Regulating sustainable construction in Europe: An inquiry into the European Commission's harmonization attempts

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Jeroen van der Heijden, Australian National University & University of Amsterdam
Ellen van Bueren, Delft University of Technology

Corresponding author: Jeroen van der Heijden: j.j.vanderheijden@anu.edu.au

Abstract

The purpose of this paper is (i) to gain insight into how the European member states have addressed the concept of sustainability in their building regulatory frameworks; and (ii) to gain insight in the effects of harmonization attempts of these frameworks by the European Commission (EC).

Data on the member states' building regulatory regimes was gathered using a survey questionnaire. The survey questionnaire addressed over sixty different aspects of sustainable construction that may, in various ways, be regulated by the member states. The data obtained shows mixed results. Some aspects of sustainable construction show far reaching homogeneity, whilst others do not. It appears that current EC directives have a positive effect on homogeneity of sustainable construction regulation throughout Europe. However, this does not provide a firm base to advise more directives as these often appear a too resource intensive tool to achieve sustainable construction in a timely fashion. Additional and complementary approaches to such directives are proposed.

The paper presents an overview of how European member states have addressed various aspects of sustainable construction in their construction regulatory frameworks. This provides valuable insights for further studies on regulatory change, regulatory convergence and divergence, and policy outcomes related to sustainable construction in the European Union. Also, the study presents a number of approaches to achieve homogeneity that may complement earlier approaches taken by the EC.

Key words: sustainable construction, policy making, regulation and enforcement

1 Introduction

The construction industry and the buildings it produces have a major negative impact on our ecological environment. In the European Union (EU), buildings account for roughly 40% of all energy consumption and about 35% of all greenhouse gasses (EC, 2007). Battling climate change and having the targets of the Kyoto Protocol in mind, the European Commission (EC) has introduced and implemented a range of policies and programs to improve the environmental performance of its construction sector and its built environment (for an overview, see WGBC, 2011). The most far reaching attempts to do so are a range of directives aimed at harmonising the construction regulatory frameworks in EU member states. Such harmonisation serves a dual goal: on the one hand it decreases current barriers to free trade of goods and services among EU member states (an economic goal); on the other hand it provides the EC the opportunity to address societal risks such as climate change on a European level (a social goal).

The best-known EC attempt to harmonise its member states' sustainable construction regulatory frameworks is the *Energy Performance of Buildings Directive* (EPBD). This Directive was issued in 2002 and recast in 2010. The original Directive requires, among others, that member states set minimum energy performance requirements for residential and commercial buildings – that is, for new construction work and for major renovations. Further, the 2010 recast requires, among others, that member states ensure 'nearly zero energy buildings' by the end of 2020; provide fiscal and financial incentives to encourage sustainable construction that complies with higher energy levels than regulated; and, require that energy performance certificates must be provided in all buildings and be displayed in public (EC, 2010a). Other illustrative directives are the *Energy End-use Efficiency and Energy Services Directive*, which requires member states to draw up national action plans to achieve 1% annual energy savings over nine years starting in 2008 (EC, 2006), and the *Waste Framework Directive*, which obliges member states to meet a 70% recycling target for construction and demolition waste by 2020 (EC, 2008). It is through the transposition of these directives in the member states' national construction regulatory systems that these directives come into effect.

This paper addresses the degree of homogeneity in the sustainable construction regulatory frameworks of EU member states. It asks to what extent a range of topics related to sustainable construction are addressed in these frameworks of member states. Further, it queries how the EC may achieve further homogeneity in these frameworks and increased attention for sustainable construction among member states. The paper is based on an in-depth study of the sustainable construction regulations of EU member states carried out in 2010.

The paper is structured as follows. We start with presenting the research approach and definitions used, followed by a presentation of the research findings.

Finally, we discuss the potential causes of these findings, and present alternative strategies to harmonisation that may improve homogeneity among European sustainable construction regulation.

2 Research approach and definitions

The research presented is based on an EC-commissioned study (project number: ENTR/09/006). This study aimed to screen national construction regulations in the field of sustainable construction in order to provide a broad view of the current situation of regulating sustainable construction in Europe and to provide recommendations to the EC on how to improve sustainable construction throughout Europe (cf. Vermande and Van der Heijden, 2011). The study was undertaken between January and November 2010.

