



Next-generation of Energy Performance
Assessment and Certification

D2.3 Recent EPC initiatives across Europe 3rd version

Task 2.1 Review results from previous projects
WP2 Cross assessing EPC paradigms

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EXECUTIVE SUMMARY

The objective of this document is to help the Consortium to identify, evaluate and use the results of previous and current European projects that have also worked towards the enhancement of the Energy Performance Certification. It outlines the procedure and methods that crossCert partners follow to extract the most relevant outcomes of sister or analogous projects that were funded by European programmes.

The outputs of each aforementioned project are classified according to crossCert's axes. In particular, the document retrieves the information from those projects that have tested the current EPCs at a country level and/or have introduced improvements and/or have proposed new approaches, from projects that have worked with new Key Performance Indicators or have tested new software for the energy assessment of buildings. Finally, the document includes sections that refer to the human factor, for example, the updated training of the engineers, the marketing of the EPCs and the improved relation between EPCs and the building owners. It contains also a brief description of each project as well as contact details.

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1 Introduction

The EU research and innovation programmes have funded a number of initiatives related to the enhancement of the current Energy Performance Certification framework. Several projects are dealing with the development of the next-generation of Energy Performance Certificates (EPCs) trying to solve some outstanding issues with the current EPCs schemes, to address the broader concepts related to EPCs, such as building renovation roadmaps and one-stop-shops. The projects initiated from the European regional cooperation programmes have dealt with the support of local and regional authorities in public building renovation by energy and financial assessment or training tools.

Deliverable 2.3 is related to WP2 “Cross assessing EPC paradigms”. This document compiles the results of European projects to determine the starting point of the project related to the similar work already done by those consortiums either referred to as progress or as barriers towards the harmonization of EPCs across EU countries. crossCert partners assess previous projects in respect of lessons learned, EPC developments and new EPC approaches. In that way, the previous work that was funded by the European Union will be capitalised and each crossCert partner will have yeast to start processing the EPCs convergence issues.

This European project review has been performed in 3 rounds throughout crossCert lifetime to include all new approaches and developments that will be tested in the cross-assessment rounds within Task 2.3 and on the other hand to include the gained knowledge in the crossCert EPC Knowledge Exchange Center to be developed within Task 6.2.

crossCert’s Work Packages 2, 3, 4 and 5 will get any valuable input, test, analyse and compare the lessons learned, the methodologies and the recommendations and proposals of the projects, their prototypes and improvements or the people-centred dimension. WP7 will be the facilitator for the data gathering through the networking activities, while WP6 will filter and concentrate all the recommendations towards harmonized EPCs across Europe.

2 Assessment of previous projects - overview

This section describes the scope of the review, the preparatory work that has been done as well as the time frame of its implementation and the required contribution from the project partners.

2.1 The review of relevant EU funded projects

The Energy Performance Certification of buildings framework is very heterogeneous across Europe. There are, at least, 30 calculation methodologies (software) used in the EPC schemes across Europe. Such fragmentation in the EPC schemes greatly hinders the achievement of the common ambitious building renovation objectives of the European Union.

In the last few years, several H2020 projects have been launched to address these issues. Other projects have addressed concepts related to the next-generation of EPCs such as building renovation roadmaps, European Voluntary Scheme Certificates, new indicators and scales, market recognition of energy building renovation or engagement of end-users through people-centred platforms. Furthermore, some projects have created tools to support public authorities in the renovation of their public buildings.

One of the challenges that crossCert had to face is to take on board the lessons learned and the innovative approaches demonstrated in the previous projects, as well as any developments on the use of EPCs that have taken place in the Member States in order to further stimulate and enable the roll-out of next-generation energy performance assessment and certification. crossCert builds on the large effort already carried out across Europe by preceding initiatives and can take on board the gained knowledge and analyse and compare the new EPC approaches proposed.

2.2 The European projects linked with crossCert

NextGen EPC Cluster

The Next Generation Energy Performance Certificates cluster of sister projects, funded by the European Commission's research and innovation programmes, gathers 13 projects that started their activities in 4 successive generations:

- 2019: QualDeEPC, U-CERT & X-tendo
- 2020: D²EPC, E-DYCE, ePANACEA, EPC RECAST
- 2021: crossCert, EUB Super Hub, iBRoad2EPC, TIMEPAC
- 2022: CHRONICLE, SmartLivingEPC

The Projects in the Next Gen EPC cluster are continuously cooperating with each other, share results and organise common events to maximize quality, relevance, utility and effectiveness while avoiding reinventing the wheel and ensure a coordinated and convergent approach.

As shown in the list below, consortium partners are involved in several previous projects and thus can interact directly with the projects.

1. **QualDeEPC**: Enhanced Energy Performance Certification linked with deep renovation; crossCert partners participating: **CRES** [H2020, ends 2022]
2. **U-CERT**: User-Centred Energy Performance Assessment and Certification; crossCert partners participating: **NEFFECT, IRI UL** [H2020, ends 2022]
3. **X-tendo**: eXTENDING the energy performance assessment and certification schemes via a modular approach; crossCert partners participating: **CRES, KAPE** [H2020, ends 2022]

4. **ePANACEA**: Smart European Energy Performance Assessment and Certification; crossCert partners participating: **CRES** [H2020, ends 2023]
5. **E-DYCE**: Energy flexible DYnamic building Certification [H2020, ends 2023]
6. **D^2EPC**: Dynamic Digital Energy Performance Certificates; crossCert partners participating: AEA [H2020, ends 2023]
7. **EPC-RECAST**: Develops a process and a toolbox that will support the development, performance, and validation of new EPCs with particular focus on existing residential buildings with high retrofit needs. This project develops and consolidates methodologies and tools to support professionals real estate and building owners to invest more in building performance improvement. [H2020, ends 2023]
8. **iBROAD**: Individual Building Renovation Roadmaps; crossCert partners participating: **ENEFFECT, KAPE** [H2020, ends 2020]
9. **ALDREN**: Higher renovation rates by overcoming market barriers. Targets and supports investments in deep renovation. ALDREN proposes a transparent, consistent, common EU wide assessment framework to trigger more ambitious renovation projects through the inclusion of improved sustainability metrics in certifications and the use of decision-support protocols and tools. [H2020, ends 2020]
10. **TripleA-reno**: Acceptance and decision making on deep and nZE renovation attractive for consumers and end-users; crossCert partners participating: **IRI UL** [H2020, ends 2021]
11. **ECentral**: A tool to assess the possibility of energy renovations to meet the nZEB standard in public buildings; crossCert partners participating: **REGEA** [Interreg Central, ends 2021]
12. **PrioritEE-PLUS**: Online decision support tool for regional and local public authorities to carry out energy renovation measures in public buildings; crossCert partners participating: **CRES, REGEA, UNIZAR** [Interreg Med, 2022]
13. **EFFECT4buildings**: A toolbox with financial methods that can improve profitability, facilitate funding and reduce the risk of energy investments crossCert partners participating: **ECNET** [Interreg Baltic Sea Region, ends 2020]
14. **EUBSuperHub**: Scans and studies the current energy assessment schemes and certification methods. Develops common criteria to support the market penetration of certificates - creation of a harmonised certification process in the EU and will training energy and sustainability auditors on the new harmonized systems. [2021]
15. **SmartLivingEPC**: Aims to introduce a certificate that will be supplied by using digitised tools and retrieve the required assessment information for the building shell and building systems. The new certificate will be completely in line with digital logbooks and building renovation passports and will be applied to building complexes for energy certification at neighbourhood level. [2022]
16. **TIMEPAC**: Will improve existing energy certification processes and move to more holistic and dynamic approaches and will develop new methods and tools for data collection and analysis. EPCs will be enriched with concrete retrofitting solutions. Each scenario will be demonstrating to which extend the enhanced procedures contribute to improve reliability, effectiveness, user-friendliness, cost-effectiveness. [2021]
17. **MATRYCS**: Capitalises and combines existing technological breakthroughs in the areas of ML / DL and big data, to develop a new decision-making and data analytics solution for energy-efficient buildings. EREN [H2020, ends 2023]

At a first glance, crossCert will:

- test and analyse the lessons learned and proposals of **QualdeEPC** and will compare their performance with other project approaches;
- get the input from **U-CERT's** user-centred perspective for further enhancing the next-generation of EPCs concerning their people-centred dimension;
- test and analyse the **ePANACEA** prototype, compare the results with other approaches. The use of advanced models for the calculation of the building energy performance will be a valuable input;
- evaluate the **D^2EPC** approach, compare it with other EPC methodologies and make recommendations to improve its performance and to develop harmonized EPCs across Europe;
- assess the **E-DYCE** methodology and the EPC **RECAST** toolbox and compare with other EPC approaches to obtain recommendations for the next-generation of EPCs;
- analyse the output of **iBROAD** on how the next-generation of EPCs can support deep renovation measures and link with concepts such as logbooks and building renovation passports;
- compile the lessons learned in **ALDREN** regarding the creation of a harmonized energy performance rating, the association of energy renovation with health and comfort and the market recognition of the high-quality building renovation and the harmonization recommendations;
- advise **TripleA-reno** recommendations to make the next generation of people-centred EPCs;
- examine **PrioritEE's** and **eCentral's** user-friendly tool to develop guidelines and improvements;
- use the experience acquired in **EFFECT4buildings** to develop guidelines regarding the information provided to the end-user about the renovation measures and for their integration in one-stop-shops tools.

