



The European Union's programme for India

Clean Energy Cooperation with India (CECI): Legal and policy support to the development and implementation of energy efficiency legislation for the building sector in India (ACE: E²)

Specific Contract: FWC No. PI / 2015 / 368-474

Roles of manufacturers and suppliers of construction products and services

EU EXPERIENCE ON EPBD - POSITION PAPER No 6

Deliverable D1.1



This project is funded by
The European Union



A project implemented by EXERGIA S.A., member
of SACO Consortium, in collaboration with PwC India

FOREWORD

This position paper has been developed by the project “Clean Energy Cooperation with India (CECI): Legal and policy support to the development and implementation of energy efficiency legislation for the building sector in India (“ACE:E²”¹)”.

The ACE: E² project is financed by the European Union and managed by the Delegation of the European Union to India. It is carried out as part of the Framework Contract COM 2011 Lot 1 (Europeaid/129783) by EXERGIA S.A., member of SACO Consortium, in collaboration with PricewaterhouseCoopers (PwC) India, under the Specific Contract: FWC No. PI / 2015 / 368-474 signed between the Delegation of the European Union to India (EUD) and SACO on December 18th, 2015.

The contents of this paper are, however, the sole responsibility of the contractor and can in no way be taken to reflect the views of any particular individual or institution, including the European Union, the Delegation of the European Union to India, and the Bureau of Energy Efficiency (BEE) in India.

¹ ACE: E² – Adoption, Compliance, Enforcement – Energy Efficiency

ABBREVIATIONS

ACE: E2	Acronym of the project (Adoption, Compliance, Enforcement – Energy Efficiency)
BEE	Bureau of Energy Efficiency
BPIE	Building Performance Institute Europe
CECI	Clean Energy Cooperation with India
CEN	European Standards Body
CPS	Competent Persons Schemes
EUD	European Union to India
EPC	Energy Performance Certificate
IEE	Intelligent Energy for Europe
ICT	Information and Communication Technology
NZEB	Nearly Zero Energy Buildings
SBEM	Simplified Building Energy Model

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1 SUMMARY

Within EU Member States in general, manufacturers and suppliers of construction products and services took a very positive attitude to the adoption and implementation of the EPBD. This was a natural expectation, given that the Directive, and the consequential building energy codes required to be adopted by Member State authorities, required a greater use of higher specification products, many of which had been readily available for several years (for example, triple glazing, solar control products, condensing boilers, smarter controls, LED lighting, heat pumps and other renewables). However, given the near-term goal of achieving nearly zero energy buildings (NZEB) by around 2020, this has been, and continues to be, a significant challenge.

Suppliers of construction materials, energy using equipment and energy efficiency services play a key role in ensuring quality buildings with good energy performance. While operating individually within a competitive market, they have also been represented by many industry associations. Together they have played a number of roles in assisting the adoption, compliance and market impact of the EPBD. These have included:

Advocacy:

- ▶ Campaigning role, industry advertising, promotional activities and published studies/ position papers to highlight awareness and benefits of more energy efficient products and systems to their potential customers – architectural and engineering specifiers, building contractors, developers, State bodies – and to policy makers.
- ▶ Actively engaging in ongoing dialogue with Member State authorities and with the EU Commission as part of such campaigning.
- ▶ Responding to all opportunities provided by the consultative mechanisms of both EU and Member State authorities in relation to regulatory and other policy proposals.

Market preparation and wider awareness:

- ▶ Addressing attitudes of building industry players specifically to energy codes and certification, highlighting the benefits.
- ▶ Representative bodies playing an active role on Standards development committees at EU and Member State level, and/or in their industry consultations.

Assisting compliance:

- ▶ Product manuals, guidance manuals with illustrated compliant construction solutions, software tools, assisting skills development of professionals (architects and engineers) in relation to applying their products and systems within the energy performance calculation methodology, including for example ‘accepted construction details’ to avoid cold bridging or air leakage.

- ▶ Training facilities such as training and ‘knowledge centres’ for both professionals and trades – blocklayers, plasterers, glaziers, heating technicians, electrical technicians – with practical demonstrations of code compliant constructions.

Company innovation and competitiveness:

- ▶ Participation in research and product/ service innovation projects and networks at national and EU level – for both newbuild and renovation.
- ▶ Similarly, participation in energy efficiency demonstration projects highlighting cost-effective methods of compliance.
- ▶ The creation of new service specialisations – energy performance certifiers, building energy performance modelling, thermal bridge modelling, air leakage testing.
- ▶ Early certification of innovative products and services.
- ▶ Continuous improvement culture within industry in upgrading product performance and overall quality.

In its own competitive interest, the construction supply sector has thus played, and continues to play, an active role in the drive to upgrade energy and overall quality performance standards within the building industry ecosystem.

Overall, the contribution of the construction supply sector activities in relation to advocacy, promoting awareness, building product labelling schemes and innovation have complemented its initiatives to support compliance of building designs and constructions with building energy codes.