2.1 Concepts and definitions: Regulation, construction regulations, sustainable construction

When comparing policy instruments, such as construction regulations, across a range of EU member states one immediately finds that different terms and concepts are used in the different countries. In some countries the term ‘construction regulations’ refers to the technical regulations that apply to construction works or construction products and that are laid down in building codes. In other countries it has a broader meaning, also including local government planning and zoning regulations, environmental regulations, and regulations for safe working conditions (CEBC, 2006; Meijer and Visscher, 2006). The term ‘construction regulation’ also has different meanings for different people – professionals in the construction industry, academics and policy makers alike (Van der Heijden and De Jong, 2009).

Furthermore, in practice, much construction is not ‘regulated’ through legally binding provisions: many provisional requirements, quasi-mandatory regulations, and informal advisory documentation on accepted solutions exist under the formal regulations. As such, a strictly legalistic view on the topic would only provide partial insight into the current situation of the regulation of sustainable construction in EU member states.

To overcome potential issues of a too narrow definition, it was decided to use a broad definition for the term ‘regulation’ (cf. Scott, 2001). Within this study, regulation is understood to include (i) central or state/regional laws, codes, decrees, ordinances; (ii) requirements, either mandatory or advisory, imposed by insurance regimes, professional registration bodies, etc.; and, (iii) ‘quasi-mandatory’ standards, codes, approved documents and guidance and other documents which have a ‘deemed to satisfy’ status under the legal framework. Following on from this definition, construction

regulations were understood to include all those regulations (laws, ordinances, decrees, standards, codes, etc.) imposing mandatory or semi-mandatory requirements or provisions on the planning, the design, the execution, the maintenance and the use of construction works.

2.2 Defining sustainable construction

The study only aimed to cover a subset of those construction regulations, particularly those that address *sustainable* construction. But what is sustainable construction? As with the term regulation, sustainable construction has different meanings for different people (for an extensive review of possible definitions, see Wheeler and Beatley, 2009). It would be beyond the scope of this paper to provide an in-depth discussion of all definitions and approaches to 'capture' the term sustainable construction. What is relevant to note is that the study's main conceptualisation relates 'sustainable construction' to the notion of the 'triple bottom line' (Dyllick and Hockerts, 2002; Elkington, 1998), with a focus on the three 'traditional pillars' of sustainable construction: ecological quality, economic quality, and social quality (e.g. Wheeler and Beatley, 2009). Using academic, grey and professional literature, these terms were made operational as follows:

Defining ecological quality

Ecological quality focuses on: (i) *energy*, which addresses topics such as energy performance, the use of renewable energy sources, the implementation of energy efficiency techniques (e.g., low-energy light bulbs), thermal insulation, and the reduction of air-permeability; (ii) *water*, which deals with topics such as the implementation of water conservation techniques, the implementation of water efficiency techniques (e.g., low-water flush toilets), and water metering; (iii) *waste and pollution*, which attends to topics such as the minimisation of waste during construction, the registration of waste production (e.g., in site waste management plans), the separation/recycling of waste, and the limitation of the emission of CO2, ozone depleting gases, and green-house gases; (iv) *protection of biodiversity and natural environment*, which takes up topics such as the conservation of flora, wildlife and natural habitats on site; and, (v) *minimization of the use of resources*, which tackles topics such as the use of recyclable and renewable materials, and the refurbishing and redeveloping of existing buildings instead of demolition and new development.

Defining social quality

Social quality centres on: (i) *adherence to ethical values during development*, which addresses topics such as ethical trading throughout the supply chain and the provision of a safe and healthy work environment; (ii) *provision of adequate local services and facilities*, which deals with topics such as the provision of information to local community during construction activities, the provision of space for training workmen, the provision

of local schools, health facilities, and social facilities; (iii) *provision of housing that meets needs*, which attends to topics such as the development of a mix of tenure types, the provision of affordable housing, and the provision of housing for the elderly; (iv) *integration of development in local context*, which takes up topics such as the rejection or discouragement of gated development, the provision of transport links to local context, and the provision of links to adjacent neighbourhoods; (v) *conservation of local heritage*, which addresses topics such as the re-use of locally valued buildings; (vi) *access to green space*, which tackles topics such as the provision of green space within a certain distance of people's dwellings; and, (vii) *health, comfort and user satisfaction*, which addresses topics such as indoor air-quality, thermal comfort in winter, thermal comfort in summer, acoustic comfort, indoor daylight entry, and the capability of conversion by a construction/building user.

