

Building regulations and control in the face of climate change: Overview of the Portuguese situation

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Abstract:

This paper presents an analysis of the main initiatives implemented in Portugal aimed at improving the environmental performance of buildings. The study is focused on the building regulatory system. However, to describe its framework a wider context is analysed for the following reasons: a) strategies and plans on environment and energy establish main goals and actions to minimize the production of greenhouse gases and to prepare for the challenges of climate change; b) building regulations and their control system set and enforce mandatory minimum requirements for the building stock; c) voluntary certification and labelling set requirements above regulatory minimums and prove their enforcement; d) incentive programs and tax benefits give financial support to change the characteristics of the building stock; e) training and technical information increase the capacity of professionals, and finally, f) sensitization campaigns raise public awareness among consumers and contribute to changes in their behaviour. The results are that there is a coordinated set of initiatives to improve environmental performance of buildings. These initiatives: change the characteristics of the existing building stock, improve the performance level set for new buildings, and encourage more responsible environmental behaviours. Energy is the resource on which more initiatives were focused. Some initiatives set mandatory command and control regulations but most of them are incentives for voluntary improvements. Despite the many initiatives to improve environmental performance of buildings, their actual implementation and effectiveness must be assessed.

Keywords:

Building regulations, Portugal, Climate change

1. Introduction

Climate change has been recognized as one of the greatest environmental, social and economic threats that the planet and mankind face today. The answer to this problem represents a double challenge: to adopt measures that minimize causes of the problem derived from human activities (mitigate climate change) and to prepare society to deal with the biophysical and social-economic impacts of climate change (adapt to climate change).

It is well-known that buildings are of great importance in the consumption of environmental resources and in the production of greenhouse gases (GHG). Therefore in compliance with international commitments, several legal initiatives to improve environmental performance of buildings were adopted in Portugal, in recent years. The construction sector has also developed initiatives complementary to official ones. As a result, the set of regulations, certification systems, tax exemptions, incentive programs, training courses, technical information, knowledge dissemination and awareness campaigns aimed at contributing to improve the environmental performance of buildings is particularly complex.

This paper presents an analysis of the main initiatives implemented in Portugal to improve the environmental performance of buildings construction and operation. In this context the research questions addressed are as follows:

- 1) What are the guidelines set by national and local strategies and plans?
- 2) What are the environmental provisions set in the regulatory framework?
- 3) What are the voluntary certification systems oriented to construction products and buildings?
- 4) What are the incentive programs and tax benefits?
- 5) What were the recent training programs and awareness initiatives?

Answering these questions provides an overview of the modifications carried out in the Portuguese building regulations and control due to the challenges of climate change. The results may be useful for decision makers, stakeholders, technicians and the general public.

The following section explains the research methodology. The results are presented in sections 3 to 7, which deal with plans and strategies, regulatory and control instruments, voluntary certification and labelling, incentive programs, tax benefits and, finally, support and information. Section 8 describes and discusses the conclusions.

2. Research methodology

Key documents with provisions relating to environmental performance of buildings were collected. Summaries presented for each topic were based on the analysis of information collected. Final conclusions bring together and discuss the partial results.

The study addressed the building regulatory system, though a wider context was analysed in order to describe its framework. The following types of initiatives were considered relevant to the study due to the reasons mentioned hereafter:

- 1) Strategies and plans on environment and energy set guidelines for the production and review of the regulatory framework.
- 2) Building regulations set minimum quality requirements and the building control system guarantees the enforcement of these requirements.
- 3) Voluntary evaluation and certification systems of the environmental performance of buildings are intended to guarantee levels above the minimums set by building regulations.
- 4) Incentive programs and tax benefits support the implementation of some provisions set by building regulations.
- 5) Training courses provide capabilities to technicians who apply the building regulations and awareness campaigns raise society's consciousness to environmental problems and thus foster willingness to comply with building regulations.