2.3 Tasks and Responsibilities

Some crossCert partners are participating (or will participate) in several projects, and this facilitates the data collection. The crossCert networking activities under WP7 (Task 7.4) will provide a forum for detailed, in-person interactions for those projects in which none of the crossCert partners are participating.

Table 1. Task Roles and Responsibilities

Task Roles and Responsibilities	
Task Leader (TL) - CRES	Project Partners (PP)
Coordinates the activities in collaboration with work package leaders and project partners.	ALL: Identify any current or previous related projects
Collects the previous project review templates from partners ensuring that all partners deliver substantial information.	ALL: Fill in the template for the projects they are aware of.
Extracts and analyses the information from the templates and compiles it into a report.	CA: Bridge crossCert with external projects to fill in the template

2.4 Time frame

The knowledge from the previous EU experience will be gained in 3 phases and will be delivered in Month 6, Month 12 and Month 18 to bring information to the first, second and third cross-assessment rounds of crossCert. In each phase, we will focus on projects that have already been finished so that they have concrete and mature outcomes.

These are the three phases:

- Phase 1: Assessment of EPC initiatives across Europe first round (M1-M6),
- Phase 2: Assessment of EPC initiatives across Europe second round (M7-M12)
- Phase 3: Assessment of EPC initiatives across Europe third round (M13-M18).

Table 2. Task implementation and deliverables per project phase

Phase	Time	Task Deliverables
1	Sept. 2021- Feb. 2022	D2.1: Recent EPC initiatives across Europe 1 st version (CRES), M6
2	March 2022-Aug 2022	D2.2: Recent EPC initiatives across Europe 2 nd version (CRES), M12
3	Sept. 2022- Feb. 2023	D2.3: Recent EPC initiatives across Europe 3 rd version (CRES), M18

3 Implementation

The process for the sister projects assessment is planned by CRES(TL) and UNIZAR(WPL), it will be supported and monitored by CRES and will be implemented in collaboration with all project partners. The methodology that is followed is based on a data collection template for each relevant EU project.

This section describes the aggregated results of the review, in the template's main categories. **The complete forms for further analysis can be found in crossCert's public repository.**

3.1 Basic information

For each project the initial basic information consists of the:

- Title/Acronym etc.
- The starting year.
- Countries addressed.
- Brief description.
- Contact info.

The list of projects reviewed until February 2023 is as follows:

Table 3. Detailed list of sister projects

Detailed List of sister projects			
Project	Partners	Year	Main topics
ALDREN , ALliance for Deep RENovation in Buildings		2017	Targets and supports investments in deep renovation. Proposes a transparent, consistent, common EU wide assessment framework to trigger more ambitious renovation projects through the inclusion of improved sustainability metrics in certifications and the use of decision-support protocols and tools.
D²EPC Next-generation Dynamic Digital EPCs for enhanced quality and user awareness *	AEA	2020	Next-generation of dynamic EPCs through a set of digital design and monitoring tools and services. Uses the smart readiness level of the buildings and the corresponding data collection infrastructure and management systems to calculate energy, environmental, financial, and human comfort indicators. In this context, D ² EPC will be based on Level 3 6D-BIM literacy. Recommendations for the CEN standards
eCentral Energy Efficient Public Buildings in Central Europe *	REGEA	2017	Raise awareness and motivate public authorities to aim for more ambitious energy renovation standards of buildings, development of EPC Tool for public authorities, deployment of innovative financing schemes, development of training programs and building renovation strategies
EDYCE , Energy flexible DYnamic building Certification		2020	EDYCE is the natural evolution of the conventional Energy Performance Certification into real time optimization of building performance and comfort, by capturing the building's dynamic behaviour, and at the same time providing transparent feedback, through an intuitive interface. It will support communication between labelling professionals and building owners, to cultivate benefits in both indoor climate and energy savings. The transition to dynamic calculations must be supported by optimized

			and structured processes: efficient input data acquisition, data storage, interoperability, and transparent presentation and communication with the user.
EPC_RECAST Energy Performance Certificate Recast		2021	EPC RECAST will develop a process and a toolbox that will support the development, performance, and validation of new EPCs with particular focus on existing residential buildings with high retrofit needs. Develops and consolidates methodologies and tools to support professionals' real estate and building owners to invest more in building performance improvement.
ePANACEA Smart European Energy Performance Assessment & Certification *	CRES	2020	Creation of a prototype (the Smart Energy Performance Assessment Platform) making use of the most advanced techniques in dynamic and automated simulation modelling, big data analysis and machine learning, inverse modelling or the estimation of potential energy savings and economic viability check. Bi-directional knowledge transfer with stakeholders and policymakers covering the EU-27+Norway+UK
EFFECT4buildings Effective Financing Tools for implementing Energy Efficiency in Buildings	ECN	2017	The project has produced a toolbox with financial methods that can improve profitability, facilitate funding and reduce the risk of energy investment in public real estate: profitability calculations, action packages, contribution optimization, EPC, multifunctional agreements, green leases and economic models.
EUBSuperHub European Building Sustainability performance and energy certification Hub		2021	Scan and study of the current energy assessment schemes and certification methods. Development of common criteria to support the market penetration of certificates - creation of a harmonised certification process in the EU. Training energy and sustainability auditors on the new harmonized systems. 100 very diverse buildings will be tested to make sure the EUB SuperHub methodology is fully functional and valid.
iBRoad2EPC Integrating Building Renovation Passports into EPC schemes for a decarbonised building stock *	EnEffect, KAPE	2021	EPC schemes will be explored, and the Building Renovation Passport model will be adapted to become part of EPCs. The iBRoad2EPC model will be tested and the findings will support policy proposals and improve the implementation process of EPCs.
MATRYCS Modular Big Data Applications for Holistic Energy Services in Buildings	EREN	2020	Capitalisation and combination of existing technological breakthroughs in the areas of ML / DL and big data, to develop a new decision-making and data analytics solution for energy-efficient buildings. A Reference Architecture for Buildings Data exchange, management, and real-time processing, and to translate this reference architecture into an Open, Cloud-based Data Analytics Toolbox (MATRYCS Modular Toolbox). It will enable AI-based cross-sector analytics for smart energy-efficient buildings through three layers, MATRYCS-GOVERNANCE, MATRYCS-PROCESSING and MATRYCS-ANALYTICS.
NEEM Nordic Energy Efficiency Mortgages	ECN	2021	Scale-up lending to energy renovations in the Nordic countries to meet EU green deal, as well as ambitious national climate targets. The hub is comprised of a long list of institutions, all guided by Copenhagen Economics. The project will be a part of the existing Energy Efficient Mortgages Initiative.

<p>PHOENIX, Adapt-&-Play Holistic cOst-Effective and user-frieNdly Innovations with high replicability to upgrade smartness of eXisting buildings with legacy equipment</p>		2020	<p>Portfolio of ICT solutions covering all aspects from hardware and software upgrades needed in legacy equipment and optimal deployment of sensors, to data analytics and services for both building users and energy utilities. Human-centric new services for building users and improvement on both execution of grid operations and data sharing. The project intends to explore the use of SRI for communicating aspects of smart buildings to consumers.</p>
<p>PrioritEE PLUS Transferring the PrioritEE Decision Support Tool to public authorities in the MED area</p>	UNIZAR	2021	<p>Improvement of capacity building of public authorities in the energy management of public buildings and local sustainable energy planning. Analytical tools (DST) for informed decisions and the promotion of replicable technical solutions. It includes structured training and transferring process.</p>
<p>QualDeEPC Increasing the quality and cross-EU convergence of EPC schemes and enhancing the link between EPCs and deep renovation. *</p>	CRES	2019	<p>QualDeEPC works on EU-wide convergence of the building assessment and the issuance, design, and use of quality-enhanced EPCs as well as their recommendations for building renovation.</p>
<p>SmartLivingEPC Advanced Energy Performance Assessment towards Smart Living in Building and District Level</p>		2022	<p>Aims to introduce a certificate that will be supplied by using digitised tools and retrieve the required assessment information for the building shell and building systems. The new certificate will be completely in line with digital logbooks and building renovation passports and will be applied to building complexes for energy certification at neighbourhood level.</p>
<p>TIMEPAC Towards Innovative Methods for Energy Performance Assessment and Certification of Buildings</p>		2021	<p>TIMEPAC will improve existing energy certification processes and move to more holistic and dynamic approaches Will develop new methods and tools for data collection and analysis. EPCs will be enriched with concrete retrofitting solutions. Transversal Deployment Scenarios encompasses various stages of the EPC workflow, involving multiple stakeholders and resources. Each scenario, will be demonstrating to which extend the enhanced procedures contribute to improve reliability, effectiveness, user-friendliness, cost-effectiveness.</p>
<p>TripleA-reno Attractive, Acceptable and Affordable deep Renovation by a consumer orientated and performance evidence-based approach</p>	IRI UL	2018	<p>Increasing attractiveness, acceptance and decision making on deep and nZEB renovation for consumers by clear information on real, proven performances on energy, Indoor Environmental Quality, and personal health in practice, strengthened by consumer centred business models. It will also develop an open end-users centred gamified platform for validation and community building.</p>
<p>U-Cert Towards a new generation of user-centred Energy Performance Assessment and</p>	EnEffect, IRI UL	2019	<p>Next-generation of user-centred certification - holistic and cost-effective. Encouragement and support of the end-users in decision making (e.g., on deep renovation).</p>

Certification; facilitated and empowered by the EPB Center *			
X-tendo eXTENDING the energy performance assessment and certification schemes via a mOdular approach	CRES	2019	X-tendo and its toolbox introduce ten features of the next generation of energy performance certificates, to provide public authorities with improved compliance, reliability, usability and convergence of next-generation energy performance assessment and certification.

