load	%	89,26	8,9	5,86	599
# Wärmepumpe	Type of heat pump					
Nennleistung beim Normpunkt	Nominal power at standard point	kW	10,8	3,15	2,8	295
Jahresarbeitszahl	Annual performance factor		3,94	0,53	0,595	295
# Solarthermie Kollektortyp	Solar thermal collector type					
Verlustfaktor	Loss factor		3,5	0,6	0	251
Konversionsrate	Conversion rate		0,8	0	0	251
Hilfsenergie	Auxiliary energy	W	100	25	18	249
# Photovoltaik Typ	Photovoltaic type					
Kollektorfläche	Collector area	m^2	35,13	15,495	5,28	36
Maximalleistung der gesamten Anlage	Maximum power of the entire plant	kW	7,5	3,9	2,4	288
Wirkungsgrad	Efficiency	%	19,4	1,6	5,9	36
PV-Export Standortklima zonenbezogen	PV export, site-climate-zonal	kWh/a	4510	3580	1960	281
PV-Export Standortklima spezifisch	PV export, site-climate-specific	kWh/m^2a	18,6	13,2	9	281

Table 28. Reference building for single family house from 1961-1980 in the climate region NF. Energy carrier (categoric variable)

Energy carrier (variables presented as defined in the database)	English description	Number of buildings
HEIZOEL_EXTRALEICHT	Heating oil, extralight	640
ERDGAS	Natural gas	316
STROM, STROM	Electricity	193
PELLETS	Pellets	178

Energy carrier (variables presented as defined in the database)	English description	Number of buildings
STROM	Electricity	140
FERNWAERME_ERNEUERBAR	District heating, renewable	104
HEIZOEL_LEICHT	Heating oil, light	84
SCHEITHOLZ	Firewood	70
HACKSCHNITZEL	Wood chips	29
FERNWAERME_NICHT_ERNEUERBAR	District heating, non-renewable	22
STROM, HEIZOEL_EXTRALEICHT	Electricity & heating oil, extralight	15
HEIZOEL	Heating oil	12
KOHLE	Coal	12
SONSTIGE	Other	12
BIOMASSE_SONSTIGE	Biomass other	8
STROM, ERDGAS	Electricity & natural gas	8
STROM, PELLETS	Electricity & pellets	5
STROM, SCHEITHOLZ	Electricity & firewood	4
FERNWAERME_KWK_DEFAULT	District heating power, default	4
GAS	Gas	4
ABWAERME_DEFAULT	Waste heat, default	3
STROM, BIOMASSE_SONSTIGE	Electricity & biomass, other	1

Table 29. Reference building for single family house from 1961-1980 in the climate region NF. Heating type (categoric variable)

Heating type (variables presented as defined in the database)	English description	Number of buildings
STANDARDKESSEL	Standard boiler	472
NIEDERTEMPERATUR	Low temperature	295
BRENNWERT	Condensing boiler	271
HEIZKESSEL	Heating boiler	269
WAERMEPUMPE, STROMDIREKT	Heat pump & direct electricity	193
FERNWAERME	District heating	133
STROMDIREKT	Direct electricity	71
WAERMEPUMPE	Heat pump	69
EINZELOFEN	Individual furnace	31
WAERMEPUMPE, STANDARDKESSEL	Heat pump & standard boiler	11
SONSTIGE	Other	10

Heating type (variables presented as defined in the database)	English description	Number of buildings
WAERMEPUMPE, HEIZKESSEL	Heat pump & boiler	9
WAERMEPUMPE, BRENNWERT	Heat pump & condensing boiler	8
KOMBITHERME_OHNE_KLEINSPEICHER	Combi heater without small storage system	8
KACHELOFEN	Cooking oven	4
OHNE	Without	3
WAERMEPUMPE, NIEDERTEMPERATUR	Heat pump, low temperature	3
WAERMEPUMPE, EINZELOFEN	Heat pump & individual furnace	2
KOMBITHERME_MIT_KLEINSPEICHER	Combi heater with small storage	2

Table 30 shows for which clusters a reference building could be identified and how many datasets were used for generating the reference building.

Table 30. Overview of clusters and identified reference buildings with number of datasets

Climate region NF	Residential buildings		Non-residential buildings				
Year of construction	Single-family houses	Apartment blocks	Hotels and restaurants	Offices	Educational buildings	Hospitals	Sports facilities
1601-1918	209	207	0	0	1	0	0
1919-1944	274	102	0	0	0	0	0
1945-1960	852	296	0	0	0	2	0
1961-1980	1864	894	0	2	1	0	1
1981-1990	861	341	1	1	1	0	0
1991-2000	840	535	0	0	0	1	0
2001-2010	405	284	0	0	0	0	0
>2010	1481	579	8	7	3	3	3
Climate region ZA							
1601-1918	149	35	1	4	0	0	0
1919-1944	84	14	0	0	0	0	0
1945-1960	667	110	2	0	0	0	0
1961-1980	1676	400	3	1	2	0	1
1981-1990	788	165	1	0	0	0	1
1991-2000	610	220	0	3	0	0	0
2001-2010	299	135	0	0	0	0	0
>2010	1488	400	14	4	0	2	1

The complete building archetype schema is presented in Annex B (Section B1) from Table B.1 to Table B.8.

EPC data were retrieved from the so-called "ZEUS" database which is the EPC database for the Austrian province of Salzburg. In future, the procedure described could be expanded to the other Austrian provinces using ZEUS (Carinthia, Styria, Lower Austria, Burgenland, and Tyrol). If the statistical evaluation is used by the ZEUS database operator in the future, the processes will have to be implemented in the database without the work-around via the Excel export, so that the potential of the applied method based on Python can be fully utilised. Current limitations in TDS5 are for example: data about transparent and opaque building elements exist but were not extracted via Excel export because another time-consuming work-around would have been necessary. The same applies to the recommendations for improving energy performance which are part of the EPC but only available as text input and not as distinct data fields per type of recommendation.

It is important to note that the EPC database Excel export contains all EPC versions based on the EPBD 2002, 2010, and 2018, and the related transposition at national and regional levels. Data fields have changed, and data fields have been added, resulting in incomplete EPC records when compared to the latest EPC version transposing the amending Directive (EU) 2018/844. Automatic quality checks have been introduced not at the beginning but at a later stage in the EPC calculation software as well as in the EPC database. Physical impossibility checks and consistency checks have not been implemented in this TDS5 work, as they are done by the EPC calculation software and by the ZEUS database. However, they are limited to a number of essential data fields, and if the developed procedure were to be implemented in the ZEUS database in the future, the existing quality checks would have to be reviewed and revised if necessary.

Regarding future development, the EPBD recast will be transposed, and as a consequence, the EPC will undergo more changes. This means that complexity will be added to the existing EPC database, and the number of EPCs will also increase.

Therefore, for future use, the developed procedure should be implemented directly in the EPC database (using MySQL) and programmed in such a way that relevant excerpts and reporting can be easily done by the staff of the administration. A revision would be required with each recast or amendment to the EPBD.

5.1.2 Croatia

As addressed in Section 3.1 and in the *Guidelines*, the statistical representation of the proposed EPC parameters is essential for the reference building creation. According to the geometrical characteristics, the thermo-physical properties of the building envelope and the technical building systems, and the energy indicators have been deduced for defined archetypes. These EPC data have been accompanied by the median and the interquartile ranges: ($Q_3 - Q_2$) and ($Q_2 - Q_1$).

Table 31. Index of representative buildings (archetypes) for climatic zone A (continental Croatia)

Climatic zone Continental Croatia (A)	Residential buildings	Non-residential buildings					
		Office	Educational building	Hospital	Sport facility	Hotel	Retail
≤ 1970 (CP1)	A_RES_CP1	A_OFF_CP1	A_EDU_CP1	A_HOS_CP1	A_SPO_CP1	A_HOT_CP1	A_RET_CP1
1971-2006 (CP2)	A_RES_CP2	A_OFF_CP2	A_EDU_CP2	A_HOS_CP2	A_SPO_CP2	A_HOT_CP2	A_RET_CP2
≥ 2007 (CP3)	A_RES_CP3	A_OFF_CP3	A_EDU_CP3	A_HOS_CP3	A_SPO_CP3	A_HOT_CP3	A_RET_CP3

Table 32. Index of representative buildings (archetypes) for climatic zone B (costal Croatia)

Climatic zone Continental Croatia (B)	Residential buildings	Non-residential buildings					
		Office	Educational building	Hospital	Sport facility	Hotel	Retail
≤ 1970 (CP1)	B_RES_CP1	B_OFF_CP1	B_EDU_CP1	B_HOS_CP1	B_SPO_CP1	B_HOT_CP1	B_RET_CP1
1971-2006 (CP2)	B_RES_CP2	B_OFF_CP2	B_EDU_CP2	B_HOS_CP2	B_SPO_CP2	B_HOT_CP2	B_RET_CP2
≥ 2007 (CP3)	B_RES_CP3	B_OFF_CP3	B_EDU_CP3	B_HOS_CP3	B_SPO_CP3	B_HOT_CP3	B_RET_CP3

The results of are shown in Annex B (Section B2). Key indicators that are represented in Croatian database for specific archetypes have been calculated for previously defined building categories and construction periods.

5.1.3 Cyprus

In Cyprus, the analysis of building archetypes and quality-checking outcomes encountered certain difficulties due to the limited sample size of available data. However, despite these challenges, we identified and clustered approximately 30 residential buildings to develop building archetypes representative of the energy performance characteristics in the country. The Building Typology Matrix for Cyprus, showcasing these archetypes, is provided in Annex B (Section B3).

It is important to highlight that the data sample for this analysis was relatively small. Nonetheless, given the available data, we tried to adhere to the proposed methodology as closely as possible. By applying the clustering methodology outlined in the project guidelines, we were able to group the identified residential buildings into three distinct clusters based on their energy performance characteristics.

To improve the EPC database and enable more comprehensive analysis in the future, it is recommended to focus on increasing the number of EPCs available for existing residential buildings in Cyprus.

While the difficulties encountered in the analysis were primarily due to the limited sample size, it is worth noting that the findings still provide a valuable starting point for understanding the energy performance characteristics of residential buildings in Cyprus. As the EPC database expands and more data becomes available, future analyses can build upon these initial findings to refine the building archetypes and enhance the accuracy and representativeness of the statistical analysis.

5.1.4 Italy

For each of the clusters defined to group EPCs, approximately 30% are discarded because the overall EPC score is higher than the acceptability threshold limit (see Table 33). Most EPCs are rejected due to null values or values above the physical limits for thermal transmittances (see Table 34). The second control that results in the most errors is the comparison of the mean height, calculated by dividing the volume by the area, and a lower limit set at 2,30 m. In the Piemonte Region case, it is not verified that the overall EPC score, given by the sum of non-critical errors, is higher than the acceptability threshold. But it is common for an EPC to be rejected because at least one critical error is present.

Table 33. Invalid EPCs due to overall EPC score > 0,686 (Piemonte Region)

Bldg code	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
	≤ 1900	1901-1920	1921-1945	1946-1960	1961-1975	1976-1990	1991-2005	> 2005
SFH	32%	34%	30%	30%	28%	29%	31%	35%
BU(AB)	27%	27%	27%	27%	28%	30%	30%	29%
HOTEL	31%	29%	24%	31%	37%	17%	25%	21%
OFF	29%	33%	29%	31%	31%	31%	31%	26%
HOSP	33%	48%	34%	34%	39%	36%	22%	22%
SPORT	23%	38%	26%	32%	36%	35%	41%	34%
EDUC	37%	43%	29%	34%	38%	37%	25%	26%

Table 34. Invalid EPCs due to incorrect *U*-values (Piemonte Region)

Bldg code	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
	≤ 1900	1901-1920	1921-1945	1946-1960	1961-1975	1976-1990	1991-2005	> 2005
SFH	22%	23%	21%	21%	19%	19%	21%	23%
BU(AB)	21%	20%	20%	22%	21%	21%	21%	18%
HOTEL	25%	18%	17%	25%	25%	11%	18%	16%
OFF	23%	27%	23%	24%	23%	23%	23%	19%
HOSP	18%	24%	14%	15%	26%	16%	9%	16%
SPORT	11%	23%	13%	21%	20%	20%	25%	22%
EDUC	25%	20%	17%	16%	14%	13%	16%	16%

The complete building archetype schema for SFHs and BU(AB) is presented in Annex B (Section B4), from Table B.54 to Table B.69. The following graphs illustrate key indicators extracted from the building archetypes: Figure 38 and Figure 39 compare the opaque and transparent thermal transmittance and the window-to-wall ratio (*WWR*) per different CPs. The plotted histograms represent the median value. The trend is for the thermal transmittance value to decrease as CP progresses. Small fluctuations of the median value should be accompanied by a reading of the interquartile ranges. For instance, the thermal transmittance of CP5 in BU(AB) (Figure 39) is slightly above the previous construction period. However, the range of variability in the absolute value of

CP5 (Table B.66) is wider than that of CP4 (Table B.65). Other causes could be a higher rate of energy renovation in past periods than in more recent ones.

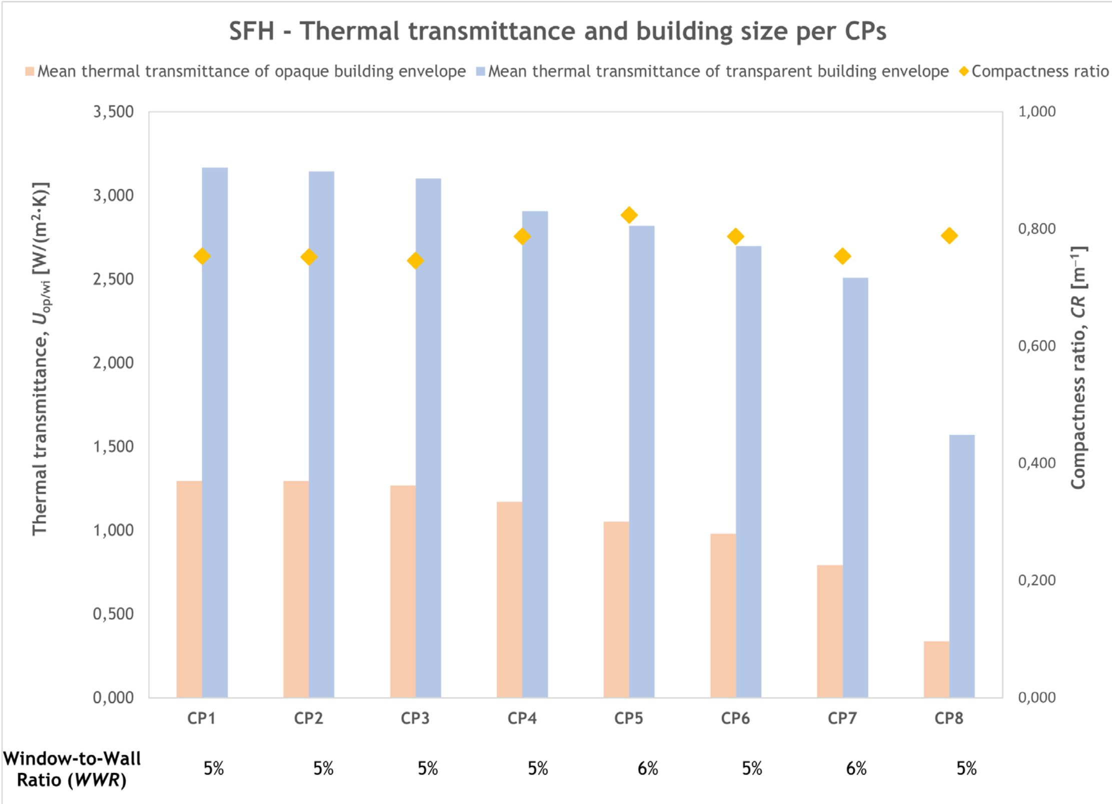

Figure 38. Opaque and transparent components *U*-value and *WWR* per CP for SFH (Piemonte)

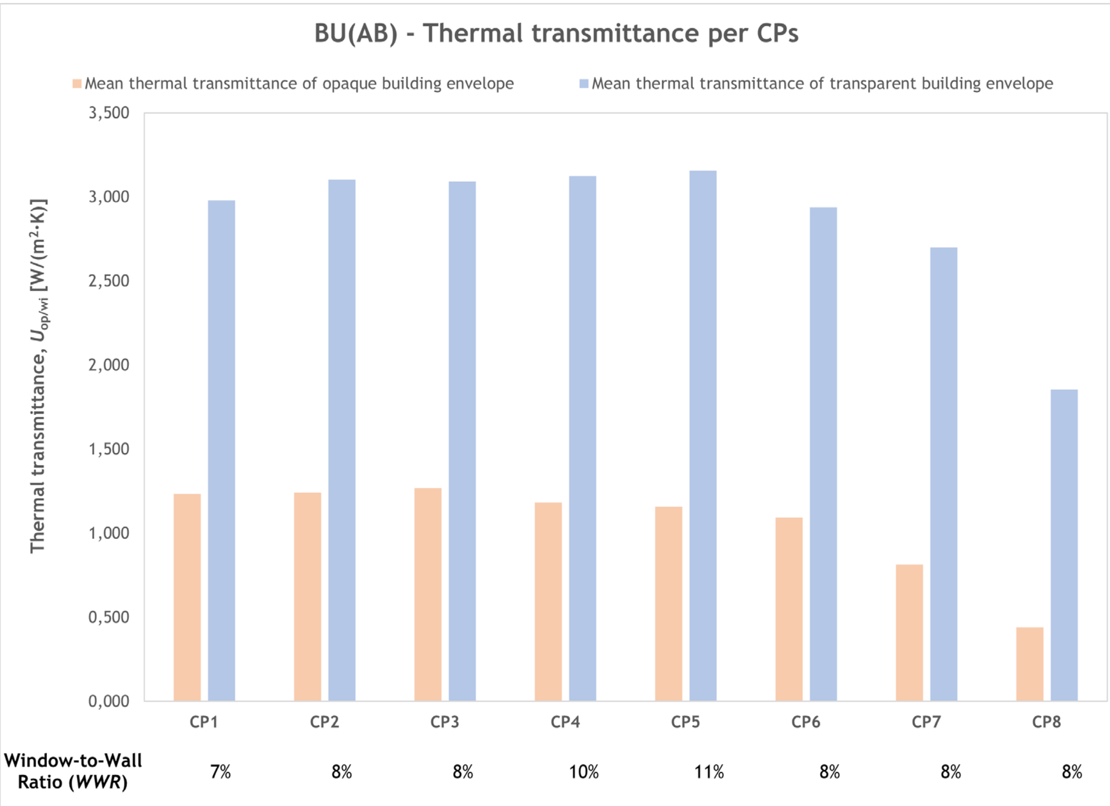

Figure 39. Opaque and transparent components *U*-value and *WWR* per CP for BU(AB) (Piemonte)

Figure 40 and Figure 41 report the energy carrier share for space heating and domestic hot water, respectively, for SFHs located in Piemonte. Equally, Figure 42 and Figure 43 show the energy carriers used for heating and domestic hot water in BU(AB)s. In both cases (i.e., SFH and BU(AB)), the energy carrier for space cooling has not been indicated because this energy service is completely (99-100%) covered by electricity (see Table B.54 to Table B.69).

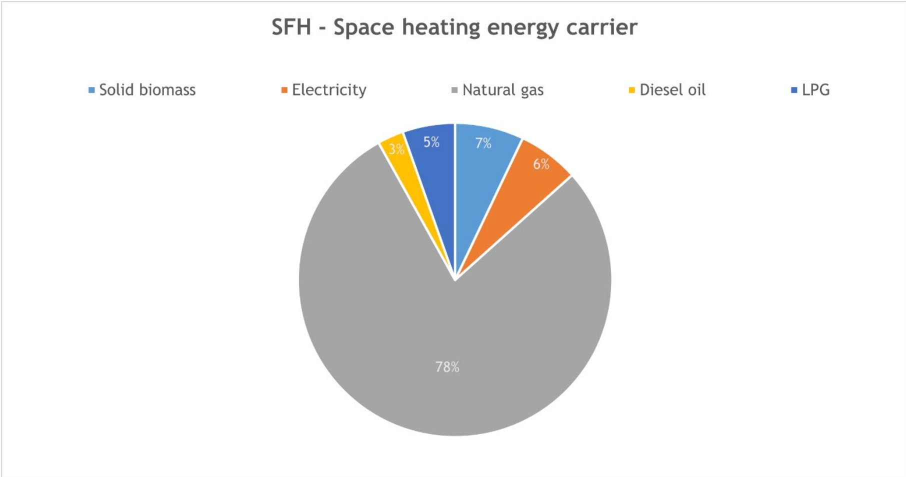

Figure 40. Space heating energy carrier per SFH (Piemonte Region)

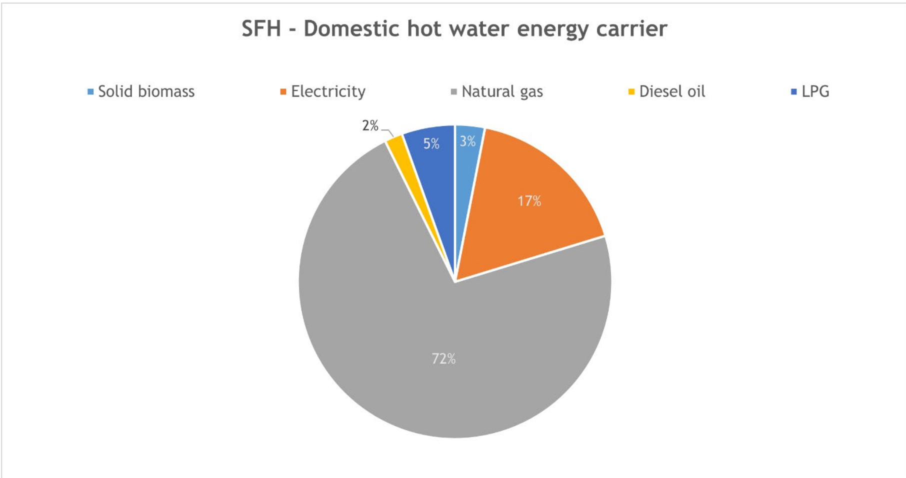

Figure 41. Domestic hot water energy carrier per SFH (Piemonte Region)

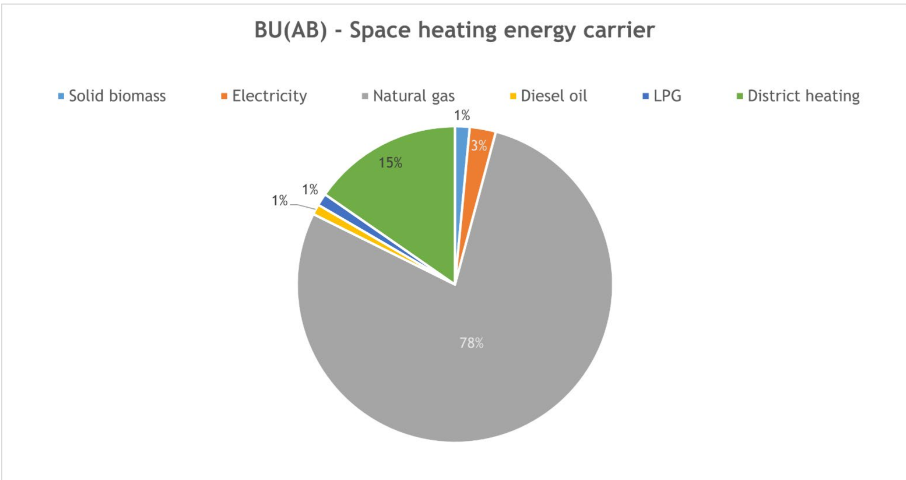

Figure 42. Space heating energy carrier per BU(AB) (Piemonte Region)

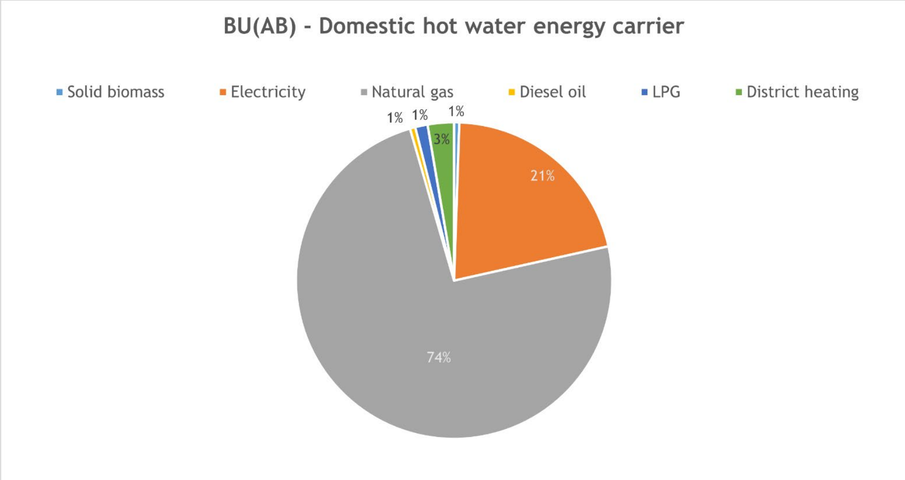

Figure 43. Domestic hot water energy carrier per BU(AB) (Piemonte Region)

Figure 44 and Figure 45 report the energy performance indicators for the three energy services considered in terms of energy need and non-renewable energy performance. For space heating and domestic hot water, the trend foresees energy need greater than the non-renewable energy performance indicator except for CP8 where the introduction of renewable energy sources, accompanied by an increase in the mean seasonal energy efficiency, determines an increase of $EP_{H/C/W;nren}$.

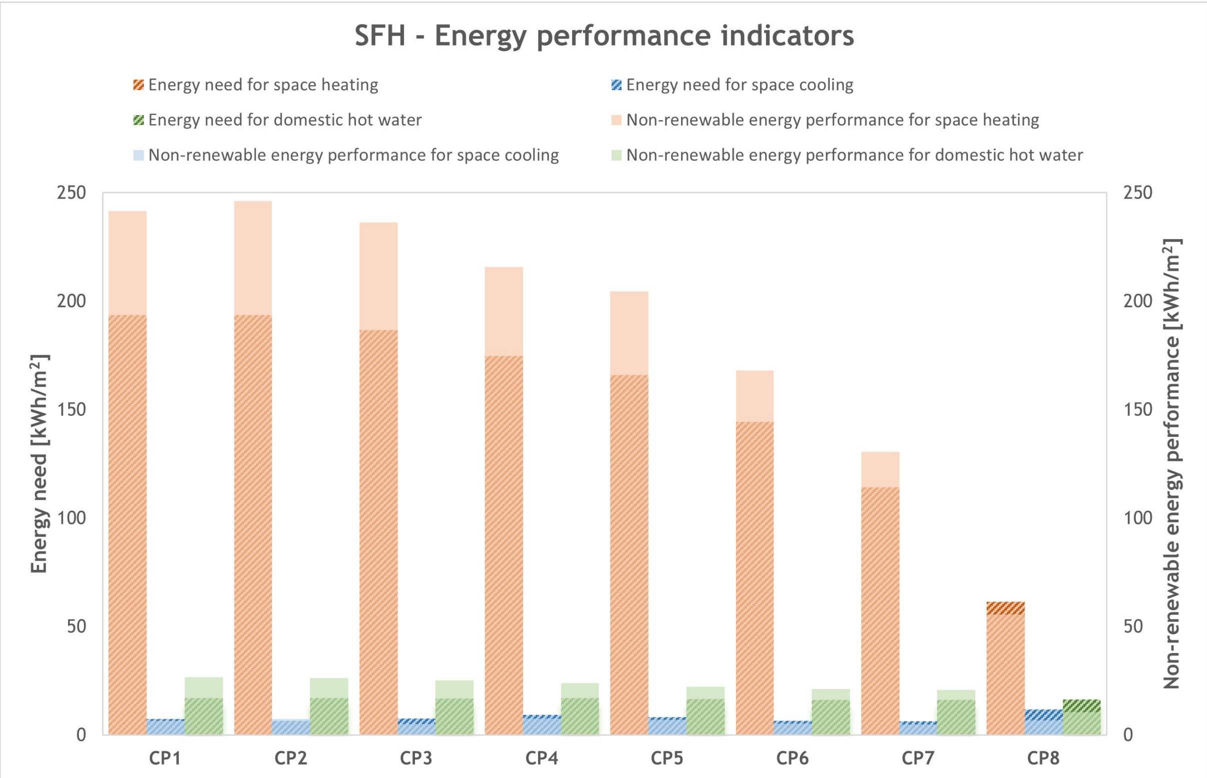

Figure 44. Energy performance indicators per CP for SFH (Piemonte Region)

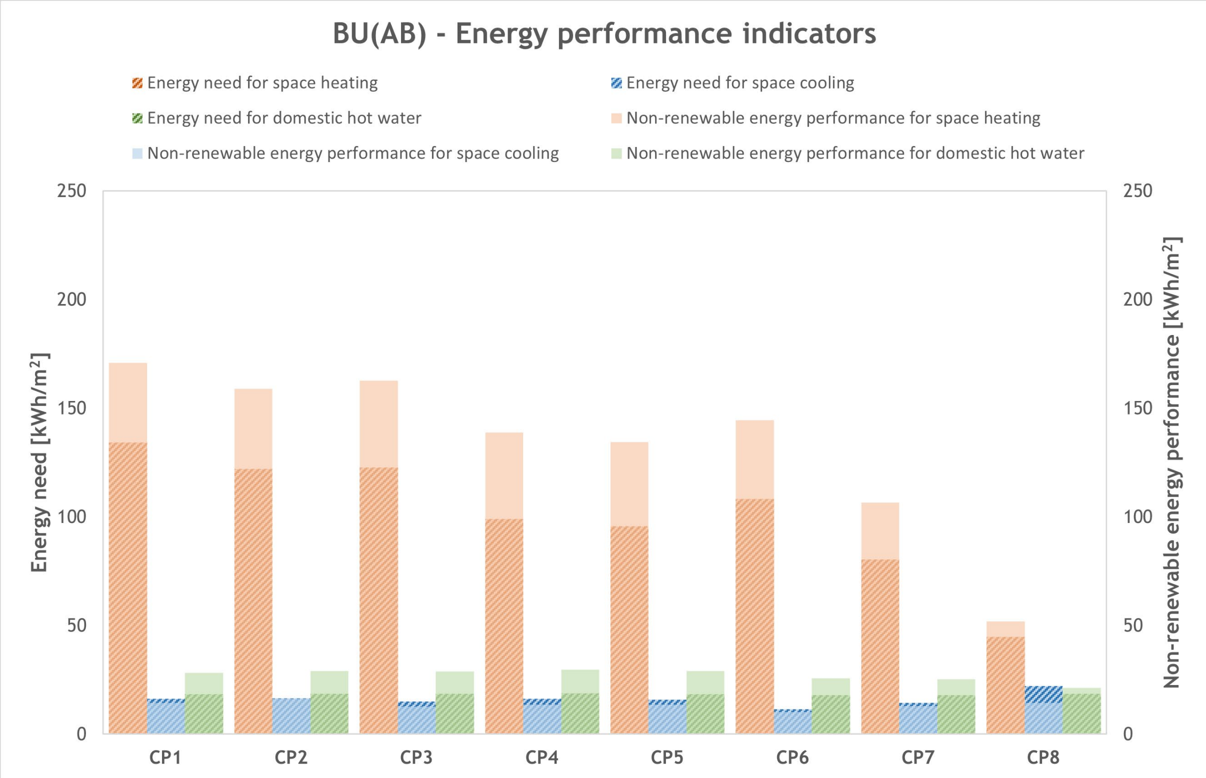

Figure 45. Energy performance indicators per CP for BU(AB) (Piemonte Region)

In principle, the following five non-residential uses have been considered in the analysis for the building archetype generation: offices, hospitals, educational buildings, sports facilities, and hotels. However, as reported in Table 10, the number of EPCs for the above-mentioned building use categories is limited. Furthermore, it is essential to take into account that approximately 30% of EPCs will be rejected due to errors (see Table 33). Non-residential uses are highly affected by the geometry of the buildings. For instance, the Italian building classification “E7” includes kindergarten, primary and secondary school, and university, which determine an evident variability in building size. In addition, another aspect that affects the representativeness of the sample is that the distribution of buildings for a particular cluster is random. Thus, in a specific construction period range it can be recorded that kindergartens or primary schools are more widespread than other uses.

To examine the non-residential buildings size variability, the boxplots of the heated gross volumes have been presented in Figure 46. These graphs are useful to evaluate the spread and skewness of the sample compared to the middle value in the dataset. In some cases, the amplitude of the interquartile range increases (e.g., hospitals).

Therefore, for the non-residential uses, only the two most representative categories have been chosen: offices and educational buildings. However, due to the low representativeness of the sample (Table 10) and due to the high geometric variability (Figure 46), further analyses for these building categories are needed to define the most frequent building size range. For this purpose, these analyses lead to a restriction of the building size interval. On the other hand, the building archetypes for the other three building use categories (i.e., hospitals, sport facilities, and hotels), due to the above-mentioned aspects, will not be generated.

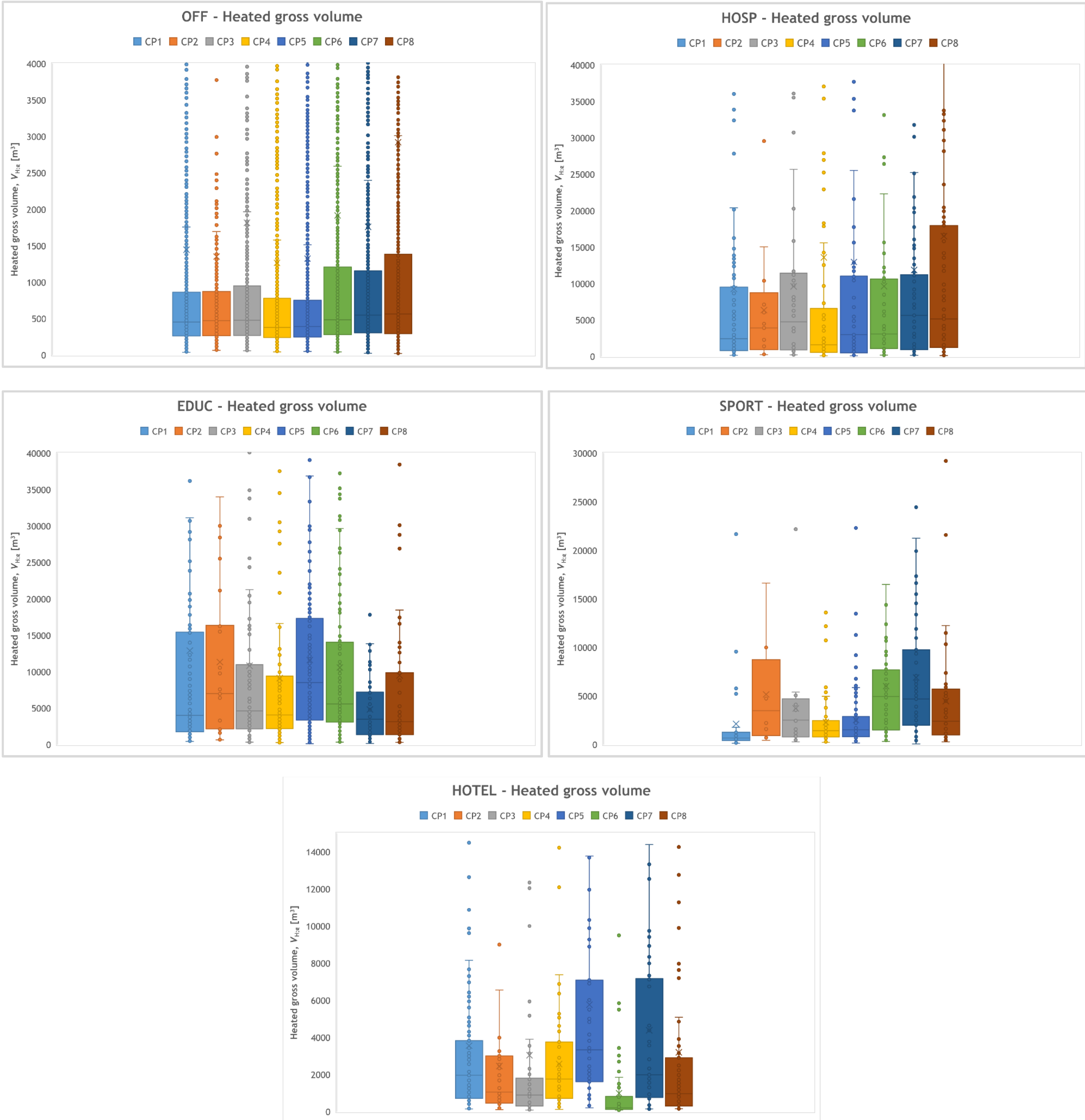

Figure 46. Heated gross volume boxplots per non-residential uses in Piemonte

For offices (OFFs) and educational buildings (EDUCs), the distribution between 10th and 90th percentile in terms of heated gross volumes have been adopted. In this way, the most probable building size distributions have been defined. The volume classes per each CP for OFFs and EDUCs have been respectively listed in Table 35 and Table 36.

The subsequent analyses of TDS5 (i.e., building archetypes and confidence interval creation) for the two mentioned categories will be conducted for the proposed heated gross volume classes.

Table 35. Heated gross volume percentile distribution for OFFs

OFF	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
	Heated gross volume, $V_{H;g}$ [m^3]							
10th percentile	165	175	168	159	170	191	195	179
90th percentile	2170	1623	3034	1834	1993	3684	2764	3456

Table 36. Heated gross volume percentile distribution for EDUCs

EDUC	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
	Heated gross volume, $V_{H;g}$ [m^3]							
10th percentile	804	683	615	1291	1855	1861	821	600
90th percentile	29116	28899	24596	23070	26617	26563	11297	18168

In Figure 47 and Figure 48, the mean opaque and transparent thermal transmittances and window-to-wall ratios are reported for OFFs and EDUCs. Moreover, the energy carriers most used to satisfy space heating and domestic hot water are shown from Figure 49 to Figure 52, respectively for OFFs and EDUCs. Even in this case, the energy carrier consumed for the space cooling has not been plotted, since the electricity is used in around 97-98% of the sample. Lastly, the energy performance indicators, in terms of energy need and primary energy, for the two non-residential building use categories are illustrated in Figure 53 and Figure 54.

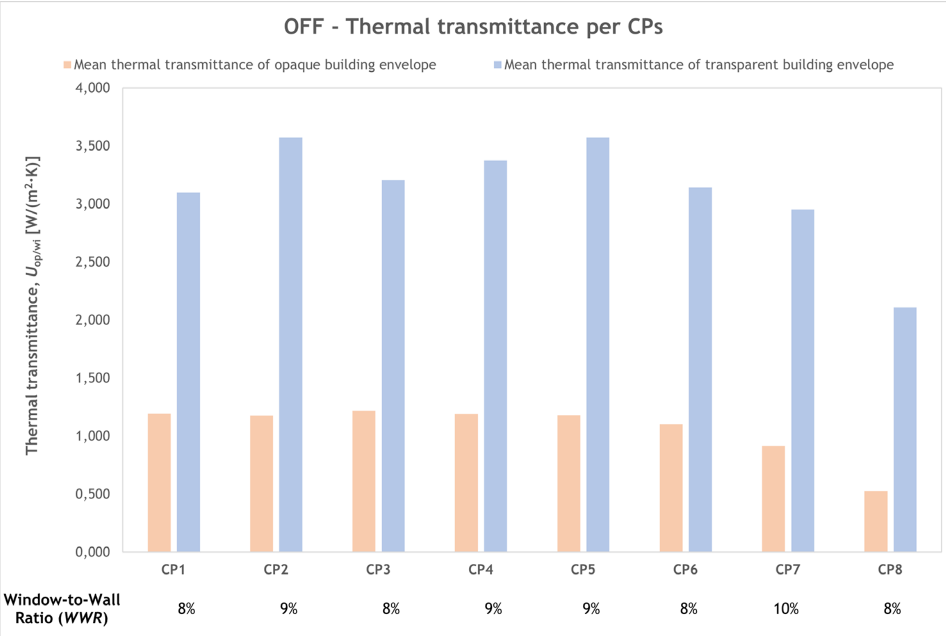

Figure 47. Opaque and transparent components *U*-value and *WWR* per CP for OFF (Piemonte)

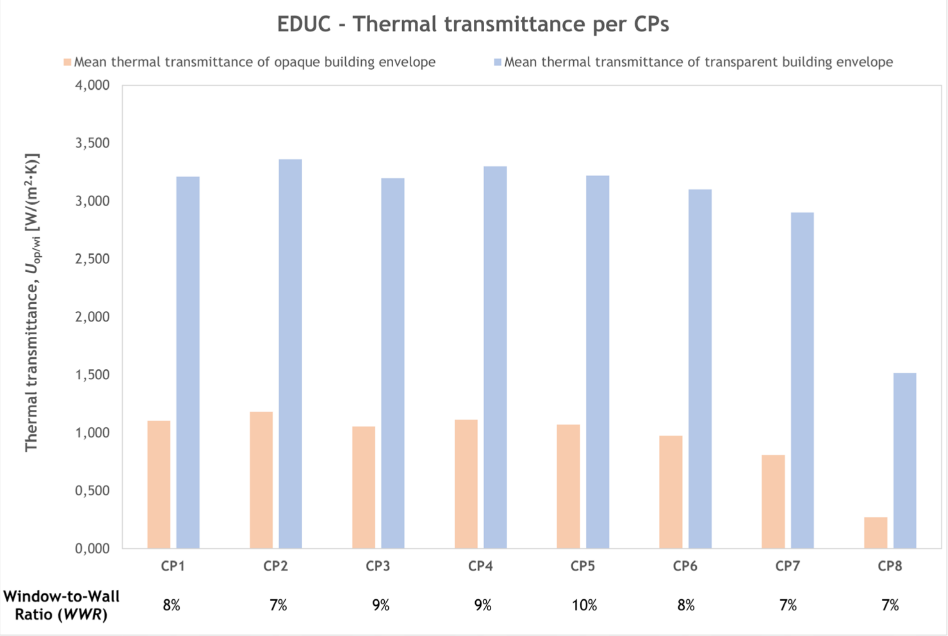

Figure 48. Opaque and transparent components *U*-value and *WWR* per CP for EDUC (Piemonte)

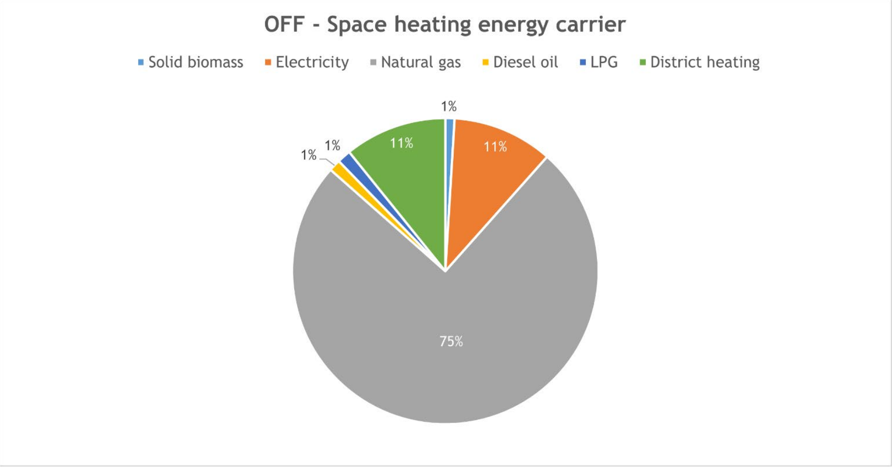

Figure 49. Space heating energy carrier per OFF (Piemonte Region)

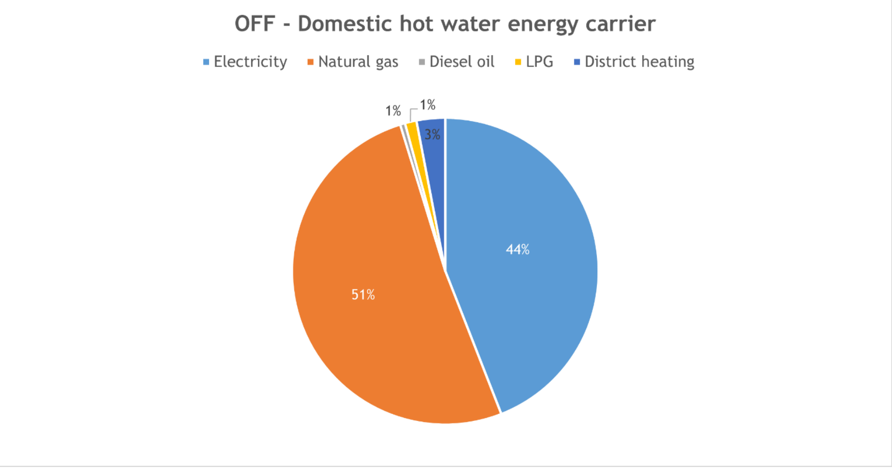

Figure 50. Domestic hot water energy carrier per OFF (Piemonte Region)

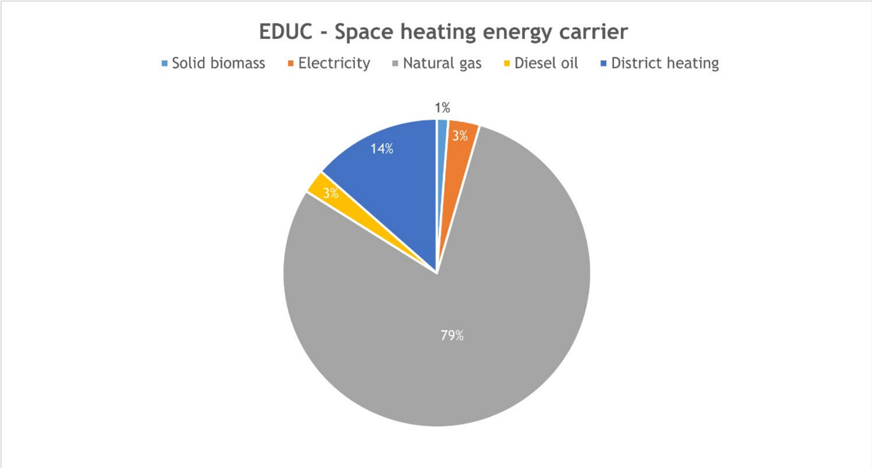

Figure 51. Space heating energy carrier per EDUC (Piemonte Region)

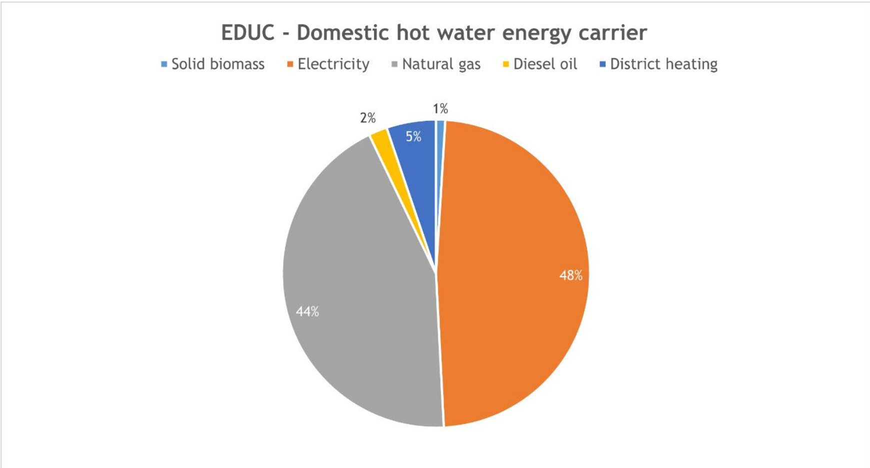

Figure 52. Domestic hot water energy carrier per EDUC (Piemonte Region)

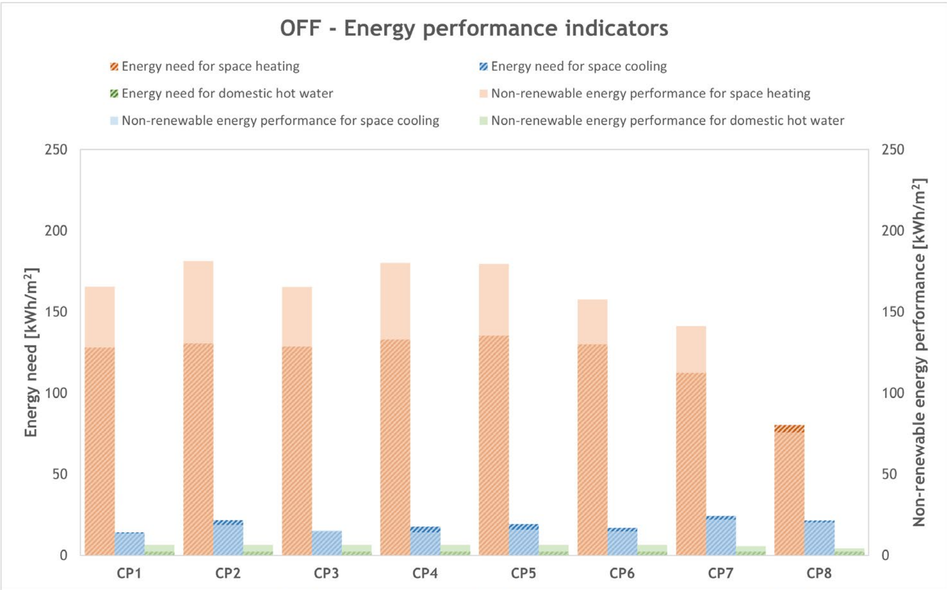

Figure 53. Energy performance indicators per OFF (Piemonte Region)

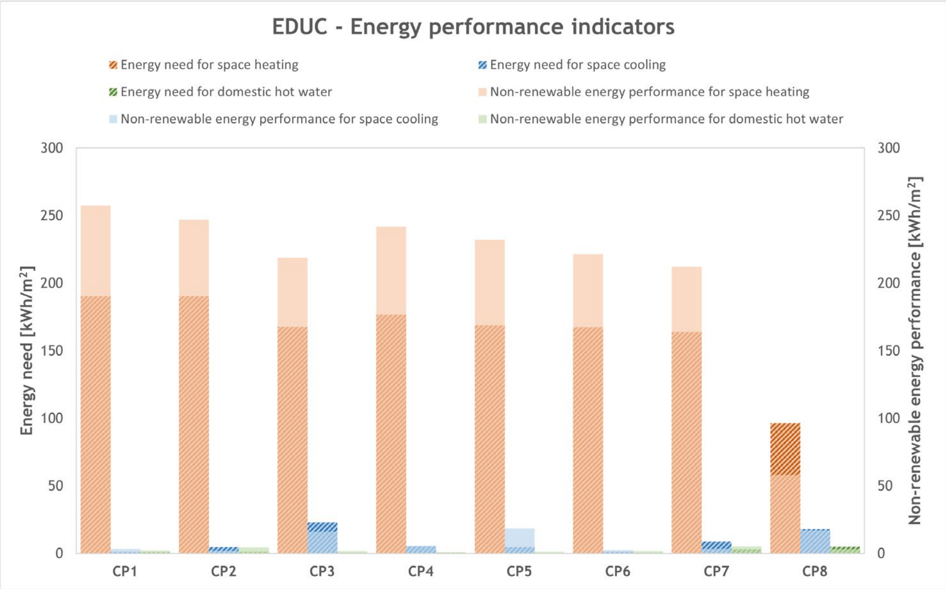

Figure 54. Energy performance indicators per EDUC (Piemonte Region)

At the end, for the eight defined CPs, two different sizes for residential buildings and two non-residential uses have been considered in the TDS5 analysis. In Table 37, the Piemonte regional building typology matrix, composed of the different building use categories and CPs, is summarised. Totally, 32 building archetypes have been generated, available from Table B.54 to Table B.85.