Environmental resources analysed were energy, water, materials and waste. These resources were selected due to the impact that, in Portugal, construction and use of buildings has on their production and consumption, as described below:

- 1) Buildings account for 30% of total primary energy consumption and for 62% of power consumption. Therefore, the reduction in energy consumption and use of energy from renewable sources in the building sector are measures to reduce both the energy dependency of Portugal from foreign sources and the emission of GHG (Isolani, 2008).
- 2) The urban sector accounts for 9% of total water consumption (industry for 5% and agriculture for the remaining 86%), but represents 46% of the associated cost. In the urban sector, domestic consumption accounts for 45%, commercial consumption for 9% and public consumption for 6%. The remaining 40% are losses due to inefficiency of the system. Water is a limited, structural and strategic natural resource. Therefore, the reduction of consumption, through efficient use and the minimization of waste, particularly in the urban sector, is a measure with environmental and economic gains for the country (INAG, 2010).
- 3) It is estimated that the construction sector is responsible for more than 50% of waste generated. The flow of waste from construction and demolition has special features which hamper its management, in particular, the heterogeneous constitution with fractions of different sizes and different levels of dangerousness. In addition, construction activity presents itself some specificities, such as, it is geographically dispersed and the works have a temporary nature, which make it difficult to control and monitor the environmental performance of industry (PCS, 2011).

3. Plans and strategies

Portuguese national policies on environment and energy are closely articulated and both are integrated in the national strategy for sustainable development. These policies are formalized in a set of national strategies and plans for several areas. The main changes in the buildings regulatory system introduced to improve the environmental performance of buildings arise from guidelines and actions set in these strategies and plans. Therefore, in this section, we present a summary of the main strategies and plans that include guidelines and actions for buildings.

The "National Strategy for Adaptation to Climate Change"¹ sets guidelines to prepare Portugal for the challenges of climate change. At the level of urban planning, the protection of buildings against extreme climatic conditions is identified as a priority. The measures set out in the "National Programme for Climate Change"² for buildings focus on improving energy efficiency as a way to reduce GHG emissions.

The "National Strategy for Energy 2020"³ aims to reduce dependence on foreign energy as well as to cut GHG emissions. The priorities set for buildings are to improve their energy efficiency and to increase the decentralized energy production from renewable sources. Urban regeneration is seen as an opportunity to improve the energy efficiency of the existing building stock. The "National Action Plan for Energy Efficiency"⁴ sets actions to enforce the priorities set by the national strategy, including actions to increase energy efficiency and production from renewable sources in buildings. To promote the implementation of these actions, the action plan establishes the creation of incentive programs, tax benefits and awareness campaigns.

The "National Water Plan"⁵ sets guidelines for integrated water management. Although specific guidelines for buildings are not included, some general actions aimed at raising public awareness about the environment and water and to promote users participation are set. The "National Programme for the Efficient Use of Water"⁶ includes 50 actions applicable to the urban sector, but the 12 actions selected to be implemented in a first phase do not directly apply to buildings.

The "General System for Waste Management"⁷ provides the framework for waste management and aims to ensure an adequate prevention, recycling and recovery. Specific plans are being enforced for managing specific types of waste, but no plan applies specifically to buildings. However, the "Solid Waste Strategic Plan"⁸ sets actions for public awareness, for support of research and for certification of recycled products. The "National allocation plan of emissions"⁹ limits GHG emissions from plants producing some types of building materials.

In September 2009, 118 municipalities and 21 parishes in Portugal had a Local Agenda 21 (GEA, 2011). A local agenda is an action strategy for sustainable development. Though resulting from the community participation, in general the local agendas apply at a local level most of the guidelines set out by national strategies for environment and energy. In this sense, the actions set out in local agendas which apply to buildings regard mainly energy.

In May 2011, 59 Portuguese municipalities had joined the "Covenant of Mayors" and 6 of these had submitted a sustainable energy "Action Plan" (CMO, 2011). The action

¹ Resolution of the Council of Ministers no. 24/2010. OJ (PT) no. 64, 1 April 2010.

² Resolution of the Council of Ministers no. 1/2008. OJ (PT) no. 3, 4 January 2008.

