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Cost-benefit analysis of the Voluntary Common European Union Certification Scheme (EVCS) implementation

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This report assesses the potential benefits of the implementation of a European-wide voluntary certification scheme for non-residential buildings. Arising from Article 11 (9) of the Energy Performance of Buildings Directive, the European Voluntary Certification Scheme or EVCS should present as a tool for organizations in the European market to use in their non-residential buildings.

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Abstract

This report assesses the potential benefits of the implementation of a European-wide voluntary certification scheme for non-residential buildings. Arising from Article 11 (9) of the Energy Performance of Buildings Directive, the European Voluntary Certification Scheme or EVCS should present as a tool for organizations in the European market to use in their non-residential buildings.

An analysis is made of the already existing green building voluntary schemes and an evaluation of the potential impact of the EVCS in terms of the increased costs and potential benefits both for building owners and the construction industry in terms of direct financial benefits, energy savings and the construction industry ripple effect.

An analysis of the EU non-residential building stock was performed which lead to a buildings stock projection to 2020. This analysis has allowed for the projection of scenarios of the uptake of the EVCS allowing to estimate the potential impact of this tool in a EU-wide scope with different levels of the scheme uptake.

1. Introduction

1.1. Background

In order to enhance the transparency of energy performance in the Union's non-residential property market, uniform conditions for a voluntary common certification scheme for the energy performance of non-residential buildings should be established in accordance with the Energy Performance of Buildings Directive, Article 11(9). Property owners in the non-residential sector are often large multinational property investment and development companies demanding international and European comparability of buildings and invest in the most energy efficient ones.

It is then important to gather and analyse the existing data on the nature of the non-residential sector in the EU, the uptake wider sustainable schemes such as BREAM, LEED, DGNB, Passivhaus, HQE or Minergie, and make an effort to quantify costs and benefits of different market uptake levels of the voluntary certification scheme over time.

Non-residential buildings

For the aim of the report, under the "non-residential category" every building except residential ones has being included. In particular: Public offices, private offices, public buildings, wholesale and retail trade buildings, hotels and restaurants, health care buildings, educational buildings, sport facilities and others

The Energy Performance of Buildings Directive's (EPBD) Article 11(9) foresees the development of a EU wide scheme for the certification of non-residential buildings. This scheme would include a harmonised EU label for energy performance in these buildings based on the CEN-standards for energy performance of buildings.

Article 11

Energy performance certificates

Non-residential buildings

9. The Commission shall, by 2011, in consultation with the relevant sectors, adopt a voluntary common European Union certification scheme for the energy performance of non-residential buildings. That measure shall be adopted in accordance with the advisory procedure referred to in Article 26(2). Member States are encouraged to recognise or use the scheme, or use part thereof by adapting it to national circumstances.

In line with the provisions of Article 11(9), the scheme would be a European Voluntary Certification Scheme (EVCS) and be adopted according to the advisory procedure in Article 26(2). The implementation time would depend on the standards in the EN ISO 52000 series on calculation of energy performance of buildings (which received a positive vote in January 2017). Then the technical development of the EVCS tools needed to perform the certificate would also need to be developed.

1.2. Description of the European Voluntary Certification Scheme (EVCS)

The key feature of the EVCS is that it will aim to have an EU-wide approach, meaning that it will be a common EU harmonized tool to be used by all property owners and building developers to enable comparability of building performance between different Member States. The scheme should be managed and promoted by the EU, but taken up and operationalized by the private sector in terms of the certification of buildings and the experts' training. One of the main features of this initiative is its voluntary approach. The voluntary aspect of the EVCS gives the opportunity for building developers, to aim for exemplary buildings with higher energy performances and that pose as an example for the rest of the market players. To a certain extent that happens already with the existing private environmental schemes already on the market. As a measure to avoid duplication of efforts and costs between this scheme and the mandatory Energy Performance Certificates required by the EPBD Member States' would be able to base the calculations in their own national Energy Performance Certification Schemes on the CEN standards in the same way the EVCS will do it.

The certificate of the EVCS will display key information on the energy and emissions performance of the building (see ANNEX1). It needs to be registered, kept at least 10 years, or until it is renewed, as it can be used for the quality check of the system.

The certificate will at least include:

- The energy performance of a building; description of the technical systems of the building and description of the indicators
- Reference values; i.e. minimum energy performance requirements in order to be able to complete energy performance assessments;
- Recommendations about cost-optimal or cost-effective improvement of the energy performance

The EVCS could have a structure in line with the scheme outlined in the diagram below.

Five roles have been described in the draft framework for having a certified building in accordance with the EVCS.

The EVCS promoter, i.e. the European Commission, has the role of the kick-off of the scheme by developing and promoting it e.g. through different Member States' contact points. The promoter shall also be dealing with the data collected during the duration of the programme and manage such data. This data will give the European Commission an overview of the impact of the EVCS throughout Europe and will be able to feed into the new iterations of the scheme.

The National Accreditation Body is a role developed nationally by the competent bodies in each of the Member States. This National Accreditation Body should assess compliance with the technical requirements stated in the EVCS.

The third party within the general structure of the EVCS are the Certification Bodies. The main objective of these companies should be to certify the candidate buildings. These companies usually already exist in the private sector, for different types of management systems or the traditional Energy Performance Certificates. The certifying body should also certify the needed software complying with the applicable CEN standard to the extent that the results from the software needed would be very close to result from a strict application of the CEN-standard.

The fourth element of the EVCS is the Economic Operators which are companies or individuals that wish to certify their non-residential buildings, new or existing. The Economic Operators will interact with the Certification Bodies to whom they will request the certification of the candidate building.

The Economic Operators may also involve experts or expert companies that may aid them in order to prepare the whole process of candidacy.

Even if the formal implementation and roll out of the EVCS has yet to be fully disclosed, it is from the understanding of the authors of this report and from the exchange of information while preparing it, that these EVCS parties will exist in one way or another as a part of the scheme.

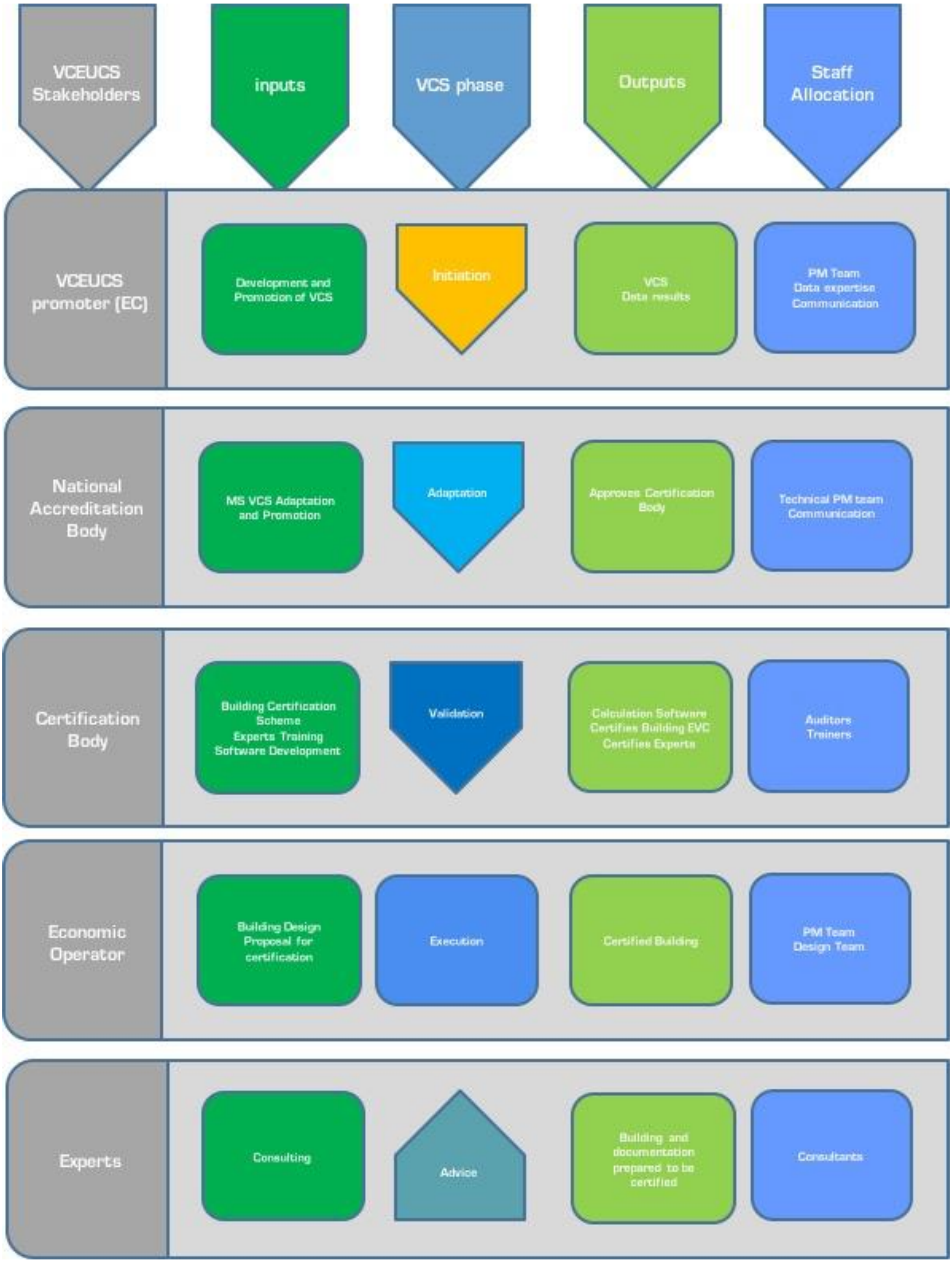


Figure 1 - EVCS Diagram

2. Methodology

2.1. Objectives

This report is divided into two main parts that aim to provide insight on the impact of the implementation of the EVCS in line with Article 11(9) of the EPBD within the European market. The first main part of the study focuses on an overview of the existing environmental building schemes in the European market and an evaluation of potential benefits and increased costs arising from the implementation of such voluntary schemes. The second main part of this study focuses on the non-residential building stock and the extrapolation relating to the impact of the implementation of the EVCS on an EU-wide scale.

For the evaluation of the cost of implementation of voluntary schemes, a literature review was done in order to realize what type of overall cost change should the buildings' developers expect when implementing a scheme like the EVCS.

In terms of the evaluation of the benefits of the implementation the EVCS, the report seeks to identify or asses the energy savings the EVCS scheme will generate. Several approaches were considered in order to evaluate these benefits;

1. Firstly, estimates of the energy savings arising from the implementation of the EVCS by the certification of the current stock and compare them with the possible implementation of the EVCS by estimating the number of buildings in 2017 and onwards. This approach had the problem that the criteria associated with the different energy levels/certificates in different Member States is not harmonised and it is very complicated to calculate the energy savings (energy consumption reduction ergo CO_2 savings per certificate). Besides this, the comparison of the energy certificates with the EVCS would be comparing different things since the EVCS is expected to be achieving higher saving just because buildings being certified according to the EVCS could have a better energy performance than the buildings being certified by the traditional energy certificates.
2. Secondly, instead of considering energy savings related to conventional energy performance certificates, an approach on reproducing the methodology described above but instead with the energy savings associated to the different levels on the different existent schemes was considered. Again, the uncertainty of the energy savings per certificate and the different types of levels and energy performance quantification in the different schemes prevented us to follow this approach. Furthermore, from the literature review it was clear that the benefits arising from the certification of non-residential buildings in these types of schemes are more than just due to energy savings, but also from other aspects of the sustainable building certification.
3. Finally, a different approach was developed. Energy savings considering the total number of non-residential buildings, and an estimation of the total number of certificates in future, with an average energy savings per certificate, considering an estimation of the total number of buildings in 2020, the total number of non-residential certified buildings 2020 and the energy savings per building considering several savings ratio.

Table 1 Concrete objectives of the study

Concrete objectives of the study
✓ Evaluate the impact of the VSC implementation based on - evaluation of the existing green building schemes in the European market - evaluation of potential benefits - evaluation of increased costs ✓ To apply the impact evaluated to three case scenario regarding the trend of number of non-residential buildings in Europe

2.2. Description of Voluntary certification schemes already in place

Voluntary Building Certification Schemes have been around for some years now in Europe, with the British Scheme (BREEAM) taking the lead in terms of pioneering, closely followed by the American one (LEED). After the launch of these two schemes, others followed, mostly dedicated to a national reality, but not exclusively.

In this chapter we give an overview of some of these schemes that are most disseminated throughout Europe. While some of these schemes go beyond energy performance in terms of the overall requirements for a building to be certified and achieve higher grades, the focus of this chapter was to gather information on the energy requirements (mandatory and optional in order to achieve higher grades necessary for building developers to achieve certification. The energy performance requirements differ from scheme to scheme as it should be expected and its comparison is not obvious. While some schemes go for a percentage reduction approach, comparing with a standard building, others take into account other criteria where an Energy Performance Ratio should be calculated. The different requirements are outlined in the sub-chapter below.

Generally, the objective for building developers to engage into a certification is to have their buildings broadly recognized according to their environmental benefits, and more specifically in terms of energy performance.

The certification with these schemes enables the buildings to be labelled under a common ground with a recognized label that is achieved through quantifiable measures that are very different depending on the scheme. The analysis of the schemes below focus on the different type of non-residential buildings energy requirements and the costs associated with the certification process.

An overview of the number of Voluntary Certification Schemes for non-residential already in place in Europe is given on the next chapter of this report.

2.2.1. Most representative Building Voluntary Certification Schemes in Europe

2.2.1.1. Building Research Establishment Environmental Assessment Method - BREEAM

As the first Voluntary Scheme, BREEAM has lead the way on the establishment of a standard to evaluate buildings' performance in terms of not only energy, but also other aspects regarding the sustainability of the buildings and its occupants. Spread out over 50 countries and with over 260.000 buildings certified, it is the the scheme with the biggest share of the market worldwide.