Defining economic quality

Economic quality focuses on: (i) *enable businesses to be efficient and competitive*, which deals with issues such as the reduction of energy consumption, the reduction of waste production, the reduction of water use during construction and the construction of adaptable buildings; (ii) *support local economic diversity*, which attends to issues such as the density of the development (e.g., minimal/maximal number of dwellings per area), mixed land use and the use of local material/goods in construction; (iii) *provide employment opportunities*, which takes up topics such as the use of local labour in construction; (iv) *technical execution and quality of the construction process*, which tackles topics such as technical execution (building the construction); and limitation of construction time (planning).

These definitions and terminology were provided to all participants in the study.

2.3 Research approach

Different sets of data were collected for this study. First, an extensive review of academic, grey and professional literature was carried out in order to arrive at working definitions (e.g., sustainable construction, regulation) and to operationalise the topic of inquiry (i.e. the regulation of sustainable construction in EU member states). Based on the literature review two relevant choices were made: to use a broad definition of the term 'regulation'; and employ a detailed operationalisation of the term 'sustainable construction' based on the criteria of ecological, social, and economic quality discussed above.[1]

Second, a series of semi-structured interviews (n=18) was carried out with key stakeholders, who were representatives of both industries and governments, to identify their perceptions of key issues, possible barriers to sustainable construction, and solicit

1 A list of sourced literature is available upon request with the authors.

comments on the scope and objectives of the study. These interviews were carried out in February and March 2010.

Third, a survey questionnaire was designed and sent to a range (n=330) of government, industry and NGO representatives in the 27 EU member states, which generated a sufficient number of responses (n = 62, or a response rate of 19%).[2] The survey addressed the regulation of sustainable construction in the member states. Respondents were asked to identify whether the topics discussed above are currently regulated, or not. If a topic is regulated, at what level of government this is done (national/regional/local); whether these regulations apply to existing buildings and/or renovations; how the regulations are formulated (performance based/prescriptive); and how the regulations were implemented (top-down government initiative/bottom-up industry initiative/collaborative government–industry initiative). Furthermore, questions were posed in regards to the enforcement of these regulations, and voluntary and complementary initiatives in addition to the member states' formal regulatory systems. The survey questionnaire was operational as an internet tool between April and October 2010.

Finally, three group discussions with industry representatives (n = 8), government representatives (n = 14) and experts on sustainable construction (n = 12) were held in Brussels. These group discussions aimed to present, discuss and validate initial findings from this study. The group discussions were held in October 2010. Further validation of findings was carried out by contrasting these with existing literature on the topic.

The main source of original data presented in the following section comes from the survey questionnaire, which was completed by representatives from 23 EU member states. Questionnaires were generally filled out and returned by at least two respondents. This provided an opportunity to cross-check the answers provided. Where different questionnaires yielded conflicting answers in regard of a single country, respondents were contacted and such discrepancies were discussed and resolved. Furthermore, the presentation and discussion of the initial findings during the group discussions provided a valuable opportunity to check the quality and consistency of the data. No major discrepancies were observed. Yet, valuable additions to the initial findings were provided by those attending these group discussions.

The chosen research approach provided for much interaction with government and industry stakeholders, as well as experts on sustainable construction throughout the EU (total: n = 114).

In total, survey data was collected from 23 out of 27 EU member states, though data from two of these 23 countries was too limited to include these countries in the

2. This may be considered a low response rate. However, we targeted a wide range of people directly involved with the construction regulatory frameworks within each country. In many countries we targeted different individuals within a single organisation. We learned that often only one individual replied to represent the view of her/his organisation.

analysis. The following section presents and discusses findings from the remaining 21 EU member states, based on the survey questionnaire and interviews. Tables 1-3 present the research findings per quality criteria, topic and countries analysed. It should be noted that any missing data is addressed as an instance of non-regulation. The term 'regulatory attention' is introduced to indicate instances of regulation per (sub-)topic. That is, we use this term when a (sub-)topic is regulated in line with our broad definition of regulation.