Table 37. Building typology matrix (Piemonte Region)

Climatic zone E	Residential bldgs		Non-residential bldgs	
	SFH	BU(AB)	OFF	EDUC
CP1	E_RES_SINGLE_CP1	E_RES_BU(AB)_CP1	E_OFF_CP1	E_EDUC_CP1
CP2	E_RES_SINGLE_CP2	E_RES_BU(AB)_CP2	E_OFF_CP2	E_EDUC_CP2
CP3	E_RES_SINGLE_CP3	E_RES_BU(AB)_CP3	E_OFF_CP3	E_EDUC_CP3
CP4	E_RES_SINGLE_CP4	E_RES_BU(AB)_CP4	E_OFF_CP4	E_EDUC_CP4
CP5	E_RES_SINGLE_CP5	E_RES_BU(AB)_CP5	E_OFF_CP5	E_EDUC_CP5
CP6	E_RES_SINGLE_CP6	E_RES_BU(AB)_CP6	E_OFF_CP6	E_EDUC_CP6
CP7	E_RES_SINGLE_CP7	E_RES_BU(AB)_CP7	E_OFF_CP7	E_EDUC_CP7
CP8	E_RES_SINGLE_CP8	E_RES_BU(AB)_CP8	E_OFF_CP8	E_EDUC_CP8

5.1.5 Slovenia

The building archetypes for Slovenia were created for 6 building periods and for two residential buildings (single - SFH and multi-family house - MFH) and 5 non-residential, public buildings (buildings for education - EDU, buildings for cultural activities - CUL, museums and libraries - MUL, public office buildings - POB, buildings for sports - SPO and health care buildings - HCB). Altogether these total 48 different building archetypes (Table 38 and Table 39).

A large share of EPCs were issued during the first 2 years after the establishment of the database. A major shortcoming of the database is the fact that many of relevant data were not collected in the EPC at that time, but are being collected now after two upgrades. Data such as windows-to-wall ratio is collected now, but was not at the beginning when large share of EPCs was issued and thus today only a fraction of the entire database has this data and cannot be taken into account in further analyses. The vice versa is also possible – useful data collected at the beginning, but not today, e.g., mean thermal transmittance of the transparent building envelope.

The basic data categories selected are (1) the geometrical data (e.g., compactness ratio, thermally heated/cooled floor area, heated/cooled volume), and (2) the typologies and energy performance of the TBS (energy source, energy needs, delivered energy). In order to be consistent with the proposed methodology, *RER*, overall renewable and non-renewable energy performance was calculated additionally based on data of delivered energy according to use and energy source.

As addressed in Section 3.1 and in the *Guidelines*, the statistical representation of the proposed EPC parameters is essential for the reference building creation. According to the geometrical characteristics, the thermo-physical properties of the building envelope and the technical building systems, and the energy indicators have been deduced for defined archetypes. These EPC data have been accompanied by the median and the interquartile ranges: ($Q_3 - Q_2$) and ($Q_2 - Q_1$).

Table 38. Index of residential representative buildings (archetypes) for Slovenia

Climatic zone	Residential bldgs	
	SFH	MFH
≤ 1945 (CP1)	SI_RES_SFH_CP1	SI_RES_MFH_CP1
1946-1970 (CP2)	SI_RES_SFH_CP2	SI_RES_MFH_CP2
1971-1980 (CP3)	SI_RES_SFH_CP3	SI_RES_MFH_CP3
1981-2002 (CP4)	SI_RES_SFH_CP4	SI_RES_MFH_CP4
2003-2008 (CP5)	SI_RES_SFH_CP5	SI_RES_MFH_CP5
>2008 (CP6)	SI_RES_SFH_CP6	SI_RES_MFH_CP6

Table 39. Index of non-residential representative buildings (archetypes) for Slovenia

Climatic zone	Non-residential bldgs					
	EDUC	CUL	MUL	POB	SPO	HCB
≤ 1945 (CP1)	SI_EDUC_CP1	SI_CUL_CP1	SI_MUL_CP1	SI_POB_CP1	SI_SPO_CP1	SI_HCB_CP1
1946-1970 (CP2)	SI_EDUC_CP2	SI_CUL_CP2	SI_MUL_CP2	SI_POB_CP2	SI_SPO_CP2	SI_HCB_CP2
1971-1980 (CP3)	SI_EDUC_CP3	SI_CUL_CP3	SI_MUL_CP3	SI_POB_CP3	SI_SPO_CP3	SI_HCB_CP3
1981-2002 (CP4)	SI_EDUC_CP4	SI_CUL_CP4	SI_MUL_CP4	SI_POB_CP4	SI_SPO_CP4	SI_HCB_CP4
2003-2008 (CP5)	SI_EDUC_CP5	SI_CUL_CP5	SI_MUL_CP5	SI_POB_CP5	SI_SPO_CP5	SI_HCB_CP5

Climatic zone	Non-residential bldgs					
	EDUC	CUL	MUL	POB	SPO	HCB
> 2008 (CP6)	SI_EDUC_CP6	SI_CUL_CP6	SI_MUL_CP6	SI_POB_CP6	SI_SPO_CP6	SI_HCB_CP6

The results are shown in Annex B (Section B5, from Table B.86 to Table B.133). Key indicators that are represented in Slovenian database for specific archetypes have been calculated for previously defined building categories and construction periods.

5.1.6 Spain

The data quality checking procedure has been applied to the whole EPC database of Catalonia with around 1.400.000 EPCs. The output of the procedure is the percentage of invalid EPCs invalid due to having an overall EPC score greater than 0,7174 per construction period and building use (Table 40). Here are some key observations:

Construction Period Impact: The figures suggest that the construction period of a building has a noticeable influence on the likelihood of having an invalid EPC. Buildings constructed before 1900 and between 1981 and 2006 consistently exhibit higher percentages of invalid EPCs across all building code categories.

Building use: The table segments the data into three building code categories: tertiary buildings, single-family homes, and apartment buildings. Among these categories, apartment buildings consistently have the highest percentages of invalid EPCs across various construction periods.

Recent Buildings: Surprisingly, tertiary buildings constructed after 2007 show a relatively lower percentage of invalid EPCs compared to the preceding periods.

Overall Trend: In general, there seems to be a slight increase in the percentage of invalid EPCs from older to more recent construction periods for all building code categories. This trend might be indicative of the evolving energy efficiency requirements and standards over time, with newer constructions expected to meet higher efficiency benchmarks.

Table 40. Invalid EPCs due to overall EPC score > 0,7174 (Catalan Region)

Bldg use	CP1	CP2	CP3	CP4	CP5	CP6
	≤ 1900	1901-1936	1937-1960	1961-1980	1981-2006	> 2007
Tertiary	34%	23%	20%	21%	27%	18%
SFH	19%	23%	21%	24%	29%	27%
AB	24%	27%	24%	25%	35%	39%

Most EPCs are rejected due to null values and incorrect cooling or heating performance values (see Table 41). Comparing the two tables, the percentages of invalid EPCs due to incorrect cooling or heating performance values are quite similar to the percentages of invalid EPCs based on the overall EPC score. This suggests that incorrect cooling or heating performance values contribute significantly to the overall EPC score.

Key observations from the comparison include:

Tertiary Buildings and Single-Family Homes: The percentages of invalid EPCs in Table 41 are slightly lower than those in Table 40 for all construction periods. This indicates that incorrect cooling or heating performance values have a relatively smaller impact on the overall EPC score for tertiary buildings and single-family houses.

Apartment Buildings: The percentages of invalid EPCs due to incorrect cooling or heating performance values in Table 41 are mostly consistent with those in Table 40. Both tables indicate that incorrect cooling or heating performance values contribute significantly to the overall EPC score for apartment buildings.

Table 41. Invalid EPCs due to incorrect cooling or heating performance values (Catalan Region)

Bldg code	CP1	CP2	CP3	CP4	CP5	CP6
	≤ 1900	1901-1936	1937-1960	1961-1980	1981-2006	> 2007
Tertiary	33%	23%	20%	21%	27%	18%

Bldg code	CP1	CP2	CP3	CP4	CP5	CP6
	≤ 1900	1901-1936	1937-1960	1961-1980	1981-2006	> 2007
SFH	18%	22%	21%	23%	28%	24%
AB	24%	27%	23%	25%	34%	38%

For the building archetypes in Catalonia, it has been considered only those archetypes which have a representativeness of 10.000 EPCs. The complete building archetype schema is presented in Annex B (Section B6) from Table B.134 to Table B.154.

When it comes to building stock energy modelling, only archetypes belonging to C2 climate zone have been taken into account. The characteristics of the archetypes of apartment block in Catalonia are summarised Table 42. Based on these characteristics, the following observations can be made:

Thermally heated gross volume and floor area: The thermally heated gross volume and floor area vary slightly among different construction periods. The values for these parameters show some fluctuations, with no clear trend observed across the construction periods. However, the differences are relatively small, indicating similar sizes of apartment blocks across different periods.

Transparent thermal envelope area: The transparent thermal envelope area represents the proportion of the building envelope that consists of transparent elements (e.g., windows). The values in the table indicate that there is variation in the proportion of transparent thermal envelope area among different construction periods, with CP4 having the highest value (20%) and CP3 having the lowest value (16%). This suggests that apartment blocks built in the 1960s (CP4) had a larger proportion of windows compared to other periods.

Mean seasonal efficiency of the heating generation sub-system: This parameter measures the efficiency of the heating system, specifically for natural gas. The values in the table indicate a significant improvement in mean seasonal efficiency for apartment blocks built after the 1960s (CP4, CP5, and CP6). This suggests that newer apartment blocks have more efficient heating systems, resulting in lower energy consumption for space heating.

Energy needs for space heating, cooling, and domestic hot water: The energy needs for space heating, cooling, and domestic hot water vary among different construction periods. Generally, the energy needs for space heating decrease as we move from older to newer apartment blocks, indicating improved energy efficiency in heating systems. The energy needs for space cooling and domestic hot water show some fluctuations with no clear trend observed across the construction periods.

Non-renewable energy performance: The non-renewable energy performance values represent the energy consumption of the apartment blocks for different purposes. The values vary among different construction periods, with the highest values observed for CP4 and CP5, and relatively lower values for CP6. This suggests that apartment blocks built after 2007 (CP6) have better non-renewable energy performance, indicating lower energy consumption and improved energy efficiency compared to older constructions.

Overall, the insights from Table 42 suggest that newer apartment blocks in Catalonia tend to have better thermal insulation, more efficient heating systems, and lower energy consumption for space heating. However, there is variation in the characteristics across different construction periods, and some parameters show fluctuations without a clear trend.

Table 42. Summary of the archetype's characteristics for apartment blocks in Catalonia

	CP2	CP3	CP4	CP5	CP6
	1901-1936	1937-1960	1961-1980	1981-2006	> 2007
Compactness ratio	2,85	2,93	2,96	2,76	2,76
Thermally heated gross volume	201	202	198	209	190
Thermally heated floor area	70	73	75	80	73
Transparent thermal envelope area on thermal envelope area	18	16	20	18	18
Mean thermal transmittance of opaque building envelope	1,66	1,61	1,54	1,04	0,51
Mean thermal transmittance of transparent building envelope	4,52	4,64	4,64	3,78	3,58
Mean seasonal efficiency of the heating generation sub-system (natural gas)	0,78	0,77	0,77	0,77	0,98
Energy need for space heating	94,1	91	92,2	77,2	53,8
Energy need for space cooling	5,4	5,3	5,3	4,6	5
Energy need for domestic hot water	80	87,1	100	84	84
Non-renewable energy performance per space heating	130,8	129,4	132,6	115,4	74,7
Overall non-renewable energy performance	187,9	258,6	274,9	228	131,7

The characteristics of the archetypes of single-family houses in Catalonia are summarised in Table 43. Based on these characteristics, the following observations can be made:

Thermally heated gross volume and floor area: There is a general increase in the thermally heated gross volume and floor area as we move from older to newer houses. The values for these parameters increase steadily from CP3 to CP6, indicating larger houses being constructed in later years.

Mean thermal transmittance of opaque and transparent building envelope: The mean thermal transmittance values provide insights into the thermal insulation properties of the building envelope. A lower value indicates better insulation. As expected, newer houses (CP5 and CP6) have lower mean thermal transmittance values for both the opaque and transparent building envelope, indicating improved insulation compared to older houses (CP3 and CP4).

Mean seasonal efficiency of the heating generation sub-system: This parameter measures the efficiency of the heating system, specifically for natural gas. The values remain relatively consistent across the different construction periods, with newer houses (CP5 and CP6) having a slightly higher mean seasonal efficiency compared to older houses (CP3 and CP4).

Energy needs for space heating, cooling, and domestic hot water: The energy needs for space heating, cooling, and domestic hot water decrease as we move from older to newer houses. This suggests that newer houses are more energy-efficient in terms of maintaining comfortable indoor conditions and providing hot water.

Non-renewable energy performance: The non-renewable energy performance values represent the energy consumption of the houses for different purposes. The values decrease significantly from CP3 to CP6, indicating a substantial improvement in energy efficiency over time. Newer houses have much lower non-renewable energy consumption, reflecting advancements in building design, insulation, and energy systems.

The insights from Table 43 suggest that newer single-family houses in Catalonia tend to be more energy-efficient, have improved thermal insulation, and consume less non-renewable energy for space heating, cooling, and domestic hot water compared to older houses. These findings align with the general trend of increasing awareness and regulations regarding energy efficiency in building construction.

Table 43. Summary of the archetype's characteristics for single-family houses in Catalonia

	CP3	CP4	CP5	CP6
	1937-1960	1961-1980	1981-2006	> 2007
Compactness ratio	1,14	1	1,18	1,26
Thermally heated gross volume	263	267	336	380
Thermally heated floor area	96	100	128	140
Transparent thermal envelope area on thermal envelope area	18	20	20	23
Mean thermal transmittance of opaque building envelope	1,63	1,56	1,16	0,51
Mean thermal transmittance of transparent building envelope	4,31	4,14	3,78	3,44
Mean seasonal efficiency of the heating generation sub-system (natural gas)	0,77	0,77	0,77	0,88
Energy need for space heating	139,1	151,5	125,3	74,4
Energy need for space cooling	6,9	7,7	5,4	6,3
Energy need for domestic hot water	112	112	126	130
Non-renewable energy performance per space heating	202	216,5	183,5	96,1
Overall non-renewable energy performance	258,6	274,9	228	131,7

5.2 Building stock energy model

In the following subsections, the results of the energy balance and the renovation scenarios of the building stock are presented for each country or region involved in TIMEPAC. The renovation scenarios have been only performed by Piemonte Region (Italy) and Slovenia.

5.2.1 Austria

An example of building stock energy performance is presented in Table 44. This exercise is done for residential buildings only, because the sample for developing reference buildings for non-residential building types was too small.

Conversion factors (primary energy and GHG emissions) are taken from OIB Guideline 6 (OIB-330.6-026/19) which is the official source for EPBD related calculations in Austria.

The floor area per reference building cluster was retrieved from Statistics Austria via fee-based access to the STATcube database.

Table 44. Key indicators (explanation of abbreviations see Table 21) for apartment buildings, climate zone NF, province of Salzburg

Indicator	Unit	Until 1919	1919 - 1944	1945 - 1960	1961 - 1970	1971 - 1980	1981 - 1990	1991 - 2000	2001 - 2005	2006 and after	Total
HWB	GWh/a	41,13	25,58	50,28	59,87	108,58	54,76	39,81	14,45	15,49	409,94
WWB	GWh/a	4,52	3,27	6,99	9,48	14,85	9,32	7,41	3,54	5,55	64,94
HE	GWh/a	58,76	37,43	78,16	93,05	168,91	68,23	60,90	23,62	24,17	613,21
PE-HE	GWh/a	79,82	49,60	108,73	129,05	239,23	105,13	83,60	30,69	35,85	861,72
PE-HE e	GWh/a	35,019	12,81	40,87	53,05	88,245	38,375	26,17	14,31	24,47	333,31
PE-HE ne	GWh/a	44,81	36,79	67,86	76,00	150,98	66,76	57,44	16,38	11,38	528,41
CO_2equ	t/a	10430	8757	15848	17832	35667	15154	13442	3797	2475	123400

In view of the future need to develop national renovation plans which should be based on regional if not municipal renovation plans, the developed methodology represents a feasible approach to develop building stock energy models, and based on this, renovation scenarios. However, statistical data need to be prepared (allocation of municipalities to climate zones, net floor area by municipality, construction period and building type) and made available ready for use by authorities, to avoid the work-around which was necessary to perform this task.

5.2.2 Croatia

For single-family houses and apartment buildings, median key indicators were calculated. From Table 45 to Table 48, key indicators are shown, separately for single, family houses and apartment blocks and climatic zones (costal and continental Croatia). Each table has data separated according to construction periods (CP1 – till 1907, CP2 – from 1971 to 2006, CP3 – after 2007).

Table 45. Key indicators for single-family buildings in continental Croatia

	Data	Symbol	Unit of measure	Median for CP1	Median for CP2	Median for CP3
Geometry	Compactness ratio	CR	m^{-1}	0,83	0,79	0,82
	Thermally heated gross volume	$V_{H;g}$	m^3	457	385	369
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	134	160	154
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2·K)$	1,070	0,900	0,370
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2·K)$	1,100	1,100	0,900
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	157,3	129,2	49,6
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	13,4	13,8	15,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	12,5	12,5	12,5
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	213,2	180,7	76,4

Table 46. Key indicators for apartment buildings in continental Croatia

	Data	Symbol	Unit of measure	Median for CP1	Median for CP2	Median for CP3
Geometry	Compactness ratio	CR	m^{-1}	0,50	0,45	0,59
	Thermally heated gross volume	$V_{H;g}$	m^3	204	144	174
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	60	60	73
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2·K)$	1,180	0,890	0,430
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2·K)$	1,100	1,100	1,100
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	100,3	66,1	40,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	18,4	19,2	20,8
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	16,0	16,0	16,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	157,6	113,4	79,7

Table 47. Key indicators for single-family buildings in costal Croatia

	Data	Symbol	Unit of measure	Median for CP1	Median for CP2	Median for CP3
Geometry	Compactness ratio	CR	m^{-1}	0,77	0,78	0,81
	Thermally heated gross volume	$V_{H;g}$	m^3	396	392	376
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	116	163	157
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	1,320	1,160	0,450
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,100	1,100	1,100
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	97,8	78,9	23,3
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	31,6	32,4	32,6
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	12,5	12,5	12,5
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	114,5	97,4	29,6

Table 48. Key indicators for apartment buildings in costal Croatia

	Data	Symbol	Unit of measure	Median for CP1	Median for CP2	Median for CP3
Geometry	Compactness ratio	CR	m^{-1}	0,63	0,66	0,69
	Thermally heated gross volume	$V_{H;g}$	m^3	215	149	454
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	63	62	189
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	1,240	1,000	0,490
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,100	1,100	1,100
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	68,0	49,6	21,6
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	32,9	32,1	32,3
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	16,0	16,0	16,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	85,9	70,9	34,5

Key indicators were used to calculate overall energy balance of the stock. To have the comprehensive energy overview, floor areas of the residential building stock in Croatia have to be known. Data is shown in Table 49.

Table 49. Overall floor area for residential sector in Croatia

	Data	Symbol	Unit of measure	Overall for CP1	Overall for CP2	Overall for CP3
Single-family houses	Floor area - continental	*A*	m^2	23.073.454	31.574.200	6.071.962
	Floor area - costal	*A*	m^2	8.649.470	11.836.117	2.276.176
Apartment buildings	Floor area - continental	*A*	m^2	8.856.331	12.763.535	4.428.165
	Floor area - costal	*A*	m^2	6.596.527	9.506.760	3.298.264

The results of the building stock energy model in terms of energy performance indicators are provided in Table 50 and in Table 51.

Table 50. Residential building stock energy model for continental Croatia

	Data	Symbol	Unit of measure	Overall for CP1	Overall for CP2	Overall for CP3
Single-family houses	Energy need for space heating	$EP_{H;nd;ztc}$	[GWh]	3.629,8	4.080,6	301,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	[GWh]	309,6	437,0	96,6
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	[GWh]	288,4	394,7	75,9
	Overall non-renewable energy performance	$EP_{gl;nren}$	[GWh]	4.920,1	5.704,8	463,9
Apartment buildings	Energy need for space heating	$EP_{H;nd;ztc}$	[GWh]	888,4	843,7	176,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	[GWh]	163,1	245,4	92,1
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	[GWh]	141,7	204,2	70,9
	Overall non-renewable energy performance	$EP_{gl;nren}$	[GWh]	1.396,0	1.446,9	353,1

Table 51. Residential building stock energy model for costal Croatia

	Data	Symbol	Unit of measure	Overall for CP1	Overall for CP2	Overall for CP3
Single-family houses	Energy need for space heating	$EP_{H;nd;ztc}$	[GWh]	845,5	933,9	53,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	[GWh]	273,1	383,0	74,3
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	[GWh]	108,1	148,0	28,5
	Overall non-renewable energy performance	$EP_{gl;nren}$	[GWh]	990,5	1.153,1	67,4
Apartment buildings	Energy need for space heating	$EP_{H;nd;ztc}$	[GWh]	448,3	471,3	71,3
	Energy need for space cooling	$EP_{C;nd;ztc}$	[GWh]	217,2	304,9	106,6
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	[GWh]	105,5	152,1	52,8
	Overall non-renewable energy performance	$EP_{gl;nren}$	[GWh]	566,7	673,7	113,7

Using assumptions for energy carrier shares in non-renewable energy performance and their GHG emissions, CO_2 emissions for building stock can be estimated; the results are shown in Table 52.

Table 52. Residential building stock GHG emission model for Croatia

	Data	Symbol	Unit of measure	Overall for CP1	Overall for CP2	Overall for CP3
Single-family houses	GHG emission associated to the overall non-renewable energy performance - continental Croatia	$K_{CO2e;EPgl;nren}$	[tCO_{2e}]	1.103.984	1.280.071	104.091
	GHG emission associated to the overall non-renewable energy performance - costal Croatia	$K_{CO2e;EPgl;nren}$	[tCO_{2e}]	286.825	333.937	19.518
Apartment buildings	GHG emission associated to the overall non-renewable energy performance - continental Croatia	$K_{CO2e;EPgl;nren}$	[tCO_{2e}]	292.331	302.980	73.945
	GHG emission associated to the overall non-renewable energy performance - costal Croatia	$K_{CO2e;EPgl;nren}$	[tCO_{2e}]	165.290	196.495	33.150

5.2.3 Cyprus

In the context of Cyprus, the analysis of the energy balance of the building stock encountered significant difficulties primarily due to the current state of available data. As previously mentioned, the low number of EPCs in the database posed a substantial challenge in accurately conducting the analysis.

The limited data sample prevented us from obtaining the necessary numerical consistency required for performing a comprehensive energy balance assessment of the building stock in Cyprus. The absence of sufficient data on a wide range of buildings hindered the ability to derive meaningful insights and draw reliable conclusions about the overall energy performance of the building stock. Furthermore, the scarcity of data for various building types and sizes made it challenging to adequately represent the building stock's diversity. As a result, the outcomes of the energy balance analysis could not capture the full spectrum of energy performance characteristics present in Cyprus.

To improve the EPC database and other data sources for future energy balance activities, it is crucial to implement strategies to increase data collection and availability. One approach involves enhancing the issuance and registration of EPCs for both new and existing buildings. This could be achieved through awareness campaigns, incentives, and streamlined procedures to encourage building owners to obtain and submit EPCs.

Promoting data sharing can also contribute to a more comprehensive and representative dataset. Partnering with local authorities, real estate agencies, and energy assessors to gather and consolidate data on various building types can help in overcoming the challenges posed by the limited sample size.
Moreover, exploring alternative data sources such as utility consumption data, building permits, and construction records can supplement the EPC database and provide additional insights into the energy performance of buildings. Integrating data from different sources can help to enhance the accuracy and completeness of the energy balance analysis.

5.2.4 Italy

The results of the energy balance of the regional building stock (current state and long-term scenario) for the two residential building typologies are presented in Figure 55 and Figure 56. As described in Section 4.2.4, three different renovation scenarios have been identified and applied: 1. refurbishment of the opaque building envelope (i.e., SCEN1), 2. renovation of the opaque and transparent building envelope (i.e., SCEN2), and 3. refurbishment of the opaque building envelope and replacement of the space heating system (i.e., SCEN3). The percentage of building stock floor area assumed to be yearly renovated for each scenario is presented in Table 53. This assumption would allow to achieve the climate protection targets as foreseen in previous research works (IEE, 2013).

Table 53. Percentage of building stock floor area yearly renovated for each scenario

	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8
SCEN1	3%	3%	3%	3%	3%	3%	3%	3%
SCEN2	2%	2%	2%	2%	2%	2%	2%	2%
SCEN3	2%	2%	2%	2%	2%	2%	2%	2%

The yearly energy savings have been calculated according to the developed tool; in this preliminary assessment, they have been assumed constant in the considered calculation period (i.e., 27 years). In long-term scenario, the reduction of the $EP_{gl;nren}$ is around 74% for SFHs and 71% for BU(AB)s.

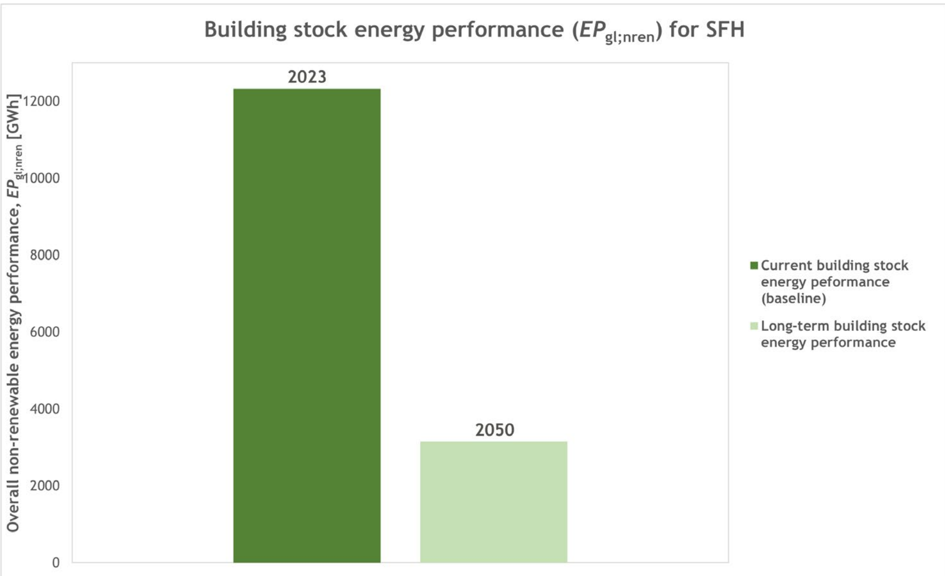

Figure 55. Current and long-term energy intensity of the SFHs of the Piemonte Region

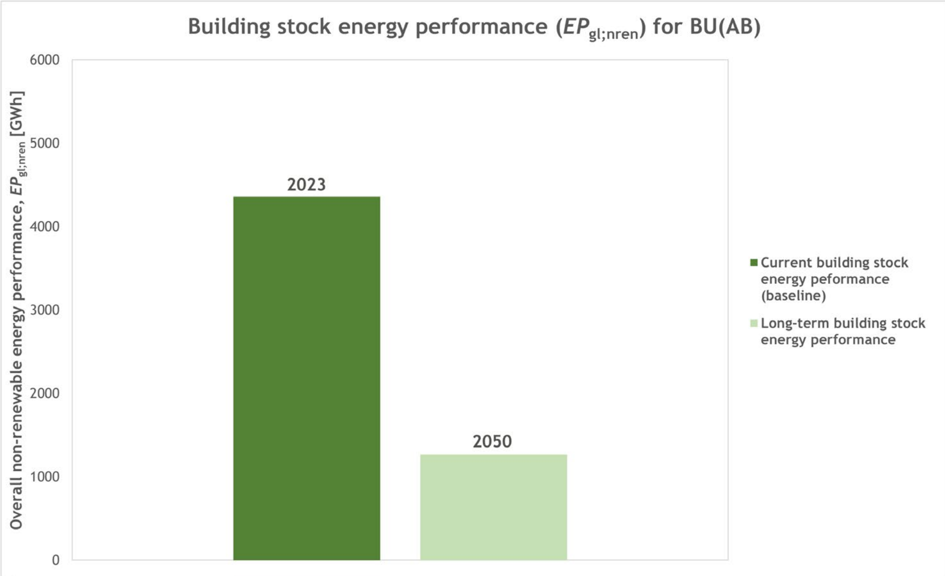

Figure 56. Current and long-term energy intensity of the BU(AB)s of the Piemonte Region

5.2.5 Slovenia

The building stock in North Primorska regions consists of 4,45 million m^2 total floor area of residential buildings. 82% of those belong to single family houses, the rest are apartment blocks. The reality is that many of those buildings still have not been energy renovated, thus altogether present a technical potential for renovation and decarbonisation of the buildings before 2050.

The overall energy balance for SFH is 663,7 GWh/a of non-renewable energy performance, which equals to 181,7 kWh/m^2 of specific non-renewable energy performance. The energy balance for BU(AB) sums up to 118,4 GWh/a or 149,8 kWh/m^2 of specific non-renewable energy performance. This reflects the fact the buildings in this region are predominately energy inefficient and thus need to be renovated. In the scope of TDS5 three renovation scenarios were proposed:

- REN1: Transparent building envelope replacement: thermal insulation of façade, roof or unheated attic, and basement ceiling;
- REN2: Opaque and transparent building envelope insulation: replacement of windows where this has not been done yet;
- REN3: Space heating technical building system renovation: upgrade of thermal substation with more efficient and up-to date technologies; upgrade of heating systems.

The analysis of EPC showed the majority of SFH is being heated by fuel oil, while on the other hand BU(AB) are heated by district heating networks. National heating and cooling strategy directs heating systems of BU(AB) to be connected to the district heating networks if there is one available. Renovation scenarios for heating systems (REN3) of those buildings until 2050 thus present only a replacement of the same core technology with more up-to date efficient one. The prevailing technology for SFH are heat pumps.

Table 54 and Table 55 show the share of annually renovated SFH and BU(AB), respectively, corresponding to renovation scenarios and building period of constructed buildings.

Table 54. Share of the annually renovated SFH according to scenarios REN1 – REN3

		CP1	CP2	CP3	CP4	CP5	CP6
SFH		**≤ 1944**	**1945-1970**	**1971-1980**	**1981-2002**	**2003-2008**	**> 2008**
REN1	[%]	3%	4%	4%	4%	3%	1%
REN2	[%]	5%	5%	6%	5%	4%	1%
REN3	[%]	3%	4%	5%	3%	3%	1%
NOREN	[%]	89%	87%	85%	88%	90%	97%

Table 55. Share of the annually renovated BU(AB) according to scenarios REN1 – REN3

		CP1	CP2	CP3	CP4	CP5	CP6
AB		**≤ 1944**	**1945-1970**	**1971-1980**	**1981-2002**	**2003-2008**	**> 2008**
REN1	[%]	2%	3%	4%	3%	2%	1%
REN2	[%]	2%	3%	4%	3%	2%	1%
REN3	[%]	2%	3%	3%	3%	2%	1%
NOREN	[%]	94%	91%	89%	91%	94%	97%

After undertaking all three renovation scenarios for SFH and BU(AB), the overall energy balance decreases drastically, i.e., by 57% for SFH (Figure 57) and by 94% for BU(AB) (Figure 58), respectively. The results show the decarbonisation of AB is possible, since the overall non-renewable energy performance decreases for more than 90% and further analysis should be done in order to exploit how to completely reduce this to zero. Further steps of such analysis should focus on carbon emission in next steps, since this is overall goal. The work in the scope of TDS5 tackles more the overall principle from European Commission called “energy efficiency first”, so next step should exploit the methodology upgrade that would capture emission aspect too.

On the other hand, the results show that the balance in the SFH is decreasing at a rate that is not sufficient. The annual rates thus should be higher, but higher rates of renovation in the range of 5-7% are not realistic. This warning should be sent to the national authorities to draw the attention of the problem in the context of building a decarbonisation strategy by 2050.

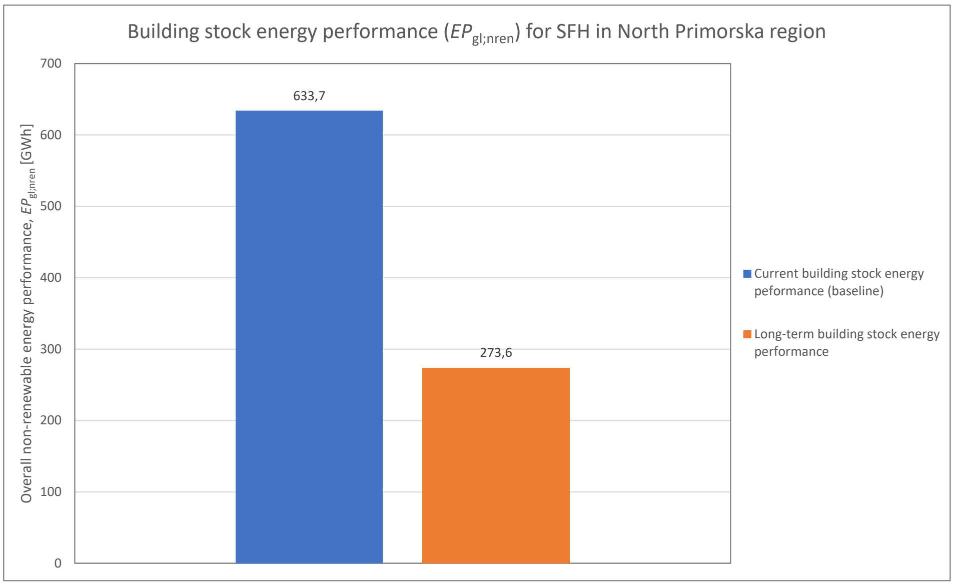

Figure 57. Current and long-term energy balance for SFH in North Primorska region

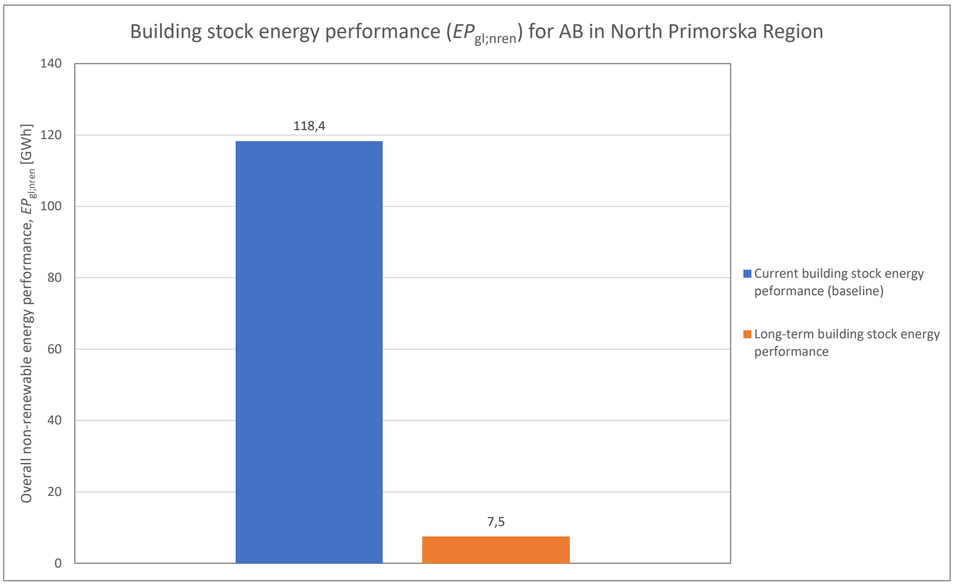

Figure 58. Current and long-term energy balance for AB in North Primorska region

5.2.6 Spain

To calculate overall energy balance of the stock, the floor area of the complete building stock in C2 climate zone for the selected archetypes has been calculated from the Cadastre data source[15] (Table 56).

Table 56. Overall floor area for residential sector in Catalonia (Spain)

	Symbol	Unit of measure	CP2	CP3	CP4	CP5	CP6
Single-family houses	*A*	km^2	-	32	80	120	44
Apartment buildings	*A*	km^2	47	70	823	610	173

The characteristics of the building archetypes (Section 5.1.6) and the floor area have been introduced in the building stock energy model described in Section 3.2. The output of the energy model with regards the energy performance can be found in Table 57.

Table 57. Residential building stock energy model for Catalonia

	Data	Symbol	Unit of measure	CP2	CP3	CP4	CP5	CP6
Single-family houses	Energy need for space heating	$EP_{H;nd;ztc}$	[GWh]	-	4.477	12.131	15.037	3.335
	Energy need for space cooling	$EP_{C;nd;ztc}$	[GWh]	-	222	616	648	282
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	[GWh]	-	3.605	8.968	15.121	5.827
	Non-renewable energy performance per space heating	$EP_{H;nren}$	[GWh]	-	6.502	17.335	22.021	4.308
	Overall non-renewable energy performance	$EP_{gl;nren}$	[GWh]	-	8.324	22.012	27.361	5.903
Apartment buildings	Energy need for space heating	$EP_{H;nd;ztc}$	[GWh]	4.489	6.392	75.899	47.141	9.330
	Energy need for space cooling	$EP_{C;nd;ztc}$	[GWh]	257	372	4363,0	2.808	867
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	[GWh]	3.816	6.118	82.320	51.293	14.567
	Non-renewable energy performance per space heating	$EP_{H;nren}$	[GWh]	6.239	9.089	109.156	70.467	12.954
	Overall non-renewable energy performance	$EP_{gl;nren}$	[GWh]	8.963	18.165	226.297	139.225	22.839

[15] https://www.catastro.meh.es/esp/productos.asp

To calculate the GHG emission associated to the overall non-renewable energy performance, the following assumptions have been made with regards energy carrier types and primary energy factor per energy carrier for all archetypes (Table 58).

Table 58. Energy carrier types and primary energy factor per energy carrier for single-family houses

	Heating	Cooling	Domestic hot water
Energy carrier type 1	Natural gas	Electricity	Natural gas
Energy carrier type 2	Electricity		Electricity
Non-renewable primary energy factor per energy carrier 1	1,05	1,95	1,05
Non-renewable primary energy factor per energy carrier 2	1,95		1,95
GHG emission per energy carrier 1 (gCO_2/kWh)	210	460	210
GHG emission per energy carrier 2 (gCO_2/kWh)	460		460

The energy carriers share for single-family houses and apartment blocks can be found in Table 59. The data comes from the statistical analyses of the Catalan EPC database.

Table 59. Energy carrier share for single-family houses and apartment blocks

Building use	Energy Carrier	Heating	Cooling	Domestic hot water
Single-family house	Energy carrier share 1	56%	100%	44%
	Energy carrier share 2	20%		31%
Apartment block	Energy carrier share 1	73%	100%	67%
	Energy carrier share 2	25%		28%

Using assumptions for energy carrier shares in non-renewable energy performance and their GHG emissions, CO_2 emissions for building stock can be estimated (Table 60).

Table 60. Residential building stock GHG emission associated to the overall non-renewable energy performance for Catalonia

	Symbol	Unit of measure	CP2	CP3	CP4	CP5	CP6
Single-family houses	$K_{CO2e;EPgl;nren}$	[$ktCO_{2e}$]	-	1.535	4.061	5.048	1.089
Apartment buildings	$K_{CO2e;EPgl;nren}$	[$ktCO_{2e}$]	1.682	3.409	42.474	26.131	4.286

5.3 Cross-country comparison

This section compares the applications and outcomes from various countries on the TDS5 objectives. Generally, the requirements for compiling specific EPC data fields vary among the EU countries; in Figure 59, the number of EPCs analysed by each country is presented.

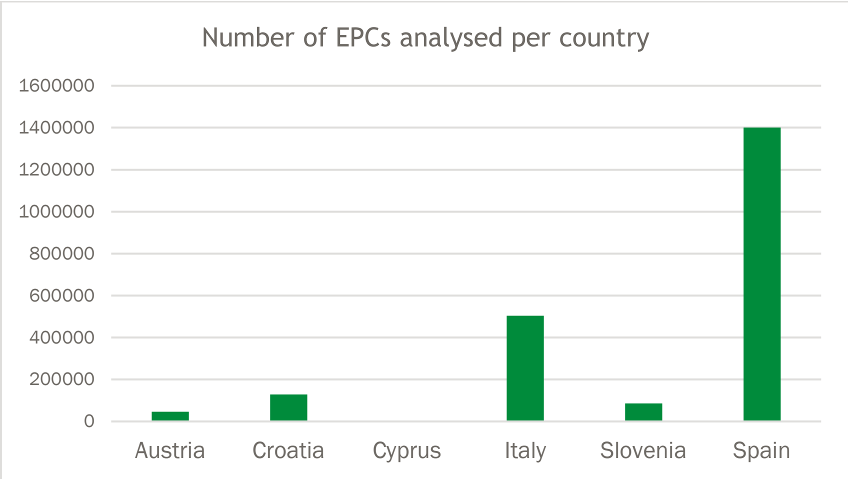

Figure 59. Number of EPC databases used for statistical analysis per country

To proceed with the large-scale statistical analysis of EPCs databases, each country partner applied the TDS5 methodology, which has been provided in the *Guidelines to create archetypes of the building stock from EPC data* (Annex A), to different extents of the building stock based on their available data and resources. Generally, each involved country followed the common methodology with same differentiations in the use of the input dataset or the tools adopted to process the information.

For data quality checking and building archetypes (Sections 4.1 and 5.1), after an initial filtering process, the statistical analysis programs "Pandas" and "NumPy" were used with Python 3 to implement the *Guidelines* in the Austrian case. Pandas was used to perform data type checks, but it was not necessary to apply physical impossibility and consistency tests since the calculation software and the "ZEUS" database already performed them.

Croatia utilised data from the EPC database and compared it with the TDS5 common methodology of EPC data selection to identify the specific data required for individual EPCs. The TDS5 *Guidelines*' methodology for assessing EPC quality was closely followed, maintaining the same rules and solely excluding segments not present in the Croatian database. Also the Cypriot approach was in line with the *Guidelines*, but uncertain results were got due to the very limited sample considered in the analysis for unavailability of data. Despite the results given, the methodology proved to be applicable also with the dataset included in the EPC schema of Cyprus.

The Italian procedure for verifying EPC data quality and creating archetypes was in complete alignment with the provided *Guidelines*, with some adaptations necessary to move from the subset of the regional building stock used for the example application (Moncalieri, Section A2) to the whole regional EPCs of Piemonte.

In the Slovenian database, data quality checking was not entirely conducted following the proposed methodology due to inconsistency data capture within the database. The methodology for quality check was the same, but calculated separately. The statistical analysis for observed parameters was performed partly in Excel and partly in SPSS software.

In the Spanish case (Catalonia), the procedure for EPC data quality checking and building archetype definition was implemented in accordance with the *Guidelines*. To overcome Excel limitations (feasibility to manage a very high amount of EPCs, see also Figure 59), SQL commands were utilised for data quality checking and archetype characterisation. However, specific information regarding tertiary buildings was lacking in the database.

In summary, 8 archetypes for Austria, 42 archetypes for Croatia, 3 archetypes for Cyprus, 32 archetypes for Italy, 48 for Slovenia, and 21 for Spain were developed for residential and non-residential buildings over different construction periods. For Austria, archetypes for non-residential buildings have been developed but have not been further used due to the small number of buildings available for statistical analysis. As concerns the way to represent the results, both tables and graphs are used. Among the latter, the most used are the relative frequency plot, the grouped boxplot, and the grouped relative frequency plot.

For building stock energy models (Sections 4.2 and 5.2), all the involved countries used the proposed method and the related tool addressed in Section 3.2. For Austria, Croatia, and Spain, the analysis was done only for the base case without considering any refurbishment scenarios. In this case, the energy performance status of the building stock has been reported. On the other hand, for Italy and Slovenia, three different renovation scenarios have been identified and applied. In the case of Italy, the analysis solely depended on the information available in the EPC (i.e., type of energy efficiency measures and related energy savings), leading to the consideration of the variability of the only overall non-renewable energy performance indicator ($EP_{\text{gl;nren}}$) in the analysis. Conversely, for Slovenia, the energy performance achievable with the building renovation was assessed on the developed archetypes using a monthly steady-state calculation method. In both cases, the tool demonstrated to perform well the assessment; the yearly energy savings of the building stock were calculated and reported for long-term analysis.

5.4 Confidence intervals on input data

The confidence intervals were calculated for the selected input data from the EPCs of Piemonte, as described in Section 4.3. Table 61 presents the mean and the standard deviation (SD), along with the lower limit (LL) and upper limit (UL) of the 95% confidence interval, for the mean thermal transmittance of the opaque building envelope (U_{op}) and of the transparent building envelope (U_{wi}) of single-family houses (SFH) in the Piemonte Region, categorised by construction period.

Table 61. The confidence interval of thermal transmittance of the opaque and transparent building envelopes (SFH-Piemonte)

SFH	U_{op} [W/(m²·K)]			U_{wi} [W/(m²·K)]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	1,259 ± 0,45	1,250	1,268	3,234 ± 1,30	3,209	3,260
CP2	1,243 ± 0,45	1,225	1,261	3,209 ± 1,25	3,159	3,258
CP3	1,216 ± 0,44	1,205	1,227	3,170 ± 1,30	3,138	3,203
CP4	1,114 ± 0,45	1,104	1,125	2,960 ± 1,29	2,929	2,991
CP5	1,019 ± 0,42	1,009	1,030	2,872 ± 1,32	2,840	2,905
CP6	0,970 ± 0,38	0,959	0,981	2,678 ± 1,14	2,645	2,712
CP7	0,830 ± 0,33	0,820	0,840	2,390 ± 0,81	2,366	2,415
CP8	0,447 ± 0,30	0,439	0,456	1,749 ± 0,68	1,730	1,769

The same procedure was performed for all the selected input data (U_{op}, U_{wi}, A_{wi}/A_{env}, and CR) on building units (BU(AB)), offices, and educational buildings in the Piemonte Region. The outcomes of this analysis can be found in Annex C.