The classification for achieving a BREEAM Certification is attributed by a sum of all the standards that make up the scheme, divided by different areas. 1 point is attributed to achieving the minimum requirements. Further points must be obtained in order to aim for a higher level of certification.

Target Buildings: New and renovation buildings of different typologies - Commercial (Offices, Industrial, Retail), Education, Hotels and Residential institutions, Non-standard building types (Administration, Hospitals, research, etc.)

There are optional standards that may or may not be achieved to get a certification and minimum requirement standards, which are mandatory and need to be achieved in order to get a certification. This is the case of ***Ene 01 Reduction of energy use and carbon emissions***, which is the BREEAM standard for energy performance and is a mandatory standard.

Energy Requirements:

New Buildings:

An Energy Performance Ratio (EPR) is calculated with a modelling comparison between a standard building and the proposing building to be certified.

The EPR is a ratio that defines the performance of a BREEAM-assessed building in terms of its service energy demand, primary energy consumption and CO_2 emissions. It is calculated through the consideration of three performance metrics of the modelled building. These metrics are the Building's heating and cooling demand, primary energy consumption and the total resulting CO_2 emissions.

An EPR between **0.06 and 0.3** gives BREEAM credits from 1 to 5 that must be achieved to comply with the minimum requirements. An EPR from **0.36 to 0.5** gives 6 to 9 credits that must be achieved for getting a BREEAM Excellent Certification. An EPR from **0.6 to 0.9** gives 10 to 15 credits which are required to achieve the highest certification level, a BREEAM Outstand certification.

The other option to achieve this Energy performance standard is through an alternative way where energy efficient design features are evaluated. In this case, no building modelling is required. However, design features like lighting, water heat efficiency, space heat generator efficiency or cooling and ventilation are evaluated and assembled in order to comply with the Ene 01 Standard.

It has to be noted that innovation plays an important role in achieving extra certification points. For example, an Energy positive building leads to a plus five credits on innovation.

Renovation Buildings:

While for New Buildings, the standard relates to the relation between a modelled Normal Building and the projected building to be certified, in the case of renovation buildings, the Energy performance related standard makes the comparison between the building prior and after the certification. The aim for this Standard ***Ene 01 Reduction of energy use and carbon emissions*** is to reduce operational energy demand, primary energy consumption and carbon emissions. Depending on the type of refurbishment, whether it is a major renovation or just a shell and core renovation, different parts of the building should be analysed in terms of its energy performance. In the case of a major renovation which should be the case if a building developer wishes to have its building certified according the EVCS and thus comparable to this situation, all parts of the building (Fabric and Structure, Core Services and Local Services) need to be taken into consideration when evaluating the energy performance criteria. In order to comply with this criterion shall prove, under an energy modelling software specifically focusing on the different parts of the building being refurbished, the improvements on the different parts of the buildings, namely:

- Fabric and structure: thermal performance and air tightness of the building fabric;
- Core services: energy performance of core heating, hot water, cooling and ventilation systems and controls;
- Local services: energy performance of local heating, cooling, ventilation, lighting and controls as relevant.

Due to the subjective character of this criterion is not possible to indicate objective energy reduction values needed in order to achieve compliance with this criterion *Ene 01 Reduction of energy use and carbon emissions,* for renovation projects.

2.2.1.2. Leadership in Energy and Environmental Design - LEED

LEED is the American Green Building Voluntary Scheme, developed and promoted by the USGBC, and as BREEAM focuses not only on the Energy performance of the building but also other sustainability aspects in diverse subjects such as Sustainable site or water efficiency.

In order to achieve a certification, a building developer should fulfil a set of mandatory prerequisites, plus obtain a certain level of credits in order to pursue different levels of certification (Certified (40-49 points), Silver (50-59 points), Gold (60-79 points) and Platinum (80+)).

The LEED scheme is divided into four different sub-schemes. Regarding non-residential buildings, the Building Design + Construction Guide is the scheme applicable and concerns new or major renovation buildings,

Target Buildings: New Construction, Core and Shell, Schools, Retail, Healthcare, Data Centres, Hospitality, Warehouses and Distribution Centres.

Energy Requirements:

The ***Minimum Energy Performance*** standard is a mandatory prerequisite standard that needs to be fulfilled in order for a building to get certified in LEED. In order to comply with this mandatory standard, the building needs to demonstrate an improvement of the Energy Performance by **5% for new construction**, 3% for major renovations and 2% for core and shell projects, in comparison with a baseline building performance rating calculated from a whole building energy simulation complying with an USGBC approved software. Other options for the compliance of this standard are also foreseen, but the compliance criteria is not as straightforward as the percentage reductions.

In the same line of the *Minimum Energy Performance Standard,* there is an optional standard that helps to build the scoring for the overall sustainable building standards'. The ***Optimized Energy Performance*** is applicable to all types of non-residential buildings and the points achievable go from 1 to 20 points.

In the case of New Construction an improvement of the energy performance of 6% gives 1 extra credit, 8% gives 2 extra credits, and up to a **50% increase** of the energy performance that gives 18 extra credits accounting for the overall score and always in comparison to a baseline building performance rating.

2.2.1.3. Haute Qualité Environnementale – HQE

HQE is a French standard for green buildings and has certified over 380 000 projects and more than 59 million square meters worldwide in all categories of buildings.

As a green building certification scheme, HQE goes further than just tackling energy performance and takes into consideration also other issues on the sustainability of the buildings throughout the whole lifecycle of the building. The assessment categories for a HQE building are Energy, Environment, Health and Comfort.

The Ratings to achieve a HQE certification are Pass, Good, Very Good, Excellent and Exceptional

Target Buildings: New and Renovation residential and non-residential buildings.

Energy Requirements:

There are two standards regarding energy performance in the HQE scheme for new non-residential buildings: ***Reducing energy use through architectural design*** is a prerequisite standard and can be achieved by proving a reduction in the energy demand of the proposed building and is calculated through a Dynamic Simulation Model and then compared with the reference consumption level of the local thermal regulations. The other standard relating to the energy performance of the building is named ***Reducing primary energy consumption*** and can be achieved by making proof of a **10% energy savings**, using the Dynamic

Simulation Model taking into account the following building services: Heating, Cooling, Service Water Heating, Ventilation for heating, cooling and ventilation, Distribution and generation ancillary systems for heating, cooling and service water heating and Artificial Lighting. Further energy savings guarantee extra points for the certification process, going from 20 % (5 extra points) up to a positive building (20 extra points).

2.2.1.4. Passivhaus

Passivhaus is a German green building voluntary scheme that is *"driven by air quality and comfort where thermal comfort can be achieved solely by post-heating or post-cooling the fresh air flow required for a good indoor air quality, without the need for additional recirculation of air."*

Passivhaus is energy-performance-oriented voluntary scheme with the criteria having much to do with the heating/cooling demand, primary energy and air tightness.

Although the majority of the Passivhaus certified buildings are residential ones, the Passive House Institute has also developed criteria for non-residential buildings.

To be noted that depending on the location of the building, climate adjustments to the energy standard should be foreseen.

Target Buildings: New and Renovation residential and non-residential buildings. Offices, Schools, swimming pools, hospital, cafeterias and commercial kitchens, retail.

Energy Requirements:

For new non-residential Passivehaus buildings, the certification criteria (for cool, temperate climates like Central Europe) are divided into four points:

Heating:

Specific space heating demand lower than 15 kWh/(m2a)

or alternatively: heating load lower than 10 W/m²

Cooling

Specific useful cooling demand lower than 15 kWh/ (m²a)

Primary energy

Total specific primary energy demand lower than 120 kWh/ (m²a)

Airtightness

Pressure test result, $n_{50} \leq 0.6\ h^{-1}$

For renovation projects, the criteria for certification is based on the heating demand of the building: QH ≤ 25 kWh/(m²a) or as an alternative, the building has to meet several criteria regarding the different components like opaqueness of the envelope, Windows, external doors or ventilation. In terms of primary energy, there is an equation to be done where the value for the heating demand is integrated with the value of the primary energy value for new buildings (129 kWh/(m^2a)).

2.2.1.5. Minergie

Minergie is the Swiss voluntary scheme for green buildings and enjoys a noteworthy spread also in the EU-28.

As Passivhaus, also Minergie is built under the concept of minimizing the energy consumption of the buildings, taking into consideration aspects like heating and cooling, envelope or air changes. The ultimate objective of Minergie is defined as a limit value for the energy consumption. There are four levels of Minergie certification, in crescent demanding criteria for the overall consumption. The Minergie certification levels are: Minergie, Minergie-P, Minergie-A which has a 0 kW/m^2 limit and Minergie-Eco/P-Eco/A-Eco which relates more to ecological issues other than just energy efficiency.

Target Buildings: Minergie targets the following non-residential buildings: Administration, Schools, Retail, Restaurants, Meeting Places, Hospitals, Warehouses, Sporting facilities, Swimming Pools.

Energy Requirements:

Regarding the Energy requirements for the certification of Minergie buildings, there are prerequisites in terms of energy consumption per square meter of area. Other requirements are foreseen like a building heating requirement (Qh) that needs to be below the national norm and additional requirements like illumination, refrigeration or renewable energy percentage.

Minergie/ Minergie P

Energy Performance for new non-residential buildings:

Table 2 Minergie Energy Performance for new non-residential buildings

	Minergie (kW/m^2)	Minergie P (kW/m^2)
Administration	40	25
Schools	40	25
Retail	40	25
Meeting Places	40	25
Restaurants	45	40
Hospitals	70	45
Industry/	20	15

Warehouses		
Sporting Facilities	25	20

For all the categories and comparing with the legal limit, the Qh needs to be ≤ 90% for Minergie and ≤ 60% or Qh ≤ 15 kWh/m2 for Minergie P.

Energy Performance for buildings earlier than 2000:

Table 3 Minergie Energy Performance for buildings earlier than 2000:

	Minergie (kW/m^2)	Minergie P (kW/m^2)
Administration	55	25
Schools	55	25
Retail	55	25
Meeting Places	60	40
Restaurants	65	40
Hospitals	85	45
Industry/ Warehouses	40/35	35/15
Sporting Facilities	40	20

For all categories there is no requirement regarding the building heating requirement for Minergie and ≤ 80% or Qh ≤ 15 kWh/m2 for Minergie P.

2.2.1.6. DGNB

DGNB is, like Passivhaus, a Building Voluntary Scheme developed in Germany. While Passivhaus focuses mainly in the energy performance of the building, DGNB is a sustainability/green building set of standards, i.e., takes into consideration also other aspects of the building and has a great focus in the assessment of the whole Lifecycle of the buildings.

Like other examples of voluntary schemes, also DGNB has different levels of implementation, from a pre-certification stage to a bronze, silver and gold level. Also, as other schemes, there is the need to comply with prerequisite standards, without which the certification is not possible. Although the German Version encompasses different types of buildings to be certified under DGNB, the international version only contemplates Office buildings.

DGNB buildings' overall performance in terms of sustainability is assessed on the basis of around 40 different criteria which all need to be implemented in order for a project to be certified. Also, during a pilot phase, minimum requirements must be considered such as Indoor Air Quality – VOC, Design for All, Legal requirements for fire safety, and sound insulation.

Target Buildings: New offices, Existing offices, Residential buildings, Healthcare, Education facilities, Hotels, Retail, Assembly buildings, Industrial, Tenant fit-out, New urban districts, New business districts, Industrial locations.

Energy Requirements:

I terms of Energy Requirements, DGNB has several standards relating to the energy performance of the building, namely Envelope or Thermal Comfort, however, the standard Env 2.1 Life Cycle Assessment – Primary Energy, is the most objective and comparable standard in relation with the other schemes.

In order to achieve this standard, the building promoter must take into consideration three indicators: Non- renewable primary energy demand, Total primary energy demand and the Proportion of renewable primary energy. Two methods are needed to evaluate this standard. An LCA of the building components for the manufacturing and construction phase and a Life Cycle Energy Modelling for the use phase of the building.

The final result of this standard is directly dependent of the share of renewables used in the building in comparison with the overall primary energy demand and it is not a single value that can be indicated here. The less primary energy and the most renewables will lead to maximum performance and the obtainment of more certification points that will contribute to the overall score of the building to be certified.