A basic, but practical approach was chosen to analyse the data for regulatory homogeneity. First, the regulatory homogeneity for all sub-topics is calculated by a simple count. For instance, when a sub-topic is regulated in all member states in the study, this is addressed as full (100%) regulatory homogeneity; when a sub-topic is regulated in none of the member states this is addressed as full non-regulatory homogeneity – in both instances we see full homogeneity, yet the outcome is different. Subsequently, when for instance a sub-topic is regulated in 4 out of 6 member states this is addressed as 67% regulatory homogeneity. Further, a pragmatic approach was chosen to define 'far-reaching' regulatory homogeneity. Within the study this was considered to apply when 75% or more of the member states in the study addressed an individual sub-topic.[3]

3 Findings: The current situation in the regulation of sustainable construction in Europe

3.1 Ecological quality

Table 1 shows that all member states have implemented regulations that address the energy performance of buildings. A strong EU directive (*Energy Performance Building Directive*, EPDB, see EC, 2010a) may be considered the driver for this far-reaching degree of homogeneity – i.e., a process of harmonisation. The use of renewable energy sources and the implementation of energy efficiency techniques have less attention across the range of member states in Table 1. The interviews indicated that these sub-topics are considered to be taken up by the market under the influence of consumer demands. Yet, no evidence of these claims could be provided. Subsequently, requirements for thermal insulation are set throughout the range of member states. It may be concluded that this topic relates to the EPBD and may be considered a traditional topic of construction regulations (Meijer and Visscher, 2006; Pedro et al., 2010). Finally, the reduction of air-permeability is addressed in a number of member

3. This paper does by no means aim to introduce or develop a theory on regulatory homogeneity, we simply made this choice and used the percentages as presented for pragmatic reasons.

states. Here interviewees related this particular sub-topic to the topic ‘health, comfort and user satisfaction’ as addressed under social quality.

The topic ‘water’ receives considerably less attention from the member states in the analysis than the topic ‘energy’. The only sub-topic that has considerable regulatory attention is ‘water metering’. Interviewees were unable to explain the limited attention to this particular topic. When asked whether, for instance, the current EU *Water Framework Directive* (EC, 2000) may have a future harmonising effect, interviewees mentioned the wide range of EU directives in different policy areas and the difficulties of streamlining these on a national level.

The topic ‘waste’ has regulatory attention in most of the countries analysed. Here a driver for existing regulation may be found in the EU *Waste Framework Directive* (EC, 2008). Yet, as with the *Water Framework Directive*, this directive does not directly address the construction sector, which may be an explanation why we do not see full homogeneity on this topic.

The topic ‘pollution’ receives considerable attention in all EU member states. An explanation may be found in the fact that this particular topic is one of the first major issues in the international climate change debate (e.g. Giddens, 2009). International attention and societal pressure may have had a converging effect on national policies (cf. Andresen and Agrawala, 2002).

The protection of biodiversity has the most regulatory attention of all topics addressed. This topic appears high on the EC’s policy agenda (see for instance the Habitat and Birds Directives: EC, 1992, 2009), which may have had a converging effect across the EU member states. Interview data does not provide alternative explanations.

Contrary to the above topics, minimisation of the use of resources has limited regulatory attention throughout the range of member states in the analysis. Interviewees noted that this particular topic is considered a market issue: the more efficient building materials and buildings are produced, the more net gains their producers receive. This was considered a driver for efficiency in itself.

TABLE 1 ABOUT HERE

3.2. Social quality

Table 2 reveals that ethical trading throughout the supply chain has limited regulatory attention. Interviewees considered this particular sub-topic to be an aspect of private agreements between suppliers and end users. Regulations for a safe and healthy work environment apply in most member states in the analysis. Again this is a topic that appears high on the EC’s policy agenda (EC, 2010b), but does not have a specific focus on the construction sector.

At a local level, regulations often apply to the provision of information to local communities during construction activities, and to the construction of schools, health

and social facilities. Interviewees considered both information provision and the setting of requirements to the construction of schools, health and social facilities to be traditional topics for local construction regulations. Then, the provision of space for the training of workmen receives little regulatory attention across the member states analysed. In contrast, the provision of housing that meets needs is addressed in most member states.

