D2.2 Report on EPC best practices

QualDeEPC H2020 project

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Table 3: Document History

ABBREVIATIONS

EPC: Energy Performance Certificate

PROJECT PARTNERS

WI: Wuppertal Institut für KLIMA, UMWELT, ENERGIE gGMBH

CRES: Centre for renewable energy sources and saving

DENA: Deutsche Energie-Agentur GmbH (dena)

EAP: Energy agency of Plovdiv Association

EKODOMA

ENERGIAKLUB: Energiaklub Szakpolitikai Intezet Modszertani Kozpont Egyesulet

E-P-C: EPC Project Corporation Climate. Sustainability. Communications. mbH

FEDARENE: Federation euopeenne des agencies et des regions pour l'energie et l'environnement

ESCAN: Escan SL

CIT ENERGY MANAGEMENT AB

PUBLISHABLE SUMMARY

The QualDeEPC project is aiming to both improve quality and cross-EU convergence of Energy Performance Certificate (EPC) schemes, and the link between EPCs and deep renovation: High-quality Energy Performance Assessment and Certification in Europe Accelerating Deep Energy Renovation (QualDeEPC). The objective of the project is to improve the practical implementation of the assessment, issuance, design, and use of EPCs as well as their renovation recommendations, in the participating countries and beyond.

The main objectives of Task 2.2, Validation of key (success) factors in EPC assessment and certification, are (1) to identify the key success factors to deliver a high-quality EPC scheme and (2) to enhance the preliminary vision from the QualDeEPC project proposal to an overall concept vision for an enhanced and converging EPC scheme, building on best practice examples. It will serve as a basis for the action plan to be developed in Task 2.4. Input from Task 2.2. will be used in Tasks 2.3., 2.4., and 3.1 to 3.4.

This report is deliverable D2.2 of the project. In chapter 2, various characteristics of a successful EPC scheme such as transparency, cost-effectiveness, reliability, comparability, functionality and neutrality were analysed. The improvement options identified in Task 2.1 are presented in table form as for their significance with respect to the above mentioned characteristics or success factors. All the elements for improvement were analysed in terms of their impact for the success factors. Country-specific assessment was also implemented, based on averaged normalized total weighted score. Chapter 3 provides good practice EPC examples of energy performance certification schemes and is based on a study conducted to compile existing good practices and examples for innovative solutions.

Building on the results from these two parts of analysis, the main purpose of the document is to create a common vision for an improved EPC scheme to serve as a basis for Task 2.4, Development Strategy Plan, and WP3, Development of enhanced EPC schemes. This overall concept vision is presented in chapter 4. The analysis indicates that EU Member States should combine many different individual measures and tools towards enhanced EPC schemes fulfilling the four main functions:

1. Improving the usefulness and use of EPCs for supporting deep renovation
2. Usefulness and use of EPCs in building markets
3. Improving the quality and precision of EPCs in general
4. Certification and training of EPC assessors/issuers

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1 INTRODUCTION

The QualDeEPC project is aiming to both improve quality and cross-EU convergence of Energy Performance Certificate (EPC) schemes, and the link between EPCs and deep renovation: High-quality Energy Performance Assessment and Certification in Europe Accelerating Deep Energy Renovation. The objective of the project is to improve the practical implementation of the assessment, issuance, design, and use of EPCs as well as their renovation recommendations, in the participating countries and beyond.

The main objectives of Task 2.2, *Validation of key (success) factors in EPC assessment and certification*, are (1) to identify the key success factors to deliver a high-quality EPC scheme and (2) to enhance the preliminary vision from the QualDeEPC project proposal to an overall concept vision for an enhanced and converging EPC scheme, building on best practice examples. It will serve as a basis for the action plan to be developed in Task 2.4. Input from Task 2.2. will be used in Tasks 2.3., 2.4., and 3.1 to 3.4.

In the first task of the project, Task 2.1, existing EPC schemes were analysed. This serves as a basis for both this Task 2.2 and Task 2.3, which analyses shortcomings of existing EPC schemes and identifies a longlist of priorities for improvement.

This report is deliverable D2.2 of the project. In chapter 2, various characteristics of a successful EPC scheme such as transparency, cost-effectiveness, reliability, comparability, functionality and neutrality were analysed. The improvement options identified in Task 2.1 are presented in table form as for their significance with respect to the above mentioned characteristics or success factors. All the elements for improvement were analysed in terms of their impact for the success factors. Country-specific assessment was also implemented, based on averaged normalized total weighted score. Chapter 3 provides good practice EPC examples of energy performance certification schemes and is based on a study conducted to compile existing good practices and examples for innovative solutions.

Building on the results from these two parts of analysis, the main purpose of the document is to create a common vision for an improved EPC scheme to serve as a basis for Task 2.4, Development Strategy Plan, and WP3, Development of enhanced EPC schemes. This overall concept vision is presented in chapter 4. Finally, chapter 5 provides conclusions from this report.

2 VALIDATION OF KEY SUCCESS FACTORS IN EPC ASSESSMENT AND CERTIFICATION

Six success factors were defined by the partners in the project proposal stage, as important aspects of a high quality EPC scheme. The first subchapter 2.1 provides detail on the definition of the success factors. Chapter 2.2 presents an analysis of country-specific EPC schemes in the seven countries represented in QualDeEPC with regard to the success factors. In addition, around 40 options for improvement, i.e. potential elements of an enhanced and converging EPC scheme, were identified in the proposal or in Task 2.1 of the project. Therefore, a common template was established for this Task 2.2 to assess the contribution of each of the elements to achievement of the six success factors (cf. chapter 2.3).

2.1 Definition of success factors

2.1.1 Transparency

Transparency, as one of the basic principles of good governance, implies the public insight in the work of public bodies and ensuring excellent awareness of stakeholders in all levels of the procedure. Citizens should be involved in the work of the public administration as well as the availability of instruments for monitoring the decision-making process. In addition, citizens should be familiar with the regulations applied in the procedure for exercising their rights, in a clear and understandable way.

A transparent EPC scheme should ensure the involvement and thorough information of citizens, the institutions, control bodies, and stakeholders at all levels of the process.

In this regard, one of the most important phases of the EPC scheme is monitoring, which involves monitoring, evaluating and controlling the implementation of activities and measures. Monitoring is closely linked to all phases of the EPC performance evaluation. Evaluation and control are important as these activities allow corrective action to be taken if progress is unsatisfactory or if conditions change. It is also important to report on progress towards the general objectives by preparing interim and annual reports on which follow-up actions should be taken.

Transparent EPC procedures could guarantee a quality implementation, provision of technical capacity, conducting systematic information campaigns on the benefits of energy performance certifications.

The transparency of the EPC scheme is very important for the public trust and acceptance of the certificates.

2.1.2 Cost-effectiveness

Cost-effectiveness in its simplest form is a measure of whether an investment's benefits exceed its costs. The concept of cost effectiveness means the best balance between the resources used and the results achieved and should be a determining factor for the success of EPCs and EPC schemes.

In terms of EPC schemes cost effectiveness could have two dimensions

- Cost effectiveness of the EPC procedure itself – optimisation of the costs and resources for management, control and implementation of the EPC schemes; this is the dimension we have used with priority in the analysis in chapter 2.2 and the assessment in chapter 2.3

- Cost effectiveness of the energy efficiency recommendations – considering the energy recommendations, so that as much savings can be achieved, as they are cost-effective, i.e. as long as the investment costs are lower than the energy cost savings.

  The EPBD states that EPC shall provide an indication as to where the owner or tenant can receive more detailed information, including as regards the cost-effectiveness of the recommendations made in the energy performance certificate. The evaluation of cost effectiveness shall be based on a set of standard conditions, such as the assessment of energy savings and underlying energy prices and a preliminary cost forecast. In addition, it shall contain information on the steps to be taken to implement the recommendations. Other information on related topics, such as energy audits or incentives of a financial or other nature and financing possibilities may also be provided to the owner or tenant.

  The objective of cost-effective or cost-optimal energy efficiency levels may, in certain circumstances, for example in the light of climatic differences, justify the setting by Member States of cost-effective or cost-optimal requirements for building elements that would in practice limit the installation of building products that comply with standards set by Union legislation, provided that such requirements do not constitute an unjustifiable market barrier.

  Cost-effectiveness of the energy efficiency recommendations will thus be a relevant factor for any development activities of the QualDeEPC project regarding the renovation recommendations in the EPCs.

2.1.3 Reliability

A successful EPC scheme should ensure reliability in terms of data quality and identification of objectively verifiable indicators for their achievement. In the context of energy performance indicators, managing authorities should establish a system of appropriate and measurable performance indicators as well as appropriate processes for achieving high data quality.

Accurate data include:

- Specific and concrete data
- Accurate measurements of building and energy data (e.g. floor space; calculated energy consumption)
- accurate renovations for recommendation
- high level of control and monitoring will improve reliability

2.1.4 Comparability

Comparability in terms of EPC means that EPC results and recommendations should be comparable for similar buildings. That is, variability in EPC assessment due to factors, such as EPC assessors qualification and experience, choice of EPC software, input data, cost of EPCs should not affect the EPC calculation results, class and recommendations, significantly. Comparability is, of course, an important factor within a country, but convergence between EPC calculation methodology across EU by adhering to a common methodology, such as CEN OAS, will increase comparability of EPCs within the EU.

2.1.5 Functionality/ Usability

Functionality means high level of accessibility for convenient, fast and accurate servicing of the system at any level of implementation and high level of user-friendliness.

Usability is "the extent (convenience) of which the EPC can be used and implement by all stakeholders to achieve certain goals with the required efficiency, productivity and satisfaction under the specified conditions.

2.1.6 Neutrality

Neutrality leads to equal conditions for all actors and lack of conflict of interest and non-discriminatory conditions.

2.2 Country specific analysis of the success factors

Based on the partners' opinion about success factors and barriers in D2.1 and some desk research from other initiatives, the following table summarizes the country-specific enablers and barriers – from EPC schemes and beyond – for the different success factors.

Country	Enablers	Barriers
Transparency		
Bulgaria	• Well structured and comprehensive regulatory framework and procedure for implementation of EPC at national level – transparent procedure and detailed requirements for the experts and for the certificates • Existing and official list of registered energy auditors • Public database (protecting privacy) of EPC ratings is available - There is a National Energy Efficiency Information System For Certified Buildings (D2.1)	• Low level of awareness among building owners regarding EPC procedures • Building owners do not have a good understanding of their building and its energy performance, or how it can be improved • The main barriers to energy efficiency improvements are described as uncertainty about which measures to implement and a lack of awareness about available financial support.(iBroad Factsheet)
Germany	• Manifold energy advice structures able to provide transparency on EPCs	• Lack of understanding of the information • Lack of linking the information to the renovation process • An official registry of EPC assessors is not available (D2.1) • Public database (protecting privacy) of EPC ratings is not available • Coexistence of asset rating and operational rating EPCs may create confusion
Greece	• EPC databases allowing for implementation monitoring and identification of gaps • An official registry of EPC assessors is available (D2.1)	• Low level of awareness and interest of building owners in EPC information • The EPC database is not publicly accessible. Access is limited to the Ministry and the operator of the platform (CRES). (D2.1)
Hungary	• An official registry of EPC assessors is available (D2.1) • Public database (protecting privacy) of EPC ratings is available (D2.1)	• No data
Latvia	• An official registry of EPC assessors is available (D2.1) • Public database (protecting privacy) of EPC ratings is available (D2.1)	• No data

Country	Enablers	Barriers
Spain	• There is an official registry in some Regions. (D2.1) • Ensure that each of the 17 Regional Governments have regulated and managed the organization and registration of Energy Certificates of new buildings and existing buildings. In most Regional Governments there is also a Registry of Certifiers. The registration procedure is done electronically.	• Weak promotion by organizations and institutions to boost certification • Public database (protecting privacy) of EPC ratings is not available (D2.1)
Sweden	• An official registry of EPC assessors is available (D2.1) • Public database (protecting privacy) of EPC ratings is available (D2.1)	• No data
Cost-effectiveness		
Bulgaria	• National Program for Energy Renovation supports issuing of energy certificates of multifamily residential buildings • Automatic validity check is already partially implemented in Bulgaria, but can be improved, for example, through additional data-base functionality.(D2.1)	• EPC is based on detailed energy audit, which causes higher costs • Lack of ambitious recommendations for deep renovation (only basic measures are recommended in residential buildings for reaching energy class C) • The relatively low requirement for existing buildings, of EPC class C, can create 'lock-in effects', making the path to a highly-efficienct building stock less cost-effective. (iBroad Factsheet)
Germany	• Automatic validity/quality check during assessment is available (D2.1) • Possibility of operational rating EPCs reduces cost	• High costs for asset rating EPCs • Possibility of operational rating EPCs reduces quality of renovation recommendations, posing risk of losing opportunities for saving energy costs • Certification system managed by 16 Regional Governments (positive or negative), may involve using more resources than a central system may need. • design and programming of the software interface is very time-consuming; a manual interface might be more convenient for the user.(iBroad factsheet)
Greece	• Automatic validity check is performed for all EPCs uploaded on the web platform and operated by CRES, On-desk checks of data entry are also performed for a randomly selected sample, by the competent Ministry's assigned staff.(D2.1.)	• The access to financial incentives and programmes is essential to increase the depth and rate of renovation. Experts noted that the bureaucratic nature of "Saving at Home" and the mandatory private contribution via bank loan restrict the access of low-income households to the programme. • The EPC certification is disconnected from the renting/sale market and, except for buildings labelled A/A+, it doesn't seem to have an impact on transaction prices.(iBroadr Factsheets)
Hungary	• No data	• No data
Latvia	• When registering EPC in a database only basic math is checked (it is checked if numbers that should make a certain sum do actually make this sum and other similar mathematical checking) (D2.1)	• EPC requires an energy audit, which causes higher costs
Spain	• Automatic input validation (D2.1) • An automatic quality check in the EPC registry is implemented after the EPC(D2.1)	• Certification system managed by Regional Governments (positive or negative), may involve using more resources than a central system may need. Create and manage 17 Certificate Registries and some Certifier Registries and with different levels of control (some regulations are more advanced than others).
Sweden	• EPC registry performs automatic check. (D2.1) • Focus on measures that are cost-effective from the building owner's perspective.	• The system has received criticism for being costly in relation to the resulting benefits

Country	Enablers	Barriers
	Reliability	
Bulgaria	• On-site inspections are obligatory for issuing EPC (D2.1) • Existing approved software based on the national Methodology for calculation of the energy performance of buildings • Default data for the different climate zones are integrated in the EPC software. • An initial and mandatory training on assessment and recommendations is required for accreditation. (D2.1) • Eligibility requirements for EPC assessor certification (D2.1) • Both level of control C and C* are achieved(D2.1) • The Energy performance certificate is integral part of an energy audit procedure. (D2.1)	• Trainings for energy auditors are not conducted frequently, resulting in poor quality of EPC • No periodic verification for the assessor is mandatory (D2.1.)
Germany	• Quality assurance (for process and content) • Education, further education of the EPC issuer • Eligibility requirements for EPC assessor certification (D2.1) • Both level of control C and C* are achieved(D2.1)	• Training is not mandatory for experts certified for proving energy performance of new buildings or who are a sworn public expert. (D2.1) • Lack of quality and therefore not enough trust in the information for relevant stakeholders • Currently, on-site visit is not mandatory (D2.1) • No periodic verification for the assessor is mandatory (D2.1.) • EPC is not based on detailed energy audit (D2.1) • Guidance on default values for input data in the EPC software is unavailable (D2.1)
Greece	• Quality control of EPCs and energy auditors • Although not mandatory, training seminars are organized by vocational centers and academic institutions and attended on a voluntary basis by interested auditors. (D2.1) • On-site inspection is required for all buildings (D2.1) • Default values are available as a part of the reference building standards. EPC calculation software also provides default values for climatic data of the various climate zones in Greece (D2.1) • Both level of control C and C* are achieved(D2.1) • A process of identification of errors or faulty procedures is performed on the platform and automatic warning or written notification is sent to the assessor, the common mistakes / errors are not yet aggregated to be used in statistics or in future training (D2.1)	• Low level of credibility and acceptance of EPC as an efficient tool for building renovation • Low fees of energy audits resulting in low quality of EPC • Lack of regular promotional-awareness activities on EPCs and deep building renovation • No periodic verification for the assessor is mandatory (D2.1.) • EPC is not based on detailed energy audit (D2.1)
Hungary	• On-site inspection is mandatory as per law (D2.1) • Practical default values for input data are available in the EPC software (D2.1) • EPC assessors must undergo mandatory training for accreditation.(D2.1) Both level of control C and C* are achieved(D2.1)	• Periodic training is not required for certified assessors (D2.1) • No periodic verification for the assessor is mandatory (D2.1.) • EPC is not based on detailed energy audit (D2.1) • Validity ranges for input data are unavailable in the EPC software (D2.1)
Latvia	• It is common practice that the buildings get inspected (D2.1) • In the beginning of March 2020 national annexes to around 40 different ISO standards about building energy efficiency were published. In these national annexes default values for input data also are described. (D2.1) • It is mandatory to work under (train) for 2 years under the guidance of a certified EPC assessor to be able to take the exam for becoming an energy auditor (D2.1) • Usually EPC is viewed as an annex of energy audit (D2.1)	• Periodic training is not required for certified assessor • No periodic verification for the assessor is mandatory (D2.1.) • Validity ranges for input data are unavailable in the EPC software (D2.1)

Country	Enablers	Barriers
	• C and C* level of control are achieved (D2.1)	
Spain	• Some Regional Governments propose regulatory improvements. It is important to emphasize that these Regional Governments are of different political sign, so it is a "strong point" that consensus has been achieved in this area. For example, the Basque Country has published Decree 25/2019 of February 26, with a unique text that incorporates and improves the existing regulation on the subject • Both level of control C and C* are achieved(D2.1)	• Slow process of transposition of some European Directives, which has several implications. • Currently, on-site visit is not mandatory (D2.1) • Validity ranges for input data are unavailable. (D2.1) • No mandatory trainings are available for energy auditors the only requisite to become EPC assessor is to have the academic degree of engineer, architect or technical vocational training in Spanish FP (D.2.1) • No eligibility requirements for EPC assessor certification (D.2.1) • No periodic verification for the assessor is mandatory (D2.1.) • EPC is not based on detailed energy audit (D2.1)
Sweden	• Using metered values (operational rating) for assessment of the energy performance. => closer to reality • On-site visit is mandatory for all buildings (D2.1) • There are commercial programs for sale that are adapted to Swedish EPC (D2.1) • Default values for data connected to user behaviour are available, for different types of buildings (domestic, office, educational), to calculate energy performance of new buildings before they are built. These values are also used to adjust the measured energy performance of existing buildings to normal use of a building. The EPCs are based on measured energy use adjusted to normal use and a normal year. (D2.1) • The certificate for assessors is valid for 5 years. After that it needs to be renewed with a new theoretical test. • Both level of control C and C* are achieved(D2.1) • The EPC is quite detailed. It includes on-site inspection, measured individual energy and water use and an assessment of indoor climate to determine the energy performance and suggest cost-effective renovation measures. However, a detailed energy audit may be needed in order to exactly design and calculate the profitability of the suggested measures and package the measures into a deep renovation plan. (D2.1)	• No mandatory trainings are available for energy auditors (D2.1.)
Comparability		
Bulgaria	• The national methodology for calculating energy consumption indicators and the energy performance of buildings was developed on the basis of BDS EN ISO 13790 and the best European practices in the field of determining the annual energy consumption for heating, ventilation, cooling and hot water. (D2.1)	• No data

Country	Enablers	Barriers
Germany	• Better focus on needs and information depth for the different stakeholder groups • link to other instruments concerning energy performance and renovation issues available (e.g. energy consultancy, renovation strategy, grants,…) • Existing tool from the Ministry for Economic Affairs and Energy. Germany is also a partner in the RentalCal project and has dedicated national pages on the rental market and and a translated RentalCal tool in German (RentalCal, n.d.-b).	• The execution of energy audits in residential buildings is voluntary. The main goal of building owners who pay for this service is to reduce their energy consumption (iBroad factsheets) • Coexistence of asset rating and operational rating EPCs reduces comparability
Greece	• The adoption of CEN OAS standards and the corresponding calculation methodology are under consideration in Greece	• No data
Latvia	• No data	There are some tools made by energy auditors but they are not certified or mandated by law. (D2.1)
Spain	• No data	• There is no mandatory procedure for the certification of EPC assessors, nor a specific period to perform the work of being an assessor.
Sweden	• No data	• Using metered values (operational rating) for assessment of the energy performance. => less comparable between similar buildings
Functionality/Usability		
Bulgaria	• National Program for Energy Renovation supports issuing of energy certificates of multifamily residential buildings • EPC rating and recommendations as well as potential energy (and cost) savings and benefits are presented in the certificate (D2.1)	• Links to financial support are not provided in the EPC (D2.1)
Germany	• Access to understandable information for non-technicians • Existing tool from the Ministry for Economic Affairs and Energy. Germany is also a partner in the RentalCal project and has dedicated national pages on the rental market and and a translated RentalCal tool in German (RentalCal, n.d.-b). (D2.1) • Renovation recommendations are provided along with energy savings, payback periods and potential upgrade of the energy class. (D2.1)	• Links to financial support are not provided (D.2.1) • When preparing renovation measures, the EPC information is considered slightly useful to the building owner. The recommendations in the EPC are, in general, too generic and cannot be a sound basis for decision-making. (iBroad factsheet)
Greece	• User-friendliness of EPC • Usefulness of EPCs recommendations in deep renovations • Renovation recommendations are provided along with energy savings, payback periods and potential upgrade of the energy class (D2.1) • National programmes providing incentives (financial / fiscal) for building renovation • An online decision support tool -EnergyHUB for ALL- was developed in the frame of the Request2Action project and is still in operation. The tool is integrated in an One-stop-shop for building renovation platform	• Limited funding boosting deep renovation of the building stock • The bureaucracy linked to deep renovation (owners must submit a plan to the local urban planning authority and get a building permit) has a negative impact on deep renovations, since it raises both costs and administrative burden. (iBroad Factsheets) • EPCs are considered as an administrative burden rather than a helpful tool for building owners and tenants.(iBroad Factsheets) • Links for further information and financial support are not provided (D2.1).