The confidence interval is narrow for SFH and BU(AB) based on the results. This is because a large sample size of EPCs is available for residential buildings in the Piemonte Region, particularly for BU(AB). The confidence interval for offices and educational buildings is wider than for residential buildings due to a smaller sample size. However, the difference is not substantial as the data between the 10th and 90th percentile in terms of heated gross volumes have been adopted for offices and educational buildings in order to reduce the dispersion.

A narrow confidence interval indicates that the estimated value is relatively stable and allows for inferences about the population with a level of certainty for generating enhanced EPCs. These confidence intervals serve as valuable tools for energy certifiers to create EPCs and assess the energy performance of building stocks across various databases.

In order to identify the distribution function of the input data, kernel density estimation figures are utilised for key inputs: U_{op}, U_{wi}, A_{wi}/A_{env}, and CR. Specifically, these figures are provided as an example of the first construction period for SFH, as illustrated in Figure 60. By employing kernel density estimation, valuable insights into the characteristics and patterns of the data are obtained. These estimates provide information to estimate the underlying probability density functions (PDFs) of the dataset. As discussed in Section 3.3, kernel density estimation is selected as the preferred method due to its ability to overcome the limitations associated with histogram analysis. As shown in Figure 60, kernel density estimation can provide smooth representations of the estimates. For the future generation of enhanced EPCs, density functions allow certifiers for a more accurate depiction of the data's distribution, a more comprehensive understanding of the data, and facilitates further analysis.

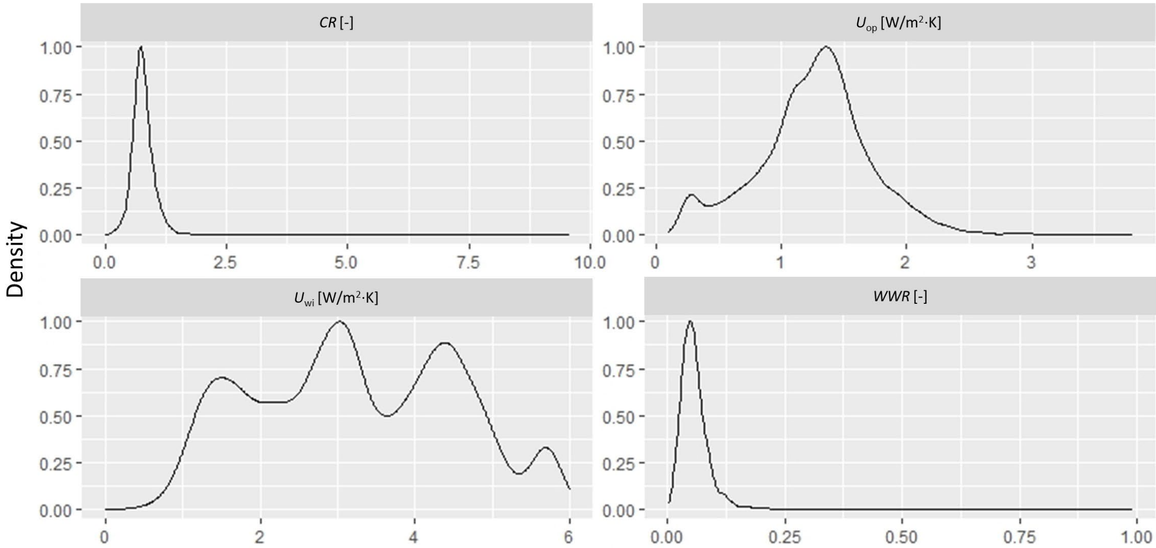

Figure 60. Example of kernel density functions (SFH-Piemonte - CP1)

The same process was applied to the selected input data for all construction periods of single-family houses and building units in the Piemonte Region. The results can be found in Annex C. However, the analysis was not conducted for offices and educational buildings due to the low number of samples.

Additionally, multiple regression analysis was conducted to find the relationship between the output variable ($EP_{H;nd;ztc;an}$) and the correlated input data (U_{op}, U_{wi}, A_{wi}/A_{env}, and CR) for single-family houses in the Piemonte Region. The results of this analysis are presented in Table 62, categorised according to the construction period.

Table 62. Regression model for SFH of the Piemonte Region

SFH	Regression model	R^2 value
CP1	$EP_{H;nd;ztc;an} = -0,060 + 0,88(A_{wi} / A_{env}) + 0,091(CR) + 0,053(U_{op}) + 0,004(U_{wi})$	"0,71"
CP3	$EP_{H;nd;ztc;an} = -0,058 + 0,060(A_{wi} / A_{env}) + 0,086(CR) + 0,049(U_{op}) + 0,005(U_{wi})$	"0,70"
CP4	$EP_{H;nd;ztc;an} = -0,073 + 0,009(A_{wi} / A_{env}) + 0,098(CR) + 0,058(U_{op}) + 0,003(U_{wi})$	"0,61"
CP8	$EP_{H;nd;ztc;an} = -0,024 + 0,060(A_{wi} / A_{env}) + 0,036(CR) + 0,049(U_{op}) + 0,005(U_{wi})$	"0,61"

The results revealed relations between the output and correlated input data for construction periods 1, 3, 4, and 8 of SFH. These equations provide valuable insights into the observed relationships and patterns in the Piemonte Region EPC database. They serve as an additional beneficial tool for enhanced EPC generation by facilitating the identification of correlations between input and output data. Moreover, they also present the coefficient of determination (R^2 value), indicating the model's goodness of fit and the level of correlation.

For BU(AB), offices, and educational buildings, the null hypothesis could not be rejected for some input data, indicating that a relationship cannot be verified in all the construction periods. This limitation is primarily due to constraints imposed by the available samples, such as the dispersion of data for building units and the limited number of observations for offices and educational buildings.

6 Conclusions

The objectives set out in Task 2.5 of TIMEPAC have been achieved; the work done lays the foundations for the enhancement of the exploitability of the EPCs in the future, as foreseen by the framework of the TIMEPAC project. A common methodology to exploit the EPC database has been developed; it proved to be easily applicable and upgradable, adaptable to country specific needs and tasks to be performed.

The *Guidelines* to create archetypes of the building stock from the EPC data can be applied with different tools, even to reduce the computational time that occurs when a huge amount of data should be processed. For example, in the Spanish case, the entire process of checking the quality of the EPCs and characterising the archetypes was optimised; it took less than 10 minutes on a standard computer. For future use, the developed procedure could be implemented directly in the EPC database and programmed in such a way that relevant excerpts and reporting can be easily done by the stakeholder (e.g., the staff of the administration), so that the potential of the applied method can be fully utilised.

The EPC database in the different countries demonstrated to be a useful source of data but with current limitations, first of all related to data quality that was properly checked and guaranteed in the analysis, but that resulted in removing of a high number of EPCs. The EPC data quality will be increased in the future by applying the outcomes of TDS5 related to the distribution and the confidence intervals of input data; they could be easily implemented within the instruments for the EPC generation at regional/national level as to produce warnings to the energy certifier. In this way, the aware technician, during the uploading phase, could correct the EPC data before the transmission to the dedicated database. The methodology to create the confidence intervals has been set-up and tested for the EPC database of Piemonte (Italy) and can be easily implemented in other countries/regions.

The results of the methodology to create representative buildings and to analyse the energy balance of the building stock are currently affected by the actual limitations of the EPC data, but will be overcome in the future also thanks to the objectives addressed by the other TDSs developed in TIMEPAC. More specifically, the TDS5 analyses will be improved by:

- the introduction of new indicators (TDS2, TDS4), which would increase the information framework of the archetypes,
- the definition of effective and feasible energy efficiency measures from the Building Renovation Passports (TDS3), which would enrich the reliability of the renovation scenarios of the building stock in accordance with the Renovation Wave of the EU, and
- the use of an integrated building information framework (TDS1), which would let the access to external data sources to increase interoperability.

In addition, the general enhancement of the EPC as a holistic and dynamic entity would determine an increase in the number of EPCs issued by country/region, in such a way to increase the representativeness of the database sample.

Both the archetypes and the energy model of the building stock would be subject to continuous updates, in line with the variability of the EPC database content. Undeniably, a higher effectiveness and reliability of the numerical results of TDS5 will be achieved with the enhanced EPC being developed in TIMEPAC, which will constitute the future EPC databases in EU.

Besides the overall limitation due to the current EPC data quality, a minor drawback is related the methodology to create archetypes that, being characterised by a very plain structure, presents a lower level of complexity and accurateness compared to other approaches available in literature (e.g., those exploiting Artificial Intelligence-based techniques). The complexity level of this approach has been set in such a way to reach a balance between ease of assessment and accuracy of the outcomes, in order to provide the final users with an applicable and shared model, without the need of intervention of a highly specialised technician (e.g., a specialised researcher).

The tool developed to carry out the energy balance of the building stock, or of subsets of the whole stock (baseline), and to perform renovation scenarios demonstrated to be easily applicable, with a level of detail and accuracy that is in line with the current framework of the available data. Anyhow, the tool can be upgradable with additional functionalities, according to the needs of the stakeholders and the requests of the new EPBD. In this view, the work that will be carried out in WP3 "Verification Scenarios" would better shape the outputs of the model.

Future steps of such analysis should focus on carbon emissions and on model calibration of the building stock, the latter taking advantage from the outcomes of TDS2 that introduces the operational energy data in the EPC. In fact, the current building stock energy balance is based on the standard energy performance assessment because is the only information that at present can be derived from the EPC.

The methods and outcomes of this task will be delivered in the programme of the TIMEPAC Academy in the context of WP4 "EPC Standardisation, Training and Capacity Building". Some training modules will be addressed to the implementation of the procedure of data quality enhancement, the definition of building archetypes, and the development of building stock energy models at targeted stakeholders.

To this regard, it is important to recall the target groups to whom TDS5 refers from Section 1.1, and to deepen in which way TDS5 outcomes can be used by each of them. In Figure 61, the TDS5 results are associated to the intended audience describing the short-term and the long-term objectives. Compared to Table 2 in Section 1.1, in Figure 61 the key actors have been further detailed in accordance with the single outcomes of TDS5. The icons included in Figure 61 derive from the methodology flowchart (Section 3, Figure 7).

Due to the need of the EPC enhancement for the effectiveness of the TDS5 outcomes tackled above, short-term and long-term objectives are identified. The short-term objectives refer to the goals achievable in a relatively short period, for which the developed methods and results of TDS5 will be used. The results should be periodically updated, when new (and improved) EPCs become available. In long-term, taking advantage by the enhanced EPC, the methods developed in TDS5 will be improved with more reliable results and will effectively support the energy policy on the definition of measures and investments addressed to the achievement of the EU climate protection targets.

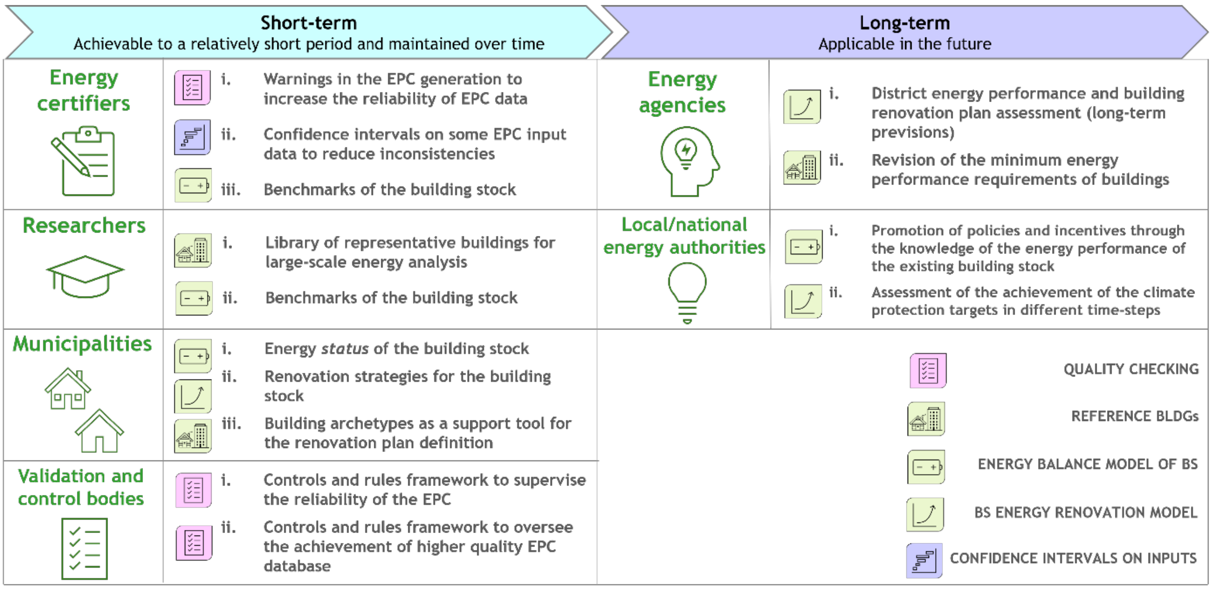

Figure 61. Target groups to whom the TDS5 outcomes are addressed

References

Austrian Institute of Construction Engineering (OIB). (2019). OIB Guideline 6: Energy saving and thermal insulation.

Ballarini, I., Corgnati, S. P., & Corrado, V. (2014). Use of reference buildings to assess the energy saving potentials of the residential building stock: The experience of TABULA project. *Energy Policy, 68*, 273-284. https://doi.org/10.1016/j.enpol.2014.01.027.

Ballarini, I., Corgnati, S. P., Corrado, V., & Talà, N. (2011). *Improving energy modeling of large building stock through the development of archetype buildings*. *Proceedings of Building Simulation 2011, Australia*, 2874-2881.

BUILD_ME. (2018). *BUILD_ME: Towards a Low-Carbon Building Sector in the MENA Region - Building typology database*. Retrieved November 26, 2022, from https://www.buildings-mena.com/typologies.

Capozzoli, A., Grassi, D., Piscitelli, M. S., & Serale, G. (2015). Discovering Knowledge from a Residential Building Stock through Data Mining Analysis for Engineering Sustainability. *Energy Procedia, 83*, 370-379. https://doi.org/10.1016/j.egypro.2015.12.212.

Collective Intelligence for Energy Flexibility (COLLECTiEF). (2021). *COLLECTiEF web-site*. Retrieved July 6, 2023, from https://collectief-project.eu/.

Croatian Republic. (2020). *Dugoročna Strategija Obnove Nacionalnog Fonda Zgrada do 2050*. Godine. Retrieved May 29, 2023, from https://energy.ec.europa.eu/system/files/2021-01/hr_ltrs_2020_0.pdf.

Cross Assessment of Energy Certificates in Europe (crossCert). (2021). *crossCert web-site*. Retrieved July 6, 2023, from https://www.crosscert.eu/.

Cross Assessment of Energy Certificates in Europe (crossCert). (2022a). D5.1 Report on existing EPC attitudes, expectations and needs - Task 5.1 Analysis of user experience in current EPC schemes.

Cross Assessment of Energy Certificates in Europe (crossCert). (2022b). D2.4 EPC cross-testing procedure - Task 2.2 Design of Cross-Assessment Tests WP2 Cross Assessing EPC Paradigms.

Department of Energy (DOE) of United States of America. (2013). *Prototype Building Models*. Retrieved November 26, 2022, from https://www.energycodes.gov/prototype-building-models.

Droutsa, K. G., Kontoyiannidis, S., Dascalaki, E. G., & Balaras, C. A. (2016). Mapping the energy performance of hellenic residential buildings from EPC (energy performance certificate) data. *Energy, 98*, 284-295. https://doi.org/10.1016/j.energy.2015.12.137.

Energy flexible DYnamic building CErtification (E-DYCE). (2020). *E-DYCE web-site*. Retrieved July 6, 2023, from https://edyce.eu/.

Energy Performance Certificate Recast (EPC RECAST). (2020). *EPC RECAST web-site*. Retrieved July 6, 2023, from https://epc-recast.eu/.

European Building Sustainability performance and energy certification Hub (EUB SuperHub). (2021). *EUB SuperHub web-site*. Retrieved July 6, 2023, from https://eubsuperhub.eu/.

European Building Sustainability performance and energy certification Hub (EUB SuperHub). (2021). Quality, Usability and Visibility of Energy and Sustainability Certificates in the Real Estate Market.

European Commission. (2023). Amendments adopted by the European Parliament on 14 March 2023 on the proposal for a Directive of the European Parliament and of the Council on the Energy

Performance of Buildings (recast). https://www.europarl.europa.eu/doceo/document/TA-9-2023-0068_EN.pdf.

European Parliament. (2002). *Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings*. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0071:EN:PDF.

European Parliament. (2010). *Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&from=EN.

European Parliament. (2018). *Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0844&from=IT.

eXTENDing the energy performance assessment and certification schemes via a mOdular approach (X-tendo). (2019). *X-tendo web-site*. Retrieved July 6, 2023, from https://x-tendo.eu/.

eXTENDing the energy performance assessment and certification schemes via a mOdular approach (X-tendo). (2022). D4.4 Description of methodologies and concepts for the technical implementation of each feature regarding improved handling and use of EPC data in selected implementing countries.

Goudarzi, S., Anisi, M. H., Kama, N., Doctor, F., Soleymani, S. A., & Sangaiah, A. K. (2019). Predictive modelling of building energy consumption based on a hybrid nature-inspired optimization algorithm. *Energy and Buildings, 196*, 83-93.

Hadjinicolaou, N. (2020). Implementation of the EPBD Cyprus: Status in 2020. https://epbd-ca.eu/wp-content/uploads/2022/03/Implementation-of-the-EPBD-in-Cyprus.pdf.

Hardy, A., & Glew, D. (2019). An analysis of errors in the Energy Performance certificate database. *Energy Policy, 129*, 1168–1178. https://doi.org/10.1016/j.enpol.2019.03.022.

High-quality Energy Performance Assessment and Certification in Europe Accelerating Deep Energy Renovation (QualDeEPC). (2019). *QualDeEPC web-site*. Retrieved July 6, 2023, from https://qualdeepc.eu/.

Integrating Building Renovation Passports into Energy Performance Certification schemes for a decarbonised building stock (iBRoad2EPC). (2021). *iBRoad2EPC web-site*. Retrieved July 6, 2023, from https://ibroad2epc.eu/.

Intelligent Energy Europe (IEE) Programme. (2009) Project TABULA "Typology Approach for Building Stock Energy Assessment", from https://episcope.eu/welcome/.

Intelligent Energy Europe (IEE) Programme. (2013) Project EPISCOPE "Energy Performance Indicator Tracking Schemes for the Continuous Optimisation of Refurbishment Processes in European Housing Stocks", from https://episcope.eu/welcome/.

Italian National Institute of Statistics (ISTAT). (2011). *Censimento generale della popolazione e delle abitazioni*. Retrieved June 26, 2023, from http://dati-censimentopopolazione.istat.it/Index.aspx.

Italian Republic. (1993). DPR 26 agosto 1993, n. 412 – Regolamento recante norme per la progettazione, l'installazione, l'esercizio e la manutenzione degli impianti termici degli edifici ai fini del contenimento dei consumi di energia, in attuazione dell'art. 4, comma 4, della legge 9 gennaio 1991, n. 10. In Italian.

Italian Republic. (2015). DM 26 giugno 2015 – Applicazione delle metodologie di calcolo delle prestazioni energetiche e definizione delle prescrizioni e dei requisiti minimi degli edifici. In Italian.

Italian Republic. (2021). Decreto Legislativo 8 novembre 2021, n. 199 – Attuazione della direttiva (UE) 2018/2001 del Parlamento europeo e del Consiglio, dell'11 dicembre 2018, sulla promozione dell'uso dell'energia da fonti rinnovabili. In Italian.

Italian Thermotechnical Committee (CTI). (2022). Italian National Annex to UNI EN ISO 52000-1 (no. 20400124) https://www.cti2000.it/index.php?controller=documenti&action=schedaAllMsg&id=65325&tipodoc=3. Restricted document.

Li, Y., Kubicki, S., Guerriero, A., & Rezgui, Y. (2019). Review of building energy performance certification schemes towards future improvement. *Renewable and Sustainable Energy Reviews, 113*, 109244. https://doi.org/10.1016/j.rser.2019.109244.

Marinosci, C., & Morini, G.L. (2014). Check-in and control activities on the energy performance certificates in Emilia-Romagna (Italy). *Energy Procedia, 45*, 434–442. https://doi.org/10.1016/j.egypro.2014.01.047.

Next-generation Dynamic Digital EPCs for Enhanced Quality and User Awareness (D^2EPC). (2020). *D^2EPC web-site*. Retrieved July 6, 2023, from https://www.d2epc.eu/en.

Pagliaro, F., Hugony, F., Zanghirella, F., Basili, R., Misceo, M., Colasuonno, L., & Del Fatto, V. (2021). Assessing building energy performance and energy policy impact through the combined analysis of EPC data – The Italian case study of SIAPE. *Energy Policy, 159*, 112609. https://doi.org/10.1016/j.enpol.2021.112609.

Seyedzadeh, S., Rahimian, F. P., Oliver, S., Glesk, I., & Kumar, B. (2020). Data driven model improved by multi-objective optimisation for prediction of building energy loads. *Automation in Construction, 116*, 103188.

Smart European Energy Performance AssessmeNt And CErtificAtion (ePANACEA). (2020). *ePANACEA web-site*. Retrieved July 6, 2023, from https://epanacea.eu/.

Social Energy Renovations (SER). (2021). *SER web-site*. Retrieved July 6, 2023, from https://www.ser4impact.eu/.

Spanish Cadastre. (2023). *Spanish Cadastre*. Retrieved July 17, 2023, from https://www.catastro.meh.es/esp/productos.asp.

Statistics Austria. (2023). *Statistics Austria*. Retrieved July 15, 2023, from https://www.statistik.at/en/databases/statcube-statistical-database.

Sun, Y., Haghighat, F., & Fung, B. C. (2020). A review of the-state-of-the-art in data-driven approaches for building energy prediction. *Energy and Buildings, 221*, 110022.

Towards a new generation of user-centred Energy Performance Assessment and Certification (U-CERT). (2019). *U-CERT web-site*. Retrieved July 6, 2023, from https://u-certproject.eu/.

Towards Innovative Methods for Energy Performance Assessment and Certification (TIMEPAC). (2022). *TIMEPAC web-site*. Retrieved July 6, 2023, from https://timepac.eu/.

Towards Innovative Methods for Energy Performance Assessment and Certification (TIMEPAC). (2022). Deliverable 1.3 - Report on EPC data analysis.

Typology Approach for Building Stock Energy Assessment (TABULA). (2012). *TABULA WebTool*. Retrieved June 26, 2023, from https://webtool.building-typology.eu.

Urban Reference Buildings for Energy Modelling (URBEM). (2022). *Urban Reference Buildings for Energy Modelling - PRIN2020*. Retrieved July 6, 2023, from https://www.urbem.polimi.it/.

Annex A - Guidelines to create archetypes of the building stock from EPC data

Table of Annex A contents

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A1 Methodology to create archetypes

This document, which is an important part of Deliverable 2.5 of the TIMEPAC project and it is compiled in the form of *Guidelines*, refers to a portion of the research carried out in the Transversal Deployment Scenario 5 (TDS5) that is represented within the shaped area of Figure A.1. The *Guidelines* provide the procedure to create reference buildings (archetypes) of the building stock from EPC data; they are subdivided into methodology (Section A.1, this section) and application (Section A.2). The latter refers to a subset of the Piemonte regional EPC database, which has been used to validate the proposed methodology. In accordance with the flowchart shown in Figure A.1, and considering the different steps of the methodology and the related application, the *Guidelines* are structured into the following topics:

1) EPC data selection (Sections A1.1 and A2.1),
2) EPC data clustering (Sections A1.2 and A2.2),
3) EPC data quality checking (Sections A1.3 and A2.3),
4) Statistical analysis (Sections A1.4 and A2.4), and
5) Identification of reference buildings (Sections A1.5 and A2.5).

For each topic, three sub-sections are provided: purpose, methods, and implementation. Even if the *Guidelines* have been presented in such a way to provide a general methodological approach, not limited to a territorial context but applicable at EU level, however references to the countries/regions involved in the TIMEPAC project are given to justify the choices behind the use of specific data and methods. In addition, the methodology has been developed in such a way to be flexible, adaptable to the specificities of the single countries and their own EPC databases. It allows to be implemented in different tools or procedures.

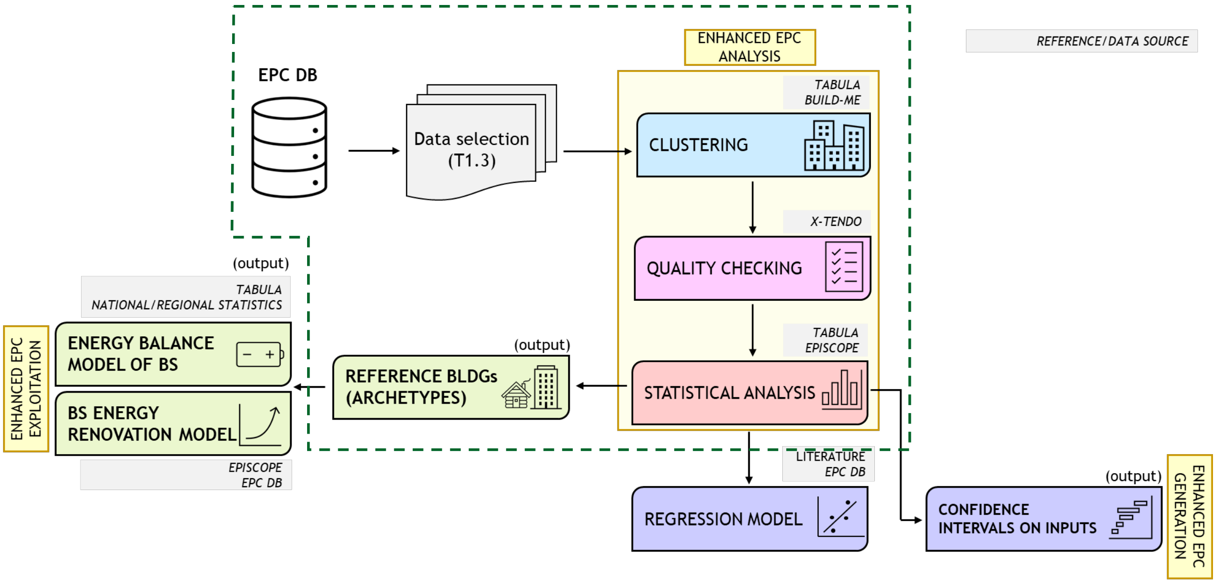

Figure A.1. Methodology to create archetypes in the overall flowchart of TDS5 of TIMEPAC (portion within the shaped area)

A1.1 EPC data selection

A1.1.1 Purpose

The purpose of the EPC data selection is the identification of the input and output metrics set, in this case common to the TIMEPAC countries. The parameters have been derived from the regional or national energy certificates to define a shared, harmonised, and replicable methodology to carry out the subsequent operative phases. The EPC databases considered in the analysis are the ZEUS database of the Salzburg region in Austria, the EPC databases of Croatia, of Cyprus, of the Piemonte Region (Italy), of Slovenia, and of the region of Catalonia (Spain). The equality between regional and national databases has been reported.

A1.1.2 Methods

The EPC data selection originates from the outcomes of Task 1.3 of the TIMEPAC project (Deliverable 1.3 “Report on EPC data analysis”), where each country partner identified the data availability and the EPC data quality based on the source type and way of determination. The outcomes of T1.3 have been elaborated and presented in Figure A.2, where the availability of the EPC data for each TIMEPAC country is reported. Further analysis regarding the availability of the non-renewable energy performance per energy service ($EP_{H/C/W;nren}$) should be conducted for the countries/regions (like Austria, Croatia, Cyprus, and Slovenia) that did not provide this information. Otherwise, these EPC data would not appear in the reference building schema (see Table A.12).

Data name	AUSTRIA	CROATIA	CYPRUS	ITALY	SLOVENIA	SPAIN	p-100%	p-83%	p-67%	p-50%	p-33%	p-17%
Assessed object	Yes	Yes	Yes	Yes	Yes	Yes	x					
Application type	Yes	Yes	Yes	Yes	No	Yes		x				
EPC ID code	Yes	Yes	Yes	Yes	Yes	Yes	x					
Building ~~address~~ city	Yes	Yes	Yes	Yes	Yes	Yes	x					
Number of building units	Yes	No	Yes	Yes	Yes	Yes		x				
Building typology	No	Yes	Yes	Yes	Yes	Yes		x				
Building constructive typology	Yes	No	Yes	Yes	Yes	Yes		x				
Building use	Yes	Yes	Yes	Yes	Yes	Yes	x					
Year of construction	Yes	Yes	No	Yes	Yes	Yes		x				
Climatic region	Yes	Yes	Yes	Yes	Yes	Yes	x					
Degree days	Yes	No	Yes	Yes	Yes	No			x			
Thermally conditioned floor area	Yes	Yes	Yes	Yes	Yes	Yes	x					
Thermally conditioned gross volume	Yes	Yes	No	Yes	Yes	Yes		x				
Compactness ratio	Yes	Yes	No	Yes	Yes	Yes		x				
Thermal envelope area	Yes	No	Yes	Yes	Yes	Yes		x				
Opaque thermal envelope area	Yes	No	Yes	Yes	Yes	Yes		x				
Transparent thermal envelope area	Yes	Yes	Yes	Yes	Yes	Yes	x					
Mean thermal transmittance of the total building envelope	Yes	Yes	Yes	Yes	Yes	No		x				
Mean thermal transmittance of opaque building envelope	Yes	No	Yes	Yes	Yes	No			x			
Mean thermal transmittance of transparent building envelope	Yes	No	Yes	Yes	Yes	No			x			
Energy services	Yes	Yes	Yes	Yes	Yes	Yes	x					
Technical building system (TBS) type of generator per ~~energy service~~ space heating	Yes	Yes	Yes	Yes	Yes	Yes	x					
TBS energy carrier per energy service	Yes	Yes	Yes	Yes	Yes	Yes	x					
TBS mean overall seasonal efficiency per energy service	Yes	No	Yes	Yes	No	Yes			x			
TBS nominal power per ~~energy service~~ space heating	Yes	Yes	Yes	Yes	Yes	Yes	x					
TBS subsystems efficiency per ~~energy service~~ space heating	Yes	No	Yes	Yes	Yes	No			x			
Energy need for space heating	Yes	Yes	Yes	Yes	Yes	Yes	x					
Energy need for space cooling	Yes	Yes	Yes	Yes	Yes	Yes	x					
Overall non-renewable energy performance	Yes	Yes	Yes	Yes	Yes	Yes	x					
Non-renewable energy performance per energy service	No	No	No	Yes	No	Yes					x	
Delivered energy per energy carrier	Yes	Yes	Yes	Yes	Yes	No		x				
Recommended energy efficiency measure (EEM)	Yes	Yes	Yes	Yes	Yes	Yes	x					

Figure A.2. Cross-country comparison of I/O dataset

Table A.1 shows the whole picture of the parameters involved in the subsequent analysis, common to the TIMEPAC country partners, accompanied by their data type. Mostly, the data types are classified into strings, numbers, and Boolean value groups. If a regional or a national energy certificate does not contain some metrics reported in Table A.1 (e.g., the heating degree days for Croatia and Spain, or the thermally conditioned gross volume for Cyprus, etc.), the introduction of some assumptions should be done or the findability of data from other sources or databases should be realised, where possible.

Table A.1. EPC data types considered in the analysis

Data name	Data type
Assessed object	string
Application type	string
EPC ID code	string
Building city	string
Number of building units	number (integer)
Building typology	string
Building construction typology	string
Building category	string
Year of construction	number (integer)
Climatic region	string
Heating degree days	number (integer)
Thermally heated/cooled floor area	number (decimal)
Thermally heated/cooled gross volume	number (decimal)
Compactness ratio	number (decimal)
Opaque/transparent thermal envelope area	number (decimal)
Mean thermal transmittance of the total/opaque/transparent building envelope	number (decimal)
Heating/cooling/domestic hot water energy service	Boolean value
Energy carrier per space heating/cooling/domestic hot water	string
Main technical building system (TBS) type of space heating generator	string and/or number (decimal)
Overall mean seasonal efficiency of the heating/cooling/domestic hot water system	number (decimal)
Mean seasonal efficiency of the heating generation/distribution/control/emission sub-system	number (decimal)
Energy need for heating/cooling	number (decimal)
Overall non-renewable energy performance	number (decimal)
Delivered natural gas/electricity/ thermal energy from district heating	number (decimal)
Recommended energy efficiency measures	string and/or number (decimal)

A1.1.3 Implementation

The metrics reported in Table A.1 are common to Austria, Croatia, Cyprus, Italy, Spain, and Slovenia. However, if some additional parameters are missing in the above table and are deemed to be influential for the subsequent phase of the analysis, they could be exploited anyway.

A1.2 EPC data clustering

A1.2.1 Purpose

The EPC data clustering aims to group buildings with similar thermo-physical properties of the opaque and transparent building envelope and comparable technical building systems (TBSs) characteristics. This procedure is based on assigning to an urbanised area real or theoretical, reference residential and non-residential buildings, with known characteristics and energy consumptions useful to assess the energy and environmental performance at a larger scale. The association is based on the climatic zone, building use category, year of construction, and building size and shape (the last only for residential buildings).

A1.2.2 Methods

The methodology for clustering buildings has been derived from the outcomes of the project TABULA[16], aimed at harmonising the European building typology, and the follow-up project EPISCOPE[17] focused on building stock monitoring. The clusters defined, as presented in Figure A.3, are the climatic zone, the building use category, the year of construction, and the building size and shape for residential buildings.

The clustering approach is applicable to the EPCs following a sequential procedure: (1) to group buildings according to the climatic zone (each country/region could have more than one climatic zone), (2) within a climatic zone, to group buildings belonging to the same intended use (residential and non-residential) as to cover more building categories, (3) within each intended use cluster, to group buildings giving priority either to the construction period or the building size according to specific criteria (e.g., the amount of existing buildings represented, etc.), and (4) within the innermost cluster, a further grouping may be performed according to the scope (e.g., in function of the *U*-value range, the space heating generator type, etc.).

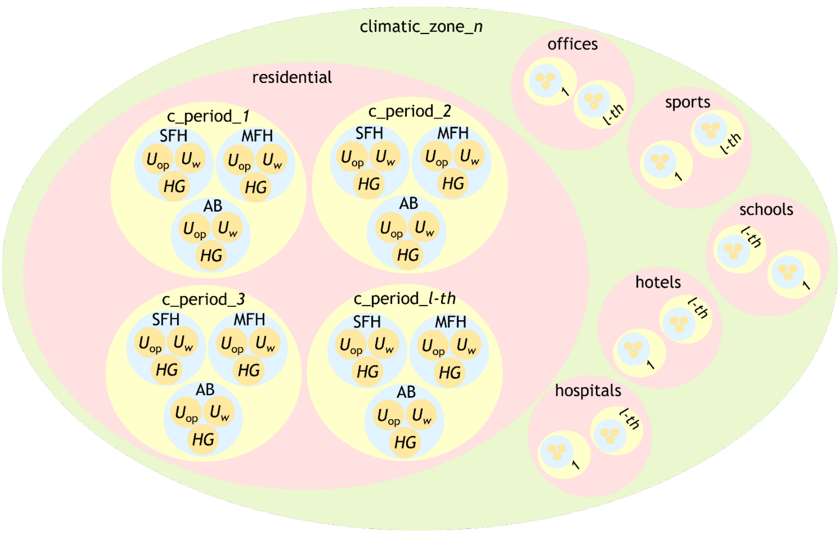

Figure A.3. EPC data clustering

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[16] episcope.eu/iee-project/tabula

[17] episcope.eu/iee-project/episcope

The building use categories have been deduced from the EN ISO 52000-1 (CEN, 2017) technical standards completed with the TABULA and EPISCOPE outcomes. The building categories, reported in Table A.2, are the most representative to summarise the building stock. As regards the third cluster, the reference construction periods have been derived from TABULA and are listed in Table A.3. In the TABULA and EPISCOPE projects, the majority of TIMEPAC countries are included, except for Croatia where the construction periods have been equalised to national legislation (see Table A.3).

Table A.2. Building categories (CEN, 2017)

Intended use	Type	Description
Residential	*BLDNGCAT_RES_SINGLE*	Single-family houses of different types
	BLDNGCAT_RES_APPBLOCK	Apartment blocks (multi-family houses included)
Non-residential	*BLDNGCAT_OFF*	Offices
	BLDNGCAT_EDUC	Educational buildings
	BLDNGCAT_HOSP	Hospitals
	BLDNGCAT_HOTEL	Hotels and restaurants
	BLDNGCAT_SPORT	Sports facilities

Table A.3. Construction periods (TABULA-EPISCOPE)

Country	Construction periods
Austria	≤1918; 1919-1944; 1945-1960; 1961-1980; 1981-1990; 1991-2000; 2001-2010; >2010
Croatia	≤1940; 1941-1970; 1971-1980; 1981-1987; 1988-2005; ≥2006
Cyprus	≤1980; 1981-2006; 2007-2013; >2013
Italy	≤1900; 1901-1920; 1921-1945; 1946-1960; 1961-1975; 1976-1990; 1991-2005; >2005
Slovenia	≤1944; 1945-1970; 1971-1980; 1981-2002; 2003-2008; >2008
Spain	≤1900; 1901-1936; 1937-1959; 1960-1979; 1980-2006; >2006

A1.2.3 Implementation

In accordance with the clustering approach introduced in Section A1.2.2, the following clusters have been defined in TIMEPAC:

- No. of climatic zones: n = (1, …, 6) – because six are the TIMEPAC country partners,
- No. of building categories: m = (1, …, 6) – because six are the maximum number of the building categories chosen. However, according to Figure A.3, single-family houses (SFHs), multi-family houses (MFHs), and apartment blocks (ABs) are included in the same set, which is the residential buildings. The other clusters are offices, educational buildings, hospitals, hotels and restaurants, sports facilities,
- No. of construction periods: l = (1, …, 8) – according to TABULA and EPISCOPE, the maximum number of construction periods is set to eight (i.e., Austria and Italy). This threshold value could be subject to changes,
- No. of building size: o = (1, …, 3) – the building size and shape is considered only for residential building, especially considering single-family house (SFH), multi-family house

(MFH), and apartment blocks (AB). However, the concept may be extended to non-residential buildings, and
- No. of key-values: k = (1, …, 3) – in the case the energy assessor has to perform a further clustering (by space heating system type, or ***U***-values), a further statistical analysis should be carried out to support the decision making of the technician in charge.

Some modifications per country to the year of construction (Table A.3) or to other clusters could be formulated to take into account local, regional, or national legislation in the energy and environmental fields.

A1.3 EPC data quality checking

A1.3.1 Purpose

The EPC data quality checking procedure is a fundamental phase to have reliable energy certificates free of inaccuracies to carry out large-scale energy analyses. The deep renovation of building stock, in order to achieve the EU 2030 and 2050 GHG emission reduction goals, goes through the reliable creation of the urban building's energy models. In this regard, the energy certificate represents a crucial source of data to build urban energy analysis. Undoubtedly, the EPC information should be enhanced, real-time upgradeable, implemented, and made interoperable. However, it is crucial to establish the validity of the EPC data already contained in the energy certificate.

The aim of the EPC data quality procedure is to derive only the reliable energy certificates, whose information will be processed in the subsequent phase of the analysis. This methodology draws inspiration from the X-tendo project (X-tendo, 2022), especially for the EPC data score attribution. The proposed procedure is applicable to the energy certificates still uploaded into the reference local, regional, or national EPC databases. Moreover, it can be implemented in the EPC database system in the future, as a support to validation and control bodies in identifying the errors contained in the document, but also as a support to energy certifiers in providing warnings on input data in the EPC generation phase.

A1.3.2 Methods

The EPC data quality checking procedure provides the score attribution to parameters and values contained in the energy certificates. For each of the EPC data, a validity rule has been associated. For each rule, a score has been attributed to the non-respected rule. Therefore, the overall score, originating from summing the single score of each parameter, will be compared to the cut-off value. This value represents the acceptability threshold value for all energy certificate parameters. Whether the overall EPC data score is greater than the threshold value then all the EPC data will be neglected, and they will not appear in the subsequent phases (e.g., statistical analysis, reference buildings identification, and confidence intervals generation).

Some metrics have been defined as 'critical' (see Table A.4), whose validity is considered fundamental for statistical analysis. The non-compliance rules for critical parameters give a score greater than the threshold value and thus every EPC data will be neglected. The inaccuracies of these parameters drastically affect the reliability of the entire procedure, so they will not be considered. The overall picture of EPC data involved in the energy certificate data quality checking procedure, rules, and scores is shown in Table A.4.

Three groups of rules are summarised as follows:

- <u>Data types of checks</u> are the simplest control and represent that set of rules which evaluate the data types (i.e., integer, string, Boolean value, etc.) of the data analysed. For instance, the compactness ratio is a decimal number and not a string, or the year of construction of the building must be an integer and not a Boolean value. These rules have been associated with both critical and non-critical parameters,

- Physical impossibility checks represent that set of rules which evaluate the order of magnitude of EPC data comparing them with the physical admissibility for that parameter. For example, the thermal energy need for space heating cannot be a negative value, or the thermal transmittance of the building envelope opaque component cannot be greater than a threshold value (e.g., 4,5 W/(m^2K)). These rules have been associated with both critical and non-critical parameters,
- Consistency checks represent that set of rules which determine the validity of a parameter compared to another one. For example, the energy carrier for the space cooling service should be invalid or null whether the energy service flag for space cooling is set to "NO". The consistency checks could also refer to national regulations (e.g., the minimum average height of a building should not be less than reasonable values). These rules have been associated with both critical and non-critical parameters.

Considering *n* as the total number of EPC data and *m* as the total amount of critical parameters, the score for the non-critical parameter has been calculated as $s = 1/(n - m)$. Indeed, the invalidity score border, i.e., the threshold value beyond which an energy certificate, and all data contained therein, is considered rejected, is calculated as $e = (n \cdot s)/2$. So, whether the overall score of the EPC is greater (>) than *e* then the EPC is rejected and will not be considered in the subsequent statistical analysis. Instead, if the overall score of the EPC is less or equal (≤) to *e* then the energy certificate is considered valid with reliable EPC data. For this purpose, the score for the non-respected rule for critical parameters is set to 1, i.e., a value greater than the threshold one.

Obviously, the proposed procedure is a first check about the reliability of the EPC data, because energy certificates with respected rule outliers for some parameters may progress in the later stage of the work development. Mainly, the EPC data quality check procedure sets lower limits because *a priori* it is difficult to set upper limits.

A1.3.3 Implementation

In Table A.4, the rules and scores are attributed to the common EPC data of the six TIMEPAC countries. Additional country parameters could enrich the proposed list (e.g., the year of the last renovation, the *no.* of the floor, or the overall renewable energy performance, in case of the Piemonte Region EPC). For the additional parameters, the recommendation is to encourage their introduction in the analysis, doing only a validity control on their data types. Moreover, these parameters should not be considered critical.

Table A.4. EPC data rules and scores

Data name (Critical parameter*)	Typology of rules	Rule	Respected rule (score)	Unrespected rule (score)
Assessed object	D	string not null	0,000	$1/(n-m)$
Application type	D	string not null	0,000	$1/(n-m)$
EPC ID code*	D	string not null	0,000	1,000
Building city	D	string not null	0,000	$1/(n-m)$
Number of building units	D	string not null *or* integer ≥ 0	0,000	$1/(n-m)$
Building typology	D	string not null	0,000	$1/(n-m)$
Building construction typology	D	string not null	0,000	$1/(n-m)$
Building category	D	string not null	0,000	1,000
Year of construction	D, P	integer > 0	0,000	1,000

Data name (Critical parameter*)	Typology of rules	Rule	Respected rule (score)	Unrespected rule (score)
Climatic region	D	string not null	0,000	$1/(n-m)$
Heating degree days	D, P	integer > 0	0,000	$1/(n-m)$
Thermally heated/cooled floor area	D, P, C	decimal > 0 if the space heating/cooling service exists	0,000	1,000
Thermally heated/cooled gross volume	D, P, C	decimal > 0 if the space heating/cooling service exists	0,000	1,000
Compactness ratio	D, P	decimal > 0	0,000	$1/(n-m)$
Thermal envelope area	D, P	decimal > 0	0,000	1,000
Opaque/transparent thermal envelope area	D, P, C	decimal > 0	0,000	$1/(n-m)$
Mean thermal transmittance of the total building envelope	D, P	decimal (0,0; 6,0] W/(m²·K)	0,000	$1/(n-m)$
Mean thermal transmittance of the opaque building envelope	D, P	decimal (0,0; 4,5] W/(m²·K)	0,000	$1/(n-m)$
Mean thermal transmittance of the transparent building envelope	D, P	decimal (0,0; 6,0] W/(m²·K)	0,000	$1/(n-m)$
Heating/cooling/domestic hot water energy service	D	Boolean value	0,000	$1/(n-m)$
Energy carrier per heating/cooling/domestic hot water	D, C	string not null if the heating/cooling/domestic hot water service exists	0,000	$1/(n-m)$
Main technical building system (TBS) type of space heating generator	D, C	string not null if the space heating service exists	0,000	$1/(n-m)$
Overall mean seasonal efficiency of the heating/cooling/domestic hot water system	D, P, C	decimal > 0 if the heating/cooling/domestic hot water service exists	0,000	$1/(n-m)$
Mean seasonal efficiency of the heating generation	D, P, C	decimal > 0 if the space heating service exists	0,000	$1/(n-m)$
Mean seasonal efficiency of the heating distribution/control/emission sub-system	D, P, C	decimal (0; 1] if the space	0,000	$1/(n-m)$

Data name (Critical parameter*)	Typology of rules	Rule	Respected rule (score)	Unrespected rule (score)
		heating service exists		
Energy need for space heating	D, P, C	decimal ≥ 0 if the space heating service exists	0,000	1,000
Energy need for space cooling	D, P, C	decimal ≥ 0 if the space cooling service exists	0,000	$1/(n-m)$
Overall non-renewable energy performance	D, P	decimal ≥ 0	0,000	1,000
Delivered natural gas/electricity/ thermal energy from district heating	D, P, C	decimal > 0 if natural gas/electricity/thermal energy from district heating consumed	0,000	$1/(n-m)$
Recommended energy efficiency measures	D	string not null	0,000	$1/(n-m)$
D = data types of checks; P = physical impossibility checks; C = consistency checks				

A1.4 Statistical analysis

A1.4.1 Purpose

After the EPC data quality checking, the statistical analysis aims to extract the most probable data to generate representative buildings for the specific climatic zone. Reference buildings means buildings with mean geometrical and technological characteristics, representative of the regional or national building stock. Therefore, the statistical observations (see examples reported in Figure A.4) help to find the data necessary to create the national building typology.

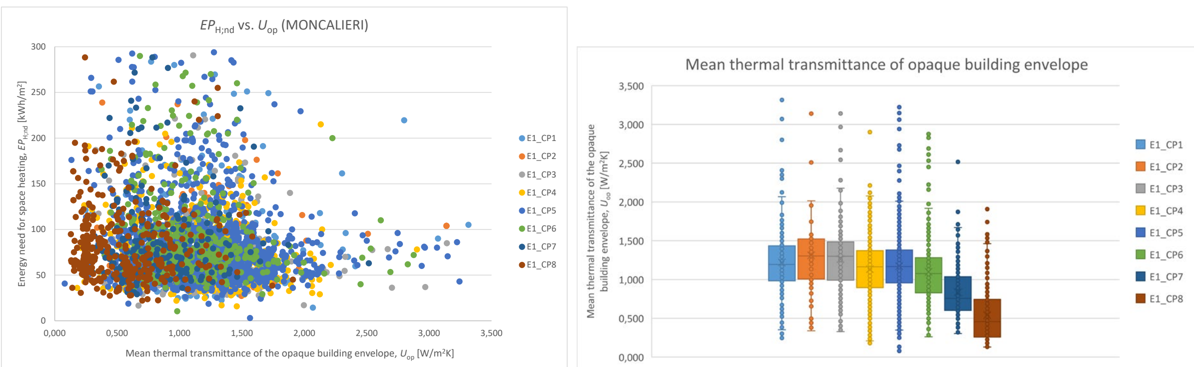

Figure A.4. Statistical representations of parameters for a subset of the Piemonte Region (Italy) EPC database (example)

A1.4.2 Methods

For quantitative parameters, the boxplot is a basic statistical description sufficient for the identification of the input and output EPC data to develop reference buildings. The five key elements of the boxplot are summarised as follows:

- the zero quartile Q_0, i.e., the minimum value,
- the first quartile Q_1, i.e., the first 25% of the statistical distribution,
- the second quartile Q_2, i.e., the median value,
- the third quartile Q_3, i.e., 75% of the data falls below the third quartile, and
- the fourth quartile Q_4, i.e., the maximum value.

