crossCert

Next-generation of Energy Performance Assessment and Certification

D3.4 Cross-country comparison of format and nature of recommended improvements in different EPCs

Task 3.3 Evaluation of the renovation measures recommended by EPCs

WP3 Deriving Technical Guidelines for EPCs

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EXECUTIVE SUMMARY

This report is the outcome of Task 3.3, "Evaluation of the renovation measures recommended by EPCs". It summarises the advice provided as recommendations in EPC documents across chosen European countries, focusing on those relevant to the crossCert project. Sources of information used for devising this report include EPC documents from the partner countries, as well as questionnaires and workshop outcomes.

The main aspects studied in this report include the format the recommendations are presented in on EPC documents, the source and nature of these recommendations, and the relevant information and indicators provided. In addition, the role of assessors in providing these recommendations and potential gaps between assessor training and background education, with the knowledge required for proposing suitable recommendations, is investigated. Based on the collected information and the results of the cross-testing stage, a comparison is also made between countries' approaches towards EPC calculation and their approaches towards EPC recommendations.

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1 Introduction

Article 11 of the Energy Performance of Buildings Directive (EPBD) (EPBD, 2010) requires the member states to include recommendations for improvement of the energy efficiency of the buildings in their EPC certificates unless there is no reasonable potential for such improvement compared to the energy performance requirements in force. According to the EPBD, the recommendations should cover both measures in connection with, and independent of, a major renovation of the building envelope or technical building system. The recommendations should also be technically feasible and cost-effective and provide resources for more detailed information and the necessary steps for implementing the recommendations.

This report focuses on how the crossCert partner countries have implemented the EPBD requirements in their EPC methodologies regarding recommendations. In addition, it tries to link the level of assessor training and background requirements to the level of technical details in the recommendations provided in each country's methodology. Sources of information used for devising this report include the available EPC documents from the partner countries and the partner's responses to a questionnaire produced by HWU (Appendix 1) regarding details of their recommendations' requirements. In addition, a workshop was held by HWU during the fifth steering committee meeting in Varna, where the partners discussed different aspects of the recommendations in their countries' EPC methodologies. Furthermore, as part of the second round of cross-testing EPC methodologies, the partners were asked by UNIZAR to complete questionnaires about certain aspects of recommendations in their methodology. The responses to these questionnaires were also used to investigate the differences between countries' approaches towards EPC recommendations.

2 Format of recommendations and the provided information

2.1 Austria

In Austria, the recommendations are not included in the EPC document but are presented separately. The Austrian EPC software, Gebäudeprofi, generates two forms of recommendation reports: a short one-page assessment of renovation measures and a more extended report. The long report includes a list of recommendations, energy and cost savings, improved heating and DHW demand values, carbon emission savings and improved EPC ratings (Figure 1).

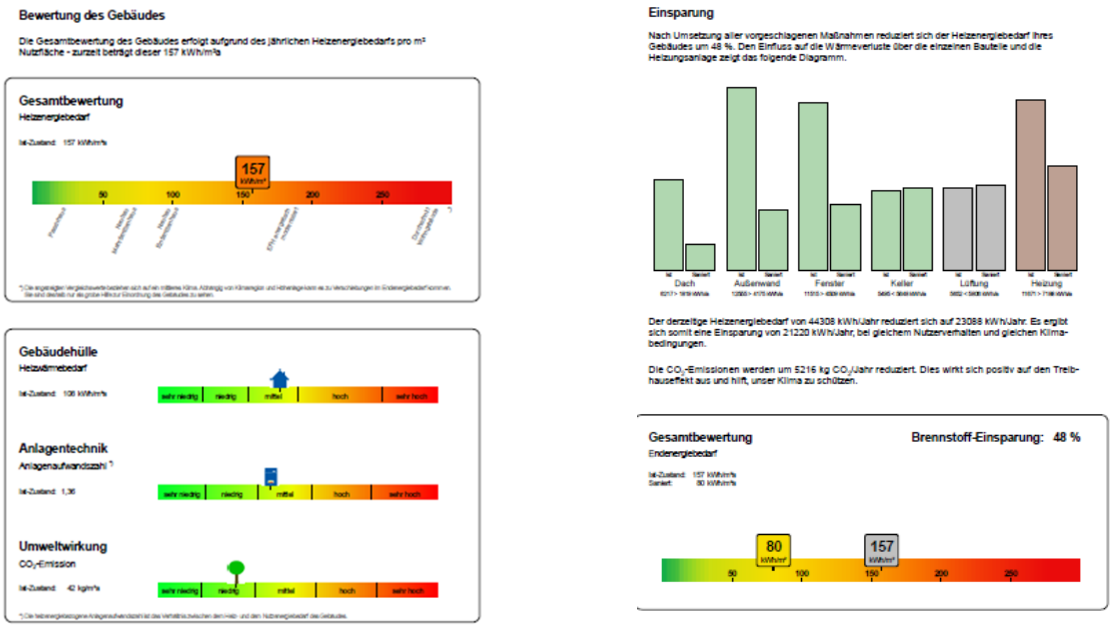


Figure 1- Recommendation report in Austria

2.2 Bulgaria

In Bulgaria, the recommended energy-saving measures for the building are included as a table on the last page of the EPC document in order of the payback period. The table includes the required investment, energy and carbon emission savings, and the payback period. The same information for renewable energy measures is also presented separately in the EPC. The measures can be described in more detail in the energy audit report or the standardised summary, provided alongside the EPC document.