Respondents and interviewees considered topics such as the integration of development in local contexts, the conservation of local heritage and access to green space again to be topics of local construction regulations. The high degree of homogeneity for a number of sub-topics (e.g., re-use of local buildings, green space within a certain distance) is not explained by any harmonising EC efforts, as the EC does not traditionally address such local planning-related issues (cf. Jordan, 2003). Interviewees were not able to provide explanations for this observed homogeneity.

The various sub-topics under health, comfort and user satisfaction show relatively high scores on regulatory attention throughout the range of member states in the analysis. Again interviewees looked upon this topic as a traditional aspect of construction regulations (see also CEBC, 2006; Meijer and Visscher, 2006; Pedro et al., 2010).

TABLE 2 ABOUT HERE

3.3. Economic quality

Table 3 indicates that in broad terms the different sub-topics related to economic quality receive limited regulatory attention throughout the range of member states. Interviewees informed us that these sub-topics are by and large considered to be issues that should be taken up in and by the construction sector itself – see also the earlier explanation under ‘minimisation of resources’.

The lack of regulatory attention for topics such as the minimisation of energy, water and waste during construction is notable. Particularly, as the constructions themselves have to meet certain criteria – see the results under ‘ecological quality’.

Major exemptions to this general finding are local issues, such as the density of development and mixed land use. Again interviewees explained that these topics are traditionally taken up by local government; and that traditionally the EC does not address such local issues through EU directives (Jordan, 2003).

TABLE 3 ABOUT HERE

4 Discussion and conclusion: EC directives and alternative strategies

This paper asked the question to what extent the sustainable construction regulations of EU member states are homogeneous across a range of relevant topics and whether earlier harmonisation attempts of the EC have been successful.

The analysis of the data accumulated for this study does not provide a straightforward answer to either of these questions. A number of topics may indeed be considered to reveal far-reaching homogeneity, which we defined earlier as 75% or more of the countries including such topics in their sustainable regulatory systems. However, Table 4 reveals that only 10 out of the 20 ecological quality topics show such far-reaching homogeneity; 8 out of the 19 social quality topics; and 1 out of the 12 economical quality topics.

TABLE 4 ABOUT HERE

4.1 The effects of harmonisation

Most of the topics that do show far-reaching homogeneity are addressed in EU directives – either directly by directives that regulate the construction industry (e.g., EPBD), or indirectly by directives that regulate related industries (e.g., the *Waste Framework Directive*, *Natura 2000* – the Directive on the conservation of natural habitats and of wild fauna and flora). Interviewee accounts discuss the 'spill-over' effect of such directives on the regulation of sustainable construction. As such it may be concluded that harmonisation through EU directives is a successful approach. Even more, currently only the EPBD requires member states to transpose regulatory requirements into their national construction regulatory frameworks. The relevant topic, 'energy performance', is taken up by regulation in all countries in our study. The other directives have longer time horizons for transposition (WGBC, 2011).

But harmonisation through directives cannot fully explain the homogeneity in regulatory attention among the member states in the study. Instances of high regulatory homogeneity without EC harmonisation efforts (e.g., the topic 'health, comfort and user satisfaction') may simply be a result of certain topics being traditional topics of construction regulation (CEBC, 2006; Meijer & Visscher, 2006; Pedro et al., 2010). Over the years these topics may have moved from being considered as 'normal' aspects of construction regulations to being specific aspects of sustainable construction. Also, the introduction of Eurocodes for the construction industry (a set of harmonized technical laws for the structural design of construction works developed by the European Committee for Standardisation) and with it the introduction of a singular 'language' among the member states was considered helpful by the participants of the study – i.e. the Eurocodes provide definitions, areas of attention, assessment criteria, etc.

Further, the mere fact of being part of the European Union is often found to have a homogenising effect on the member states (cf. Liefferink and Jordan, 2005) – i.e. 'Europeanisation'. This assumes that when representatives of member states meet

each other they share experiences, knowledge and information. As a result they may learn from each other, mimic each other's policies, or implement best practices from other countries in their own settings (e.g. Holzinger, Knill, and Sommerer, 2008). The participants of the study considered the various platforms supported by the EC a valuable approach to ensure more homogeneity in regulatory attention – e.g. the CEN 350 Working Group that develops standards for environmental assessment.