³ Resolution of the Council of Ministers no. 29/2010. OJ (PT) no. 73, 15 April 2010.

⁴ Resolution of the Council of Ministers no. 80/2008. OJ (PT) 97, 20 May 2008.

⁵ Decree-Law no. 112/2002. OJ (PT) no. 90, 17 April 2002.

⁶ Ministerial Order no. 2339/2007. OJ (PT) no. 32, 14 February 2007.

⁷ Decree-Law no. 178/2006. OJ (PT) no. 171, 5 September 2006.

⁸ Ordinance no. 187/2007. OJ (PT) no. 30, 12 February 2007.

⁹ Resolution of the Council of Ministers no. 1/2008. OJ (PT) no. 3, 4 January 2008.

plan outlines how a municipality intends to reach its CO₂ reduction target by 2020. Most actions are aimed at increasing energy efficiency and use of renewable energy sources. The actions that apply to buildings can be grouped into: renovating buildings, tax incentives, awareness campaigns, counselling services, awards and certification of performance (Cascais Energia, 2010; CMA & AGENEAL, 2010; Vieira et al., 2010). The action plans of Lisbon and Porto, the two major cities, were based on local energy matrixes and also include actions relating to water, materials and waste (Lisboa E-nova, 2008; AdEPorto, 2009).

4. Building regulations and control

In every European Union (EU) country there is a building regulatory system encompassing building regulations and the building control system. Building regulations set minimum quality requirements to ensure that buildings are safe, healthy, energy-efficient and accessible to everyone who lives and works in and around them. Building control aims to guarantee the application and enforcement of these minimum requirements. In this section, we present a summary of the main building regulations with provisions on the environmental performance of buildings and an analysis of the relevant building control systems.

General building Code

In Portugal, there is no single Building Act that serves as a legal basis for building regulations and procedures, and defines duties and responsibilities of parties involved in construction. The "General Building Regulation" is the main national building regulation, but there are more than 45 national building regulations and other regulatory documents that focus on specific requirements. There are also local building regulations that complement the national ones.

The "General Building Code"¹⁰ has been in force since 1951 and, despite several amendments, no fundamental revision has been approved. This regulation sets out general provisions for buildings, regarding construction, health, safety and aesthetics. No requirements concerning energy saving or environmental protection are included. In 2006, a proposal to review the "General Building Code" included general requirements on energy saving and environmental protection. However, the proposal was not implemented.

Energy

The "Regulation of the Thermal Behaviour Characteristics in Buildings"¹¹ sets provisions so that: a) requirements of thermal comfort and ventilation, as well as hot water needs, can be met without excessive consumption of energy, and b) pathological situations in building components caused by either surface or internal condensation are minimized. This regulation applies to design of new residential buildings and office buildings without centralized climate control systems. It also applies to major

¹⁰ Decree-Law no. 38382. OJ (PT) no. 166, 7 August 1951.

¹¹ Decree-Law no. 80/2006. OJ (PT) no. 67, 4 March 2006.

alterations of existing buildings (i.e., alterations that amount to more than a quarter of the value of an identical model building).

The "Regulation on Energy Systems and Air Conditioning of Buildings"¹² sets rules for designing office and residential buildings with centralized climate control systems, which, in addition to requirements related to the built envelope and the limitation of energy consumption, also covers the efficiency and maintenance of those systems.

A special management system has been set for factories that have an intensive consumption of energy. Its aim is to promote energy efficiency and monitor energy consumption¹³.

Water

The "Regime of Design, Installation and Operation of Public and Building Systems of Water Distribution and Sewerage"¹⁴ sets general principles to be met by these systems and aims to ensure their proper overall functioning, preserving safety, public health and users convenience. The "General Regulation of Public and Building Systems of Water Distribution and Sewerage"¹⁵ sets the technical provisions to be met by the design, construction and operation of these systems, and their standards of hygiene and safety.

None of these regulations includes provisions to promote the efficient use of water. On the contrary, the regulation prohibits the existence of distribution networks in dwellings of non-drinking water, which inhibits the use of rainwater and the reuse of domestic wastewater (Pedroso, 2009).