Table 4 - Voluntary Schemes comparison

	BREEAM	LEED	HQE	Passive haus	Minergie	DGNB
Types of buildings	Commercial, Education, Hotels, Non-standard building (Administra. Hospitals, research…)	New Construction, Core and Shell, Schools, Retail, Healthcare, Data Centres, Hospitality, Warehouses and Distribution Centres	New and Renovation non-residential buildings	New and Renovation Offices, Schools, swimming pools, hospital, cafeterias and commercial kitchens, retail.	Administration, Schools, Retail, Restaurants, Meeting Places, Hospitals, Warehouses, Sporting facilities, Swimming Pools	New offices, Existing offices, , Healthcare, Education, Hotels, Retail, Assembly buildings, Industrial
Energy Assessme	Energy Performance	Energy performance	Energy reduction	Energy performance	Energy performance	Life Cycle Energy

	BREEAM	LEED	HQE	Passive haus	Minergie	DGNB
nt Method	Ratio (EPR)	comparison with similar modelled building	through Dynamic simulation model	calculation	calculation	Modelling
Maximum level criteria for new buildings	Zero emissions	50%	Positive building	No value for Heating and cooling; Renewable Energy generation > 120kWh/(m²a)	15 kW/m2 for industry, 20 for sporting facilities, 25 for Administration, Schools, meeting places, 40 for Restaurants, 45 for Hospitals	NA Multi-criteria weighing
Minimum level criteria for new buildings	0.06 EPR	5%	10%	heating demand < 15 kWh/(m2a) or heating load < than 10 W/m² ; cooling < 15 kWh/(m²a) ; Renewable Primary Energy <60 kWh/(m²a)	20 kW/m2 for industry, 25 for sporting facilities, 40 for Administration, Schools, meeting places, 45 for Restaurants, 70 for Hospitals	Multi-criteria weighing
Baseline case	Local Building Regulations	Compliance with ASHRAE/IESNA 90.1-2004 or Dynamic building model	Local Building regulation or Dynamic Building Model	NA	NA	LCA Reference Building calculation
Certification fee	6000-15000	3000-25000	12000-250000	-	1000-10000	5000-15000

2.3. Costs for implementing Voluntary Certification Schemes

The costs associated with the implementation of a voluntary certification scheme vary depending on the type of scheme, as expected. The first conclusion from the analysis of the voluntary schemes and literature on the impact of these schemes in terms of costs and benefits is that it is very hard to compare the different schemes because of their specificities. The feature of the voluntary schemes that makes them especially hard to evaluate in terms of increased costs is that for the most part, their standards take into account other building features besides just energy systems. Only Minergie and Passivhaus take into account just the energy performance and the energy systems overall. Having this into account the following findings of the costs associated with the implementation of the existing voluntary schemes are both from these "energy-only" schemes and from the "green building" schemes. For being the most spread out schemes both in Europe and in the rest of the world, LEED and BREEAM studies are also the ones with the most cost analysis results.

From the literature review it was possible to realize the big discrepancy of values regarding extra costs associated with the certification of voluntary schemes. These values are intrinsically related to the type of building and its specificities and it is not possible to draw a formula in order to calculate the cost premiums associated with such certifications. It is often mentioned (e.g. Dwaikat et al), that the extra costs for green buildings is no greater or not that much of an increased investment in comparison with non-green buildings, going from zero to 1 or 2% of cost increase for just the basic green building certification. Among these increased costs are the higher prices for design teams to adapt the designs in order to comply with the schemes requirements, experts' teams that accompany the process of construction up to the certification, certification fees and materials and more efficient technologies needing to be installed for the schemes' compliance.

A study developed by Minergie in 2005 regarding the implementation of this scheme in 18 schools has found an increase from 0 to 11% increase in the investment costs, with an average of 5.6% increase. No lower costs have been found in this study. More specifically, the increase of investments can be distributed as of 1.1% for the building envelope, 4% for HVAC and 0.5% other investments like lighting, photovoltaic and overall constructive and design costs.

A 2013 study from the World Green Building Council "The Business Case for Green Building", evaluating the impact of several types of green building schemes has outlined the range of the increased costs that building developers incur when implementing green building schemes. The focus is on design and construction costs such as architectural design, consultants' fees and construction costs. According to this study based on the analysis of other research studies from 2000 to 2012, the range of increased costs for green buildings averages from 0% to 12.5% in comparison with building code compliant buildings.

The range of the increased costs in new green buildings is directly associated to the degree of implementation of such schemes. While for a simple certification, the extra costs can rise from 1% to up to 10 % in a BREEAM Outstanding certification. The same study refers that the cost typically ranges from 0 to 4% of increase for just a certification and 2 to 12% for premium certifications when analysing studies from the last 10 years.

It is mentioned by the different players dealing with voluntary schemes as these that a way to reduce the costs of green buildings is adopting green strategies from an early stage of the design process and involving experienced design and construction teams in the process. Also, another finding in this study is that the trend is that the premium costs of certifying buildings according green building standards are coming down, in comparison with the building codes compliant buildings, probably due to the evolution of the more demanding construction sector and the increase of the minimum building standards.

Despite that in the studies analysed the increased costs of green building certification can lead to cost premiums rising up to over 10%, it is also true that these results are a minority from all the green building impact studies analysed. The increased costs should not pose themselves as a barrier for going green, without first weighing in all the other benefits.

A study from Dwaikat *et al* has evaluated 17 empirical studies on the costs premium in green building projects and a summary of this analysis is presented in the figure below, where is possible to realize the extent of cost premiums when implementing a green building project .

No.	Author(s) (Year)	Publication type	Country	Methodology	Findings
1	Xenergy and Sera Architects (2000)	Trade publication	USA	Multiple-case study research: Cost analysis of re-designing three constructed office buildings to meet certain LEED criteria.	The cost premium required to meet LEED requirements ranges from −0.3% to 1.3%.
2	Packard foundation (2002)	Trade publication	USA	Single case study research: Comparative modeled cost analysis of different LEED certification levels against a market baseline typical office building.	The green cost premium ranges from 0.9% to 21% for various LEED levels.
3	Kats et al. (2003)	Trade publication	USA	Cost comparative analysis of 33 LEED certified green buildings against conventional design for the same buildings.	The average green cost premium is 1.84%.
4	Matthiessen and Morris (2004)	Trade publication	USA	Statistical analysis of the actual cost of 45 LEED seeking buildings against 93 similar conventional buildings. Cost comparative analysis of 61 LEED seeking buildings against their initial budget.	There is no statistically significant difference between the cost of green buildings and the cost of conventional buildings. Majority of buildings were able to achieve LEED certification without additional budget.
5	Steven Winter Associates (2004)	Trade publication	USA	Cost comparative analysis of modeled cost of various green design scenarios for two buildings against modeled conventional design cost for the same buildings.	The cost premium ranges from around −0.4% to 8.1% depending on the level of LEED certification.
6	BRE and Cyril Sweett (2005)	Trade publication	UK	Multiple-case study: Cost comparative analysis of the actual cost of four case studies against modeled design cost based on standard building regulations.	The green cost premium ranges from 0% to 7%.
7	Kats (2006)	Trade publication	USA	Cost comparative analysis of the cost of 30 green schools against the average national conventional schools cost.	Green schools cost on average 1.7% more than conventional schools.
8	Matthiessen and Morris (2007)	Trade publication	USA	Cost per square foot comparative analysis of 83 LEED seeking buildings against another 138 conventional buildings.	There is no significant difference in average cost for green buildings as compared to non-green buildings.
9	Davis Langdon (2007)	Trade publication	Australia	Cost comparative analysis of green office buildings modeled cost against similar non-green buildings.	The impact on the construction cost ranges from 3% to 5% for 5 Star rating. And more than 5% for 6 Star non-iconic design solutions.
10	Houghton et al. (2009)	Scientific journal article—peer reviewed	USA	Multiple-case study: Cost comparative analysis of the impact of green design on the cost of 13 Healthcare LEED buildings	The green cost premium ranges from 0% to 5%.
11	NAHB research center (2009)	Trade publication	USA	Single case study research: Itemized cost impact analysis of incorporating the national green building standard to a green home.	The cost premium required to meet a silver level is around 17%.
12	USGBC (2009)	Trade publication	USA	Statistical analysis of a sample of 15 LEED residential new construction projects and 22 non-LEED projects, and for a sample of 12 LEED commercial interior projects and 13 non-LEED projects.	The cost per square foot of green buildings is not significantly different than that of non-green buildings.
13	Kats (2010)	Book	USA	Estimating the green cost premium of 170 green buildings through information from green buildings developers and architects.	The green cost premium ranges from 0% to 18%, but majority of the cost premiums fall within a range from 0% to 4%.
14	Mapp et al. (2011)	Scientific journal article—peer reviewed	USA	Multiple-case study: Cost comparative analysis of the actual cost of two LEED certified bank buildings against the actual cost of similar eight non-green bank buildings.	The cost of green bank buildings is similar to and within the range of the cost of non-green bank buildings. LEED certification process adds less than 2% to the total project cost.
15	Shrestha and Pushpala (2012)	Conference paper	USA	Cost comparative analysis of 30 green school buildings against 30 conventional school buildings using statistical methods.	The green school buildings cost is 46% higher than conventional school buildings. The mean construction cost per square foot of green schools is significantly higher than that of conventional schools.
16	Rehm and Ade (2013)	Scientific journal article—peer reviewed	New Zealand	Cost comparative analysis of the actual cost of 17 green office buildings against modeled cost for the same buildings using statistical methods.	Green office buildings cost is higher on average than conventional buildings, but the difference is not statistically significant.
17	Kim et al. (2014)	Scientific journal article—peer reviewed	USA	Single case study. Cost comparative analysis of one green residential building against similar conventional counterpart.	Construction cost increased by 10.77% as a result of incorporating green features.

Figure 2 - Summary of cost premium on green building projects (Dwaikat et al)

2.4. Benefits for implementing Voluntary Certification Schemes

Financial benefits:

Literature identifies several aspects in terms of potential financial benefits when implementing a green building scheme; namely higher rental/lease rates, lower operating expenses, higher occupancy rates and lower yields at the time of sale. Some of the values found relating to the return of the investments reach up to rates of return of 14% higher from the extra costs associated with the implementation of such schemes.

In the World Green Building Council study from 2013 and in the *Dwaikat et all* paper, results comparing certified green buildings to regular buildings and showing price premiums in terms of sales within a range of 0 to 40% are presented. More conservative values are within the range of 10%. The same studies show that generally more demanding levels of certification also lead to higher sales prices.

In terms of rental prices, the World Green Building Council Study refer a 5 to 10% higher rental rate, although some more recent ones claim even higher values, near a 20% increase. As for the sale prices, also rent prices tend to increase in the case of higher levels of certification. Another study from the World Green Building Council from 2016 analysing the market trends that when analysing the benefits of green building also point out the increased rents as an important benefit.

Other aspects that are often referred in the studies evaluating the impact of green building schemes relate very much to the "Well Being" part of such schemes in terms of the reduction of absenteeism, higher satisfaction and increase of productivity from the buildings' occupants, due to, for example, the use of more natural instead of artificial lighting. This well-being factor of a green building relates not only to the well-being of its occupants, but by also to the well-being of the building itself, with reported maintenance costs being reduced in the order of 10%.

An aspect that is not easily accounted, but also often mentioned is a "green perception factor" that a building and inherently a promoter reach when implementing a voluntary scheme like this.

Energy Savings:

In what concerns energy savings, these are first of all, arising from the specific standards relating to the energy performance of the buildings and are often more complex than just demanding an energy reduction of X, in comparison with a reference building. From the studies evaluated and as stated in *Dwaikat et all*, the energy savings can go from 30 to 50% in comparison with reference buildings. The savings related to energy systems, however, do not finish just in the plain terms of energy savings, but due to the implementation of more holistic energy systems, economic savings arise from, for example, photovoltaic energy systems and other renewables, thus reducing energy costs due to self-production.

A study on the return of investment for LEED projects in the United States by *Kats et all* in 2003, found that an investment increase of 20% ultimately leads to savings of up to ten times for a 20-year cycle, considering, not only energy savings but also employees' productivity and health.

In the 2015 U.S. Green Building Council report on "Green Building Economic Impact Study" the Energy Savings from the different certifications levels in 2014 go from 4 Euro/m^2 for a simply certified LEED to almost 7 Euro/m^2 for a LEED Platinum certification.

The European Commission's Joint Research Centre had a set of Voluntary Programmes established in 2000, 2003 and 2006 and ended in 2014: the GreenLight Programme (GLP), the Motor Challenge Programme (MCP) and the GreenBuilding Programme (GBP). During the timeframe of its existence, in particular the GBP has supported owners of non-residential buildings to enhance the energy efficiency of their buildings, including the envelope and energy systems. It targeted both existing and new buildings: the existing buildings had to undergo an economically viable refurbishment, bringing to at least a 25% reduction in the total primary energy consumption whereas the new buildings had instead to demonstrate that they could reduce their primary energy consumption by 25% as compared to the building standards in force locally.

During the timeframe of this programme, questionnaires have been sent to the programme participants and three motivations to join the programme have been outlined. The answers showed that environmental considerations were the upmost reason for joining, followed by energy costs reduction and the expected increase in the value of the property. Other key motivations were the reinforcing of the market position, the using of GBP as a competitive advantage and as a communication tool to clients, the leading role achievable by providing best practice examples, the possibility of demonstrating an effective use of public money (for public organizations) and the improving of the overall thermal and comfort conditions in the buildings.

The competitive advantage of giving a better environmental image and the demonstration of an effective use of public money (in the case of public organizations buildings) were drivers for the participation in all the voluntary programmes. Generally, the survey sent to the programme participants confirmed that voluntary programmes were not per se the main reason to initiate energy efficiency projects, but they can be co-drivers.

In terms of obstacles for the participation in such programme, results showed that energy efficiency investments were financed either by the future energy savings (47% in 2008 and 85% in 2011), by the future available cash flow (13% in 2008 and 7% in 2011) or by using the increased value of the property or the value of the purchased asset as collateral for the financing.

Similarly, in 2008 and 2011 GBP surveys, one third of the respondents who refurbished their buildings benefited from the external expertise of ESCOs. This reveals that the technicalities of the projects and, even more, their communication to the actors involved were perceived as limitations.

Respondents initially focusing on economic targets finally recognised that non-economic benefits had a significant and positive impact on the organisation, and that their customers also profited from the projects outcomes in terms of increased visibility. Overall, the increased building value following project implementation was considered as a relevant advantage (30% of the respondents), together with an unexpectedly more comfortable working environment (30% of the answers).

Among other benefits, public recognition was mentioned by GBP partners, in relation to the marketing use of the GreenBuilding Certificate

When asked to compare the cost of new energy-efficient buildings with conventional (non-efficient) buildings, the majority of respondents declared that they did not face increased costs or that additional costs were not exceeding 10% of the total expected costs. For most of the responding companies, energy efficiency in new buildings allowed achieving at least 25% reduction in energy consumption (compared to local building standards) without exceeding 10% of extra costs

Moreover, the actual savings achieved were reported to be as high as or higher than estimated before the project implementation.