2 CONTEXT

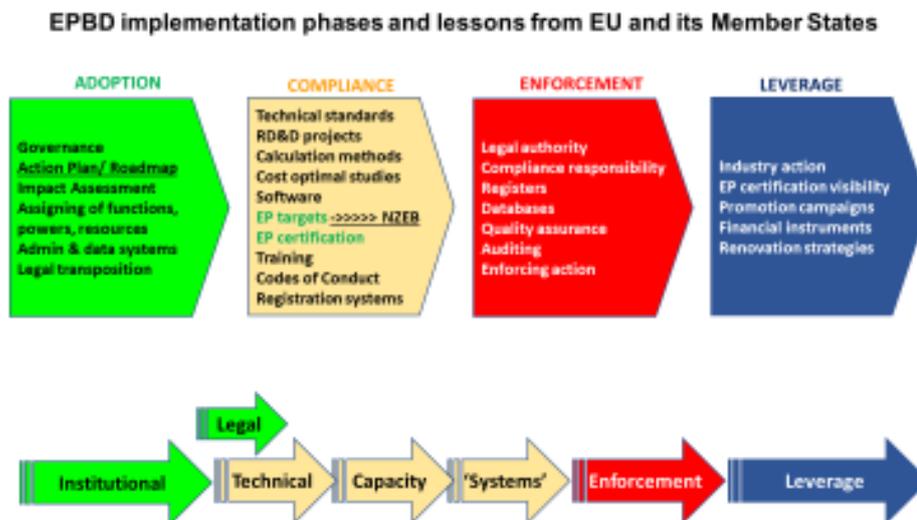
The role of manufacturers and suppliers of construction products and services in the context of building energy code implementation within the EPBD sits within an overall four stage implementation framework and within an overall supply chain ‘ecosystem’ as shown below.

2.1 EPBD implementation: the four-stage process

The multiple requirements of the EPBD posed a significant challenge for EU Member States to meet the requirements of the Directive within the specified timescales. A well-coordinated approach was necessary for success.

Figure 2-1 is a schematic overview of key activities required to be delivered. These are grouped into four blocks, consisting of Adoption > Compliance > Enforcement > Leverage, which in broad terms are logically sequential (although many of the actions would be implemented in parallel). While the EPBD and India’s ECBC are not identical in their obligations, the first three blocks in the diagram broadly align with the framework prescribed for the ACE:E² project itself. The fourth block, ‘Leverage’, is a supplement to the others, involving actions which were aimed at amplifying the effectiveness and impact of the EPBD.

Figure 2-1 Primary blocks of tasks necessary for EPBD implementation and effectiveness

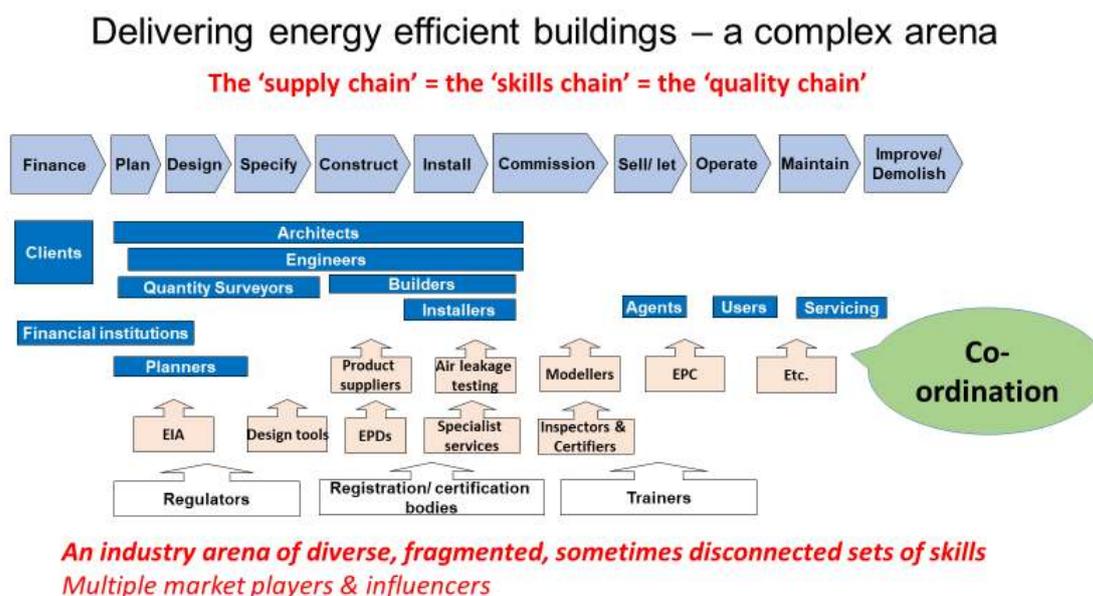


2.2 The building industry supply chain

Figure 2-2 outlines the process of delivering code compliant energy efficient buildings, from planning through to operation and maintenance, showing the range of steps, diverse responsible parties and resources involved. These constitute a ‘supply chain’ of activities, which can also be seen as a ‘skills chain’ and ‘quality chain’, in which overall compliance

requires that each entity has the necessary skills to make its necessary contribution to a quality outcome. This diagram can also be regarded as a ‘stakeholder map’. In this context, capacity building includes the engagement, upskilling and co-ordinated mobilisation of the responsible construction professionals, product and service specialists and site trades to deliver code compliant buildings, and also the necessary engagement of enforcement authorities.