Country	Enablers	Barriers
Hungary	• No data	• EPCs in Hungary contain the calculations, with lots of formulae and numbers, which is usually non-comprehendible by the user. They usually don't understand anything apart from the energy class, but it doesn't mean much to them. (D2.1) • Although the recommendations part is compulsory, it is not very well developed, it usually includes only broad suggestions of measures (such as: heat insulation of the facades is recommended). The current practice does not moti-vate homeowners to use EPCs, they only find it a burden. (D2.1) • Potential energy (and cost) savings and benefits are not presented (D2.1)
Latvia	• EPC rating and recommendations as well as potential energy (and cost) savings and benefits are presented. (D2.1) • EPC has a mandatory annex with calculation of energy efficiency measures.(D2.1)	• No data
Spain	• There is another proposal of the year 2018 to modify the Technical Building Code regarding the minimum energy efficiency requirements of buildings, which will improve the process of certification and implementation of improvements. • Match the energy certification before and after performing the action on the building envelope. The demand decrease for heating and cooling must be at least 30% to obtain public assistance	• With an estimate of 9,730,999 buildings and 25,645,100 homes in 2017, until 2018 only 3,637,688 energy performance certificates have been registered that may correspond to buildings or units that have been independently certified (IDAE). It's a weak percentage. • The rating scale has a very high range, in each letter, of CO2 emissions, it would be necessary to update it. • There should be a number of m2 in the reforms, from which it would be mandatory to issue the certificate (e.g. from 2000 m2), it seems that this point is not contemplated in current legislation. • Failure to show the Energy Label in numerous public buildings and those frequented regularly. • EPC rating is presented in classes in the certificate, but potential energy (and cost) savings and benefits are not presented.(D2.1) • Not mandatory to present the recommendations in EPC: The EPC assessor may write or not the recommendations and these are included in another file. (D2.1.)
Sweden	• Improving the quality of recommendations of renovation (cost effective energy measures). • Energy class, recommendations and indicative potential of energy (and cost) savings should be reported if they are cost-effective in the certificate (D2.1)	• Less transparent, and thereby less useful, since December 2016 when regulations regarding BEN were introduced. Before BEN, metered values were presented in the EPCs. With BEN, metered values in the EPC have been corrected to normal use of energy. This means that today, the values displayed in the EPC are a mix of metered and calculated data. • Recommendations are not presented in the EPC (D2.1.)
Neutrality		
Bulgaria	• The quality control includes conducting a verification of compliance with the regulatory requirements (completeness of documents, form and model) of the submitted documentation from the energy efficiency audit and building certification; sending notification letters to correct identified deficiencies; performing input control for the accuracy of the data and the results	• Sanctions for building owners missing to obtain / present an EPC are not in place (D.2.1)

Country	Enablers	Barriers
	of documentation from energy efficiency audits of industrial systems and energy efficiency audits and certification of buildings; sending notification letters in case of identification of gaps in the received documentation for the elimination of the gaps and correction of the data. (D2.1) • The Control and Monitoring Department of SEDA publishes yearly reports of the control activities. According to the published reports for 2018 it is performed check of 65% (or 1061 documents) of the received energy audits. 11 visits to control at place for implementation of the energy recommendations have been performed.(D2.1) • Differentiated and staged sanctions for EPC issuers are defined in EE Act (D2.1)	
Germany	• The EnEV requires that the random samples must each cover a statistically significant percentage of all newly issued energy certificates in a calendar year. (D2.1) • Differentiated and staged sanctions for EPC issuers in case of poor quality assessments or recommendations are in place - Based on non-compliance found during random EPC controls, EPC issuers may be threatened with fines (D2.1) • Sanctions for building owners missing to obtain / present an EPC are in place (D2.1)	• Not all state authorities do request the submission of EPCs for new buildings, which is criticised by stakeholders as a lack of enforcement/compliance iBroad factheets). • The EPC control system, based on a random sample, still needs to prove its effectiveness. (iBroad factsheets) • The Deutsches Institut für Bautechnik (DIBt) carries out random electronic 1st level controls. 2nd and 3rd level (more detailed) controls are under the sovereignty of the Federal States. These probably have different quality criteria.(D2.1)
Greece	• Checks on-site are performed by the Ministry's assigned staff whenever required (e.g. depending on the results of on-desk checks or in case of complaints). On-desk checks of all EPCs issued for the purposes of national subsidy programmes are performed. (D2.1) • On EPC registration platform, all EPCs are checked automatically. In addition, law requires on-desk check of a randomly selected sample of 5%. All EPCs issued for obtaining renovation grants or finance are checked too. Up to the end of 2018, approx. a 2.5% of all EPCs issued has been further checked on-desk or on-site. (D2.1) • Differentiated and staged sanctions for EPC issuers in case of poor quality assessments or recommendations are in place. Administrative and monetary sanctions are imposed to assessors for faulty procedures and errors. A 1st warning is sent if repeated faults are identified.(D2.1) • Sanctions for building owners missing to obtain / present an EPC are in place (D2.1)	• Lack of monitoring of compliance with the existing legislation on EPCs in real estate advertisement – no sanctions foreseen
Hungary	• 2.5% of EPCs are checked, of which 0.5% (i.e. 20% of the total sample size) should have total inspection with on-site visit. • Differentiated and staged sanctions for EPC issuers in case of poor quality assessments or recommendations are in place • Penalties up to withdrawal of accreditation are in place.	• There is no particular body designated to quality control. The experts of the two chambers can perform controlling activities, but they are separately assigned and subcontracted for this purpose, they are not employees of the Chambers.(D2.1) • Sanctions for building owners missing to obtain / present an EPC are not in place (D.2.1)

Country	Enablers	Barriers
Latvia	• There is a provision for independent control. (D2.1) • Differentiated and staged sanctions for EPC issuers in case of poor quality assessments or recommendations are in place - A penalty point system is implemented (Regulation No.531 Regulations Regarding Assessment of the Competence of Independent Ex-perts and Monitoring of Professional Activity Thereof in the Field of Energy Performance of Buildings). With 10 penalty points, the EPC assessor certificate is withdrawn. • Sanctions for building owners missing to obtain / present an EPC are in place (D2.1)	• The monitoring of presenting EPC by owners is weak and the sanctions have never been applied. (D.2.1)
Spain	• The situation is that 100% of EPCs are automatically controlled, thanks to computer mechanism. Additionally, a document control is carried out on nearly 50% of the EPCs, the number of document control was 1.392.880 in 2017. Also specific inspection that reach 0.5% of EPCs and a deep inspection with visit to the building with 0.05 of the EPCs in 2017. The verification of competent technicians as of 2017 covered 27029 assessors(D2.1) • Differentiated and staged sanctions for EPC issuers in case of poor quality assessments or recommendations are in place - . Initially warnings are issued if EPC data is found to be incorrect. Usually the mistakes are corrected, and the EPC is registered again. (D2.1) • Sanctions for building owners missing to obtain / present an EPC are in place - Display the energy class of the EPC during sales or rental is mandatory. In the household sales contract, an EPC should be attached; in the renting contract the label should be attached. The person who sells is the responsible to get the EPC and the notary will include EPC in the contract. Non-compliance building owners can be fined with penalties of 601 up to 1,000 €. Penalties for falsifying information between 1,001 and 6,000 €.	• The certification of public buildings can be carried out by the officials themselves; this creates discrimination in the so-called free market, and the opportunities for certifiers can be reduced.
Sweden	• Recertification of energy experts after 5 years. • Boverket, the National Board of Housing, Building and Planning, makes yearly check of 1% of EPCs. (D2.1) • Differentiated and staged sanctions for EPC issuers in case of poor quality assessments or recommendations are in place - If the EPC assessor fails in its independence or has issued incorrect declarations, it may be notified to the certification body which may withdraw the certification. The Swedish National Board of Housing, Building and Planning can also withdraw certifications. • Sanctions for building owners missing to obtain / present an EPC are in place (D2.1)	• No data

Table 4 Country-specific enablers and barriers for the different success factors

2.3 Analysis of potential elements for an enhanced EPC scheme with regard to success factors

A common template was created in order to assess the contribution of each potential element of enhanced EPC schemes identified in T2.1 in terms of the six success factors. Three aspects of the factors were assessed: 1) Country-specific weightage for the six factors; 2) Common contribution scoring for each element in terms of the different success factors; and combining the two, 3) Country-specific normalized total weighted score for each potential element of enhanced EPC schemes. The latter can be averaged over countries. Since this is the main result showing the assessment by QualDeEPC experts on the contribution of an element to the success of EPC schemes, it will be presented in chapter 2.3.2, before the common contribution scoring for each element, which is only serving as input factors, in chapter 2.3.3. The individual countries' specific weighted scores conclude this chapter in section 2.3.4.

2.3.1 Country-specific weightage assessment

First, the partners were asked to assess the country specific weightage of the success factors in their country. The weightage is from 1-5; with 1 being very low priority, and 5 very high priority. Using these country specific weights for success factors, a country specific normalized weighted score for each element has been calculated. The country specific normalized weighted score helps in identifying EPC elements that have cumulatively high success value in each partner country.

The following table represents the country specific weightage for the six success factors:

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality
Bulgaria	5	4	5	3	5	3
Germany	3	2	3	4	3	2
Greece	4	2	5	4	3	1
Hungary	4	2	5	2	5	3
Latvia	3	5	3	3	4	3
Spain	5	4	4	3	5	5
Sweden	4	1	4	3	5	2

Table 5 Country specific weightage for the success factors

It can be seen that the success factors Functionality/Usability, Reliability and Transparency are those with the highest weightage among the seven partner countries, and no country applying a weight less than 3 to any of these factors, which means that these factors have a high importance for a successful EPC scheme. The other factors: Cost-effectiveness, Comparability and Neutrality, are estimated with medium importance for the success of EPC schemes:

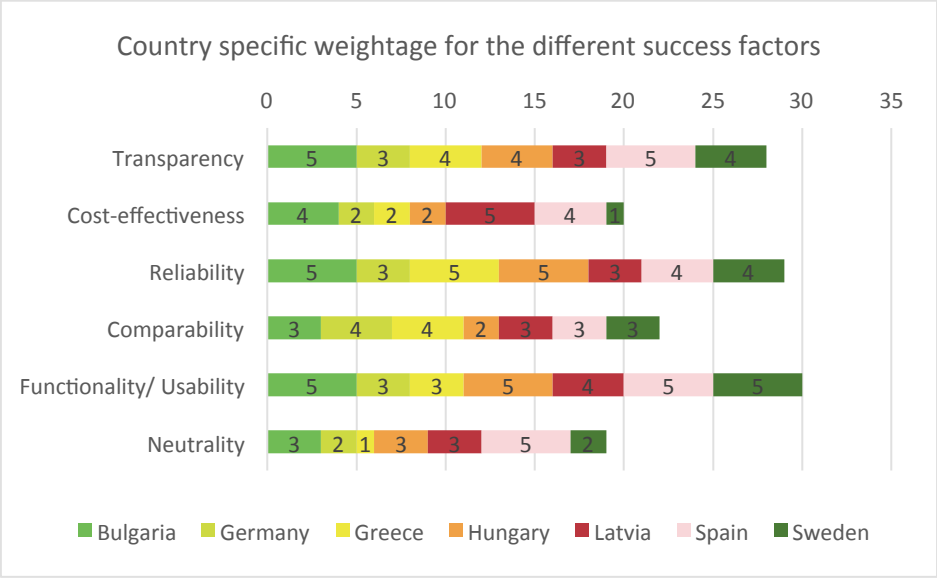

Figure 1 Country specific weightage comparing by factors

In the following graphic, it can be seen that the averaged weightage for Transparency, Functionality/Usability and Reliability is higher than 4, and for Neutrality, Comparability and Cost-effectiveness weightage it is around 3, so it could be concluded that the factors **Transparency, Functionality/Usability and Reliability have a very high level of importance for a successful EPC scheme.**

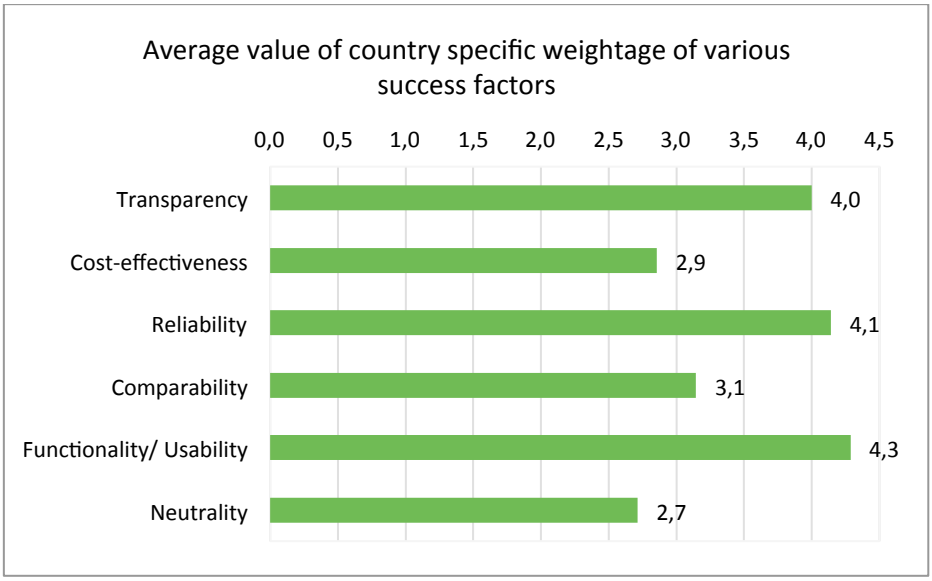

Figure 2 Average weightage for the success factors

The analysis of partners' opinion about the impact of the different success factors for the quality of the EPC scheme can conclude that although some factors as Transparency, Reliability and Functionality/Usability have highest scores, there are some differences between partner countries for the factor assessment. We can see that the Cost-effectiveness has a 1 for Sweden but a 5 for Latvia, while Neutrality is very important for Spain (5) but not for Greece (1), and low for Germany and Sweden (both 2). All rank Functionality/Usability, Reliability and Transparency with at least 3.

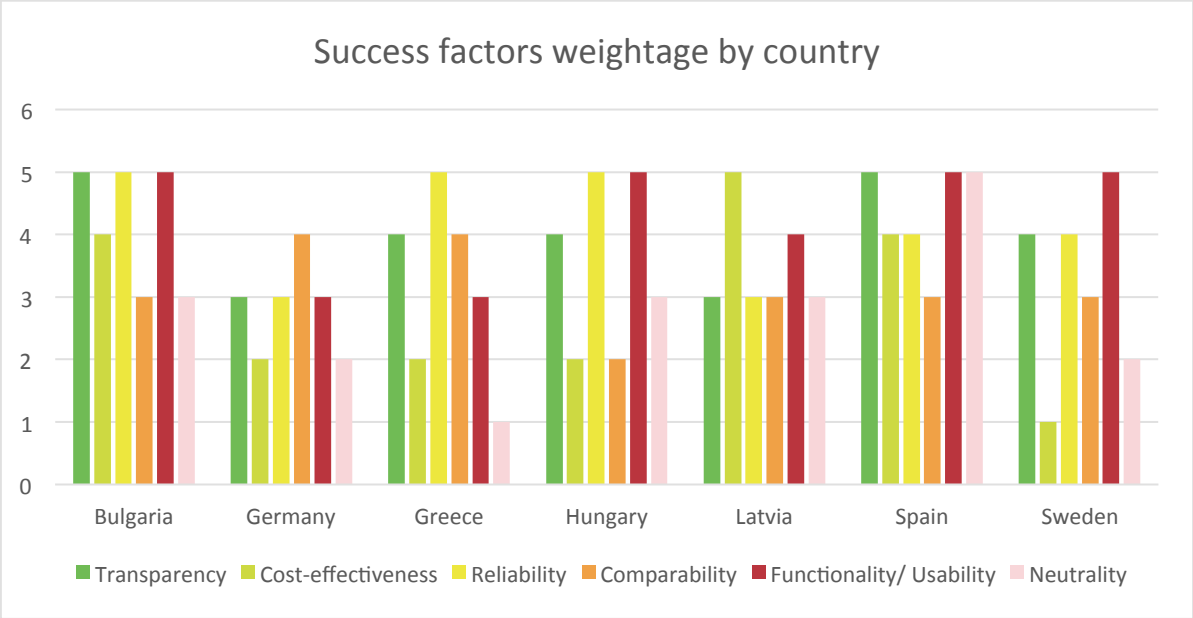

Figure 3 Success factors weightage by country

2.3.2 Averages for country-specific total weighted scorings

The country-specific total weighted scores for each of the elements (cf. chapter 2.3.4.), which are normalized to the country-specific weightage for the six success factors, were averaged in order to rank the elements in terms of their impact to the success of the EPC scheme.

We can consider that elements with an averaged country-specific weighted score below 2.5 could be considered as elements with lower impact, and hence lower importance.

For transparency of the presentation, the elements have been grouped by five areas of processes within EPC schemes and uses of EPCs, to which they belong.