Generally, the survey confirmed that voluntary programmes were not per se the main reason to initiate energy efficiency projects, but they can be co-drivers.

Industry ripple effect

Although the most palpable benefits should be seen by the economic operators due to the reduction of costs and increase of property values, there are benefits to be reaped within the whole green building ecosystem. It is expected that jobs should grow in different levels, from the consulting and design firms providing expertise to the economic operators developing the buildings, to the already existing construction sector and the industry developing new materials that can meet the requirements needed to achieve high levels of energy performance towards the certification.

The impact of green construction in terms of innovation is already a reality. The European Patent Office has disclosed information on the number of green-construction-related patents being tripled in little over a decade in the years 2000-2011, with patents in the areas of HVAC, energy efficient insulation, green lighting and the incorporation of renewable energies as the most dynamic sectors. This is a clear sign that the market is adapting to its times, probably pushed by the ground-breaking pieces of legislation like the EPBD or like the Voluntary Schemes implemented in the market.

In the 2015 study by the USGBC it is also mentioned that, in the United States, a growth on the "green industry" is foreseen, with its influence reaching across the country's economy on both an environmental and social level. This study shows that green building construction has surpassed the growth rate of general construction, with a growth rate of 15% per year. In a market as big as the American, this sector is showing an increasing impact on GDP, jobs and labour earnings, supporting over 3 million jobs for the years 2015-2018.

Although the American market has different characteristics, and these values should be taken in moderation, with the demand rise of more efficient solutions, in terms of materials to be applied in new and refurbished buildings, it is expected that a growth in the construction materials and all the supply chain sectors associated to the development of more efficient buildings should occur.

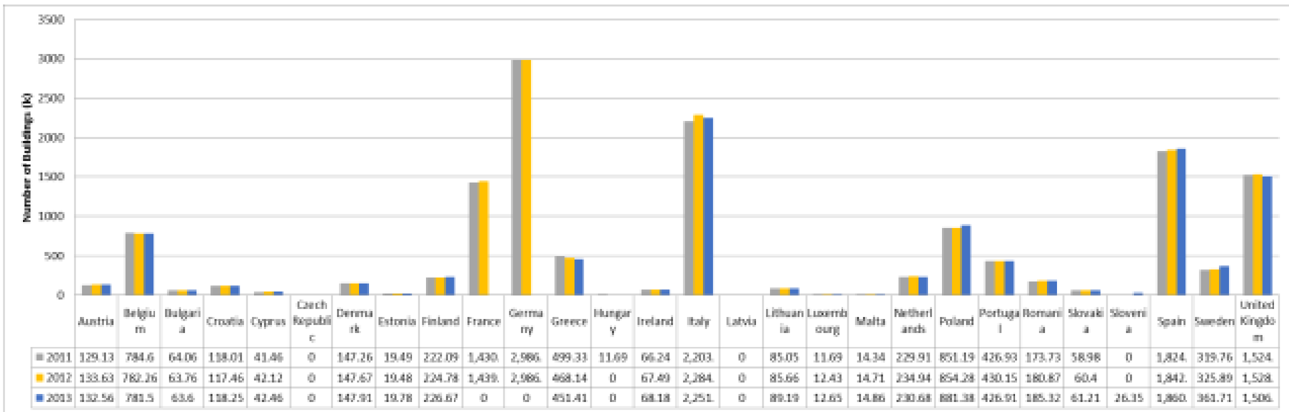
2.5. EU non-residential stock analysis

This chapter intends to give an overview on the EU-28 non-residential building stock. In order to provide accurate information on the nature of the building stock sector by subsectors, and the uptake of actual voluntary schemes (such as BREEAM; LEED; DGNB; Passivhaus; HQE and Minergie) described previously.

While evaluating the potential data sources to realize this evaluation and analysing the most accurate building data sources, the choice fell on the "EU buildings observatory" that while being in a beta-stage of development at the moment of the consultation, delivered a consistent, up to date, reliable one-stop shop source in comparison with other dispersed sources that eventually fed into the building observatory database.

Note: The methodology focus on data from the period 2011 to 2013 in order to firstly minimize the data gaps occurring in earlier years and/or lack of data of later years.

2.5.1. Total number of non- residential buildings EU-wide for the period (2011-2013)



	Austria	Belgium	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland
2011	129.13	784.6	64.06	118.01	41.46	0	147.26	19.49	222.09	1,430.	2,986.	499.33	11.69	66.24
2012	133.63	782.26	63.76	117.46	42.12	0	147.67	19.48	224.78	1,439.	2,986.	468.14	0	67.49
2013	132.56	781.5	63.6	118.25	42.46	0	147.91	19.78	226.67	0	0	451.41	0	68.18

	Italy	Latvia	Lithuania	Luxembourg	Malta	Netherlands	Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	United Kingdom
2011	2,203.	0	85.05	11.69	14.34	229.91	851.19	426.93	173.73	58.98	0	1,824.	319.76	1,524.
2012	2,284.	0	85.66	12.43	14.71	234.94	854.28	430.15	180.87	60.4	0	1,842.	325.89	1,528.
2013	2,251.	0	89.19	12.65	14.86	230.68	881.38	426.91	185.32	61.21	26.35	1,860.	361.71	1,506.

Figure 3 - Number of non-residential buildings per Member State for the period 2011-2013

Five Member States stand out from the remainder, with Germany, Italy and Spain being the top three Member States with the biggest number of non-residential buildings, followed by the United Kingdom and France.

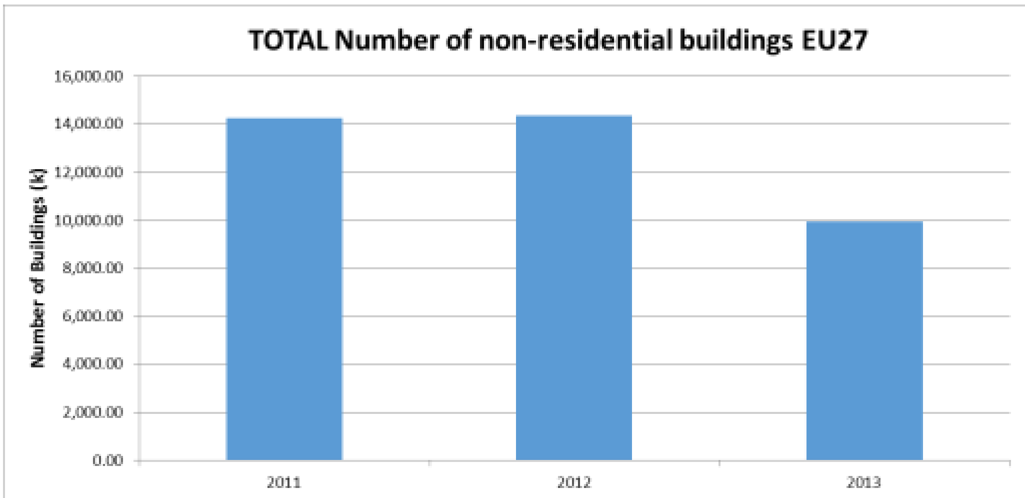


Figure 4 - EU non-residential building stock evolution (without correction factor)

Figure 4 - EU non-residential building stock evolution (without correction factor)gives out the evolution of the overall number of non-residential buildings from 2011 to 2013. This data and without any sort of treatment shows a surprisingly decreasing trend regarding the overall number of non-residential

buildings observed from 2007, with this evident negative trend from 2011. This evolution has been also indicated in several reports (*Energy Efficiency Trends in Buildings in the EU, Odyssee, 2015)*. After some analysis it was possible to realize that this negative trend originated from the lack of data Germany and France for the year 2013.

In order to overcome this lack of data, a harmonisation has been applied to those countries (see annex 2) in order to obtain realistic data, as shown in figures 4.

Introducing the correction for France and Germany, the real trend of the non-residential sector in the EU is slightly positive as shown in the figure below, with a total of non-residential buildings slightly below 14,4 million buildings.

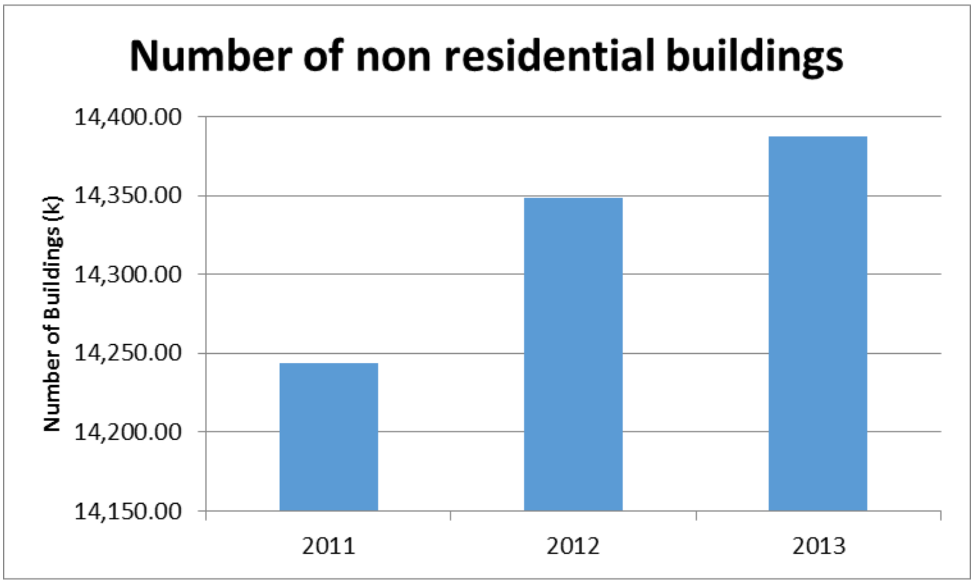


Figure 5 - EU non-residential building stock evolution

2.5.2. *Evolution of EU non-residential buildings per sub-sectors*

In what concerns the distribution of the non-residential building sectors, the following figures give a distribution per sector, namely:

- Wholesale and retail trade buildings
- Hotels and restaurants
- Health care buildings
- Educational buildings

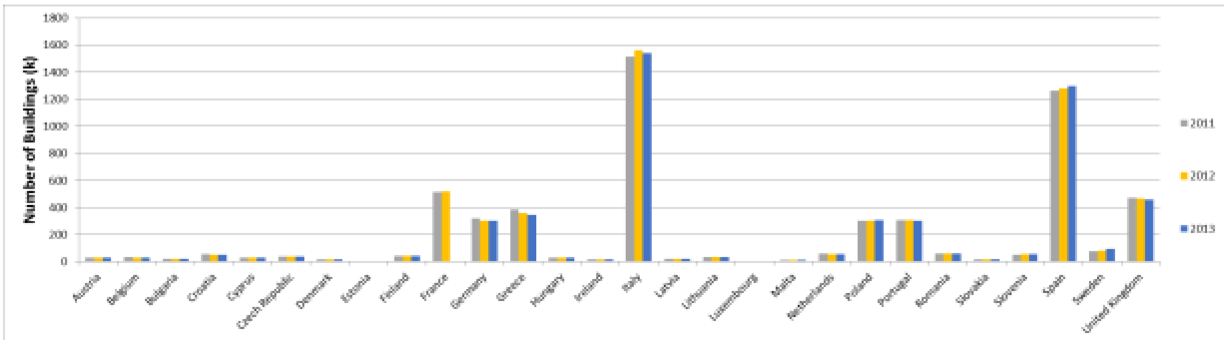


Figure 6 - Number of wholesale and retail trade buildings per Member State for the period 2011-2013

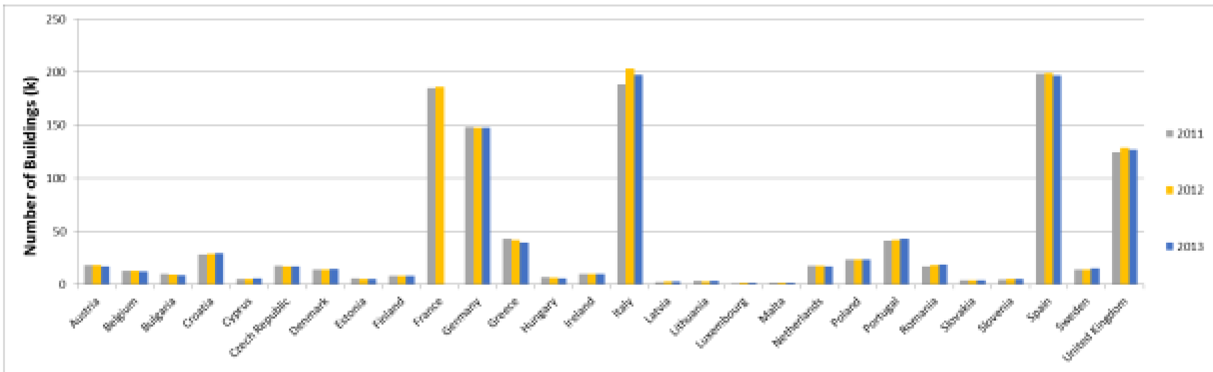


Figure 7 - Number of Hotels and restaurants per Member State for the period 2011-2013