Figure 2-2 Schematic of positions and roles of market, regulatory and facilitative parties in the building industry supply chain



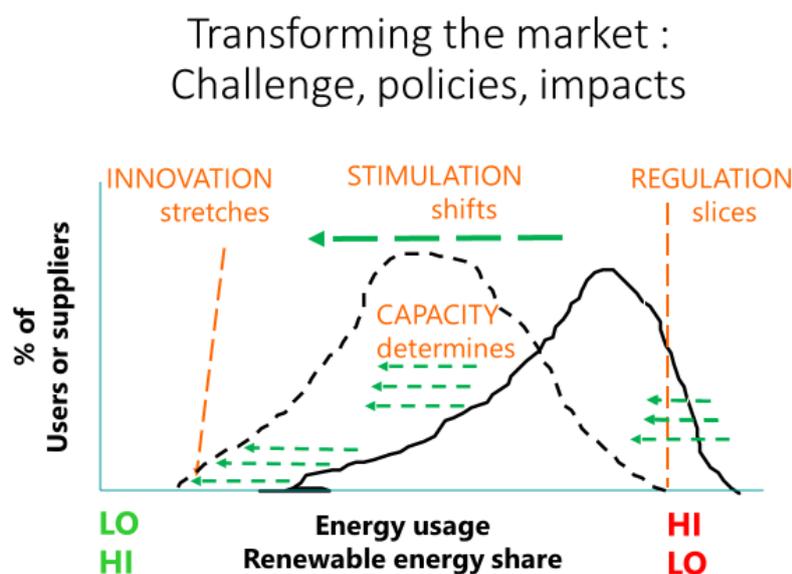
Within EU Member States in general, **manufacturers and suppliers of construction products and services took a very positive attitude to the adoption and implementation of the EPBD.** This was a natural expectation, given that the Directive, and the consequential building energy codes required to be adopted by Member State authorities, required a greater use of higher specification products, many of which had been readily available for several years (for example, triple glazing, solar control products, condensing boilers, smarter controls, LED lighting, heat pumps and other renewables). However, given the near-term goal of achieving nearly zero energy buildings (NZEB) by around 2020, this has been, and continues to be, a significant challenge.

2.3 The market change agenda

The goal of energy efficiency (and associated renewable energy) policies for buildings is shown schematically in Figure 2-3. It illustrates the nature of the market impacts of different policy instruments. Regulation sets a minimum performance level, eliminating the poorest performers and progressively drives out inferior performing products (e.g. ordinary double glazing, non-condensing boilers, uncontrolled air leakage). The more progressive players in the industry have a role not only in delivering a compliant response to regulation, but also in influencing and promoting ambitious but practical performance targets set in regulations.

The industry clearly has a role in generating new solutions which extend the previous boundaries of excellence, and it is common for the leading EU building industry supply companies to invest in continuing research and development (R&D) for this purpose (These activities will be outlined further in Position Paper 7). Financial incentives and promotional activities stimulate a general market shift towards improved performance, while the capacity of the industry supply chain determines the speed at which the overall market change can take place. **The industry supply companies thus have an important role to play in promoting compliant and cost-effective solutions through initiatives in awareness, tooling, training and upskilling specifiers and installers of their products.**

Figure 2-3 Schematic of the roles of policy factors in improving energy performance



2.4 Scope: Products and Services

A wide range of products and services are potentially affected by the building energy code requirements of the EPBD, including the drive towards NZEBs.

Building materials – such as thermal insulation, concrete products, brick products etc., windows, solar control products, doors, vapour barriers, air tightness barriers, jointing details to avoid cold bridging (e.g. at window cills and lintels).

Energy related equipment – boilers, pumps, heat emitters, fans, heating controls (sensors, valves, actuators), air conditioning units, cogeneration systems, lighting products (lamps, luminaires, controls), heat pumps, solar thermal systems, solar photovoltaic systems, heat meters, smart meters, Building energy management systems (BEMS).

Services – design and certification advisory services, software providers, specialist modelling services, specialist testing and certification services, Energy Services Companies (ESCOs).

In general across the EU, these industries were already ‘market ready’ in terms of having products available to enable compliance with future building energy code specifications under the EPBD. Nevertheless, it remained a continuous challenge to not only provide technically compliant products and services, but to provide superior offerings in terms of even further improved performance and more and more cost-effective solutions.

3 ROLES OF INDUSTRY AND INDUSTRY ASSOCIATIONS

3.1 Overview of roles

As reflected in Table 3-1 suppliers of building materials, energy using equipment and energy efficiency services in the EU construction and renovation sector play a key role in ensuring quality buildings with good energy performance. While operating individually within a competitive market, within the EU they have also been represented by many industry associations, and hence have been delivering a number of roles in assisting the implementation and effectiveness of the EPBD, acting both individually and collectively.