ЕНЕРГОСПЕСТЯВАЩИ МЕРКИ И ОПОЛЗОТВОРЯВАНЕ НА ЕНЕРГИЯ ОТ ВЪЗОБНОВЯЕМИ ИЗТОЧНИЦИ

Енергоспестяващи мерки (ECM)	Инвести-ции, лева	Спестена потребна енергия, kWh/год.	Спестени емисии CO_2, тона/год.	Срок на откупу-ване, год.
Мерки по огр.елементи				
B1.....				
B2.....				
B3.....				
B4.....				
B5.....				
Мерки по системите				
C6.....				
C7.....				
C8.....				
C9.....				
C10.....				
C11.....				
C12.....				
D13.....				
D14.....				
Пакети от мерки				
П1.....				
Оползотворяване на енергия от възобновяеми източници				
Слънчева – PV електричество				
Слънчева – Термална				
Вятърна – електричество				
От околната среда: Гео-;Аеро-; Хидротермална				
ЕНЕРГОСПЕСТЯВАЩИ МЕРКИ И ОПОЛЗОТВОРЯВАНЕ НА ЕНЕРГИЯ ОТ ВИ				
ОБЩО				

Избран пакет за изпълнение от възложителя/собственика на сградата	П1
Клас на енергопотребление след изпълнение на избрания пакет от ECM	.....

Потребна енергия след изпълнение на ECM от избрания пакет		Първична невъзобновяема енергия след изпълнение на ECM от избрания пакет		Първична възобновяема енергия след изпълнение на ECM от избрания пакет		Спестени Емисии CO_2
Специфично	Общо	Специфично	Общо	Специфично	Общо	Общо
kWh/m²	kWh/год.	kWh/m²	kWh/год.	kWh/m²	kWh/год.	тона/год.
.....	.....	.....	.....	.....	.....	.....

Figure 2- Recommendations in Bulgarian EPC documents

2.3 Croatia

The recommendations are listed in a table in the last section of the EPC document, along with the corresponding payback period. Cumulative carbon emission savings, the improved EPC rating, and the payback period, are included in another table.

Redni broj	Dio zgrade na koji se mjera odnosi	Opis mjera	JPP [a] [5]
1.	Sustav rasvjete	Revitalizacija sustava rasvjete	12,6
2.	Vanjska ovojnica	Toplinska izolacija stropova prema vanjskom zraku s 20 cm toplinskoizolacijskog materijala	29,6
3.	Vanjska ovojnica	Toplinska izolacija pročelja zgrade s 16 cm toplinskoizolacijskog materijala u tipu ETICS sustava	>50,0
4.	Vanjska ovojnica	Zamjena dotrajale drvene stolarije i ugradnja nove PVC stolarija s dvostrukim IZO staklom 4c/16Ar/4mm, U_w<1,60	>50,0
5.	Vanjska ovojnica	Integralna građevinska mjera (sumarno mjere od 2-4)	>50,0
6.	Sustav grijanja	Ugradnja centralnog sustava grijanja s kotlom na drva i pelete kao izvorom toplinske energije za stanje nakon rekonstrukcije vanjske ovojnice	>50,0

Figure 3- List of recommendations in Croatian EPCs

2.4 Denmark

A brief list of recommendations is included on the first page of the EPC report, along with the annual cost savings and initial investments. A graphic representation of the improvement measures is also provided on the same page (Figure 4).