However, this all should not cloud the findings of the study: most of the topics addressed do *not* show far-reaching regulatory homogeneity among the member states. Further, a wide range of topics addressed are hardly taken up in any of the member states. In short, most attention is paid to energy efficiency and waste reduction. More holistic approaches to sustainable construction are often absent in the regulations of the member states. With the goals of the EC's environmental and climate change policy in mind (WGBC, 2011), this calls for action. In that case the relevant question is: what EC action is most effective in (i) harmonising the member states' sustainable construction regulatory systems, *and* (ii) ensuring a move beyond the traditional topics of sustainable construction?

4.2 How the EC may improve sustainable construction throughout Europe *in a timely fashion*

Although harmonisation through directives appears a successful approach in achieving homogeneity, participants of the study questioned whether further harmonisation efforts through EU directives are needed and wanted. Given the many member states and various interest groups involved in the drafting of such directives it goes without saying that finding consensus on particular topics and finding the right terminology is not an easy task: it may take years to decennia to draft and implement an EU directive and for outcomes to materialise. The same holds true for potential spill-over effects on the regulation of sustainable construction from non-construction related EU directives. It remains a question whether there is sufficient time to wait for such long-term outcomes. As indicated by our participants, quicker results may be expected from:

1. Taking the *lead* and setting *examples* through demonstration projects. The EC could use its own construction projects or its own buildings to implement and test new construction methods and processes (cf. Hong and Laurenzi, 2007). This may result in valuable lessons and experiences with alternative approaches to sustainable construction, which can then be widely communicated. Alternatively, the EC may support the governments of EU member states in taking a leadership role in this respect.
2. The introduction of *financial incentives*. Economic incentives may be investment subsidies or low-interest loans for projects that move beyond current sustainable construction regulation requirements. Fiscal incentives may be tax reduction, tax credits or tax reductions. Fiscal incentives most likely have to be implemented

through national governments, but the EC may financially support these in doing so. Alternatively, the EC may introduce a range of financial prizes to award outstanding projects and practices. By actively disseminating the 'winners', these may set an example or benchmark for others to work towards (cf. Braithwaite et al., 2007).

3. Stimulating and supporting policy *learning* among member states. Here the EC may aim to set up new or support existing networks of member states, regions and municipalities, which aim to develop and share knowledge on existing and new policy practices. Such learning may ultimately result in evidence-based policy making (Rose, 2001). Here leading countries or regions could share experiences on policy practices with lagging countries or regions. Cross-country or cross-region learning may help such lagging countries or regions to gain an understanding of how to improve their construction regulatory systems as to improve sustainable construction.
4. Raising public *awareness*. Where the above strategies may be considered top-down approaches the EC may as well aim to create bottom-up approaches. Directly addressing the public at large through information campaigns may be a fruitful approach. On the one hand information campaigns may indirectly affect the construction industry when consumer preferences are changed. On the other hand it may directly affect the use of the current built environment when owners and users of buildings become more aware of their environmental impact. After all, regulating sustainable construction is of little avail when buildings are used in an unsustainable manner (cf. Evans et al., 2005).
5. A *lower* level of governance. The EC often has a nation state-dominated perspective (Jordan, 2003), but for the field of sustainable construction it may be a more viable strategy to shift the perspective to local government, industry players and end-users (e.g., building owners, building users). This study revealed that currently many initiatives in the field of sustainable construction are developed by municipalities, industry players and end-users. Such practices are often voluntary and move beyond mere bottom-line compliance with formal regulations on sustainable construction (for examples see Wheeler and Beatley, 2009; Yudelson, 2009). A better understanding of how these initiatives work and under what circumstances they have an effect, may provide valuable lessons to policy makers and practitioners throughout Europe. In this case the EC may work towards a platform of collecting and disseminating such experiences.
6. Addressing the *existing building stock*. Current strategies all have a strong focus on new and future construction. Yet, the existing built environment plays a significant part in energy use and greenhouse gas emissions (EC, 2007). All of the above strategies may very well be applied to improving the existing built environment. However, one of the major issues in addressing existing construction works are existing property rights – building owners cannot, or can

hardly be forced to make changes to their buildings. Here the EC could support national and local governments by developing policies that address this particular issue.