Table 3-1 Overview of EU industry and industry association roles

Roles	Individual companies	Collective – industry associations or networks	Comment
Advocacy and stakeholder consultation	✓	✓	At EU and Member State level
Campaigning and awareness	✓	✓	Alliances
Advance preparation and training of customers (Skills)	✓		Skills Technical guidance to specifiers
Compliance tools and resources	✓		
Innovation and product development	✓	✓	Can include not just products and equipment, but also overall packaged technical systems and new business models

Together they have played a number of roles in assisting the adoption, compliance and market impact of the EPBD. As indicated in the Table, these have included: advocacy and campaigning; advance market preparation, upskilling and wider awareness; tools and resources to assist compliance; and ongoing innovation of product and service offerings for the purposes of gaining or maintaining competitive advantage.

3.2 Industry associations

Table 3-2 lists a wide range of industry associations and a selection of their member companies, illustrating the strength of activity of this sector across the EU.

Table 3-2 EU industry associations working towards low energy, low carbon buildings

Association	Activities	Examples of members
EURIMA www.eurima.org	European mineral wool insulation manufacturers association	Knauf, Isover, Paroc, Rockwool, Ursa, etc.
Euro ACE https://euroace.org	European Alliance of Companies for Energy Efficiency in Buildings	Armcell, Daikin, Danfoss, Grundfos, Ingersoll Rand, Johnson Controls, Kingspan, Knauf, Rockwool, Saint Gobain, Signify, United Tehnologies, Ursa, Velux
Glass for Europe https://glassforeurope.com	Represents the building glass value chain across Europe	AGC Glass Europe, Guardian, NSG-Group, Saint-Gobain Glass, Şişecam-Trakya Cam
REHVA www.rehva.eu	Federation of European Heating, Ventilation and Air Conditioning associations	27 national associations, 1500 industrial companies, 120000 engineers and technicians
Eurovent https://eurovent.eu	Industry Association for Indoor Climate (HVAC), Process Cooling and Food Cold Chain Technologies	Over 1.000 manufacturers from over 30 countries, employing around 150.000
EAE www.ea-etics.eu	European Association for External Thermal Insulation Composite Systems (ETICS). Umbrella body of 11 national ETICS associations and 6 EU supplier associations (insulation materials, reinforcements, profiles).	25 members from manufacturers and representative associations
COGEN Europe www.cogeneurope.eu	European Association for the Promotion of Cogeneration	60 members
Lighting Europe	Represents the lighting industry in Europe.	Over 1000 lighting companies employing over 100,000
EREF www.eref-europe.org	Federation of national renewable energy associations from EU Member States	34 member associations representing wind, solar, small hydro, bio-energy, tidal, wave, and geothermal sectors
EHPA www.ehpa.org	European Heat Pump Association.	120 organisations - heat pump and component manufacturers, research institutes, universities, testing labs and energy agencies
Solar Heat Europe www.solarheateurope.eu	Representative body of European solar heating industry	50 members
Solar Power Europe www.solarpowereurope.org	Voice of European solar power industry	Over 200 members from 35 countries

Some of these associations have a role in providing technical support services to their members. However, a common characteristic of all is their role as the voice of the industry, advocating public policy, at EU and Member State level, which favours more ambitious uptake of more energy efficient products in the building sector, including appropriate renewable energy deployment. A common element of this role is monitoring of policy developments and issuing of position papers in support of the outcomes being advocated.

In conjunction with the above direct industry interests, professional bodies such as the Architects Council of Europe, the professional engineering bodies ASHRAE and CIBSE, and the Royal Institution of Chartered Surveyors (RICS), and facilities management organisations and associations, have a voice at EU level in advocating policy actions to improve energy performance as well as providing direct educational services to their members. A further example is the global network of 70 Green Building Councils (www.worldgbc.org), whose membership at national level often includes a strong representation from leading construction product manufacturers, builders and developers. Within Europe there are 23 national Green Building Councils, covering over 4,500 companies.

4 ROLE IN ADVOCACY AND CONSULTATION

The advocacy and representation role, either directly by building industry companies themselves or through their representative bodies, has included the following:

- ▶ Campaigning role, industry advertising, promotional activities and published studies/ position papers to highlight awareness and benefits of more energy efficient products and systems to their potential customers – architectural and engineering specifiers, building contractors, developers, State bodies – and to policy makers.
- ▶ Actively engaging in ongoing dialogue with Member State authorities and with the EU Commission as part of such campaigning.
- ▶ Responding to all opportunities provided by the consultative mechanisms of both EU and Member State authorities in relation to regulatory and other policy proposals.