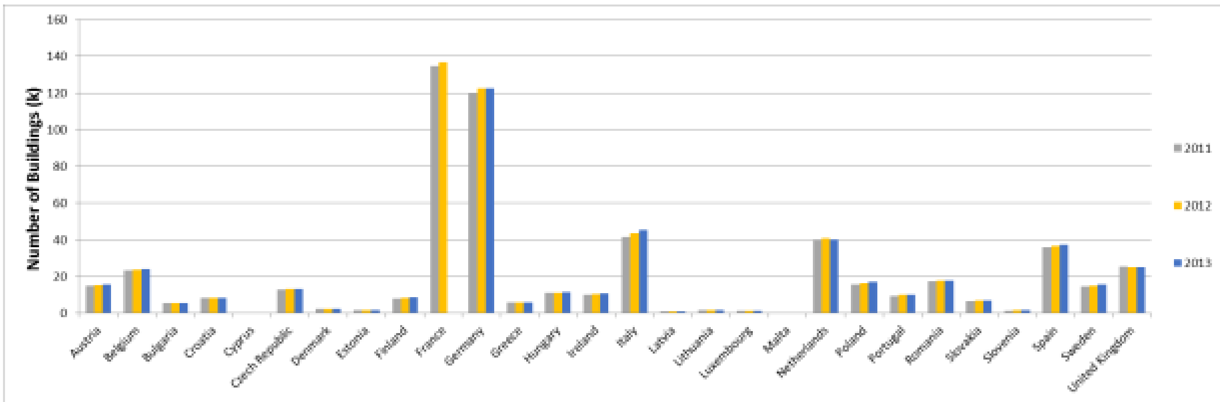


Figure 8 - Number of Health care buildings per Member State for the period 2011-2013

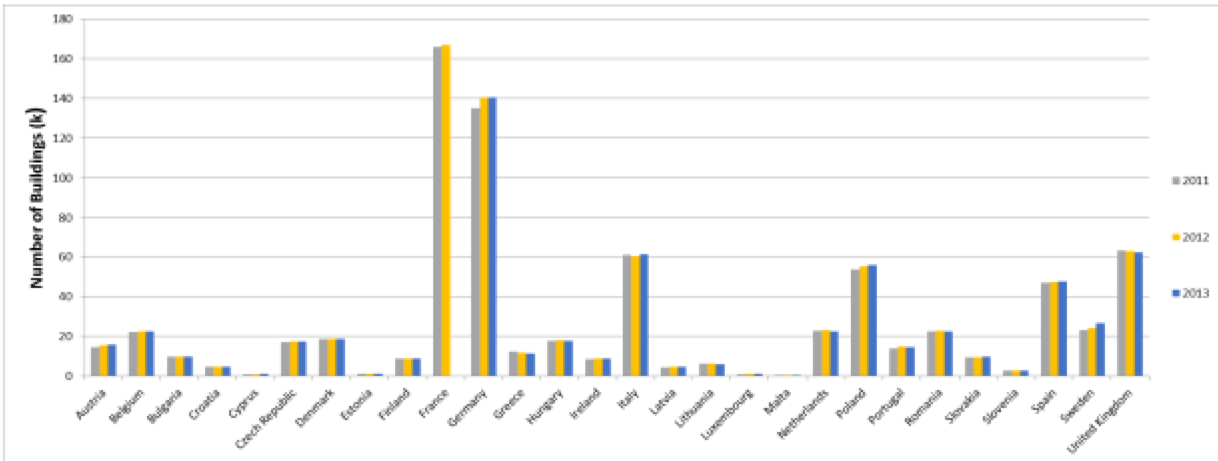


Figure 9 - Number of Educational buildings per Member State for the period 2011-2013

Note that for the offices, public buildings, sport facilities and "others" sectors, no reliable and consistent data could be gathered from the sources investigated, neither from the EU building observatory. The remainder of these sectors were aggregated in the following figure as "Rest" and unsurprisingly represents the biggest share of the non-residential sector, closely followed by the wholesale/retail sector.

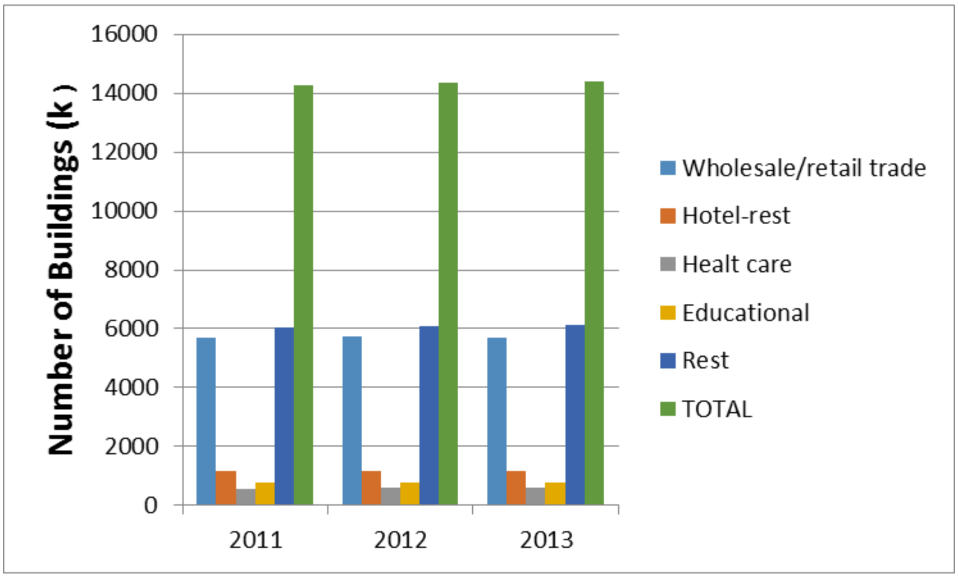


Figure 10 - Evolution of main non-residential sub-sectors for the period 2011-2013 (number of buildings)

Considering the general evolution of non-residential main subsectors in the period studied, it is noticeable that the **wholesale/ retail trade** would be the targeted sector for the implementation of the Voluntary Certification Scheme. The "Rest" subsector presents also an increasing trend. Since offices are under this subsector and these are traditionally one of the types of buildings with a biggest share within the non-residential buildings, also the private building offices could be ideally targeted for the implementation of the EVCS.

2.5.3 Share of EU non-residential buildings sub-sectors

Table 5 - Non- residential buildings by subsector (in thousands)

	Wholesale/retail trade	Hotel-restaurants	Health care	Educational	Rest	TOTAL
2011	5712	1156	573	769	6034	14244
2012	5719	1176	584	782	6088	14348
2013	5713	1166	590	782	6136	14387
2011	40.1%	8.1%	4.0%	5.4%	42.4%	100%
2012	39.9%	8.2%	4.1%	5.4%	42.4%	100%
2013	39.7%	8.1%	4.1%	5.4%	42.6%	100%

Below it is possible to see the total number of non-residential buildings per sub-sector throughout 2011 to 2013, where it is possible to realize that the distribution share of the sub-sectors remains almost stagnant through the analysed period.

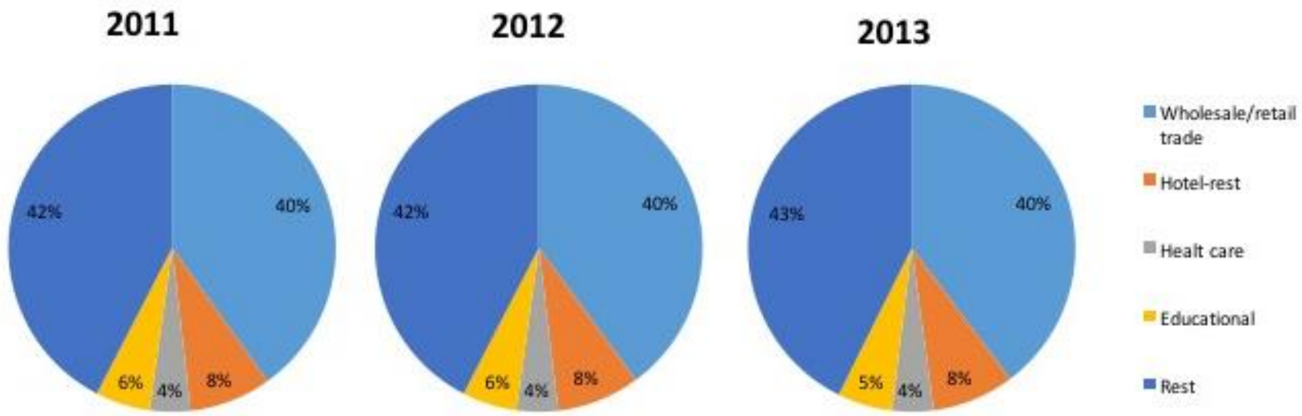


Figure 11 - Share of non-residential building type for the period 2011-2013

As mentioned before, the share of the sub-sectors is really stable during the evaluated period. For the purpose of the new scheme, Wholesale/retail trade buildings and offices, that lay under the "Rest" umbrella would be the targeted subsectors due to its overall importance in the non-residential sector (>80%), thus allowing a bigger impact of the introduction of the scheme, not just considering the non-residential, but also the entire buildings sector, a realistic uptake of the EVCS will tendentiously come from new buildings instead of renovated existing ones and from outstanding energy-performing buildings when compared with the status quo.

2.5.4- New construction buildings (permit –m2 useful floor area), per country per year from, 2011 to 2014)

Despite the number of building increasing, as can be seen in the figures below, the data analysed shows that when analysing new construction, there is a trending decrease, with the number of new permits decaying from numbers above 2100 permits in the years 2011 and 2012 to a number below in the following two years (Figure 12 - Evolution of the total number EU non-residential building permits for the period 2011-2014.

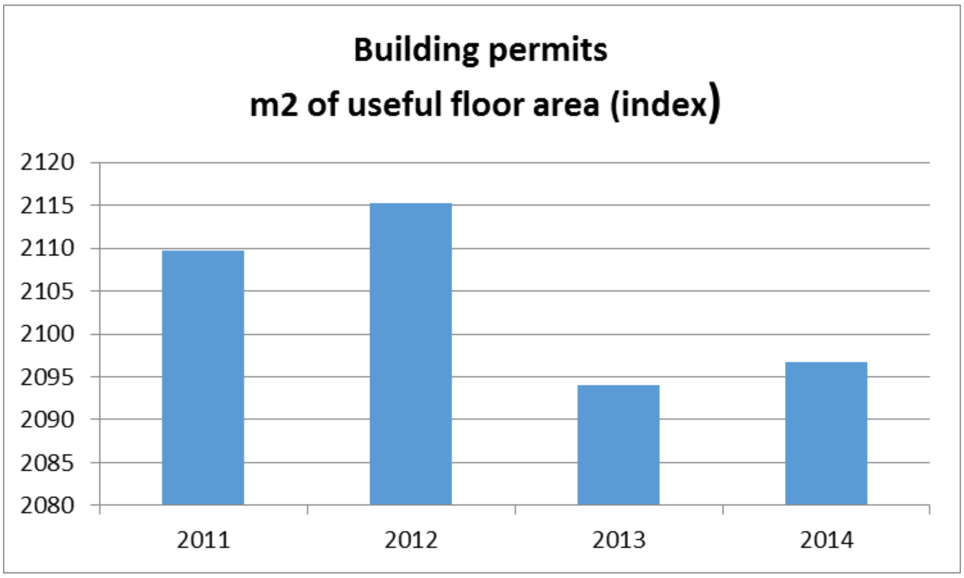


Figure 12 - Evolution of the total number EU non-residential building permits for the period 2011-2014

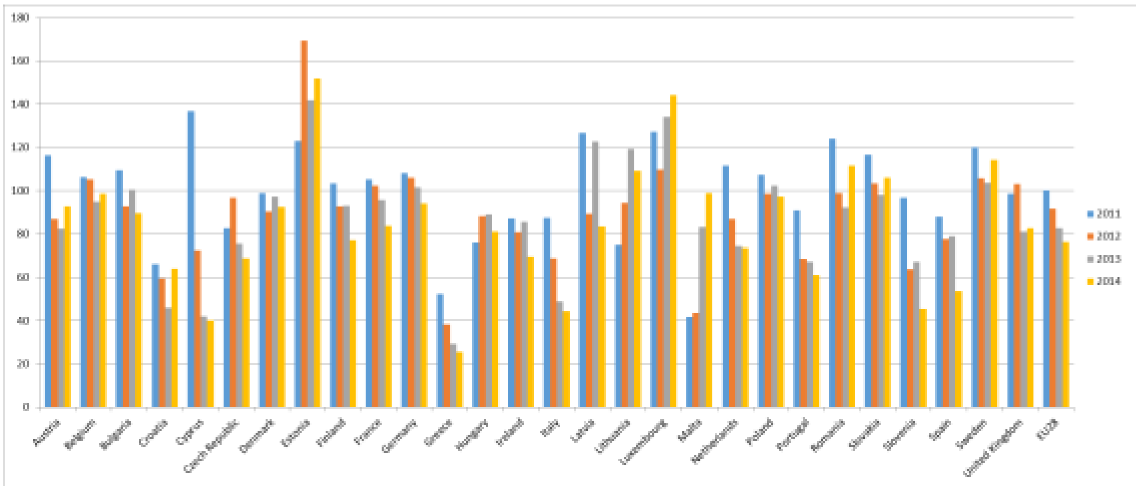


Figure 13 - building permits per Member Estate for the period 2011-2014

2.5.5- Number of NON RESIDENTIAL building per country and year with EPC

As shown in Figure 14 - Evolution of number of non-residential buildings with EPC in EU for the period 2011-2013 and Figure 15 - Evolution of number of non-residential buildings with EPC per Member Stare for the period 2011-2015, the total number of EPC certified buildings is increasing as it was expected.

As mentioned in previous chapters, the data regarding the EPC evolution is not robust and harmonised enough among the MS to perform calculations in order to estimate energy savings in the future.