The distance between the third quartile, Q_3, and the first quartile, Q_1 is called the interquartile range (IQR). Obviously, for the quantitative dataset outlier's removal, i.e., the elimination of the points greater than Q_4 and lower than Q_0, will decrease the dispersion between data.

Other qualitative data (e.g., energy carrier per space heating, energy efficiency measures recommendations, building construction typology, etc.) can be represented considering absolute or relative frequency (see Figure A.5).

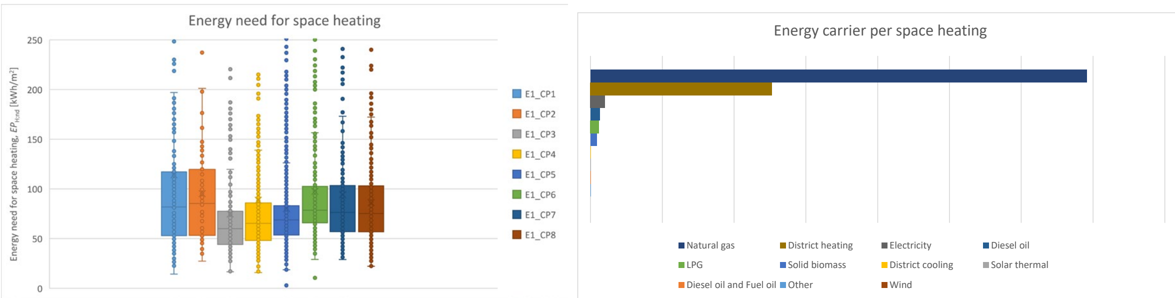

Figure A.5. Boxplot and relative frequency graphs of parameters for a subset of the Piemonte Region (Italy) EPC database (example)

A1.4.3 Implementation

Considering the innermost cluster (see Section A1.2.3), the types of statistical representation that can be provided are summarised in Table A.5.

Table A.5. Statistical representation of the EPC data

Data name	Qualitative or quantitative	Statistical representation
Number of building units	quantitative	boxplot or relative frequency
Building typology	qualitative	relative frequency
Building construction typology	qualitative	relative frequency
Heating degree days	quantitative	not needed
Thermally heated/cooled floor area	quantitative	boxplot
Thermally heated/cooled gross volume	quantitative	boxplot
Compactness ratio	quantitative	boxplot
Thermal envelope area	quantitative	boxplot
Opaque/transparent thermal envelope area	quantitative	boxplot

Data name	Qualitative or quantitative	Statistical representation
Mean thermal transmittance of the total building envelope	quantitative	boxplot
Mean thermal transmittance of the opaque building envelope	quantitative	boxplot
Mean thermal transmittance of the transparent building envelope	quantitative	boxplot
Heating/cooling/domestic hot water energy service	qualitative	relative frequency
Energy carrier per heating/cooling/domestic hot water	qualitative	relative frequency
Main technical building system (TBS) type of space heating generator	qualitative	relative frequency
Overall mean seasonal efficiency of the heating/cooling/domestic hot water system	quantitative	boxplot
Mean seasonal efficiency of the heating generation	quantitative	boxplot
Mean seasonal efficiency of the heating distribution/control/emission sub-system	quantitative	boxplot
Energy need for space heating	quantitative	boxplot
Energy need for space cooling	quantitative	boxplot
Overall non-renewable energy performance	quantitative	boxplot

A1.5 Identification of reference buildings

A1.5.1 Purpose

The reference buildings have to reflect the most common geometrical characteristics, technical specifications of the building envelope, and technical building system typology, representing the average situation in a market segment. The identification of a library of reference buildings plays a crucial role, especially for the energy performance benchmarking of the national or regional building stock. The identification of the reference buildings should be an adequate number of real and/or 'virtual' residential and non-residential buildings to cover the most spread building categories in a climatic zone.

The basic energy related parameters of the categories to be selected are (1) the geometrical data (e.g., compactness ratio, thermally heated/cooled floor area, heated/cooled volume, windows-to-wall ratio, etc.), (2) the thermo-physical properties of the opaque and transparent building envelope (e.g., mean thermal transmittance of the opaque building envelope, mean thermal transmittance of the transparent building envelope), and (3) the types and energy performance of the technical building systems (TBS).

A1.5.2 Methods

The main reference for the definition of national building typologies in Europe is the TABULA project (Ballarini et al., 2014). For several European countries, a *Building Type Matrix* was defined to represent residential building types categorised by climatic zone, construction year class, and size and shape class. Another reference is BUILD_ME (BUILD_ME, 2018), which developed a building typology database, reflecting the region's typical architecture and technical building systems of Egypt, Jordan, and Lebanon. The *Prototype Building Models* (PBM), created by the U.S. Department of Energy (DOE, 2013), instead, allowed associating a scorecard to the building model containing the key modelling input information.

The methodology is based on deriving from the statistical representation average parameters, representative of climatic zone, building use category, year of construction, and size and shape (see also Section A1.4.2).

A1.5.3 Implementation

The statistical analysis allows the creation of reference buildings, according to Section A1.4.3. The reference building is represented by means of the median value of each characterising parameter; the values falling in the Interquartile ranges (IQRs) ($Q_3 - Q_2$ and $Q_2 - Q_1$) are admitted as well.

A2 Example for a subset of the regional building stock of Piemonte (Italy)

This section provides an application of the methodology to create archetypes starting from a subset of the EPC data stored in the Piemonte Region energy certificates database and referred to the municipality of Moncalieri, in the metropolitan city of Torino. The proposed methodology, as described in Section A1, is replicable and can be suitable for the other TIMEPAC countries: Austria, Croatia, Cyprus, Slovenia, and Spain. The structure of this section follows the same structure as Section A1: (A2.1) EPC data selection, (A2.2) EPC data clustering, (A2.3) EPC data quality checking, (A2.4) statistical analysis, and (A2.5) identification of reference buildings.

A2.1 EPC data selection

The EPC data selection for the Piemonte Region provides the majority of energy certificate data presented in Table A.1 and Table A.4. However, due to the lack of some EPC data, some adjustments and calculations, presented in Table A.6, have been done to make available the required parameters.

Table A.6. EPC data adjustments and calculations on the EPC database of Piemonte

Data name	Note
Heating degree days (*HDD*)	The parameter is not directly present in the Piemonte Region EPC. *HDD* is derived from another database linked through the building city.
Mean thermal transmittance of the total building envelope (U)	Calculated as the weighted average of the mean thermal transmittance of the opaque building envelope (U_{op}), the mean thermal transmittance of the transparent building envelope (U_{wi}), and the opaque (A_{op}) and transparent (A_{wi}) thermal envelope area.
Main technical building system (TBS) type of space heating generator	Theoretically, for an EPC ID, there can be an infinite number of heat generators installed (e.g., the EPC of an apartment block or a multi-family house with an autonomous boiler for each building unit). Therefore, only one space heat generator was identified for each EPC, i.e., the one with the highest nominal power.
Energy need for space cooling ($EP_{C;nd}$)	Calculated as the product between the overall mean seasonal efficiency of the space cooling system ($\eta_{s;C}$) and the total energy performance per space cooling ($EP_{C;tot}$).
Recommended energy efficiency measures (EEMs)	The recommended EEMs have been subdivided in: 1. Building fabric - Opaque building envelope 2. Building fabric - Transparent building envelope 3. Technical building system - Space heating 4. Technical building system - Space cooling 5. Technical building system - Other systems 6. Technical building system - Renewable plants
Year of last renovation	Additional data (contained in the Piemonte Region EPC) to make further analysis.

Data name	Note
No. of floor	Additional data (contained in the Piemonte Region EPC) to make further analysis.
Mean overall heat transfer coefficient by thermal transmission (H'_T)	Additional data (contained in the Piemonte Region EPC) to make further analysis.
Energy need for domestic hot water ($EP_{W;nd}$)	Calculated as the product between the overall mean seasonal efficiency of the domestic hot water system ($\eta_{s;W}$) and the total energy performance per domestic hot water ($EP_{W;tot}$).
Non-renewable energy performance per space heating ($EP_{H;nren}$)	Additional data (contained in the Piemonte Region EPC) to make further analysis.
Non-renewable energy performance per space cooling ($EP_{C;nren}$)	Additional data (contained in the Piemonte Region EPC) to make further analysis.
Non-renewable energy performance per domestic hot water ($EP_{W;nren}$)	Additional data (contained in the Piemonte Region EPC) to make further analysis.
Overall renewable energy performance ($EP_{gl;ren}$)	Additional data (contained in the Piemonte Region EPC) to make further analysis.

A2.2 EPC data clustering

Table A.7 reports the set of clusters that identify the Piemonte Region-building typology matrix. According to DPR 412/93 (Italian Republic, 1993) the Piemonte Region is divided into climatic zone E (2101 ≤ *HDD* ≤ 3000) and climatic zone F (*HDD* ≥ 3001). The municipality of Moncalieri belongs to the climatic zone E. The clusters are grouped into residential and non-residential buildings. The residential buildings have been divided into single family houses (SFHs) and building units in apartment blocks and multi-family houses (BU(AB)). The most representative and common non-residential building use categories have been selected. The cells of the building typology matrix (Table A.7) represent different groups of energy certificates according to climatic zone, building use category, year of construction, and size and shape. For each of the proposed clusters, at least one building should be defined, if the sample is representative.

Table A.7. Piemonte Region building typology matrix (also used for Moncalieri)

Climatic zone E	Residential bldgs		Non-residential bldgs				
	Single-family house (SFH)	Building unit (BU(AB))	Office	Educational building	Hospital	Sport facility	Hotel
≤ 1900 (CP1)	…	…	…	…	…	…	…
1901-1920 (CP2)	…	…	…	…	…	…	…
1921-1945 (CP3)	…	…	…	…	…	…	…
1946-1960 (CP4)	…	…	…	…	…	…	…

Climatic zone E	Residential bldgs		Non-residential bldgs				
	Single-family house (SFH)	Building unit (BU(AB))	Office	Educational building	Hospital	Sport facility	Hotel
1961-1975 (CP5)	…	…	…	…	…	…	…
1976-1990 (CP6)	…	…	…	…	…	…	…
1991-2005 (CP7)	…	…	…	…	…	…	…
> 2005 (CP8)	…	…	…	…	…	…	…

The EPC data contained in the energy certificates have been processed with MS Excel. However, other similar tools (e.g., Python or MATLAB) could be used, especially whether the number of information increases. In the MS Excel environment, in order to reduce the computational effort, it is highly recommended to avoid links between different files.

The number of spreadsheets in the Excel file has been set consistently with the number of construction periods (CPs) per country (see Table A.3). Thus, each Excel spreadsheet will contain the EPC data per intended use and construction period (e.g., RES_CP1, RES_CP2, …, RES_CPn).

The cluster structure for Moncalieri is shown in Figure A.6. The characters before the underscore symbol represent the residential building use category ("E1"), according to Italian legislation (Italian Republic, 1993).

Figure A.6. MS Excel cluster's structure for Moncalieri (residential use)

The EPC data quality scoring procedure has been integrated into the MS Excel sheet. To facilitate the analysis, some cells have been coloured differently. The colour of the cells refers to the indications presented in Figure A.7, and summarised as follows:

- Yellow cells provide a link to other MS Excel spreadsheets (the EPC Piemonte Region database),
- Red cells contain formulas that determine the result of the selected EPC parameter (e.g., EPC data quality score, *U*-value, $EP_{C;nd}$, etc.). As indicated in Table A.6, some EPC parameters have been calculated for the Piemonte Region case, and
- Green cells provide additional Piemonte Region EPC data compared to the set presented in the EPC data selection (Section A1.1).

	Cells linked to other spreadsheet
	Cells containing formulas
	Additional country EPC data

Figure A.7. Colour caption of the MS Excel spreadsheet cells

As regards the MS Excel structure, each row represents a different energy performance certificate, and the EPC data are reported along the columns (see Figure A.8).

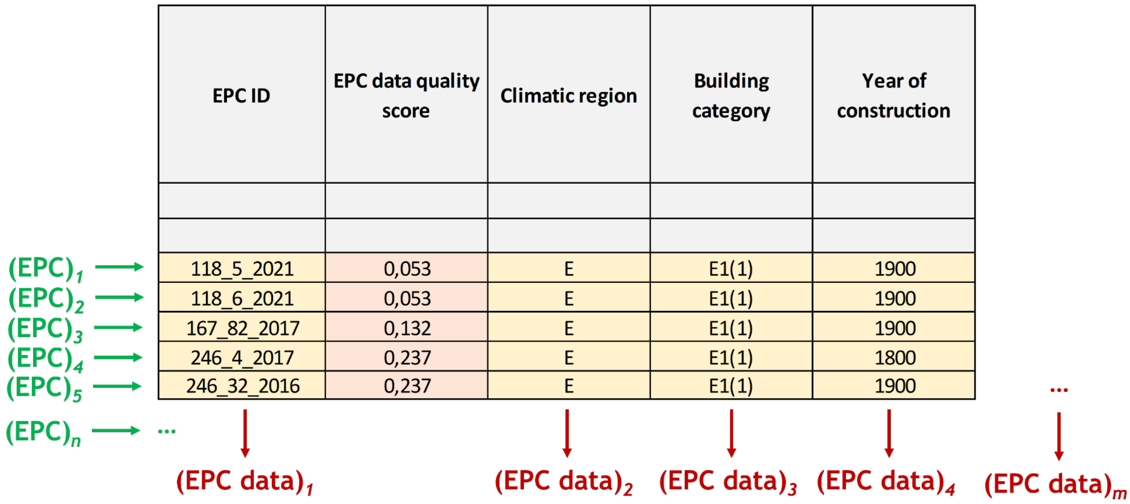

Figure A.8. MS Excel spreadsheet structure per building typology (climatic zone E_residential_BU(AB)_CP1)

A2.3 EPC data quality checking

The EPC data quality rules and scores, presented in Table A.8, have been integrated into the MS Excel spreadsheet mentioned in the previous Section A2.2.

Table A.8. Piemonte Region EPC data rules and scores

Data name (Critical parameter*)	Typology of rules	Rule	Respected rule (score)	Unrespected rule (score)
Assessed object	D	string not null	0,000	0,026
Application type	D	string not null	0,000	0,026
EPC ID code*	D	string not null	0,000	1,000
Building city	D	string not null	0,000	0,026
Number of building units	D	string not null *or* integer ≥ 0	0,000	0,026
Building typology	D	string not null	0,000	0,026
Building construction typology	D	string not null	0,000	0,026
Building category	D	string not null	0,000	1,000
Year of construction	D, P	integer > 0	0,000	1,000
Climatic region	D	string not null	0,000	0,026
Heating degree days	D, P	integer > 0	0,000	0,026
Thermally heated/cooled floor area	D, P, C	decimal > 0 if the space heating/cooling service exists	0,000	1,000
Thermally heated/cooled gross volume	D, P, C	decimal > 0 if the space	0,000	1,000

Data name (Critical parameter*)	Typology of rules	Rule	Respected rule (score)	Unrespected rule (score)
		heating/cooling service exists		
Compactness ratio	D, P	decimal > 0	0,000	0,026
Thermal envelope area	D, P	decimal > 0	0,000	1,000
Opaque/transparent thermal envelope area	D, P	decimal > 0	0,000	0,026
Mean thermal transmittance of the total building envelope	D, P	decimal (0,0; 6,0] W/(m^2·K)	0,000	0,026
Mean thermal transmittance of the opaque building envelope	D, P	decimal (0,0; 4,5] W/(m^2·K)	0,000	0,026
Mean thermal transmittance of the transparent building envelope	D, P	decimal (0,0; 6,0] W/(m^2·K)	0,000	0,026
Heating/cooling/domestic hot water energy service	D	Boolean value	0,000	0,026
Energy carrier per heating/cooling/domestic hot water	D, C	string not null if the heating/cooling/domestic hot water service exists	0,000	0,026
Main technical building system (TBS) type of space heating generator	D, C	string not null if the space heating service exists	0,000	0,026
Overall mean seasonal efficiency of the heating/cooling/domestic hot water system	D, P, C	decimal > 0 if the heating/cooling/domestic hot water service exists	0,000	0,026
Mean seasonal efficiency of the heating generation	D, P, C	decimal > 0 if the space heating service exists	0,000	0,026
Mean seasonal efficiency of the heating distribution/control/emission sub-system	D, P, C	decimal (0; 1] if the space heating service exists	0,000	0,026
Energy need for space heating	D, P, C	decimal ≥ 0 if the space heating service exists	0,000	1,000
Energy need for space cooling	D, P, C	decimal ≥ 0 if the space cooling service exists	0,000	0,026

Data name (Critical parameter*)	Typology of rules	Rule	Respected rule (score)	Unrespected rule (score)
Overall non-renewable energy performance	D, P	decimal ≥ 0	0,000	1,000
Delivered natural gas/electricity/ thermal energy from district heating	D, P, C	decimal > 0 if natural gas/electricity/thermal energy from district heating consumed	0,000	0,026
Recommended energy efficiency measures	D	string not null	0,000	0,026
Year of last renovation	D, P	integer > 0	0,000	0,026
No. of floor	D, P	integer > 0	0,000	0,026
Mean overall heat transfer coefficient by thermal transmission (H'_T)	D, P	decimal ≥ 0	0,000	0,026
Energy need for domestic hot water ($EP_{W;nd}$)	D, P	decimal ≥ 0	0,000	0,026
Non-renewable energy performance per space heating ($EP_{H;nren}$)	D, P	decimal ≥ 0	0,000	0,026
Non-renewable energy performance per space cooling ($EP_{C;nren}$)	D, P	decimal ≥ 0	0,000	0,026
Non-renewable energy performance per domestic hot water ($EP_{W;nren}$)	D, P	decimal ≥ 0	0,000	0,026
Overall renewable energy performance ($EP_{gl;ren}$)	D, P	decimal ≥ 0	0,000	0,026
D = data types of checks; P = physical impossibility checks; C = consistency checks				

Moreover, some additional rules (Table A.9) of the consistency check categories have been introduced in the MS Excel spreadsheet.

Table A.9. Additional consistency checks for the Piemonte Region case (Moncalieri subset)

Data name	Rule description
Thermally heated/cooled floor area ($A_{H/C;use;ztc}$)	The thermally heated/cooled gross volume is divided by the thermally heated/cooled gross floor area. The average height calculated will be compared with the minimum height in Italian legislation. The following factor (UNI, 2008) to convert the thermally heated/cooled (net) floor area to the thermally heated/cooled gross floor area: – $f_n = 0{,}9761 - 0{,}3055 \cdot d_m$ – d_m represents the average thickness of the vertical enclosures (d_m = 45 cm)
Thermally heated/cooled gross volume ($V_{H/C;g}$)	

Data name	Rule description
Opaque/transparent thermal envelope area ($A_{op/wi}$)	In the Piemonte Region case, the thermal envelope area has been considered as a reference. Moreover, the A_{env} is not calculated as the sum between the opaque and the transparent thermal envelope area. The following are the admissibility ranges to be met: – ($A_{op} + A_{wi} \geq 0{,}85 \cdot A_{env}$) AND ($A_{op} + A_{wi} \leq A_{env}$)

For each I/O EPC data, the set of rules (Table A.8 and Table A.9) have been introduced in each MS Excel spreadsheet (see Figure A.9). For instance, according to Figure A.9, the cells coloured in red represent the non-respected rule for a critical parameter (thermally cooled gross volume, $V_{C;g}$) with the attribution of the maximum score value. Instead, the yellow cells represent the non-respected rule for a non-critical parameter (opaque thermal envelope area, A_{op}). The acceptability threshold value, for the proposed example, corresponds to 0,631, namely equal to the sum of the score of half of the EPC data considered in the analysis, thus neglecting the number of additional EPC parameters (i.e., $EP_{W;nd}$, $EP_{H;nren}$, $EP_{C;nren}$, etc.).

Summarising, the *i*-th EPC data will not appear in the statistical processing if one of the two following circumstances occurs:

- The overall EPC score is greater than 0,631 (acceptability threshold value), or
- The score for that specific EPC data is greater than 0.

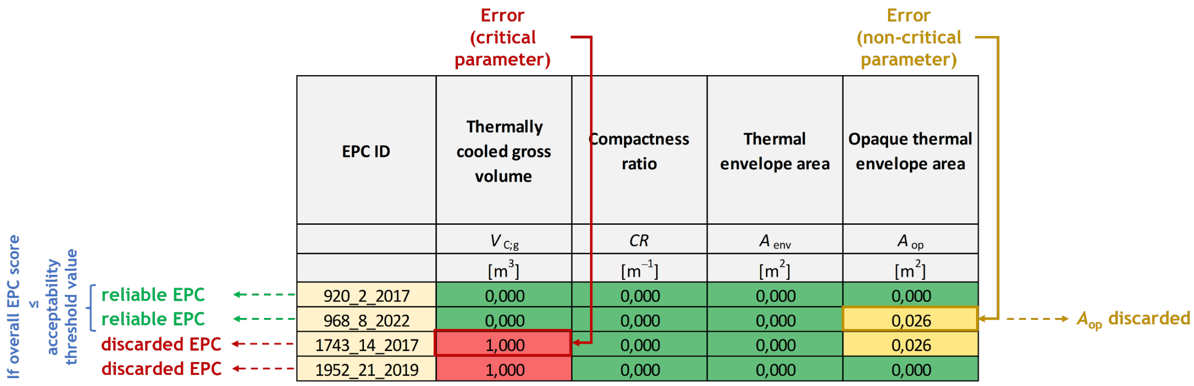

Figure A.9. Set of scores for the Piemonte EPC database (example)

A2.4 Statistical analysis

The statistical analysis described in A1.4 has been applied to the Piemonte Region case (Moncalieri) in the MS Excel environment. The analysed dataset is limited and it is used to discover the applicability of the proposed methodology. In some cases, the sample is non-representative, i.e., the information is randomly distributed without identifying any general trend, resulting in wide interquartile ranges.

Table A.10 presents the EPC input and output data necessary to create the reference buildings. If the goal is to create a representative apartment block from EPCs issued for building units, some hypotheses have to be formulated. For instance, some geometrical characteristics (i.e., compactness ratio, gross volume, etc.) could be derived from TABULA, in order to assemble the virtual representative apartment block or multi-family house. Otherwise, the defined reference building is referred to as the building unit archetype.

The main results for Moncalieri are shown from Figure A.10 to Figure A.31.

Table A.10. Reference building data definition (db = database)

Representative EPC data	Single-family house (SFH)	Apartment block
Building construction typology	Piemonte EPC db	Piemonte EPC db
Building typology	Piemonte EPC db	TABULA
Compactness ratio, *CR*	Piemonte EPC db	TABULA
Thermally heated gross volume, $V_{H;g}$	Piemonte EPC db	TABULA
Thermally conditioned floor area, $A_{H;use;ztc}$	Piemonte EPC db	TABULA
Ratio between transparent thermal envelope area and thermal envelope area, A_{wi}/A_{env}	Piemonte EPC db	Piemonte EPC db
Mean thermal transmittance of opaque building envelope, U_{op}	Piemonte EPC db	Piemonte EPC db
Mean thermal transmittance of transparent building envelope, U_{wi}	Piemonte EPC db	Piemonte EPC db
Energy carrier per space heating	Piemonte EPC db	Piemonte EPC db
Energy carrier per space cooling	Piemonte EPC db	Piemonte EPC db
Energy carrier per domestic hot water	Piemonte EPC db	Piemonte EPC db
Mean seasonal efficiency of the heating generation sub-system per energy carrier	Piemonte EPC db	Piemonte EPC db
Utilisation efficiency, $\eta_{H;u}$ ($\eta_{H;d} \times \eta_{H;c} \times \eta_{H;e}$)	Piemonte EPC db	Piemonte EPC db
Energy need for space heating, $EP_{H;nd}$	Piemonte EPC db	Piemonte EPC db
Energy need for space cooling, $EP_{C;nd}$	Piemonte EPC db	Piemonte EPC db
Energy need for domestic hot water, $EP_{W;nd}$	Piemonte EPC db	Piemonte EPC db
Overall mean seasonal efficiency of the space heating system, $\eta_{s;H}$	Piemonte EPC db	Piemonte EPC db
Overall mean seasonal efficiency of the space cooling system, $\eta_{s;C}$	Piemonte EPC db	Piemonte EPC db
Overall mean seasonal efficiency of the domestic hot water system, $\eta_{s;W}$	Piemonte EPC db	Piemonte EPC db
Non-renewable energy performance per space heating, $EP_{H;nren}$	Piemonte EPC db	Piemonte EPC db
Non-renewable energy performance per space cooling, $EP_{C;nren}$	Piemonte EPC db	Piemonte EPC db
Non-renewable energy performance per domestic hot water, $EP_{W;nren}$	Piemonte EPC db	Piemonte EPC db
Overall non-renewable energy performance, $EP_{gl;nren}$	Piemonte EPC db	Piemonte EPC db
Overall renewable energy performance, $EP_{gl;ren}$	Piemonte EPC db	Piemonte EPC db
Renewable Energy Ratio, RER ($EP_{gl;ren}/EP_{gl;tot}$)	Piemonte EPC db	Piemonte EPC db

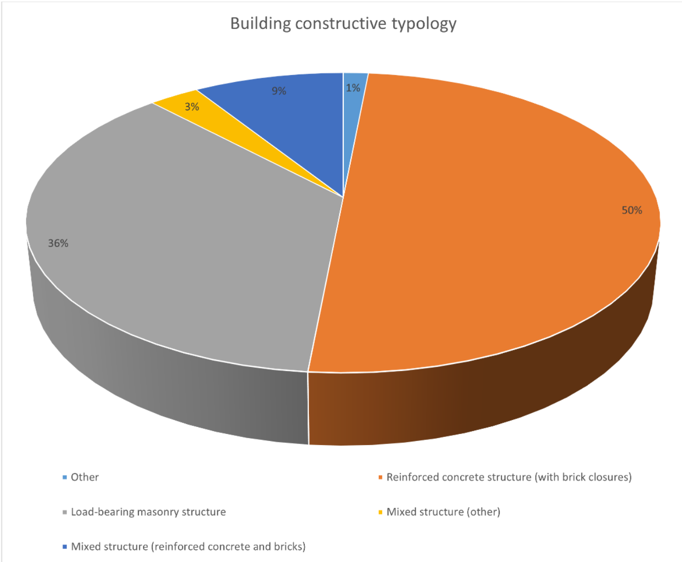

Figure A.10. (SFH) Building construction typology

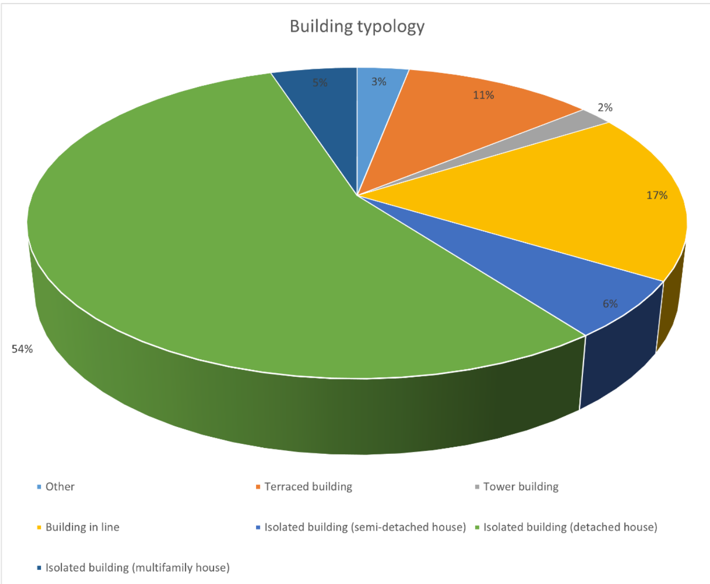

Figure A.11. (SFH) Building typology

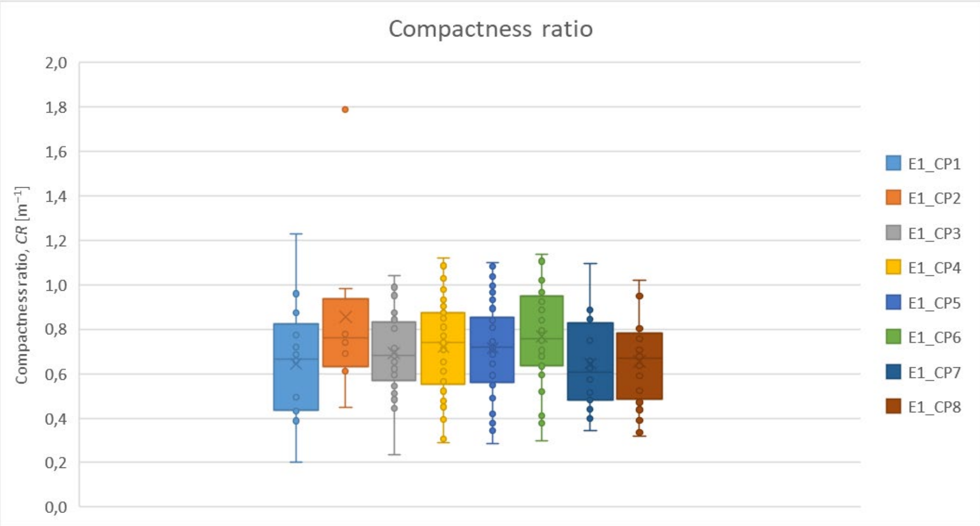

Figure A.12. (SFH) Compactness ratio

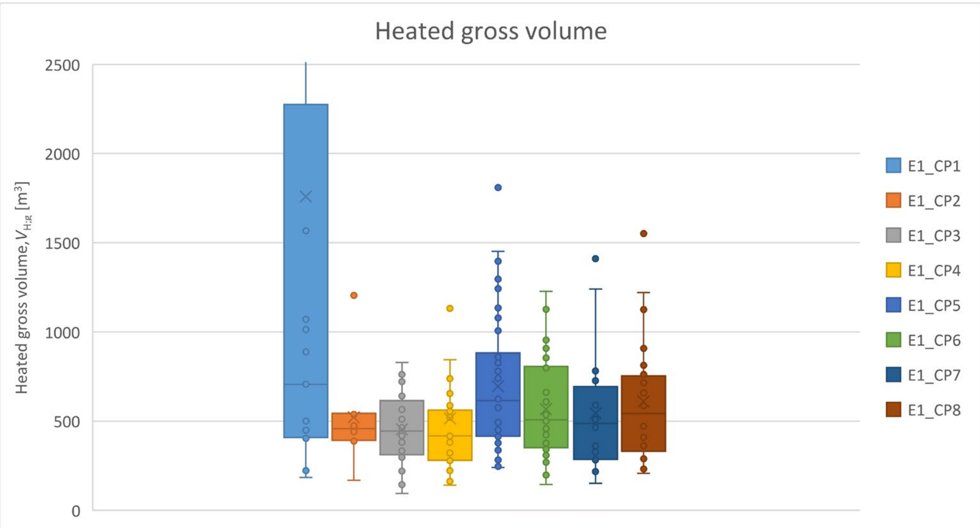

Figure A.13. (SFH) Thermally heated gross volume (non-representative sample (i.e., CP1(SFH))

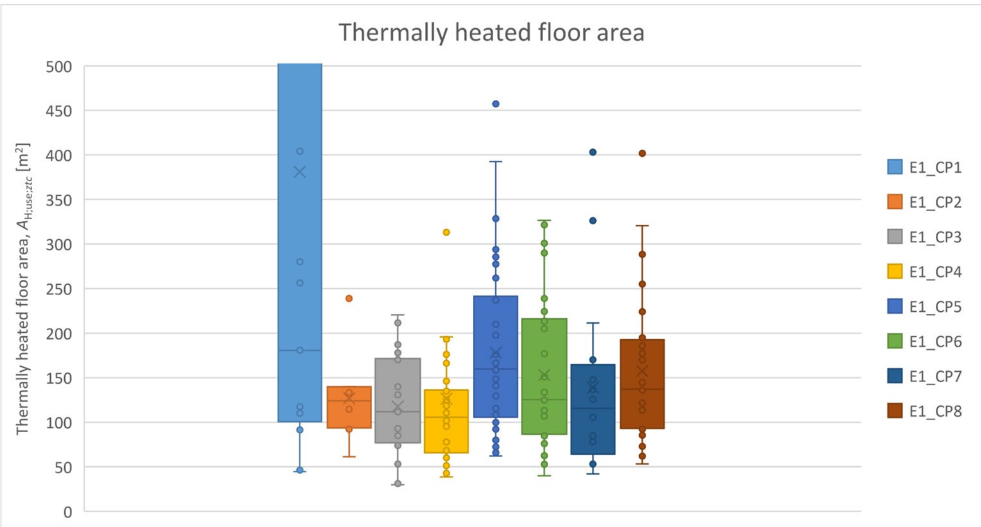

Figure A.14. (SFH) Thermally heated floor area (non-representative sample (i.e., CP1(SFH))

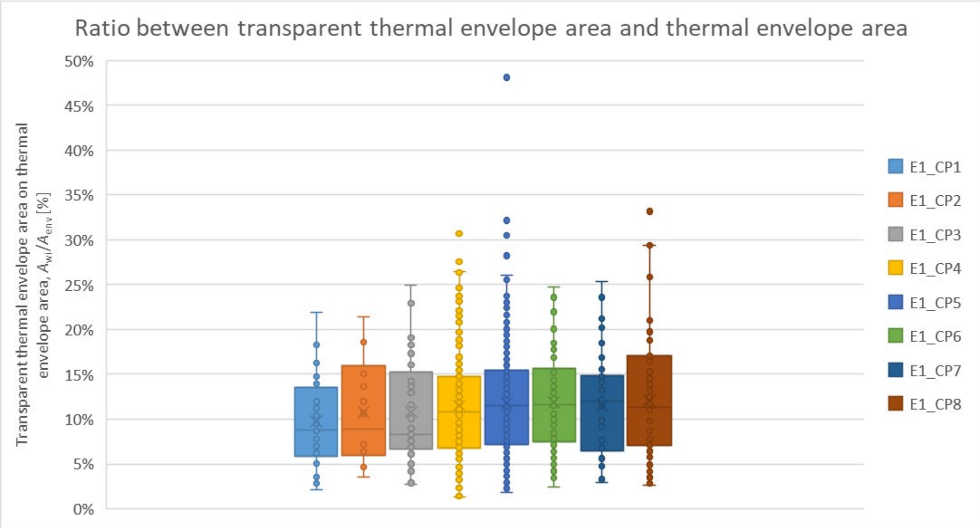

Figure A.15. (BU(AB)) Ratio between transparent thermal envelope area and thermal envelope area

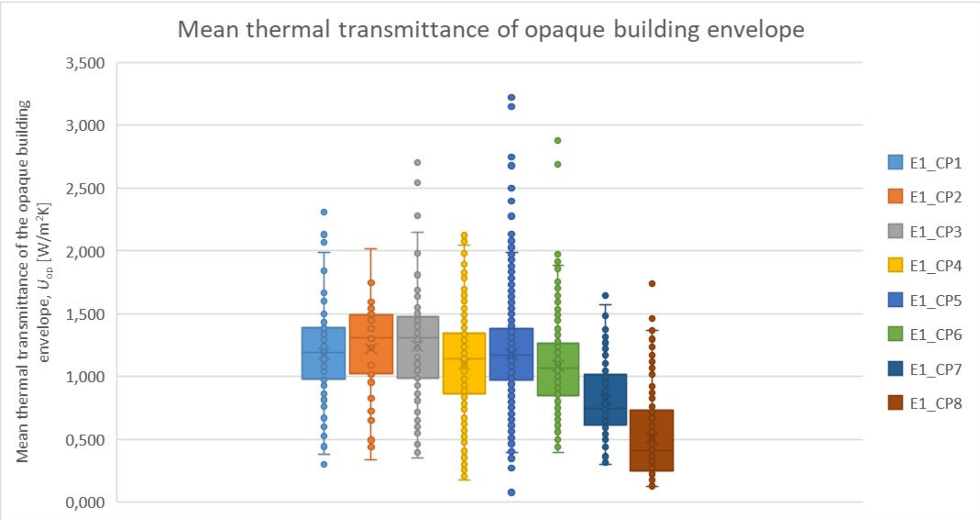

Figure A.16. (BU(AB)) Mean thermal transmittance of opaque building envelope

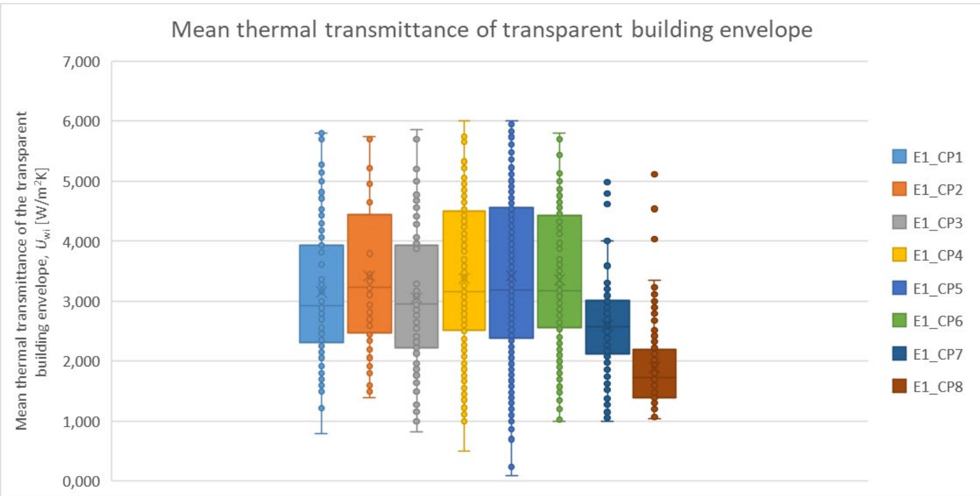

Figure A.17. (BU(AB)) Mean thermal transmittance of transparent building envelope

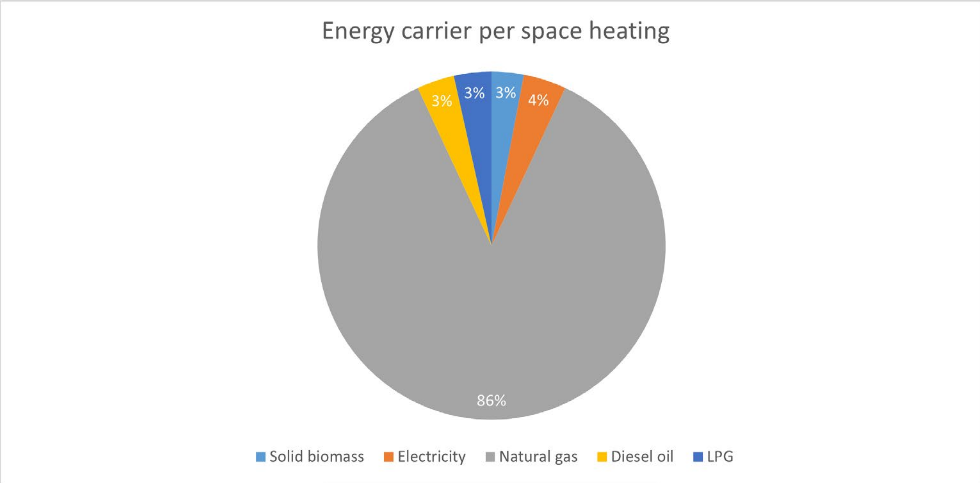

Figure A.18. (SFH) Energy carrier per space heating

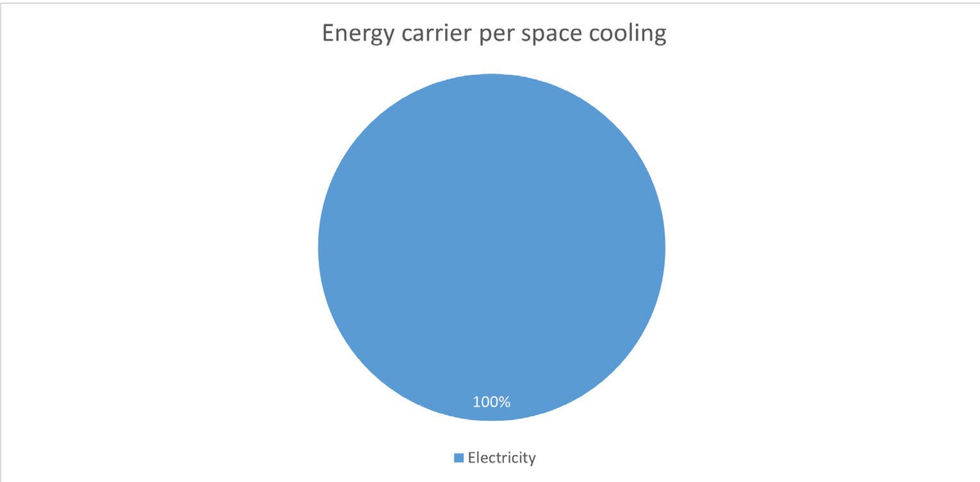

Figure A.19. (SFH) Energy carrier per space cooling

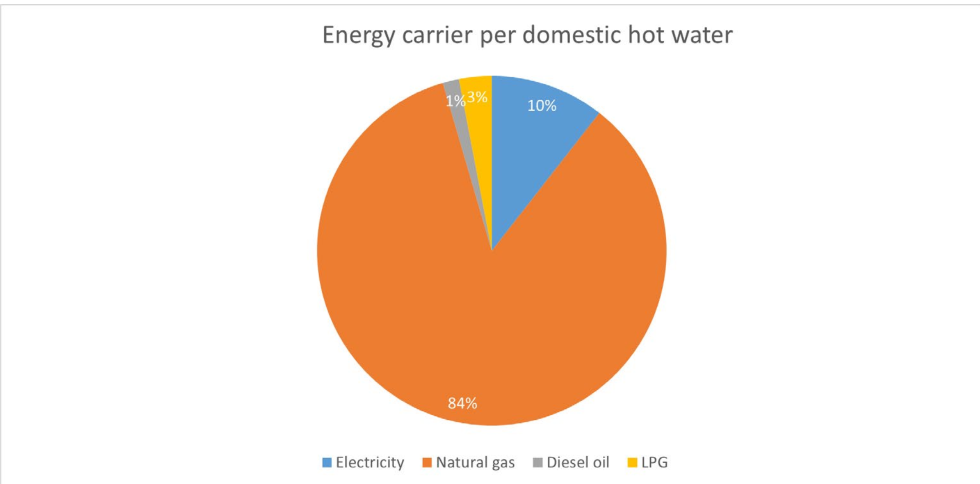

Figure A.20. (SFH) Energy carrier per domestic hot water

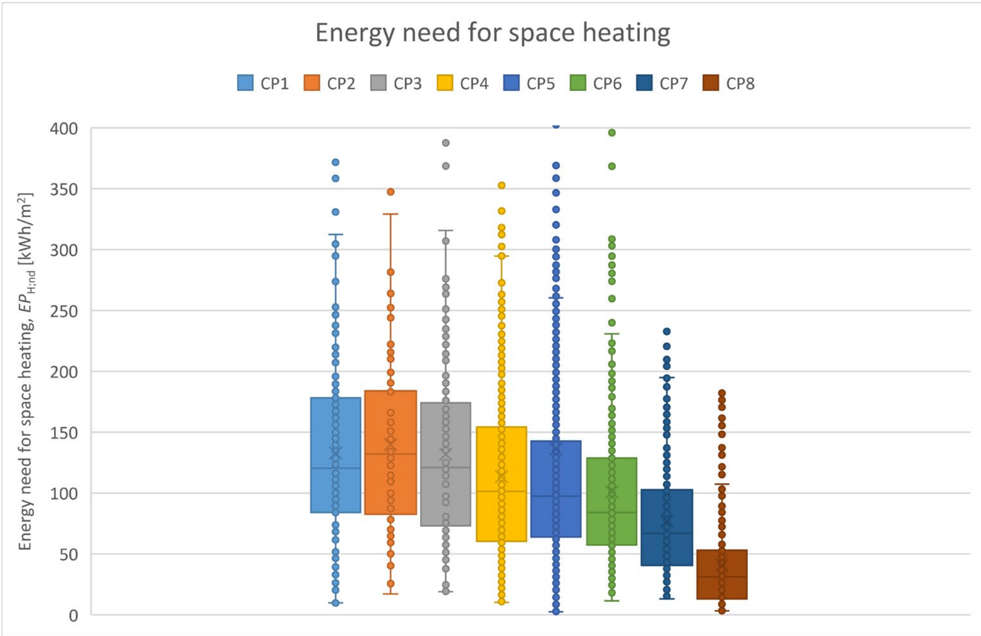

Figure A.21. (BU(AB)) Energy need for space heating

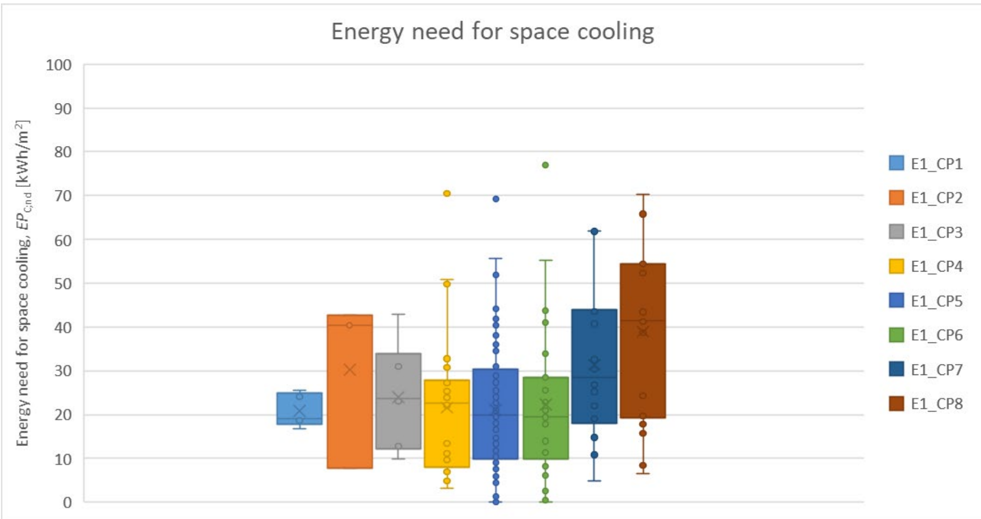

Figure A.22. (BU(AB)) Energy need for space cooling (non-representative sample (i.e., CP2(BU(AB)), CP3(BU(AB)))

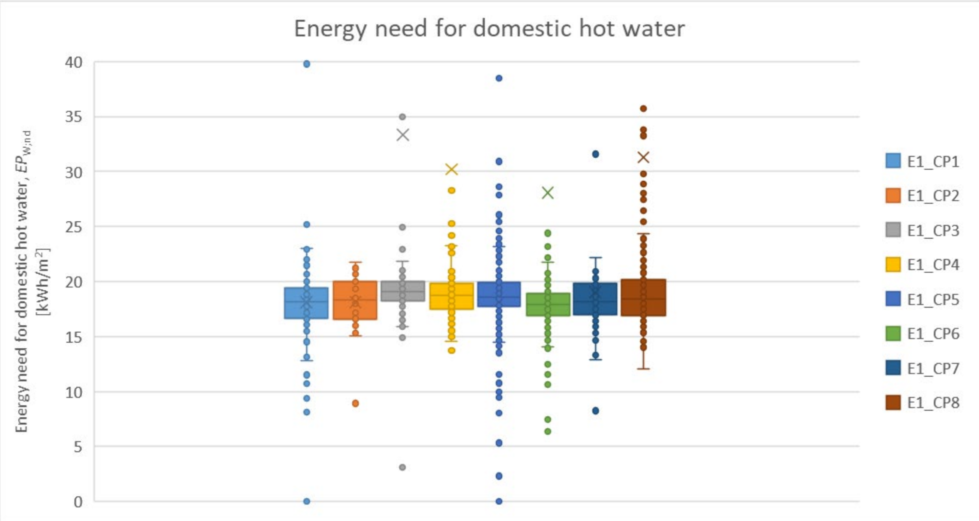

Figure A.23. (BU(AB)) Energy need for domestic hot water

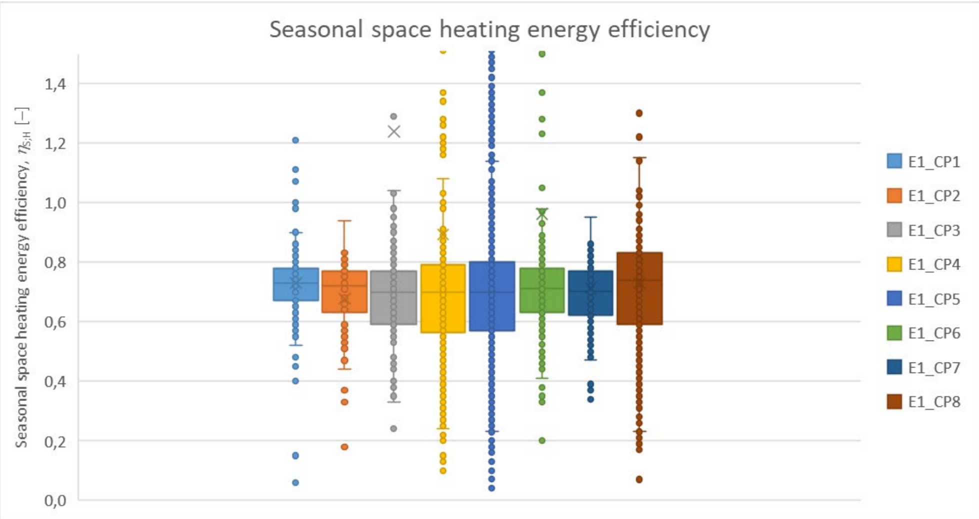

Figure A.24. (BU(AB)) Overall mean seasonal efficiency of the space heating system