The projects with the * have a direct relationship with the EPC methodologies.

The table below, shows the distribution of the projects in the EU Member States.

Table 4. Representation of the projects in EU countries

	AU	BE	BG	HR	CZ	CY	DK	EE	FI	FR	DE	GR	HU	IE	IT	LV	LT	LU	NO	NL	PL	PT	RO	SI	ES	SE	SK	UK	
ALDREN																													
D ² EPC																													
eCentral																													
EDYCE																													
EPC RECAST																													
ePANACEA																													
EUB SuperHub																													
EFFECT4																													
iBRoad2EPC																													
MATRYCS																													
NEEM																													
PHOENIX																													
PrioritEE																													
QualDeEPC																													
SmartLiving EPC																													
TIMEPAC																													
TripleA-reno																													
U-Cert																													
X-tendo																													

3.2 Type of information gathered on current EPC approaches in different countries

Initially, after the basic description, we are looking for the type of information that has been gathered by the different projects. This field of the template gives us details on whether a project has worked with the general approach or has gone deeper and can provide already reports that include the information contained in the EPCs in different countries, types of methodologies and software used, etc. This table is focused on the projects with the information required for crossCert EPC assessments.

Table 5. Type of data each project has produced

	Improvements/quality/verification	Calculation & Software	Indicators	Experts & Skills
ALDREN	EUROPEAN VOLUNTARY CERTIFICATE (EVC)	Based on the new European standards developed under the Commission Mandate M/480.	Health & well-being. RES, NZEB	Webinars on the volunteer schemes
D²EPC	Improvements, Incentives, Restrictions	Calculation, Software, Tools	Financial, Environmental, Indoor	Joint database, Skills
EDYCE	Major shortcomings and effort to progress towards DEPC. General information in some MS.	Tools & methods. Use of data from EPCs	Disaggregated KPIs for DEPC protocol. List for tenants (no experts) and professionals	
e-central		EPC methodology	Cost-effective nZEB measures	
EPC RECAST	Process and toolbox for new EPCs (residential buildings with high retrofit needs)			Consolidated methodologies and tools for professionals and building certifiers. a decisive decision-supporting tool for real estate, owners and tenants
e-Panacea		State-of-the-art regarding European and international certification schemes		
EUB SuperHub	A cross-analysis comparison of the EPC quality, visibility, usability aspects. Sustainability certificates. Connections with real estate. Standards, validation. Journals.			Training material. Advanced UIs and visual analytics for the end-users
MATRYCS	Harmonization and data share of EPCs, compliance and checking procedures	Calculation system of the actual energy savings after refurbishment (assessment of the final energy in the EPCs and the real consumption data from the smart meters)		
iBRoad2EPC	Alignment with national Long-term renovation strategies - Consistency - Scenarios			Auditors, Construction specialists
NEEM	EPC approaches in view of easing access of financiers			
QualDeEPC	Priorities for improvement - Good Practices - Shortcomings		Renovation recommendations - Energy classification	
SmartLivingEPC	SRI analysis, life cycle assessment tools, non energy aspects and technical audits into one uniform rating system	SmartLivingEPC's CIEM along with an IoT platform for the visualization and decision making assistance. A digital twin tool along with a digital logbook for data and actions logging. APIs for the calculation of the envisioned EPCs	SRI, the Level(s), the energy performance rating and the results from technical audits	Training and guidance for SmartLivingEPC
TIMEPAC	EPC data analysis. deficiencies. Data quality. Analysis of data storage. Context analysis of EPC generation. Improvement of existing energy certification processes. holistic and	Current use of BIM software to generate EPCs. New methods and tools to provide an improved basis for data collection and analysis	Transversal Deployment Scenarios to which extend the enhanced procedures contribute to improve reliability, effectiveness, user-friendliness, cost-effectiveness	Concrete retrofitting solutions and experts can be better trained
TRIPLA			Energy performance & Validation - Environmental - Indoor & well-being	
U-cert		EPC data	Consumption - Energy - Indoor	
X-tendo	The value of EPC databases as a tool for quality assurance and data mining. Assessing their status and potential			

3.3 Current and new EPC approaches

crossCert assesses the current EPC approach in each participating country. If some projects have already that information, crossCert will not start from scratch. crossCert will also propose new, enhanced approaches for the common harmonization and for that will also be based on the recommendations, guidelines, strategies, and roadmaps, available from previous efforts.

For each previous project, we investigate whether they have examined the National EPC methodologies. If any testing on the current national EPC approaches has taken place, for instance analysing how accurate it is, the energy performance gap or any other relevant outcome of the EPC methodologies, we will take these results into account.

On the other hand, some projects have developed and/or proposed a new/modified methodology for EPCs. Regarding the new EPC proposals, overall new methodologies have been developed. Regarding the current methodologies, improvements have been proposed and, in some cases, new software for EPC issuing has been developed. Further research gives us the type of improvement (qualitative or quantitative).

Table 6. Level of testing EPC approaches of each project

Level of testing EPC approaches of each project			
Test current EPCs	Proposals on current EPCs	Proposals on new EPCs	New software
	ALDREN: Harmonized and transparent calculation methodology based on the new European standards developed under the Commission Mandate M/480, that provides the results closer to the actual consumption Methodology notes on energy rating procedure.	European Voluntary Certificate (EVC+) with the actual (measured) energy performance, the IEQ (TAIL-index about health & well-being) and impacts of proposed energy renovation actions on financial value.	Possibility for calibration of calculation model using the measured energy (actual and calculated heating power based on EN 15378-3).
		D^2EPC Introduction and establishment of the concept of the dynamic EPC.	D^2EPC: Layered Conceptual Architecture: from sensors data to Web Platform, Web GIS and Credibility UI through calculations with the BIM-based Digital Twin.
EDYCE , Studies in Denmark, and Switzerland about performance gap.		EDYCE is developing new approach towards dynamic EPC.	EDYCE is relying on existing and validated, dynamic tools (EnergyPlus, Dial+).
	EPC RECAST Methodology and protocol to improve comparability and reliability of existing buildings energy performance and sets the ground for the development of innovative financing and public policies instruments.		
EUB SuperHub A cross-analysis comparison of	To create a framework to assess energy in buildings	A scalable methodology to view, assess and monitor	EUB SuperHub Platform to track and understand the impact of the user behaviour

the EPC quality, visibility, usability aspects.	and develop a common certification method.	the buildings throughout their life cycle.	on the carbon footprint of the building and close the performance gap. Calculation of the energy assessment criteria.
eCentral	Cost-optimal combination of measures to achieve nZEB using updated investment and cost parameters in the EPC Tools database Getting practical information to be used in SEAPs and local energy renovation roadmaps.	Simplified and uniformed methodology for achieving cost-optimal combination of energy efficiency/renewable energy measures to achieve nZEB.	Living Energy Performance Certificates managing tool and database - A web platform designed according to the needs of public authorities.
ePANACEA	Supplementing EPCs with additional measured or calculated data. List of individual features in terms of accuracy, reliability, user-friendliness, and cost-effectiveness. Combinations or packages of such features are to be evaluated and validated. Inventory, containing novel, smart, and innovative technologies which have an impact on the building energy performance.		a) An open-source simulation tool b) Standardised computer file format suggestion for information exchange focused on weather servers and utility companies.
		iBRoad2EPC To bridge the Building Renovation Passport with the EPC, test and evaluate the applicability of iBRoad2EPC in six countries, authorities in the six countries will be directly involved in the process of conceptualisation.	The developed-in iBRoad tools will be upgraded by adapting to specific pilot country condition's ability to cooperate with EPCs databases.
	MATRYCS will support harmonization and data share of ECPs, facilitate their compliance and checking procedures (using big data technologies).		
NEEM in view of easing access of financiers.		Partly integrated with the new design of the Danish EPC.	