2.3.2.1 Assessment and Certification

In the category 'Assessment and Certification' it can be seen that most of the elements are with relatively high score (more than 2.5), and the highest score have the elements: *Official or certified EPC Software to ensure quality and comparability of assessments*; *Online tool for comparing EPC recommendations to deep energy renovation recommendations*; and *On-site inspection during EPC assessment*, while there are three elements with scores lower than 2.5: *Compliance between EPC rating and operational rating*; *EPC issuance at reasonable cost*; and *Including Smart readiness indicator on EPC* (cf. Figure 4).

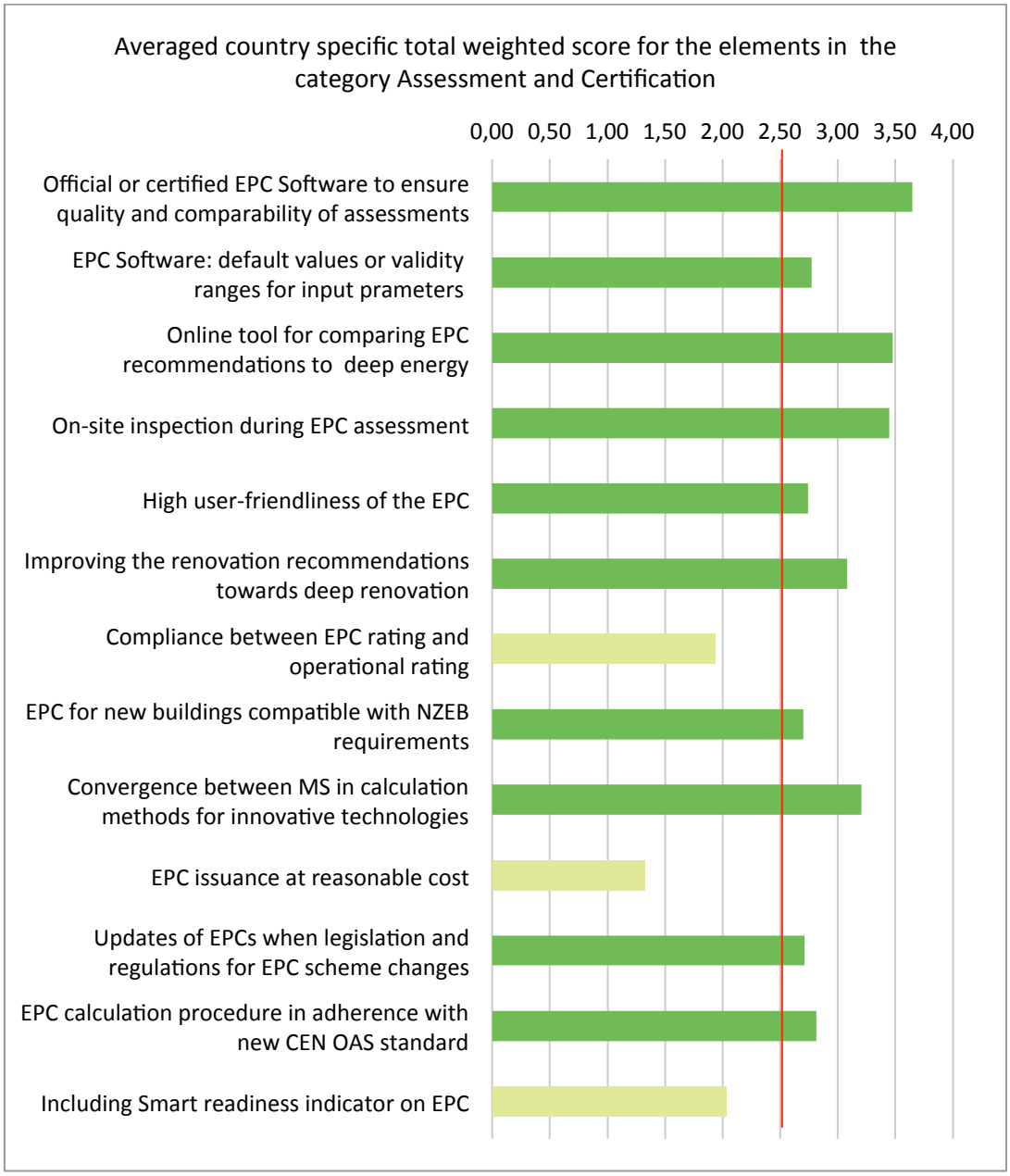

Figure 4 Averaged country specific total weighted score for the elements in the category Assessment and Certification

2.3.2.2 Requirements for qualified experts

In the category 'Requirements for qualified experts', the only element with a scoring below 2.5 is *Eligibility requirements (pre-qualification) for EPC assessor certification*. The highest score for the success factors has the element *Registry of EPC assessors*:

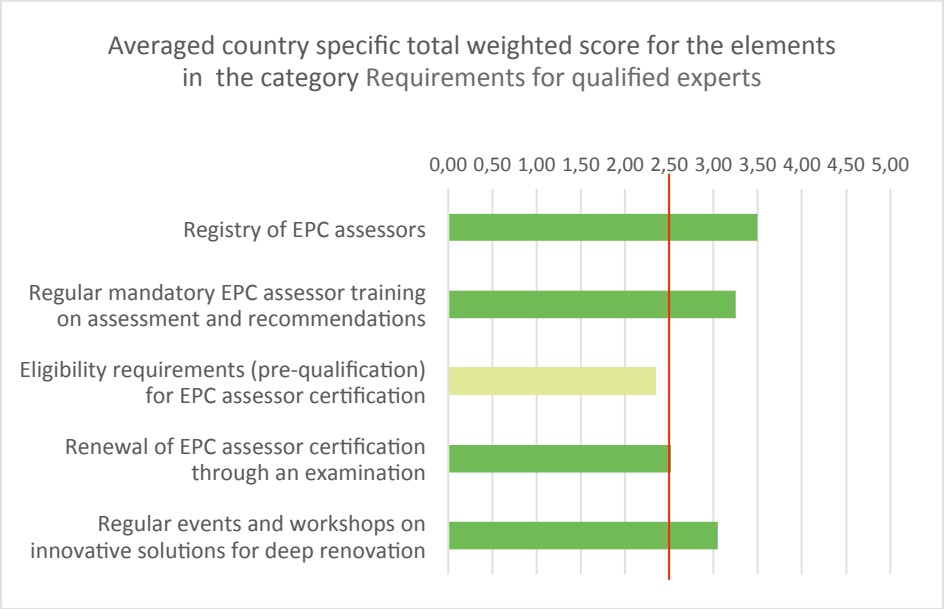

Figure 5 Averaged country specific total weighted score for the elements in the category Requirements for qualified experts

2.3.2.3 Independent control systems

In this category, it seems the elements *Using common quality criteria for independent control* and *Reporting of errors in EPC assessments from controls for learning,* have the highest average scores, while two elements only achieve a score below 2.5: *Achieving C or C* level control of EPC assessments for the sample according to EPBD* and *Channeling revenues from sanctions for enhancing EPC schemes*. *Quality control of both EPCs and assessors* and *Performing automatic validity check of EPCs* are also assessed as important for the success of EPC schemes.

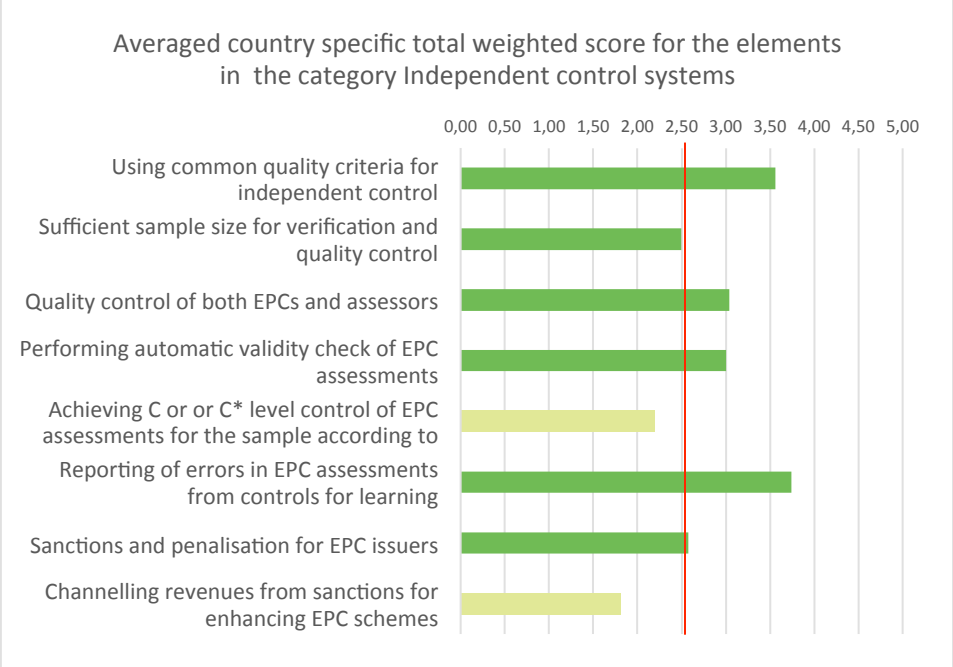

Figure 6 Averaged country specific total weighted score for the elements in the category Independent control systems

2.3.2.4 Use of EPC data, including in wider buildings-related databases

The element *Public database of EPCs* is estimated as the most important for the successful EPC scheme in terms of 'Use of EPC data, including in wider buildings-related databases'. Only two elements from this category have an average score below 2.5 - *Sanctions for building owners with missing EPCs* and *Presenting EPC to official building sales bodies (i.e. notaries, etc.) as an obligatory/mandatory measure*:

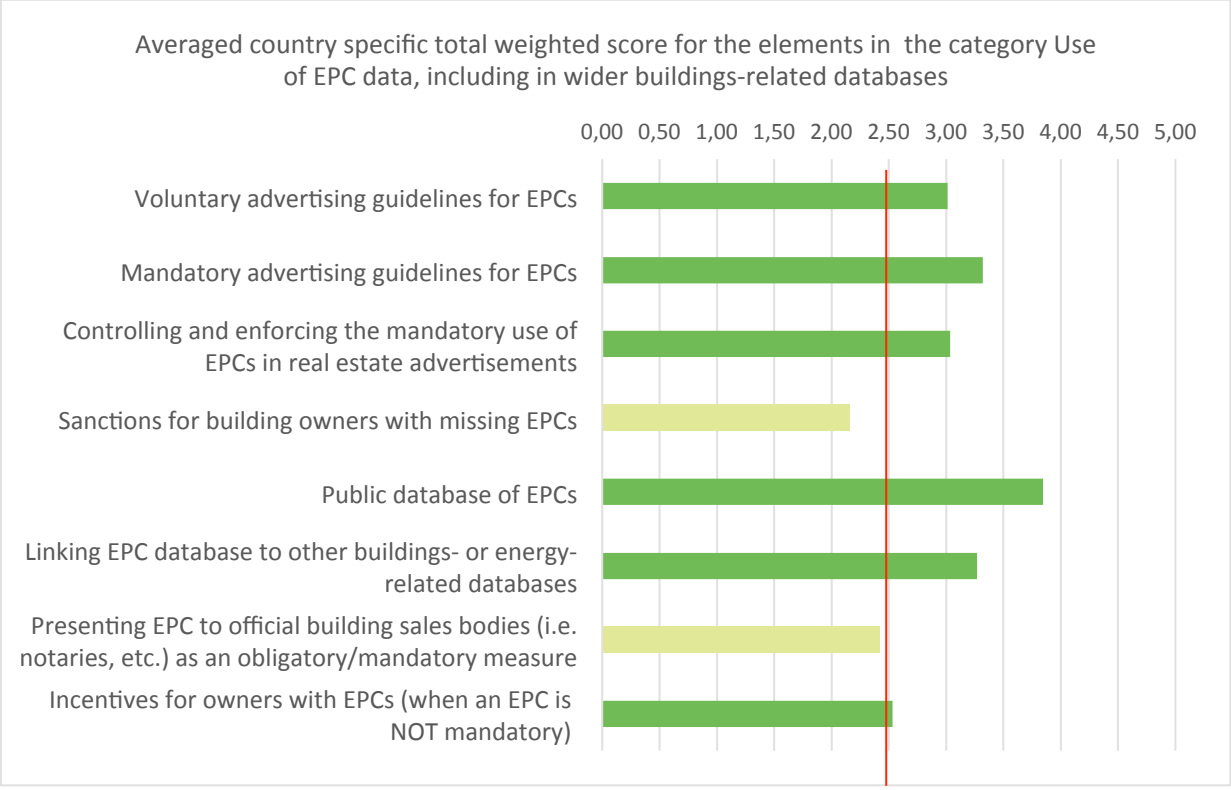

Figure 7 Averaged country total weighted specific score for the elements in the category Use of EPC data, including in wider buildings-related databases

2.3.2.5 How are EPCs embedded in wider policies and public activities to stimulate deep renovation

All the elements from the category 'How are EPCs embedded in wider policies and public activities to stimulate deep renovation' are assessed as important for a successful EPC scheme and achieve a score higher than 2.5, whereas the *Creating Deep Renovation Network Platforms* has the highest score here:

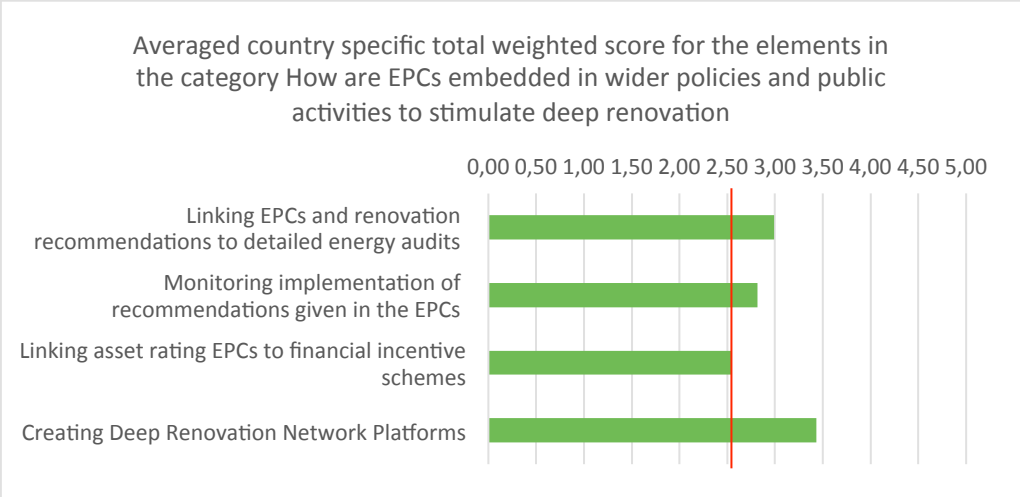

Figure 8 Averaged country specific total weighted score for the elements in the category How are EPCs embedded in wider policies and public activities to stimulate deep renovation

2.3.3 Common scoring for each element in terms of the different success factors

The second step in the analysis of success factors was to assess the contribution of each of the around 40 improvement options, i.e. potential elements of an enhanced EPC scheme, with regard to each of the six success factors. This was an expert assessment was performed by the authors of this report, and commented by the other QualDeEPC partners. The final version takes the partners' comments into account. The scores of each element by success factor are presented in graphics in this chapter 2.3.3 and in numbers in the Annex to this report. The Annex also holds the considerations on which the scores were based, as well as the unweighted total score for each element, averaged across success factors.

2.3.3.1 Assessment and Certification

The following figure show the results from assessment of the elements by success under the category 'assessment and certification'.

We can see that most of the elements have relatively high and positive impact in terms of the different success factors for example:

- *Official or certified EPC Software* will increase transparency in the methodology for energy calculations and also will increase the reliability of EPC outcomes due to the accuracy of energy performance calculations
- *Default values or validity ranges for input parameters* will decrease costs of EPCs by minimizing the time and effort required for data acquisition - e.g., by avoiding taking additional on-site measurements, performing intermediate calculations etc.
- *Online tool for comparing EPC recommendations to deep energy renovation recommendations* will improve comparability of EPC certification and renovation recommendations within the country and across the EU

Still, for some of the elements the impact is assessed as negative for some factors, for example:

- *On-site inspection* is estimated as negative for the Cost-effectiveness, because it may increase the costs of EPC significantly

- *High user-friendliness of the EPC* - may slightly increase the costs due to enhanced amount of information and presentation
- *Compliance between EPC rating and operational rating* is negative in terms of Comparability due to potential influence of user behavior on energy consumption
- *Issuing EPC at reasonable (affordable) costs to the building owners* may lead to decrease in the reliability due to the omission of certain optional but critical elements, such as on-site visits, investment in continuing education etc.

Figure 9 Elements regarding Assessment and Certification: common scores by success factors

2.3.3.2 Requirements for qualified experts

The elements in the category 'Requirements for qualified experts' are mostly important for the Transparency, Reliability and Functionality/Usability, but some could have a relatively negative impact in terms of Cost-effectiveness:

- *Regular training* may impact cost-effectiveness, as the cost of training may lead to an increase in assessor fee; however, assessors may become faster through techniques they learnt
- *Eligibility requirements (pre-qualification) for EPC assessor certification* may slightly increase the costs of certification due to increased professional charges
- *Renewal of EPC assessor certification through an examination* may entail extra costs and therefore increase the costs of EPC

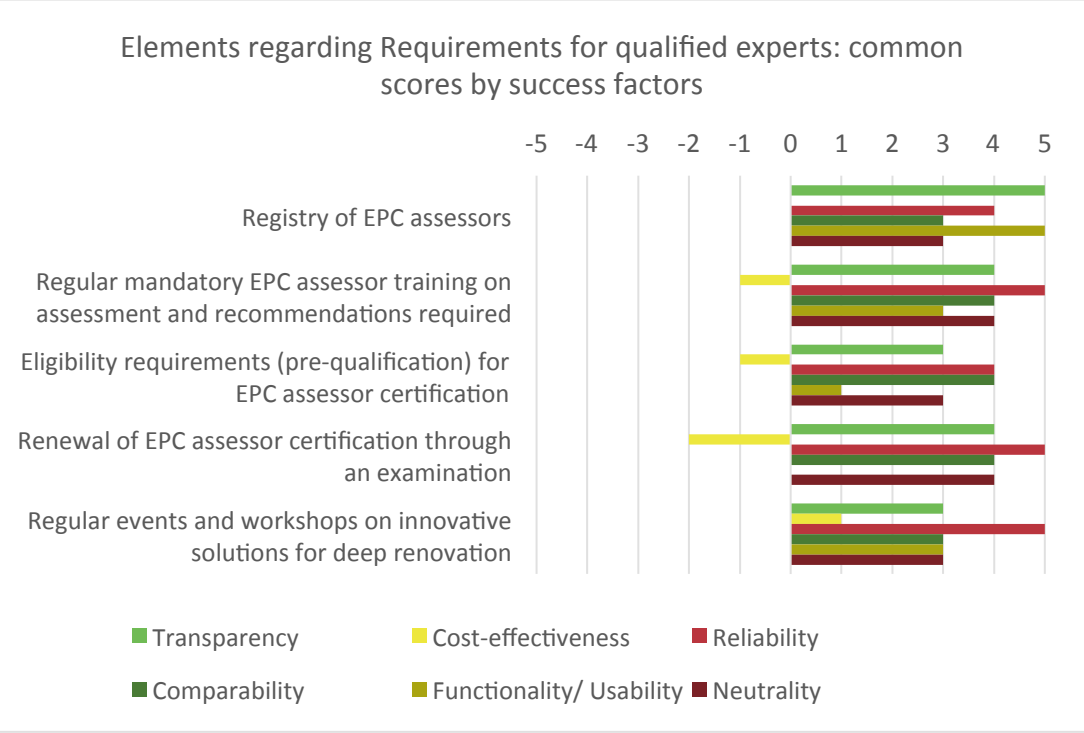

Figure 10 Elements regarding Requirements for qualified experts: common scores by success factors

2.3.3.3 Independent control systems

The elements in the category 'Independent control systems' are mostly important for the Transparency, Reliability and Functionality/Usability, Comparability but could have a relatively negative impact in terms of Cost-effectiveness:

- *Sufficient sample size for verification and quality control* may slightly increase the administrative costs because of the costs of controls
- *Quality control of both EPCs and assessors* could lead to higher costs for EPC control body
- *Achieving C or C* level control of EPC assessments for the sample according to EPBD* increases the costs of EPCs because of increased costs for elaborate controls.