Such activities can be seen as part of the ‘Leverage’ actions illustrated in Figure 2-1 above. An example of a typical industry association role in contributing to key decision processes at EU level is that of the representative body for the external thermal insulation industry (EAE), which has included:

- ▶ Active involvement in European technical standardisation forums and consultations in different bodies (including standards, certification and accreditation bodies)
- ▶ Networking with EU Commission and other EU institutions
- ▶ Participation in European working groups and public policy consultations; this supports creation of a reliable legal framework
- ▶ Internal working groups preparing common positions and proposals, often as formal written submissions to such consultations
- ▶ Conferences to exchange experience and know-how.

A significant related initiative is the ‘Renovate Europe’ campaign (www.renovate-europe.eu). This has brought together an alliance led by EuroACE with a strong representative voice from manufacturer associations, policy analysts and other advocates. It consists of a political communications campaign with the ambition to reduce the energy demand of the EU building stock by 80% until 2050 compared to 2005 levels through legislation and ambitious renovation programmes. It aims to bring the energy performance of the entire building stock in the EU to a nZEB performance level. Building energy codes requiring NZEB performance levels are an important early step in this process, highlighting new technical solutions for building energy renovation.

5 ROLE IN PREPARING THE MARKET

As skilled members of the supply chain, the role of industry companies and their representative bodies in preliminary preparation of the market and raising of awareness in relation to the requirements of the EPBD has included the following:

- Highlighting the benefits (including non-energy co-benefits) and business opportunities for developers, builders and real estate investors from the delivery of more efficient building energy codes and associated energy performance certification (EPC). Notably, the benefits of code compliant new buildings being of overall higher quality compared with many older buildings, with this comparison being visibly reflected through EPC labels, and hence meriting higher market valuation for rental or selling purposes.
- Representative bodies playing an active role on Standards development committees at EU and Member State level, and/or in their industry consultations. These Standards provided the foundation for the technical calculation methodologies, EPC label design, building envelope and component methodologies in relation to building materials and HVAC and lighting equipment.

Such activities have helped in preparing and motivating their customers to take a positive attitude in responding to the requirements of the EPBD regarding building energy codes and certification. An example of promotional literature produced by the representative body for the EU external thermal insulation industry and highlighting the benefits of EPBD compliance is shown in Figure 5-1.

Figure 5-1 Example of promotional technical literature highlighting EPBD benefits



Across EU Member States, it has been important to sustain a multi-channel campaign of promotion to create and maintain awareness of energy performance and EPC requirements and benefits to stakeholders and stimulate a market appetite for more energy efficient buildings. These activities are closely linked to initiatives outlined in the following section to assist compliance. Therefore within those stakeholders, such a campaign should be accompanied by knowledge sharing and guidance initiatives specifically directed at key actors such as designers and specifiers, builders, materials and equipment technicians, site

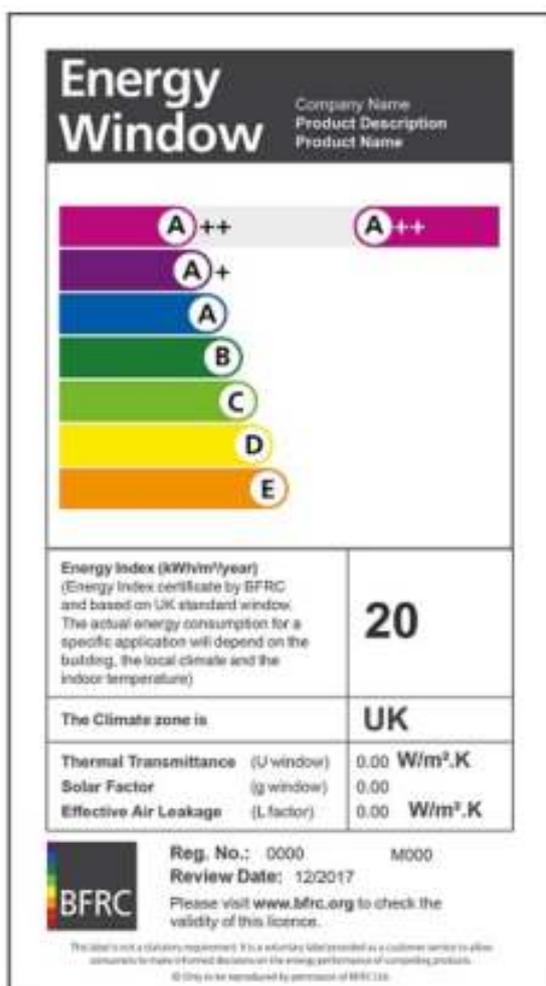
supervisors and building control inspectors. As now indicated, several such initiatives have been driven from within the industry itself and not require resourcing by the authorities.