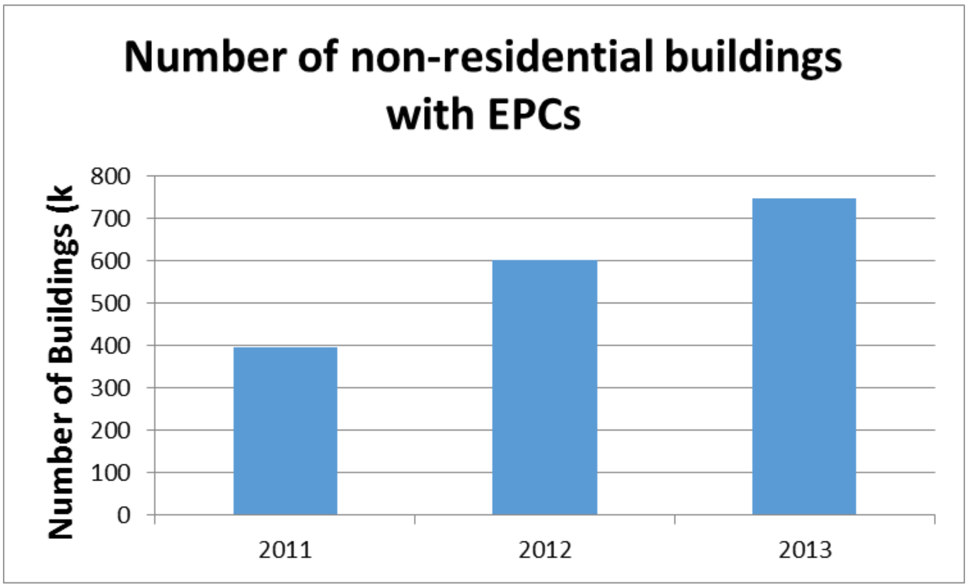


Figure 14 - Evolution of number of non-residential buildings with EPC in EU for the period 2011-2013

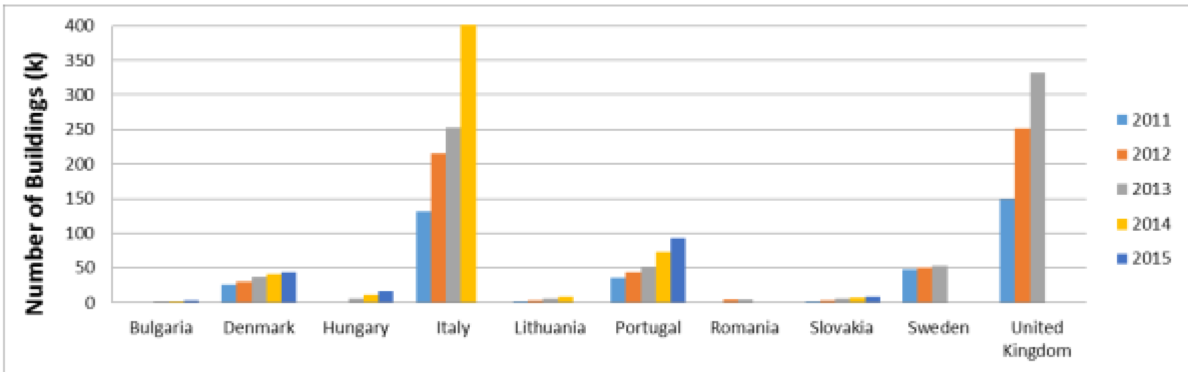


Figure 15 - Evolution of number of non-residential buildings with EPC per Member Stare for the period 2011-2015

2.5.6- Voluntary certificates. Total number of non-residential certifications per year per country from 2011 to 2014

Regarding the implementation of Voluntary schemes certificates for the non-residential sector, the building observatory delivers data on the number of certificates for Passivehaus, Minergie, LEED, BREEAM, DGNB and HQE, for all types of sub-sectors. In the table below (table 6) it is possible to see the number of certificates for each of these schemes and the number of Member States in which these certificates have been achieved (in brackets). As expected BREEAM is the leading scheme in terms of certifications, with 12496 certificates in the year 2014, due probably to being a pioneer and with a strong presence in the UK, but not limited to it since it is present in 25 of the 28 Member States. HQE is second with 1793 in the year 2014 but only present in 5 Member States, followed by LEED that has a much broader dissemination, being present in 24 of the 28 MS. To be noted that from the six voluntary schemes, the schemes only considering the energy performance of the building (Passivehaus and Minergie) are the schemes with the less dissemination, in comparison with the green building schemes taking into account other aspects besides energy performance/savings.

Both for Passivehaus and Minergie, the only data available is from 2014 and for all the schemes no data was available for the year 2013.

Considering that for the year 2013, overall in Europe the non-residential building sector had a total of 14,387 million buildings, and with a total of 15629 voluntary certificates from the most important schemes in 2014, the share of non-residential buildings with a voluntary certificate is around 0,1% from the total of non-residential buildings, showing that even if there is a motion going on towards the adoption of such schemes is still very little in comparison with the whole stock. This approximation was used due to the fact explained before that the data on the total number of non-residential buildings, in 2014, is not very well consolidated, thus not having been studied.

Table 6 - Number of non-residential buildings certifications for the period 2011-2015. In brackets the number of MS providing data

Certificate	Number of certificates in 2011	Number of certificates in 2012	Number of certificates in 2013	Number of certificates in 2014	Share in 2014
Passivehaus	-	-	-	148 (13)	0.9%
Minergie	-	-	-	36 (2)	0.2%
LEED	152(21)	317(21)	-	669(24)	4.3%
BREEAM	4507 (21)	7794 (23)	-	12496(25)	80%
DGNB	318(8)	421(9)	-	487(12)	3.1%
HQE	1089(4)	1095(5)	-	1793 (5)	11.5%
TOTAL	6066	9627	-	15629	

Regarding the schemes with the biggest representation, LEED has a good representation geographically and for a long period, due to its antiquity.

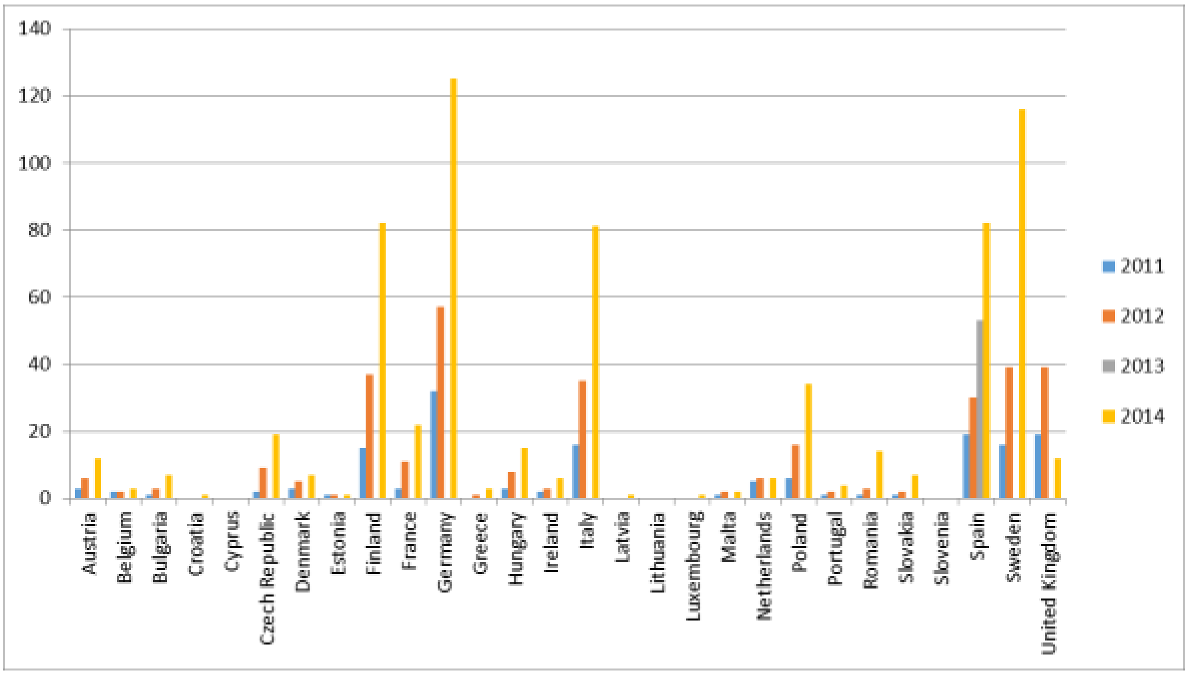


Figure 16 - Number of LEED certifications per MS for the period 2011-2014

The same applies to BREEAM that represents the lion share of the voluntary schemes, although with 95% of its certified buildings belonging in the UK territory, while DGNB and HQE are mostly represented in their original country of development.

In Figure 17 - Evolution of the total number of voluntary certifications for the period 2011-2014it is possible to view the evolution of the Voluntary schemes for the years 2011, 2012 and 2014 while in Figure 18 - Contribution of the different voluntary schemesthe share of the different schemes with a clear dominion

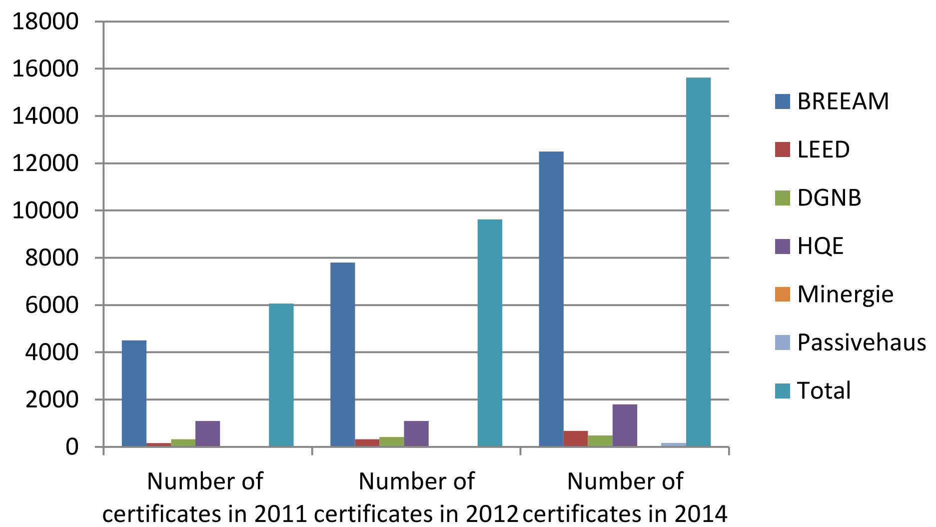


Figure 17 - Evolution of the total number of voluntary certifications for the period 2011-2014

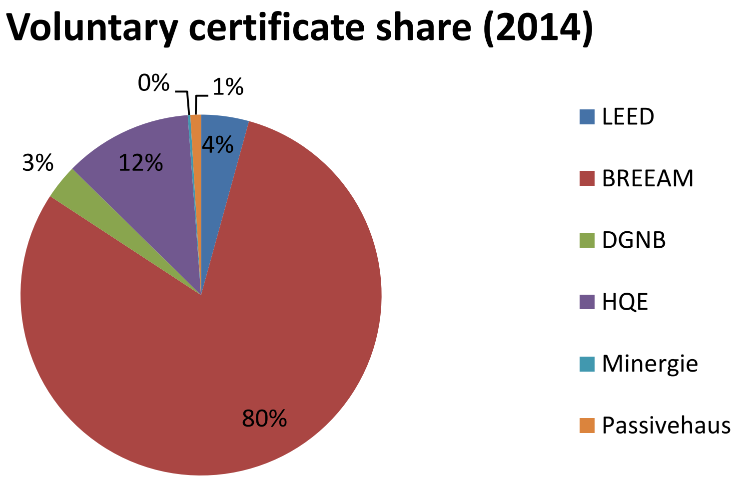


Figure 18 - Contribution of the different voluntary schemes

3. Results

The aim of this chapter is to give a prospective view of the trends of the building stock and the evolution of the voluntary schemes and to evaluate the EVCS impact in terms of energy savings.

The year of 2020 was chosen to serve as a target year in order to check the impact of the EVCS, considering the building stock projection based on the data analysed in the previous chapter and the energy consumption of the non-residential sector also linearly projected to the year 2020.

3.1 Building stock projection to 2020

Firstly, a projection on the number of non-residential buildings was performed for the year 2020 considering the more recent data. A linear regression was performed, reaching to a projection of 19833400 non-residential buildings for the year 2020. This value will then be prompted for the overall impact in terms of energy savings of the EVCS

Projection to 2020 : 749670*2020-1494500000=19833400

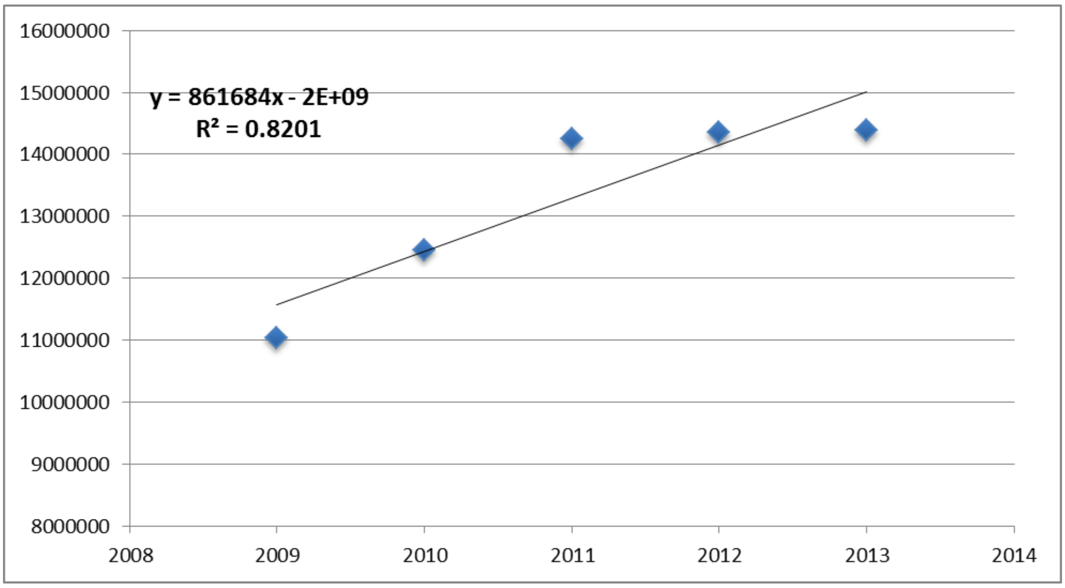


Figure 19 - Total number of non residential building linear regression projection

Also using a linear projection for the number of non-residential certified buildings for 2020, although the regression is built upon only three points, we reach a prospective number of 41682 voluntarily certificate non-residential buildings.