In this category, the element *Using common quality criteria for independent control* is assessed with highest scores

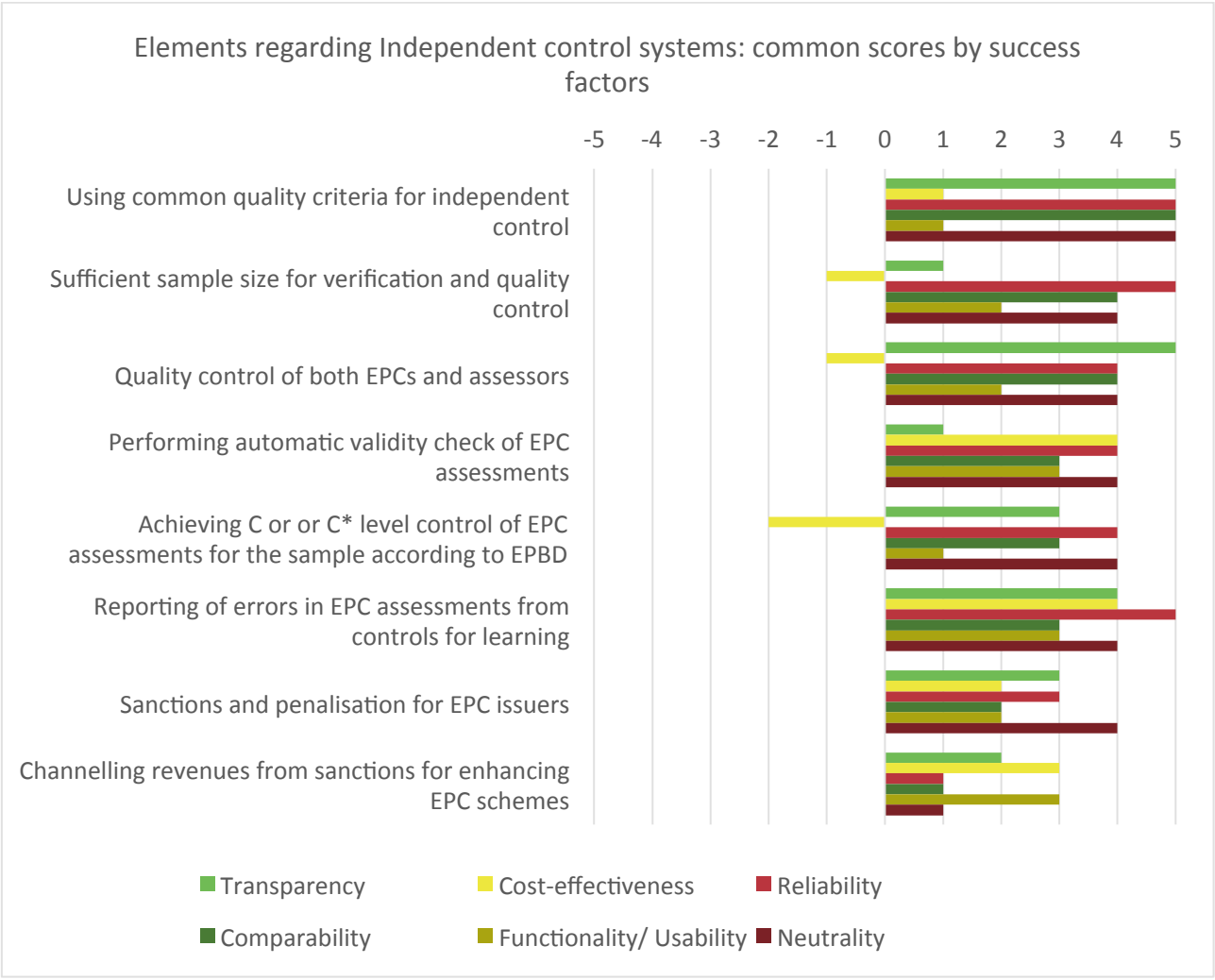

Figure 11 Elements regarding Independent control systems: common scores by success factors

2.3.3.4 Use of EPC data, including in wider buildings-related databases

The elements in this category will improve the EPC schemes mainly in terms of Transparency and Functionality/Usability, as almost all of the elements are assessed with highest score for these factors.

Only one element here has a slightly negative impact for the Cost-effectiveness: *Controlling and enforcing the mandatory use of EPCs in real estate advertisements,* as enforcing may entail extra costs.

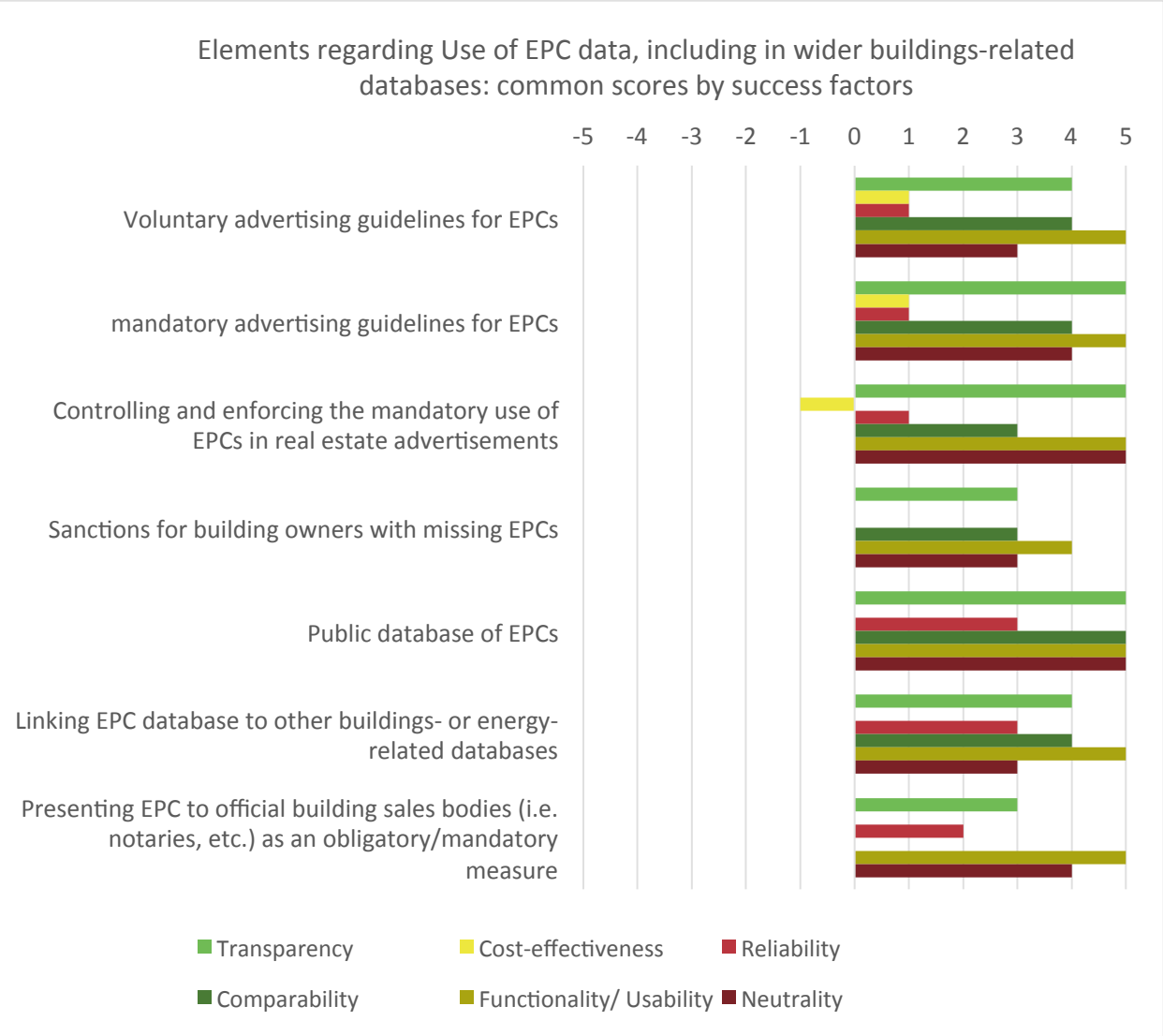

Figure 12 Elements regarding Use of EPC data, including in wider buildings-related databases: common scores by success factors

2.3.3.5 How are EPCs embedded in wider policies and public activities to stimulate deep renovation

In this category, most of the elements are assessed with high impact in terms of Transparency and Functionality/Usability, and relatively high impact in terms of Reliability and Neutrality.

Three of the elements have a slightly negative impact for the Cost-effectiveness:

- *Linking EPCs and renovation recommendations to detailed energy audits* could increase the costs for EPC
- *Monitoring implementation of recommendations given in the EPCs* may entail extra costs for effective controlling and monitoring
- *A mandatory issuance of asset rating EPCs before and after renovation* could entail double costs of EPC issuance

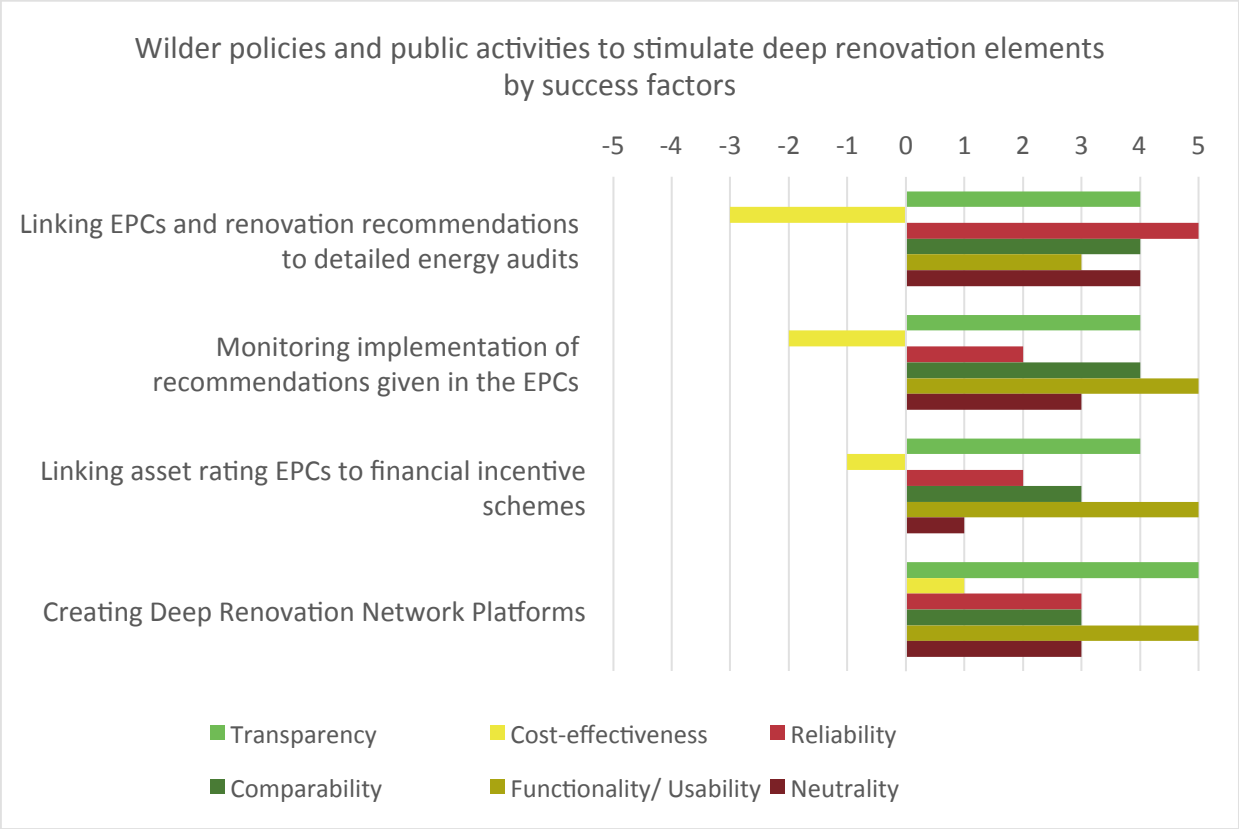

Figure 13 Elements regarding Wider policies and public activities to stimulate deep renovation: common scores by Success factors

2.3.4 Country-specific normalized total weighted score

Based on the common scoring consolidated by all the partners for each element (chapter 2.3.3) and the country-specific weightage for the six factors (chapter 2.3.1), all the elements were assessed with regard to their normalized total weighted score, i.e. their total contribution to a successful EPC scheme, at country level.

For each of the approximately 50 EPC elements, a country specifc weighted average score has been obtained by applying the 'country specific weightage' (chapter 2.3.2, table 5, figure 6) to the 'common scores by success factor' (chapter 2.3.1, figures 1-5). This score provides insight into the country-specific potential of success of each EPC element.

The results from the country-specific normalized weightes scores are discussed in the subsequent sub sections. For explanation purposes, the approximately 50 EPC elements are grouped under the five categories, similar to the categorization followed in the deliverable 2.1.

2.3.4.1 Assessment and Certification

The differences between elements mainly result from the average weighted scores (between 1.3 for *reasonable cost* and 3.7 for *common software,* cf. figure 4), while the differences between the seven countries for one element are smaller – maximum 1.5 points, for *on-site inspection*.

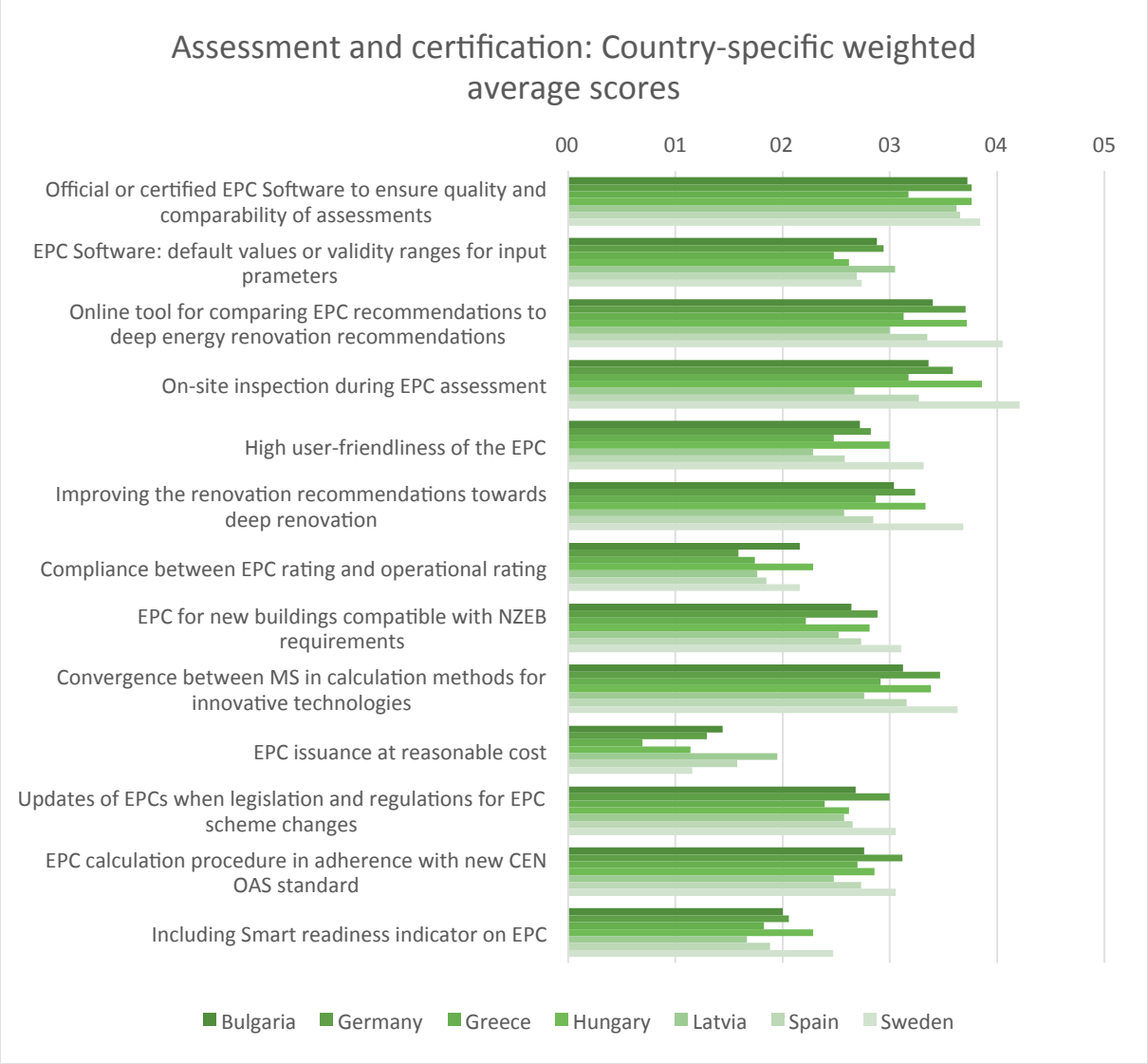

Figure 14 Elements regarding Assessment and Certification: Country-specific normalized total weighted scores

2.3.4.2 Requirements for qualified experts

In this category, the country differences are relatively low (lower than 1), while the main difference between the elements in scoring is based on the common assessment of scores.