6 CAPACITY BUILDING ROLE IN COMPLIANCE

The capacity building role of industry companies and their representative bodies in assisting skills development and achievement of compliance in relation to the requirements of the EPBD has included the following:

- ▶ The development and promotion of good practice product technical manuals, guidance manuals with illustrated compliant construction solutions, software tools, incorporating the deployment of their product offerings.
- ▶ This has included live demonstration events on the manufacturer's premises, or on-site, to assist skills development of specifying professionals (architects and engineers) in relation to applying their products and systems within the energy performance calculation methodology.
- ▶ In the case of thermal insulation, this has included 'accepted construction details' to avoid thermal bridging or air leakage. In the case of glazing it has included participation in voluntary product energy efficiency labelling schemes and demonstrating techniques for taping and sealing to avoid uncontrolled air leakage. In the case of high efficiency condensing boilers and renewable energy system installations, it has included product assemblies within demonstration 'mock up' installations.
- ▶ Training facilities such as training and 'knowledge centres' for both professional specifiers and trades – blocklayers, plasterers, glaziers, heating technicians, electrical technicians – have incorporated practical demonstrations of code compliant constructions.

Figure 6-1 Example of a voluntary energy label for a building product (window)



An example of a voluntary standard encouraged by innovative industry players, with independent certification, is the UK initiative by the ‘British Fenestration Rating Council (BFRC for glazing, www.bfrc.org) which provides an energy rating based on a combination of tests of heat transmission, solar gain and air leakage characteristics of a window. A label for such a rating is shown in Figure 6-1.

Across EU Member States, a number of initiatives involving collaborative alliances between the authorities and the industry are helping to raise standards and improve compliance. The EU BUILD UP Skills initiative (<http://www.buildup.eu/en/skills>) has been supporting the provision of training to building craftsmen and other on-site construction workers and systems installers to ensure high energy performance quality construction works. In the UK, the Zero Carbon Hub (<http://www.zerocarbonhub.org/>) for housing has produced the “Builders Book” which illustrates detailed technical and practical solutions to help overcome the construction challenges that impact significantly on building energy performance. In Finland, cooperation within the building sub-sectors and the active involvement of professionals in the field has ensured good acceptance and compliance with the legislation and building codes.

7 ROLE IN INNOVATION AND COMPETITIVENESS

7.1 New concepts, tools, skills and innovation

In the process of establishing the mandatory performance standards and EPCs within Member States, the EPBD has generated a much stronger focus on the potential for improving the energy performance of buildings. In several countries this has been triggering interest among progressive investors in the construction and property sector in going beyond the minimum standards or seeking to undertake energy-saving refurbishment of the existing building stock. This has been happening in both the commercial and apartment building sectors.

The Directive has also promoted new tools and concepts to drive forward improvements in the energy performance of the building stock. Examples highlighted in previous Position Papers have included a common methodology to calculate the energy performance of buildings, common CEN standards, EPCs, NZEBs and cost-optimality. Such tools and concepts are accompanied by the stimulation of new or improved professional, trade and industry skills in these fields. This includes new types of product solutions, such as external insulation cladding of existing buildings, developed by the product manufacturing sector.

The EPBD has been particularly helpful in giving clarity about the level of future energy requirements in regulatory building codes, notably in establishing a clear policy pathway for adopting NZEBs. The improvement in standards and associated tools as a result of the EPBD's mandatory requirements has been a strong driver in many Member States for innovation as well as the learning curve in the construction sector, which has traditionally been slow to evolve. Such innovation, normally led by product manufacturers, can help to improve competitiveness - not only through energy efficiency and quality of buildings but can also help to reduce costs.

Probably the most active innovation sector within the building industry has been in the field of smart control systems, based on advances in product miniaturisation, software, the internet and cloud, and connectivity protocols which are impacting practices, operational management and business models in all sectors, not only building industry practices. The concept of the smart electricity grid, with flexibility mechanisms to facilitate the integration of variable renewable energy sources, and the concept of the connected smart city are major research and development and business advancement themes across the EU as a whole. It is a reflection of this agenda that the newest update to the EPBD, adopted in 2018, includes specific new requirement elements in relation to 'smart readiness' of buildings to enable both import and export of power to the grid and, for example, also the facilitation of electric vehicle charging points in car parks of commercial buildings.

Through such innovations also, developers and manufacturers of building energy management systems (BEMS), originally applicable only to large commercial and public buildings, have succeeded in continuous technical improvements. As a result, such systems have now become practical, accessible and affordable for application in smaller buildings and for providing an efficient automated means of monitoring, tracking and controlling energy

usage. This is set to continue, and will become increasingly important in controlling and verifying the energy performance of NZEBs and other low energy buildings.

7.2 Company innovation and competitiveness

Many individual product manufacturing companies and energy services companies across the EU have engaged in a number of initiatives which have assisted a pathway to higher energy performance standards in buildings, and developed new solutions with quality, performance and cost advantages. Such initiatives have included:

- ▶ Participation in research and product/ service innovation projects and networks at national and EU level – for both newbuild and renovation.
- ▶ Similarly, participation in energy efficiency demonstration projects highlighting cost-effective methods of compliance, and helping to gain market confidence in superior standards.
- ▶ The creation of new service specialisations – energy performance certifiers, building energy performance modelling, thermal bridge modelling and air leakage testing.
- ▶ Early certification of innovative products and services. This has included certification and energy labelling to highlight compliance with the EU EcoDesign and Energy Labelling Directives, which apply to products such as: oil boilers, gas boilers, solid fuel stoves, water heaters, air conditioners, heat pumps, LED lighting.
- ▶ A continuous improvement culture within industry in upgrading product performance and overall quality.