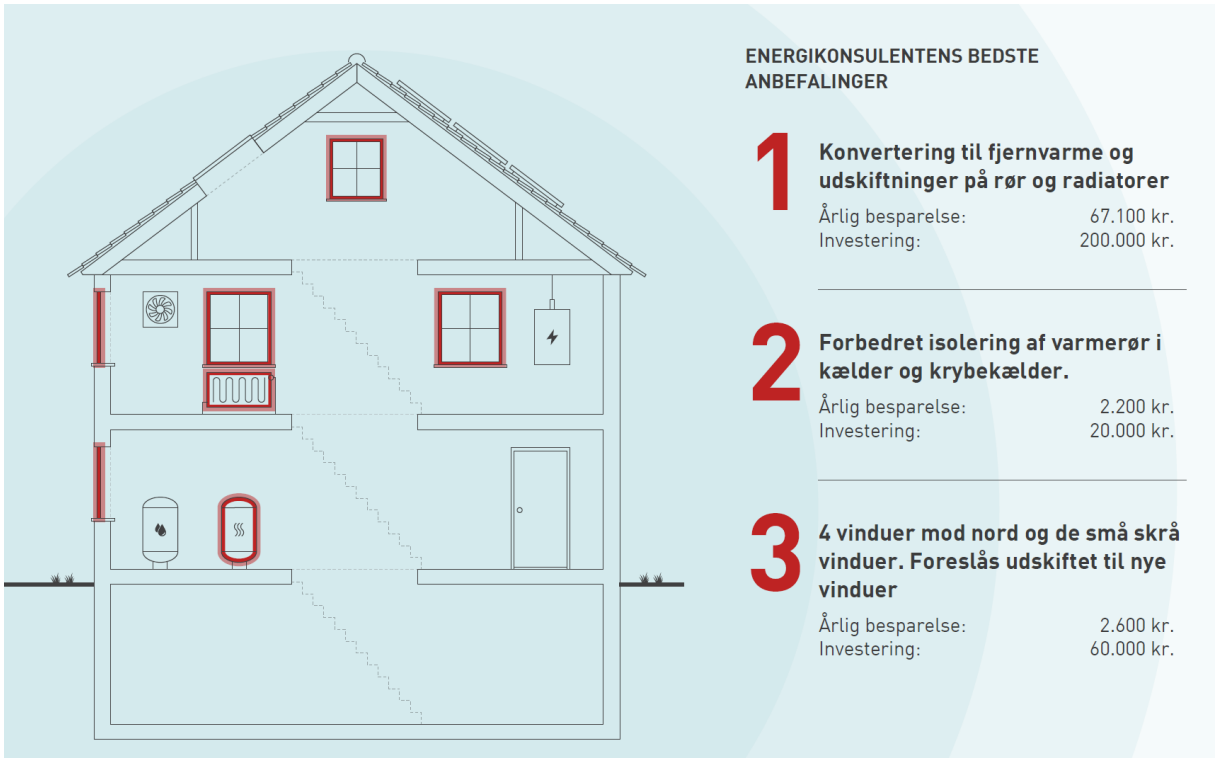


Figure 4- List of recommendations in Danish EPCs

The following pages of the EPC document include a more detailed description of each recommendation, in addition to annual savings, investment and carbon emission savings and the time needed to install each measure (Figure 5).

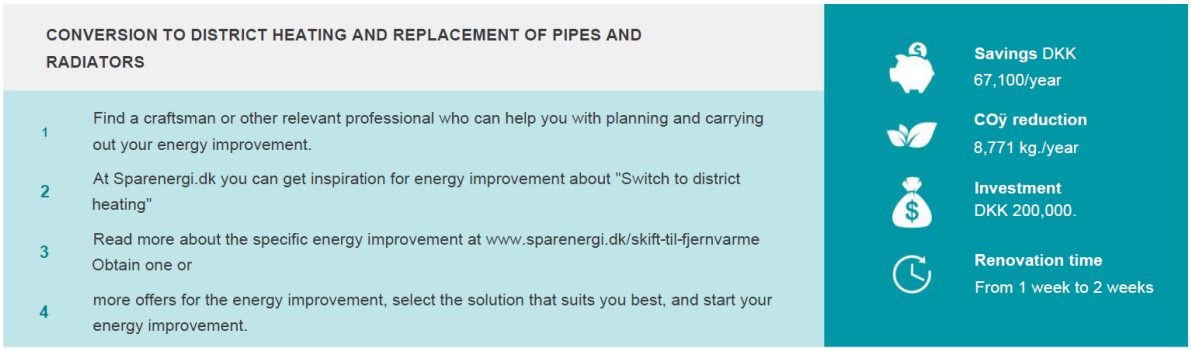


Figure 5- Details of recommendations in Danish EPCs

2.5 Greece

The recommendations are provided in a measures table as part of the EPC certificate. A separate table includes the estimated investments, energy, carbon emissions and cost savings, and the payback period for each set of measures. Also, the resulting EPC rating for each set of measures is provided (Figure 6).

ΣΥΣΤΑΣΕΙΣ ΓΙΑ ΤΗ ΒΕΛΤΙΩΣΗ ΤΗΣ ΕΝΕΡΓΕΙΑΚΗΣ ΑΠΟΔΟΣΗΣ

1. Θερμομόνωση, A/C και ηλιακός θερμοσίφωνας
2. ----
3. ----

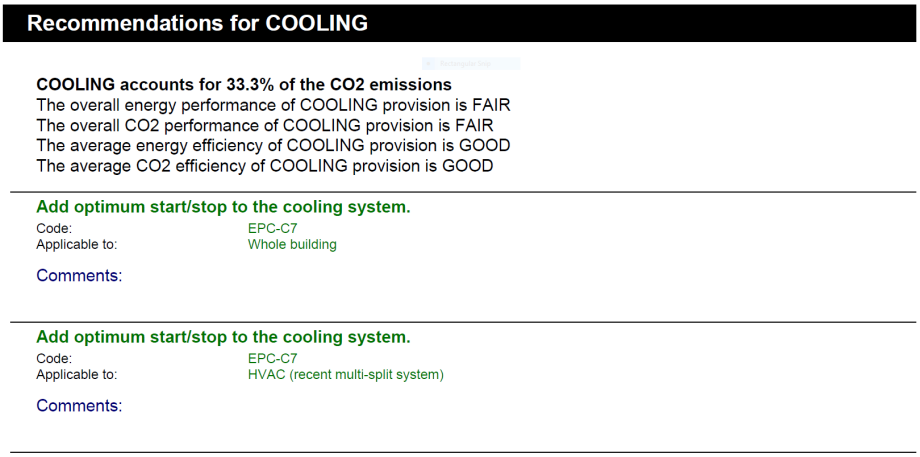
Σύσταση	Εκτιμώμενο Αρχικό Κόστος Επένδυσης [€]	Εκτιμώμενη ετήσια εξοικονόμηση πρωτογενούς ενέργειας & τιμή μονάδας			Εκτιμώμενη απλή περίοδος αποπληρωμής	Εκτιμώμενη ετήσια μείωση εκπομπών CO_2	Ενεργειακή κατηγορία
		[kWh/m²]	[%]	[€/kWh]	[έτη]	[kg/m²]	-
1.	0.0	46.7	22.1	0.0	0.0	12.54	Γ
2.	0.0	0.0	0.0	0.0	0.0	0.0	??
3.	0.0	0.0	0.0	0.0	0.0	0.0	??