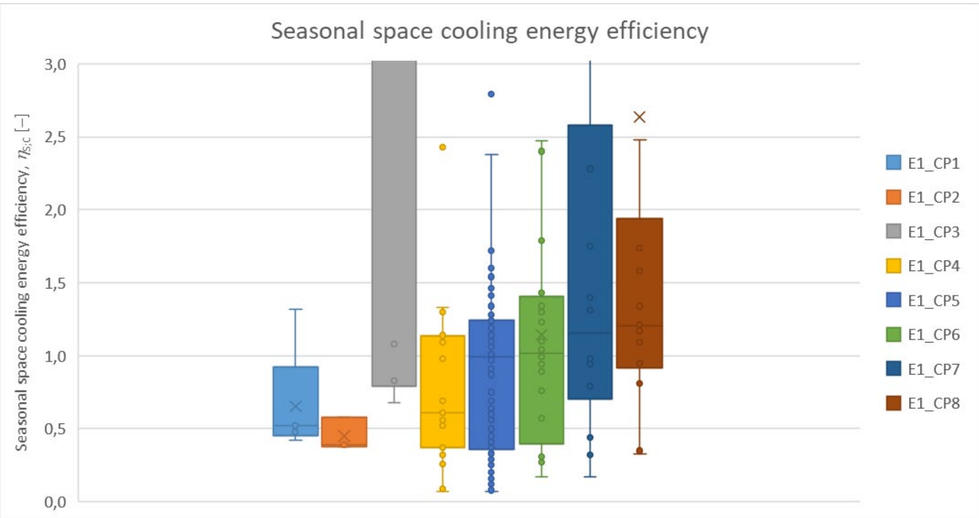

Figure A.25. (BU(AB)) Seasonal efficiency of the space cooling system (non-representative sample (i.e., CP3(BU(AB)), CP7(BU(AB)))

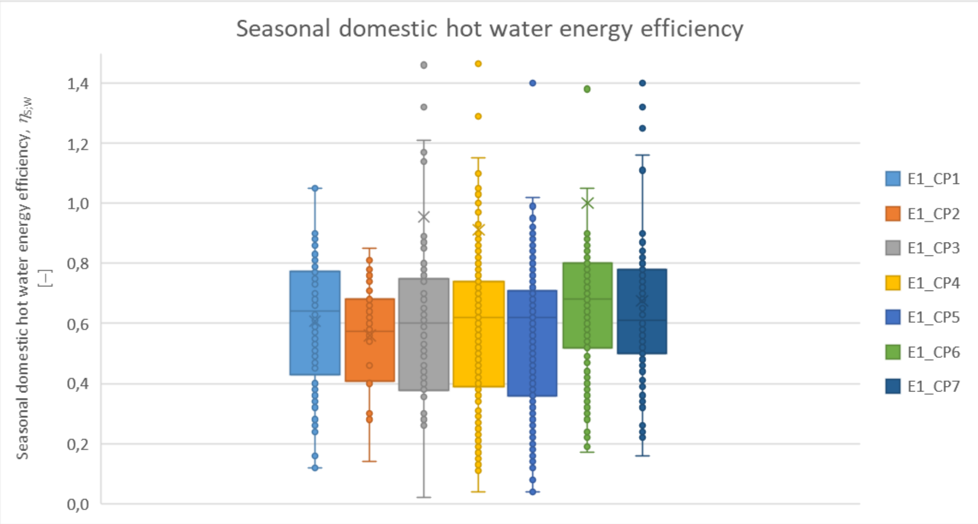

Figure A.26. (BU(AB)) Seasonal efficiency of the domestic hot water system

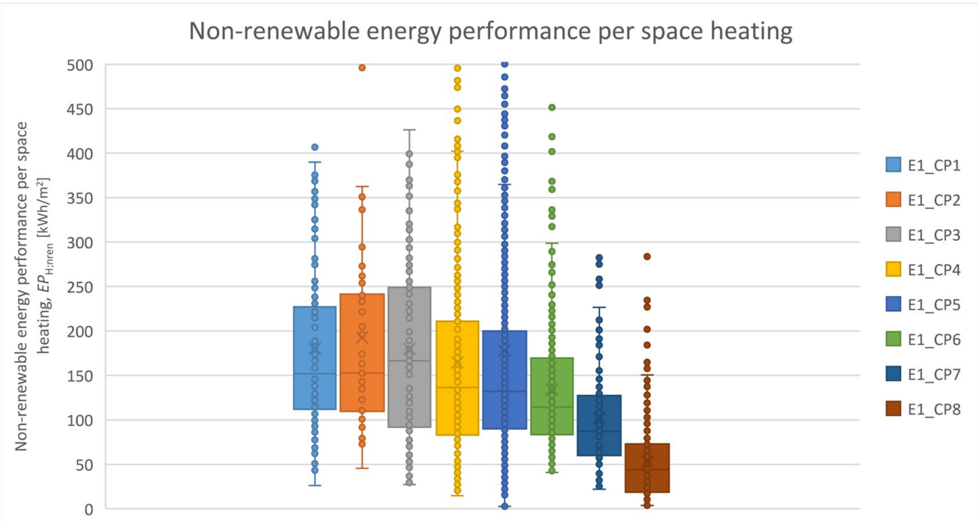

Figure A.27. (BU(AB)) Non-renewable energy performance per space heating

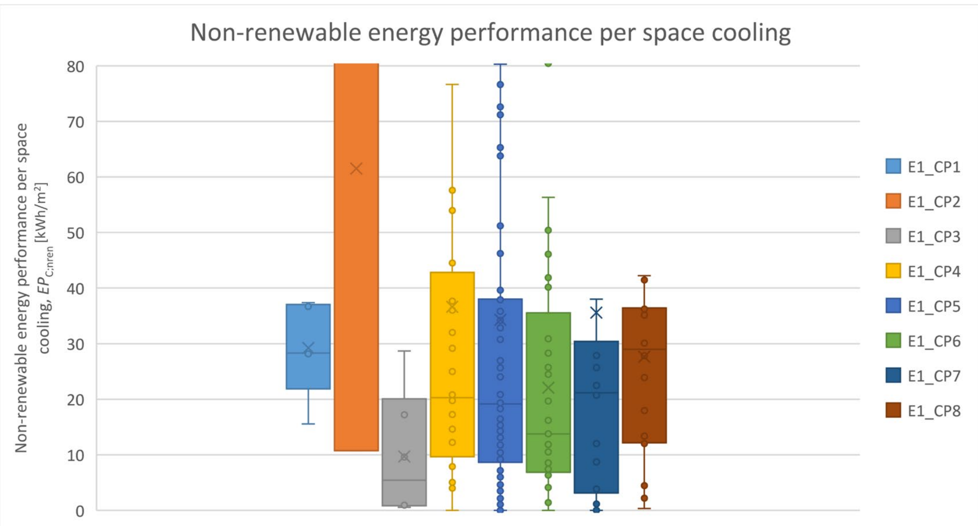

Figure A.28. (BU(AB)) Non-renewable energy performance per space cooling (non-representative sample (i.e., CP2(BU(AB)))

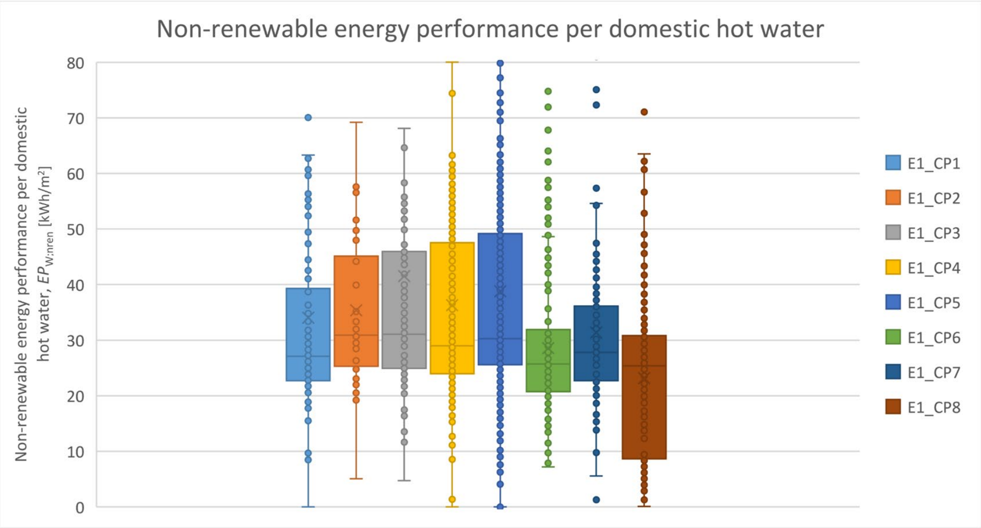

Figure A.29. (BU(AB)) Non-renewable energy performance per domestic hot water

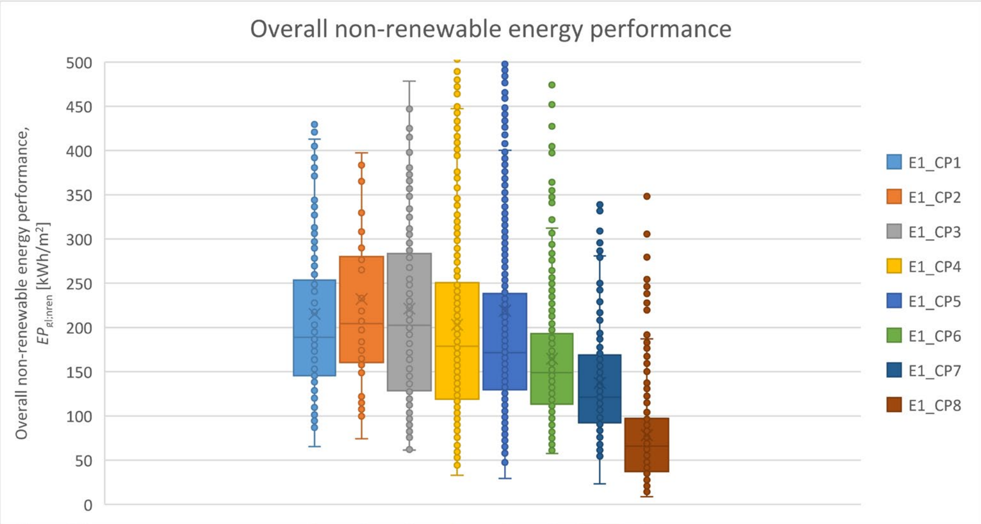

Figure A.30. (BU(AB)) Overall non-renewable energy performance

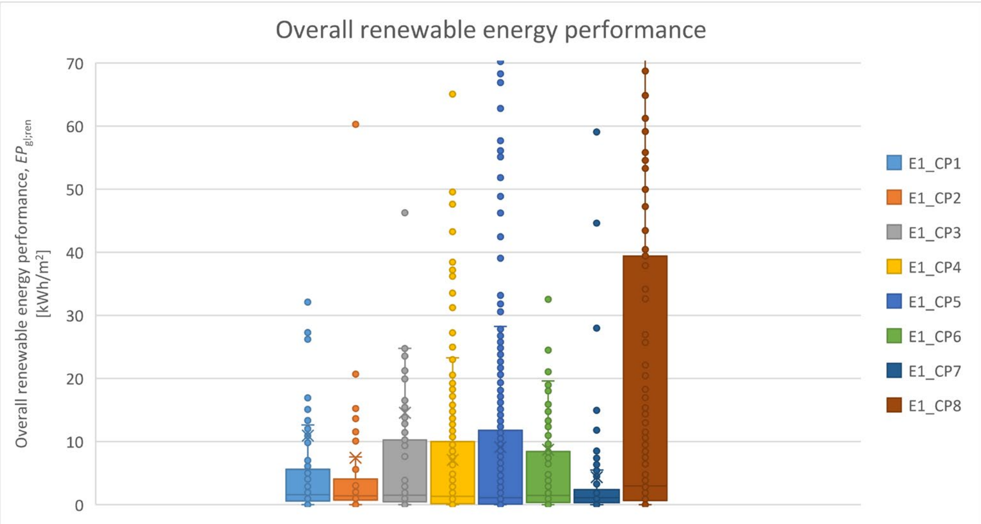

Figure A.31. (BU(AB)) Overall renewable energy performance

A2.5 Identification of reference buildings

As introduced in Section A2.4, the statistical representation of the proposed EPC parameters is essential for the reference building description. According to the limited sample analysed in this example of application, and in order to show the results of the general methodology, only an archetype is reported for Moncalieri; it refers to E_RES_CP6_SFH (Table A.11).

The geometrical characteristics, the thermo-physical properties of the building envelope and of the technical building systems, and the energy indicators are reported for this archetype in Table A.12, in the form of the median and the interquartile ranges ($Q_3 - Q_2$) and ($Q_2 - Q_1$).

The data related to the technical building system section of Table A.12 are independent on the year of construction, but dependent on the climatic region, building use category, and building size and shape (in the case of residential buildings).

Table A.11. Representative building E_RES_SINGLE_CP6 in the building typology matrix of Piemonte

Climatic zone E	Residential bldgs		Non-residential bldgs				
	Single-family house (SFH)	Building unit (BU(AB))	Office	Educational building	Hospital	Sport facility	Hotel
≤ 1900 (CP1)	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
1976-1990 (CP6)	E_RES_SINGLE_CP6	...	...	...	...	...	...
...	...	...	...	...	...	...	...

Table A.12. Building archetype for a subset of the building stock of Piemonte (Moncalieri)

MONCALIERI DATABASE – E_RES_SINGLE_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**(Q_3-Q_2)**	**(Q_2-Q_1)**
Geometry	Compactness ratio	CR	m^{-1}	0,75	0,18	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	508	291	149
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	125	86	34
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	6,55	3,24	1,58
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,924	0,302	0,164
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,971	0,329	0,634
Technical building system	Energy carrier per space heating	Natural gas = 84%; electricity = 6% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 95%; natural gas = 5% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 82%; electricity = 12% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,800	0,085	0,040
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	na (*)	na	na
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,883	0,048	0,071
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	125	86	34
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	14	3	5
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	15	2	1
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,760	0,048	0,058
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	na	na	na
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,735	0,055	0,155
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	158	80	65
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	na	na	na
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	21	7	3
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	197	61	85
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,5	1,9	0,8
	Renewable Energy Ratio	RER	%	0,65	2,52	0,35
(*) The sample analysed does not allow the statistical representation of these parameters ($\eta_{H;gn}$, $EP_{C;nren}$, and $\eta_{s;C}$).						

References

Ballarini, I., Corgnati, S. P., Corrado, V. (2014). Use of reference buildings to assess the energy saving potentials of the residential building stock: The experience of TABULA project. *Energy Policy*, *68*, 273-284. https://doi.org/10.1016/j.enpol.2014.01.027.

BUILD_ME. (2018). *BUILD_ME: Towards a Low-Carbon Building Sector in the MENA Region - Building typology database*. Retrieved November 26, 2022, from https://www.buildings-mena.com/typologies.

Department of Energy (DOE) of United States of America. (2013). *Prototype Building Models*. Retrieved November 26, 2022, from https://www.energycodes.gov/prototype-building-models.

European Committee for Standardisation (CEN). (2017). EN ISO 52000-1: Energy performance of buildings —Overarching EPB assessment — Part 1: General framework and procedures.

eXTENDing the energy performance assessment and certification schemes via a mOdular approach (X-tendo). (2022). D4.4 Description of methodologies and concepts for the technical implementation of each feature regarding improved handling and use of EPC data in selected implementing countries.

Italian Organisation for Standardisation (UNI). (2008). UNI/TS 11300-1: Energy performance of buildings - Part 1: Evaluation of energy need for space heating and cooling. UNI: Milan, Italy.

Italian Republic. (1993). DPR 26 August 1993, n. 412 - Regolamento recante norme per la progettazione, l'installazione, l'esercizio e la manutenzione degli impianti termici degli edifici ai fini del contenimento dei consumi di energia, in attuazione dell'art. 4, comma 4, della legge 9 gennaio 1991, n. 10

Annex B - Archetypes of the building stock in the TIMEPAC countries

Table of Annex B contents

B1 Archetypes of building stock in Austria (Salzburg)

Archetypes were developed for residential buildings (single family houses and multi-unit residential buildings) for all construction periods and the two climate regions (NF and ZA) of the province of Salzburg. Below, archetypes for single-family houses per construction period and climate region NF are listed in an exemplary way. Archetypes for non-residential buildings (hotels and restaurants, offices, educational buildings), have been developed, but have not been further used due to the small number of buildings available for the statistical analysis.

For the translation of the terms, see Table 3, Table 4, Table 7, Table 8, Table 22 and Table 27.

Table B.1. Archetype - residential building (SFH), climate region NF, construction period < 1919

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	1	1	0	209
Baujahr	1890	10	36	209
Heizgradtage 20/12 [kd]	3662	334	47	209
HWB Standortklima spezifisch [kWh/m²a]	158	64,9	49,4	209
Warmwasserwärmebedarf Standortklima spezifisch [kWh/m²a]	12,8	0	0	209
Heizenergiebedarf Standortklima spezifisch [kWh/m²a]	217,8	90,8	64,6	209
Energieaufwandszahl Heizen	1,3	0,22	0,19	209
Endenergiebedarf Standortklima spezifisch [kWh/m²a]	234,3	86,7	64,7	209
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch [kWh/m²a]	117,3	171	68,9	209
Primärenergiebedarf erneuerbar Standortklima spezifisch [kWh/m²a]	57,5	166,3	44,5	209
Mittlerer U-Wert [W/m²K]	0,82	0,28	0,27	209
Kompaktheit [1/m]	0,67	0,08	0,07	209
Bruttovolumen konditioniert [m³]	902,42	331,79	262,37	209
Gebäudehüllfläche [m²]	606,83	149,28	137,5	209
Bruttogrundfläche [m²]	303,56	92,94	77,4	209
# Boiler				
Nennwärmeleistung [kW]	24	11	4,805	124
Wirkungsgrad Volllast [%]	86,62	3,9475	3,3625	124
Wirkungsgrad Teillast [%]	88,2	10	4,88	59
Bereitschaftsverlust [%]	1,55	0,61	0,4525	124
# Heat pump				
Nennleistung beim Normpunkt [kW]	12,9	3,875	4,55	23
Jahresarbeitszahl	3,97	0,525	0,44	23
Leistungszahl (Coefficient Of Performance)	4,8	0,2	0,4	23
# Solar thermal				
Verlustfaktor	3,5	0,6	0	25
Konversionsrate	0,8	0	0	25
Hilfsenergie [W]	110	21	18	25

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
# Photovoltaic				
Kollektorfläche [m²]	34,08	3,79	3,79	2
Maximalleistung der gesamten Anlage [kW]	20,25	9,975	14,295	34
Wirkungsgrad [%]	13,8	0,9	0,9	2
PV-Export Standortklima zonenbezogen [kWh/a]	16272	7673	13378	33
PV-Export Standortklima spezifisch [kWh/m²a]	40,2	26,3	29,8	33

Energieträger	Number of buildings
ERDGAS	47
SCHEITHOLZ	34
HEIZOEL_EXTRALEICHT	28
STROM	27
PELLETS	18
FERNWAERME_ERNEUERBAR	18
HACKSCHNITZEL	14
STROM, STROM	10
FERNWAERME_NICHT_ERNEUERBAR	4
FERNWAERME_KWK_DEFAULT	2
GAS	2
STROM, PELLETS	1
STROM, ERDGAS	1
HEIZOEL_LEICHT	1
KOHLE	1
STROM, BIOMASSE_SONSTIGE	1

Heizungstyp	Number of buildings
HEIZKESSEL	45
STANDARDKESSEL	32
BRENNWERT	28
FERNWAERME	24
EINZELOFEN	23
STROMDIREKT	17
NIEDERTEMPERATUR	14
WAERMEPUMPE, STROMDIREKT	10
WAERMEPUMPE	10
KOMBITHERME_OHNE_KLEINSPEICHER	2
WAERMEPUMPE, HEIZKESSEL	2
HERD	1
WAERMEPUMPE, KOMBITHERME_OHNE_KLEINSPEICHER	1

Table B.2. Archetype - residential building (SFH), climate region NF, construction period 1919-1944

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	1	1	0	274
Baujahr	1933	5	3	274
Heizgradtage 20/12 [kd]	3623	28	8	274
HWB Standortklima spezifisch [kWh/m²a]	139,25	79,2	53,625	274
Warmwasserwärmebedarf Standortklima spezifisch [kWh/m²a]	12,8	0	0	274
Heizenergiebedarf Standortklima spezifisch [kWh/m²a]	206,8	97,125	91,675	274
Energieaufwandszahl Heizen	1,305	0,165	0,1925	274
Endenergiebedarf Standortklima spezifisch [kWh/m²a]	223,2	97,15	91,6	274
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch [kWh/m²a]	192,3	156,375	127,675	274
Primärenergiebedarf erneuerbar Standortklima spezifisch [kWh/m²a]	18,25	60,9	7,45	274
Mittlerer U-Wert [W/m²K]	0,68	0,3275	0,22	274
Kompaktheit [1/m]	0,73	0,0875	0,06	274
Bruttovolumen konditioniert [m³]	703	218,885	199,6375	274
Gebäudehüllfläche [m²]	511,035	117,9275	96,9675	274
Bruttogrundfläche [m²]	234,41	68,205	62,215	274
# Boiler				
Nennwärmeleistung [kW]	20	5,25	4,54	187
Wirkungsgrad Volllast [%]	86,67	5,37	1,99	187
Wirkungsgrad Teillast [%]	92,2	6,015	7,975	87
Bereitschaftsverlust [%]	1,48	0,51	0,37	187
# Heat pump				
Nennleistung beim Normpunkt [kW]	11,17	2,37	2,67	42
Jahresarbeitszahl	3,955	0,425	0,5025	42
Leistungszahl (Coefficient Of Performance)	4,85	0,225	0,25	42
# Solar thermal				
Verlustfaktor	3,5	0,6	0	32
Konversionsrate	0,8	0	0	32
Hilfsenergie [W]	115,4	44,6	29,2	32
# Photovoltaic				
Kollektorfläche [m²]	53,15	14,075	14,075	2
Maximalleistung der gesamten Anlage [kW]	8,88	3,12	3,6	37
Wirkungsgrad [%]	10,91	5,395	5,395	2
PV-Export Standortklima zonenbezogen [kWh/a]	5302	3491,5	2062,5	35
PV-Export Standortklima spezifisch [kWh/m²a]	20,8	12,75	9,6	35

Energieträger	Number of buildings
ERDGAS	89
HEIZOEL_EXTRALEICHT	55
STROM	31
SCHEITHOLZ	20
PELLETS	20
STROM, STROM	19
FERNWAERME_ERNEUERBAR	18
FERNWAERME_NICHT_ERNEUERBAR	5
HEIZOEL_LEICHT	4
FERNWAERME_KWK_DEFAULT	3
SONSTIGE	2
HACKSCHNITZEL	2
STROM, HEIZOEL_EXTRALEICHT	2
STROM, PELLETS	2
KOHLE	1
STROM, SCHEITHOLZ	1

Heizungstyp	Number of buildings
STANDARDKESSEL	59
BRENNWERT	53
HEIZKESSEL	34
NIEDERTEMPERATUR	27
FERNWAERME	26
WAERMEPUMPE, STROMDIREKT	19
WAERMEPUMPE	18
STROMDIREKT	13
EINZELOFEN	9
KOMBITHERME_OHNE_KLEINSPEICHER	5
WAERMEPUMPE, HEIZKESSEL	3
WAERMEPUMPE, STANDARDKESSEL	2
KOMBITHERME_MIT_KLEINSPEICHER	2
SONSTIGE	2
KACHELOFEN	1
HERD	1

Table B.3. Archetype - residential building (SFH), climate region NF, construction period 1945-1960

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	1	1	0	852
Baujahr	1955	4	5	852
Heizgradtage 20/12 [kd]	3632	75	17	852
HWB Standortklima spezifisch [kWh/m²a]	126,7	69,25	48,25	852
Warmwasserwärmebedarf Standortklima spezifisch [kWh/m²a]	12,8	0	0	852
Heizenergiebedarf Standortklima spezifisch [kWh/m²a]	194,45	98,4	79,275	852
Energieaufwandszahl Heizen	1,35	0,17	0,21	852
Endenergiebedarf Standortklima spezifisch [kWh/m²a]	210,3	98,95	79,225	852
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch [kWh/m²a]	199,7	137,95	135,8	852
Primärenergiebedarf erneuerbar Standortklima spezifisch [kWh/m²a]	18,25	30,35	6,95	852
Mittlerer U-Wert [W/m²K]	0,65	0,3	0,22	852
Kompaktheit [1/m]	0,74	0,07	0,07	852
Bruttovolumen konditioniert [m³]	601,28	190,48	140,28	852
Gebäudehüllfläche [m²]	457,215	109,86	88,46	852
Bruttogrundfläche [m²]	204,81	62,108	44,788	852
# Boiler				
Nennwärmeleistung [kW]	18	5	3,68	589
Wirkungsgrad Volllast [%]	86,76	5,24	1,76	589
Wirkungsgrad Teillast [%]	89,565	8,6375	5,7875	264
Bereitschaftsverlust [%]	1,44	0,52	0,33	589
# Heat pump				
Nennleistung beim Normpunkt [kW]	10,4	2,6	3,355	139
Jahresarbeitszahl	3,86	0,435	0,49	139
Leistungszahl (Coefficient Of Performance)	4,7	0,3	0,5	139
# Solar thermal				
Verlustfaktor	3,5	0,6	0	79
Konversionsrate	0,8	0	0	79
Hilfsenergie [W]	88	24	12	78
# Photovoltaic				
Kollektorfläche [m²]	41,48	34,72	5,48	12
Maximalleistung der gesamten Anlage [kW]	7,28	3,52	2,255	126
Wirkungsgrad [%]	17,5	2,75	3,7	12
PV-Export Standortklima zonenbezogen [kWh/a]	4409	3210	2051	125
PV-Export Standortklima spezifisch [kWh/m²a]	18,5	12	9,81	125

Energieträger	Number of buildings
ERDGAS	240
HEIZOEL_EXTRALEICHT	198
STROM, STROM	96
STROM	73
PELLETS	58
SCHEITHOLZ	48
HEIZOEL_LEICHT	41
FERNWAERME_ERNEUERBAR	36
HACKSCHNITZEL	13
FERNWAERME_KWK_DEFAULT	7
FERNWAERME_NICHT_ERNEUERBAR	7
KOHLE	7
BIOMASSE_SONSTIGE	6
STROM, HEIZOEL_EXTRALEICHT	5
HEIZOEL	5
GAS	4
STROM, PELLETS	2
STROM, ERDGAS	2
SONSTIGE	2
ABWAERME_DEFAULT	1
STROM, SCHEITHOLZ	1

Heizungstyp	Number of buildings
STANDARDKESSEL	192
BRENNWERT	141
NIEDERTEMPERATUR	129
HEIZKESSEL	100
WAERMEPUMPE, STROMDIREKT	96
FERNWAERME	51
STROMDIREKT	39
EINZELOFEN	37
WAERMEPUMPE	33
KOMBITHERME_OHNE_KLEINSPEICHER	13
KACHELOFEN	4
KOMBITHERME_MIT_KLEINSPEICHER	3
WAERMEPUMPE, BRENNWERT	3
WAERMEPUMPE, STANDARDKESSEL	2
WAERMEPUMPE, HEIZKESSEL	2
SONSTIGE	2
WAERMEPUMPE, NIEDERTEMPERATUR	2
OHNE	1
HERD	1
WAERMEPUMPE, EINZELOFEN	1

Table B.4. Archetype – residential building (SFH), climate region NF, construction period 1961-1980

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	1	1	0	1864
Baujahr	1972	4	5	1864
Heizgradtage 20/12 [kd]	3651	345	30	1864
HWB Standortklima spezifisch [kWh/m²a]	113,7	53,425	39,075	1864
Warmwasserwärmebedarf Standortklima spezifisch [kWh/m²a]	12,8	0	0	1864
Heizenergiebedarf Standortklima spezifisch [kWh/m²a]	172,6	85	63,875	1864
Energieaufwandszahl Heizen	1,36	0,17	0,2	1864
Endenergiebedarf Standortklima spezifisch [kWh/m²a]	188,55	85,275	63,9	1864
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch [kWh/m²a]	189,4	122,3	133,825	1864
Primärenergiebedarf erneuerbar Standortklima spezifisch [kWh/m²a]	15	44,975	3,4	1864
Mittlerer U-Wert [W/m²K]	0,6	0,22	0,19	1864
Kompaktheit [1/m]	0,71	0,06	0,0525	1864
Bruttovolumen konditioniert [m³]	744,24	207,96	170,6175	1864
Gebäudehüllfläche [m²]	533,81	108,79	92,48	1864
Bruttogrundfläche [m²]	248,76	67,55	55,595	1864
# Boiler				
Nennwärmeleistung [kW]	20	5	4,35	1357
Wirkungsgrad Volllast [%]	86,57	4,33	1,92	1357
Wirkungsgrad Teillast [%]	89,26	8,9	5,86	599
Bereitschaftsverlust [%]	1,48	0,51	0,37	1356
# Heat pump				
Nennleistung beim Normpunkt [kW]	10,8	3,15	2,8	295
Jahresarbeitszahl	3,94	0,53	0,595	295
Leistungszahl (Coefficient Of Performance)	4,8	0,3	0,7	295
# Solar thermal				
Verlustfaktor	3,5	0,6	0	251
Konversionsrate	0,8	0	0	251
Hilfsenergie [W]	100	25	18	249
# Photovoltaic				
Kollektorfläche [m²]	35,13	15,495	5,28	36
Maximalleistung der gesamten Anlage [kW]	7,5	3,9	2,4	288
Wirkungsgrad [%]	19,4	1,6	5,9	36
PV-Export Standortklima zonenbezogen [kWh/a]	4510	3580	1960	281
PV-Export Standortklima spezifisch [kWh/m²a]	18,6	13,2	9	281

Energieträger	Number of buildings
HEIZOEL_EXTRALEICHT	640
ERDGAS	316
STROM, STROM	193
PELLETS	178
STROM	140
FERNWAERME_ERNEUERBAR	104
HEIZOEL_LEICHT	84
SCHEITHOLZ	70
HACKSCHNITZEL	29
FERNWAERME_NICHT_ERNEUERBAR	22
STROM, HEIZOEL_EXTRALEICHT	15
HEIZOEL	12
KOHLE	12
SONSTIGE	12
BIOMASSE_SONSTIGE	8
STROM, ERDGAS	8
STROM, PELLETS	5
STROM, SCHEITHOLZ	4
FERNWAERME_KWK_DEFAULT	4
GAS	4
ABWAERME_DEFAULT	3
STROM, BIOMASSE_SONSTIGE	1

Heizungstyp	Number of buildings
STANDARDKESSEL	472
NIEDERTEMPERATUR	295
BRENNWERT	271
HEIZKESSEL	269
WAERMEPUMPE, STROMDIREKT	193
FERNWAERME	133
STROMDIREKT	71
WAERMEPUMPE	69
EINZELOFEN	31
WAERMEPUMPE, STANDARDKESSEL	11
SONSTIGE	10
WAERMEPUMPE, HEIZKESSEL	9
WAERMEPUMPE, BRENNWERT	8
KOMBITHERME_OHNE_KLEINSPEICHER	8
KACHELOFEN	4
OHNE	3
WAERMEPUMPE, NIEDERTEMPERATUR	3
WAERMEPUMPE, EINZELOFEN	2
KOMBITHERME_MIT_KLEINSPEICHER	2

Table B.5. Archetype – residential building (SFH), climate region NF, construction period 1981-1990

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	1	0	0	861
Baujahr	1985	3	2	861
Heizgradtage 20/12 [kd]	3675	326	47	861
HWB Standortklima spezifisch [kWh/m²a]	102,5	23,21	20,7	861
Warmwasserwärmebedarf Standortklima spezifisch [kWh/m²a]	12,8	0	0	861
Heizenergiebedarf Standortklima spezifisch [kWh/m²a]	146,7	41,8	43	861
Energieaufwandszahl Heizen	1,33	0,17	0,27	861
Endenergiebedarf Standortklima spezifisch [kWh/m²a]	162,4	42,1	43,5	861
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch [kWh/m²a]	172,2	61,2	117,2	861
Primärenergiebedarf erneuerbar Standortklima spezifisch [kWh/m²a]	20,8	63,9	9,1	861
Mittlerer U-Wert [W/m²K]	0,54	0,1	0,1	861
Kompaktheit [1/m]	0,72	0,05	0,06	861
Bruttovolumen konditioniert [m³]	674,8	206,31	145,04	861
Gebäudehüllfläche [m²]	494,61	115,25	101,51	861
Bruttogrundfläche [m²]	229,21	61,55	48,61	861
# Boiler				
Nennwärmeleistung [kW]	17	4	3,385	560
Wirkungsgrad Volllast [%]	86,35	3,8875	1,5825	560
Wirkungsgrad Teillast [%]	86,945	11,115	3,7025	296
Bereitschaftsverlust [%]	1,52	0,34	0,36	560
# Heat pump				
Nennleistung beim Normpunkt [kW]	11,4	3,46	2,8	173
Jahresarbeitszahl	3,87	0,4	0,59	173
Leistungszahl (Coefficient Of Performance)	4,7	0,3	0,6	173
# Solar thermal				
Verlustfaktor	3,5	0,6	0	124
Konversionsrate	0,8	0	0	124
Hilfsenergie [W]	100	28	15	121
# Photovoltaic				
Kollektorfläche [m²]	40,8	7,8	12,8	13
Maximalleistung der gesamten Anlage [kW]	8,325	3,2475	2,825	140
Wirkungsgrad [%]	18,5	1,1	6,5	13
PV-Export Standortklima zonenbezogen [kWh/a]	4806	2924,2	2341,7	138
PV-Export Standortklima spezifisch [kWh/m²a]	20,6	11,5	11,3	137

Energieträger	Number of buildings
HEIZOEL_EXTRALEICHT	224
ERDGAS	154
STROM	130
STROM, STROM	105
PELLETS	85
SCHEITHOLZ	38
FERNWAERME_ERNEUERBAR	33
HEIZOEL_LEICHT	31
HACKSCHNITZEL	11
BIOMASSE_SONSTIGE	10
STROM, HEIZOEL_EXTRALEICHT	8
STROM, PELLETS	8
FERNWAERME_NICHT_ERNEUERBAR	6
FERNWAERME_KWK_DEFAULT	6
HEIZOEL	5
GAS	2
KOHLE	2
STROM, HEIZOEL_LEICHT	1
FESTBRENNSTOFF_SONSTIGE	1
STROM, FERNWAERME_ERNEUERBAR	1

Heizungstyp	Number of buildings
STANDARDKESSEL	162
NIEDERTEMPERATUR	147
HEIZKESSEL	128
WAERMEPUMPE, STROMDIREKT	105
BRENNWERT	104
STROMDIREKT	80
WAERMEPUMPE	50
FERNWAERME	45
EINZELOFEN	17
WAERMEPUMPE, HEIZKESSEL	8
WAERMEPUMPE, STANDARDKESSEL	4
WAERMEPUMPE, NIEDERTEMPERATUR	3
KACHELOFEN	2
WAERMEPUMPE, BRENNWERT	2
WAERMEPUMPE, FERNWAERME	1
KOMBITHERME_MIT_KLEINSPEICHER	1
KOMBITHERME_OHNE_KLEINSPEICHER	1
SONSTIGE	1

Table B.6. Archetype - residential building (SFH), climate region NF, construction period 1991-2000

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	1	0	0	840
Baujahr	1995	2	2	840
Heizgradtage 20/12 [kd]	3699	303	66	840
HWB Standortklima spezifisch [kWh/m²a]	85,345	17,955	14,345	840
Warmwasserwärmebedarf Standortklima spezifisch [kWh/m²a]	12,8	0	0	840
Heizenergiebedarf Standortklima spezifisch [kWh/m²a]	126,4	34,25	36,5	840
Energieaufwandszahl Heizen	1,33	0,17	0,23	840
Endenergiebedarf Standortklima spezifisch [kWh/m²a]	142,35	34,45	38,2	840
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch [kWh/m²a]	149,95	49,895	95,3	840
Primärenergiebedarf erneuerbar Standortklima spezifisch [kWh/m²a]	13	17,315	2,5	840
Mittlerer U-Wert [W/m²K]	0,46	0,1	0,06	840
Kompaktheit [1/m]	0,71	0,04	0,07	840
Bruttovolumen konditioniert [m³]	635,59	218,018	122,61	840
Gebäudehüllfläche [m²]	462,77	128,77	101,13	840
Bruttogrundfläche [m²]	212,8	70,2375	40,37	840
# Boiler				
Nennwärmeleistung [kW]	16,43	4,57	4,43	576
Wirkungsgrad Volllast [%]	89,26	2,8	3,1	577
Wirkungsgrad Teillast [%]	89,26	8,82	5,49	393
Bereitschaftsverlust [%]	1,38	0,3	0,28	577
# Heat pump				
Nennleistung beim Normpunkt [kW]	11,35	2,35	2,85	178
Jahresarbeitszahl	4,02	0,42	0,54	178
Leistungszahl (Coefficient Of Performance)	4,7	0,3	0,6	178
# Solar thermal				
Verlustfaktor	3,5	0,6	0	176
Konversionsrate	0,8	0	0	176
Hilfsenergie [W]	96	26	20	174
# Photovoltaic				
Kollektorfläche [m²]	37,15	15,4925	10,225	18
Maximalleistung der gesamten Anlage [kW]	7,295	3,265	2,105	168
Wirkungsgrad [%]	12	8,725	0	18
PV-Export Standortklima zonenbezogen [kWh/a]	4608	3170,25	2064	166
PV-Export Standortklima spezifisch [kWh/m²a]	20,495	14,28	9,395	166

Energieträger	Number of buildings
ERDGAS	264
HEIZOEL_EXTRALEICHT	179
STROM, STROM	126
STROM	59
PELLETS	56
FERNWAERME_ERNEUERBAR	47
HEIZOEL_LEICHT	26
SCHEITHOLZ	24
HACKSCHNITZEL	17
FERNWAERME_NICHT_ERNEUERBAR	17
HEIZOEL	9
STROM, ERDGAS	3
STROM, HEIZOEL_EXTRALEICHT	3
STROM, SCHEITHOLZ	2
SONSTIGE	2
BIOMASSE_SONSTIGE	2
FLUESSIGGAS	1
STROM, PELLETS	1
FERNWAERME_KWK_DEFAULT	1
STROM, FERNWAERME_ERNEUERBAR	1

Heizungstyp	Number of buildings
NIEDERTEMPERATUR	175
STANDARDKESSEL	146
BRENNWERT	145
WAERMEPUMPE, STROMDIREKT	126
HEIZKESSEL	89
FERNWAERME	65
WAERMEPUMPE	42
STROMDIREKT	17
KOMBITHERME_OHNE_KLEINSPEICHER	9
EINZELOFEN	7
KOMBITHERME_MIT_KLEINSPEICHER	4
WAERMEPUMPE, STANDARDKESSEL	3
KACHELOFEN	3
WAERMEPUMPE, BRENNWERT	3
SONSTIGE	2
WAERMEPUMPE, KACHELOFEN	2
WAERMEPUMPE, FERNWAERME	1
WAERMEPUMPE, HEIZKESSEL	1

Table B.7. Archetype – residential building (SFH), climate region NF, construction period 2001-2010

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	1	0	0	405
Baujahr	2006	2	3	405
Heizgradtage 20/12 [kd]	3676	325	45	405
HWB Standortklima spezifisch [kWh/m²a]	59,1	12,7	10,3	405
Warmwasserwärmebedarf Standortklima spezifisch [kWh/m²a]	12,8	0	0	405
Heizenergiebedarf Standortklima spezifisch [kWh/m²a]	85,71	30,49	56,01	405
Energieaufwandszahl Heizen	1,25	0,21	0,84	405
Endenergiebedarf Standortklima spezifisch [kWh/m²a]	99,9	31,1	57,37	405
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch [kWh/m²a]	54,8	79,9	16,9	405
Primärenergiebedarf erneuerbar Standortklima spezifisch [kWh/m²a]	19,2	40,8	8,5	405
Mittlerer U-Wert [W/m²K]	0,35	0,06	0,06	405
Kompaktheit [1/m]	0,7	0,05	0,06	405
Bruttovolumen konditioniert [m³]	737,21	223,07	168,57	405
Gebäudehüllfläche [m²]	527,59	128,94	104,85	405
Bruttogrundfläche [m²]	234	69,66	48,5	405
# Boiler				
Nennwärmeleistung [kW]	15,605	4,435	4,21	230
Wirkungsgrad Volllast [%]	89,38	2,7775	3,5325	230
Wirkungsgrad Teillast [%]	89,7	8,46	5,93	176
Bereitschaftsverlust [%]	1,2	0,9975	0,11	230
# Heat pump				
Nennleistung beim Normpunkt [kW]	10,32	3,52	2,12	125
Jahresarbeitszahl	4,06	0,52	0,52	125
Leistungszahl (Coefficient Of Performance)	4,5	0,5	0,54	125
# Solar thermal				
Verlustfaktor	3,5	0,6	0	86
Konversionsrate	0,8	0	0	86
Hilfsenergie [W]	88	24	12	86
# Photovoltaic				
Kollektorfläche [m²]	41,18	7,045	5,63	14
Maximalleistung der gesamten Anlage [kW]	9,12	2,8	2,64	103
Wirkungsgrad [%]	15,8	6,225	3,8	14
PV-Export Standortklima zonenbezogen [kWh/a]	6148	2913,5	1959,25	102
PV-Export Standortklima spezifisch [kWh/m²a]	25,5	12,5	8,175	102

Energieträger	Number of buildings
ERDGAS	122
STROM	65
STROM, STROM	65
PELLETS	43
FERNWAERME_ERNEUERBAR	35
HEIZOEL_EXTRALEICHT	29
SCHEITHOLZ	21
HACKSCHNITZEL	7
FERNWAERME_NICHT_ERNEUERBAR	6
BIOMASSE_SONSTIGE	4
HEIZOEL	2
GAS	2
STROM, ERDGAS	1
HEIZOEL_LEICHT	1
FERNWAERME_KWK_DEFAULT	1
SONSTIGE	1

Heizungstyp	Number of buildings
BRENNWERT	85
HEIZKESSEL	72
WAERMEPUMPE, STROMDIREKT	65
WAERMEPUMPE	59
FERNWAERME	42
NIEDERTEMPERATUR	36
STANDARDKESSEL	30
STROMDIREKT	6
KOMBITHERME_OHNE_KLEINSPEICHER	3
EINZELOFEN	3
KOMBITHERME_MIT_KLEINSPEICHER	2
SONSTIGE	1
WAERMEPUMPE, BRENNWERT	1

Table B.8. Archetype – residential building (SFH), climate region NF, construction period >2010

Variables	Median	$Q_3 - Q_2$	$Q_2 - Q_1$	Number of buildings
Nutzungseinheiten im Energieausweis	1	0	0	1481
Baujahr	2018	2	1	1481
Heizgradtage 20/12 [kd]	3698	298	67	1481
HWB Standortklima spezifisch [kWh/m²a]	39,7	5,4	4,9	1481
Warmwasserwärmebedarf Standortklima spezifisch [kWh/m²a]	12,8	0	0	1481
Heizenergiebedarf Standortklima spezifisch [kWh/m²a]	18,8	7,2	3	1481
Energieaufwandszahl Heizen	0,36	0,1	0,05	1481
Endenergiebedarf Standortklima spezifisch [kWh/m²a]	29,1	6,9	3	1481
Primärenergiebedarf nicht erneuerbar Standortklima spezifisch [kWh/m²a]	36,3	4,3	3,4	1481
Primärenergiebedarf erneuerbar Standortklima spezifisch [kWh/m²a]	16,7	3	1,7	1481
Mittlerer U-Wert [W/m²K]	0,23	0,02	0,01	1481
Kompaktheit [1/m]	0,68	0,05	0,06	1481
Bruttovolumen konditioniert [m³]	747,26	225,84	162,63	1481
Gebäudehüllfläche [m²]	524,26	119,6	101,74	1481
Bruttogrundfläche [m²]	225,9	67,3	44,49	1481
# Boiler				
Nennwärmeleistung [kW]	14,185	7,5675	4,1525	110
Wirkungsgrad Volllast [%]	90,56	2,025	5,0425	110
Wirkungsgrad Teillast [%]	91,5	6,68	6,5	85
Bereitschaftsverlust [%]	1,365	0,945	0,3075	108
# Heat pump				
Nennleistung beim Normpunkt [kW]	8,7	2,6	1,91	1173
Jahresarbeitszahl	4,16	0,37	0,32	1173
Leistungszahl (Coefficient Of Performance)	4,7	0,3	0,2	1172
# Solar thermal				
Verlustfaktor	3,5	0	0	62
Konversionsrate	0,8	0	0	62
Hilfsenergie [W]	100	16,3	29,5	62
# Photovoltaic				
Kollektorfläche [m²]	17,25	9,1	4,975	202
Maximalleistung der gesamten Anlage [kW]	3,2	1,8	0,95	1137
Wirkungsgrad [%]	16,4	2,2	4,4	165
PV-Export Standortklima zonenbezogen [kWh/a]	1186	1340	562	1071
PV-Export Standortklima spezifisch [kWh/m²a]	6	5,4	3,2	1065

Energieträger	Number of buildings
STROM, STROM	719
STROM	454
FERNWAERME_ERNEUERBAR	173
ERDGAS	38
PELLETS	33
SCHEITHOLZ	25
HEIZOEL_EXTRALEICHT	10
STROM, SCHEITHOLZ	7
HEIZOEL	7
BIOMASSE_SONSTIGE	4
FERNWAERME_KWK_DEFAULT	2
FERNWAERME_NICHT_ERNEUERBAR	2
STROM, ERDGAS	2
HACKSCHNITZEL	2
HEIZOEL_LEICHT	2
ABWAERME_DEFAULT	1

Heizungstyp	Number of buildings
WAERMEPUMPE, STROMDIREKT	719
WAERMEPUMPE	445
FERNWAERME	178
HEIZKESSEL	50
BRENNWERT	32
NIEDERTEMPERATUR	14
KACHELOFEN	10
STROMDIREKT	9
STANDARDKESSEL	6
WAERMEPUMPE, EINZELOFEN	5
KOMBITHERME_MIT_KLEINSPEICHER	4
EINZELOFEN	2
WAERMEPUMPE, BRENNWERT	2
KOMBITHERME_OHNE_KLEINSPEICHER	1
HERD	1
SONSTIGE	1
WAERMEPUMPE, KACHELOFEN	1
WAERMEPUMPE, HEIZKESSEL	1