Figure 7-1 shows a selection of examples from a leading glass manufacturing company of innovative products developed in recent years which can contribute to superior specifications for energy performance of buildings.

Figure 7-1 Example of innovative energy performing products developed by a company



Overall, in its own competitive interest, the construction supply sector has thus played, and continues to play, an active role in the drive to upgrade energy and overall quality performance standards within the building industry ecosystem.

The above examples reflect the fact that energy regulation, standards, labelling and promotional policies have a significant impact in driving innovation.

7.3 EU level RD&D projects

The EU Commission operates a competitive research, development, demonstration (RD&D) programme, in which leading manufacturers of construction products and equipment have participated and collaborated for the purposes of developing more energy efficient products and service solutions. This has contributed to the capacity of the market to respond actively to meet or surpass the requirements of the EPBD and other policies. The Commission has also operated a support programme entitled ‘Intelligent Energy for Europe’ (IEE) to tackle barriers and assist market deployment of energy efficiency. These programmes supported projects in the fields of improving technologies, tools, skills development, market analysis, databases, market awareness initiatives and financial initiatives, and generated useful insights, findings and case examples. The full range of project supports has been integrated in the form of the EU Horizon 2020 programme (<https://ec.europa.eu/programmes/horizon2020/en/area/energy>)

The EU Commission funded the development and ongoing enhancement of a wide ranging website called ‘BuildUp’ (www.buildup.eu) covering all aspects of energy efficiency in buildings from policy level (e.g. national reports on EPBD implementation) to practical case studies on various technology and market issues. In relation to RD&D projects, Figure 7-1 lists a small selection of projects supported by EU Commission programmes. A full range of projects supported by the Horizon 2020 programme and its predecessors can be accessed on a database called ‘Cordis’ (<https://cordis.europa.eu/projects/en>).

Table 7-1 Examples of low energy buildings research projects supported by EU

AIDA:	Support to NZEBs in municipalities
ENTRANZE:	Policy support to EPBD
MaTrID:	Integrated Energy Design for NZEBs
mountEE:	Support to NZEBs in mountain communities
NZB2021:	Open door campaigns
PassREG:	NZEBs in regional policy
POWER HOUSE NZC:	Support to NZEBs in social housing
Sustainco:	Support to NZEBs in rural communities
COHERENO:	One stop solutions
EuroPHit:	Passive House standards
EPISCOPE:	Market development
LEAF:	NZEB renovation in multi-ownership buildings
NEZEH:	NZEB refurbishment in hotels
ZEMEDS:	NZEB refurbishment in schools
RenoValue:	Strengthening the role of valuation professionals in market transition

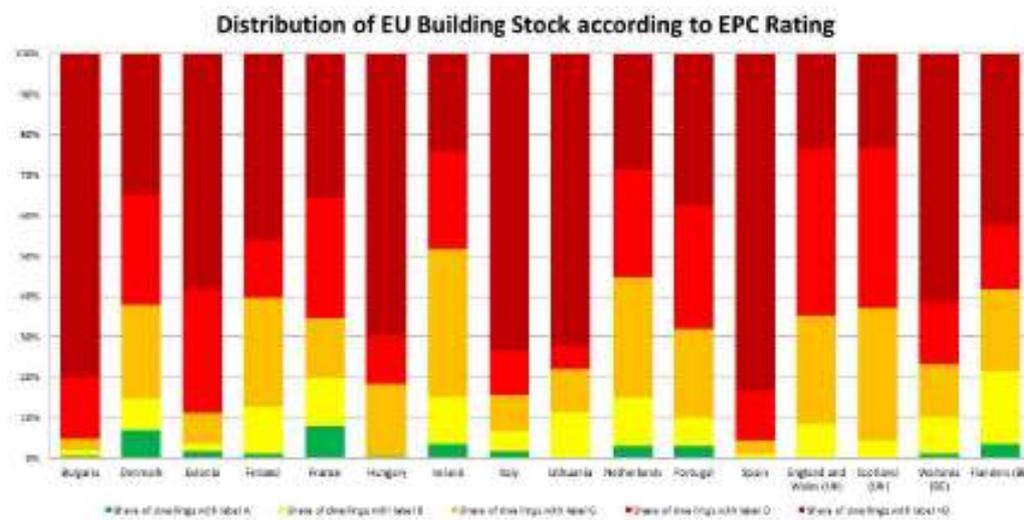
Many EU Member States also commissioned national studies and pilot projects for a similar purpose, aimed at informing the design of the EPBD implementation systems and their effectiveness.

8 INDICATIONS OF IMPACT

The foregoing roles of building energy product and service providers – in Advocacy and Promotion, Market Preparation, Assisting Compliance and Innovation – collectively contribute to the impact of the EPBD. Illustrations of the emergence of such impact can be seen in the following diagrams.