Οι συστάσεις είναι ιεραρχημένες σε σχέση με το κόστος – ενεργειακό όφελος που προκύπτει. Η εξοικονόμηση ενέργειας και τιμή μονάδας αφορά την κάθε επί μέρους σύσταση και τα ποσά δεν αθροίζονται. Ομοίως για την ετήσια μείωση εκπομπών CO_2 και την περίοδο αποπληρωμής.
• Η απλή περίοδος αποπληρωμής υπολογίζεται με βάση την τελική ενεργειακή κατανάλωση και όχι την κατανάλωση πρωτογενούς ενέργειας.

Figure 6- List of recommendations in Greek EPCs

2.6 Malta

For residential EPCs, there is an advisory report/ recommendations section on the EPC certificate, which lists the improvement measures categorised by the building feature (lighting, heating, cooling, etc.). For non-residential EPCs, a recommendations report is provided, which lists improvement measures categorised by building feature. For each feature, the current conditions for energy efficiency and carbon emissions are described (Figure 7).



Recommendations for COOLING

COOLING accounts for 33.3% of the CO2 emissions
The overall energy performance of COOLING provision is FAIR
The overall CO2 performance of COOLING provision is FAIR
The average energy efficiency of COOLING provision is GOOD
The average CO2 efficiency of COOLING provision is GOOD

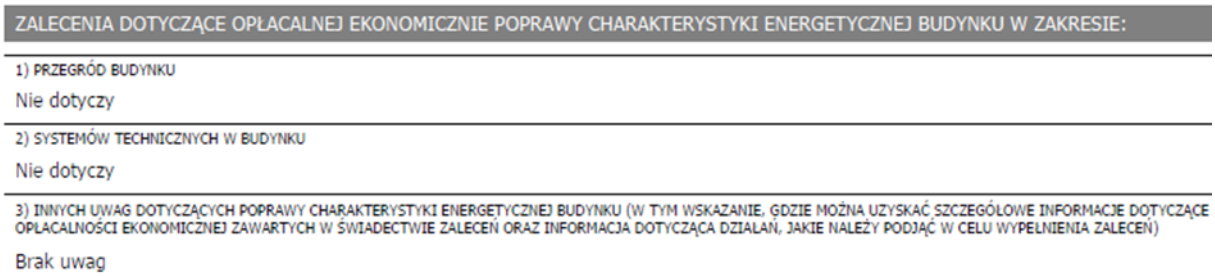
Add optimum start/stop to the cooling system.
Code: EPC-C7
Applicable to: Whole building
Comments:

Add optimum start/stop to the cooling system.
Code: EPC-C7
Applicable to: HVAC (recent multi-split system)
Comments:

Figure 7- List of recommendations in Maltese EPCs

2.7 Poland

A list of improvement measures is included in the last section of the EPC document (Figure 8).



ZALECENIA DOTYCZĄCE OPŁACALNEJ EKONOMICZNIE POPRAWY CHARAKTERYSTYKI ENERGETYCZNEJ BUDYNKU W ZAKRESIE:

1) PRZEGRÓD BUDYNKU
Nie dotyczy

2) SYSTEMÓW TECHNICZNYCH W BUDYNKU
Nie dotyczy

3) INNYCH UWAG DOTYCZĄCYCH POPRAWY CHARAKTERYSTYKI ENERGETYCZNEJ BUDYNKU (W TYM WSKAZANIE, GDZIE MOŻNA UZYSKAĆ SZCZEGÓŁOWE INFORMACJE DOTYCZĄCE OPŁACALNOŚCI EKONOMICZNEJ ZAWARTYCH W ŚWIADECTWIE ZALECEŃ ORAZ INFORMACJA DOTYCZĄCA DZIAŁAŃ, JAKIE NALEŻY PODJĄĆ W CELU WYPEŁNIENIA ZALECEŃ)
Brak uwag

Figure 8- List of recommendations in Polish EPCs

2.8 Slovenia

A list of recommendations is provided as part of the EPC certificate, categorised by the building feature (envelope, HVAC system, renewable energy sources).