<p>In PHOENIX Building modelling outputs are referred to quite generically, with specific data being collected for the generation of SRI. Performance by country seems less explored.</p>	<p>The suitability of the described approach will vary depending on the assessment protocol, and data availability in each country. The described approach may provide a method for generating future metrics (like SRI) that require an understanding of transient/dynamic building response.</p>	<p>The intention appears to be rapid, automatic generation of EPC that can then be linked to smart building assessment - though internal temperature and space conditioning time-series data is required to populate this algorithm (along with other building data).</p>	<p>A user-focussed API has been developed that uses algorithms and a dashboard to output the results. Although automatic EPC generation is part of this, the wider objective concerns smart buildings. The approach, and the software, has been trialled across the partner countries in a number of pilot projects.</p>
<p>QualDeEPC the existing EPC practices were tested for 98 pilot buildings.</p>		<p>Improving the recommendations for renovation provided on the EPCs towards deep energy renovation.</p>	<p>Online tool for comparing EPC recommendations to deep energy renovation recommendations. Online master tool for comparing EPC recommendations to deep energy renovation recommendations. Currently available for Greece (in English and Greek).</p>
		<p>SmartLivingEPC Establishment of EPC framework asset methodology where SRI analysis, life cycle assessment tools, non-energy aspects and technical audits are integrated into one uniform rating system. Development of EPC framework operational methodology with the integration of other aspects Artificial intelligence and benchmarking and evaluation tools.</p>	
<p>TIMEPAC conducted a survey to find out the current use of BIM software to generate EPCs. EPC data analysis. Deficiencies, data quality, data storage and context analysis of EPC generation.</p>	<p>Potential improvements of current EPC data quality and on existing energy certification processes and move from single, static certification to more holistic and dynamic approaches. Development of a large-scale analysis methodology to predict the building energy demand at multiple scales and the impact of the refurbishing measures.</p>	<p>The Transversal Deployment Scenarios encompass various stages of the EPC workflow (generation, storage, analysis, and exploitation), involving multiple stakeholders (research groups, energy agencies, ESCOS, etc.) and resources (data, tools, methods). In each scenario, it will be demonstrated to which extend the enhanced procedures contribute to improve reliability, effectiveness, user-friendliness, cost-effectiveness.</p>	<p>Building information modelling (BIM) can be used to generate EPCs using advanced simulation tools.</p>

		U-CERT's converged set of National Datasheets may significantly support further harmonization of the set of EPB standards. Non-expert user-friendly EPC design, including SRI calculator and other tools.	Comparison and calculation toolkit for national Annexes, Service tool transforming product information into suitable input for energy calculations, Open data solution, Rating solution (cloud-based service).
X-tendo: The value of EPC databases as a tool for quality assurance and data mining to enable more effective retrofit policies and programmes. The gap between real energy performance and EPC modelled performance	Provision of tailored renovation recommendations and financial support.	1) Innovative indicators: smart readiness, comfort, outdoor air pollution, real energy consumption and district energy 2) Innovative EPC data handling: EPC databases, enhanced recommendations, logbook, financing options and one-stop-shops	For each innovative indicator plus the enhanced recommendation feature calculation spread sheets were developed. Also, for the EPC databases feature a Phython programming tool

3.4 Extended EPC developments

The European Commission proposes that next-generation energy performance assessment schemes will value buildings in a holistic and cost-effective manner. Furthermore, the recommendations should embed the EPCs in broader concepts.

Based on that, crossCert will assess the complementary dimensions of the next generation EPCs, from the energy performance to the new Key Performance Indicators (KPIs), which include, among others, building comfort and building smart readiness. The new methods of calculating the EPCs should also consider output measures of performance. Under WP3, crossCert will evaluate how empirical measurements can be integrated into the next-generation EPCs to improve their quality and reliability with respect to the performance gap and the assessment of the new KPIs, which will merge with those projects that have developed and/or proposed new KPIs to include in EPCs, for instance, indoor air quality, comfort, etc.

The objective of WP4 is to increase the usefulness of EPCs by assessing how the data of existing and new EPC approaches can be exploited for its use in energy audits, national/regional databases, one-stop-shop platforms, and broader EPC concepts such as building renovation passports or building logbooks. If previous/current projects have analysed and/or proposed the integration of EPCs with other initiatives, crossCert will build upon them to arrive at value-added recommendations for new EPC approaches.

Table 7. List of projects that have contributed to extended EPC developments

Extended EPC developments	
New KPIs	Connection with broader concepts
ALDERN introduces the IEQ (TAIL-index about health & well-being). Two main common indicators for the benchmark on the common scale based on the non-renewable primary energy use either (a) with only the self-used PV electricity or (b) Also including the export to the grid. The indicators were aligned with the existing schemes (BREEAM, DGNB, HQE, IVE-BES)	Methodology notes on energy rating procedure/ Methodology note on linking the EVCS to building financial valuation. Methodology notes on rendering of the collected data and results in a building passport Roadmap for implementation and market uptake of the project results
D²EPC introduces environmental, financial, human comfort and technical aspects	
EDYCE has developed entire list of disaggregated KPIs for DEPC protocol. There is	Renovation strategies, and influence of using dynamic tools on proposed renovation solutions.

list for tenants (no experts) and professionals (EPC experts, professionals, building owners/administrators).	
	eCentral has developed Regional and local energy renovation roadmaps until 2030 - nZEB principles have been embedded in SEAPs. Databases from EPC tools were the starting point in this process.
ePANACEA covers at least the Smart Readiness Indicator (SRI).	a) a combined EPC-SRI assessment, b) Building Renovation Passport (BRP) and a Digital Building Logbook (DBL) c) Economic feasibility of tailored recommendations for buildings.
EFFECT4buildings has brought novelty for tools to finance energy renovation measures.	EFFECT4buildings has developed tools that could be used in one-stop-shops. This includes tools for financial calculations, bundling, funding, Energy Performance Contracting, Multi-Service Contracting, Green Lease Contract and Prosumerism.
	EUB SuperHub aims to create a combined EPC-SRI assessment, Building Renovation Passport (BRP) and a Digital Building Logbook (DBL), including economic feasibility of tailored recommendations for buildings. It will examine the applicability of the harmonized EPCs and passports and the connection with Real Estate.
iBRoad2EPC deals with aesthetics, health, noise protection, security, thermal comfort, indoor air quality and lighting.	iBRoad2EPC ; Building Renovation Passport.
	MATRYCS contributes to de-risking investments in the EE sector, by analysing the refurbishment options contained in Energy Performance Certificates.
	NEEM methods to be integrated with one-stop-shop.
SRI and other smart building assessments have been presented in PHOENIX . This includes metrics such as level of smart readiness, number of smart services, self-sufficiency etc. This is expanded on here	Much of this work reads as being parallel to EPCs, Building Renovation Passports etc. But the focus on SRI provides an interesting comparison with projects generating SRI without the level of data being collected and used in the PHOENIX project (i.e., does smart building assessment work better with data that is less available from a traditional EPC assessment).
QualDeEPC proposes a high user-friendliness of the EPC through the enhanced EPC template with the "Energy Rating" indicator. The indicator provides information about the energy performance of the building envelope components and technical systems, by using three coloured symbols (green, yellow, red).	The Deep Renovation Network Platforms (DRNPs): The main objective is creating concepts for platforms providing one-stop-shops for deep renovation linked to EPCs, including administrative, energy advice, financial, and supply-side information to building owners.
SmartLivingEPC will create a new building level classification that will result as a weighted average of four other indicators, that is the SRI, the Level(s), the energy performance rating and the results from technical audits.	Water consumption, noise pollution and acoustics. Digital logbooks, building renovation passports, neighborhood scale.
TIMEPAC will integrate Smart Readiness Indicators and sustainability indicators in EPC The energy performance of a building will be	Creating Building Renovation Passports from data repositories. Procedures and guidelines to track the building energy performance and energy use over

assessed through the EPC, but also with new instruments such as SRIs. The overall assessment should consider the sustainability indicators included in the Level(s) framework.	time using simulation tools and storing the information in digital building logbooks. Integrating Smart Readiness Indicators and sustainability indicators in EPC. The energy performance of a building will be assessed through the EPC, but also with new instruments such as SRIs. The overall assessment should consider the sustainability indicators included in the Level(s) framework.
TripleA-reno has developed energy performance, indoor environmental quality, and well-being indicators.	
U-CERT has analysed the Smart Readiness Indicator (SRI) and a IEQ (Indoor Environmental Quality) indicator.	Building Renovation Passports and Energy label atlases. New business models for EPC-related services developed. New tools for policymakers implementing EPBD and services offered by EPC issuers.
X-tendo researched Smart readiness indicator, comfort indicator, outdoor air and pollution indicator, real energy consumption and district energy.	X-tendo identifies how EPC registers and systems at different stages of development can support the development of more dynamic logbooks.