Projection to 2020: 4254.1*2020 -8551600 = 41682

Total number of non-residential certified buildings in 2020.

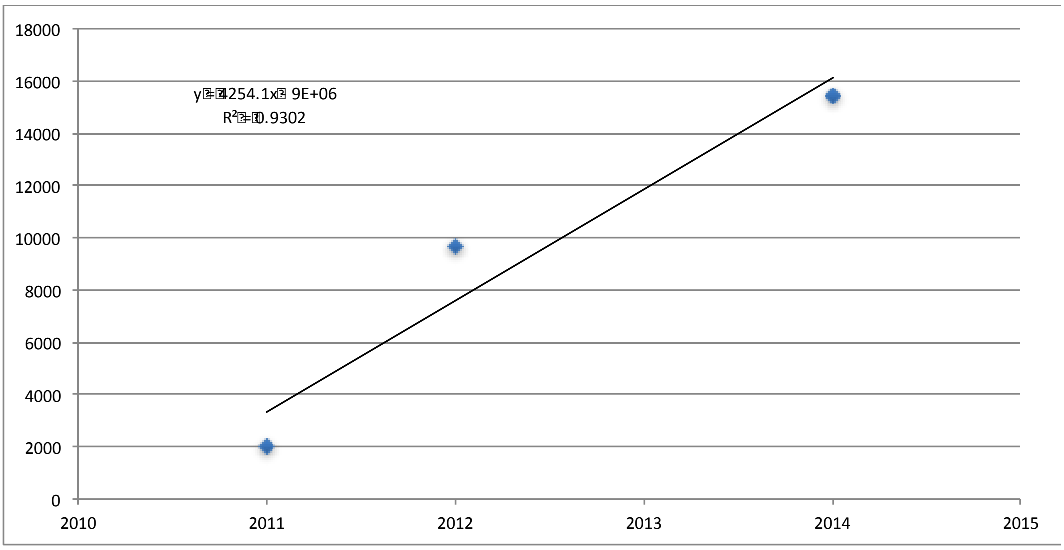


Figure 20 - Total number of non- residential certified building linear regression projection

Considering the evolution, both of the total number of non-residential buildings and the number of certified buildings, the share of certified buildings goes from the previously identified 0,1% to around 0,2%. To be noted that this is a very rough estimate due to the lack of waypoints to calculate the projection.

Energy consumption building stock evolution

Applying the same methodology of a linear regression projection, the total energy consumption of the non-residential sector has a tendency to reach a value of 125.92 Mtoe in 2020. This value will serve for the calculation of the potential energy savings in the different scenarios.

Projection to 2020: -2.939*2020+6062.7 = 125.92

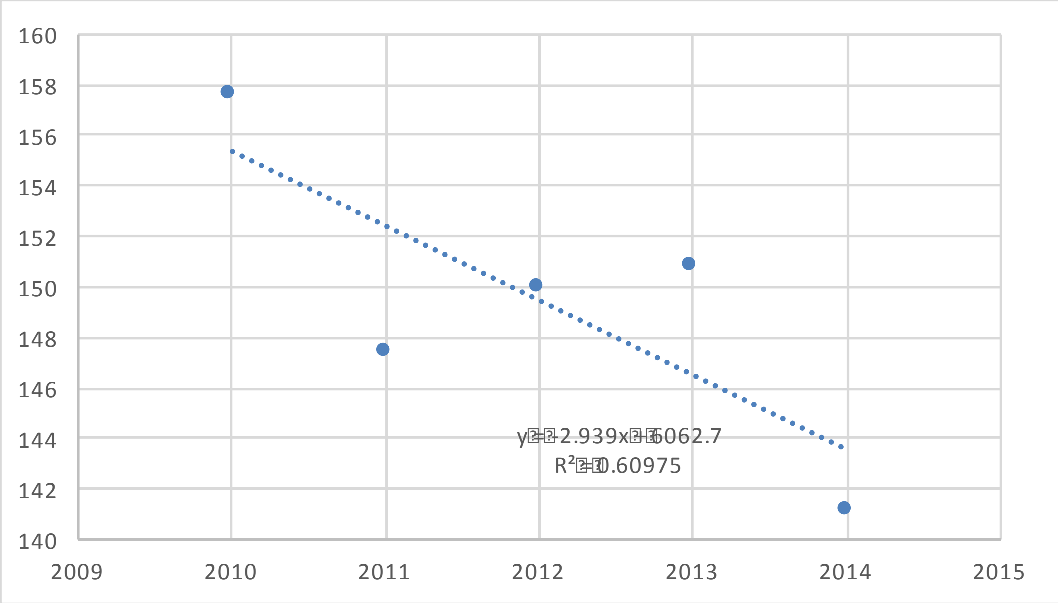


Figure 21 - Total energy consumption linear regression projection

3.2 Benefits of introducing the scheme in the current and future stock

In order to realize tangible benefits from the introduction of the EVCS in terms of energy savings in the year 2020, the following methodology was applied.

The variables to assess a potential impact of the EVCS are:

1) Considering the number of certified buildings in the years 2011, 2012, 2014 and with the projection of the number of certified buildings in 2020 and considering that the energy savings from the certified buildings in such years are 20%, 40% and 80%, for all the certified buildings. The fact that the years 2011, 2012 and 2014 are being considered is to give a perspective on how would the EVCS impact in the case that was already implemented by these years, thus giving a notion of the influence of such mechanism in the overall non-residential sector.

Table 7 – Scenarios for the EVCS in the case of 20, 40 and 80% of energy savings criteria

Year	2011	2012	2014	2020
Number of non-residential buildings	14243990	14348200	14439770	19833400
Number of certified buildings	2009	9627	15444	41682
Energy Consumption EU28 (Mtoe)	147,39	149,94	150,88	125,92
Energy consumption with 20% E savings for certified buildings	147,37	149,82	150,69	125,6
Savings share in non-residential sector (20%)	0,017	0,080	0,128	0,252
Energy consumption with 40% E savings for certified buildings (Mtoe)	147,36	149,8	150,65	125,55
Savings share in non-residential sector (40%)	0,0197	0,094	0,150	0,294
Energy consumption with 80% E savings for certified buildings (Mtoe)	147,35	149,72	150,53	125,35
Savings share in non-residential sector (80%)	0,030	0,145	0,231	0,454

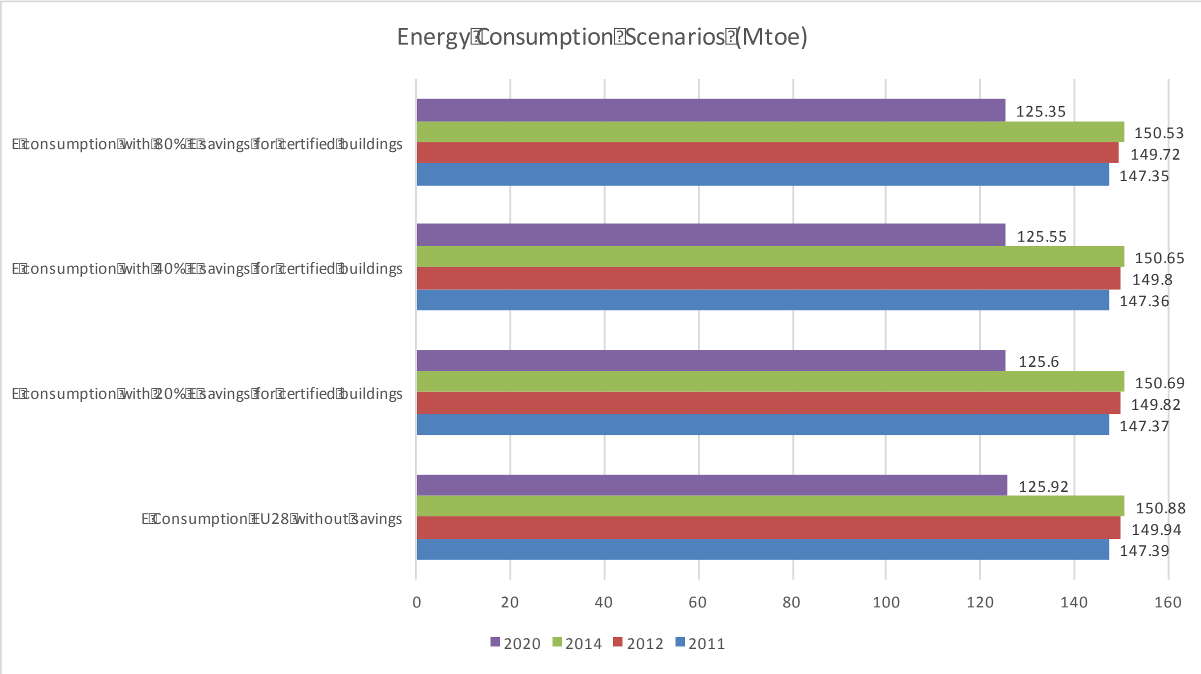


Figure 22- Scenarios for the implementation of the EVCS (Energy Consumption variable)

2) Considering for the year 2020 with an overall number of non-residential buildings of 19833400 and an energy consumption of 125,92 Mtoe, the variable is the uptake of the EVCS with a buildings' certified percentage of 0,2%, 0,3%, 0,5%, 1% and 2% of the overall building stock. The table below represents the energy consumptions and the share of the savings in the overall non-residential building stock.

It can be seen in the table that when the number of buildings and the energy savings tighter requirements increase, the **EVCS can have a big impact on the non-residential building stock energy savings**, being able to **reach up to 4%** in total of the whole energy consumption of the sector (if a 80% criteria is chosen for all the certified buildings). Although this value may seem ambitious, it still gives good perspectives on the potential of such tool, when well promoted and implemented.

Table 8- Scenarios for the EVCS in 2020 with different uptake of the scheme and energy savings criteria

Year	2020				
Number of non-residential buildings	**19833400**				
Number of certified buildings	**0,2%**	**0,3%**	**0,5%**	**1%**	**2%**
	41682	59500	99167	198334	396668
Energy Consumption EU28 (Mtoe)	**125,92**				
Energy consumption with 20% E savings for certified buildings (Mtoe)	125,6	125,47	125,16	124,41	122,9
Savings share in non-residential sector (20%)	0,25	0,36	0,6	1,2	2,4
Energy consumption with 40% E savings for certified buildings (Mtoe)	125,55	125,39	125,04	124,16	122,39
Savings share in non-residential sector (40%)	0,29	0,42	0,7	1,4	2,8
Energy consumption with 80% E savings for certified buildings (Mtoe)	125,35	125,1	124,56	123,2	120,48
Savings share in non-residential sector (80%)	0,45	0,648	1,08	2,16	4,32

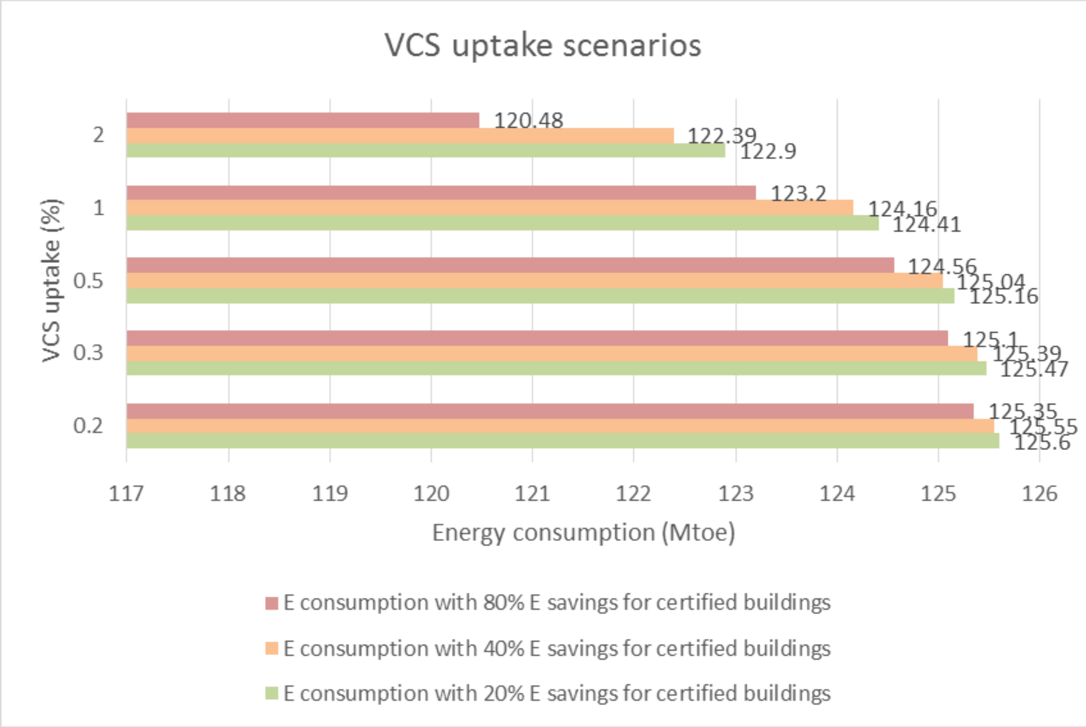


Figure 23 – Scenarios for the implementation of the EVCS in 2020 (uptake variable)

4. Conclusions and Recommendations

Overall conclusions

The ultimate aim of this report was to find the cost-benefit of the implementation of the European Voluntary Certification Scheme foreseen by article 11(9) of the Energy Performance Building Directive and give an overview of the non-residential building stock. That for, the study focused first on an evaluation of the existing green building schemes in the European market and an evaluation of potential benefits and increased costs decurrently from the implementation of such voluntary schemes. Moreover, the study seeks to evaluate the real impact of the scheme implementation by extrapolation of the non-residential stock growth.