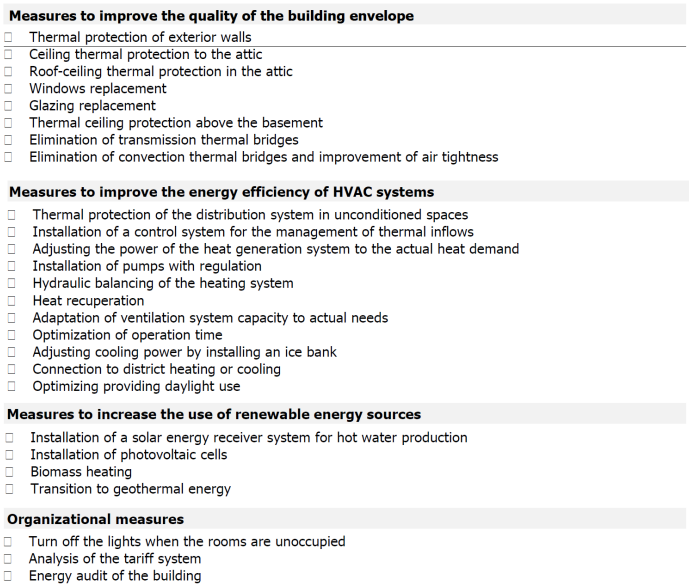
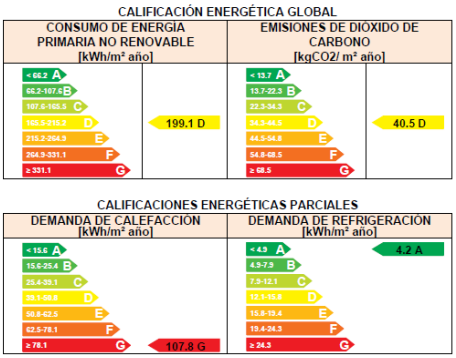


Figure 9- List of improvement measures

2.9 Spain

The Spanish EPC software, CE3X, provides the recommendations as an annex of the EPC (Annex III: Recommended energy efficiency measures). This annex includes the improved EPC and carbon emissions ratings as well as improved heating and cooling demand ratings. A table listing the percentage of savings in each energy consumption category in terms of final energy, primary energy, CO2 emissions and demand is also provided. In addition, a separate table presents the details of the suggested improvement measures and the estimated costs (Figure 10).



(a)

Indicador	Calefacción			Refrigeración			ACS			Iluminación			Total		
	Valor		ahorro respecto a la situación original	Valor		ahorro respecto a la situación original	Valor		ahorro respecto a la situación original	Valor		ahorro respecto a la situación original	Valor		ahorro respecto a la situación original
Consumo Energía final [kWh/m² año]	129.92		6.1%	2.98		-26.9%	4.55		0.0%	17.03		0.0%	154.48		4.8%
Consumo Energía primaria no renovable [kWh/m² año]	154.60	G	6.1%	5.83	B	-26.9%	5.42	G	0.0%	33.27	A	0.0%	199.12	D	4.2%
Emisiones de CO2 [kgCO2/m² año]	32.74	F	6.1%	0.99	B	-26.9%	1.15	G	0.0%	5.64	A	0.0%	40.51	D	4.5%
Demanda [kWh/m² año]	107.83	G	6.1%	4.20	A	-26.9%									

(b)

DESCRIPCIÓN DE LA MEDIDA DE MEJORA
Características de la medida (modelo de equipos, materiales, parámetros característicos)
Coste estimado de la medida 6000.0 €
Otros datos de interés

(c)

Figure 10-Recommendations in Spanish EPCs: (a) improved ratings, (b) the percentage of savings, (c) improvement costs.

2.10 UK

The UK EPC methodology differs between Scotland and the rest of the UK. In addition, there are separate assessment methodologies for residential and non-residential properties. For the Scottish residential EPCs, a "Recommendations Report" is provided along with the EPC. This report includes several sections. The first part includes a table containing energy efficiency and environmental ratings of property features such as walls, windows, floor, roof, heating, hot water, and lighting (Figure 11).

Element	Description	Energy Efficiency	Environmental
Walls	Cavity wall, as built, no insulation (assumed)	★★☆☆☆	★★☆☆☆
Roof	Pitched, 200 mm loft insulation	★★★★☆	★★★★☆
Floor	Suspended, no insulation (assumed)	—	—
Windows	Fully double glazed	★★★★☆	★★★★☆
Main heating	Boiler and radiators, mains gas	★★★★☆	★★★★☆
Main heating controls	Programmer, TRVs and bypass	★★★☆☆	★★★☆☆
Secondary heating	Room heaters, mains gas	—	—
Hot water	From main system	★★★★☆	★★★★☆
Lighting	Low energy lighting in 55% of fixed outlets	★★★★☆	★★★★☆

(a)

Feature	Description	Rating
Wall	Cavity wall, as built, insulated (assumed)	Good
Roof	Pitched, 200 mm loft insulation	Good
Window	Fully double glazed	Average
Main heating	Boiler and radiators, oil	Average
Main heating control	Programmer and room thermostat	Average
Hot water	From main system	Average
Lighting	Low energy lighting in 25% of fixed outlets	Average
Floor	Solid, no insulation (assumed)	N/A
Secondary heating	Room heaters, electric	N/A

(b)

Figure 11- Building elements ratings (a) Scottish residential EPC, (b) England and Wales residential EPC

The improvement measures are listed in another table (Figure 12) in order of the magnitude of their impact on the EPC rating, along with the indicative cost, typical savings per year and the resulting EPC and Environmental rating. The performance ratings after improvements listed in the table are cumulative, meaning they assume the improvements have been installed in the order in which they appear. The resulting ratings are provided only in the online version in the England and Wales residential EPC format.

A table providing current estimated annual energy costs and the potential costs after installing the recommended measures for each category of energy use, is also included in both formats (Figure 13).