3.5 The human factor

The ultimate goal of crossCert is to establish guidelines for the convergence of EPCs in the EU. One of the areas where harmonization issues will be addressed is the human factor corresponding to the user-friendliness of the EPC for non-experts and the training requirements and certification procedures for experts working on EPCs. As a result, crossCert will not only investigate the technical performance or the data exploitation outputs of other projects but also their approach concerning the human behaviour aspects, the training of EPC issuers and the promotion and marketing of EPCs,

Table 8. List of projects that have worked with the human factor

List of projects that have worked with the human factor	
Training	Behaviour
ALDREN: Webinar about the holistic, reliable, transparent European Voluntary Certification Scheme (EVCS).	Link of reported energy performance with the thermal comfort score based on the operative temperature obtained from the hourly energy simulation.
D²EPC: EPC issuers in the new indicators and tools.	In EDYCE the behaviour of tenants is considered but through indirect measurements.
eCentral: Training programme for local/regional authorities on how to use Living EPC Tool and database - how to get info from EPCs and get a cost-optimal combination of measures to achieve nZEB for a specific building.	Increased the knowledge of public decision-makers by providing them with an attractive, versatile, and easy to use nZEB tool to convince them to use it.
	ePANACEA a) Fact sheet on energy-related behaviour patterns in the context of buildings, b) possible implementation of advanced occupant models.
EFFECT4buildings: Public property owners.	
	EPC RECAST will design user-centred, user-friendly, building specific energy performance assessment and certification outputs, facilitating the overall process (EPC assessor) and journey

	(building owners/tenants), raising awareness, leading to improved clarity of EPC results, increased building performance literacy of homeowners, specific and pragmatic recommendations and investments, pathways in energy retrofiting actions.
EUB SuperHub will train auditors on the new harmonized systems and has access to a large network of ECP public managers and auditors qualified as assessors in Protocollo ITACA, 100 in KGA, 300 in BNB/BNK; 1000 in CSTB.	Evaluation of public acceptance.
iBRoad2EPC: energy auditors and construction specialists.	
PHOENIX has published a communication and training strategy . Stakeholder groups are noted though it is not clear whether EPC assessors would be a key target end-user for this training.	PHOENIX refers to "human-centric" component of the work, which is partly about the interaction between end-user and API/tool being developed. However, there is also the suggestion that the nature of the data being collected is very specific to a given occupant, and feedback can be obtained via the dashboard to communicate with the user to adjust behaviour in an optimal way.
NEEM: financing institutions.	The NEEM method will build on studies of behavioural aspects.
QualDeEPC: Regular mandatory EPC assessor training on assessment and recommendations required for certification/accreditation and registry.	Voluntary/mandatory advertising guidelines for EPCs; Improving compliance with the mandatory use of EPCs in real estate advertisement; policy proposal.
SmartLivingEPC: training and guidance for SmartLivingEPC implementation.	Advanced UIs and visual analytics will be developed for visualizing the information to the end-users.
TIMEPAC results will contain cutting edge training materials for building experts.	
U-CERT Training programme for national experts on people-centred EPCs.	Prototypes of people centred EPCs developed.
	X-tendo explores end-user needs and expectations. Human behaviour aspects are especially considered in the methodologies of the features comfort, real energy consumption as well as one-stop-shops.

4 EU- initiatives and related projects

In this chapter, projects that are indirect connected to crossCert are described. The projects below are dealing with subjects that may be included in future Energy Performance Certificates, such as SRI assessment or metrics of water consumption and comfort conditions and other concepts on the broader exploitation of energy efficiency improvements and EPCs such as in the Real Estate sector, in the market uptake and smart investments or to digital logbooks.

CA EPBD DATABASE

The CA EPBD has collected a wealth of information useful to EPBD national policy experts and other stakeholders. The key public outputs of the CA EPBD are gathered in the [present database](#) of publications, structured around Countries/Regions and Themes. The contents in this database are being updated during CA EPBD 2018 - 2022 to reflect recent developments.

COLLECTiEF Project - **Collective Intelligence for Energy Flexibility (2021-2025)**

The COLLECTiEF consortium implements, tests, and qualifies an interoperability and scalable energy management system. It will develop software and hardware packages for a Collective Intelligence-based demand-side management (CI-DSM) that increases data security, energy flexibility and climate resilience of existing buildings while reducing installation cost, data transfer and computational power. It will be installed in 13 buildings and 1 living laboratory at pilot sites in Cyprus, France, Italy, and Norway. The findings will be used to formulate a business model for energy services. Non-profit organizations acquire comfortable and sustainable energy-efficient buildings to continue supporting their local communities, while financial institutions and private investors gain access to secure, high impact investments aligned with the ESG criteria.

Objectives: (1) Enhancement and adaptation of algorithms for creating a CI-based energy flexible network. (2) Realization of CI-based cost-effective system components with easy deployment and maintenance. (3) Demonstration and testing of a CI-based energy network in the real environment. (4) Testing and implementing a scalable and customizable occupant-centric fusion sensor network for accurate and non-invasive environmental monitoring. (5) Designing and implementing a smart, user-centric, and user-friendly digital platform for interacting with users and controlling technical building systems. (6) New business model for energy services including a clear model for commercialization of COLLECTiEF system.

CHRONICLE Project - Building Performance Digitalisation and Dynamic Logbooks for Future Value-Driven Services (2022 - 2025)

CHRONICLE will deliver a holistic, life-cycle performance assessment framework and tool-suite for different building variants, integrating ongoing initiatives, like EPCs, Level(s), SRI, under the umbrella of the Digital Building Logbook concept. It will support sustainable design, construction and efficient renovation and investment decision-making.

Performance will be assessed based on different information, such as sensor measurements that are adapted to various types of uses and building life cycle phases for new or existing buildings being refurbished. The project will take into account key market players such as energy service companies, as well as building owners and tenants.

Aggregated EPC advanced information will facilitate efficient energy planning.

DEMO-BLOG project - Development and Demonstration of Digital Building Logbooks (2023-2025)

Demo-Blog is focused on digital building logbooks. This tool will integrate data from EPCs. Therefore, this project should study the data collected and results generated by the different EPCs approaches in each country partner.

The DBLs demonstrated in this project have the potential to eventually reflect the whole lifecycle with a capacity for unlimited data access, input and output, and data export. They are also capable of embracing

future technological developments, such as widespread use of BIM, IoT, digital twins and blockchain. Demo-BLog has considerable potential to optimise the use of resources and waste, performance prediction, visual analytics and energy management contributing to the overall goal of making Europe the first digitally led circular, climate neutral and sustainable economy.

EPC4EU project - Harmonisation of datasets of Energy Performance Certificates of buildings across Europe (2019- 2021)

EPC approaches in Spain and Italy are analysed, particularly with respect to the datasets generated by current EPC approaches. EPC4EU designs, implements, and tests an EPC data model reusable across EU to harmonise heterogeneous EPC datasets produced at national/regional level. EPC datasets contain location data related to energy consumption and energy efficiency, which are at the same time semantically rich and spatially detailed (at building level). Therefore, they contribute to improve considerably the data accuracy at local level, which is explicitly required by the energy efficiency policy instruments, aiming to overcome the current limitations of using top-down statistical approaches for energy efficiency assessments at local level. In addition, used in combination with scale-up methodologies from building to district, city, regional up to national level, EPC datasets may represent a solid knowledge base to support the whole lifecycle of the energy policies, from planning to implementation, reporting and monitoring.

EPC4SES project – EPC based Digital Building Twins for Smart Energy Systems (2020-2023)

EPC4SES is a project taking the diverging landscape of EPC in Europe, adding utility to EPC, and thus introducing a new way for convergence and improvement of EPC quality. It investigates all usage scenarios for data resulting from the EPC process, either for policy support, planning or operation of smart energy systems. Since there will be four pilots in three different countries (Austria, Germany, and Spain), information gathered on current EPC approaches in different countries should be addressed. EPC4SES will develop applications based on the EPC data. These applications will be:

1) Energy consulting for individual buildings, 2) Support of market development for building thermal refurbishment, 3) Support of energy policy, 4) Pre-planning of energy systems, 5) Building energy management and 6) Network/grid energy management.

FINSESCO project - Fintech for Smart Energy Contracting (2021-2024)

FINSESCO's aim is reviving contracting for renovation of buildings and investments in renewable energy converters in/on buildings and mobilizing money from private investors via crowd investing. The big challenge of the project is deploying artificial intelligence for compiling renovation projects from assets based on Energy Performance Certification (EPC) derived data. FinSESCO aims at re-using data, which was created during the assessment of the building in the Energy Performance Certification. Such data often stored as XML allows calculating savings applying deep renovation, and exchange of energy converters. Finsesco will be developing a Fintech Platform Solution for Sustainable Energy System Intracting and Contracting. (Austria, Germany, Romania, Spain and India).