That all having been said, a first question should of course be whether sustainable construction is really served by higher levels of regulatory homogeneity. Time and again research points out that achieving a sustainable built environment largely is a local matter, affected by local climate, culture, institutions, and so on. Far reaching regulatory homogeneity may smoothen certain paths towards higher levels of sustainability in Europe's built environment, but it will surely raise some barriers as well.

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Table 1: Regulatory attention for ecological quality

	BE	BG	CY	CZ	DE	DK	EE	ES	FR	HU	IE	IT	LU	MT	NL	PL	RO	SE	SK	SL	UK	[H]
Energy performance	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	100 %
Renewable energy sources	x	x	x	-	x	-	x	x	-	-	x	x	-	-	-	x	-	-	-	x	x	50%
Energy efficiency techniques	x	x	-	-	x	x	-	x	-	?	x	-	x	x	-	x	x	-	-	x	x	53%
Thermal insulation	x	x	x	x	x	x	-	x	x	-	x	x	x	x	x	x	x	x	x	x	x	88%
Reduce air permeability	-	?	-	x	x	x	?	x	-	-	x	x	x	x	x	x	x	x	-	x	x	63%
Water conservation	x	x	-	-	-	?	?	x	x	-	-	x	-	x	-	x	-	x	-	-	-	-59%
Water efficiency	-	x	-	-	-	?	-	-	x	-	x	x	-	-	-	-	-	x	-	-	x	-81%
Water metering	x	x	x	x	x	x	-	x	x	x	x	x	-	x	-	x	x	-	x	x	-	81%
Waste reduction during construction	x	x	x	-	-	x	-	-	-	x	x	x	x	-	x	-	-	-	x	-	x	50%
Waste registration	x	x	x	x	x	x	x	x	-	x	-	-	-	?	-	x	x	-	x	x	x	72%
Separate/recycle waste	x	x	x	x	x	x	x	-	-	x	-	x	x	x	x	x	x	-	x	x	x	94%
Limit emission of CO2	x	x	x	x	x	x	x	x	-	x	x	x	x	x	-	-	-	-	x	x	x	75%
Limit ozone depleting gasses	x	x	x	x	x	x	x	-	-	x	x	-	x	x	x	x	?	x	x	x	-	84%
Limit green house gasses	x	x	x	x	x	x	?	-	-	x	x	x	x	x	-	x	x	?	x	x	-	84%
Conserve flora on sites	-	x	-	x	x	-	?	x	x	x	x	x	x	?	x	x	x	x	x	x	x	81%
Conserve wildlife on site	x	x	-	x	x	x	-	x	x	x	x	x	x	?	x	x	x	x	x	x	x	84%
Conserve natural habitats on site	x	x	-	x	x	x	-	x	x	x	x	x	x	?	x	x	x	x	x	x	x	84%
Recyclable materials	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x	-	-	-87%
Renewable materials	-	-	-	-	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-87%
Refurbish and redevelop existing buildings	-	-	-	x	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	x	-	-81%

Notes:

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Table 2: Regulatory attention for social quality