While collecting information to execute the report, several drawbacks were found, especially in terms of finding consolidated and reliable data to form a consistent database of the non-residential building stock and the unavailability to find quantitative results on the benefits arising from the implementation of these types of schemes.

The thought behind the constitution of the EVCS is, according to the authors of this report, a noble one and is based on the assumption of being a success in terms of its uptake from a very early age, if active promotion is done.

The fact that this EVCS is built to be an **EU-wide** scheme that can be adopted by both individual building promoters and multinational companies is of critical importance. The transparency factor of a scheme being promoted by the European Commission and with market surveillance by the National Accreditation Bodies is of great significance. This EU-wide feature that allows an economic operator to compare its assets throughout the European Union, withholds the principles of an open European market that can meet the ambition of a green building sector spreading throughout the Union without technical borders.

The fact that it builds upon the new CEN standards for the energy performance of buildings ensures a trustworthy way of evaluating the energy performance of the buildings, making it transparent, comparable and with a continental reach.

While the buildings certified under the existing voluntary schemes are usually new and state of the art efficient buildings, the EVCS leaves space to a large array of buildings, new or not, to be certified in order to enter the scheme. It is however, from the perspective of the authors of this report that in a first stage, the early adopters of the scheme will be economic operators that have already a mind-set focused on the benefits of energy efficient buildings for their business model and may consider the EVCS as a way to gain further certification in a scheme promoted by the European Commission and that will be comparable between the different Member States where these companies are operating.

Even if the EVCS does not aim to replace the traditional Energy Performance Certificates, it is very interesting that it could potentially do so. Member States could choose to adopt the EVCS requirements as their own Energy Performance EPC and building promoters can rely in a certified third-party methodology allows for a game-changing perspective in the sector. If the scheme was adopted as a norm by Member states, it could have a significant impact on the building sector and all its supply chain, making the market to adapt to more strict requirements, creating a ripple effect on the traditional building sector’s industry.

Schemes comparative

Evaluating the different types of voluntary schemes operating in the market, some issues arose as well regarding the complexity of these schemes and the disparity of assessment methods and criteria of evaluation. Two main types of schemes were found. Energy only schemes, where only the energy performance of the building matters, and the most divulged type of schemes, the green-building sustainability schemes, where energy performance is one of many aspects to be taken into account when in the process of certifying a building. The difficulty of comparison the criteria are especially noticeable when trying to find common touch-points and metrics to measure the cost-benefit of the implementation of these schemes.

Nevertheless, this first part of the report can be considered as a good exercise of comparison, highlighting the common points and main divergences of the market schemes nowadays

Implementation benefits

Regarding the benefits of the implementation of these types of schemes in terms of energy savings, several reports proclaim energy savings up to 50%, in comparison with similar buildings, depending on the level of certification achieved. The benefits savings arising from better and more efficient energy systems do not end in terms of measures regarding the envelope of the buildings or HVAC systems, but also more complex energy systems that take into consideration aspects like the production of renewable energies or comfort of the occupants of the building, originating benefits other than monetary. Other types of benefits from the implementation of green building schemes can be the lower costs of maintenance, operational costs, the raise of the assets price and rents, proving to be very much cost-beneficial in many cases, even considering the higher investments that need to be made, especially when certifying higher demand levels.

Although it is challenging to quantify what type of external impacts a scheme like the EVCS will have, besides the extrapolation on the energy savings associated with certain uptake rates of the scheme, it is expected that the implementation of a scheme on an EU-wide scale should trigger the various sectors of the construction ecosystem that tendentiously should adapt to the demands of the market, impacting directly all the supply chain involved, from materials development and manufacturing to associated services.

Implementation costs

In terms of the costs of the implementation of green building schemes, these also vary very much from different schemes and levels of implementation. With the tightening of the criteria of standard buildings, it is not rare to find buildings certified under a green building scheme, where the premium costs are almost insignificant in comparison with the costs of a regular building.

From the scenarios drawn in order to understand a potential impact that the EVCS may have within the EU, it was possible to realize that the EVCS has the prospective ability to make a difference in the non-residential building sector, delivering significant energy savings, if the number of the certified buildings is high such as the requirements.

Recommendations

For the EVCS to be successful it should be an easy to understand, well-formed scheme, with clear instructions that there is a common methodology across Europe with some exceptional adaptions as the use of climatic data. One of the aspects that turn the EVCS successful is the recognition by peers and the market that the promoter is actually making an effort to be more efficient and sustainable.

A central body to coordinate the whole scheme and promote it at global and local levels is seen as a good strategy for the success of the EVCS. The same applies for a possible body that should be responsible for dealing with all the data arising from the certificated buildings, thus learning and building upon into new versions of the EVCS. A database for this needs to be in place.

One of the main challenges foreseen is that already today the voluntary schemes are considered a niche in comparison with the overall building stock. An integrated approach from the EVCS would be desired in terms of promotion. Another potential barrier for a smooth and fast roll-out of the EVCS may be the lack of certified and trained professionals that can keep up with the, hopefully, high demand of the EVCS by building promoters. Communication with the non-residential sector and the trained experts when moving forward with the scheme will help mitigate this barrier.

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List of abbreviations and definitions

EVCS the European Common Voluntary Certification Scheme for non-residential buildings

SBA Sustainable Building Alliance

EC European Commission

EE Energy efficiency

EP Energy performance

EPC Energy performance certificate

EPBD Directive 2010/31/EU of 19 May 2010 on energy performance of buildings (recast)

PE Primary energy

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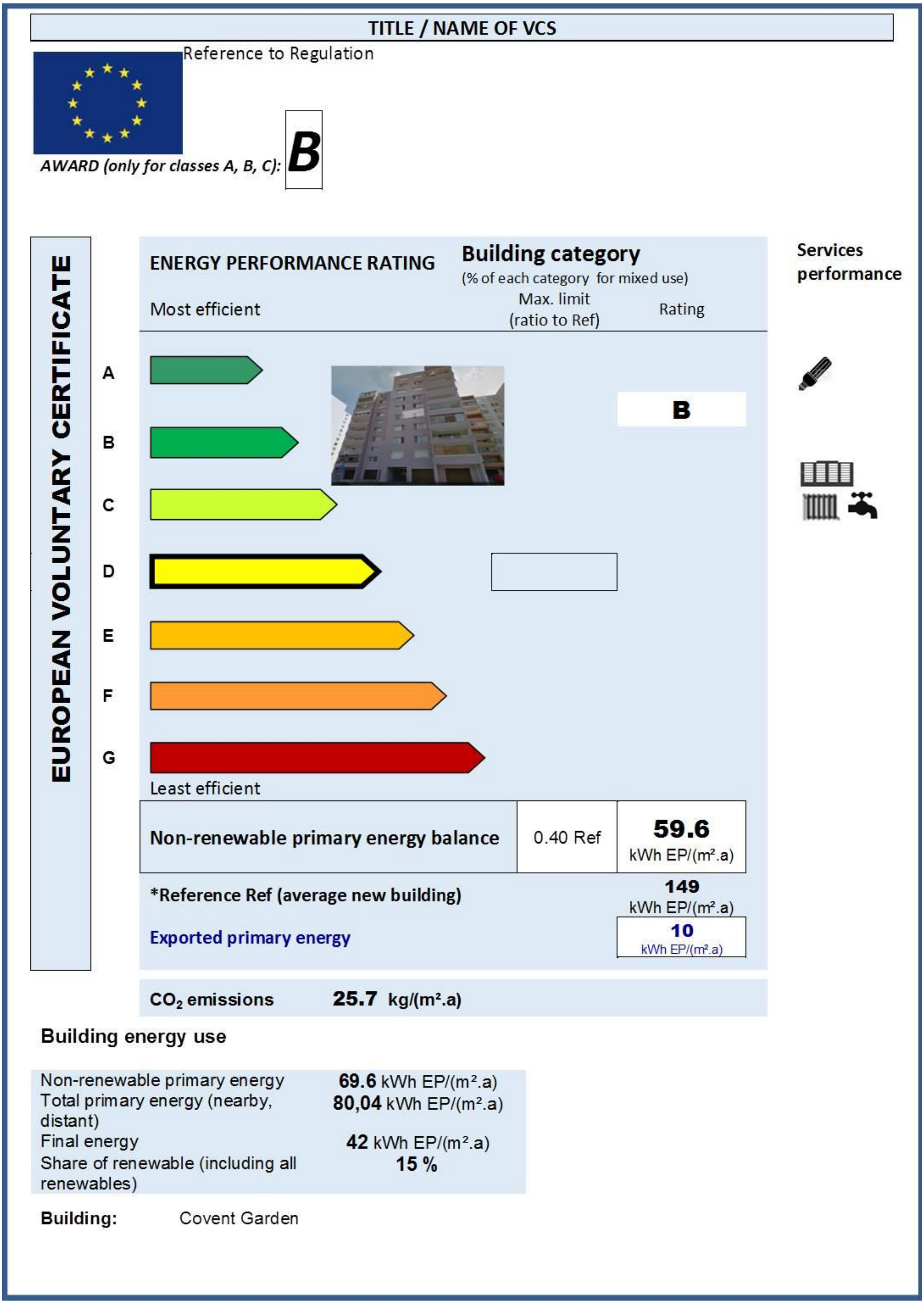
ANNEX 1 Energy performance certificate

Figure 24 EVCS Certificate front page



ANNEX 2 2013 France and Germany data correction

Table 9 - Non treated non-residential buildings data

Number of non residential buildings					
	2009	2010	2011	2012	2013
Austria	128.77	128.26	129.13	133.63	132.56
Belgium	787.11	786.26	784.6	782.26	781.5
Bulgaria	68.67	65.19	64.06	63.76	63.6
Croatia	123.69	118.74	118.01	117.46	118.25
Cyprus	39.7	40.93	41.46	42.12	42.46
Czech Republic	-	-	-	-	-
Denmark	-	-	147.26	147.67	147.91
Estonia	19.5	19.39	19.49	19.48	19.78
Finland	217.61	219.49	222.09	224.78	226.67
France	1,402.17	1,416.72	1,430.06	1,439.37	-
Germany	-	1,368.32	2,986.24	2,986.24	-
Greece	523.24	530.76	499.33	468.14	451.41
Hungary	-	-	11.69	-	-
Ireland	68.2	66.64	66.24	67.49	68.18
Italy	2,130.00	2,178.43	2,203.65	2,284.78	2,251.97
Latvia	-	-	-	-	-
Lithuania	86.99	84.93	85.05	85.66	89.19
Luxembourg	10.65	11.08	11.69	12.43	12.65
Malta	13.91	14.53	14.34	14.71	14.86
Netherlands	229.83	224.65	229.91	234.94	230.68
Poland	849.61	849.63	851.19	854.28	881.38
Portugal	434.16	437.16	426.93	430.15	426.91
Romania	174.37	171.47	173.73	180.87	185.32
Slovakia	60.97	58.98	58.98	60.4	61.21
Slovenia	-	-	-	-	26.35
Spain	1,781.51	1,806.04	1,824.63	1,842.91	1,860.54
Sweden	309.32	315.63	319.76	325.89	361.71
United Kingdom	1,570.09	1,532.59	1,524.47	1,528.78	1,506.21
TOTAL Number of non-residential buildings EU27	11,030.07	12,445.82	14,243.99	14,348.20	9,961.30

Table 10 Treated data (correction for France and Germany following the 5 years trend)

Number of non residential buildings					
	2009	2010	2011	2012	2013
Austria	128.77	128.26	129.13	133.63	132.56
Belgium	787.11	786.26	784.6	782.26	781.5
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Croatia	123.69	118.74	118.01	117.46	118.25
Cyprus	39.7	40.93	41.46	42.12	42.46
Czech Republic	-	-	-	-	-
Denmark	-	-	147.26	147.67	147.91
Estonia	19.5	19.39	19.49	19.48	19.78
Finland	217.61	219.49	222.09	224.78	226.67
France	1,402.17	1,416.72	1,430.06	1,439.37	1440
Germany	-	1,368.32	2,986.24	2,986.24	2986
Greece	523.24	530.76	499.33	468.14	451.41
Hungary	-	-	11.69	-	-
Ireland	68.2	66.64	66.24	67.49	68.18
Italy	2,130.00	2,178.43	2,203.65	2,284.78	2,251.97
Latvia	-	-	-	-	-
Lithuania	86.99	84.93	85.05	85.66	89.19
Luxembourg	10.65	11.08	11.69	12.43	12.65
Malta	13.91	14.53	14.34	14.71	14.86
Netherlands	229.83	224.65	229.91	234.94	230.68
Poland	849.61	849.63	851.19	854.28	881.38
Portugal	434.16	437.16	426.93	430.15	426.91
Romania	174.37	171.47	173.73	180.87	185.32
Slovakia	60.97	58.98	58.98	60.4	61.21
Slovenia	-	-	-	-	26.35
Spain	1,781.51	1,806.04	1,824.63	1,842.91	1,860.54
Sweden	309.32	315.63	319.76	325.89	361.71
United Kingdom	1,570.09	1,532.59	1,524.47	1,528.78	1,506.21
TOTAL Number of non-residential buildings EU27	11,030.07	12,445.82	14,243.99	14,348.20	14,387.30

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