Recommended measures	Indicative cost	Typical saving per year	Rating after improvement	
			Energy	Environment
1 Cavity wall insulation	£500 - £1,500	£261	E 47	E 39
2 Floor insulation (suspended floor)	£800 - £1,200	£55	E 49	E 41
3 Low energy lighting for all fixed outlets	£25	£22	E 49	E 41
4 Upgrade heating controls	£350 - £450	£55	E 51	E 43
5 Solar water heating	£4,000 - £6,000	£35	E 52	E 44
6 Solar photovoltaic panels, 2.5 kWp	£5,000 - £8,000	£247	D 62	E 51

(a)

Recommendation	Typical installation cost	Typical yearly saving
1. Floor insulation (solid floor)	£4,000 - £6,000	£115
2. Low energy lighting	£45	£48
3. Heating controls (TRVs)	£350 - £450	£44
4. Condensing boiler	£2,200 - £3,000	£59
5. Solar water heating	£4,000 - £6,000	£45
6. Solar photovoltaic panels	£3,500 - £5,500	£322

(b)

Figure 12- Recommended measures (a) Scottish residential EPC, (b) England and Wales residential EPC

Estimated energy costs for this home

	Current energy costs	Potential energy costs	Potential future savings
Heating	£5,142 over 3 years	£4,041 over 3 years	You could save £1,284 over 3 years
Hot water	£330 over 3 years	£225 over 3 years	
Lighting	£249 over 3 years	£171 over 3 years	
Totals	£5,721	£4,437	

(a)

Estimated energy use and potential savings

Estimated yearly energy cost for this property	£1107
Potential saving	£311

Estimated energy used to heat this property

Space heating	12354 kWh per year
Water heating	2935 kWh per year

(b)

Figure 13- Cost savings (a) Scottish residential EPC, (b) England and Wales residential EPC

For Non-residential EPCs across all of the UK, a Recommendations Report is provided along with the EPC. This report includes a list of Recommended measures in order of the payback period and provides information about the relevant potential impact on carbon emissions. Furthermore, a list of additional recommendations is provided, which are measures selected by your assessor based on an understanding of the building and/or a valid existing Recommendations Report (Figure 14).

Recommended measures with a short payback period (less than 3 years)

Recommendations (short payback)	Potential Impact

Recommended measures with a medium payback period (3 to 7 years)

Recommendations (medium payback)	Potential Impact

Recommended measures with a long payback period (more than 7 years)

Recommendations (long payback)	Potential Impact

(a)

Changes that pay for themselves within 3 to 7 years

Recommendation	Potential impact
Consider switching from gas to biomass.	High

Changes that pay for themselves in more than 7 years

Recommendation	Potential impact
Consider installing building mounted wind turbine(s).	Low

Additional recommendations

Recommendation	Potential impact
Provide PIR control to the lighting in internal rooms which currently have on/off switching.	High

(b)

Figure 14- Recommended measures (a) Scottish non-residential EPC, (b) England and Wales non-residential EPC

3 The nature of recommendations and the role of assessors

3.1 Austria

In the Austrian methodology, there is no list of standard recommendations available, and the recommendations are suggested by the assessors, depending on their experience, knowledge and individual building characteristics. To calculate the impact of the recommendation on the building, the assessor creates a refurbishment model by copying the existing model and applying refurbishment measures to the building elements. The software calculates the initial costs, energy savings and the resulting EPC rating.

The renovation EPC provides tailor-made recommendations and accurate calculations of the resulting savings. However, due to this being a separate document, sometimes EPC assessors don't issue it which is usually the case in cheaper assessments. In Austria, a wide range of backgrounds, ranging from chimney sweepers to architects and civil engineers, can become EPC assessors, and there is no mandatory training in place for them (Sayfikar and Jenkins, 2022). Therefore, the quality of the recommendations is highly dependent on the individual assessor's knowledge and experience.

3.2 Bulgaria

In the Bulgarian methodology, a list including standard categories of energy-saving measures is available to assessors. The list contains three general categories and 14 sub-categories of measures focused on the building envelope, building systems, and other measures. The assessors propose various measures for each building considering its particular needs. These measures must be categorized based on the standard list and for each category, energy, carbon emissions and cost savings are calculated. Also, the initial investment and the payback period should be calculated by the assessor and included in the EPC document. The regulations in Bulgaria require all recommended energy efficiency measures to be cost effective, and the assessors should always prioritise the measures resulting in a higher energy rating with less investment. There are no official databases for information such as the cost of equipment and fuel. Therefore, it is up to the assessor to collect such information and calculate the payback period for each category of measures. In addition to the standard items, assessors can add recommendations about other issues, such as resources for financing energy-efficient systems. However, this is usually not practised since it is not highlighted as a requirement in the regulations and is not controlled in the EPC quality checks.

The background and training requirements for becoming an assessor are high in Bulgaria. A minimum of a secondary technical education (with six years of experience) or a university degree in a technical subject (with a minimum of 3 years of experience for holders of BSc degrees and two years for MSc or above degrees) is necessary for becoming an assessor. In addition, the assessors have to take mandatory training, which varies between 80 and 115 hours depending on the building type (Kulevska and Markovsk, 2016). Due to these high requirements, the assessors are qualified to select suitable recommendations and perform the relevant calculations. However, since the Bulgarian EPC methodology is complicated and assessments are time-consuming, the price of assessments does not necessarily match the labour (and education) of those assessors, leading to less reliable recommendations.