Figure 8-1 shows an estimated distribution of the EU building stock according the range of EPC ratings in different Member States. This shows the small but growing emergence of low energy buildings (the green coloured fraction) across almost all EU Member States.

Figure 8-1 Profile of EPC ratings across EU building stock



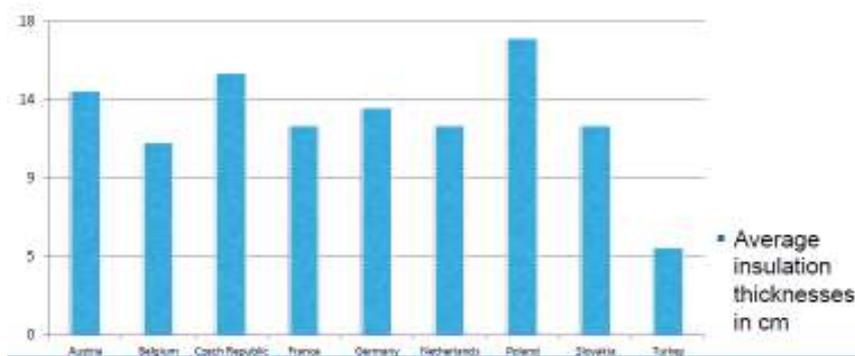
At a component level, Figure 8-2 illustrates a growing market share for triple glazed high energy performance windows across most EU Member States, particularly in Northern Europe.

Figure 8-2 Distribution of market shares of triple glazed window sales across EU



Similarly, Figure 8-3 shows a consistency in insulation levels for the building envelope, corresponding to thermal transmittance (U-value) levels of less than $0.2 \text{ W/m}^2\text{K}$.

Figure 8-3 Average wall and roof insulation thickness across some EU countries



In countries such as Denmark which have adopted pro-active and ambitious national building energy efficiency policies and roadmaps, this has assisted their building products and energy services sectors in gaining innovative and competitive advantage in terms of leading-edge solutions for low energy buildings, both newbuild and renovation. This is particularly clear with regard to the NZEB roadmapping, but equally applies to other aspects of the EPBD, which is seen as an evolving and ever strengthening policy instrument on the journey to a society that is served by ever more efficient and cleaner sources of energy.

9 CONCLUSION

Across EU Member States in general, the overall supply chain of the building industry – and particularly manufacturers and suppliers of building products, equipment and services - have been actively supportive of EPBD implementation. This was a natural expectation, given that the Directive, and the consequential building energy codes required to be adopted by Member State authorities, required a greater use of higher specification products, many of which had been readily available for several years (for example, triple glazing, solar control products, condensing boilers, smarter controls, LED lighting, heat pumps and other renewables).

Suppliers of construction materials, energy using equipment and energy efficiency services play a key role in ensuring quality buildings with good energy performance. While operating individually within a competitive market, they have also been represented by many industry associations. Together they have played a number of roles in assisting the adoption, compliance and market impact of the EPBD. These have included advocacy at the levels of national and EU policy making, publicising the benefits of energy efficient buildings, promoting energy performance certificates (EPCs), providing practical technical help in preparing the market for improved energy efficiency standards required by the EPBD, practical tools and skills development to assist compliance with the EPBD requirements, continuous product research, innovation and improvement to gain competitive advantage, through internal RD&D and through collaborative participation in national and EU RD&D support programmes.

At both national and EU level a number of energy efficient product and equipment manufacturing associations have participated in such RD&D programmes, developed new product solutions (in which embedded ICT technologies are playing an increasingly influential role), taken initiatives on training the workforce and indeed often have campaigned for even more ambitious energy performance requirements than have been adopted by Member States under the Directive.

Within the EU, there has been a history of building energy codes embedded in regulation and for developers this has tended to result in increased costs initially. However, as such codes create a level playing field in the market they do not distort competition, and the societal rationale is clear in the same way as applies to health and safety regulations. Indeed, history has shown that strengthened building energy codes drive industry adaptiveness and innovation, from the level of the product manufacturer/ supplier (through R&D) to developer/ builder and, and for countries such as Denmark it has gained several of their companies competitive advantage in international markets.

Visible indications of the collective contribution of such initiatives in assisting higher specifications and performance are now becoming evident, particularly in the newer cohorts of the building stock in Europe.

10 WEB RESOURCES

In addition to the various websites referenced in the foregoing sections of this paper, the following is a small selection of portal websites from which useful information can be obtained on EPBD implementation.

Website title and address	Description
Build Up www.buildup.eu	EU portal for energy efficiency in buildings. Extensive library of documents, webinars etc. relating to EPBD and related implementation
Building Performance Institute Europe (BPIE) www.bpie.eu	A European ‘think tank’ providing policy research and advice on energy in buildings, with publications and monitoring of progress with EPBD implementation
EU Commission – energy efficiency in buildings https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings	Covering EPBD and allied Directives, independent reports, national reports, events
EPBD Concerted Action www.epbd-ca.eu	Public website for collaborative forum of Member States to assist EPBD implementation