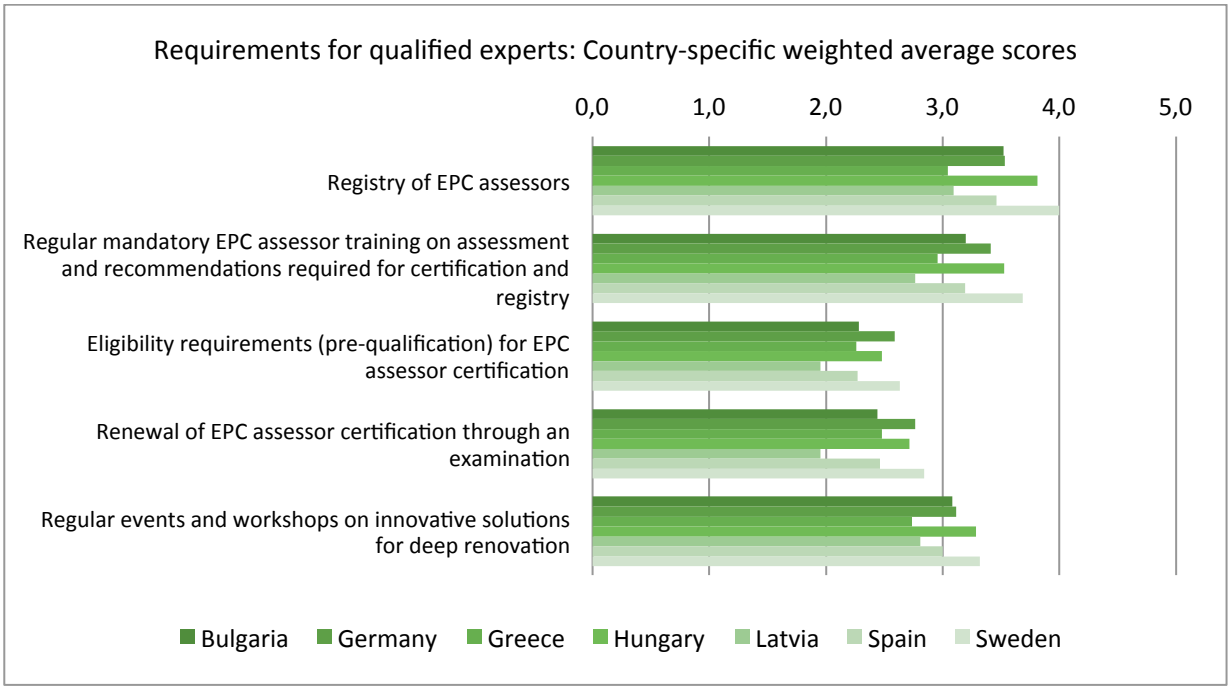

Figure 15 Elements regarding Requirements for qualified experts: Country-specific normalized total weighted scores

2.3.4.3 Independent control systems

In this category, again there are no big differences between the partners' country-specific assessments for the individual elements:

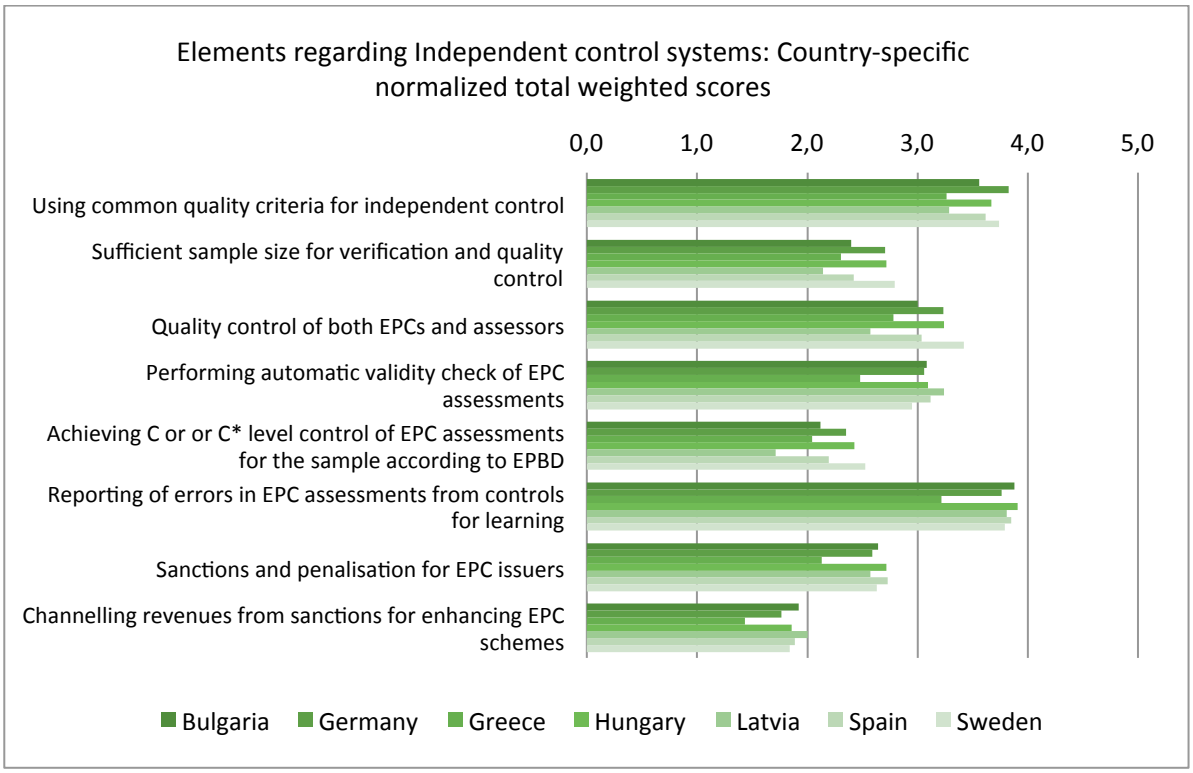

Figure 16 Elements regarding Independent control systems: Country-specific normalized total weighted scores

2.3.4.4 Use of EPC data, including in wider buildings-related databases

In this category too, there are no big differences between the partners' country-specific assessments for the individual elements:

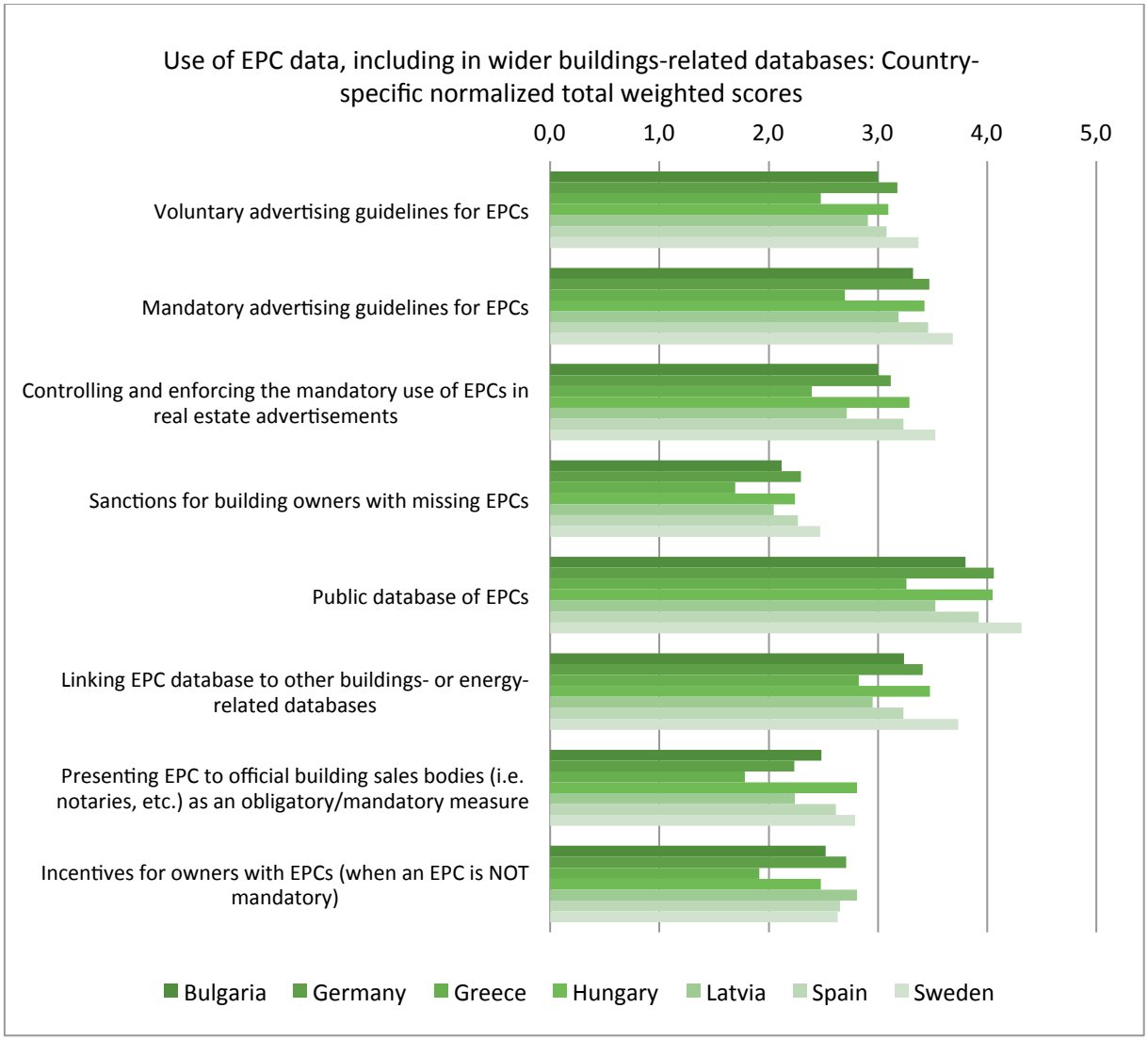

Figure 17 Elements regarding Use of EPC data, including in wider buildings-related databases: Country-specific normalized total weighted scores

2.3.4.5 How are EPCs embedded in wider policies and public activities to stimulate deep renovation

In this category, it can be seen, that for the element *Linking EPCs and renovation recommendations to detailed energy audits* there is a difference of 1,3 between Latvia and Sweden. For the other elements, country-specific assessments are similar to each other.

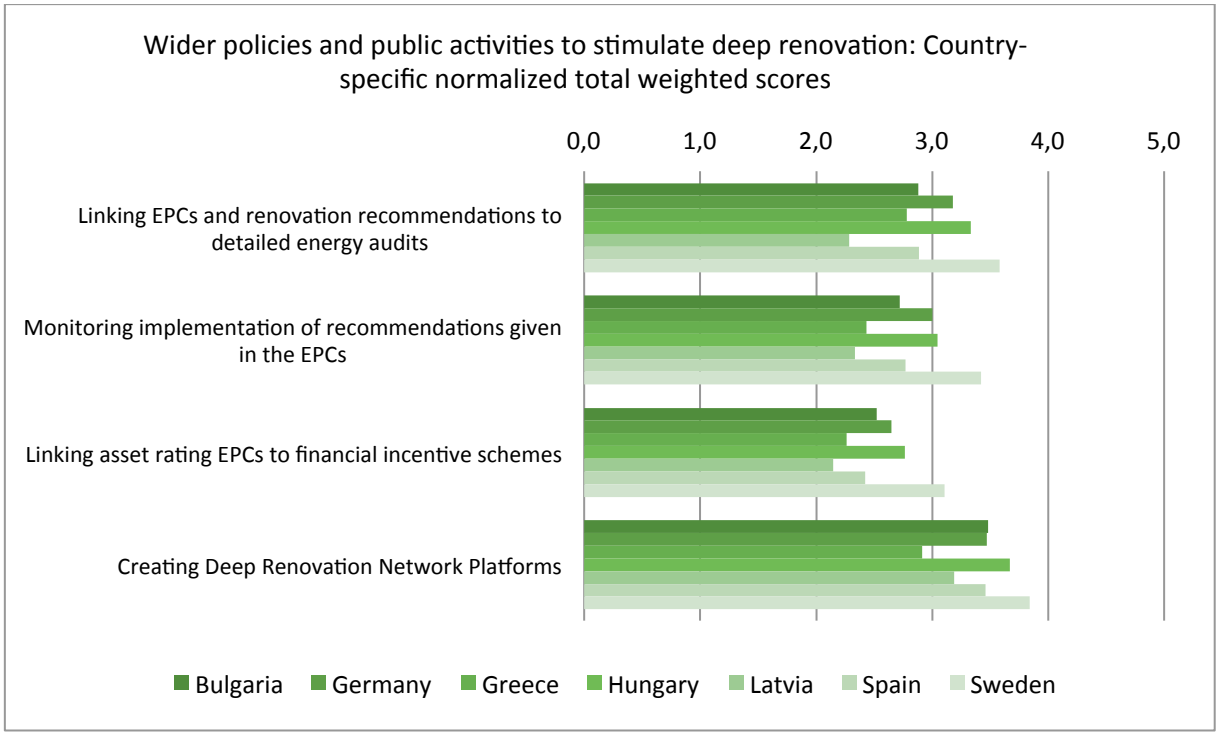

Figure 18 Elements regarding Wider policies and public activities to stimulate deep renovation: Country-specific normalized total weighted scores

3 EXAMPLES OF BEST EPC PRACTICES

For this report on best EPC practices, we collected good examples from EU Member States plus the UK of their approaches and tools to implement EPC schemes and their embedding in wider energy efficiency measures. European examples were collected from literary sources, similar projects and initiatives, and analysed according to the project needs to establish an overall concept vision for an enhanced and converging EPC scheme and its link to deep renovation.

The list below is the result of gathering best practices in the EU countries plus the UK, in alphabetical order.

Country	Best practice EPC example	Related category in QualDeEPC
Austria	The Austrian Klima:aktiv initiative, which is the major Austrian climate protection programme, promotes voluntary quality standards for buildings (for new constructions and renovations as well as infrastructure, ecological building construction materials and indoor air quality). Furthermore, the Austrian Klima:aktiv initiative provides training for professionals and disseminates information to home owners and companies. Since 2004 the initiative is one of the most influential systems for implementing energy efficiency. Every year projects are awarded equally for their architectural value as well as their quality with respect to ecology, energy use, and social and economic sustainability in this programme. The Klima:aktiv platform will continue setting best practice examples for the promotion of sustainability in buildings.	• EPCs are embedded in wider policies and public activities to stimulate deep renovation; e.g., offers a Deep Renovation Network Platform at regional level
Belgium	In Brussels, communication has started towards the professional target groups that will be involved in the EPC scheme (information, training, helpdesk for professionals, brochures and seminars). In the Flanders region there is a database in which all EPCs are collected, which is also used for quality control, for the building permit process and for the automatic attribution of subsidies and discounts for energy efficient buildings. There is a strict enforcement system with financial penalties for non-compliance with EPC regulations (for building owners and energy experts). In Flanders, there is also a dedicated website and a public campaign supported by flyers, brochures and seminars. Information is provided to the public concerning the EPC related to subsidies and tax benefits. Currently, the EPC is being adapted based on a stakeholder and end-user involvement process, to develop an EPC+, integrating customised Energy renovation advice.	• Requirements for qualified experts; • Independent control systems; • Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation;
Bulgaria	• The government's "National Programme for Energy Efficiency of Multi-Family Buildings" (Programme) was launched during February 2015. The Programme builds upon past efforts aiming at much higher results. The Programme is fully in line with the country's and the EU's climate and energy strategy. It aims at: - improving energy efficiency of multi-family residential buildings; - extending the lifetime of buildings; - contributing to a reduction in local and global air pollution. The "Programme Development Objective" is to secure better living conditions for citizens at multi-family buildings, heat comfort and better quality of the living environment through implementing energy efficiency measures. The programme covers the costs for technical passports of the buildings, energy audits, technical design projects and implementation of the energy recommendations.	• Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation • Assessment and certification

Country	Best practice EPC example	Related category in QualDeEPC
	• Another initiative of Sustainable Energy Efficiency Agency (SEEA) is Enhancing the institutional capacity of the Agency to deliver more and better energy efficiency services. New software for calculating the energy performance of buildings was developed. The software includes advanced energy recommendations and has improved functionalities. • Moreover, SEEA has developed a simplified energy calculation tool for households, which helps them to assess and understand their energy consumption, energy behaviour and which measures could improve their energy performance.	
Croatia	In Croatia, the combination of requirements set for new buildings, renovated buildings and NZEB, and subsidies that were assigned to the improvement of the energy efficiency of existing buildings will bring significant energy savings over the coming years. The recommendations in the EPCs serve as good guidelines to help owners decide on implementing some of the possible energy improvements. The number of qualified experts necessary for issuing EPCs and for regular inspections of technical systems is sufficient to cover all the market needs.	• Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation
Cyprus	In Cyprus, an incentive using EPCs is the establishment of the 5% extra building space allowance for buildings that reach A class, with at least 25% of their primary energy consumption coming from RES, established in 2014. Most of the interest for this incentive comes from developers of large buildings. This incentive can also be used in the construction of new buildings.	• EPCs are embedded in wider policies and public activities to stimulate deep renovation
Czech Republic	In 2016, the Czech Republic launched an information campaign to raise public awareness for the EPC on a national level. A broad range of texts were prepared, highlighting the importance of the EPC and explaining its parts, including who can issue an EPC and where complaints can be filed in case of improper processing. Energy savings calculations were done to show what role the EPC can play when considering a rental or house bargain. Finally, it also included requests for public advertisement. A relevant web page was created to contain all the necessary information in an 'easy-to-understand' format. The campaign was based on two model houses commonly used by the public – a family house and an apartment house – in order to present different costs using different sources of energy and different energy classifications. The family house model costs were calculated for heating and hot water preparation using natural gas, heat pumps and electricity.	• Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation
Denmark	Information initiatives to reduce the energy consumption in the existing building stock are one of the key elements in the Danish Energy Agreement of 22 March 2012. Previous and current activities aim at producing cost-efficient information material in cooperation with relevant actors that deal with energy saving. The importance of the local perspective and private ownership is a significant part of the activities. The Danish Energy Agency hosts websites containing both general and specific information on energy savings in buildings as well as on the EPC. The main website of the information campaign, www.SparEnergi.dk, contains a variety of tools, information and knowledge that supports energy saving. Furthermore, a number of initiatives have been launched to promote the EPC and reduce energy consumption in buildings, e.g., "*BetterHomes*". "*BetterHomes*" is a Danish national consultancy scheme, which is voluntary and market-driven. It extends the EPC scheme and aims to promote refurbishment of private residential	• Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation

Country	Best practice EPC example	Related category in QualDeEPC
	buildings by removing barriers and making it easier and more manageable to refurbish and reduce the buildings' energy consumption through counselling during the building process.	
Estonia	Estonia has had the courage to establish ambitious minimum energy performance requirements by regulations and make the construction sector stick to the requirements. A study carried out by an international group of building scientists showed that Estonia is among the countries with the most energy efficient buildings in Europe. The analyses of the NZEB energy performance requirements and reference apartment buildings in four countries (Estonia, Norway, Finland and Sweden) showed that the nearly zero energy buildings constructed in Estonia are most energy-efficient, i.e. their energy consumption is the lowest. The strict energy efficiency requirements constitute a kind of consumer protection for a house or apartment buyer, which is proven by the EPCs issued for the new buildings.	• How are EPCs embedded in wider policies and public activities to stimulate deep renovation
Finland	A good example from Finland is that organisations from the building ownership and building maintenance sectors are involved in developing the national transposition and disseminating EPCs. Through workshops and networking forums, the Finnish authorities are in constant communication with the professionals to ensure compliance and quality of EPCs. For example, together with *Motiva Oy*, the Ministry of the Environment organises a networking day for EPC qualified assessors twice a year to inform the experts on EPC related developments and to discuss key issues. The involvement of stakeholders helps to ensure support and acceptance of the new legislation and implementation of initiatives. This is further supported by specific information activities and active voluntary energy efficiency agreements.	• Use of EPC data, including in wider buildings-related databases; • Requirements for qualified experts; • EPCs are embedded in wider policies and public activities to stimulate deep renovation
France	In France, a testing scheme called "E+ C-" (standing for Energy plus Carbon minus) was created, for voluntary developers, which started in late 2016. Developers test the technical and financial feasibility of building construction in accordance with future regulations. In this respect, public developers intend to pave the way by integrating renewable electricity production systems into their buildings and by developing low-carbon construction processes. A test observatory will collect feedback and best practices to refine indicators and establish future regulatory thresholds. To reward the first buildings constructed under the new regulations, the Government has introduced a new label that is awarded after the assessment of the technical and economic feasibility of the new requirements. Intended to distinguish positive energy buildings in the same way as low-carbon buildings, this label will incorporate several performance levels. There are four different levels based on the energy consumption and two on the carbon footprint set by the scheme. The energy performance assessment relies on the currently used calculation methodology, with the first two levels corresponding to the energy performance expected by the RT 2012 but with a higher share of RES. The third level involves a higher energy performance than the current regulation and the fourth level matches the positive energy building (meaning that the energy performance is lower than zero). The carbon footprint assessment is based on a complete life cycle analysis, from the manufacture of components to the recycling of rubble. The first level of the label is easy to reach and aims at having all the stakeholders involved in the construction to implement an overall reflexion on the environmental impacts of a building. The second level is however more challenging and requires a real decrease of the carbon emissions of the building.	• Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation

Country	Best practice EPC example	Related category in QualDeEPC
	The setting of the E+C- scheme has been a long-term endeavour that included numerous stakeholders working in a common direction. Having such a result is truly a success, since it ambitiously paves the road for the new regulation on two combined aspects. Firstly, it pushes the technical and environmental requirements further than ever. However, secondly, the testing scheme enable the assurance that the future regulation requirements are effectively attainable, which is considered as most important.	
Germany	A good example from Germany is the Info Portal of the BBSR. The Federal Institute for Research on Building, Urban Affairs and Spatial Development advises the responsible federal ministries on technical and scientific questions of energy saving and continuously takes part in the amendment of norms concerning the energy saving. • https://www.bbsr-energieeinsparung.de/EnEVPortal/DE/Home/home_node.html • The portal offers information regarding: • Energy certificates for buildings • Regulations concerning the issuance of energy certificates • Bulletins • Climate correction factors • Independent control system • Property advertisements • Date of issuance for new buildings • Transitional Provisions • Issuing experts • Forms • Printing application • Publications • Recommendations for improvement of energy efficiency FAQs concerning energy certificates The Federal Government also financially supports the advice given by energy experts to building owners. The Federal Office for Economic Affairs and Export Control (*BAFA*) supports on-site-advice ("*Vor-Ort-Beratung*") for residential buildings and energy advice for medium-sized enterprises ("*Energieberatung Mittelstand*"). If the expert is also an EPC assessor, (s)he can issue EPCs based on the data collected and the calculation. The advice of listed energy efficiency experts can also be financially supported by the *KfW*. In addition, the "*Verbraucherzentrale*" (publicly supported organisation providing advice to consumers) provides information, including on EPCs, and Energy-Checks for households.	• Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation
Greece	The EnergyHUB for ALL is a portal of information on energy performance of buildings and at the same time a "node" for communication between the different stakeholders involved in energy renovation of households. The goals of EnergyHUB for ALL: • Encouraging the use of PEA recommendations through the provision of reliable information and instructions • Build trust between the consumer and the market to understand the possibilities of renovation, cost and depreciation • Supporting the supply chain in designing housing promotion strategies, identifying customers and building corporate relationships to implement the measures to reduce carbon dioxide emissions	• EPCs are embedded in wider policies and public activities to stimulate deep renovation
Hungary	Good EPC practice in Hungary is the EPC electronic registration system has been in operation since 2013. An EPC is only valid after upload into the online system.	• Requirements for qualified experts;

Country	Best practice EPC example	Related category in QualDeEPC
	Roughly, 150,000 EPCs are issued annually. The online system also serves as a first level of quality control: first, it automatically checks the permit of the energy expert. Following this step, the system checks for unrealistic figures. The second and third control levels are performed by the Hungarian Chamber of Engineers. Randomly selected, 2.5% of the EPCs are verified by an office check and 0.5% (20% of the 2.5%) are verified on-site. Both controls are carried out by independent experts and all control results are registered in an electronic database. From the beginning of 2017, targeted controls are also possible. If the quality control detects a miscalculation leading to a difference of more than two energy classes, the expert loses his licence for 3 years. Since 2017, further sanctions can be applied, including fines and penalties.	• Independent control systems;
Ireland	Sustainable Energy Authority of Ireland launched a free online training resource to help businesses and residential sector to reduce their energy costs. The SEAI Energy Academy can help to lower energy bills by as much as 10%, potentially even more, by educating businesses and employees on changing energy use behaviours and effective energy management. They are working with homeowners, businesses, communities and government to transform how we think about, generate and use energy. A lot of useful information about energy performance certificates and energy measures are provided in the platform as well as databases of registered energy assessors. https://www.seai.ie/	• EPCs are embedded in wider policies and public activities to stimulate deep renovation • Use of EPC data, including in wider buildings-related databases;
Italy	The new EPC system was the outcome of a positive stakeholder consultation, involving regions, industry, and experts' associations. The shared vision on EPC in the Italian transposition of the EPBD was implemented by the 2015 decree. Beyond various EPC features, the public consultation asked for better coordination of the action at national level and for a harmonised national EPC information system (named SIAPE) that could improve analysis and use of EPC data, as well as knowledge of the building stock. SIAPE indicators have been agreed with regions and other key stakeholders. They encompass information from inspections and the reporting of building technical heating and cooling systems. From 2017, regional EPC data are sent to the SIAPE (developed and managed by ENEA) on an annual basis. SIAPE is a multi-tier web portal that allows regions to access and analyse their own raw data, and other users (citizens, trades, local authorities) to retrieve aggregated data. Interoperability with the existing regional systems is guaranteed, taking into account specificities of regional EPC and technical building systems inspection databases. Compatibility with the building cadastre and other databases (census, national renovation incentives) is being studied. A pilot tool combining EPC data with other databases has been developed as a pilot experience within the IEE Request2Action project, taking advantage of the open EPC database and management experience in the Lombardy region. The SIAPE will provide the national statistics on the number of EPCs and related controls, average costs for issuing EPCs for different typologies, EPC distribution by energy class and NZEB, and other relevant energy performance data contained in the EPCs. The aim is to facilitate policy making on sustainable building at national and regional levels. Training for regional officers will be assured as well.	• Use of EPC data, including in wider buildings-related databases;
Latvia	With an aim to digitalise the documentation of the entire construction process, Latvia has introduced the *BIS* that also offers public access to the *Register of Independent Experts in the Field of Energy Performance of Buildings* and the *Register of Certificates of Energy Performance of Buildings.* This digitalisation	• Requirements for qualified experts; • Use of EPC data, including in wider

Country	Best practice EPC example	Related category in QualDeEPC
	process lessens the administrative and paperwork burden involved with the certification of qualified experts, as any new information is always available online for anyone to check. Implementing the *BIS* will give access to better statistical data and lead to a better understanding of how requirements work in practice. Another good example from Latvia is a campaign named "Living warmer". This, basically, is a platform which unifies different experts about energy efficiency of buildings. In the beginning of March this year there was an event where 36 different associations signed a memorandum that we are going to work together to move on with building renovation and energy efficiency measures. During the last 10 years, there have been many seminars and educational events thanks to "Dzīvo siltāk" initiative and therefore many buildings (mostly apartment buildings) have been renovated in Latvia. There is a contest about the most energy efficient building held each year in Latvia, where the most energy efficient buildings are chosen in 5 different categories: apartment building, new building, public building, single-family house and industrial building. There are many criteria that are used for judging these buildings but one of the most important is the energy performance certificate of the building. This contest is a way to promote energy efficiency and that you have to think about it when building new buildings and refurbishing existing buildings. http://www.energoefektivakaeka.lv/	buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation
Lithuania	In Lithuania, all EPCs are collected in the national central database and register. The database is always updated according to the requirements of the Building Technical Regulation. Every qualified expert has an obligation to send every EPC to the central database. Only registered and published EPCs are valid and can be presented to the customer. Collection and registration of EPCs in the central database allows for quality control, statistical analysis and monitoring of processes. More than 93% of registered certificates have been issued since January 2013 after new requirements for certification of energy performance of buildings came into force. Approximately 100-200 certificates are issued daily and 2,500-3,000 certificates monthly. The database of EPCs can be used only by responsible specialists. The central register is published on www.spsc.lt and can be used by related institutions, specialists and private persons**.** Since July 2014, all data are also transferred to the Real Property Register and Cadastre of Lithuania.	• Use of EPC data, including in wider buildings-related databases;
Luxemburg	Over the last few years, Luxembourg has made numerous efforts to provide detailed information on energy savings and the use of RES to energy consumers. These efforts are illustrated by the achievements of the public energy advisory and information provider *myenergy*, whose activities include raising awareness as well as informing and assisting households, companies, municipalities and professionals regarding energy savings, the use of renewable and sustainable energy and the development of sustainable residential buildings. The website www.myenergy.lu is an important tool for informing the aforementioned target groups. The free, impartial and basic advice to private individuals is provided over phone (hotline number 8002 11 90) or in personal advisory sessions held in one of the numerous regional *myenergy* information points. These information points are part of a large network of *myenergy*'s local advice centres. Representatives of *myenergy* also organise action weeks, including on-site consultations, information events with presentations and awareness-raising	• EPCs are embedded in wider policies and public activities to stimulate deep renovation

Country	Best practice EPC example	Related category in QualDeEPC
	activities, attend national trade shows, create information flyers and internet platforms and ensure a regular presence in the national media. *myenergy* has also developed virtual interactive gamification tools, providing key messages in the conception of high-energy-efficient buildings.	
Malta	In Malta with the introduction of the EPBD, and with national legislation related to energy performance coming into force, architecture and engineering professionals were then tasked with new responsibilities. Establishing responsibilities applicable to minimum requirements and EPCs as well as NZEB within the current system was viewed as a golden opportunity. Architects and civil engineers would now be responsible for drawing up recommendations to improve the building's energy efficiency, since these professionals were deemed the most competent persons within the construction industry due to their experience in construction and renovations. Similarly, heating and AC inspections were entrusted to experienced building service engineers, as these are the professionals with the best available knowledge as to how to improve the efficiency of installed systems and may therefore advise building owners accordingly. It was understood from the very beginning that training building professionals in energy efficiency aspects will have a multiplier effect in the sense that the training they undergo for energy performance certification and system inspection may then be put to good use when these same professionals are carrying out unrelated design work. Similarly, the same professionals are then able to impart the knowledge gained from EPC and inspection training onto associated professionals, trade persons within the construction industry, building users and owners.	• Assessment and certification; • Requirements for qualified experts;
Poland	Poland implemented a lot of awareness activities with the aim to promote EPCs and energy efficiency in buildings: • The "Guide to Improve the Energy Performance of Buildings", developed on March 2016 by the Ministry of Infrastructure and Construction. The guide is aimed at a wide range of customers, including owners and users of buildings or their parts, investors, building managers, local government units, building contractors, architects, engineers, people authorised to draw up EPCs and inspect heating and AC systems, and energy auditors. • "The House, Which Saves for Me" campaign, conducted by the Ministry of the Environment. • Certain information and educational campaigns related to RES, e.g., the "Operational Programme Knowledge Education Development (POWER)", in the financial perspective for 2014-2020 taken by the Ministry for the Economy on basis of the law of 20 February 2015. POWER is a two-tier operational programme addressing the need for reforms in the areas of employment, social inclusion, education, health and good governance, and providing direct support in areas where support at a national level is justified by objective considerations. • Actions by educational faculties to increase research capacity in the scope of environmental technologies. In addition, there are many other organisations, associations, institutions, etc., that provide services of information and consultancy to promote energy conservation issues.	• Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in wider policies and public activities to stimulate deep renovation
Portugal	In Portugal, the EPC is a tool that provides access to funding schemes and is also used as a validation mechanism (by the qualified expert) regarding the effectiveness of the implemented recommendations supported by those incentives. In order for the validation to occur, the EPC is issued at the beginning of the process in order to assess the status (baseline) of the building. It clearly identifies which building component has to be replaced or renovated, in order to evaluate the future performance of the building and the resulting associated	• Independent control systems; • Use of EPC data, including in wider buildings-related databases; • EPCs are embedded in

Country	Best practice EPC example	Related category in QualDeEPC
	savings, in terms of either energy consumption or monetary value. Because of this, the EPC is a mandatory document for the application process. After the construction/renovation phase, a final EPC is issued which will be used as a validation and conformity check of the works that were carried out, and to evaluate new energy indicators and improvements. Since all information is stored in a central database, it makes it easier to establish connections with other databases to better operate the funding schemes. Having a single EPC ID number that not only identifies the EPC (with around 150 variables per certificate) but also the building in question, allows for several public and private bodies that are not necessarily familiar with technical data to gain easy access to the relevant information. In 2016, a marketing campaign was drafted and put into practice which specifically focused on EPC recommendations. After analysing all issued EPCs, and particularly the almost 2 million proposed recommendations, the top ten measures were identified, five related to building envelope – wall insulation, roof insulation, windows, solar shading and ventilation, and five related to technical building systems – solar thermal collectors, wood stoves, boilers, heat pumps and PV, and a set of small brochures were designed (around ten pages each). These brochures had a clear message in mind – to provide a better understanding to the building owner of the building features that can be improved when considering the potential energy reduction or achieving costs savings. Each brochure follows the same structure and has a coherent design, which allows homeowners to understand the impact of that specific recommendation as well as any possible constraints or difficulties in implementing it.	wider policies and public activities to stimulate deep renovation
Romania	In Romania, every building energy expert must keep a registry with all EPCs issued, including all relevant information. The energy expert is required to transmit an electronic version of the EPC to the central database. Since there is no standardised template defined for the EPC, there is a great diversity in the formats received. The central register of the EPC and the national database is managed by the research institute NIRD URBAN-INCERC since 2008.	• EPCs are embedded in wider policies and public activities to stimulate deep renovation
Slovak Republic	In the Slovak Republic, information campaigns are organised through TV specials (broadcasted monthly), focusing on energy certification, measures recommended for major and deep building renovations, construction products, as well as information about technical building systems and components. Similarly, there are also radio broadcasts focusing on energy certification. Information about the energy performance of buildings is available at *www.mindop.sk*. There are already some ongoing information campaigns, e.g. "*Live with Energy*" and "*Energy for you*".	• EPCs are embedded in wider policies and public activities to stimulate deep renovation
Slovenia	In Slovenia, advertising with the inclusion of the EPC energy performance indicator is obligatory when selling and/or renting the building or the building unit. The control is the responsibility of the market inspectorate. Various intensive additional activities are ongoing in this field. The Ministry of Infrastructure is testing the application for the electronic comparison of the database of the real estate transaction, the rental database and an EPC database. The Energy Act EZ-1 defines the penalties for non-compliance with EPC rules. On 24 February 2014, penalties of between 1,000 € and 10,000 € were introduced for public building owners/users if an EPC is not displayed. A fine is also set for the person responsible for the task (from 100 € to 500 €). The penalties (250 €) for building owners advertising the selling/renting of the building without displaying the energy indicators from an EPC were put in place as of 1 January 2015, while as	• Use of EPC data, including in wider buildings-related databases;

Country	Best practice EPC example	Related category in QualDeEPC
	of 24 February 2015 the penalty for selling/renting a building without an EPC is 300 €.	
Spain	Regional Government of País Vasco established a Law about certification of buildings, this is the Decree 25/2019 of 26th February energy performance certification of building the control and register. 1 Timing procedure of the certificate: The certification is issued by technical competente The time since the EPC is carried out until the EPC is registered is 1 month maximum 2 Control of EPCs: 1 or 2 visits are mandatory and the procedure is more strict PAREER financial programme for buildings of residential sector; the building owners will received the 20-30% of the cost of the energy efficiency renovation if the EPC is improved by 1 letter The improvements include in the programme are: 1. Improvement of the energy efficiency with the new building envelope 2. Improvement of the energy efficiency of the lighting and thermal installations 3. Replacement of heating system by biomass boiler 4. Geothermal for heating	• Assessment and certification; • Independent control systems; • EPCs are embedded in wider policies and public activities to stimulate deep renovation
Sweden	Swedish EPCs are, with few exceptions, based on metered values and on-site visits. Compared to EPCs based entirely on calculation and simulation, this procedure is perceived to increases the quality and accuracy of the EPCs, since it better reflects the reality. Also, recommendations presented in the EPCs are more likely to be building specific, rather than general. Both EPC assessors (certified energy experts) and property owners have commented that they find it difficult to see how EPCs could be carried out without visiting the building (in most cases). For a successful use of metered data, figures presented in the EPCs should be clear, and adjustments of metered data should be transparent and traceable. With the introduction of user normalisation in 2016, these qualities were unfortunately lost to some extent. It would be good if also original metered data are presented in the EPCs, in addition to normalised values. In order to increase property owners´ ambitions to carry out major energy retrofitting projects, a tool for identifying major energy savings in existing buildings was developed and introduced in connection with EPC introduction in Sweden. The Total Concept (Totalmetodiken) offers a method and a financial tool that can provide the information required by establishing an informed platform for decisions about investments in energy-saving measures in non-residential buildings. A similar tool designed for multi-family houses was introduced some years later called Rekorderlig Renovering (proper renovation). The identification of energy measures in the EPC builds a foundation for implementation of energy measures while using the Total Concept tool. The EPC and the Total Concept tool helps building owners to understand the financial benefits and opportunities with energy retrofitting and making it possible to come much further with energy improvements.	• Assessment and certification; • EPCs are embedded in wider policies and public activities to stimulate deep renovation
The Netherlands	Between January and March 2015, 4.5 million home owners that did not have an EPC received a letter with a temporary energy label for their home. The intention of this initiative was to make them aware of the energy performance of their property and the opportunities to improve it, as well as of their obligation to have a definitive EPC when selling or renting their house. The latter obligation was also	• Use of EPC data, including in wider buildings-related databases; • EPCs are

Country	Best practice EPC example	Related category in QualDeEPC
	communicated through social media and other national and regional public channels. Municipalities developed additional awareness campaigns and organised local information desks. A new national campaign focusing on how to make homes more energy-efficient started in 2016. The slogan and figurative mark ensure recognisability in the different campaign expressions. The "Saving energy now" campaign will run until 2018. The first phase will focus on improving home insulation in the private owned sector. Later, the focus of the campaign will shift to, e.g., other energy-saving measures or specific target groups. The Association of Dutch Municipalities ("Vereniging van Nederlandse Gemeenten"6) regionally and locally supports the campaign with the so-called Energy Centres. The Energy Centres offer homeowners the possibility of personal advice on energy saving measures, and assistance in finding a suitable building company.	embedded in wider policies and public activities to stimulate deep renovation
UK-England	Calculated EPCs are produced for buildings on construction, sale and rent, and are valid for 10 years. All EPCs become valid after they are recorded on the register. The register contains about 14.5 million EPCs (including cancelled, "not for issue" and multiple EPCs on a single property) and is growing by about 1 million/year, which represents a valuable source of information as they cover an increasingly larger proportion of the ~27 million UK homes. Most EPCs on the register are publicly accessible through an address search, unless the building owner opted out. All EPCs on the register are accessible through a unique reference number search. EPCs statistics are also available on the register. Government provides statistics on EPC activity in England & Wales.	• Use of EPC data, including in wider buildings-related databases;

Table 6: Best practice EPC examples from various member states plus UK

4 OVERALL CONCEPT VISION FOR AN ENHANCED AND CONVERGING EPC SCHEME

4.1 Objectives and development of the Overall concept vision

Based on the analysis of tasks 2.2 and 2.3 of the QualDeEPC project, we can now conclude on an *Overall concept vision for an enhanced and converging EPC scheme*. This Overall concept vision can guide EU Member States in improvement of their national EPC schemes and the use of EPCs in building markets in general, and particularly for supporting deep renovation. It will thus also be a basis for further deliverables of the project, most notably the Guidebook for improved EPCs (Deliverable D5.3) and the Conclusive policy recommendations guide (Deliverable D7.2). The QualDeEPC project itself will not be able to address all the elements in detail in its further development, testing, dialogue, and implementation work. The project will focus on a selection of priority elements from this overall vision, as developed in the Development strategy plan (Deliverable D2.4).

The Overall concept vision is made up of those of the around 40 options for improvement – or potential elements – that we found as very important for a successful scheme and hence should be included in an overall good practice scheme. This importance has been assessed based on 1) the analysis of success factors in chapter 2 of this report, the good practice examples included in chapter 3 of this report, and the replies from the stakeholders on what should be included a good practice EPC scheme (cf. figures 7, 9, 11, 13, and 15 in chapter 3.1 of the QualDeEPC deliverable D2.3).