REVALUE Recognising Energy Efficiency Value in Residential Buildings (2015-2019)

The main key findings from the project (taken from the Final report from August 2019):

- Valuation methods are inherently flexible and can accommodate the impact of sustainability. Further guidance for valuers must be developed but no new techniques are needed.
- Energy efficiency labels do not currently play a key role in determining values in the residential rented sector but some energy characteristics, notably visual ones such as high-quality glazing, are factored in.
- EPCs have raised awareness but could be more effective if consistency and occurrence were improved.
- Although EPCs do not exert a key role in determining value, there is often limited energy data availability and where there is data available, it does not readily integrate with valuations.

- Despite this, moves to encourage investment in greater energy efficiency places a need for valuers to work with energy experts and develop greater knowledge around renewable energy sources and how they change the technology used in buildings.
- The motivation to upgrade is based on a range of factors. For social housing providers, making capital gains through 'added value' is not the key driver.

SRI2MARKET project - Paving the way for the adoption of the SRI into national regulation and market (2022 - 2025)

SRI2MARKET is focused on facilitating the implementation of SRI in the partner countries. It will produce recommendations for each of the targeted Member States on integrating the SRI into the current national regulatory framework for buildings (including performance requirements and building certification schemes) and evaluating whether the default SRI calculation methodology is appropriate or whether adaptations are required. SRI2MARKET will use lessons learned by countries that are well advanced in rolling out SRI to support and inspire action among those that are not early movers. SRI2MARKET will develop tools to guide SRI assessors and streamline building assessments.

The tools are collectively referred to as the "SRI2MARKET Tool Suite", and they will all be accessible through a unifying, multilingual web portal. SRI2MARKET will provide training to on the SRI and the methodology of its calculation. It will offer e-learning lessons on the SRI and its assessment methodology. The learning materials will be developed originally in the English language and then, translated into native project partner languages by each project partner.

SRI-ENACT project - Co-creating Tools and Services for Smart Readiness Indicator Uptake (2022-2025)

SRI-ENACT is more focussed on generating a solution to facilitate the SRI uptake in Europe. Challenges related to tailoring SRI to different national contexts will be studied. SRI-ENACT will provide methodological and technological outcomes (integrated in a SRI toolkit) to facilitate the implementation of this indicator across Europe.

SRI-ENACT provides a holistic solution to facilitate the SRI uptake in Europe, by engaging stakeholders in the co-creation of national-tailored SRI implementations and the development of the SRI-ENACT toolkit, encompassing SRI assessment and decision support tools to promote informed decision making for smartness upgrades. SRI-ENACT will deliver a package for the training and certification of the prospective SRI auditors. The resulting solution will be applied in 8 EU countries (Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania and Spain).

SMARTREADY-easySRI project - Improving and demonstrating the potential of SRI (2022-2025)

easySRI aims to enable a smooth and extendable web platform that offers services for the automated calculation of the SRI. It will introduce additional parameters that address energy efficiency and financial dimensions in view of making the acquired information more understandable and quantitative for the user of the building. Furthermore, easySRI will support the implementation of a number of ML services (i.e., ML-based core engine and wizard tool for performance and smartness upgrades and SRT interventions), which will assist the evaluation and assessment of the building system's performance and smartness in more than one normalised metrics as per the SRI framework, and provide customised recommendations for upgrades, considering the cost of investment. Furthermore, novel business strategies will promote adoption and engage stakeholders towards evaluating and upgrading smartness in their facilities, while dedicated workshops and training material will facilitate deployment. Finally, the project aspires the update of current standards as well as the inclusion of its outcomes in new or future standards and will investigate links with other EU initiatives such as EPCs, B-Logs and renovation passports to maximize the use of SRI concept in EU policies in the fields of energy and buildings.

ZEBRA2020 project - Nearly Zero-Energy Building Strategy (2014 –2016)

One of the goals of the project was to analyse the impact of EPCs on property values. Within this project, an interesting survey was conducted investigating the opinion of real estate agents in 8 Member States (Austria, France, Germany, Italy, Norway, Poland, Romania, and Spain). The results of the real estate agents' survey provided significant recommendations on how to increase the impact of EPCs on the property value and how to overcome obstacles to wider use of EPCs across the EU. Also, an investigation of the assessment of regression study on EPC price surpluses for both the sales and rental markets is performed by analysing data in 12 EU countries confirming the existence of a greater surplus for sales transactions than rental transactions.

ZEBRA2020 monitored inter alia energy performance certificates, energy efficiency measures and the integration of renewable energy sources. Within ZEBRA2020 project the following two investigations were performed:

- Survey market analysis among real estate agents, (D3.1 The impact of energy performance certificates on property values and nearly zero-energy buildings – report for policy makers (July 2016) - focus on the existing housing stock)
- Assessment of regression study on EPC price surpluses. (The impact of energy performance certificates on property values and nearly zero-energy buildings – an analysis for market professionals, owners, and tenants)

In those two investigations, the impact of energy performance certificates on the property values and nearly zero-energy buildings was investigated. Within D3.1 survey among real estate agents has been carried out in 8 countries (Austria, France, Germany, Italy, Norway, Poland, Romania, and Spain) and included 618 interviews in total. The aim of the survey was to collect real estate agents' professional opinion on what are the main factors that households consider when selecting properties to buy or rent. Additionally, the survey asked questions concerning impact of energy performance.

5 Project updates

QualDeEPC: Launch of the :

a) [NATIONALLY ADAPTED ENHANCED ASSESSMENT AND CERTIFICATION SCHEMES](#)

This report presents the adaptation approach, at national level, of the developed practical concepts, proposals, and tools for an enhanced EPC scheme towards deep renovation on the seven priorities addressed by the QualDeEPC project and

b) [NATIONALLY ADAPTED DEEP RENOVATION NETWORK PLATFORM CONCEPTS](#)

This report presents the nationally adapted policy proposals and concepts of the Deep Renovation Network Platforms (DRNPs). It includes the policy proposals about DRNPs in the seven partner countries and how the partners will implement a national DRNP with the consensus elements identified in previous tasks.

U-CERT:

By the end of December 2022, National events: two roadshows, one training and one final workshop were organised. 143 participants joined the online national events where three finalized tools were presented: Tool 1: The U-CERT Comparison and calculation toolkit for National Annexes is operational in U-CERT white-label environment, incl. user and choice guidance report, Tool 2: The U-CERT Building Operational Rating and Tool 3 (SRI calculator): The U-CERT Indoor Air Quality Assessment Tool.

Until the end of November 2022, National events: two roadshows, one training and one final workshop were organised. Three tools are in final stages: Tool 1: The U-CERT Comparison and calculation toolkit for National Annexes is operational in U-CERT white-label environment, including user and choice guidance report, Tool 2: The U-CERT Building Operational Rating and Tool 3: The U-CERT Service tool for product suppliers, transforming product information into suitable input for energy calculations.

TRIPLEA-reno:

The TripleA-reno Combined Label methodology includes interesting elements, however the supporting digital tool, already created, is intended to be a support to EPB Assessments, rather than a fine proposition for the inclusion of IEQ indicators in EPB calculations. Further use is still under discussion. Depends on the budget and time available for IT to connect properly.

6 Cooperation

QualDeEPC (CRES)

crossCert and QualDeEPC organised a common event for the greek stakeholders in 1st June.2022. Watching the QualDeEPC session, we identified the following results that have a great interest for crossCERT:

1. The proposal for the "Improved, user-friendly EPC, A template adapted to Greek conditions". During the presentation there was a reference, interpretation, and use of the "energy index" for the structural elements and systems of the building.
2. There was a discussion with stakeholders on tools presented such as: "Networking platform for deep renovation" with feedback that can be used in CROSS CERT activities.
3. the "White Paper on Good Practices in the Assessment, Certification and Use of EPCs" that could be used for the crossCert Knowledge Centre.

QualDeEPC (UNIZAR)

crossCert (UNIZAR) attended the third Spanish National Workshop on rehabilitation and energy certification of buildings organized by Escan S.L. Energy Consulting, in the context of the European project QualDeEPC, in Madrid, on May 11, 2022.

The work and results obtained in the QualDeEPC project were presented. Then the workshop participants debated the QualDeEPC proposals for improving energy certification. Finally, other projects (related to the workshop topic) were introduced, such as ePanacea (H2020), which is also related to energy certification.

crossCert (REGEA) also attended the final conference of QualDeEPC project, titled *How energy performance certificates support the deep renovation*. All the progress made since the start of the project in 2019 has kept the deep renovation measures at its core. During the final conference of QualDeEPC, partners presented the new EPC template, tools developed, and policy recommendations drafted during the project. During the second panel discussion, representatives of the Next Gen EPC H2020 cluster which is the hub of the H2020 projects working on EPC joined the event and discussed the relations with QualDeEPC's work. Milka Hrbud, REGEA, representing crossCert mentioned resolving the status quo of EPBs in Europe and assessing the performance gap, increasing the value of EPBs (e.g., with roadmaps), user-friendliness and recommendations across the EU. She added that the traffic light system is very useful. Andrei Litiu, REHVA, representing U-Cert and EPB Center, highlighted the policy recommendations and stakeholder networks. Jana Bendzalova, ENBEE, representing EPC RECAST, explained that their project's focus is on technical developments & toolboxes, but that policy recommendations and user-friendly design are important topics.