3.3 Croatia

Even though there is no list of recommendations supplied in the Croatian EPC software, an online list of standard improvement measures comprising different categories is available as part of the official methodology the assessors should use. The assessor chooses the measures from the list and calculates the carbon emission saving and the improved EPC rating by creating a new building model with revised input parameters. In addition, cost savings and the payback period are calculated manually by the assessor using fuel prices at the time of calculation and the price of the recommended refurbishments.

In Croatia, only architects, construction engineers, electrical engineers, and mechanical engineers with at least three years of experience are qualified to become EPC assessors. On top of that, the assessors have to participate in a two-week course and pass an examination (Marđetko Škoro, 2016). Therefore, most assessors have the necessary knowledge to choose suitable improvement measures. However, due to the low price of EPC assessments, the assessors don't perform highly detailed calculations.

3.4 Denmark

In the Danish methodology, the assessor has access to a database of standard improvement measures. They use this list to choose the most suitable measures for the assessed building and can add other recommendations and change key figures related to the measures based on their knowledge and experience. The assessor should examine the feasibility of each measure before including it in the EPC document.

The assessors in Denmark should have a relevant technical education at a minimum European Qualification Framework (EQF) level 4 or higher, of a minimum of 3 years duration (Thomsen *et al.*, 2020; Sayfikar and Jenkins, 2022). Mandatory training is optional for becoming an assessor. However, they should pass an examination depending on the building type they will assess (Thomsen *et al.*, 2020). There is mandatory training that assessors attend regularly after becoming certified in accordance with the Danish Energy Agency's regulations. Therefore, the assessors are equipped with the necessary knowledge to propose recommendations and determine their feasibility. However, due to the low cost and time allocated to each EPC assessment, the assessors can't go into details for each building, which makes the recommendations less reliable.

3.5 Greece

A list of recommendations is implemented in the official Greek EPC software. These recommendations are categorised into measures for building envelope, heating/cooling systems, DHW, solar thermal systems, and mechanical ventilation. The assessor picks suitable measures based on the assessed building. If the EPC is issued for a funding scheme, the recommendations must improve the energy class of the building by at least one energy class or decrease the yearly primary energy consumption by 30%. The assessors should provide a minimum of one and a maximum of three sets of recommendations on the EPC certificate. After choosing the measures, they need to apply the recommended measures to the building model and

calculate an improved EPC. In Greece, the assessors should have engineering degrees; therefore, they are usually equipped with the necessary background knowledge about energy-saving measures. However, no mandatory training is in place, which limits the possibility of updating their knowledge.

3.6 Malta

In Malta, assessors add the recommendations for residential buildings to the EPC certificate after conversations with the building owner, and no standard advice is available. For non-residential buildings, the assessors can choose the recommendations from a standard list, and they can add their own advice as well. Therefore, recommendations depend on the assessor's judgement to a high degree. Since assessors should have a degree in architecture or engineering, they are mostly qualified to apply their technical judgement to suggest improvement measures. However, due to the low cost of certification, the details in the assessment and the effect of the recommended measures on the EPC rating are usually ignored, leading to less reliable advice.

3.7 Poland

The recommendations in the Polish methodology are not standardised and are suggested by the assessors, depending on their experience and knowledge. In practice, the recommendations are very general and don't include any financial or energy savings details.

In Poland, assessors should have an engineering degree and be licensed engineers (Bekierski *et al.*, 2016). They must also complete a training course or post-graduate study, including 50 hours of training on certification methodology, calculation, regulations, and assessment of buildings on thermal protection, HVAC and lighting systems (Buildings Performance Institute Europe, 2017). Therefore, the assessors have enough background technical knowledge to provide such advice.

3.8 Slovenia

In the Slovenian methodology, the assessor chooses the recommendations from a list of standard measures. However, the impacts of these measures on energy or cost savings aren't calculated. In addition, they can add tailored recommendations based on their own opinion. In Slovenia, EPC assessors should be engineers or architects and have to take obligatory annual training. There are many chances for voluntary training as well. For example, as a part of the LIFE IP CARE4CLIMATE project around 500 people attend three day courses on facilitating building renovation and net zero energy buildings ('Energetska izkaznica stavbe', 2024). Therefore, the assessors are highly qualified to choose and recommend improvement measures.

3.9 Spain

In the Spanish methodology, assessors can select recommendations from a set of default measures in the CE3X software, or they can opt to manually create recommendations. Subsequently, the assessors utilize the software to calculate the resulting savings. Choosing appropriate recommendations necessitates a reasonably high level of knowledge about energy efficiency measures in buildings and the financial aspects associated with such measures. Due to the absence of mandatory training (Gokarakonda, 2020), some assessors lack sufficient expertise in these areas. Consequently, the quality of recommendations heavily depends on the experience and background of the assessors.

3.10 UK

In the UK EPC methodology, the software automatically generates recommendations based on the input data and calculation results. Therefore, the assessor has limited involvement in producing the recommendations, except for direct interactions with the building users. The role of the assessor is, therefore, mostly linked to the assumptions made during the assessment.