B2 Archetypes of building stock in Croatia

Table B.9. Archetype – residential building, continental Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – A_RES_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,66	0,2	0,22
	Thermally heated gross volume	$V_{H;g}$	m^3	280,36	264,93	97,11
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	82,46	77,92	28,56
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,13	0,34	0,42
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	1,4	0,30
Technical building system	Energy carrier per space heating	Natural gas = 66%, electricity = 9%,Wood = 12%, heat = 6% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 90% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 63%, electricity = 27%, heat = 4% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	120,07	60,52	45,18
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,33	7,34	4,64
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	174,98	74,89	56,05
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.10. Archetype – office building, continental Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – A_OFF_CP1							
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,52	0,15	0,13
	Thermally heated gross volume	$V_{H;g}$	m^3	817,84	1.411,75	489,16
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	240,54	415,22	143,87
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,15	0,37	0,39
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,40	2	0,30
Technical building system	Energy carrier per space heating	Natural gas = 65%, electricity = 17%,Wood = 2%, heat = 8% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 96% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 32%, electricity = 57%, heat = 2% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	96,33	38,07	32,83
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,72	8,56	5,68
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	145,80	58,62	52,98
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.11. Archetype – educational building, continental Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – A_EDU_CP1						
	Data	Symbol	Unit of measure	Median	(Q_3-Q_2)	(Q_2-Q_1)
Geometry	Compactness ratio	CR	m^{-1}	0,45	0,1	0,07
	Thermally heated gross volume	$V_{H;g}$	m^3	6.184,1	4.043,86	3.874,69
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1.818,8	1.189,37	1.139,62
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,52	0,52	0,10
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,10	0	0,50
Technical building system	Energy carrier per space heating	Natural gas = 68%, electricity = 5%,Wood = 0%, heat = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 94% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 43%, electricity = 40%, heat = 3% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	72,91	38,04	28,28
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	25,11	9,24	7,07
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	103,95	63,53	41,20
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.12. Archetype – hospital, continental Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – A_ HOS _CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	*CR*	m^{-1}	0,52	0,14	0,13
	Thermally heated gross volume	$V_{H;g}$	m^3	3.708,6	4.354,03	2.151,70
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1.090,8	1.280,6	632,85
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,88	0,45	0,45
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	1,3	0,50
Technical building system	Energy carrier per space heating	Natural gas = 66%, electricity = 2%,Wood = 1%, heat = 13% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 55%, electricity = 22%, heat = 12% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	142,45	94,71	61,19
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	23,08	12,29	7,63
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	242,53	152,03	114,09
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	*RER*	%	-	-	-

Table B.13. Archetype – sports building, continental Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – A_SPO_CP1						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,59	0,15	0,17
	Thermally heated gross volume	$V_{H;g}$	m^3	1.921,4	996,57	830,55
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	565,12	293,11	244,28
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,13	0,47	0,68
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,40	0,5	1,70
Technical building system	Energy carrier per space heating	Natural gas = 53%, electricity = 18%,Wood = 3%, heat = 9% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 38%, electricity = 41%, heat = 6% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	139,47	45,35	79,45
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	17,15	10,29	8,29
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	194,76	101,68	61,44
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.14. Archetype – hotels and restaurants, continental Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – A_HOT_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,57	0,17	0,17
	Thermally heated gross volume	$V_{H;g}$	m^3	756,84	2.137,85	466,12
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	222,60	628,78	137,10
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,88	0,43	0,30
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	2,10	0,9	1,00
Technical building system	Energy carrier per space heating	Natural gas = 57%, electricity = 33%,Wood = 4%, heat = 3% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 96% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 43%, electricity = 43%, heat = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	152,87	82,37	64,59
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	22,42	10,47	9,33
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	162,45	142,53	36,90
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.15. Archetype – retail building, continental Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – A_RET_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,63	0,17	0,13
	Thermally heated gross volume	$V_{H;g}$	m^3	218,08	190,5	103,50
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	64,14	56,03	30,44
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,17	0,32	0,28
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,00	2,7	1,90
Technical building system	Energy carrier per space heating	Natural gas = 43%, electricity = 49%,Wood = 1%, heat = 3% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 20%, electricity = 66%, heat = 1% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	144,85	51,13	36,51
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	19,24	12,28	9,30
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	232,65	65,1	71,13
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.16. Archetype – residential building, continental Croatia, construction period 1971-2006

CROATIA EPC DATABASE – A_RES_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**(Q_3-Q_2)**	**(Q_2-Q_1)**
Geometry	Compactness ratio	CR	m^{-1}	0,70	0,15	0,21
	Thermally heated gross volume	$V_{H;g}$	m^3	278,02	154,94	129,15
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	115,84	64,56	53,81
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,89	0,38	0,30
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	1,3	0,40
Technical building system	Energy carrier per space heating	Natural gas = 59%, electricity = 4%,Wood = 15%, heat = 11% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 90% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 58%, electricity = 21%, heat = 9% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	94,94	56,72	35,04
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,28	6,93	4,72
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	144,10	73,61	44,51
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.17. Archetype – office building, continental Croatia, construction period 1971-2006

CROATIA EPC DATABASE – A_OFF_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,59	0,18	0,15
	Thermally heated gross volume	$V_{H;g}$	m^3	471,72	822,57	296,26
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	196,55	342,74	123,44
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,88	0,43	0,30
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,10	1,3	0,40
Technical building system	Energy carrier per space heating	Natural gas = 61%, electricity = 14%,Wood = 1%, heat = 12% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 94% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 41%, electricity = 40%, heat = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	71,61	39,8	23,86
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	20,95	12,29	7,74
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	115,76	56,13	33,14
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.18. Archetype – educational building, continental Croatia, construction period 1971-2006

CROATIA EPC DATABASE – A_EDU_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,57	0,14	0,11
	Thermally heated gross volume	$V_{H;g}$	m^3	3.353,5	2.563,2	1.781,23
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1.397,3	1.068	742,18
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,44	0,22	0,08
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	0,60
Technical building system	Energy carrier per space heating	Natural gas = 69%, electricity = 2%,Wood = 0%, heat = 8% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 91% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 49%, electricity = 32%, heat = 4% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	62,47	37,16	24,28
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	23,48	11,2	7,32
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	93,57	49,59	32,44
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.19. Archetype – hospital, continental Croatia, construction period 1971-2006

CROATIA EPC DATABASE – A_HOS_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,65	0,23	0,20
	Thermally heated gross volume	$V_{H;g}$	m^3	1.379,7	4.267,45	777,40
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	574,90	1778,11	323,92
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2·K)$	0,69	0,36	0,23
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2·K)$	1,10	0	0,50
Technical building system	Energy carrier per space heating	Natural gas = 76%, electricity = 1%,Wood = 0%, heat = 9% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 53%, electricity = 20%, heat = 7% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	122,06	61,01	50,18
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	26,60	9,4	9,06
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	244,40	104,5	86,55
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.20. Archetype – sports building, continental Croatia, construction period 1971-2006

CROATIA EPC DATABASE – A_SPO_CP2							
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,42	0,19	0,09
	Thermally heated gross volume	$V_{H;g}$	m^3	2.514,2	2.806,56	1.578,24
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1.047,6	1.169,4	657,60
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,61	0,55	0,23
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	1,75	0,45
Technical building system	Energy carrier per space heating	Natural gas = 57%, electricity = 17%,Wood = 0%, heat = 14% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 48%, electricity = 37%, heat = 2% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	67,20	70,69	28,86
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	21,32	10,42	6,93
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	147,43	121,34	68,77
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.21. Archetype – hotels and restaurants, continental Croatia, construction period 1971-2006

CROATIA EPC DATABASE – A_HOT_CP2							
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,62	0,13	0,16
	Thermally heated gross volume	$V_{H;g}$	m^3	759,82	1.539,72	424,21
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	316,59	641,55	176,76
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,78	0,37	0,21
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,40	1,3	0,30
Technical building system	Energy carrier per space heating	Natural gas = 56%, electricity = 11%,Wood = 10%, heat = 9% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 94% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 52%, electricity = 24%, heat = 6% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	112,37	89,05	31,38
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	25,05	15,42	7,70
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	219,93	70,8	70,37
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.22. Archetype – retail building, continental Croatia, construction period 1971-2006

CROATIA EPC DATABASE – A_RET_CP2							
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,69	0,2	0,20
	Thermally heated gross volume	$V_{H;g}$	m^3	327,31	455,42	182,06
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	136,38	189,76	75,86
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,99	0,44	0,42
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	1,4	0,00
Technical building system	Energy carrier per space heating	Natural gas = 56%, electricity = 31%,Wood = 2%, heat = 6% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 31%, electricity = 56%, heat = 2% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	118,42	58,2	51,05
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	27,20	16,43	11,05
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	198,17	82,8	70,64
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.23. Archetype – residential building, continental Croatia, construction period > 2007

CROATIA EPC DATABASE – A_RES_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,71	0,16	0,16
	Thermally heated gross volume	$V_{H;g}$	m^3	301,56	222,36	143,90
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	125,65	92,65	59,96
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,40	0,12	0,07
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	0,40
Technical building system	Energy carrier per space heating	Natural gas = 74%, electricity = 12%,Wood = 7%, heat = 2% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 88% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 73%, electricity = 18%, heat = 2% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	45,40	14,69	11,74
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	18,67	7,37	5,30
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	78,18	24,95	22,07
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.24. Archetype – office building, continental Croatia, construction period > 2007

CROATIA EPC DATABASE – A_OFF_CP						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,62	0,2	0,17
	Thermally heated gross volume	$V_{H;g}$	m^3	614,74	815,04	320,24
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	256,14	339,6	133,44
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,39	0,11	0,06
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	0,40
Technical building system	Energy carrier per space heating	Natural gas = 54%, electricity = 32%,Wood = 1%, heat = 4% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 93% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 46%, electricity = 36%, heat = 2% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	35,64	13,84	9,79
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	20,23	12,13	7,09
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	53,90	25,33	22,72
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.25. Archetype – educational building, continental Croatia, construction period > 2007

CROATIA EPC DATABASE – A_EDU_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,65	0,1	0,13
	Thermally heated gross volume	$V_{H;g}$	m^3	1.212	1.222	463,37
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	504,98	509,18	193,07
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,32	0,05	0,06
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	0,70	0,4	0,20
Technical building system	Energy carrier per space heating	Natural gas = 69%, electricity = 22%,Wood = 0%, heat = 2% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 90% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 63%, electricity = 19%, heat = 2% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	35,29	19,18	10,48
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	20,19	8,12	5,86
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	45,09	23,54	15,98
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.26. Archetype –hotels, continental Croatia, construction period > 2007

CROATIA EPC DATABASE – A_HOS_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,48	0,17	0,15
	Thermally heated gross volume	$V_{H;g}$	m^3	1.987,3	4.977,96	1.402,18
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	828,06	2.074,15	584,24
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,36	0,06	0,05
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	0,90	0,2	0,30
Technical building system	Energy carrier per space heating	Natural gas = 47%, electricity = 23%,Wood = 0%, heat = 22% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 91% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 48%, electricity = 23%, heat = 20% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	41,56	35,17	9,67
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	21,52	10,05	7,23
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	85,04	96,19	25,78
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.27. Archetype – sports building, continental Croatia, construction period > 2007

CROATIA EPC DATABASE – A_SPO_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,40	0,12	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	3.985,2	5.412,08	2.202,95
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1.660,5	2.255,03	917,90
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,33	0,03	0,04
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	0,33
Technical building system	Energy carrier per space heating	Natural gas = 77%, electricity = 14%,Wood = 0%, heat = 3% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 96% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 73%, electricity = 12%, heat = 3% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	40,51	11,38	10,01
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	19,82	8,77	6,05
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	66,76	62,34	19,35
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.28. Archetype – hotels and restaurants, continental Croatia, construction period > 2007

CROATIA EPC DATABASE – A_HOT_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,68	0,26	0,15
	Thermally heated gross volume	$V_{H;g}$	m^3	718,94	611,69	465,92
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	299,56	254,87	194,14
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,38	0,12	0,07
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	0,50
Technical building system	Energy carrier per space heating	Natural gas = 32%, electricity = 50%,Wood = 1%, heat = 3% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 96% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 36%, electricity = 45%, heat = 4% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	56,30	31,28	18,20
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	25,40	17,86	11,64
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	82,39	41,29	27,91
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.29. Archetype – retail building, continental Croatia, construction period > 2007

CROATIA EPC DATABASE – A_RET_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,58	0,21	0,15
Geometry	Thermally heated gross volume	$V_{H;g}$	m^3	798,67	3.070,51	472,81
Geometry	Thermally heated floor area	$A_{H;use;ztc}$	m^2	332,78	1.279,38	197,00
Geometry	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,35	0,09	0,06
Envelope	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	0,40
Technical building system	Energy carrier per space heating	Natural gas = 44%, electricity = 48%,Wood = 1%, heat = 2% (of the analysed sample)				
Technical building system	Energy carrier per space cooling	Electricity = 95% (of the analysed sample)				
Technical building system	Energy carrier per domestic hot water	Natural gas = 35%, electricity = 53%, heat = 1% (of the analysed sample)				
Technical building system	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
Technical building system	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
Technical building system	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	45,43	17,24	11,64
Energy indicators	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	21,34	19,06	7,34
Energy indicators	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
Energy indicators	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
Energy indicators	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
Energy indicators	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
Energy indicators	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
Energy indicators	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
Energy indicators	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
Energy indicators	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	89,02	43,02	35,77
Energy indicators	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
Energy indicators	Renewable Energy Ratio	RER	%	-	-	-

Table B.30. Archetype – residential building, costal Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – B_RES_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,70	0,21	0,18
	Thermally heated gross volume	$V_{H;g}$	m^3	271,59	212,94	87,01
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	79,88	62,63	25,59
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,28	0,44	0,48
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	1,9	0,40
Technical building system	Energy carrier per space heating	Natural gas = 5%, electricity = 79%,Wood = 10%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 95% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 4%, electricity = 93%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	78,01	37,29	30,97
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	32,36	9,96	6,46
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	95,09	59,6	40,47
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.31. Archetype – office building, costal Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – B_OFF_CP1							
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,53	0,17	0,13
	Thermally heated gross volume	$V_{H;g}$	m^3	296,65	328,58	159,02
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	87,25	96,64	46,77
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,33	0,4	0,33
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	2,4	1,10
Technical building system	Energy carrier per space heating	Natural gas = 7%, electricity = 87%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 6%, electricity = 85%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	50,37	18,91	16,62
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	29,04	10,49	6,97
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	59,26	30,37	16,38
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.32. Archetype – educational building, costal Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – B_EDU_CP1						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,50	0,13	0,10
	Thermally heated gross volume	$V_{H;g}$	m^3	3.797,6	4.682,77	2.799,47
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1.117	1377,29	823,37
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,67	0,63	0,16
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	1,10
Technical building system	Energy carrier per space heating	Natural gas = 19%, electricity = 37%,Wood = 1%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 92% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 10%, electricity = 70%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	44,75	24,08	21,91
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	40,54	9,4	8,06
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	67,12	31,87	31,41
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.33. Archetype – hospital, costal Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – B_HOS_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,46	0,13	0,10
	Thermally heated gross volume	$V_{H;g}$	m^3	1.466,6	2.859,23	957,83
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	431,35	840,95	281,72
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,32	0,32	0,61
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	1,38	1,10
Technical building system	Energy carrier per space heating	Natural gas = 25%, electricity = 30%,Wood = 0%, heat = 2% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 7%, electricity = 57%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	84,74	60,62	37,63
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	42,01	9,42	8,03
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	174,20	83,08	55,71
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.34. Archetype – sports building, costal Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – B_SPO_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,60	0,1	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	2.279,1	1.638,35	1.843,84
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	670,34	481,87	542,31
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,15	0,24	0,22
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,60	2,1	2,18
Technical building system	Energy carrier per space heating	Natural gas = 20%, electricity = 80%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 0%, electricity = 100%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	55,07	1,95	17,35
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	33,20	1,33	2,31
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	98,77	28,14	43,27
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	*RER*	%	-	-	-

Table B.35. Archetype – hotels and restaurants, costal Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – B_HOT_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,56	0,19	0,14
	Thermally heated gross volume	$V_{H;g}$	m^3	713,46	2.634,71	447,46
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	209,84	774,92	131,61
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,21	0,37	0,34
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,40	2	0,90
Technical building system	Energy carrier per space heating	Natural gas = 3%, electricity = 75%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 4%, electricity = 72%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	91,67	42,94	37,95
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	43,01	16,78	10,52
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	110,41	100,94	48,02
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.36. Archetype – retail building, costal Croatia, construction period ≤ 1970

CROATIA EPC DATABASE – B_RET_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,59	0,18	0,11
	Thermally heated gross volume	$V_{H;g}$	m^3	212,13	147,74	99,28
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	62,39	43,45	29,20
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,14	0,36	0,26
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,40	2,3	1,30
Technical building system	Energy carrier per space heating	Natural gas = 2%, electricity = 96%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 4%, electricity = 85%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	57,77	28,99	18,67
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	39,21	16,05	13,08
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	113,56	43,51	32,96
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.37. Archetype – residential building, costal Croatia, construction period 1971-2006

CROATIA EPC DATABASE – B_RES_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,73	0,18	0,16
	Thermally heated gross volume	$V_{H;g}$	m^3	217,56	232,43	84,70
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	90,65	96,85	35,29
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	1,07	0,49	0,39
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,10	1,1	0,20
Technical building system	Energy carrier per space heating	Natural gas = 4%, electricity = 72%,Wood = 10%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 95% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 4%, electricity = 89%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	59,84	35,42	22,89
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	32,20	9,82	5,93
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	80,94	49,69	31,41
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.38. Archetype – office building, costal Croatia, construction period 1971-2006

CROATIA EPC DATABASE – B_OFF_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,60	0,21	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	252,12	488,96	150,35
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	105,05	203,73	62,65
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,33	0,63	0,49
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	1,8	1,10
Technical building system	Energy carrier per space heating	Natural gas = 7%, electricity = 79%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 96% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 5%, electricity = 83%, heat = 1% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	47,67	18,63	17,32
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	34,44	15,86	10,28
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	68,08	30,47	17,46
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.39. Archetype – educational building, costal Croatia, construction period 1971-2006

CROATIA EPC DATABASE – B_EDU_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,57	0,14	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	3.112,6	2.397,94	1.899,34
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1.296,9	999,14	791,39
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,71	0,62	0,20
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0,25	1,10
Technical building system	Energy carrier per space heating	Natural gas = 13%, electricity = 34%,Wood = 0%, heat = 1% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 94% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 9%, electricity = 66%, heat = 1% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	41,77	29,74	17,92
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	39,39	9,68	10,67
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	57,38	41,2	19,37
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.40. Archetype – hospital, costal Croatia, construction period 1971-2006

CROATIA EPC DATABASE – B_HOS_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,50	0,22	0,15
	Thermally heated gross volume	$V_{H;g}$	m^3	1.848,8	6.338,55	927,98
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	770,32	2.641,06	386,66
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,98	0,78	0,42
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	0,00	1,1	0,00
Technical building system	Energy carrier per space heating	Natural gas = 22%, electricity = 25%,Wood = 0%, heat = 3% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 19%, electricity = 47%, heat = 3% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	76,42	64,14	29,31
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	41,35	15,4	9,67
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	200,92	47,46	117,04
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.41. Archetype – sports building, costal Croatia, construction period 1971-2006

CROATIA EPC DATABASE – B_SPO_CP2							
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,35	0,26	0,06
	Thermally heated gross volume	$V_{H;g}$	m^3	2.101,8	3.995,88	1.449,27
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	875,77	1.664,95	603,86
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,10	1,02	0,49
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,25	2,45	0,93
Technical building system	Energy carrier per space heating	Natural gas = 0%, electricity = 69%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 94% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 0%, electricity = 75%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	63,86	64,94	29,70
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	46,75	6,14	10,17
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	121,75	36,77	16,36
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.42. Archetype – hotels and restaurants, costal Croatia, construction period 1971-2006

CROATIA EPC DATABASE – B_HOT_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,77	0,22	0,23
	Thermally heated gross volume	$V_{H;g}$	m^3	376,40	580,38	206,96
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	156,84	241,83	86,24
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,10	0,39	0,47
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0,45	1,10
Technical building system	Energy carrier per space heating	Natural gas = 2%, electricity = 79%,Wood = 0%, heat = 11% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 84% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 7%, electricity = 66%, heat = 13% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	67,66	28,6	29,32
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	56,34	17,86	18,17
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	66,51	61,17	14,00
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.43. Archetype – retail building, costal Croatia, construction period 1971-2006

CROATIA EPC DATABASE – B_RET_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,65	0,28	0,18
	Thermally heated gross volume	$V_{H;g}$	m^3	281,28	579,41	133,44
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	117,20	241,42	55,60
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	1,25	0,43	0,50
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,10	1,8	1,10
Technical building system	Energy carrier per space heating	Natural gas = 3%, electricity = 92%,Wood = 0%, heat = 1% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 6%, electricity = 86%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	57,34	31,56	21,57
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	45,14	27,99	14,67
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	133,75	30,34	39,01
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.44. Archetype – residential building, costal Croatia, construction period > 2007

CROATIA EPC DATABASE – B_RES_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	*CR*	m^{-1}	0,76	0,14	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	394,07	225,13	163,20
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	164,20	93,81	68,00
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,47	0,09	0,06
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,10	0	0,40
Technical building system	Energy carrier per space heating	Natural gas = 3%, electricity = 87%,Wood = 5%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 96% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 3%, electricity = 92%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	22,57	8,57	5,69
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	32,46	10,02	6,24
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	31,98	18,35	10,53
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	*RER*	%	-	-	-

Table B.45. Archetype – office building, costal Croatia, construction period > 2007

CROATIA EPC DATABASE – B_OFF_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	*CR*	m^{-1}	0,68	0,23	0,14
	Thermally heated gross volume	$V_{H;g}$	m^3	464,16	743,89	252,46
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	193,40	309,95	105,19
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,48	0,11	0,07
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,10	0	0,40
Technical building system	Energy carrier per space heating	Natural gas = 4%, electricity = 90%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 96% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 3%, electricity = 84%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	18,86	8,55	5,30
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	31,71	13,64	9,68
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	26,77	10,74	9,99
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	*RER*	%	-	-	-

Table B.46. Archetype – educational building, costal Croatia, construction period > 2007

CROATIA EPC DATABASE – B_EDU_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,59	0,18	0,13
	Thermally heated gross volume	$V_{H;g}$	m^3	1.502,6	816,16	718,04
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	626,09	340,07	299,19
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,40	0,1	0,06
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,00	0,1	0,50
Technical building system	Energy carrier per space heating	Natural gas = 11%, electricity = 73%,Wood = 0%, heat = 1% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 96% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 12%, electricity = 73%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	20,38	13,03	5,21
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	33,46	12,08	8,78
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	25,07	8,56	8,52
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.47. Archetype –hospital, costal Croatia, construction period > 2007

CROATIA EPC DATABASE – B_HOS_CP3						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,43	0,17	0,14
	Thermally heated gross volume	$V_{H;g}$	m^3	411,89	1.297,64	158,24
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	171,62	540,68	65,94
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,56	0,24	0,13
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	1,10
Technical building system	Energy carrier per space heating	Natural gas = 16%, electricity = 84%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 13%, electricity = 79%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	29,43	11,11	6,30
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	52,80	32,74	17,35
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	49,87	40,96	13,91
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	RER	%	-	-	-

Table B.48. Archetype – sports building, costal Croatia, construction period > 2007

CROATIA EPC DATABASE – B_SPO_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	*CR*	m^{-1}	0,49	0,4	0,13
	Thermally heated gross volume	$V_{H;g}$	m^3	1.829,1	2.254,46	1.325,06
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	762,14	939,36	552,11
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	0,41	0,12	0,06
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,10	0	0,25
Technical building system	Energy carrier per space heating	Natural gas = 15%, electricity = 64%,Wood = 3%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 94% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 24%, electricity = 48%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	18,70	11,6	6,12
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	39,04	18,19	12,82
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	57,38	48,56	22,98
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	*RER*	%	-	-	-

Table B.49. Archetype – hotels and restaurants, costal Croatia, construction period > 2007

CROATIA EPC DATABASE – B_HOT_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,70	0,2	0,18
	Thermally heated gross volume	$V_{H;g}$	m^3	414,34	1418,4	279,94
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	172,64	591	116,64
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,54	0,09	0,11
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,10	0	1,10
Technical building system	Energy carrier per space heating	Natural gas = 2%, electricity = 93%,Wood = 0%, heat = 1% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 5%, electricity = 79%, heat = 1% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	56,30	31,28	18,20
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	25,40	17,86	11,64
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	27,20	22,11	7,43
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	44,32	25,49	12,81
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	-	-	-
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.50. Archetype – retail building, costal Croatia, construction period > 2007

CROATIA EPC DATABASE – B_RET_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	*CR*	m^{-1}	0,60	0,2	0,18
	Thermally heated gross volume	$V_{H;g}$	m^3	829,20	3061,92	441,24
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	345,50	1275,8	183,85
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	-	-	-
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	0,39	0,12	0,07
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,10	0	1,10
Technical building system	Energy carrier per space heating	Natural gas = 7%, electricity = 89%,Wood = 0%, heat = 0% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 7%, electricity = 79%, heat = 0% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	-	-	-
	Mean seasonal efficiency of the heating generation sub-system (electricity)	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	20,91	6,93	6,48
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	33,03	14,74	11,19
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	-	-	-
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	54,84	40,59	24,55
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	0,00	0	0,00
	Renewable Energy Ratio	*RER*	%	-	-	-

B3 Archetypes of building stock in Cyprus

Table B.51. Archetype - residential building, climatic zone Cyprus, construction period 1960-1979

CYPRUS EPC DATABASE – CY_RES_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,660	0,008	0,040
	Thermally heated gross volume	$V_{H;g}$	m^3	460	20	49
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	142	6	14
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	12	0	1
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,820	0,310	0,010
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	5,620	0,450	0,420
Technical building system	Energy carrier per space heating	–				
	Energy carrier per space cooling	–				
	Energy carrier per domestic hot water	–				
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 1)	$\eta_{H;gn}$	–	–	–	–
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 2)	$\eta_{H;gn}$	–	–	–	–
	Utilisation energy efficiency	$\eta_{H;u}$	–	–	–	–
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	90,2	0,0	1,7
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	45,3	14,0	13,5
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	5,2	1,5	0,5
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,870	0,000	0,050
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	3,200	0,000	0,000
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	–	–	–
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	90,2	0,0	1,7
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	33,8	13,5	4,9
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	0,0	0,0	0,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	310,4	31,0	29,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	19,0	0,0	0,0
	Renewable Energy Ratio	RER	%	4	1	2

Table B.52. Archetype – residential building, climatic zone Cyprus, construction period 1980-2006

CYPRUS EPC DATABASE – CY_RES_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,540	0,105	0,125
	Thermally heated gross volume	$V_{H;g}$	m^3	636	121	110
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	191	46	44
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	14	4	2
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2{\cdot}K)$	1,780	0,440	0,320
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,800	0,280	0,490
Technical building system	Energy carrier per space heating	–				
	Energy carrier per space cooling	–				
	Energy carrier per domestic hot water	–				
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 1)	$\eta_{H;gn}$	–	–	–	–
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 2)	$\eta_{H;gn}$	–	–	–	–
	Utilisation energy efficiency	$\eta_{H;u}$	–	–	–	–
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	42,0	16,6	14,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	52,3	23,0	25,0
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	6,5	5,2	0,3
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,960	0,050	0,050
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	4,240	1,208	0,125
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	–	–	–
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	41,9	16,6	13,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	47,8	23,0	40,6
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	1,4	0,0	0,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	261,3	64,0	101,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	14,5	0,0	4,0
	Renewable Energy Ratio	RER	%	11	3	3

Table B.53. Archetype – residential building, climatic zone Cyprus, construction period > 2006

CYPRUS EPC DATABASE – CY_RES_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,670	0,027	0,042
	Thermally heated gross volume	$V_{H;g}$	m^3	450	25	27
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	157	18	8
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	11	1	0
Envelope	Mean overall heat transfer coefficient by thermal transmission	U_{op}	$W/(m^2 \cdot K)$	1,090	0,465	0,035
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	5,790	1,625	0,180
Technical building system	Energy carrier per space heating	–				
	Energy carrier per space cooling	–				
	Energy carrier per domestic hot water	–				
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 1)	$\eta_{H;gn}$	–	–	–	–
	Mean seasonal efficiency of the heating generation sub-system (energy carrier 2)	$\eta_{H;gn}$	–	–	–	–
	Utilisation energy efficiency	$\eta_{H;u}$	–	–	–	–
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	19,9	9,3	6,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	34,4	2,8	1,2
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	6,1	1,5	0,3
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	2,010	1,700	0,330
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	5,190	0,000	1,450
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	–	–	–
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	18,8	11,5	6,4
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	20,5	0,5	0,2
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	0,0	0,0	0,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	131,1	75,0	40,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	73,9	16,5	39,5
	Renewable Energy Ratio	RER	%	41	20	53

B4 Archetypes of building stock in Italy (Piemonte)

Table B.54. Archetype - residential building (SFH), climatic zone E (Piemonte Region), construction period ≤ 1900

PIEMONTE REGION EPC DATABASE - E_RES_SINGLE_CP1						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,754	0,128	0,114
	Thermally heated gross volume	$V_{H;g}$	m^3	457	+196	145
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	110	47	35
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	5%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,295	0,221	0,262
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,166	1,211	0,940
Technical building system	Energy carrier per space heating	Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,917	0,093	0,127
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,750	0,186	0,290
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,875	0,048	0,065
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	193,7	65,6	56,6
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	7,3	6,7	4,4
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	17,0	2,0	1,4
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,040	0,050
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,190	1,440	0,470
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,580	0,170	0,080
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	241,5	102,0	94,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	6,6	8,5	4,1
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	26,7	8,8	7,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	270,8	105,7	98,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,8	12,7	1,3
	Renewable Energy Ratio	RER	%	1%	5%	1%

Table B.55. Archetype – residential building (SFH), climatic zone E (Piemonte Region), construction period 1901-1920

PIEMONTE REGION EPC DATABASE - E_RES_SINGLE_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,752	0,118	0,112
	Thermally heated gross volume	$V_{H;g}$	m^3	461	204	129
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	112	45	33
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	5%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,297	0,208	0,292
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,144	1,191	0,910
Technical building system	Energy carrier per space heating	Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,917	0,093	0,127
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,750	0,186	0,290
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,875	0,048	0,065
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	193,5	61,8	56,5
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	6,5	5,8	2,8
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	17,0	1,9	1,4
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,050	0,040
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,140	0,865	0,440
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,610	0,150	0,110
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	246,2	97,8	98,7
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	7,3	7,3	3,4
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	26,1	8,6	6,3
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	273,8	102,2	99,1
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	2,0	10,5	1,3
	Renewable Energy Ratio	RER	%	1%	3%	0%

Table B.56. Archetype – residential building (SFH), climatic zone E (Piemonte Region), construction period 1921-1945

PIEMONTE REGION EPC DATABASE - E_RES_SINGLE_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,746	0,126	0,107
	Thermally heated gross volume	$V_{H;g}$	m^3	464	178	136
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	113	43	33
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	5%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2·K)$	1,270	0,207	0,292
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2·K)$	3,100	1,240	0,984
Technical building system	Energy carrier per space heating	Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,917	0,093	0,127
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,750	0,186	0,290
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,875	0,048	0,065
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	186,7	63,7	57,1
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	7,5	6,8	3,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	16,9	1,9	1,3
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,050	0,040
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,280	1,135	0,475
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,630	0,140	0,090
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	236,3	98,5	89,5
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	5,1	7,0	3,0
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	25,2	8,3	5,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	265,9	98,4	95,1
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,7	10,8	1,0
	Renewable Energy Ratio	RER	%	1%	3%	0%

Table B.57. Archetype – residential building (SFH), climatic zone E (Piemonte Region), construction period 1946-1960

PIEMONTE REGION EPC DATABASE - E_RES_SINGLE_CP4						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,788	0,155	0,122
	Thermally heated gross volume	$V_{H;g}$	m^3	453	173	133
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	110	43	31
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	5%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,170	0,239	0,344
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,907	1,212	1,024
Technical building system	Energy carrier per space heating	Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,917	0,093	0,127
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,750	0,186	0,290
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,875	0,048	0,065
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	174,7	69,8	61,3
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	9,2	7,4	5,3
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	17,0	1,6	1,4
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,070	0,050
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,160	0,940	0,420
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,670	0,110	0,120
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	215,9	108,2	93,0
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	7,5	7,6	4,6
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	24,0	7,8	5,1
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	242,8	112,1	96,1
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,9	11,3	1,0
	Renewable Energy Ratio	RER	%	1%	5%	0%

Table B.58. Archetype – residential building (SFH), climatic zone E (Piemonte Region), construction period 1961-1975

PIEMONTE REGION EPC DATABASE - E_RES_SINGLE_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,824	0,137	0,137
	Thermally heated gross volume	$V_{H;g}$	m^3	497	200	130
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	121	53	31
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	6%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,052	0,274	0,324
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,820	1,159	1,116
Technical building system	Energy carrier per space heating	Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,917	0,093	0,127
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,750	0,186	0,290
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,875	0,048	0,065
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	166,0	69,0	59,1
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	8,2	6,8	4,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	16,6	1,4	1,3
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,740	0,070	0,060
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,240	1,118	0,491
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,690	0,100	0,130
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	204,5	111,4	91,0
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	6,9	8,0	4,1
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	22,2	6,6	6,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	228,6	115,8	95,2
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	2,2	13,3	1,3
	Renewable Energy Ratio	RER	%	1%	8%	0%

Table B.59. Archetype – residential building (SFH), climatic zone E (Piemonte Region), construction period 1976-1990

PIEMONTE REGION EPC DATABASE - E_RES_SINGLE_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,787	0,149	0,125
	Thermally heated gross volume	$V_{H;g}$	m^3	517	202	133
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	133	55	35
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	5%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	0,980	0,258	0,270
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	2,700	0,459	0,899
Technical building system	Energy carrier per space heating	Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,917	0,093	0,127
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,750	0,186	0,290
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,875	0,048	0,065
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	144,4	58,3	45,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	6,4	6,9	4,1
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	16,2	1,5	1,1
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,740	0,070	0,060
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,210	1,310	0,420
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,700	0,100	0,120
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	168,1	94,6	66,2
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	5,3	5,4	3,0
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	21,2	5,7	5,9
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	192,4	95,0	69,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,9	14,7	1,0
	Renewable Energy Ratio	RER	%	1%	10%	0%

Table B.60. Archetype – residential building (SFH), climatic zone E (Piemonte Region), construction period 1991-2005

PIEMONTE REGION EPC DATABASE - E_RES_SINGLE_CP7						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,754	0,126	0,121
	Thermally heated gross volume	$V_{H;g}$	m^3	522	181	126
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	138	49	34
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	6%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,793	0,236	0,194
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,508	0,414	0,676
Technical building system	Energy carrier per space heating	Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,917	0,093	0,127
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,750	0,186	0,290
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,875	0,048	0,065
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	114,3	40,5	32,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	6,3	6,6	3,8
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	16,1	1,3	1,1
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,760	0,060	0,060
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,330	1,260	0,420
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,720	0,090	0,120
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	130,5	56,8	46,0
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	4,9	6,2	2,7
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	20,9	5,1	5,2
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	153,7	58,4	48,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,6	15,2	0,8
	Renewable Energy Ratio	RER	%	1%	10%	0%

Table B.61. Archetype – residential building (SFH), climatic zone E (Piemonte Region), construction period > 2005

PIEMONTE REGION EPC DATABASE - E_RES_SINGLE_CP8						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,788	0,111	0,102
	Thermally heated gross volume	$V_{H;g}$	m^3	534	179	117
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	130	43	28
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	5%	1%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	0,338	0,244	0,097
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,570	0,498	0,280
Technical building system	Energy carrier per space heating	Natural gas = 78%; solid biomass = 7%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 100% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 72%; electricity = 17%; others = 11% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,917	0,093	0,127
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,750	0,186	0,290
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,875	0,048	0,065
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	61,4	30,2	17,1
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	11,9	8,9	6,0
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	16,4	1,6	1,1
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,800	0,080	0,090
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,675	1,185	0,665
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,720	0,110	0,110
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	55,6	40,6	28,0
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	6,8	8,4	4,2
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	10,5	10,4	6,4
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	72,2	45,9	35,2
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	21,8	44,4	18,4
	Renewable Energy Ratio	RER	%	24%	42%	21%

Table B.62. Archetype – residential building (BU(AB)), climatic zone E (Piemonte Region), construction period ≤ 1900

PIEMONTE REGION EPC DATABASE - E_RES_BU(AB)_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,596	0,161	0,220
	Thermally heated gross volume	$V_{H;g}$	m^3	289	148	92
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	69	34	22
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	7%	4%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,235	0,240	0,235
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	2,980	1,264	0,785
Technical building system	Energy carrier per space heating	Natural gas = 78%; district heating = 15%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99%; natural gas = 1% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 74%; electricity = 21%; others = 15% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,926	0,126	0,136
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,960	0,040	0,263
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,878	0,046	0,050
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	134,3	66,3	55,7
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,3	11,0	8,3
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	18,4	1,6	1,6
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,050	0,070
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,000	0,415	0,400
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,610	0,160	0,150
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	171,0	94,6	70,4
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	14,5	11,5	7,6
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	28,2	10,7	5,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	205,0	96,1	71,6
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,6	8,2	1,1
	Renewable Energy Ratio	RER	%	1%	3%	1%

Table B.63. Archetype - residential building (BU(AB)), climatic zone E (Piemonte Region), construction period 1901-1920

PIEMONTE REGION EPC DATABASE - E_RES_BU(AB)_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,530	0,186	0,222
	Thermally heated gross volume	$V_{H;g}$	m^3	271	130	83
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	64	31	20
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	6%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,242	0,221	0,224
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,105	1,278	0,846
Technical building system	Energy carrier per space heating	Natural gas = 78%; district heating = 15%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99%; natural gas = 1% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 74%; electricity = 21%; others = 15% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,926	0,126	0,136
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,960	0,040	0,263
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,878	0,046	0,050
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	122,0	67,0	51,5
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,5	12,8	8,5
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	18,5	1,5	1,5
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,060	0,090
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	0,960	0,330	0,390
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,600	0,160	0,210
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	158,9	93,2	64,6
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	16,3	11,1	8,9
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	29,1	14,6	6,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	193,6	93,9	63,3
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,8	9,1	1,3
	Renewable Energy Ratio	RER	%	1%	4%	1%

Table B.64. Archetype – residential building (BU(AB)), climatic zone E (Piemonte Region), construction period 1921-1945

PIEMONTE REGION EPC DATABASE - E_RES_BU(AB)_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,548	0,174	0,229
	Thermally heated gross volume	$V_{H;g}$	m^3	265	116	76
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	64	28	18
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	6%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2·K)$	1,267	0,208	0,237
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2·K)$	3,092	1,265	0,807
Technical building system	Energy carrier per space heating	Natural gas = 78%; district heating = 15%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99%; natural gas = 1% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 74%; electricity = 21%; others = 15% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,926	0,126	0,136
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,960	0,040	0,263
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,878	0,046	0,050
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	122,8	65,3	50,1
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	15,0	11,2	8,0
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	18,6	1,4	1,4
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,050	0,080
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,000	0,455	0,340
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,620	0,140	0,220
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	162,7	89,5	64,6
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	12,7	10,7	7,3
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	29,0	14,1	5,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	197,2	91,0	64,1
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,6	9,0	1,2
	Renewable Energy Ratio	RER	%	1%	3%	1%

Table B.65. Archetype – residential building (BU(AB)), climatic zone E (Piemonte Region), construction period 1946-1960

PIEMONTE REGION EPC DATABASE - E_RES_BU(AB)_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,452	0,229	0,149
	Thermally heated gross volume	$V_{H;g}$	m^3	254	75	58
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	65	19	15
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	10%	5%	4%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,183	0,226	0,239
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,124	1,356	0,810
Technical building system	Energy carrier per space heating	Natural gas = 78%; district heating = 15%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99%; natural gas = 1% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 74%; electricity = 21%; others = 15% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,926	0,126	0,136
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,960	0,040	0,263
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,878	0,046	0,050
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	99,0	58,1	36,5
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,2	11,3	8,6
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	18,8	1,2	1,2
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,720	0,070	0,110
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,000	0,360	0,340
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,620	0,110	0,260
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	138,8	77,9	50,5
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	13,6	12,5	7,3
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	29,8	18,8	5,3
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	177,0	77,4	51,2
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,6	10,4	1,3
	Renewable Energy Ratio	RER	%	1%	4%	1%

Table B.66. Archetype – residential building (BU(AB)), climatic zone E (Piemonte Region), construction period 1961-1975

PIEMONTE REGION EPC DATABASE - E_RES_BU(AB)_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,433	0,235	0,125
	Thermally heated gross volume	$V_{H;g}$	m^3	278	72	57
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	72	19	15
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	11%	5%	4%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,157	0,215	0,228
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,157	1,416	0,849
Technical building system	Energy carrier per space heating	Natural gas = 78%; district heating = 15%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99%; natural gas = 1% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 74%; electricity = 21%; others = 15% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,926	0,126	0,136
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,960	0,040	0,263
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,878	0,046	0,050
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	95,8	51,2	33,2
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,0	10,8	8,4
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	18,5	1,3	1,2
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,070	0,120
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,000	0,340	0,340
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,630	0,110	0,270
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	134,5	69,3	45,6
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	13,5	11,6	7,2
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	29,1	18,4	5,2
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	171,8	69,7	47,1
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,3	10,3	1,1
	Renewable Energy Ratio	RER	%	1%	4%	1%

Table B.67. Archetype - residential building (BU(AB)), climatic zone E (Piemonte Region), construction period 1976-1990

PIEMONTE REGION EPC DATABASE - E_RES_BU(AB)_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,595	0,132	0,223
	Thermally heated gross volume	$V_{H;g}$	m^3	305	80	60
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	82	20	16
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	5%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	W/(m^2·K)	1,093	0,224	0,245
	Mean thermal transmittance of transparent building envelope	U_{wi}	W/(m^2·K)	2,939	0,805	0,638
Technical building system	Energy carrier per space heating	Natural gas = 78%; district heating = 15%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99%; natural gas = 1% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 74%; electricity = 21%; others = 15% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,926	0,126	0,136
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,960	0,040	0,263
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,878	0,046	0,050
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	108,2	49,0	38,6
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	11,4	9,9	6,7
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	17,9	1,2	1,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,060	0,080
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,000	0,380	0,380
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,680	0,100	0,170
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	144,6	65,7	49,9
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	10,2	10,0	5,7
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	25,8	8,7	3,8
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	176,2	66,3	50,8
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,2	2,7	0,8
	Renewable Energy Ratio	RER	%	1%	1%	0%

Table B.68. Archetype – residential building (BU(AB)), climatic zone E (Piemonte Region), construction period 1991-2005

PIEMONTE REGION EPC DATABASE - E_RES_BU(AB)_CP7						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,590	0,138	0,206
	Thermally heated gross volume	$V_{H;g}$	m^3	291	98	63
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	80	25	18
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	5%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2·K)$	0,814	0,253	0,187
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2·K)$	2,700	0,281	0,528
Technical building system	Energy carrier per space heating	Natural gas = 78%; district heating = 15%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99%; natural gas = 1% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 74%; electricity = 21%; others = 15% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,926	0,126	0,136
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,960	0,040	0,263
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,878	0,046	0,050
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	80,5	37,1	28,2
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	14,4	11,6	8,5
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	18,0	1,3	1,2
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,060	0,080
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,000	0,340	0,348
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,700	0,090	0,150
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	106,6	46,5	35,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	13,0	12,8	7,2
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	25,3	7,0	3,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	137,4	46,8	35,9
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	1,1	1,5	0,6
	Renewable Energy Ratio	RER	%	1%	1%	0%

Table B.69. Archetype – residential building (BU(AB)), climatic zone E (Piemonte Region), construction period > 2005

PIEMONTE REGION EPC DATABASE - E_RES_BU(AB)_CP8						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,596	0,133	0,192
	Thermally heated gross volume	$V_{H;g}$	m^3	278	102	69
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	72	25	18
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	5%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	0,439	0,271	0,160
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	1,854	0,631	0,396
Technical building system	Energy carrier per space heating	Natural gas = 78%; district heating = 15%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 99%; natural gas = 1% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 74%; electricity = 21%; others = 15% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,926	0,126	0,136
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,960	0,040	0,263
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,878	0,046	0,050
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	44,9	27,4	17,3
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	22,3	13,1	9,8
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	18,6	1,4	1,4
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,760	0,090	0,120
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,240	0,563	0,350
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,700	0,110	0,160
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	51,9	36,2	26,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	14,5	12,0	7,6
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	21,3	6,6	10,8
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	79,6	38,7	30,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	9,4	24,0	8,4
	Renewable Energy Ratio	RER	%	9%	31%	8%

Table B.70. Archetype – non-residential building (OFF), climatic zone E (Piemonte Region), construction period ≤ 1900

PIEMONTE REGION EPC DATABASE - E_OFF_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,456	0,170	0,190
	Thermally heated gross volume	$V_{H;g}$	m^3	452	285	155
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	99	60	33
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	5%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,194	0,192	0,192
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,100	1,375	0,759
Technical building system	Energy carrier per space heating	Natural gas = 74%; district heating = 11%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97%; natural gas = 3% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 51%; electricity = 44%; others = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,938	0,265	0,138
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,973	0,027	0,274
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,834	0,067	0,834
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	128,2	54,6	49,1
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	14,3	11,2	7,8
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	2,4	0,1	0,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,070	0,070
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	0,920	0,393	0,370
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,400	0,360	0,110
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	165,5	76,4	63,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	13,6	11,6	7,3
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	6,5	3,3	2,9
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	213,6	83,1	75,5
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	8,3	11,3	6,6
	Renewable Energy Ratio	RER	%	4%	4%	3%

Table B.71. Archetype – non-residential building (OFF), climatic zone E (Piemonte Region), construction period 1901-1920

PIEMONTE REGION EPC DATABASE - E_OFF_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,492	0,138	0,197
	Thermally heated gross volume	$V_{H;g}$	m^3	469	266	173
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	100	55	33
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	9%	6%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,177	0,197	0,154
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,573	1,125	0,955
Technical building system	Energy carrier per space heating	Natural gas = 74%; district heating = 11%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97%; natural gas = 3% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 51%; electricity = 44%; others = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,938	0,265	0,138
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,973	0,027	0,274
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,834	0,067	0,834
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	130,7	57,3	47,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	21,7	14,1	10,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	2,4	0,5	0,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,738	0,062	0,098
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	0,955	0,315	0,325
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,360	0,360	0,070
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	181,4	75,5	71,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	18,8	16,0	9,8
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	6,5	3,0	1,9
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	224,4	97,4	80,2
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	8,1	15,6	6,5
	Renewable Energy Ratio	RER	%	4%	5%	3%

Table B.72. Archetype – non-residential building (OFF), climatic zone E (Piemonte Region), construction period 1921-1945

PIEMONTE REGION EPC DATABASE - E_OFF_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,511	0,143	0,206
	Thermally heated gross volume	$V_{H;g}$	m^3	478	308	168
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	108	67	38
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	5%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	W/(m²·K)	1,218	0,219	0,218
	Mean thermal transmittance of transparent building envelope	U_{wi}	W/(m²·K)	3,206	1,311	0,731
Technical building system	Energy carrier per space heating	Natural gas = 74%; district heating = 11%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97%; natural gas = 3% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 51%; electricity = 44%; others = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,938	0,265	0,138
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,973	0,027	0,274
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,834	0,067	0,834
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	128,8	53,2	47,4
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	14,7	16,9	7,3
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m²	2,4	0,5	0,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,740	0,070	0,090
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	0,970	0,380	0,520
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,370	0,340	0,080
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m²	165,3	80,5	59,5
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m²	15,5	14,4	8,7
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m²	6,5	2,3	2,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	216,9	83,1	73,2
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	8,2	14,3	6,3
	Renewable Energy Ratio	RER	%	4%	4%	3%

Table B.73. Archetype – non-residential building (OFF), climatic zone E (Piemonte Region), construction period 1946-1960

PIEMONTE REGION EPC DATABASE - E_OFF_CP4						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,558	0,138	0,193
	Thermally heated gross volume	$V_{H;g}$	m^3	379	270	108
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	94	64	31
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	9%	5%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	W/(m²·K)	1,192	0,200	0,242
	Mean thermal transmittance of transparent building envelope	U_{wi}	W/(m²·K)	3,374	1,288	0,804
Technical building system	Energy carrier per space heating	Natural gas = 74%; district heating = 11%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97%; natural gas = 3% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 51%; electricity = 44%; others = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,938	0,265	0,138
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,973	0,027	0,274
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,834	0,067	0,834
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	133,2	63,5	46,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	17,8	14,7	10,1
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m²	2,4	0,1	0,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,720	0,060	0,100
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,000	0,335	0,390
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,370	0,380	0,080
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m²	180,3	82,8	64,7
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m²	14,3	13,0	8,2
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m²	6,5	1,6	2,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	226,2	102,3	68,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	9,5	15,1	7,4
	Renewable Energy Ratio	RER	%	4%	4%	3%

Table B.74. Archetype – non-residential building (OFF), climatic zone E (Piemonte Region), construction period 1961-1975