	BE	BG	CY	CZ	DE	DK	EE	ES	FR	HU	IE	IT	LU	MT	NL	PL	RO	SE	SK	SL	UK	[H]
Ethical trading throughout supply chain	-	-	x	-	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	?	-	-85%
Safe and healthy work environment	x	x	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	95%
Provide information to local community during construction activities	x	x	x	x	x	x	x	-	x	x	-	x	x	x	x	x	x	x	x	x	x	90%
Provide space for training workmen	-	-	-	-	-	?	-	-	-	?	-	x	x	-	-	-	?	-	-	?	-	-88%
Provide local schools, health, social facilities	-	x	x	-	x	x	-	-	-	x	x	-	x	?	x	x	x	x	x	x	x	70%
Develop a mix of tenure types	x	-	-	-	-	x	?	-	x	?	x	x	x	-	x	-	-	-	-	-	-	-63%
Provide affordable housing	x	-	x	x	x	x	-	x	x	x	x	x	x	-	x	x	x	x	-	-	x	76%
Provide housing for the elderly	-	x	x	-	x	x	-	x	x	x	x	x	-	-	x	x	x	x	x	x	-	71%
Reject/ discourage gated development	-	-	-	-	-	?	-	-	x	-	x	-	?	-	-	-	?	x	?	-	-	-82%
Provide transport links to local context	x	-	x	x	x	x	?	-	x	x	x	-	-	-	x	x	x	x	x	?	-	68%
Provide links to adjacent neighbourhoods	-	x	x	-	x	x	-	-	x	?	x	-	-	-	-	-	x	x	x	?	x	53%
Reuse locally valued buildings	x	x	-	-	x	x	-	-	x	x	-	x	?	-	x	-	x	x	-	-	x	55%
Green space within a certain distance	-	x	x	x	x	x	-	-	x	x	x	x	x	-	x	x	x	x	-	x	x	76%
Indoor air-quality	x	x	x	x	x	x	-	x	-	x	x	x	x	x	x	x	x	x	x	x	x	90%
Thermal comfort in winter	-	x	x	x	x	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	90%
Thermal comfort in summer	-	x	x	-	x	x	-	x	x	x	x	x	-	x	-	x	x	x	x	x	x	76%
Acoustic comfort	-	x	x	x	x	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	90%
In-door daylight entry	-	x	x	x	x	x	-	x	-	-	-	x	-	x	x	x	x	x	x	x	-	67%
Capability of conversion by a construction/building user	-	x	-	-	?	-	-	-	-	?	-	-	-	-	-	x	x	-	-	-	-	-84%

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Table 3: Regulatory attention for economical quality

	BE	BG	CY	CZ	DE	DK	EE	ES	FR	HU	IE	IT	LU	MT	NL	PL	RO	SE	SK	SL	UK	[H]
Reduce energy consumption during the construction process	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	?	-	-	-	x	-90%
Reduce waste during the construction process	x	x	x	?	x	x	-	-	-	-	x	-	-	-	x	-	-	x	x	-	x	-57%
Keep water use to a minimum during the construction process	-	-	-	?	-	-	-	-	-	-	-	-	-	-	-	-	?	-	-	-	-	-100%
Construct adaptable buildings	-	-	-	-	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-	x	x	-81%
Density of the development (e.g. minimal number of dwellings per area)	x	x	x	x	x	x	-	x	x	x	x	x	x	-	x	x	x	-	x	x	x	81%
Mixed land use	x	x	x	?	x	x	-	-	x	x	x	-	x	?	x	-	x	-	x	x	x	62%
Use local material/goods in construction	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-95%
Use local labour in construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-100%
Limit construction time (planning)	-	-	x	-	-	?	-	-	-	-	-	-	-	-	x	-	?	-	x	-	-	-86%
Construction management	-	-	x	x	x	?	x	-	-	x	-	x	?	x	-	x	?	x	-	x	x	-52%
Keeping records on construction progress	-	x	x	x	-	?	x	x	-	x	-	-	-	-	-	x	?	x	x	x	x	52%
Education/experience of builders	x	x	x	x	x	?	x	-	-	?	-	x	-	x	-	x	-	x	x	x	x	57%

Notes:

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Table 4: Sustainable construction topics that showfFar-reaching homogenisation inregulatory attention among EU member states

Ecological quality	Social quality	Economic quality
- Energy performance (100%) - Thermal insulation (88%) - Water metering (81%) - Waste separation and recycling (94%) - CO2 reduction (75%) - Reduction of ozone depleting gasses (84%) - Reduction of greenhouse gasses (84%) - Conservation of flora on sites (81%) - Conservation of wildlife on sites (84%) - Conservation of natural habitats on sites (84%)	- Safe and healthy workplaces (95%) - Provision of information to local communities during construction (90%) - Provision of affordable housing (76%) - Provision of green space within a certain distance (76%) - Indoor air-quality (90%) - Thermal comfort in winter (90%) - Thermal comfort in summer (76%) - Acoustic comfort (90%)	- Density of development (81%)

Note: Percentages indicate the regulatory homogeneity among the countries in the study.