So far in our analysis and in this report, we have sorted the potential elements by five *categories* based on processes of EPC assessment, issuance, control, and use, to which an element can be *logically attached*.

- *Assessment and Certification* relates to the building assessment, the design, and the issuance of EPCs
- *Requirements for qualified experts* are also related to building assessment and the issuance of EPCs
- *Independent control systems* aim at improving the quality of the EPCs issued
- *Use of EPC data, including in wider buildings-related databases* is one area of EPC use
- *How are EPCs embedded in wider policies and public activities to stimulate deep renovation* is a special area of EPC use that is in the focus of the QualDeEPC project.

However, for the development of an *Overall concept vision for an enhanced and converging EPC scheme*, it will be more important to analyse the *improvement function* that an option is meant to fulfil. As the first step, we therefore assess, to which of the four main improvement functions that were introduced chapter 3.1.6 of D2.3 each element contributes:

1. Improving the usefulness and use of EPCs for supporting deep renovation
2. Usefulness and use of EPCs in building markets
3. Improving the quality and precision of EPCs in general
4. Certification and training of EPC assessors/issuers

The first two functions relate to the uses of EPCs, while the other two are supportive to the first two.

The results of this first step of analysis are presented in Table 3 in a matrix, with the lines being the 44 elements grouped by the five categories based on EPC and use processes in the first column, and

the four improvement functions as the next columns, and sorting the elements to the functions. In addition, the last two columns show 1) the results of the analysis of the contribution of the elements to the success factors, as summarized in the averaged country-specific total weighted scores and 2) the stakeholders' votes as to whether an element should belong to a good practice EPC scheme.

When sorting the elements to the four functions, the main function is highlighted by strong green colour. Some elements may serve more than one function. Secondary functions are highlighted by slightly transparent green colour.

Element by 5 groups/Function	Improving the usefulness and use of EPCs for supporting deep renovation	Usefulness and use of EPCs in building markets	Improving the quality and precision of EPCs in general	Certification and training of EPC assessors/issuers	Averaged country-specific score no lower than 2,5	Number of votes in terms of importance for a good practice EPC scheme
Assessment and Certification						
Official or certified EPC Software to ensure quality and comparability of assessments					3,65	27
EPC Software: default values or validity ranges for input prameters					2,77	28
Online tool for comparing EPC recommendations to deep energy renovation recommendations					3,48	30
On-site inspection during EPC assessment					3,45	44
High user-friendliness of the EPC					2,74	30
Improving the renovation recommendations towards deep renovation					3,08	29
Compliance between EPC rating and operational rating					1,93	26
EPC for new buildings compatible with NZEB requirements					2,70	31
Convergence between MS in calculation methods for innovative technologies					3,20	22
EPC issuance at reasonable cost					1,32	24
Updates of EPCs when legislation and regulations for EPC scheme changes					2,71	18
EPC calculation procedure in adherence with new CEN OAS standard					2,81	16
Including Smart readiness indicator on EPC					2,03	17

Element by 5 groups/Function	Improving the usefulness and use of EPCs for supporting deep renovation	Usefulness and use of EPCs in building markets	Improving the quality and precision of EPCs in general	Certification and training of EPC assessors/issuers	Averaged country-specific score no lower than 2,5	Number of votes in terms of importance for a good practice EPC scheme
EPC provides data for energy and CO2 savings on both asset and operational rating basis					2,59	19
Requirements for qualified experts						
Registry of EPC assessors					3,49	39
Regular mandatory EPC assessor training on assessment and recommendations required for certification and registry					3,25	36
Eligibility requirements (pre-qualification) for EPC assessor certification					2,35	27
Renewal of EPC assessor certification through an examination					2,52	25
Regular events and workshops on innovative solutions for deep renovation					3,05	23
Independent control systems						
Using common quality criteria for independent control					3,56	30
Sufficient sample size for verification and quality control					2,50	27
Quality control of both EPCs and assessors					3,04	32
Performing automatic validity check of EPC assessments					3,00	34
Achieving C or or C* level control of EPC assessments for the sample according to EPBD					2,20	17
Reporting of errors in EPC assessments from controls for learning					3,74	33
Sanctions and penalisation for EPC issuers					2,57	25
Channelling revenues from sanctions for enhancing EPC schemes					1,81	17
Use of EPC data, including in wider buildings-related databases						
Voluntary advertising guidelines for EPCs					3,01	17

Element by 5 groups/Function	Improving the usefulness and use of EPCs for supporting deep renovation	Usefulness and use of EPCs in building markets	Improving the quality and precision of EPCs in general	Certification and training of EPC assessors/issuers	Averaged country-specific score no lower than 2,5	Number of votes in terms of importance for a good practice EPC scheme
Mandatory advertising guidelines for EPCs					3,32	14
Controlling and enforcing the mandatory use of EPCs in real estate advertisements					3,04	24
Sanctions for building owners with missing EPCs					2,16	16
Public database of EPCs					3,85	24
Linking EPC database to other buildings- or energy-related databases					3,27	22
Presenting EPC to official building sales bodies (i.e. notaries, etc.) as an obligatory/mandatory measure					2,42	26
Incentives for owners with EPCs (when an EPC is NOT mandatory)					2,53	
How are EPCs embedded in wider policies and public activities to stimulate deep renovation?						
Linking EPCs and renovation recommendations to detailed energy audits					2,99	13
Monitoring implementation of recommendations given in the EPCs					2,82	24
Linking asset rating EPCs to financial incentive schemes					2,55	24
Creating Deep Renovation Network Platforms					3,43	27

Table 7 Matrix for an Overall concept vision for an enhanced and converging EPC scheme

4.2 The Overall concept vision

Analysing the content of Table 3 and the good practice presented in chapter 3 allows us to compile the Overall concept vision for an enhanced and converging EPC scheme. It will be presented by the four main improvement functions introduced above and Table 3.

How can we select the elements that should be included in the Overall concept vision? In Table 3, we have marked in red the averaged country-specific total weighted scores below 2.5 in terms of success factors. All elements that pass this threshold, i.e. the value is at least 2.5, could be included in the Overall concept vision as very important for a successful EPC scheme, while those with a value 2.5 could be excluded. However, there is no clear indication as to what exactly should be the threshold value. The same is true for the votes of the stakeholders interviewed, as to which element should be

included in a good practice EPC scheme (last row of Table 3). We highlighted all elements with less than 20 positive votes in orange colour. Applying the success factor threshold would eliminate eight of the 44 candidate elements, leaving 36 inside the Overall concept vision. Taking the stakeholder votes instead, 10 elements would be eliminated and 34 remain. Combining the two criteria would exclude either 14 that fail to meet one of the two thresholds, or 4 that fail to meet both.

Therefore, we have to analyse a little more, which of the elements serve for which function in detail, which of these are important to fulfill the four main functions, and which may have positive or negative interactions between them. Sometimes, two or more elements may offer alternative ways to perform a function. In the end, it may also depend on national priorities and circumstances, which elements should be combined to a national enhanced EPC scheme that is effective in achieving its objectives.

4.2.1 Improving the usefulness and use of EPCs for supporting deep renovation

The EPBD and the national legislation transposing it requires that EPCs carry recommendations for energy efficiency renovations. However, the EPBD also requires them to be cost-effective, which has in many countries been interpreted to be "low cost". The precondition for achieving the function *Improving the usefulness and use of EPCs for supporting deep renovation* is therefore the element **Improving the renovation recommendations towards deep renovation**. For example, the Flanders region in Belgium is working towards this direction, with the ***EPC+ scheme*** under development (cf. Chapter 3).

Usefulness: quality of recommendations

The next step will be ensuring that these improved recommendations have high quality and are reliable. **Linking EPCs and renovation recommendations to detailed energy audits** is an option to achieve this, but it entails a higher cost. Maybe this is why not many stakeholders were in favour of including it into a good practice EPC scheme. An option that does not require a much higher cost is to include issuing an EPC in financial support schemes for detailed energy audits. Therefore, if the detailed data become available through the audit anyway, it will be easy to issue the EPC. Several options that involve training of EPC assessors / experts will also contribute to higher quality recommendations. For example, **Regular mandatory EPC assessor training on assessment and recommendations required for certification and registry** and particularly **Regular events and workshops on innovative solutions for deep renovation** have *Improving the usefulness and use of EPCs for supporting deep renovation* as their secondary function. ***Regular meetings of EPC assessors***, as in the Finnish good practice case, were not in our list of elements but may also be useful. Furthermore, **Convergence between MS in calculation methods for innovative technologies** will also make the recommendations involving these technologies more reliable and convergent between EU Member States.

Usefulness: data basis

An element that may improve the *usefulness* of EPCs for supporting deep renovation could be if the **EPC provides data for energy and CO_2 savings on both asset and operational rating basis**. First of all, it is important to provide data for energy and CO_2 savings at all. Adding the operational rating basis could produce more realistic savings figures. However, not too many stakeholder were in favour of it. This may be due to the fact that stakeholders and experts are divided over the usefulness of the asset or operational rating approach, respectively.

Stimulating the use for supporting deep renovation

Once the EPC can have reliable and easy to understand recommendations that point the user towards deep renovation, there remain two more tasks for policymaking to improve the actual *use* of EPCs for supporting deep renovation: 1) to increase the number of such EPCs, and 2) to foster implementation of the recommendations. An element that can support both tasks is **Creating Deep Renovation Network Platforms**, as they will both advise and support building owners to obtain renovation recommendations and to implement them. An **Online tool for comparing EPC recommendations to deep energy renovation recommendations** may also both support the decision to obtain an EPC, and the trust in recommendations in existing EPCs. **Linking asset rating EPCs to financial incentive schemes** will also obviously raise the number of EPCs issued before renovation and implementation of the recommendations with the support of the financial incentives.

Further elements serving 1) to increase the number of such EPCs can be **Incentives for owners with EPCs (when an EPC is NOT mandatory)** and **Sanctions for building owners with missing EPCs**; but interestingly, the latter failed both the success factor and the stakeholder vote criteria in our analysis.

Regarding the task 2) to foster implementation of the recommendations, a **Public database of EPCs** may inform e.g. tenants about the recommendations, so they can demand implementation from the landlord. **Monitoring implementation of recommendations** given in the EPCs may have an indirect effect by informing policy-makers about the need for stronger support for implementation or for other actions to ensure that more of the recommendations are implemented.

4.2.2 Usefulness and use of EPCs in building markets

More than 20, so around half of the potential elements for an enhanced EPC scheme would contribute to *Usefulness and use of EPCs in building markets*, either as their main or secondary function (cf. table 3).

Usefulness: user-friendliness

This is most obvious with **High user-friendliness of the EPC**. We have interpreted this as a) including the data useful for building owners as well as potential buyers or tenants and b) presenting the data in an easily understandable and highly useful way. What this exactly means remains to be analysed further.

Usefulness: additional features and requirements

One way to improve the usefulness of EPCs could be to add more features and requirements. New features or types of data would improve the information content of the EPC but may also make it more complex – usefulness and user-friendliness may thus be conflicting targets. For example, we analysed **Including the Smart readiness indicator on EPC**, but will fail both the success factor and the stakeholder votes test, if we apply the thresholds as in Table 3. A second additional feature could be **Compliance between EPC rating and operational rating**. This option may make the rating more realistic. However, it achieved a low rating with respect to the success factors (cf. Chapter 2.3), because it may negatively affect comparability and neutrality.

The Horizon 2020 'sister projects' X-tendo and U-Cert are also analysing further options for additional features, such as ***potential savings from District energy***, ***emissions related to outdoor air pollution***, ***comfort (thermal comfort, indoor air quality***) (X-tendo) or ***indoor environmental quality*** (U-Cert).

Other new features could be those related to energy savings and recommendations, like **Improving the renovation recommendations towards deep renovation** and **EPC provides data for energy and CO_2 savings on both asset and operational rating basis** that were already discussed above.

Regarding new requirements, we analysed two potential elements. One is **EPC calculation procedure in adherence with new CEN OAS standard**. This may improve quality and comparability of the EPCs. The U-Cert project is focussing on this option. However, it received relatively few stakeholder votes in our interviews. We don't know if that may be due e.g. to the fact that these standards are new and possibly not well known by stakeholders, or due to other reasons. The other requirement, which fared well in the analysis, is **EPC for new buildings compatible with NZEB requirements**.

Usefulness: cost

One aspect of EPC schemes that will be important for its acceptance by building owners is **EPC issuance at reasonable cost**. It may compromise reliability, which explains the low success factor (cf. Chapter 2.3). But this would be the case if the priority were minimising cost at all effort, which would not be a *reasonable* cost any more. However, there is also a trade-off between the new features and requirements discussed above, which may entail a higher cost, and this aspect of reasonable cost.

Usefulness: processes of EPC issuance

Usefulness of EPCs and EPC schemes can also be improved in processes of EPC issuance. For example, a **Registry of EPC assessors** will make it easier for building owners to find a trustworthy expert to issue an EPC. Automatic **Updates of EPCs when legislation and regulations for EPC scheme changes** will improve EPC comparability and reduce efforts for building owners. However, this option received relatively few stakeholder votes.

Use of EPCs in building markets

The main use of EPCs in building markets is during advertisements and transaction for selling and renting buildings. By requirement of the EPBD, it is mandatory to present key data from the EPCs in real estate advertisements. However, there is evidence from many countries that this is not always obeyed. Therefore, effectively **Controlling and enforcing the mandatory use of EPCs in real estate advertisements** is key. How can this be achieved? Particularly the controls will require staff resources and good processes. Good practice from the EU Member States can guide enhancement efforts. **Presenting EPC to official building sales bodies (i.e. notaries, etc.) as an obligatory/mandatory measure** has been required in several EU Member States. It will make use of processes and trusted actors involved in building transactions anyway to perform the control and ensure compliance, although with the requirement to obtain an EPC rather than to present the data already in advertisements.

Compliance with both legal requirements may also be improved through other instruments. **Sanctions for building owners with missing EPCs** are an instrument already in place in a number of countries. Interestingly, it will fail both the success factor and the stakeholder votes test, if we apply the thresholds as in Table 3. An alternative may be to make it easier for building owners to comply with the advertisement obligations, by offering **Voluntary advertising guidelines for EPCs** or even **Mandatory advertising guidelines for EPCs**. While the legal requirement states, which data have to be included in advertisements, these guidelines would explain the user where to find the data and how to present them. A **Public database of EPCs** may also induce building owners to obtain an EPC when needed, and be an alternative source of information for potential buyers and sellers, also to check if the data in the advertisement are correct. If such a database exists, it will be possible to

implement the **Linking EPC database to other buildings- or energy-related databases**, which may make the combined databases more useful for building market actors but also administrations and policy-makers. Finally, the number of EPCs and thus their usefulness and use in building markets will also be increased through **Incentives for owners with EPCs (when an EPC is NOT mandatory)**.

Finally, EPC use for deep renovation is also an aspect of their use in building markets. The options discussed above will also contribute here, namely **Online tool for comparing EPC recommendations to deep energy renovation recommendations**, **Linking asset rating EPCs to financial incentive schemes**, and **Monitoring implementation of recommendations**.

4.2.3 Improving the quality and precision of EPCs in general

There are two broad avenues towards achieving this purpose, hence the functions of the different improvement options we analysed: improving the EPC assessment and issuance/certification methods and processes, and improving the independent control systems.

EPC assessment and certification

Two elements for enhanced EPC schemes address the assessment software. **Official or certified EPC Software to ensure quality and comparability of assessments** will particularly improve reliability and comparability as well as transparency, while **EPC Software: default values or validity ranges for input parameters** aims to balance reliability and cost. A software, however, is only as good as the data inserted to it. Therefore, **On-site inspection during EPC assessment** can greatly improve the quality, although it comes at an additional cost. This is the option that received by far the highest number of votes from stakeholders.

Other options to improve the assessment could be **Convergence between MS in calculation methods for innovative technologies**, **EPC calculation procedure in adherence with new CEN OAS standard**, and **EPC for new buildings compatible with NZEB requirements**.

Independent control systems

The first step in the independent control of EPCs and assessors is **Performing automatic validity check of EPC assessments**, when uploading the EPC data to the national or regional database. This is a low-cost measure with high effectiveness, and therefore quite common among EU Member States (cf. QualDeEPC deliverable D2.1).

The second step is the independent in-depth control of a sample of EPCs. Obviously, a **Sufficient sample size for verification and quality control** is key, and **Using common quality criteria for independent control** will enhance convergence of EPC schemes between EU Member States. The European Commission has defined levels of control. For example, C level includes a full check of input data, calculation results, and recommendations; the C* level includes an additional check through an on-site visit, if the C level shows major deviations. **Achieving C or C* level control of EPC assessments for the sample according to EPBD** therefore seems reasonable, but it will fail both the success factor and the stakeholder votes test, if we apply the thresholds as in Table 3.

Not only the quality of the EPCs can be checked and improved but also that of EPC assessors or issuers. **Quality control of both EPCs and assessors** is therefore advisable, but also **Sanctions and penalisation for EPC issuers** failing to present good quality EPCs. An interesting idea is **Channelling revenues from sanctions for enhancing EPC schemes**, but it will fail both the success factor and the stakeholder votes test, if we apply the thresholds as in Table 3. The likely reason may be that in most countries this revenue has been negligible.

Reporting of errors in EPC assessments from controls for learning will also improve the quality of EPC assessors or issuers over time, and hence the quality of their assessments.

4.2.4 Certification and training of EPC assessors/issuers

There are also a number of potential measures to directly support the capabilities of EPC assessors/ issuers, which in turn will support higher quality in EPC assessment and certification. The starting point could be **Eligibility requirements (pre-qualification) for EPC assessor certification**. However, the analysis of success factors yielded a lower score for this option than for those that include targeted training and examination of EPC assessors. These include mandatory options such as **Regular mandatory EPC assessor training on assessment and recommendations required for certification and registry** and the **Renewal of EPC assessor certification through an examination**, but also voluntary alternatives like **Regular events and workshops on innovative solutions for deep renovation**. It will depend on the circumstances in different countries, which would be preferable. ***Regular meetings of EPC assessors***, as in the Finnish good practice case, were not in our list of elements but may also be useful.

Quality control of both EPCs and assessors as well as **Sanctions and penalisation for EPC issuers** will provide a further incentive for them to participate in trainings.

5 CONCLUSIONS

This report analysed (1) which are the elements for improvement that will bring high impact for a successful EPC scheme; (2) which are the best EPC practices in the EU member states and how they contribute to the implementation of EPC; (3) what could be an Overall concept vision that may guide EU Member States in improvement of their national EPC schemes and the use of EPCs in building markets in general, and particularly for supporting deep renovation.

Various characteristics of a successful EPC scheme such as transparency, cost-effectiveness, reliability, comparability, functionality and neutrality were analysed in this report. It could be said that the most important successful factors for EPC scheme are Transparency, Reliability and Functionality/Usability. The improvement options identified in Task 2.1 were presented in table form as for their significance with respect to the above mentioned characteristics or success factors. All the elements for improvement, grouped by the five categories, were analysed in terms of their impact for the success factors. A country-specific assessment was also implemented, based on averaged normalized total weighted score.

A study conducted to compile existing good practices and examples for innovative solutions was performed and analysed in chapter 3 to support the Overall concept vision for an enhanced EPC scheme.