PIEMONTE REGION EPC DATABASE - E_OFF_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,569	0,134	0,207
	Thermally heated gross volume	$V_{H;g}$	m^3	389	226	115
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	97	57	29
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	9%	6%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,179	0,225	0,235
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	3,571	1,287	0,933
Technical building system	Energy carrier per space heating	Natural gas = 74%; district heating = 11%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97%; natural gas = 3% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 51%; electricity = 44%; others = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,938	0,265	0,138
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,973	0,027	0,274
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,834	0,067	0,834
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	135,6	56,5	47,4
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	19,2	13,5	9,4
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	2,4	0,1	0,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,070	0,100
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,020	0,405	0,450
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,360	0,350	0,070
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	179,6	88,0	65,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	15,9	14,2	7,8
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	6,6	2,6	2,4
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	229,1	98,3	77,9
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	9,3	12,2	7,3
	Renewable Energy Ratio	RER	%	4%	3%	3%

Table B.75. Archetype – non-residential building (OFF), climatic zone E (Piemonte Region), construction period 1976-1990

PIEMONTE REGION EPC DATABASE - E_OFF_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,584	0,160	0,181
	Thermally heated gross volume	$V_{H;g}$	m^3	484	480	167
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	125	123	44
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	5%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,101	0,291	0,270
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	3,144	0,963	0,618
Technical building system	Energy carrier per space heating	Natural gas = 74%; district heating = 11%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97%; natural gas = 3% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 51%; electricity = 44%; others = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,938	0,265	0,138
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,973	0,027	0,274
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,834	0,067	0,834
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	130,2	63,3	47,2
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	17,0	15,1	8,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	2,4	0,1	0,1
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,063	0,090
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,020	0,320	0,340
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,450	0,323	0,160
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	157,9	95,3	58,4
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	14,8	14,5	7,5
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	6,5	2,5	3,1
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	217,9	98,9	76,9
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	11,1	16,7	8,6
	Renewable Energy Ratio	RER	%	4%	6%	3%

Table B.76. Archetype – non-residential building (OFF), climatic zone E (Piemonte Region), construction period 1991-2005

PIEMONTE REGION EPC DATABASE - E_OFF_CP7						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,551	0,151	0,157
	Thermally heated gross volume	$V_{H;g}$	m^3	545	440	200
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	140	105	50
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	10%	7%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,915	0,357	0,281
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,952	0,533	0,515
Technical building system	Energy carrier per space heating	Natural gas = 74%; district heating = 11%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97%; natural gas = 3% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 51%; electricity = 44%; others = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,938	0,265	0,138
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,973	0,027	0,274
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,834	0,067	0,834
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	112,7	55,5	40,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	24,3	19,2	13,2
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	2,4	0,1	0,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,060	0,090
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	0,890	0,430	0,300
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,485	0,285	0,195
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	141,4	78,0	54,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	22,2	21,2	11,5
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	5,6	3,2	2,5
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	207,0	90,0	64,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	15,8	16,6	11,1
	Renewable Energy Ratio	RER	%	7%	5%	4%

Table B.77. Archetype – non-residential building (OFF), climatic zone E (Piemonte Region), construction period > 2005

PIEMONTE REGION EPC DATABASE - E_OFF_CP8						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,581	0,176	0,149
	Thermally heated gross volume	$V_{H;g}$	m^3	562	532	234
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	138	120	57
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	5%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,528	0,329	0,222
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,108	0,627	0,557
Technical building system	Energy carrier per space heating	Natural gas = 74%; district heating = 11%; others = 15% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 97%; natural gas = 3% (of the analysed sample)				
	Energy carrier per domestic hot water	Natural gas = 51%; electricity = 44%; others = 5% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	0,938	0,265	0,138
	Mean seasonal efficiency of the heating generation sub-system (solid biomass)	$\eta_{H;gn}$	–	0,973	0,027	0,274
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,834	0,067	0,834
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	80,4	43,0	29,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	21,5	16,7	9,1
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	2,4	0,1	0,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,740	0,110	0,110
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,000	0,625	0,435
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,520	0,290	0,230
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	75,8	54,1	37,5
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	20,5	17,9	10,6
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	4,3	2,4	2,0
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	137,8	72,5	56,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	28,4	48,1	18,9
	Renewable Energy Ratio	RER	%	15%	25%	9%

Table B.78. Archetype – non-residential building (EDUC), climatic zone E (Piemonte Region), construction period ≤ 1900

PIEMONTE REGION EPC DATABASE - E_EDUC_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	*CR*	m^{-1}	0,437	0,110	0,086
	Thermally heated gross volume	$V_{H;g}$	m^3	3995	5988	1892
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	789	1126	341
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	2%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,105	0,232	0,309
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	3,209	0,895	0,639
Technical building system	Energy carrier per space heating	Natural gas = 79%; district heating = 14%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98%; district cooling = 2% (of the analysed sample)				
	Energy carrier per domestic hot water	Electricity = 48%; natural gas = 44%; others = 8% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	1,000	4,930	0,123
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,980	2,763	0,022
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,802	0,079	0,802
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	190,5	67,4	49,6
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,5	4,8	0,7
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	1,1	6,5	0,8
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,730	0,060	0,060
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	0,620	1,188	0,323
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,290	0,470	0,000
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	257,3	97,2	61,9
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	3,5	11,5	2,8
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	2,2	13,0	1,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	292,3	110,1	73,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	8,2	6,6	6,3
	Renewable Energy Ratio	*RER*	%	3%	2%	2%

Table B.79. Archetype – non-residential building (EDUC), climatic zone E (Piemonte Region), construction period 1901-1920

PIEMONTE REGION EPC DATABASE - E_EDUC_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,408	0,125	0,045
	Thermally heated gross volume	$V_{H;g}$	m^3	6997	7251	3670
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1257	933	557
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	7%	1%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,181	0,177	0,182
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,360	0,593	0,597
Technical building system	Energy carrier per space heating	Natural gas = 79%; district heating = 14%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98%; district cooling = 2% (of the analysed sample)				
	Energy carrier per domestic hot water	Electricity = 48%; natural gas = 44%; others = 8% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	1,000	4,930	0,123
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,980	2,763	0,022
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,802	0,079	0,802
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	190,4	43,2	28,1
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	4,8	0,0	0,0
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	1,4	8,7	1,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,765	0,025	0,075
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,250	0,000	0,000
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,290	0,305	0,010
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	247,0	58,7	38,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	1,9	0,0	0,0
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	4,5	15,5	2,8
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	304,0	105,7	38,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	13,5	6,4	5,8
	Renewable Energy Ratio	RER	%	4%	2%	1%

Table B.80. Archetype – non-residential building (EDUC), climatic zone E (Piemonte Region), construction period 1921-1945

PIEMONTE REGION EPC DATABASE - E_EDUC_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,450	0,136	0,054
	Thermally heated gross volume	$V_{H;g}$	m^3	4617	4352	1886
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	874	938	353
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	9%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,054	0,231	0,295
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	3,197	1,207	1,122
Technical building system	Energy carrier per space heating	Natural gas = 79%; district heating = 14%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98%; district cooling = 2% (of the analysed sample)				
	Energy carrier per domestic hot water	Electricity = 48%; natural gas = 44%; others = 8% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	1,000	4,930	0,123
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,980	2,763	0,022
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,802	0,079	0,802
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	167,8	56,9	30,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	22,9	0,0	0,0
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	0,6	4,9	0,3
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,760	0,030	0,085
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,150	0,000	0,000
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,360	0,320	0,070
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	218,9	91,9	51,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	16,1	0,0	0,0
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	1,6	8,0	0,9
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	260,3	98,3	75,9
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	9,6	6,1	4,2
	Renewable Energy Ratio	RER	%	4%	2%	2%

Table B.81. Archetype – non-residential building (EDUC), climatic zone E (Piemonte Region), construction period 1946-1960

PIEMONTE REGION EPC DATABASE - E_EDUC_CP4						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,456	0,113	0,063
	Thermally heated gross volume	$V_{H;g}$	m^3	4054	3949	1492
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	920	633	364
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	9%	2%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,114	0,185	0,342
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,300	0,937	1,047
Technical building system	Energy carrier per space heating	Natural gas = 79%; district heating = 14%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98%; district cooling = 2% (of the analysed sample)				
	Energy carrier per domestic hot water	Electricity = 48%; natural gas = 44%; others = 8% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	1,000	4,930	0,123
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,980	2,763	0,022
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,802	0,079	0,802
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	176,7	56,5	40,4
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	5,1	15,9	4,2
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	0,4	2,6	0,2
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,710	0,070	0,060
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,130	1,020	0,657
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,400	0,340	0,110
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	241,7	112,8	89,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	5,9	2,5	3,9
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	1,2	5,7	0,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	297,1	99,4	98,4
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	9,9	4,0	4,2
	Renewable Energy Ratio	RER	%	3%	2%	1%

Table B.82. Archetype – non-residential building (EDUC), climatic zone E (Piemonte Region), construction period 1961-1975

PIEMONTE REGION EPC DATABASE - E_EDUC_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,451	0,119	0,060
	Thermally heated gross volume	$V_{H;g}$	m^3	8486	5710	4495
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1868	1294	930
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	10%	2%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,072	0,244	0,296
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,219	1,043	1,261
Technical building system	Energy carrier per space heating	Natural gas = 79%; district heating = 14%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98%; district cooling = 2% (of the analysed sample)				
	Energy carrier per domestic hot water	Electricity = 48%; natural gas = 44%; others = 8% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	1,000	4,930	0,123
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,980	2,763	0,022
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,802	0,079	0,802
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	168,9	45,9	36,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	4,6	19,0	4,0
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	0,4	2,1	0,1
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,760	0,070	0,100
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	0,875	0,235	0,293
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,290	0,133	0,000
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	232,3	59,7	73,4
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	18,5	0,9	17,9
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	1,2	4,0	0,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	258,8	68,7	60,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	9,4	5,4	2,8
	Renewable Energy Ratio	RER	%	4%	2%	1%

Table B.83. Archetype – non-residential building (EDUC), climatic zone E (Piemonte Region), construction period 1976-1990

PIEMONTE REGION EPC DATABASE - E_EDUC_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	*CR*	m^{-1}	0,522	0,139	0,091
	Thermally heated gross volume	$V_{H;g}$	m^3	5579	5395	2281
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1287	1295	519
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	8%	2%	2%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,977	0,179	0,248
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,101	0,689	0,556
Technical building system	Energy carrier per space heating	Natural gas = 79%; district heating = 14%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98%; district cooling = 2% (of the analysed sample)				
	Energy carrier per domestic hot water	Electricity = 48%; natural gas = 44%; others = 8% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	1,000	4,930	0,123
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,980	2,763	0,022
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,802	0,079	0,802
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	167,4	43,8	32,7
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,3	23,1	1,0
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	0,5	3,1	0,2
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,740	0,060	0,070
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,005	0,307	0,171
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,290	0,318	0,013
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	221,5	68,4	48,5
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	2,3	15,8	1,9
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	1,5	5,0	0,8
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	266,7	72,0	51,8
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	10,0	4,4	2,0
	Renewable Energy Ratio	*RER*	%	4%	2%	1%

Table B.84. Archetype – non-residential building (EDUC), climatic zone E (Piemonte Region), construction period 1991-2005

PIEMONTE REGION EPC DATABASE - E_EDUC_CP7						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	0,573	0,106	0,106
	Thermally heated gross volume	$V_{H;g}$	m^3	3478	2280	1815
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	766	331	351
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	7%	2%	1%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,809	0,334	0,259
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	2,902	0,539	0,351
Technical building system	Energy carrier per space heating	Natural gas = 79%; district heating = 14%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98%; district cooling = 2% (of the analysed sample)				
	Energy carrier per domestic hot water	Electricity = 48%; natural gas = 44%; others = 8% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	1,000	4,930	0,123
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,980	2,763	0,022
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,802	0,079	0,802
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	163,9	43,6	53,1
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	8,9	23,4	4,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	3,2	3,8	2,8
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,770	0,055	0,045
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	1,635	0,963	0,250
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,590	0,240	0,300
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	212,2	61,5	87,0
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	3,5	2,3	1,5
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	5,2	6,6	4,4
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	238,7	73,7	78,2
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	12,3	3,2	5,1
	Renewable Energy Ratio	RER	%	4%	3%	2%

Table B.85. Archetype – non-residential building (EDUC), climatic zone E (Piemonte Region), construction period > 2005

PIEMONTE REGION EPC DATABASE - E_EDUC_CP8						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,555	0,109	0,081
	Thermally heated gross volume	$V_{H;g}$	m^3	3118	2171	1415
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	613	625	209
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	7%	2%	3%
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,272	0,175	0,087
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	1,516	0,279	0,211
Technical building system	Energy carrier per space heating	Natural gas = 79%; district heating = 14%; others = 7% (of the analysed sample)				
	Energy carrier per space cooling	Electricity = 98%; district cooling = 2% (of the analysed sample)				
	Energy carrier per domestic hot water	Electricity = 48%; natural gas = 44%; others = 8% (of the analysed sample)				
	Mean seasonal efficiency of the heating generation sub-system (natural gas)	$\eta_{H;gn}$	–	1,000	4,930	0,123
	Mean seasonal efficiency of the heating generation sub-system (district heating)	$\eta_{H;gn}$	–	0,980	2,763	0,022
	Utilisation energy efficiency	$\eta_{H;u}$	–	0,802	0,079	0,802
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	96,3	39,2	43,5
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	18,1	23,9	8,4
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	5,0	4,6	4,6
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	0,810	0,165	0,110
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	0,860	0,415	0,385
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	0,610	0,170	0,235
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	58,0	74,4	21,2
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	17,2	10,8	6,7
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	3,3	7,4	2,6
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	107,2	83,2	49,4
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	28,2	40,4	19,6
	Renewable Energy Ratio	RER	%	27%	21%	20%

B5 Archetypes of building stock in Slovenia

Table B.86. Archetype - residential building (SFH), climatic zone Slovenia, construction period ≤ 1945

SLOVENIA EPC DATABASE - SI_RES_SFH_CP1						
	Data	Symbol	Unit of measure	Median	(Q_3-Q_2)	(Q_2-Q_1)
Geometry	Compactness ratio	CR	m^{-1}	0,88	0,2	0,16
	Thermally heated gross volume	$V_{H;g}$	m^3	384	188,25	122
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	106	50	32
System	Energy carrier per space heating and DHW (most used energy carrier)	Biomass = 36 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	207,00	88,49	71,79
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,20	0,60	0,16
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	282,60	140,40	109,88
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	26,00	10,34	7,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	199,54	182,49	90,18
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	100,54	221,33	75,15
	Renewable Energy Ratio	RER	%	0,40	0,34	0,33

Table B.87. Archetype - residential building (SFH), climatic zone Slovenia, construction period 1946-1970

SLOVENIA EPC DATABASE - SI_RES_SFH_CP2						
	Data	Symbol	Unit of measure	Median	(Q_3-Q_2)	(Q_2-Q_1)
Geometry	Compactness ratio	CR	m^{-1}	0,83	0,19	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	423	176	129,25
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	126	46	41
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 39 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	175,00	76,83	62,59
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,35	1,00	0,28
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	238,00	116,00	93,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	26,00	9,66	6,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	207,34	144,22	97,18
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	46,96	165,26	30,40
	Renewable Energy Ratio	RER	%	0,15	0,53	0,10

Table B. 88. Archetype – residential building (SFH), climatic zone Slovenia, construction period 1971-1980

SLOVENIA EPC DATABASE - SI_RES_SFH_CP3						
	Data	Symbol	Unit of measure	Median	(Q_3-Q_2)	(Q_2-Q_1)
Geometry	Compactness ratio	*CR*	m^{-1}	0,8	0,18	0,11
	Thermally heated gross volume	$V_{H;g}$	m^3	500	181	180
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	148	50,85	51
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 40 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	147,00	59,00	46,96
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,41	1,12	0,33
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	200,00	93,00	72,81
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	26,00	9,00	6,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	179,28	127,95	82,89
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	41,27	136,21	26,66
	Renewable Energy Ratio	*RER*	%	0,15	0,52	0,10

Table B. 89. Archetype – residential building (SFH), climatic zone Slovenia, construction period 1981-2002

SLOVENIA EPC DATABASE - SI_RES_SFH_CP4						
	Data	Symbol	Unit of measure	Median	(Q_3-Q_2)	(Q_2-Q_1)
Geometry	Compactness ratio	*CR*	m^{-1}	0,78	0,17	0,11
	Thermally heated gross volume	$V_{H;g}$	m^3	531,5	256,5	175,75
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	158	62,8	55,475
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 37 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	105,41	50,28	29,25
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,60	1,52	0,49
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	142,72	77,28	49,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	25,44	8,56	5,63
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	143,81	107,77	63,78
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	46,32	121,88	31,68
	Renewable Energy Ratio	*RER*	%	0,19	0,51	0,13

Table B.90. Archetype – residential building (SFH), climatic zone Slovenia, construction period 2003-2008

SLOVENIA EPC DATABASE – SI_RES_SFH_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,74	0,11	0,1
	Thermally heated gross volume	$V_{H;g}$	m^3	503	197,25	132
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	153	54	39
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 29 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	66,31	18,69	14,29
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,54	2,91	1,31
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	79,00	29,00	22,56
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	25,00	7,37	5,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	121,03	72,07	49,69
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	32,55	75,79	22,01
	Renewable Energy Ratio	RER	%	0,18	0,37	0,12

Table B.91. Archetype – residential building (SFH), climatic zone Slovenia, construction period > 2008

SLOVENIA EPC DATABASE – SI_RES_SFH_CP6						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,73	0,1	0,07
	Thermally heated gross volume	$V_{H;g}$	m^3	496	155	101
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	146	49	27,7
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 45 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	44,60	14,40	14,86
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	2,99	5,32	2,50
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	43,00	24,00	18,86
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	23,93	9,07	5,41
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	68,19	63,56	23,95
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	36,13	39,24	18,13
	Renewable Energy Ratio	RER	%	0,40	0,07	0,25

Table B.92. Archetype – residential building (MFH), climatic zone Slovenia, construction period ≤ 1945

SLOVENIA EPC DATABASE – SI_RES_MFH_CP1						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,6	0,13	0,165
	Thermally heated gross volume	$V_{H;g}$	m^3	286	923	118
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	76,25	250,75	28,25
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 32 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	118,65	56,56	39,65
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,20	0,79	0,19
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	144,00	82,00	59,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	27,12	11,34	7,12
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	192,47	109,84	73,38
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	82,84	121,64	54,95
	Renewable Energy Ratio	*RER*	%	0,40	0,04	0,29

Table B.93. Archetype – residential building (MFH), climatic zone Slovenia, construction period 1946-1970

SLOVENIA EPC DATABASE – SI_RES_MFH_CP2						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,46	0,21	0,14
	Thermally heated gross volume	$V_{H;g}$	m^3	189	636	54
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	58	133,4	14
System	Energy carrier per space heating and DHW (most used energy carrier)	District heat = 30 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	80,32	45,42	30,32
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,34	1,73	0,30
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	96,00	64,00	41,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	28,00	11,73	8,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	156,19	75,91	51,03
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	54,60	42,06	23,01
	Renewable Energy Ratio	*RER*	%	0,25	0,15	0,08

Table B.94. Archetype – residential building (MFH), climatic zone Slovenia, construction period 1971-1980

SLOVENIA EPC DATABASE – SI_RES_MFH_CP3						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,4	0,2	0,1
	Thermally heated gross volume	$V_{H;g}$	m^3	191	1587	62
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	59	461,75	17
System	Energy carrier per space heating and DHW (most used energy carrier)	District heat = 42 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	65,00	32,00	22,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,47	1,82	0,41
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	77,96	46,04	30,96
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	27,00	11,00	7,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	143,35	60,75	44,16
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	46,25	23,46	13,65
	Renewable Energy Ratio	*RER*	%	0,24	0,14	0,06

Table B.95. Archetype – residential building (MFH), climatic zone Slovenia, construction period 1981-2002

SLOVENIA EPC DATABASE – SI_RES_MFH_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,42	0,19	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	204	1909,5	57,75
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	63,2	452,3	17,2
System	Energy carrier per space heating and DHW (most used energy carrier)	District heat = 37 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	63,00	22,00	18,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,57	3,36	0,50
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	75,00	35,90	26,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	28,00	11,00	8,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	138,30	45,76	37,70
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	38,71	26,29	17,44
	Renewable Energy Ratio	*RER*	%	0,20	0,13	0,05

Table B.96. Archetype – residential building (MFH), climatic zone Slovenia, construction period 2003-2008

SLOVENIA EPC DATABASE – SI_RES_MFH_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,47	0,16	0,14
	Thermally heated gross volume	$V_{H;g}$	m^3	234	1187	78
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	68	203,05	18,25
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 58 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	48,32	13,18	12,32
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,66	3,54	0,61
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	57,00	23,00	18,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	27,92	11,08	7,92
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	116,60	32,96	23,36
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	15,59	14,91	7,27
	Renewable Energy Ratio	RER	%	0,12	0,08	0,05

Table B.97. Archetype – residential building (MFH), climatic zone Slovenia, construction period > 2008

SLOVENIA EPC DATABASE – SI_RES_MFH_CP6						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,46	0,155	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	397	3428,5	197
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	401,15	1002,775	331,15
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 44 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	33,00	17,00	12,30
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,13	8,12	1,08
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	36,47	20,53	19,47
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	25,58	10,44	8,58
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	87,35	32,61	27,62
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	15,18	15,16	9,07
	Renewable Energy Ratio	RER	%	0,15	0,25	0,08

Table B.98. Archetype – non-residential building (EDUC), climatic zone Slovenia, construction period ≤ 1945

SLOVENIA EPC DATABASE - SI_EDUC_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,47	0,125	0,05
	Thermally heated gross volume	$V_{H;g}$	m^3	2825	5867,5	1405
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	656,6	1525,4	219,6
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 24 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	77,00	40,58	28,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,20	1,45	0,12
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	101,00	50,25	41,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	19,00	30,48	13,86
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	148,76	226,90	91,75
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	58,56	82,48	41,75
	Renewable Energy Ratio	*RER*	%	0,32	0,18	0,20

Table B.99. Archetype – non-residential building (EDUC), climatic zone Slovenia, construction period 1946-1970

SLOVENIA EPC DATABASE - SI_EDUC_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,45	0,1375	0,1225
	Thermally heated gross volume	$V_{H;g}$	m^3	5963	9219,75	3488,5
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1707,25	1628	1072
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 26 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	73,00	50,25	27,96
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,25	1,00	0,20
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	92,50	64,00	40,07
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	37,50	29,00	24,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	86,36	98,37	60,95
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	25,08	72,83	17,09
	Renewable Energy Ratio	*RER*	%	0,30	0,23	0,15

Table B.100. Archetype – non-residential building (EDUC), climatic zone Slovenia, construction period 1971-1980

SLOVENIA EPC DATABASE – SI_EDUC_CP3						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,56	0,1525	0,1625
	Thermally heated gross volume	$V_{H;g}$	m^3	6014	17229,75	3449,25
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1460,95	3777,05	929,95
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 74 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	62,00	21,75	21,45
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	3,19	7,13	3,06
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	63,50	42,25	21,95
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	34,50	29,00	14,50
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	160,75	360,00	115,51
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	15,22	29,63	12,11
	Renewable Energy Ratio	*RER*	%	0,09	0,07	0,06

Table B.101. Archetype – non-residential building (EDUC), climatic zone Slovenia, construction period 1981-2002

SLOVENIA EPC DATABASE – SI_EDUC_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,5	0,145	0,09
	Thermally heated gross volume	$V_{H;g}$	m^3	4559	5149	3027
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1093	1104,4	568
System	Energy carrier per space heating and DHW (most used energy carrier)	Biomass = 27 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	59,00	35,02	18,10
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,18	0,47	0,13
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	72,00	47,25	27,26
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	25,20	32,30	12,45
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	135,48	220,35	101,19
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	40,84	173,45	30,05
	Renewable Energy Ratio	*RER*	%	0,31	0,26	0,20

Table B.102. Archetype - non-residential building (EDUC), climatic zone Slovenia, construction period 2002-2008

SLOVENIA EPC DATABASE - SI_EDUC_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,62	0,355	0,155
	Thermally heated gross volume	$V_{H;g}$	m^3	914	4380	751
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	353,5	431,175	293
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 60 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	94,69	35,06	33,44
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,15	2,69	0,56
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	110,29	49,46	17,04
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	33,00	20,13	15,50
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	436,91	1289,14	250,11
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	405,37	1734,89	281,74
	Renewable Energy Ratio	*RER*	%	0,49	0,09	0,11

Table B.103. Archetype - non-residential building (EDUC), climatic zone Slovenia, construction period > 2008

SLOVENIA EPC DATABASE - SI_EDUC_CP6						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,48	0,17	0,08
	Thermally heated gross volume	$V_{H;g}$	m^3	4134	4537	1456
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1046,9	804,6	349,9
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 66 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	23,00	12,00	9,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,59	4,84	1,59
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	23,03	17,81	13,03
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	26,50	34,05	17,25
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	101,25	220,66	59,24
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	34,75	72,66	21,90
	Renewable Energy Ratio	*RER*	%	0,25	0,24	0,12

Table B.104. Archetype – non-residential building (CUL), climatic zone Slovenia, construction period ≤ 1945

SLOVENIA EPC DATABASE – SI_CUL_CP1						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,54	0,125	0,08
	Thermally heated gross volume	$V_{H;g}$	m^3	1070	1523	650
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	323	328	186
System	Energy carrier per space heating and DHW (most used energy carrier)	Biomass = 32 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	119,00	50,00	60,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,05	0,09	0,05
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	145,00	54,00	68,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	13,00	14,50	7,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	216,06	142,12	87,79
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	62,02	74,12	34,36
	Renewable Energy Ratio	RER	%	0,25	0,15	0,16

Table B.105. Archetype – non-residential building (CUL), climatic zone Slovenia, construction period 1946-1970

SLOVENIA EPC DATABASE – SI_CUL_CP2						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,54	0,14	0,06
	Thermally heated gross volume	$V_{H;g}$	m^3	2392	1063	865
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	456	429	163,5
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 30 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	137,00	87,00	68,92
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,82	1,45	1,57
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	190,00	73,00	77,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	13,00	6,00	8,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	233,02	76,43	110,47
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	97,65	43,86	76,17
	Renewable Energy Ratio	RER	%	0,27	0,18	0,18

Table B.106. Archetype - non-residential building (CUL), climatic zone Slovenia, construction period 1971-1980

SLOVENIA EPC DATABASE - SI_CUL_CP3						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,655	0,28	0,0425
	Thermally heated gross volume	$V_{H;g}$	m^3	1513,5	1299,75	848
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	367	284	133
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 64 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	173,00	40,00	46,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,56	0,65	0,35
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	231,76	114,24	109,76
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	9,00	11,00	9,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	242,22	96,74	101,75
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	27,75	99,09	8,10
	Renewable Energy Ratio	*RER*	%	0,10	0,17	0,06

Table B.107. Archetype - non-residential building (CUL), climatic zone Slovenia, construction period 1981-2002

SLOVENIA EPC DATABASE - SI_CUL_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,54	0,265	0,1075
	Thermally heated gross volume	$V_{H;g}$	m^3	2094,5	2543,75	1528,25
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	495	243,25	372,5
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 33 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	122,50	74,50	41,75
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	–	–	–
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	176,00	105,00	67,50
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	20,00	7,50	5,75
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	210,70	51,01	55,39
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	48,07	145,02	30,40
	Renewable Energy Ratio	*RER*	%	0,20	0,27	0,10

Table B.108. Archetype – non-residential building (CUL), climatic zone Slovenia, construction period 2003-2008

SLOVENIA EPC DATABASE - SI_CUL_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,465	0,26	0,15
	Thermally heated gross volume	$V_{H;g}$	m^3	4970,5	3589	2536
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	438	1666	303
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 67 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	68,00	31,89	2,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,23	0,32	0,08
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	83,00	31,87	17,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	31,16	200,84	26,16
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	238,27	232,20	135,90
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	95,30	63,54	91,27
	Renewable Energy Ratio	RER	%	0,17	0,23	0,13

Table B.109. Archetype – non-residential building (CUL), climatic zone Slovenia, construction period > 2008

SLOVENIA EPC DATABASE - SI_CUL_CP6						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,49	0,19	0,04
	Thermally heated gross volume	$V_{H;g}$	m^3	2267	1019	1187
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	517	230	181,95
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 48 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	40,00	14,43	12,60
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,84	5,65	0,78
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	46,00	16,00	22,37
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	13,00	8,76	11,50
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	88,98	44,10	37,49
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	72,16	30,08	42,78
	Renewable Energy Ratio	RER	%	0,47	0,13	0,16

Table B.110. Archetype – non-residential building (MUL), climatic zone Slovenia, construction period < 1945

SLOVENIA EPC DATABASE – SI_MUL_CP1						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,505	0,135	0,1075
	Thermally heated gross volume	$V_{H;g}$	m^3	2423	1977	689,75
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	809,35	974,05	222,1
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 35 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	125,29	34,46	38,79
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,73	1,41	0,71
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	140,27	77,23	36,43
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	6,50	18,62	5,88
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,85	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	192,61	146,47	57,79
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	61,88	56,37	53,62
	Renewable Energy Ratio	RER	%	0,18	0,25	0,14

Table B.111. Archetype – non-residential building (MUL), climatic zone Slovenia, construction period 1946-1970

SLOVENIA EPC DATABASE – SI_MUL_CP2						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,66	0,215	0,075
	Thermally heated gross volume	$V_{H;g}$	m^3	1369	914	554,5
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	425	350,75	178,25
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 50 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	168,75	31,25	63,50
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,00	0,00	0,00
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	204,51	109,49	37,01
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	14,39	10,36	12,89
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	284,19	129,83	142,86
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	57,31	173,60	45,15
	Renewable Energy Ratio	RER	%	0,17	0,31	0,12

Table B.112. Archetype – non-residential building (MUL), climatic zone Slovenia, construction period 1971-1980

SLOVENIA EPC DATABASE – SI_MUL_CP3						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,67	0,09	0,07
	Thermally heated gross volume	$V_{H;g}$	m^3	4890	898	3949
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1412	440	1162
System	Energy carrier per space heating and DHW (most used energy carrier)	District heat = 67 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	112,00	124,00	64,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,00	0,00	0,00
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	179,00	84,00	128,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	5,00	23,00	5,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	226,96	113,20	52,61
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	59,19	9,97	38,98
	Renewable Energy Ratio	RER	%	0,17	0,08	0,09

Table B.113. Archetype – non-residential building (MUL), climatic zone Slovenia, construction period 1981-2002

SLOVENIA EPC DATABASE – SI_MUL_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,4	0,1075	0,1
	Thermally heated gross volume	$V_{H;g}$	m^3	6509	7574	4062,75
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1579	899,5	1100,8
System	Energy carrier per space heating and DHW (most used energy carrier)	District heat = 33 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	66,00	26,50	23,50
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,97	0,00	0,00
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	124,00	55,50	60,50
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	17,00	5,50	13,50
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	125,63	90,87	43,46
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	86,52	32,11	56,37
	Renewable Energy Ratio	RER	%	0,44	0,13	0,22

Table B.114. Archetype – non-residential building (MUL), climatic zone Slovenia, construction period 2003-2008

SLOVENIA EPC DATABASE – SI_MUL_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,7	0,15	0,32
	Thermally heated gross volume	$V_{H;g}$	m^3	755	526	236
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	168	605	21
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 100 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	34,00	31,25	63,50
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,00	0,00	0,00
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	29,00	109,49	37,01
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	47,00	10,36	12,89
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	120,59	129,83	142,86
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	24,40	173,60	45,15
	Renewable Energy Ratio	RER	%	0,17	0,31	0,12

Table B.115. Archetype – non-residential building (MUL), climatic zone Slovenia, construction period > 2008

SLOVENIA EPC DATABASE – SI_MUL_CP6						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,515	0,155	0,065
	Thermally heated gross volume	$V_{H;g}$	m^3	3060,5	3470,25	1804,5
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	234	709	26,4
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 44 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	54,00	10,20	27,01
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,93	0,93	0,79
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	63,00	4,02	32,11
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	18,00	33,79	8,50
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	6,04	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	74,97	27,87	39,86
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	68,16	14,95	20,20
	Renewable Energy Ratio	RER	%	0,40	0,27	0,01

Table B.116. Archetype - non-residential building (POB), climatic zone Slovenia, construction period ≤ 1945

SLOVENIA EPC DATABASE - SI_POB_CP1						
	Data	Symbol	Unit of measure	Median	(Q_3-Q_2)	(Q_2-Q_1)
Geometry	Compactness ratio	*CR*	m^{-1}	0,545	0,145	0,145
	Thermally heated gross volume	$V_{H;g}$	m^3	558,5	935,75	310,5
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	157	351	92
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 30 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	119,00	46,00	30,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,24	0,77	0,15
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	154,00	75,00	53,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	18,00	10,00	8,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	212,49	92,94	70,24
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	42,22	66,46	20,71
	Renewable Energy Ratio	*RER*	%	0,18	0,22	0,11

Table B.117. Archetype - non-residential building (POB), climatic zone Slovenia, construction period 1946-1970

SLOVENIA EPC DATABASE - SI_POB_CP2						
	Data	Symbol	Unit of measure	Median	(Q_3-Q_2)	(Q_2-Q_1)
Geometry	Compactness ratio	*CR*	m^{-1}	0,55	0,25	0,18
	Thermally heated gross volume	$V_{H;g}$	m^3	783,5	1957,75	495,75
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	247	608,7	166
System	Energy carrier per space heating and DHW (most used energy carrier)	District heat = 23 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	108,00	41,00	35,50
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,28	2,80	1,10
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	133,00	61,00	48,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	15,00	8,00	6,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	196,75	72,19	80,34
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	56,99	44,83	22,72
	Renewable Energy Ratio	*RER*	%	0,23	0,17	0,08

Table B.118. Archetype – non-residential building (POB), climatic zone Slovenia, construction period 1971-1980

SLOVENIA EPC DATABASE – SI_POB_CP3						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,53	0,145	0,16
	Thermally heated gross volume	$V_{H;g}$	m^3	915	1221,5	648
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	265,5	388,75	182
System	Energy carrier per space heating and DHW (most used energy carrier)	District heat = 27 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	102,00	35,50	34,25
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	2,62	1,18	2,07
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	131,50	57,75	50,50
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	15,00	8,00	7,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	184,99	58,65	57,67
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	51,53	48,70	20,71
	Renewable Energy Ratio	RER	%	0,23	0,17	0,07

Table B.119. Archetype – non-residential building (POB), climatic zone Slovenia, construction period 1981-2002

SLOVENIA EPC DATABASE – SI_POB_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,51	0,23	0,1
	Thermally heated gross volume	$V_{H;g}$	m^3	529	1029	288
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	147	244	77
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 51 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	94,00	35,00	27,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,00	0,00	0,00
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	129,00	45,00	37,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	15,00	13,00	8,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	192,06	56,02	56,23
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	19,71	9,42	12,41
	Renewable Energy Ratio	RER	%	0,09	0,03	0,04

Table B.120. Archetype – non-residential building (POB), climatic zone Slovenia, construction period 2003-2008

SLOVENIA EPC DATABASE - SI_POB_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,51	0,17	0,13
	Thermally heated gross volume	$V_{H;g}$	m^3	763	1391	495
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	234,5	294,75	155,5
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 56 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	58,82	26,77	15,57
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	3,98	7,02	1,60
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	72,50	35,50	24,50
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	18,00	8,00	8,75
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	145,41	49,71	47,50
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	33,77	28,77	14,81
	Renewable Energy Ratio	RER	%	0,19	0,15	0,07

Table B.121. Archetype – non-residential building (POB), climatic zone Slovenia, construction period > 2008

SLOVENIA EPC DATABASE - SI_POB_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	0,49	0,19	0,19
	Thermally heated gross volume	$V_{H;g}$	m^3	2810,5	5702,5	1743,75
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	830,7	1411,3	569,7
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 53 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	32,00	23,00	8,56
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,16	4,58	1,16
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	36,00	21,00	16,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	12,00	10,00	4,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	78,98	43,88	32,30
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	55,07	36,58	24,74
	Renewable Energy Ratio	RER	%	0,42	0,10	0,12

Table B.122. Archetype – non-residential building (SPO), climatic zone Slovenia, construction period ≤ 1945

SLOVENIA EPC DATABASE – SI_SPO_CP1						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,805	0,17	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	1111,5	7248	511
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	344	802,15	689,1
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 50 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	131,50	23,00	8,56
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,00	0,00	0,00
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	158,00	21,00	16,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	52,50	10,00	4,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	273,00	43,88	32,30
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	57,05	36,58	24,74
	Renewable Energy Ratio	RER	%	0,15	0,10	0,12

Table B.123. Archetype – non-residential building (SPO), climatic zone Slovenia, construction period 1946-1970

SLOVENIA EPC DATABASE – SI_SPO_CP2						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,41	0,17	0,12
	Thermally heated gross volume	$V_{H;g}$	m^3	3265	7248	511
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	979,25	802,15	689,1
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 37 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	125,17	81,21	46,92
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,97	0,35	0,93
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	131,07	74,41	30,94
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	28,86	137,00	17,71
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	173,55	155,19	98,95
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	82,15	17,32	57,25
	Renewable Energy Ratio	RER	%	0,40	0,13	0,32

Table B.124. Archetype – non-residential building (SPO), climatic zone Slovenia, construction period 1971-1980

SLOVENIA EPC DATABASE – SI_SPO_CP3						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,69	0,09	0,38
	Thermally heated gross volume	$V_{H;g}$	m^3	1568	3713	1143
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	598,1	983,25	288,275
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas 22 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	90,14	48,68	55,27
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,67	1,48	0,66
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	103,68	59,17	74,45
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	35,39	39,61	21,14
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,15	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	236,49	75,03	136,82
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	63,38	62,76	34,48
	Renewable Energy Ratio	*RER*	%	0,24	0,21	0,08

Table B.125. Archetype – non-residential building (SPO), climatic zone Slovenia, construction period 1981-2002

SLOVENIA EPC DATABASE – SI_SPO_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,525	0,2025	0,1275
	Thermally heated gross volume	$V_{H;g}$	m^3	3742,5	2754	1842,75
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1566	888,8	958
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas 33 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	85,41	76,50	54,80
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	1,84	4,84	1,84
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	128,48	54,52	91,30
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	25,46	20,50	22,65
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	143,89	87,94	81,46
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	54,25	64,96	22,18
	Renewable Energy Ratio	*RER*	%	0,27	0,18	0,09

Table B.126. Archetype – non-residential building (SPO), climatic zone Slovenia, construction period 2002-2008

SLOVENIA EPC DATABASE – SI_SPO_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,35	0,37	0,23
	Thermally heated gross volume	$V_{H;g}$	m^3	11471	1825	10262
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	819	810	440
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 33 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	78,00	72,00	18,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	4,35	6,51	3,56
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	163,00	17,00	72,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	6,00	179,00	5,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	162,17	390,34	73,67
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	203,73	32,78	163,34
	Renewable Energy Ratio	RER	%	0,30	0,40	0,10

Table B.127. Archetype – non-residential building (SPO), climatic zone Slovenia, construction period > 2008

SLOVENIA EPC DATABASE – SI_SPO_CP6						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,38	0,135	0,0675
	Thermally heated gross volume	$V_{H;g}$	m^3	9904,5	7577,75	8494,75
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1595,35	672,675	967,525
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 55 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	27,32	20,43	16,67
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,69	2,41	0,69
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	23,89	47,96	23,89
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	26,00	71,34	23,25
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	89,40	62,62	34,89
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	59,67	37,83	22,23
	Renewable Energy Ratio	RER	%	0,40	0,10	0,04

Table B.128. Archetype - non-residential building (HCB), climatic zone Slovenia, construction period ≤ 1945

SLOVENIA EPC DATABASE - SI_HCB_CP1						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,36	0,14	0,05
	Thermally heated gross volume	$V_{H;g}$	m^3	10419	12283	5576,5
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	850,4	1675,6	151,9
System	Energy carrier per space heating and DHW (most used energy carrier)	District heat = 56 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	144,98	43,02	68,48
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,20	1,22	0,18
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	135,00	87,55	62,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	43,84	15,66	22,24
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	231,82	96,06	46,78
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	61,94	24,76	19,21
	Renewable Energy Ratio	RER	%	0,18	0,17	0,04

Table B.129. Archetype - non-residential building (HCB), climatic zone Slovenia, construction period 1946-1970

SLOVENIA EPC DATABASE - SI_HCB_CP2						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	0,53	0,145	0,1225
	Thermally heated gross volume	$V_{H;g}$	m^3	3415	4947,75	1999,5
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1755,9	1084,7	1157,9
System	Energy carrier per space heating and DHW (most used energy carrier)	Natural gas = 40 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	78,00	43,31	41,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	0,42	4,76	0,13
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	106,00	22,00	65,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	36,00	4,00	24,12
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	1,11	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	192,80	63,75	66,93
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	46,03	41,05	13,06
	Renewable Energy Ratio	RER	%	0,19	0,25	0,05

Table B.130. Archetype - non-residential building (HCB), climatic zone Slovenia, construction period 1971-1980

SLOVENIA EPC DATABASE - SI_HCB_CP3						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,54	0,21	0,16
	Thermally heated gross volume	$V_{H;g}$	m^3	3932	14314	2999
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	1922,7	1014,3	1629,7
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 27 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	54,63	57,37	32,63
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	0,20	1,85	0,20
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	52,00	80,00	41,00
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	23,00	16,28	23,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	156,57	41,04	51,88
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	47,31	163,44	19,69
	Renewable Energy Ratio	*RER*	%	0,40	0,05	0,24

Table B.131. Archetype - non-residential building (HCB), climatic zone Slovenia, construction period 1981-2002

SLOVENIA EPC DATABASE - SI_HCB_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,52	0,275	0,15
	Thermally heated gross volume	$V_{H;g}$	m^3	3320	11265,5	2033
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	521	3283	173
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 31 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	71,00	46,00	33,82
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	2,30	8,49	2,20
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m^2	97,00	68,04	59,11
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m^2	28,00	60,43	10,50
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m^2	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	173,22	77,24	68,33
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	80,14	32,99	64,54
	Renewable Energy Ratio	*RER*	%	0,34	0,15	0,28

Table B.132. Archetype – non-residential building (HCB), climatic zone Slovenia, construction period 2003-2008

SLOVENIA EPC DATABASE – SI_HCB_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,46	0,35	0,08
	Thermally heated gross volume	$V_{H;g}$	m^3	5951	8563	512
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	2204	6853	725
System	Energy carrier per space heating and DHW (most used energy carrier)	Fuel oil = 100 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	54,50	15,00	18,25
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	4,35	6,51	3,56
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	133,50	9,75	45,50
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	32,00	10,00	9,00
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	151,70	13,00	27,38
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	0,00	0,00	0,00
	Renewable Energy Ratio	*RER*	%	0,00	0,00	0,00

Table B.133. Archetype – non-residential building (HCB), climatic zone Slovenia, construction period > 2008

SLOVENIA EPC DATABASE – SI_HCB_CP6						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	*CR*	m^{-1}	0,490	0,150	0,100
	Thermally heated gross volume	$V_{H;g}$	m^3	2941	5975	1538
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	890,4	1195,6	487,9
System	Energy carrier per space heating and DHW (most used energy carrier)	Electricity = 100 % (of the analysed sample)				
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m²	29,00	22,50	12,00
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m²	1,37	6,87	1,32
	Delivered energy for space heating	$E_{del,h,an}$	kWh/m²	20,00	30,00	10,28
	Delivered energy for domestic hot water	$E_{del,dhw,an}$	kWh/m²	30,00	54,07	15,50
	Delivered energy for ventilation	$E_{del,v,an}$	kWh/m²	0,00	0,00	0,00
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m²	146,11	71,42	74,50
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m²	89,67	78,67	48,27
	Renewable Energy Ratio	*RER*	%	0,40	0,07	0,11

B6 Archetypes of building stock in Spain (Catalonia)

Table B.134. Archetype – residential building (AB), climatic zone B3 (Catalonia Region), construction period 1961-1980

CATALAN EPC DATABASE - B3_RES_AB_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	2,980	1,280	1,390
	Thermally heated gross volume	$V_{H;g}$	m^3	180	60	58
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	70	23	22
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	20	10	4
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2·K)$	1,470	0,360	0,220
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2·K)$	4,890	0,550	1,090
Technical building system	Energy carrier per space heating	Natural gas = 74%, Electricity = 24%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 42%, Electricity = 51%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,820	0,520	0,160
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	55,7	19,0	15,5
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,0	3,6	3,2
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	61,4	50,6	17,8
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	75,4	27,7	22,0
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	147,9	43,6	33,8
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.135. Archetype – residential building (AB), climatic zone B3 (Catalonia Region), construction period 1981-2006

CATALAN EPC DATABASE - B3_RES_AB_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	2,910	1,880	1,310
	Thermally heated gross volume	$V_{H;g}$	m^3	176	48	49
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	69	19	19
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	18	5	3
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,970	0,390	0,460
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,780	0,820	0,120
Technical building system	Energy carrier per space heating	Natural gas = 55%, Electricity = 43%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 39%, Electricity = 58%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	1,000	0,470	0,280
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	46,4	19,9	14,8
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	13,7	3,3	3,1
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	58,9	47,5	17,4
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	64,4	28,8	22,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	136,4	43,0	33,3
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.136. Archetype – residential building (AB), climatic zone C2 (Catalonia Region), construction period ≤ 1900

CATALAN EPC DATABASE - C2_RES_AB_CP1						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	3,100	1,610	1,290
	Thermally heated gross volume	$V_{H;g}$	m^3	206	170	71
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	72	56	24
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	17	6	5
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,610	0,280	0,240
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	4,450	0,550	0,670
Technical building system	Energy carrier per space heating	Natural gas = 69%, Electricity = 29%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 55%, Electricity = 40%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,870	0,450	0,150
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	87,6	25,7	22,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	5,1	2,2	1,8
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	75,6	36,4	33,6
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	120,3	37,9	32,5
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	176,4	53,6	38,4
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.137. Archetype – residential building (AB), climatic zone C2 (Catalonia Region), construction period 1901-1936

CATALAN EPC DATABASE - C2_RES_AB_CP2						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	2,850	1,300	1,070
	Thermally heated gross volume	$V_{H;g}$	m^3	201	196	66
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	70	63	22
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	18	6	4
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,660	0,230	0,240
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	4,520	0,480	0,740
Technical building system	Energy carrier per space heating	Natural gas = 73%, Electricity = 27%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 67%, Electricity = 29%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,780	0,540	0,060
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	94,1	26,3	21,3
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	5,4	2,1	1,7
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	80,0	35,0	38,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	130,8	40,0	32,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	187,9	50,2	40,1
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.138. Archetype – residential building (AB), climatic zone C2 (Catalonia Region), construction period 1937-1960

CATALAN EPC DATABASE - C2_RES_AB_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	2,930	1,310	1,180
	Thermally heated gross volume	$V_{H;g}$	m^3	202	132	52
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	73	47	18
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	16	6	4
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,610	0,270	0,240
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	4,640	0,650	0,860
Technical building system	Energy carrier per space heating	Natural gas = 82%, Electricity = 17%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 72%, Electricity = 23%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,200	0,080
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	91,0	25,4	23,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	5,3	2,1	1,6
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	87,1	44,9	37,1
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	129,4	39,9	35,2
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	185,6	50,4	42,4
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.139. Archetype – residential building (AB), climatic zone C2 (Catalonia Region), construction period 1961-1980

CATALAN EPC DATABASE - C2_RES_AB_CP4						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	2,960	1,310	1,190
	Thermally heated gross volume	$V_{H;g}$	m^3	198	336	48
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	75	125	18
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	20	7	5
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,540	0,280	0,220
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	4,640	0,640	0,860
Technical building system	Energy carrier per space heating	Natural gas = 84%, Electricity = 15%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 77%, Electricity = 17%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,140	0,110
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	92,2	25,7	20
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	5,3	1,8	1,5
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	100,0	40,0	50,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	132,6	36,5	31,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	192,8	45,9	39,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.140. Archetype – residential building (AB), climatic zone C2 (Catalonia Region), construction period 1981-2006

CATALAN EPC DATABASE - C2_RES_AB_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	2,760	1,850	1,030
	Thermally heated gross volume	$V_{H;g}$	m^3	209	56	44
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	80	21	16
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	18	5	3
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,040	0,310	0,540
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,780	0,180	0,240
Technical building system	Energy carrier per space heating	Natural gas = 75%, Electricity = 23%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 71%, Electricity = 26%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,230	0,050
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	77,2	26,9	23,1
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	4,6	2,2	1,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	84,0	56,0	30,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	115,4	43,0	36,4
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	168,2	48,9	43,4
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.141. Archetype – residential building (AB), climatic zone C2 (Catalonia Region), construction period > 2007