4 The relationship between the nature of the recommendations and the EPC calculation methodology

Even though all countries provide recommendations on their EPC certificates to comply with EPBD's requirements, the details of their approaches towards recommending improvement measures are quite diverse. The information in the previous sections clearly shows these differences. For example, while some countries provide a standard list of improvement measures, others leave it up to the assessor to develop tailored advice for the assessed building. In some methodologies, a combination of these approaches is used, where, in addition to the standard advice, the assessor can add their own tailored advice to the document. In all of the crossCert countries, except Poland, Slovenia and Malta, energy and financial savings from implementing the recommended measures are calculated and included on the EPC certificates. The assumptions made in such calculations are either taken from default values (Austria, UK, Greece and Denmark) or, in some countries, are up to the assessor's judgement (Spain, Croatia and Bulgaria). Some methodologies have implemented savings calculations in their software (Spain, UK, Denmark, Austria, Bulgaria and Greece). In other countries, the assessors need to create a new model of the building and manually apply the improvement measures to the new model. Table 1 summarises these variations in approaches.

Table 1- Summary of country approach to EPC recommendations

Country	Indicators about recommendations on EPC	Default calculation inputs for recommendations	Default list of recommendations	Additional comments allowed	Savings calculation in software
Austria	energy and carbon emission saving, improved EPC rating, cost savings, investments	✓		✓	✓
Bulgaria	investments, energy and carbon emission savings, and the payback period.		✓	✓	✓
Croatia	carbon emission saving, improved EPC rating, the payback period		✓		
Denmark	cost savings, investment and carbon emission savings	✓	✓	✓	✓
Greece	Investment, energy, carbon emissions and cost savings, the payback period, improved EPC rating	✓	✓		✓
Malta	-		For non-residential buildings ✓	✓	
Poland	-				
Slovenia	-		✓	✓	
Spain	energy and carbon emissions saving, demand reduction in each energy consumption category, improved EPC rating		✓	✓	✓
UK	improved EPC rating, cost and energy savings, investments	✓	✓		✓

As indicated in crossCert's D3.1 deliverable (Sayfikar and Jenkins, 2022), the EPC methodologies across the partner countries use various levels of standardisation in their calculation approaches. The above investigation into EPC recommendations shows that different levels of standardisation can also be observed in countries' approach to recommendations. However, these approaches don't necessarily align together. For example, the Austrian methodology is highly standardised when it comes to EPC calculations. However, a list of standard recommendations is not available to the assessors and the

recommended measures on the report depend on the assessors' judgement. Table 2 compares the crossCert countries' approaches towards EPC calculation and EPC recommendations. As can be seen from this table, there is also no clear relationship between the background education requirement for assessors and the level of standardisation in recommendations. This suggests that even though in some countries the assessors are not required to have high education backgrounds, there are no standard recommendations provided, and the methodologies rely heavily on the knowledge and expertise of the assessors to provide suitable improvement measures.

Table 2- Comparison of countries' approaches towards EPC calculation and EPC recommendations

	Highly tailored									Highly standardised
Calculation methodology	Bulgaria	Poland	Slovenia	Croatia	Denmark	Spain	Greece	Malta	Austria	UK
Recommendations approach	Poland	Austria	Bulgaria	Malta	Slovenia	Spain	Croatia	Denmark	Greece	UK
Assessor background education	High requirement								Low requirement	
	Bulgaria	Croatia	Slovenia	Poland	Greece	Malta	Denmark	Spain	Austria	UK

5 Conclusion

This report conducts a comparative analysis of crossCert countries' strategies in implementing EPC recommendations. The comparison highlights variations in the presentation format of these recommendations. In Austria, Malta, and the UK, recommendations are provided in a separate report, while in other countries, they are integrated into the EPC certificate. There is a noteworthy divergence in the level of detail provided for recommendations and their impacts on energy, carbon emissions, and cost savings across different countries. For instance, Malta, Poland, and Slovenia outline improvement measures without specifying the associated savings amounts, unlike other countries that include such information with varying degrees of detail.

Moreover, similar to the distinctions in calculation methodologies discussed in previous crossCert project reports, the approaches to recommendations differ in terms of standardisation. Some countries provide assessors with lists of standardised improvement measures for selection or embed them in the EPC software for automatic integration. Conversely, other countries rely on assessors with suggesting measures based on their own expertise. Importantly, the standardisation levels in countries' approaches to EPC calculations and recommendations do not necessarily align. Furthermore, these approaches appear unrelated to the educational and training requirements of assessors, potentially compromising the reliability of advice provided by assessors based on individual experiences and knowledge.

6 References

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7 Annex I

HWU questionnaire

1. How do EPCs in your country recommend energy efficiency/carbon reduction measures?
   a. What format does this take?
   b. What level of technical detail is provided?

2. Are the recommendations heavily standardised (i.e., copied and pasted for similar buildings) or quite specific to a building?

3. Is there standard guidance outside of EPCs that would be regularly consulted on improvements (e.g., good practice guides or a route to installers)?

4. Is there a clash between the level of assessor training and the recommendations themselves? Are the assessors qualified to give the advice they are giving?

5. Are there differences between residential and non-residential?

6. What could be better, within the EPC, for improving how recommendations are communicated? Can we imagine these within a next-generation EPC (e.g. BRP)?