In this Overall concept vision, it was analysed which of the elements serve for specific functions in detail, which of these are important to fulfill the four main functions, and which may have positive or negative interactions between them. Simply requiring that EPCs be issued is not enough for a successful EPC scheme: the analysis indicates that EU Member States should combine many different individual measures and tools towards enhanced EPC schemes fulfilling the four main functions:

5. Improving the usefulness and use of EPCs for supporting deep renovation
6. Usefulness and use of EPCs in building markets
7. Improving the quality and precision of EPCs in general
8. Certification and training of EPC assessors/issuers

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7 ANNEX: COMMON SCORING FOR ANALYSIS OF SUCCESS FACTORS

The table below presents the common scoring for the analysis of the contribution of the potential elements of an enhanced EPC scheme to the six success factors. In the line below the scores for an element, the considerations can be found, on which the scores were based. The last column presents the unweighted total score for each element, averaged across the six success factors.

	Transparency	**Cost-effectiveness**	**Reliability**	**Comparability**	**Functionality/ Usability**	**Neutrality**	**Unweighted average score**
Element description	Score (-5 to +5; -1 to +1 -> Very low or no impact on the success factor; +5 -> Highly positive impact on the success factor; -5 -> Highly negative impact on the success factor)						
Assessment and Certification							
Official or certified EPC Software to ensure quality and comparability of assessments	4	3	4	4	4	3	3.7
Official or certified software:	Increases transparency in the methodology for energy calculations	Official software is usually available free of cost. Certified software may cost more than commercial software that is not certified, but may ease assessment and save costs thereby. Score is a mix for official and certified software.	increases the reliability of EPC outcomes due to the accuracy of energy performance calculations	increases the comparability of EPC outcomes by ensuring uniform methodology for energy performance calculations	increases the usability of EPC scheme due to wide dissemination (official software) and the consequent improvement in reliability and comparability	inherently ensures neutrality by providing a level playing field to private EPC software providers and removing access barriers to EPC software users (for official software, primarily)	
EPC Software: default values or validity ranges for input parameters	3	5	2	4	3	0	2.8

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
Availability of default values or validity ranges for input parameters:	increases transparency as they are publicly available and usable	decreases costs of EPCs by minimizing the time and effort required for data acquisition - e.g., by avoiding taking additional on-site measurements, performing intermediate calculations etc.	effects the reliability of EPC calculations, which in turn depends on the accuracy and suitability of the default values to the prevailing construction materials and practices	increases the comparability of EPC outcomes by ensuring use of uniform default values for energy performance calculations	increases functionality by simplifying data acquisition	does not have high impact on neutrality	
Online tool for comparing EPC recommendations to deep energy renovation recommendations	4	-1	4	5	5	3	3.3
Tools that allow building owners to compare the energy consumption data as per the EPC with market average/typical buildings, and the renovation recommendations as per the EPC with specific deep energy renovation recommendations	improve transparency of EPC certification and renovation recommendations	entails extra costs for their development and maintenance but not for the building owner	improve reliability of EPC certification and renovation recommendations	improve comparability of EPC certification and renovation recommendations within the country and across the EU	increase functionality by supporting the assessors/owners to select relevant energy saving measures	improve neutrality through objective comparison data	
On-site inspection during EPC assessment	5	-3	5	4	5	3	3.2

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
On-site inspection during EPC assessment	improves the transparency of input data	may increase the costs of EPC significantly	increase the reliability of input data and therefore energy performance calculations	more reliable calculations will also increase comparability	increases the usability of EPC scheme due to the improvement in reliability and comparability. In addition, enables improved building specific recommendations	improves neutrality through reliability and comparability	
High user-friendliness of the EPC	4	-1	3	3	5	1	2.5
very high user-friendliness of various aspects of EPCs, such as presentation of energy consumption and rating, and recommendations for renovation, potential energy (and cost) savings and other benefits	increases transparency by enhancing the visibility and improving the understanding of the EPC	may slightly increase the costs due to enhanced amount of information and presentation	increases the reliability of the EPC scheme due to presentation of understandable information	improves comparability of key EPC indicators	inherently increases the functionality of EPC schemes	has very low impact on neutrality	
Improving the renovation recommendations towards deep renovation	4	-1	4	4	5	1	2.8
Improving the renovation recommendations provided on the EPC, so that it becomes the first step towards an individual buildings 'deep renovation passport/roadmap',	highly increases transparency of the EPC scheme	may slightly increase the costs due to enhanced amount of information and presentation	increases the reliability of the EPC scheme due to enhanced quality and presentation of renovation recommendations	increases the comparability of renovation recommendations	makes EPCs much more useful and helps in implementing achievable deep renovation goals nationally and across EU	has very low impact on neutrality	
Compliance between EPC	4	2	4	-2	3	-1	1.7

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
rating and operational rating							
Compliance between EPC rating and operational rating	increases transparency due to performance based on measurements	has low impact on cost-effectiveness	increases the reliability of the EPC scheme due to energy performance based on measurements possibly being closer to reality	may have negative impact on comparability due to potential influence of user behaviour on energy consumption	may increase the usability of EPCs but may also confuse due to influence of user behaviour on energy consumption and hence EPC rating	may have slightly negative impact on neutrality due to potential influence of user behaviour on energy consumption	
EPC for new buildings compatible with NZEB requirements	3	0	1	4	5	3	2.7
EPCs for new buildings compatible with NZEB requirements	increase the transparency in terms of meeting EPBD requirements	have no effect on cost-effectiveness	slightly improve the reliability of the EPC scheme	increase comparability across buildings and the EU	helps in setting achievable NZEB goals nationally and across EU	transparency improves neutrality too	
Convergence between MS in calculation methods for innovative technologies	4	-1	4	5	3	4	3.2
Achieving converging calculation methods, especially for innovative technologies in the EPC assessment, between various member states	increase transparency of EPC ratings at EU level	could lead to slight increase in costs of EPC schemes due to introduction of new calculation methodologies for innovative technologies, for some member states	increases reliability as best practices for calculation methods will be used	highly increase the EPC comparability at EU level	will increase the applicability of EPC schemes to wide variety of buildings and technical systems	highly increase the neutrality between buildings and at EU level	

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
EPC issuance at reasonable cost	1	5	-3	1	4	1	1.5
Issuing EPC at reasonable (affordable) costs to the building owners	has low impact on the transparency	highly increases cost effectiveness of EPCs	may lead to decrease in the reliability due to the omission of certain optional but critical elements, such as on-site visits, investment in continuing education etc.	has low impact on comparability	The building owners will be more attracted to obtaining an EPC	has low impact on neutrality	
Updates of EPCs when legislation and regulations for EPC scheme changes	5	1	0	5	4	1	2.7
Generating updates of EPCs when the legislation and regulations for the EPC scheme (e.g., the labelling scale) are changed	increases the transparency of already issued EPCs	decrease the efforts for issuing an updated EPC when there are changes in the legislation, although such a mechanism itself may entail capital costs for setting up; so overall, small positive effect	will not increase the reliability of the EPCs themselves	increases comparability of EPCs issued during different prevailing legislative requirements	transparency and comparability improves the functionality and usability of the EPC scheme	has low impact on neutrality	
EPC calculation procedure in adherence with new CEN OAS standard	4	0	4	5	1	3	2.8

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
EPC calculation procedure in adherence with new CEN OAS standard	increases transparency of EPC ratings at EU level	has no impact on the costs of EPC schemes, although could lead to slight increase in costs due to introduction of new calculation methodologies for harmonizing	increases the reliability of calculation methods and then the data quality	highly increase the EPC comparability at EU level	has low impact on functionality	increases the neutrality among European calculation methods, to some extent	
Including Smart readiness indicator on EPC	2	-1	3	2	4	1	1.8
Including Smart readiness indicator on EPC	has minimal impact on transparency	may slightly increase the cost for EPC because of the additional efforts	increases reliability of EPCs for future systems	slightly increase the EPC comparability at EU level	support the implementation of new directives requirements in terms of SRI	has low impact on neutrality	
EPC provides data for energy and CO2 savings on both asset and operational rating basis	4	-1	3	2	5	1	2.3
EPC provides data for energy and CO2 savings on both asset and operational rating basis	increases transparency due to performance based on measurements	has slightly negative but small impact on cost-effectiveness due to extra calculations, which are simple and not costly	increases the reliability of the EPC scheme due to energy performance based on measurements possibly being closer to reality	has low impact on comparability due to potential influence of user behaviour on energy consumption	inherently increases the functionality of EPC schemes	has low impact on neutrality	
Requirements for qualified experts							
Registry of EPC assessors	5	0	4	3	5	3	3.3

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
An official registry of EPC assessors	increases the transparency in EPC scheme	has almost no impact on the costs of EPC scheme	increases the reliability by providing information of certified assessors	It will increase the EPC schemes comparability at EU level	It will be very useful for the end users/building owners	increases neutrality of the EPC scheme by providing a level playing field for all EPC assessors	
Regular mandatory EPC assessor training on assessment and recommendations required for certification and registry	4	-1	5	4	3	4	3.2
Regular mandatory EPC assessor training on assessment and recommendations for certification and registry	increases the transparency among assessors, building owners, and policy makers	regular training may impact cost-effectiveness, as the cost of training may lead to an increase in assessor fee; however, assessors may become faster through techniques they learnt	highly increases the reliability by providing up to date information and tools for certified assessors	increases the EPC comparability between buildings as well as EPC schemes comparability at EU level, by harmonizing the training content, especially when other EPC elements such as implementing CEN OAS standards etc. is achieved	increases the functionality and usability of the EPC scheme, as the quality of information provided by the EPC assessors increases	increases neutrality of the EPC scheme as providing a uniform training for all EPC assessors minimizes biases and errors introduced by different assessors	
Eligibility requirements (pre-qualification) for EPC assessor certification	3	-1	4	4	1	3	2.3

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
Eligibility requirements (pre-qualification) for EPC assessor certification	increases the transparency among assessors, building owners, and policy makers	may slightly increase the costs of certification due to increased professional charges	increase the reliability by ensuring EPC assessors have high educational or professional qualifications	increase the EPC comparability between buildings as well as EPC schemes comparability at EU level	has slightly positive on functionality due to higher quality, but special trainings more important than pre-qualification	Higher reliability and comparability will improve neutrality, but may create entry barrier to certain low or semi-skilled professionals, when the requirements are set to very high levels	
Renewal of EPC assessor certification through an examination	4	-2	5	4	0	4	2.5
Renewal of EPC assessor certification through an examination	increases the transparency among assessors, building owners, and policy makers	may entail extra costs and therefore increase the costs of EPC	increase the reliability by ensuring EPC assessor knowledge is up to date	increase the EPC comparability between buildings as well as EPC schemes comparability at EU level	has no impact on functionality	increase the EPC schemes comparability at EU level and will bring equal conditions for all assessors	
Regular events and workshops on innovative solutions for deep renovation	3	1	5	3	3	3	3.0
Regular events and workshops on innovative solutions for deep renovation	increases the transparency among assessors, building owners, and policy makers	slightly increase the productivity of EPC assessment and quality of renovation recommendations	increase the reliability by ensuring EPC assessor knowledge is up to date	increase the EPC EPC comparability between buildings as well as schemes comparability at EU level	increase the interest for EPCs among different stakeholders	will bring equal conditions for all assessors	
Other							
Independent control systems							

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
Using common quality criteria for independent control	5	1	5	5	1	5	3.7
Using common quality criteria for independent control	increases the transparency among assessors and policy makers	has low impact on cost-effectiveness	highly increases the reliability by ensuring common quality criteria	increases the EPC schemes comparability at EU level	has low impact on functionality	increase the EPC schemes comparability at EU level and will bring equal control conditions for all assessors and assessments	
Sufficient sample size for verification and quality control	1	-1	5	4	2	4	2.5
Sufficient sample size for verification and quality control	has low impact on the transparency	may slightly increase the administrative costs because of the costs of controls	highly increase the reliability when a statistically significant (sufficient) sample size is used for quality control	increases the EPC schemes comparability at EU level	important for effective functionality of the EPC scheme	increases the EPC schemes comparability at EU level and will bring equal conditions for all assessors	
Quality control of both EPCs and assessors	5	-1	4	4	2	4	3.0
Quality control of both EPCs and assessors	increases the transparency among assessors and policy makers	could lead to higher costs for EPC control body	increases the reliability and quality of EPC	inherently leads to more comparable EPCs	is important for effective functionality of the EPC scheme	will bring neutrality in terms of control	
Performing automatic validity check of EPC assessments	1	4	4	3	3	4	3.2
Performing automatic validity check of EPC assessments	has low impact on the transparency	decreases the costs for elaborate quality control	increases the reliability and quality of EPC	increases the comparability of EPCs by eliminating the outliers	improves the submission and verification process of the EPC scheme	brings neutrality in terms of control	

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
Achieving C or C* level control of EPC assessments for the sample according to EPBD	3	-2	4	3	1	4	2.2
Achieving C or C* level control of EPC assessments for the sample according to EPBD	increase the transparency in terms of EPC control	increases the costs of EPCs because of increased costs for elaborate controls	increases the reliability and quality of EPC scheme	increases the comparability of controls at EU level and indirectly that of EPCs	has low impact on functionality	brings neutrality in terms of control	
Reporting of errors in EPC assessments from controls for learning	4	4	5	3	3	4	3.8
Reporting of errors in EPC assessments from controls for learning	increases the transparency in terms of EPC control and errors	minimizes the costs and efforts needed for controls and therefore reduces the EPC costs	increases the reliability and quality of EPC scheme	increases the comparability	improves the functionality of the EPC scheme	brings neutrality in terms of control	
Sanctions and penalisation for EPC issuers	3	2	3	2	2	4	2.7
Sanctions and penalisation for EPC issuers	increases the transparency in terms of EPC control and errors	is a cost-effective measure to ensure high quality of EPCs	improves the reliability and quality of the EPC scheme due to legal liabilities	indirectly increases comparability through improved reliability	improves the functionality of the EPC scheme due to legal liabilities	brings neutrality in terms of control	
Channelling revenues from sanctions for enhancing EPC schemes	2	3	1	1	3	1	1.8

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
Channelling revenues from sanctions for enhancing EPC schemes	inherently increases the financial transparency of EPC scheme	increases cost-effectiveness of EPC schemes by using the revenues for offsetting administrative costs, conducting training programmes etc.	will have indirect positive impact on reliability if money is used for actions to improve it, but likely low due to low revenues from sanctions	will have indirect positive impact on comparability if money is used for actions to improve it, but likely low due to low revenues from sanctions	improves the functionality of the EPC scheme by providing additional funding, although it should not be seen as a revenue generating mechanism	has low impact on neutrality	
Use of EPC data, including in wider buildings-related databases							
Voluntary advertising guidelines for EPCs	4	1	1	4	5	3	3.0
Voluntary advertising guidelines for EPCs	highly increase the transparency in the building market (but a little less than if mandatory)	has low impact on cost-effectiveness	has low impact on reliability	increases comparability of EPC advertisements because of uniformity	will improve usability for tenants/buyers	It will increase the neutrality in building market (but a little less than if mandatory)	
Mandatory advertising guidelines for EPCs	5	1	1	4	5	4	3.3
Mandatory advertising guidelines for EPCs	highly increases the transparency in the building market	has low impact on cost-effectiveness	has low impact on reliability	increases comparability of EPC advertisements because of uniformity	will improve usability for tenants/buyers	It will increase the neutrality in building market	
Controlling and enforcing the mandatory use of EPCs in real estate advertisements	5	-1	1	3	5	5	3.0
Controlling and enforcing the mandatory use of EPCs in real estate	highly increases the transparency in the building	enforcing may entail extra costs	has low impact on reliability	increases comparability of EPC advertisements	inherently improves the functionality and usability of the EPC	It will increase the neutrality in building market	

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
advertisements	market			because of conformity with law	scheme		
Sanctions for building owners with missing EPCs	3	0	0	3	4	3	2.2
Sanctions for building owners with missing EPCs	indirectly increases the transparency in the building market	has almost no impact on cost-effectiveness	has almost no impact on reliability	increases comparability of EPC advertisements because of conformity with law	inherently improves the functionality and usability of the EPC scheme	It will indirectly increase the neutrality in building market	
Public database of EPCs	5	0	3	5	5	5	3.8
Public database of EPC ratings and if possible, renovation recommendations	highly increases the transparency in the building market and EPC scheme	has almost no costs and hence no impact on cost-effectiveness	improves reliability as it can be used for monitoring, evaluation, quality control and enforcement	increases comparability among different buildings	enables the collection of data with respect to the number of certificates issued, the average energy performance level and the recommended measures	increase the neutrality in building market	
Linking EPC database to other buildings- or energy-related databases	4	0	3	4	5	3	3.2
Linking EPC database to other buildings- or energy-related databases	It will highly increase the transparency in the building market and EPC scheme	has almost no costs and hence no impact on cost-effectiveness	improves reliability as it can be used for monitoring, evaluation, quality control and enforcement	increases comparability among different buildings	enables the collection of data with respect to the number of certificates issued, the average energy performance level and the recommended measures	may shift power between building owners and users	

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
Presenting EPC to official building sales bodies (i.e. notaries, etc.) as an obligatory/mandatory measure	3	0	2	0	5	4	2.3
Presenting EPC to official building sales bodies	slightly increases the transparency in the building market and EPC scheme	has almost no costs and hence no impact on cost-effectiveness	improves the reliability (perception) of the EPC scheme	has almost no impact on comparability	improve usability for tenants/buyers and ensure the issuing of mandatory EPCs	increases the neutrality in the building market	
Incentives for owners with EPCs (when an EPC is NOT mandatory)	1	3	0	4	5	3	2.7
Incentives for owners with EPCs (when an EPC is NOT mandatory)	Low level of impact	will increase EPC market and have economies of scale; Incentives could be used for improving the energy measures in the building	no impact	It will increase comparability among more buildings than if only mandatory EPCs are issued	It will improve usability for tenants/buyers	It will increase the neutrality in building market	
How are EPCs embedded in wider policies and public activities to stimulate deep renovation?							
Linking EPCs and renovation recommendations to detailed energy audits	4	-3	5	4	3	4	2.8
Linking EPCs and renovation recommendations to detailed energy audits	increases the transparency of the EPC issuance and calculations	increases the costs for EPC	highly increases the reliability and data quality	increases comparability among EPC issuance methodology	improves usability of EPC data and recommendations	increase the neutrality at EU level	

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
Monitoring implementation of recommendations given in the EPCs	4	-2	2	4	5	3	2.7
Monitoring implementation of recommendations given in the EPCs	inherently increases the transparency of the EPC scheme	may entail extra costs for effective controlling and monitoring	improves the reliability (perception) of the EPC scheme	increases comparability of implementation of EPC recommendations nationally and across EU	increases functionality of EPCs as a tool for deep renovation	It will increase the neutrality in building market	
Linking asset rating EPCs to financial incentive schemes	4	-1	2	3	5	1	2.3
A mandatory issuance of asset rating EPCs before and after renovation	inherently increases the transparency of the EPC scheme	entails double costs of EPC issuance	improves the reliability (perception) of the EPC scheme	increases comparability of the recommendations and the quality of renovations nationally and across EU	increases promotion of EPC as a key instrument in building renovation	has minimal impact on neutrality	
Creating Deep Renovation Network Platforms	5	1	3	3	5	3	3.3

	Transparency	Cost-effectiveness	Reliability	Comparability	Functionality/ Usability	Neutrality	Unweighted average score
Creating Deep Renovation Network Platforms	increases public awareness and information dissemination at local level in terms of understanding of owners on EPCs, guidance on EPC assessors, financial schemes for deep renovation, online tools for self-analysis and comparison etc.	has minimal impact on cost-effectiveness of EPC scheme	improves the reliability (perception) of the EPC scheme	provides an option for users to select and compare EPC assessors, service providers etc.	helps the end users to easy find the most appropriate information	transparency improves neutrality	

Table 8: Common scoring for the analysis of the contribution of the potential elements of an enhanced EPC scheme to the six success factors