CATALAN EPC DATABASE - C2_RES_AB_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	2,760	1,660	1,050
	Thermally heated gross volume	$V_{H;g}$	m^3	190	60	43
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	73	22	17
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	18	4	3
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	0,510	0,120	0,100
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	3,580	0,20	0,180
Technical building system	Energy carrier per space heating	Natural gas = 53%, Electricity = 46%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 50%, Electricity = 49%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,980	0,460	0,210
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	53,8	21,2	19,5
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	5,0	2,8	2,1
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	84,0	28,0	34,5
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	74,7	35,3	31,2
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	124,1	45,3	40,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.142. Archetype - residential building (SFH), climatic zone C2 (Catalonia Region), construction period 1937-1960

CATALAN EPC DATABASE - C2_RES_SFH_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	1,140	0,440	0,230
Geometry	Thermally heated gross volume	$V_{H;g}$	m^3	263	126	78
Geometry	Thermally heated floor area	$A_{H;use;ztc}$	m^2	96	45	28
Geometry	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	18	6	5
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,630	0,250	0,250
Envelope	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	4,310	0,690	0,590
Technical building system	Energy carrier per space heating	Natural gas = 68%, Electricity = 15%				
Technical building system	Energy carrier per space cooling	Electricity = 100%				
Technical building system	Energy carrier per domestic hot water	Natural gas = 49%, Electricity = 30%				
Technical building system	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,150	0,110
Technical building system	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
Technical building system	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	139,1	32,2	30,7
Energy indicators	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	6,9	3,3	2,3
Energy indicators	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	112,0	34,8	32,0
Energy indicators	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
Energy indicators	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
Energy indicators	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
Energy indicators	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	202,0	56,5	52,1
Energy indicators	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
Energy indicators	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
Energy indicators	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	258,6	65,0	60,5
Energy indicators	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
Energy indicators	Renewable Energy Ratio	RER	%	-	-	-

Table B.143. Archetype – residential building (SFH), climatic zone C2 (Catalonia Region), construction period 1961-1980

CATALAN EPC DATABASE - C2_RES_SFH_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	1,000	0,340	0,190
	Thermally heated gross volume	$V_{H;g}$	m^3	267	125	77
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	100	46	28
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	20	6	4
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,560	0,300	0,250
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	4,140	0,820	0,530
Technical building system	Energy carrier per space heating	Natural gas = 55%, Electricity = 14%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 38%, Electricity = 30%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,060	0,110
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	151,5	35,2	32,8
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	7,7	3,3	2,4
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	112,0	38,0	28,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	216,5	59,2	54,6
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	274,9	67,5	63,2
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.144. Archetype – residential building (SFH), climatic zone C2 (Catalonia Region), construction period 1981-2006

CATALAN EPC DATABASE - C2_RES_SFH_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	1,180	0,430	0,270
	Thermally heated gross volume	$V_{H;g}$	m^3	336	107	79
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	128	39	29
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	20	5	4
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,160	0,280	0,530
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	3,780	0,250	0,340
Technical building system	Energy carrier per space heating	Natural gas = 56%, Electricity = 16%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 50%, Electricity = 22%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,060	0,090
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	125,3	33,4	28,7
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	5,4	2,6	1,8
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	126,0	42,0	26,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	183,5	53,2	47,6
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	228	60,5	55,1
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.145. Archetype – residential building (SFH), climatic zone C2 (Catalonia Region), construction period > 2007

CATALAN EPC DATABASE - C2_RES_SFH_CP6						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	1,260	0,740	0,290
	Thermally heated gross volume	$V_{H;g}$	m^3	380	132	84
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	140	45	30
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	23	7	5
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2·K)$	0,510	0,120	0,190
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2·K)$	3,440	0,340	0,890
Technical building system	Energy carrier per space heating	Natural gas = 46%, Electricity = 38%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 42%, Electricity = 43%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,880	0,710	0,110
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	74,4	30,9	38,6
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	6,3	3,9	2,3
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	130,0	38,0	18,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	96,1	53,5	61,5
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	131,7	62,7	75,1
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.146. Archetype – non-residential building (TRY), climatic zone C2 (Catalonia Region), construction period 1937-1960

CATALAN EPC DATABASE - C2_TRY_CP3						
	Data	**Symbol**	**Unit of measure**	**Median**	**($Q_3 - Q_2$)**	**($Q_2 - Q_1$)**
Geometry	Compactness ratio	CR	m^{-1}	2,030	1,050	0,400
	Thermally heated gross volume	$V_{H;g}$	m^3	585	4392	389
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	198	1519	130
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	18	7	6
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,340	0,310	0,200
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	5,080	0,620	1,110
Technical building system	Energy carrier per space heating	Natural gas = 40%, Electricity = 57%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 24%, Electricity = 73%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	1,410	0,710	0,320
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	84,9	22,3	28,9
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	10,7	10,2	9,3
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	10,0	50,0	10,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	108,7	27,4	40,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	208,3	58,9	59,3
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.147. Archetype - non-residential building (TRY), climatic zone C2 (Catalonia Region), construction period 1961-1980

CATALAN EPC DATABASE - C2_TRY_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	2,090	1,030	0,500
	Thermally heated gross volume	$V_{H;g}$	m^3	400	2449	227
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	142	854	80
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	17	10	6
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,260	0,310	0,190
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	5,460	0,240	1,500
Technical building system	Energy carrier per space heating	Natural gas = 44%, Electricity = 55%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 20%, Electricity = 77%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	1,410	0,520	0,130
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	81,6	25,6	25,3
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	10,6	11,8	9,2
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	11,5	63,5	11,5
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	103,8	37,0	37,6
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	191,8	71,7	51,7
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.148. Archetype – non-residential building (TRY), climatic zone C2 (Catalonia Region), construction period 1981-2006

CATALAN EPC DATABASE - C2_TRY_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	2,300	1,130	0,670
	Thermally heated gross volume	$V_{H;g}$	m^3	1556	8970	1270
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	502	2558	404
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	17	10	6
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,110	0,220	0,280
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	4,140	1,560	0,440
Technical building system	Energy carrier per space heating	Natural gas = 29%, Electricity = 70%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 23%, Electricity = 72%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	1,440	0,750	0,140
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	77,3	29,0	26,0
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	16,5	13,0	11,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	36,0	220,0	36,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	95,5	41,2	38,5
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	200,5	80,6	53,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.149. Archetype – residential building (AB), climatic zone C3 (Catalonia Region), construction period 1961-1980

CATALAN EPC DATABASE - C3_RES_AB_CP4						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	2,830	1,310	1,260
	Thermally heated gross volume	$V_{H;g}$	m^3	181	54	53
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	70	20	20
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	19	8	4
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,490	0,380	0,270
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	4,630	0,540	0,850
Technical building system	Energy carrier per space heating	Natural gas = 81%, Electricity = 17%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 37%, Electricity = 55%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,560	0,110
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	97,2	29,1	24,5
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	15,9	4,1	3,6
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	88,0	32,0	32,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	132,6	42,2	34,9
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	219,9	51,9	45,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.150. Archetype – residential building (AB), climatic zone C3 (Catalonia Region), construction period 1981-2006

CATALAN EPC DATABASE - C3_RES_AB_CP5						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	2,710	1,770	1,170
	Thermally heated gross volume	$V_{H;g}$	m^3	182	46	48
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	71	18	19
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	18	5	3
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	0,990	0,220	0,440
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,780	0,570	0,110
Technical building system	Energy carrier per space heating	Natural gas = 62%, Electricity = 35%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 38%, Electricity = 58%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	1,000	0,330	0,230
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	84,0	25,7	22,2
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	13,7	3,6	3,0
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	84,0	28,0	28,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	117,1	39,4	33,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	203,0	45,8	44,3
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.151. Archetype – residential building (SFH), climatic zone C3 (Catalonia Region), construction period 1981-2006

CATALAN EPC DATABASE - C3_RES_SFH_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	*CR*	m^{-1}	1,110	0,400	0,260
	Thermally heated gross volume	$V_{H;g}$	m^3	270	93	74
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	104	34	29
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	20	6	4
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,070	0,200	0,400
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,780	0,650	0,20
Technical building system	Energy carrier per space heating	Natural gas = 53%, Electricity = 22%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 29%, Electricity = 46%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,320	0,010
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	122,9	32,7	29,7
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	17,1	3,9	3,8
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	112,0	28,0	28,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	171,1	49,5	48,0
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	239,2	60,4	56,8
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	*RER*	%	-	-	-

Table B.152. Archetype - residential building (AB), climatic zone D2 (Catalonia Region), construction period 1961-1980

CATALAN EPC DATABASE - D2_RES_AB_CP4						
	Data	Symbol	Unit of measure	Median	$(Q_3 - Q_2)$	$(Q_2 - Q_1)$
Geometry	Compactness ratio	CR	m^{-1}	2,820	1,340	1,210
	Thermally heated gross volume	$V_{H;g}$	m^3	198	50	34
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	76	19	13
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	17	4	3
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,530	0,340	0,240
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	4,220	0,780	0,470
Technical building system	Energy carrier per space heating	Natural gas = 88%, Electricity = 9%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 73%, Electricity = 21%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,060	0,110
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	131,8	35,0	29,8
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	5,3	2,0	1,7
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	112,0	28,0	28,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	196,6	56,4	46,8
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	265,6	58,5	55,6
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.153. Archetype – residential building (AB), climatic zone D2 (Catalonia Region), construction period 1981-2006

CATALAN EPC DATABASE - D2_RES_AB_CP5						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	3,070	1,690	1,360
	Thermally heated gross volume	$V_{H;g}$	m^3	195	40	39
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	76	15	16
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	17	3	3
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2{\cdot}K)$	1,000	0,240	0,490
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2{\cdot}K)$	3,780	0,000	0,340
Technical building system	Energy carrier per space heating	Natural gas = 83%, Electricity = 15%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 78%, Electricity = 20%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,770	0,060	0,110
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	110,4	27,6	26,2
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	4,3	2,0	1,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	112,0	13,0	32,0
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	171,4	48,7	43,1
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	230,2	52,0	49,3
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Table B.154. Archetype – residential building (AB), climatic zone D3 (Catalonia Region), construction period 1961-1980

CATALAN EPC DATABASE - D3_RES_AB_CP4						
	Data	**Symbol**	**Unit of measure**	**Median**	**$(Q_3 - Q_2)$**	**$(Q_2 - Q_1)$**
Geometry	Compactness ratio	CR	m^{-1}	3,000	1,410	1,250
	Thermally heated gross volume	$V_{H;g}$	m^3	224	70	43
	Thermally heated floor area	$A_{H;use;ztc}$	m^2	86	26	16
	Transparent thermal envelope area on thermal envelope area	A_{wi}/A_{env}	%	15	4	3
Envelope	Mean thermal transmittance of opaque building envelope	U_{op}	$W/(m^2 \cdot K)$	1,510	0,370	0,210
	Mean thermal transmittance of transparent building envelope	U_{wi}	$W/(m^2 \cdot K)$	4,220	0,780	0,550
Technical building system	Energy carrier per space heating	Natural gas = 80%, Electricity = 9%				
	Energy carrier per space cooling	Electricity = 100%				
	Energy carrier per domestic hot water	Natural gas = 73%, Electricity = 18%				
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	0,740	0,040	0,120
	Mean seasonal efficiency of the heating generation sub-system	$\eta_{H;gn}$	–	-	-	-
	Utilisation energy efficiency	$\eta_{H;u}$	–	-	-	-
Energy indicators	Energy need for space heating	$EP_{H;nd;ztc}$	kWh/m^2	128,3	27,8	28,6
	Energy need for space cooling	$EP_{C;nd;ztc}$	kWh/m^2	13,2	3,6	2,9
	Energy need for domestic hot water	$EP_{W;nd;ztc}$	kWh/m^2	112,0	38,0	49,3
	Seasonal space heating energy efficiency	$\eta_{s;H}$	–	-	-	-
	Seasonal space cooling energy efficiency	$\eta_{s;C}$	–	-	-	-
	Seasonal domestic hot water energy efficiency	$\eta_{s;W}$	–	-	-	-
	Non-renewable energy performance per space heating	$EP_{H;nren}$	kWh/m^2	209,5	48,6	52,3
	Non-renewable energy performance per space cooling	$EP_{C;nren}$	kWh/m^2	-	-	-
	Non-renewable energy performance per domestic hot water	$EP_{W;nren}$	kWh/m^2	-	-	-
	Overall non-renewable energy performance	$EP_{gl;nren}$	kWh/m^2	276,3	55,3	57,0
	Overall renewable energy performance	$EP_{gl;ren}$	kWh/m^2	-	-	-
	Renewable Energy Ratio	RER	%	-	-	-

Annex C - Confidence intervals and kernel density distribution of input data

Table of Annex C contents

C1 Confidence intervals of input data for SFH in Piemonte

Table C.1. The confidence interval of thermal transmittance of the opaque and transparent building envelopes (SFH-Piemonte)

SFH	U_{op} [W/(m²·K)]			U_{wi} [W/(m²·K)]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	1,259 ± 0,45	1,250	1,268	3,234 ± 1,30	3,209	3,260
CP2	1,243 ± 0,45	1,225	1,261	3,209 ± 1,25	3,159	3,258
CP3	1,216 ± 0,44	1,205	1,227	3,170 ± 1,30	3,138	3,203
CP4	1,114 ± 0,45	1,104	1,125	2,960 ± 1,29	2,929	2,991
CP5	1,019 ± 0,42	1,009	1,030	2,872 ± 1,32	2,840	2,905
CP6	0,970 ± 0,38	0,959	0,981	2,678 ± 1,14	2,645	2,712
CP7	0,830 ± 0,33	0,820	0,840	2,390 ± 0,81	2,366	2,415
CP8	0,447 ± 0,30	0,439	0,456	1,749 ± 0,68	1,730	1,769

Table C.2. The confidence interval of A_{wi}/A_{env} and *CR* (SFH-Piemonte)

SFH	A_{wi}/A_{env} [-]			*CR* [m⁻¹]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	0,06 ± 0,04	0,059	0,061	0,77 ± 0,26	0,767	0,776
CP2	0,07 ± 0,16	0,057	0,079	0,79 ± 1,06	0,754	0,828
CP3	0,06 ± 0,05	0,06	0,064	0,77 ± 0,49	0,763	0,784
CP4	0,07 ± 0,18	0,062	0,077	0,81 ± 0,90	0,789	0,828
CP5	0,07 ± 0,06	0,068	0,074	0,83 ± 1,11	0,805	0,854
CP6	0,07 ± 0,04	0,065	0,069	0,80 ± 0,28	0,789	0,804
CP7	0,07 ± 0,04	0,067	0,072	0,77 ± 0,91	0,745	0,794
CP8	0,06 ± 0,04	0,066	0,069	0,90 ± 7,69	0,710	1,090

C2 Confidence intervals of input data for BU(AB) in Piemonte

Table C.3. The confidence interval of thermal transmittance of the opaque and transparent building envelopes (BU(AB)-Piemonte)

BU(AB)	U_{op} [W/(m²·K)]			U_{wi} [W/(m²·K)]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	1,248 ± 0,45	1,244	1,253	3,119 ± 1,23	3,106	3,131
CP2	1,248 ± 0,44	1,240	1,256	3,232 ± 1,24	3,210	3,254
CP3	1,266 ± 0,44	1,261	1,271	3,218 ± 1,22	3,204	3,231
CP4	1,191 ± 0,41	1,188	1,194	3,280 ± 1,26	3,270	3,289
CP5	1,161 ± 0,38	1,159	1,164	3,327 ± 1,31	3,319	3,335
CP6	1,105 ± 0,39	1,101	1,109	3,075 ± 1,13	3,063	3,087
CP7	0,869 ± 0,34	0,864	0,873	2,619 ± 0,73	2,609	2,628
CP8	0,530 ± 0,33	0,526	0,534	2,012 ± 0,75	2,003	2,021

Table C.4. The confidence interval of A_{wi}/A_{env} and *CR* (BU(AB)-Piemonte)

BU(AB)	A_{wi}/A_{env} [-]			*CR* [m⁻¹]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	0,11 ± 0,24	0,102	0,109	0,61 ± 1,05	0,605	0,623
CP2	0,12 ± 0,09	0,115	0,120	0,56 ± 0,45	0,549	0,563
CP3	0,13 ± 0,48	0,124	0,140	0,58 ± 1,92	0,559	0,596
CP4	0,15 ± 0,51	0,144	0,156	0,52 ± 0,65	0,519	0,527
CP5	0,15 ± 0,26	0,146	0,151	0,52 ± 1,28	0,512	0,526
CP6	0,12 ± 0,27	0,117	0,126	0,58 ± 0,56	0,577	0,588
CP7	0,12 ± 0,09	0,117	0,121	0,59 ± 0,58	0,587	0,600
CP8	0,12 ± 0,11	0,115	0,119	0,60 ± 0,59	0,594	0,607

C3 Confidence intervals of input data for office buildings in Piemonte

Table C.5. The confidence interval of thermal transmittance of the opaque and transparent building envelopes (OFF-Piemonte)

OFF	U_{op} [W/(m²·K)]			U_{wi} [W/(m²·K)]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	1,201 ± 0,39	1,182	1,221	3,347 ± 1,28	3,282	3,413
CP2	1,213 ± 0,37	1,174	1,253	3,557 ± 1,36	3,413	3,701
CP3	1,198 ± 0,41	1,170	1,226	3,391 ± 1,29	3,302	3,480
CP4	1,180 ± 0,38	1,159	1,201	3,532 ± 1,31	3,459	3,604
CP5	1,186 ± 0,44	1,169	1,204	3,637 ± 1,40	3,580	3,694
CP6	1,122 ± 0,47	1,093	1,152	3,317 ± 1,21	3,241	3,394
CP7	0,993 ± 0,50	0,963	1,022	3,002 ± 0,95	2,946	3,059
CP8	0,625 ± 0,42	0,597	0,653	2,224 ± 0,92	2,162	2,286

Table C.6. The confidence interval of A_{wi}/A_{env} and CR (E_2: office buildings-Piemonte)

OFF	A_{wi}/A_{env} [-]			CR [m⁻¹]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	0,092 ± 0,07	0,086	0,097	0,51 ± 0,15	0,507	0,520
CP2	0,096 ± 0,06	0,087	0,106	0,51 ± 0,14	0,502	0,526
CP3	0,090 ± 0,06	0,084	0,096	0,54 ± 0,15	0,526	0,544
CP4	0,107 ± 0,09	0,099	0,114	0,59 ± 0,15	0,582	0,596
CP5	0,148 ± 0,14	0,140	0,156	0,58 ± 0,31	0,567	0,589
CP6	0,098 ± 0,08	0,091	0,105	0,62 ± 0,16	0,610	0,628
CP7	0,118 ± 0,09	0,111	0,126	0,60 ± 0,15	0,592	0,607
CP8	0,104 ± 0,09	0,096	0,113	0,64 ± 0,17	0,626	0,646

C4 Confidence intervals of input data for educational buildings in Piemonte

Table C.7. The confidence interval of thermal transmittance of the opaque and transparent building envelopes (EDUC-Piemonte)

EDUC	U_{op} [W/(m²·K)]			U_{wi} [W/(m²·K)]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	1,040 ± 0,40	0,960	1,121	3,247 ± 1,13	3,016	3,477
CP2	1,115 ± 0,28	1,007	1,224	3,243 ± 1,14	2,805	3,681
CP3	1,027 ± 0,40	0,932	1,122	3,025 ± 1,32	2,713	3,336
CP4	1,045 ± 0,34	0,980	1,111	3,284 ± 1,27	3,039	3,529
CP5	0,997 ± 0,41	0,942	1,051	3,130 ± 1,34	2,951	3,309
CP6	0,905 ± 0,37	0,848	0,962	3,134 ± 1,20	2,946	3,322
CP7	0,863 ± 0,38	0,762	0,964	2,975 ± 1,06	2,689	3,261
CP8	0,354 ± 0,22	0,299	0,409	1,703 ± 0,58	1,558	1,847

Table C.8. The confidence interval of A_{wi}/A_{env} and CR (EDUC-Piemonte)

EDUC	A_{wi}/A_{env} [-]			CR [m^{-1}]		
	Mean ± SD	95% CI		Mean ± SD	95% CI	
		LL	UL		LL	UL
CP1	0,082 ± 0,03	0,072	0,091	0,46 ± 0,10	0,442	0,475
CP2	0,079 ± 0,02	0,065	0,092	0,51 ± 0,12	0,470	0,552
CP3	0,128 ± 0,13	0,082	0,174	0,51 ± 0,11	0,489	0,537
CP4	0,096 ± 0,03	0,087	0,104	0,50 ± 0,11	0,483	0,522
CP5	0,106 ± 0,04	0,098	0,114	0,49 ± 0,10	0,480	0,504
CP6	0,087 ± 0,03	0,081	0,093	0,55 ± 0,12	0,530	0,563
CP7	0,087 ± 0,04	0,075	0,098	0,58 ± 0,11	0,554	0,608
CP8	0,079 ± 0,04	0,680	0,090	0,59 ± 0,10	0,565	0,612

C5 Kernel density distribution of input data for SFH in Piemonte

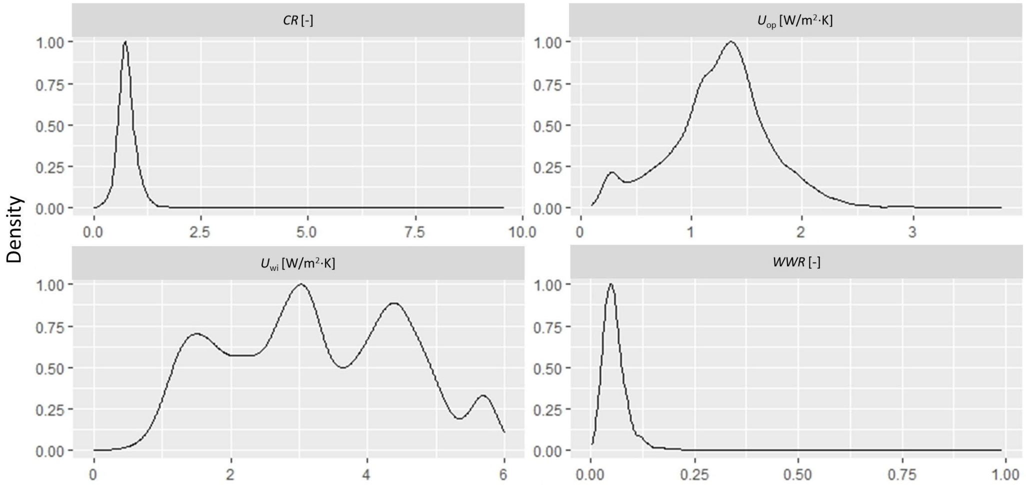

Figure C.1. Kernel density functions of input data for SFH-Piemonte - CP1

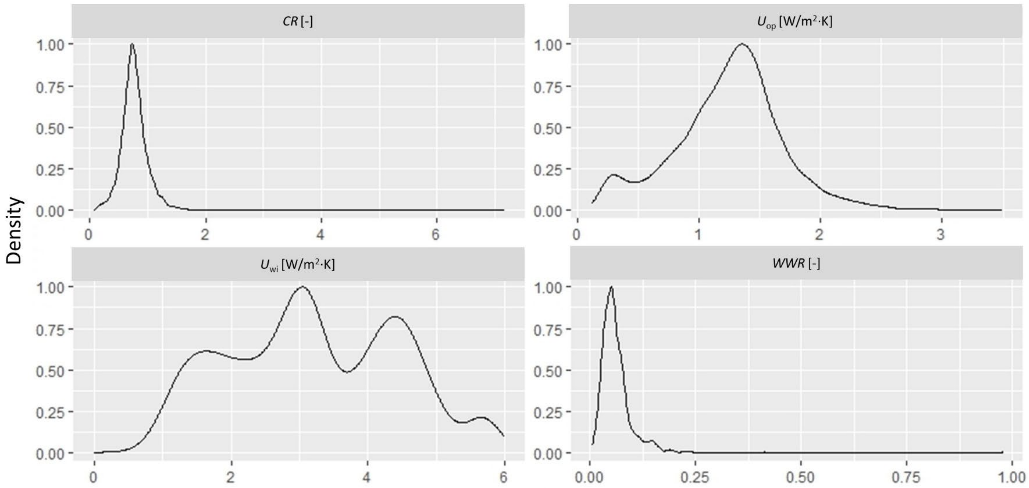

Figure C.2. Kernel density functions of input data for SFH-Piemonte - CP2

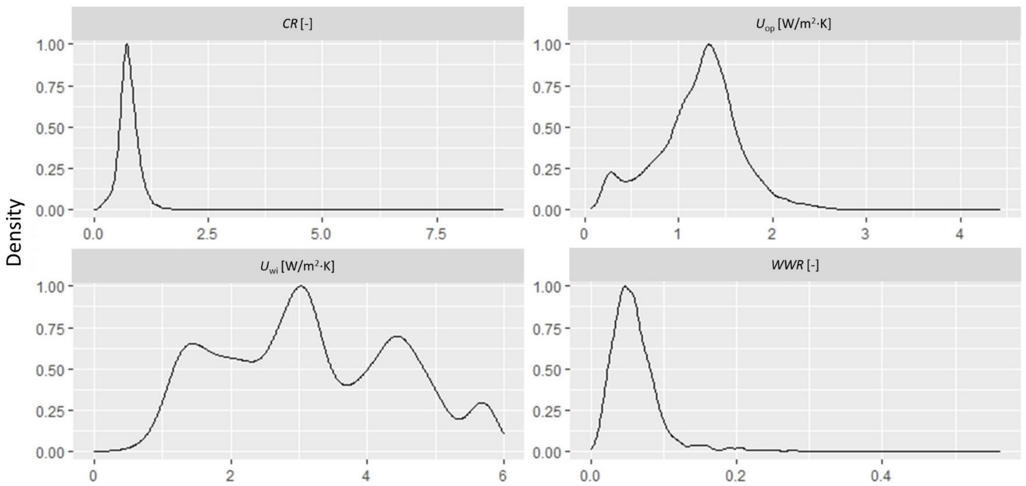

Figure C.3. Kernel density functions of input data for SFH-Piemonte - CP3

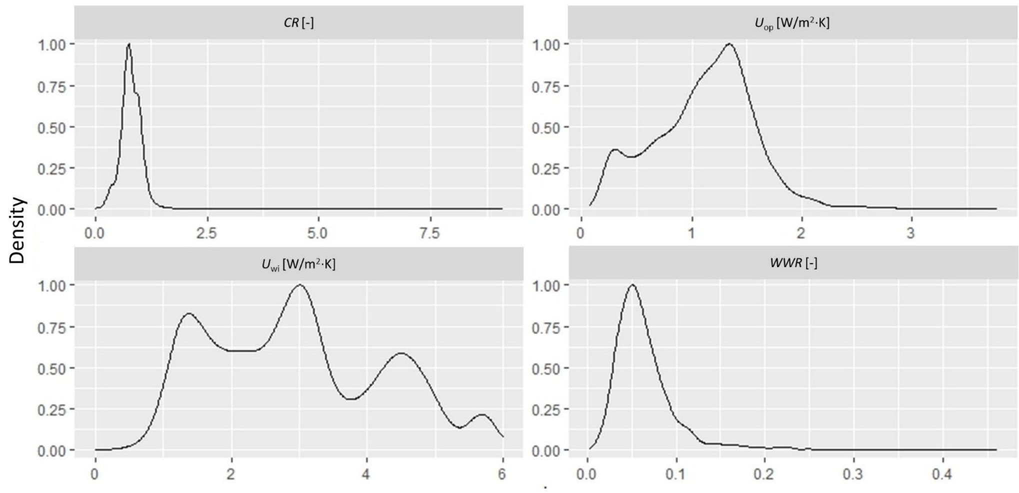

Figure C.4. Kernel density functions of input data for SFH-Piemonte - CP4

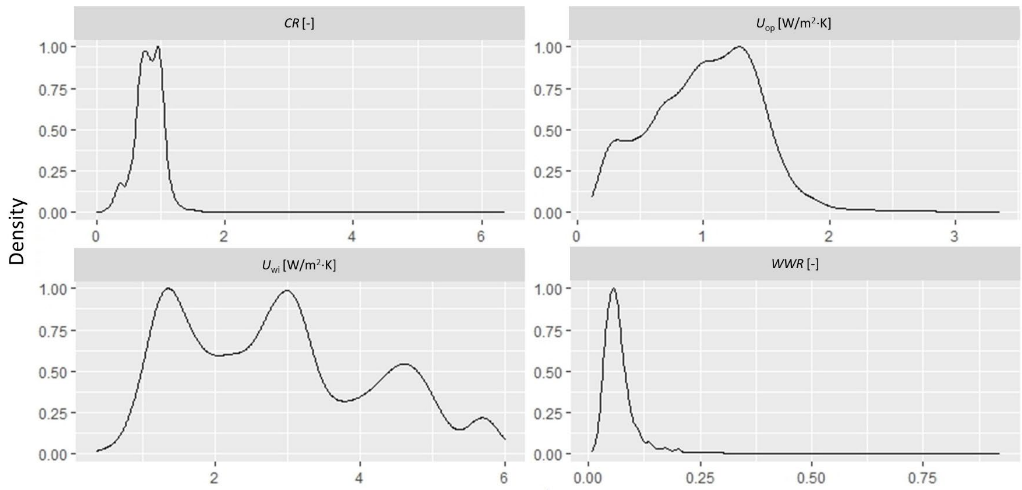

Figure C.5. Kernel density functions of input data for SFH-Piemonte - CP5

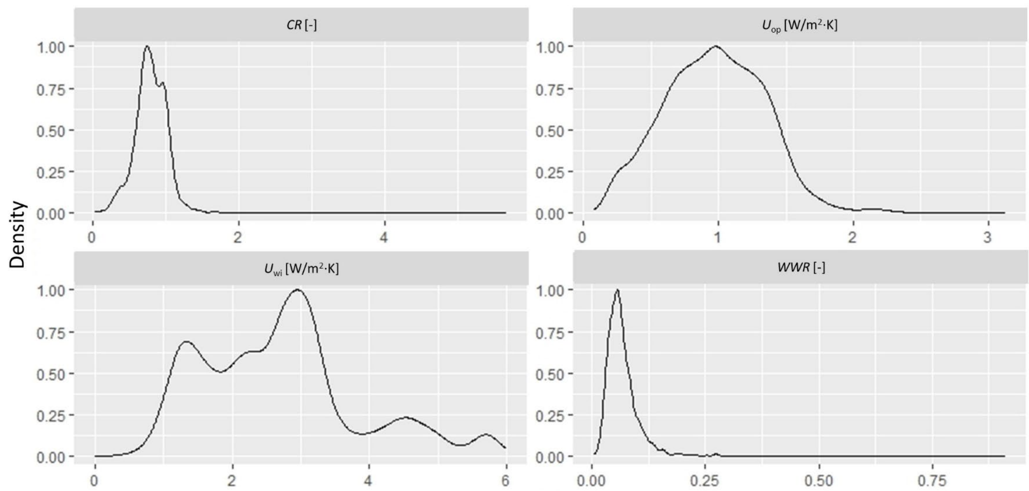

Figure C.6. Kernel density functions of input data for SFH-Piemonte - CP6

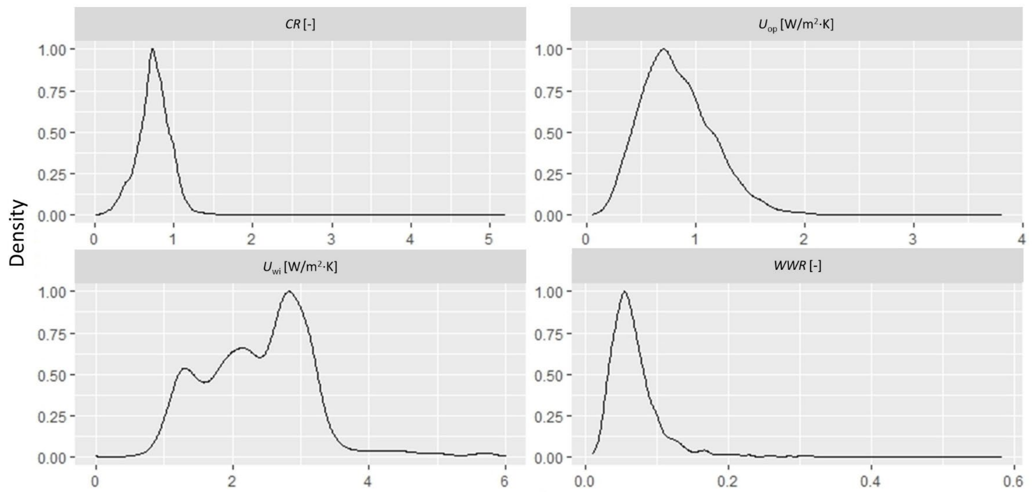

Figure C.7. Kernel density functions of input data for SFH-Piemonte - CP7

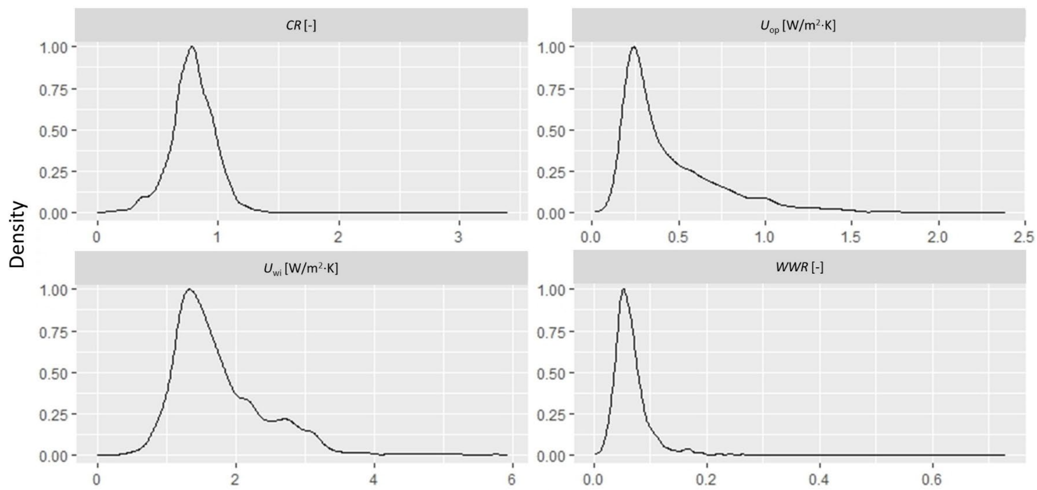

Figure C.8. Kernel density functions of input data for SFH-Piemonte - CP8

C6 Kernel density distribution of input data for BU(AB) in Piemonte

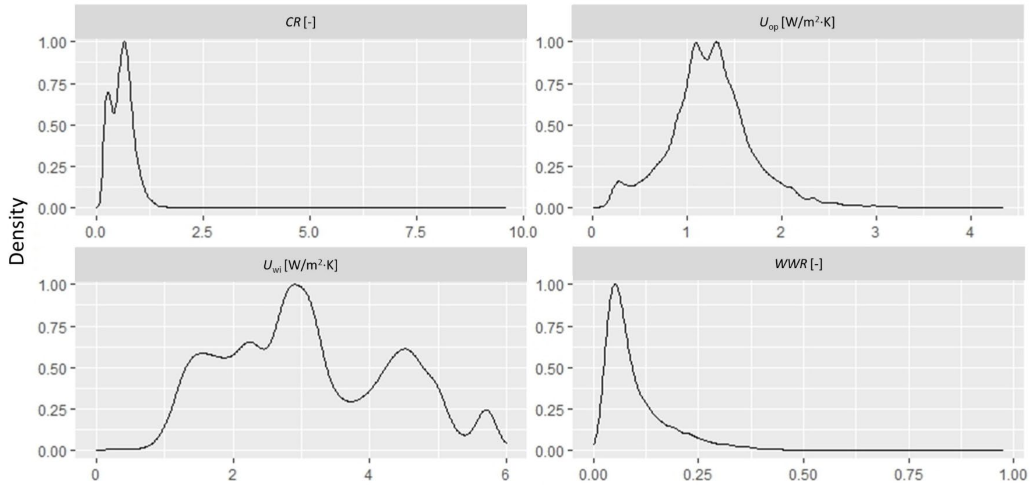

Figure C.9. Kernel density functions of input data for BU(AB)-Piemonte – CP1

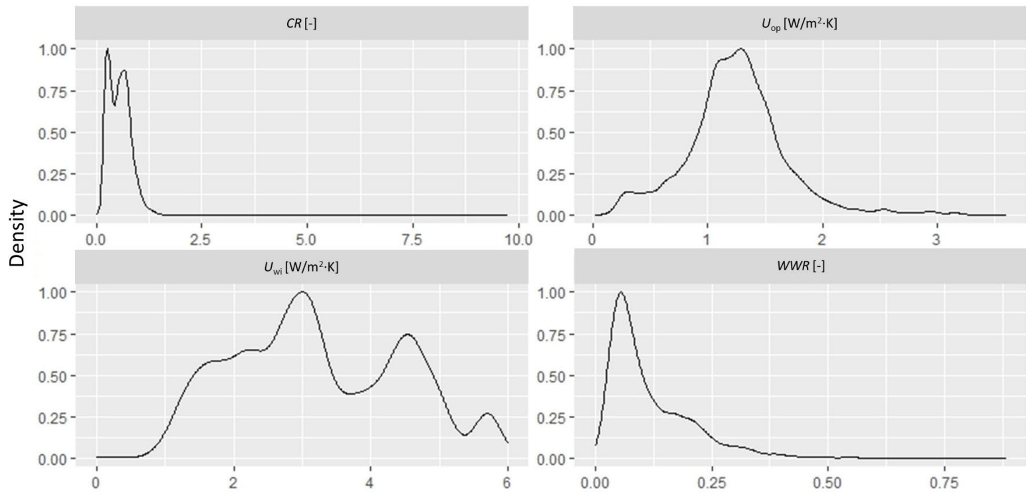

Figure C.10. Kernel density functions of input data for BU(AB)-Piemonte – CP2

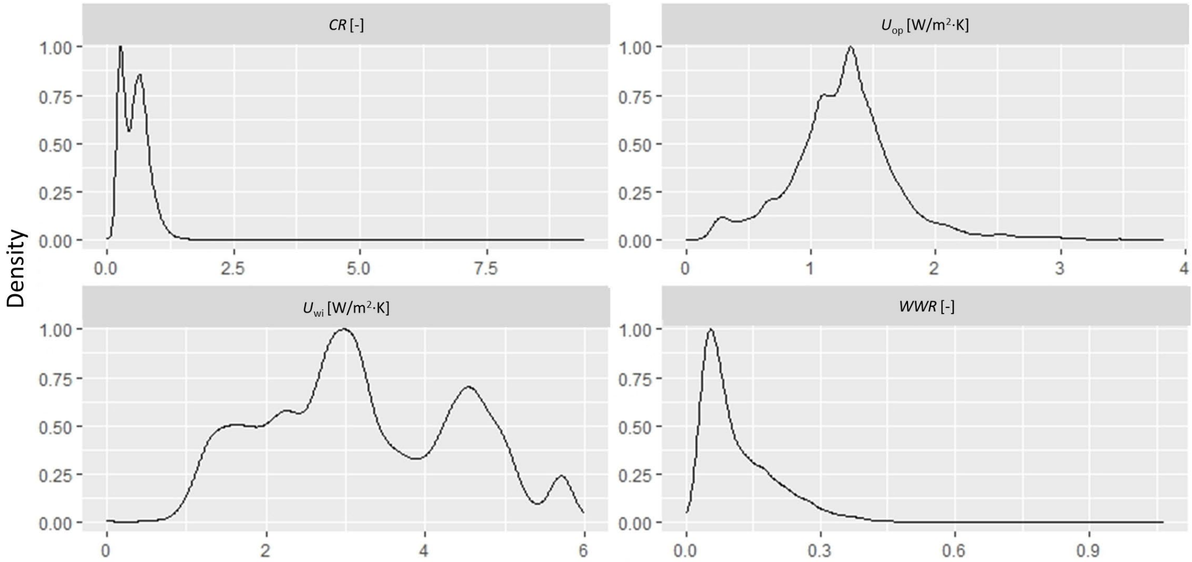

Figure C.11. Kernel density functions of input data for BU(AB)-Piemonte – CP3

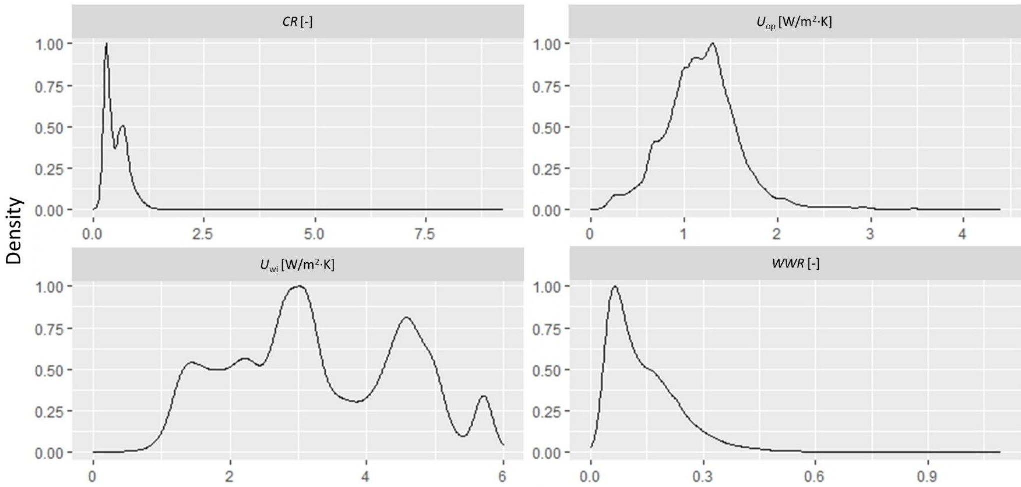

Figure C.12. Kernel density functions of input data for BU(AB)-Piemonte – CP4

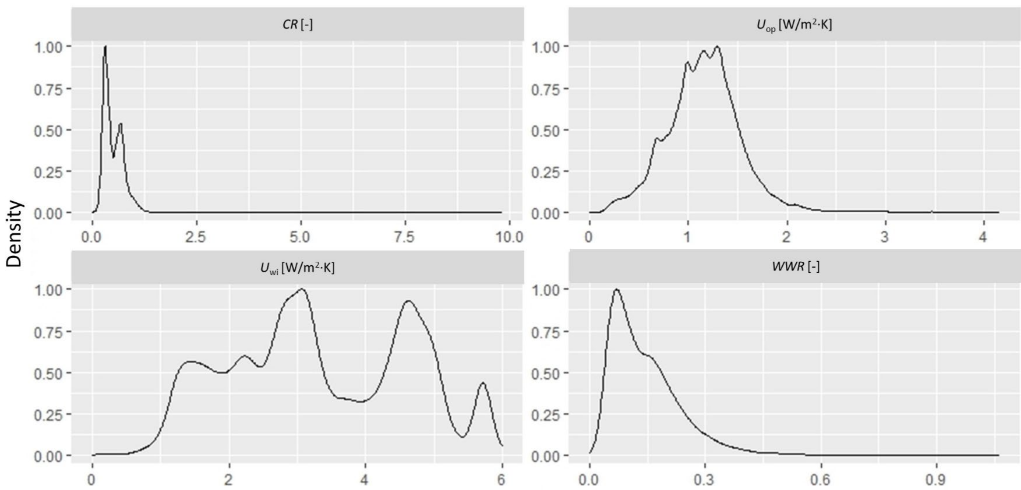

Figure C.13. Kernel density functions of input data for BU(AB)-Piemonte – CP5

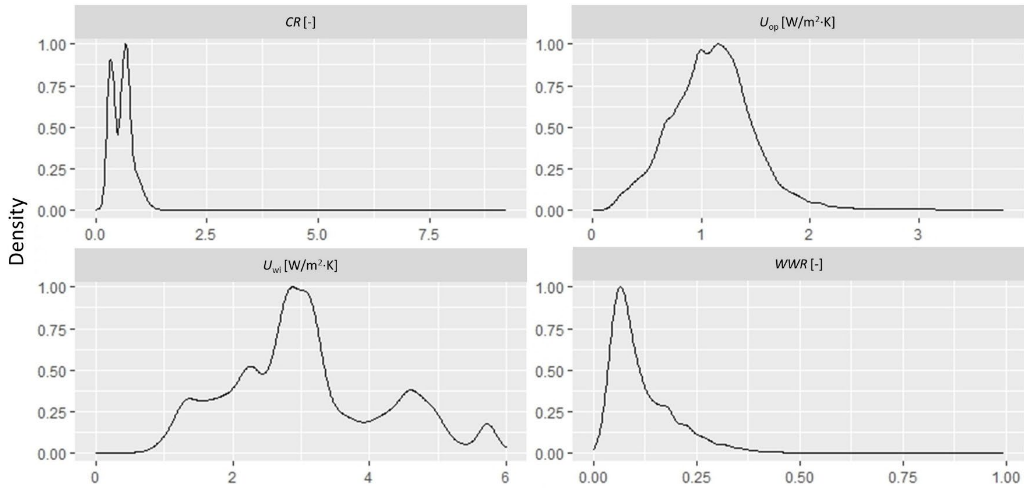

Figure C.14. Kernel density functions of input data for BU(AB)-Piemonte – CP6

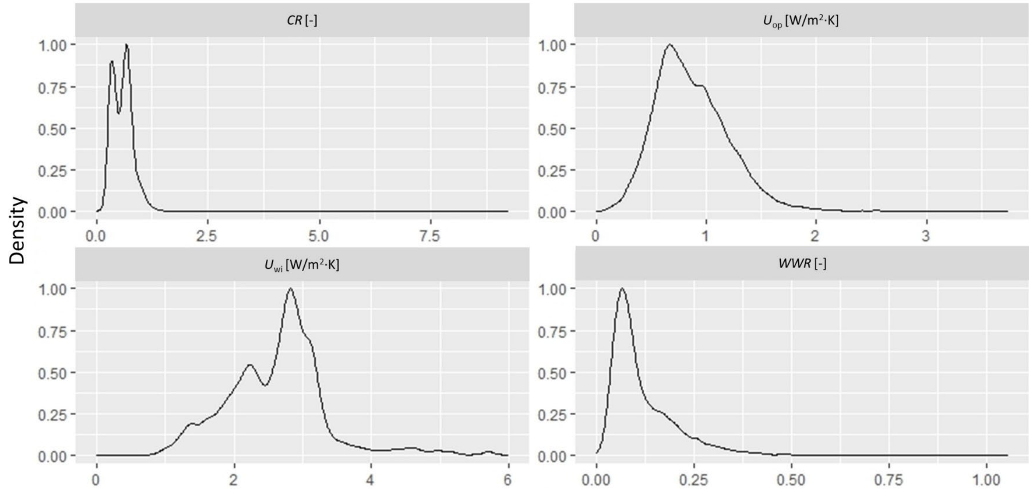

Figure C.15. Kernel density functions of input data for BU(AB)-Piemonte – CP7

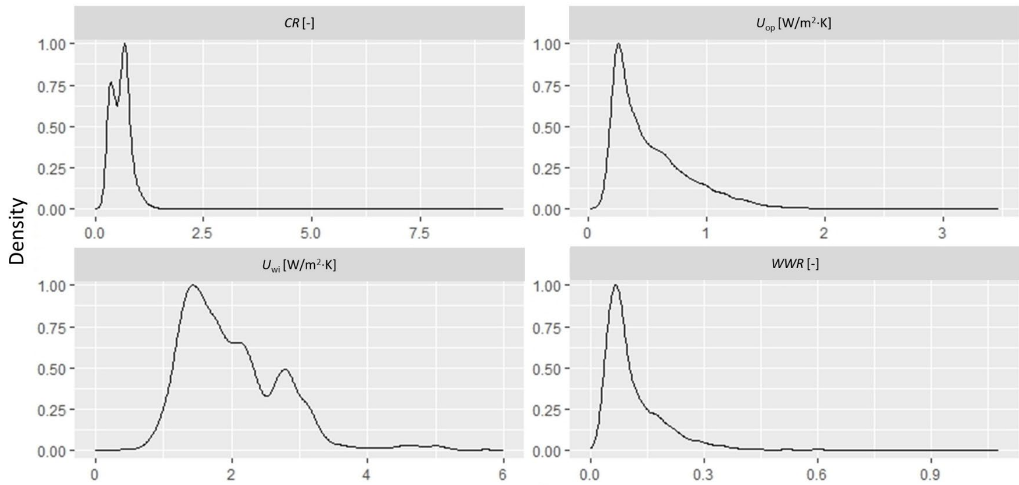

Figure C.16. Kernel density functions of input data for BU(AB)-Piemonte – CP8