QualDeEPC established a series of priorities where it has mainly developed its work (analysis and recommendations for improvement). These priorities indicated below are of great interest for study in crossCert (in brackets, the related crossCert work package):

1. A new definition of the recommendations of energy certificates aimed at promoting deep energy rehabilitation. (WP3)
2. Development of an online recommendations tool (WP4)
3. Elaboration of Deep Renovation Network Platforms (WP4)
4. Promotion of the compulsory training of certifiers and definition of training needs (WP5)
5. Creation of a new energy certificate format (WP5), including a more significant number of recommendations and a colour code to indicate the energy status of the building and the characteristics of the proposed recommendations.
6. Establishing Voluntary/Mandatory Certificate Advertising Guidelines (WP5)
7. Improving compliance with the mandatory use of EPC information (WP5)

U-CERT (IRI):

The knowledge learned from U-CERT and TRIPLEA-reno will be included into all tasks of crossCert WP5 Towards people-centred EPCs. The Future EPCs need to be integrated with the broader context - firstly by defining differences and touchpoints with related concepts, services and products (such as BIM, energy audit, inspections of building services, building renovation passport, Smart Readiness Indicator, Building Digital Logbook etc.), secondly by means of innovative business models promoting and streamlining investments in building performance improvements (energy, environmental, Indoor Environmental Quality), and thirdly by integration with existing and developing technologies. Nevertheless, the quality of user experience of EPCs for general population is strongly dependant on design aspects, such as visual (graphical) representation, content (complexity and contextualization of data), language used, availability of auxiliary services (customer support), quality of certification services (interaction with EPC issuers) etc. The knowledge learned through the U-CERT project will be added, based on the deliverable projects U-CERT D5.3 Catalogue of user and beneficiary profiles for tool development for task 5.4 and D2.3 Report on users' perception on EPC scheme in U-CERT partner countries.

ePanacea (UNIZAR)

crossCert (UNIZAR) attended the presentation of the European Project ePanacea (H2020) at the third Spanish National Workshop on rehabilitation and energy certification of buildings organized by Escan S.L. Energy Consulting, in the context of the European project QualDeEPC, in Madrid, on May 11, 2022.

ePanacea partners presented the following objectives and partial results of this project, which have a great interest for crossCert assessments:

1. New energy certificate format that improves the user-friendliness of the certificate (WP5)
2. Development and testing of a methodology for calculating the SRI (Smart Readiness Indicator) (WP3)
3. Development and implementation of a methodology to reduce the performance gap of EPCs. This methodology aims to build more accurate building energy models, calibrating the parameters of the building energy models used in the EPCs with actual data on the energy consumption of the building. (WP3)

ePanacea (CRES)

crossCert (CRES) attended as a main stakeholder, the 3rd workshop of ePanacea on 22 December 2022 and evaluated the existing EPC and the new, proposed by ePanacea, EPC. In this new EPC data is more accurate, performance gap is less and user friendliness advanced.

D²EPC (UNIZAR)

crossCert (UNIZAR) attended the D²EPC workshop "D²EPC Methodology and tools for EPC Assessors." held online on July 12, 2022. The D²EPC vision and objectives are very interesting for the crossCert assessment:

1. Introduction and establishment of the concept of the next generation dynamic Energy Performance Certificates (WP3)
2. Integration of smart readiness rationale into the buildings EPC (WP3)
3. Inclusion of a novel set of environmental, financial, human comfort and technical aspects indicators (WP3, WP4, WP5)
4. Introduction of a BIM-based digital twin coupled with a state-of-the-art IoT ecosystem (WP3)
5. Provision of improved AI-driven assessment recommendations toward energy efficiency and optimal comfort and foster energy-saving consciousness (WP3, WP5)
6. Implementation of an intelligent operational digital platform for EPCs: Web Platform and GIS tool. (WP4)

QualDeEPC (EREN)

On **May 11th, 2022**, QualdeEPC organised a Spanish stakeholder's workshop where EREN attended as members of this group and as partners of the sister project crossCert. It was presented the project results and the platform for certification and building refurbishment "qualrenovate". The following items elaborated throughout this project were discussed:

1. QualDeEPC's General proposal: a modified nZEB-based approach for defining deep energy renovation & Defining 'Deep Energy Renovation' in the partner's countries.
2. Deep energy renovation recommendations by QualDeEPC adapted to each country context.
3. Adapted enhanced EPC form and introduction of "Energy rating" indicator- definition for each country case for building envelope components and technical systems.
4. Regular mandatory EPC assessor training: nationally adapted policy proposal, framework, and content.
5. Online Tool for Comparing EPC Recommendations to Deep Energy Renovation Recommendations.
6. Deep Energy Renovation Network Platform.
7. Advertisement guidelines and compliance:
 - 1a. Nationally adapted proposal for voluntary advertising guidelines and their use
 - 1b. Nationally adapted proposal for legislation making their use mandatory if Member States wish to do so.
8. Other policy proposals to improve compliance with the mandatory presentation of EPC data in advertisements.

For each of the above-mentioned items, EREN gave its opinion by filling out a specific survey on the following topics:

1. Needs and possibilities for revisions in the existing laws, regulations, and standards.
2. Identified challenges.
3. Possible steps to follow/ proposed measures to build consensus.
4. Identified Needs for further development and dialogue.
5. Other / Comments.

On **June 15th, 2022**, FEDARENE co-organised with EREN a session dedicated to energy performance certification (EPC) and digitalisation of building's data featuring three projects: QualDeEPC, CrossCERT, and MATRYCS. As part of the FEDARENE General Assemblies that took place in León, Spain, the event welcomed about 60 participants from 40 different organisations across Europe.

The session started with an introduction to crossCert, where the University of Zaragoza advocated for having common assessment methods in EPCs around Europe to ensure to all European citizens that their house has the energy performance label they deserve. ESCAN followed up with QualDeEPC and its online tool (qualrenovate.eu) designed to guide homeowners in their decision to renovate their buildings deeply. This online tool is one of the policy recommendations drafted by the project, presented in a video by the Wuppertal Institute. The session closed with an overview of the MATRYCS project, which aims to become an energy marketplace of big data and services in the building sector. The project has 11 large-scale pilots, including one on Energy Performance Certificates.

The intense session let participants go beyond the technicalities of energy data in buildings to discuss how the EPC, as a tool, can encourage deep home renovation.

7 Connection of crossCert Work Packages with the projects

- WP2** The information in this deliverable is essential for designing the second and third rounds of cross-testing (Task 2.3). The second and third cross-testing campaigns will consist of the cross-assessment of new EPC approaches available at these moments, such as the methodologies and procedures developed in the finished projects in previous H2020 calls and other new EPCs developed under the framework of other calls (European, national, or regional).
- WP3** Three projects (SRI2MARKET, SRI-ENACT, SMARTREADY-easySRI) started recently on the SRI, which will be an important KPI in the next generation of EPCs. These projects may be interesting for WP3 tasks. Since SRI will be probably a KPI present in the next generation of EPCs, the analysis of SRI implementation in different countries could be an information relevant for crossCert. Methodologies, and training developed as well could be useful for the next gen EPC issuers training.
- Task 3.1 This task is concerned with identification of the Performance Gap between modelled and measured energy consumption of buildings. Any project using real energy consumption data is therefore of interest, but particularly those focusing on the Operation Energy Rating metric being proposed or next-generation EPCs. Therefore, the work of ALDREN, D²EPC, U-CERT, X-tendo, and ePANACEA (all which reference Performance Gap research and/or measured energy consumption data) will be relevant here.
- Task 3.2 With the aim of identifying new KPIs and metrics, this task will need to take note of the work on two of the more advanced metrics from other projects, namely Smart Readiness Indicators and Operational Energy Ratings. This covers most of the next-generation cluster of projects, but a particular focus on this is evident in D²EPC (categorizing different EPC indicators), iBRoad2EPC (more varied output metrics), SmartLivingEPC (proposing/testing new indicators including SRI), TIMEPAC (similarly testing new KPIs), TripleA-reno (metrics for retrofit), X-tendo (as other projects but also looking at comfort indicators), and projects that are specifically looking at the implementation of the SRI metric (SRI-ENACT, SRI2MARKET).
- Task 3.3 Focussing on EPC recommendations, this task will draw on the research of projects focusing on retrofit guidance from EPCs. This includes the “deep renovation” ambition of ALDREN, the renovation tools of eCENTRAL, iBRoad, and EPC RECAST, and the large number of projects looking at the Building Renovation Passport innovation. These existing projects will help distinguish differences between current EPC recommendations, and methods of disseminating recommendations in next-generation EPCs.
- Task 3.4 This task will focus on verification and control, investigating the possibility of a harmonized verification framework for all EPCs to improve consistency and quality control. MATRYCS seems the most relevant project in this area, with an objective to support data sharing and harmonization across EPCs (including compliance checking procedures). EPC4EU is concerned with harmonizing datasets and noting the differences that currently exist across European countries in terms of monitoring of EPC processes and outputs.
- Task 3.5 Task 3.5 is concerned with bringing together work of other tasks and identifying whether proposed EPC innovations are a significant improvement on current EPCs and help define how to judge/critique these innovations such that, for example, an end-user can see benefits of this new approach. In this way, all next-generation EPC projects are likely to have relevance to this task, as the remit is quite broad. However, it will be necessary to categorise other projects in terms of the type of innovation they are presenting, which could be differentiated by new metrics/KPIs, new calculation procedures (including tools or use of more advanced

building simulation techniques), attempts at harmonizing EPC processes across different countries, or approaches for engaging with end-users via the EPC.

WP4

Demo-Blog will study how integrating EPC data into Digital Building Logbooks. This can be interesting for crossCert to know how the next gen EPCs could facilitate this integration. MATRYCS will develop an accurate calculation system of the actual energy savings obtained with building's refurbishments, based on the assessment of the final energy consumption in the EPCs and the real consumption data from the smart meters. Big data techniques will be used to this end, contributing to de-risking investments in the EE sector, by analyzing the refurbishment options contained in Energy Performance Certificates. FINSESCO is reviving contracting for renovation of buildings and investments in renewable energy converters in/on buildings and mobilizing money from private investors via crowd investing. EPC4SES scenarios for data resulting from the EPC process, either for policy support, planning or operation of smart energy systems.

Task 4.1 Integration of EPCs in the Administration databases demands EU experience in this field which is investigated in the Member States with high level of administration digitalization. Thus, this Task will not be focused only on outdated available databases, experience from more digitalized societies must be shared.

Task 4.2 Adapting EPCs to user and investor needs includes guidelines to define new format of energy performance certificate – scope of data included and the visual for presenting the results to stakeholders should (besides on WP2 and WP3) be based on analysis and recommendations from other similar projects. The new energy performance certificate format requires standardization across EU, incorporating directions from new EPBD directive. The output needs to be published and promoted on project level / proposed to sister projects to form uniform input to be proposed to EU entities who will afterwards oblige national government to introduce the new methodology.

Task 4.3 Besides defining scope of data included and the visual appearance, the next generation of EPCs should be linked to energy audits, logbooks and BRPs, focusing on new elements defined in EPBD. The output needs to be integrated in existing/new project related to renovation passport/logbooks/smart readiness indicator to serve as basis. There are many projects developing tools in which such recommendations can be integrated and tested.

Task 4.4 Optimal link between next generation EPCs and national/regional one-stop-shops should be based on attractiveness of the new elements incorporated in next generation of EPCs (e.g., smart readiness indicator, up-to-date data, investment mechanisms available now). The focus is on cooperation with new EU projects focusing on up-to-date existing and new elements included in new EPCS.

WP5

The content of crossCert WP5 is closely related to the results from U-CERT project. The knowledge obtained in U-CERT was mainly related to the formation of the EPC stakeholder groups and evaluation of individual stakeholder group's perception of the EPC. The obtained experiences and improvement suggestions will be transferred to this WP of crossCert project.

WP6

Task 6.1 CrossCert is sharing some common stakeholders with e-Panacea, lbroad2, easySRI, QualDeEPC either through common national lists or through the organization of common events.

Task 6.2 The EPC knowledge exchange centre will gather and include the outputs and results of the projects.

Task 6.3 This task will extract and merge the recommendations of the projects for the new EPC. It will consider the existing barriers and constraints that projects have identified. It will also refer to other projects' recommendations in the field that crossCert is not dealing with such as smart financing, Energy management etc.

WP7 Knowing the projects and results related to building energy certification is valuable information for networking and alliances (Task 7.4). crossCert dissemination activities are focused on event-based and networking activities, typically targeting committed stakeholders. Currently, crossCert is one of the projects that is part of the Next-Gen EPC cluster, which has become a powerful tool for disseminating the knowledge and results generated by all the projects currently working in this field.

8 Conclusions

The selection of projects was fruitful as 30 projects have been analysed in this report. crossCert can take a lot of material and information to assess, elaborate on and proceed with its tasks. This report gives a summary of the information we gathered from each project, the highlights of key points and a categorisation for facilitating the search and the comparison. It is accompanied by analytical templates with a detailed and more comprehensive description of the projects and their main tasks. Further information can be found on the projects' website and by speaking to their contact point or their coordinator.

The pool of projects represents 28 European countries. Seven projects have dealt directly with the EPC approach. Twenty six projects are valuable in terms of their research and recommendations on policy, human behaviour, financing and investments and exploitation of broader concepts like SEAPS, one-stop-shop, Energy Performance Contracting, Building Renovation Passport, Digital logbooks, Smart readiness indicator but also Real Estate.

Nine projects have already analysed the current calculation methods and data set of the EPCs and have identified deficiencies as well as the potential for improvements (13 projects) that help crossCert's initial work. Thirteen projects have also proposed Key Performance Indicators on energy, environment, indoor quality, and access to funding, which crossCert can consider or merge with its own KPI proposals.

12 projects have developed software, not necessarily for issuing EPCs but also platforms and tools that are comparing EPCs or using their data or connect them with databases or simplify them for the general public or local authorities.

An important output of this research is the work that 12 projects have done on the training, which covers the auditors, the public authorities, and the homeowners. Equally important are also 12 projects' efforts to make all requirements and applications of energy performance certification more user accepted and useful.

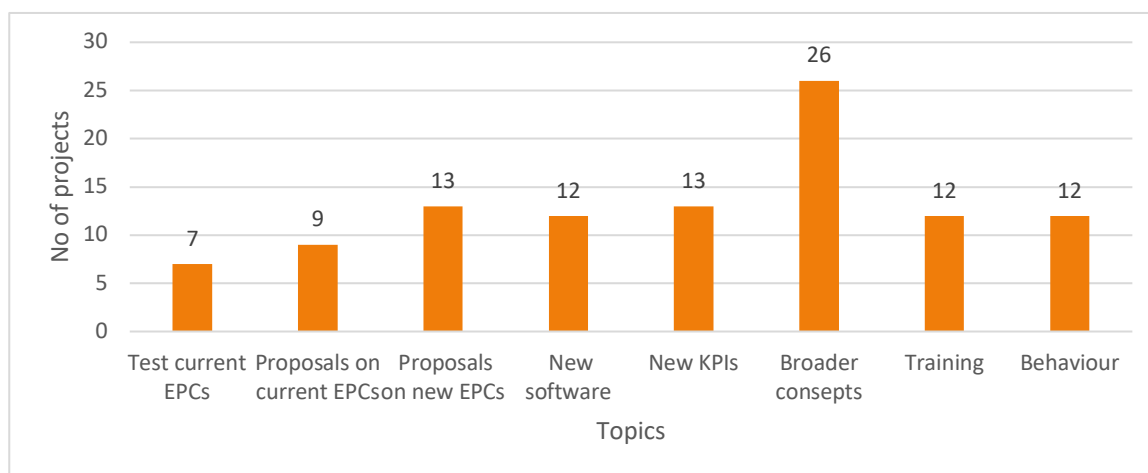


Figure 1. Overview of the topic's projects are dealing with

9 Annexes

ANNEX A: Inventory of existing projects Template

Objective: an inventory of Results from prior, related EU projects, in particular in respect of: lessons learned, new EPC approaches and other EPC developments

Partner		Compilation person:		Email:	
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Sheet of each project collected

Start Year	Title of project	ACRONYM	Countries

Brief Description of the project	
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type of information gathered on current EPC approaches in different countries	<i>This refers to which type of information has been gathered in the different projects, if only general or otherwise there are already reports that include the information contained in the EPCs in different countries, types of methodologies and software used, etc.</i>	Transferability Yes
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Have current national EPC approaches been tested within the previous project(s)	<i>If previous/current projects have done any testing on the current national EPC approaches, for instance analysing how accurate it is, the energy performance gap or any other relevant outcome of the EPC methodologies</i>
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new EPC approaches developed?	whether an overall new methodology developed	<i>If previous/current projects have developed and/or proposed a new/modified methodology for EPCs</i>
	whether improvements in current approaches	<i>If previous/current projects have proposed improvements in current EPC approaches, if so, which type of improvement (qualitative or quantitative)</i>
	new software developed	<i>If previous/current projects have developed a new software for EPC issuing</i>

other EPC developments	new KPIs	<i>If previous/current projects have developed and/or proposed new KPIs to include in EPCs, for instance indoor air quality, comfort, etc., if so, which KPIs are proposed</i>
	integration of BPR and/or one-stop-shops or other initiatives	<i>If previous/current projects have analysed and/or proposed the integration of EPCs with other initiatives such as Building Renovation Passports, or similar.</i>

Human Factor	Training	<i>If the project takes into account the training of EPC issuers and also the promotion and marketing of EPCs</i>
	Behaviour	<i>If previous/current projects takes into account the human behaviour aspects</i>

Link	
Contact person for use of	