Types of materials and waste

Portuguese legislation on waste is highly complex and is frequently updated. The main legislation in force and applicable to buildings is the following:

- 1) The "Regime of Construction and Demolition Waste Management"¹⁶ sets rules for the management of waste resulting from construction or demolition of buildings, including its prevention and reuse, as well as collecting, transporting, storing, sorting, treatment, recovery and disposal operations.
- 2) There are "Limitations on Marketing and Use of Dangerous Substances and Preparations"¹⁷ that safeguard human health and the environment. Several materials used in buildings are covered by these limitations.
- 3) There are procedures for "Removal of Asbestos in Public Buildings and Facilities"¹⁸ and rules for "Protection of workers from the risks of exposure to asbestos during work"¹⁹.

¹² Decree-Law no. 79/2006. OJ (PT) no. 67, 4 March 2006.

¹³ Decree-Law no. 71/2008. OJ (PT) no. 74, 15 April 2008.

¹⁴ Decree-Law no. 207/94. OJ (PT) no. 181, 6 August 1994.

¹⁵ Regulatory Decree no. 23/95. OJ (PT) no. 194, 23 August 1995. With amendments.

¹⁶ Decree-Law no. 46/2008. OJ (PT) no. 51, 12 March 2008.

¹⁷ Decree-Law no. 264/98. OJ (PT) no. 28, 9 February 2011.

¹⁸ Law no. 2/2011. OJ (PT) no. 190, 19 August 1998. With amendments.

¹⁹ Decree-Law no. 266/2007. OJ (PT) no. 141, 26 July 2007.

- 4) There are rules for the disposal of used PCBs in order to ensure their complete destruction.²⁰ PCBs are present in some building materials (e.g. plastic inks, hydraulic fluids and climate control systems, adhesives and wood treatment products).
- 5) The "Trading System for Greenhouse Gas Emissions within the European Union"²¹ limits GHG emissions of each facility for the 2008-2012 period. Some industrial facilities that produce building materials are listed. These facilities belong to the following sectors: ferrous metals; cement; lime; glass; bricks, roof-tiles & accessories; and wall & floor tiles.

Complementary, to inform consumers, there are mandatory rules for the labelling of products that have an impact on energy consumption²². The labels and technical specifications provide information on the consumption of energy and other essential resources.

Bylaws

Local authorities can approve building regulations and set fees on construction works. These regulations contain additional provisions to national ones and deal with subjects of municipal competency and local traditions and uses. Some local building regulations set bylaws with requirements concerning energy saving and environmental protection (e.g., Lisboa, Almada and Cascais municipalities).

Building control

The "Regime of urbanization and construction"²³ sets the rules of public control over construction works in order to ensure the public interests. According to their category, construction works can either be exempted from building permit procedures or follow a building notice procedure or a regular procedure. Since it has been in force, this regime has been amended 10 times drawing on experience gained by its application to date.

In the sixth amendment, the compliance with the "Regime of Construction and Demolition Waste Management" became compulsory²⁴. In the tenth amendment, the installation of photovoltaic solar panels, wind generators and solar heating panels for domestic hot water was exempt from building permit procedures, for simplification purpose. These construction works are not exempt in listed buildings²⁵.

The "National System of Energy Certification and Indoor Air Quality in Buildings"²⁶ aims to: a) enforce the building regulations on energy performance, b) certify the energy performance and indoor air quality in buildings, and c) identify corrective action or

²⁰ Decree-Law no. 277/99. OJ (PT) no. 170, 23 July 1999.

²¹ Decree-Law no. 233/2004. OJ (PT) no. 291, 14 December 2004. With amendments.

²² Decree-Law no. 63/2011. OJ (PT) no. 89, 9 May 2011.

Decree-Law no. 214/98. OJ (PT) no. 162, 16 July 1998.

²³ Decree-Law no. 555/99. OJ (PT) no. 291, 16 December 1999. With amendments.

²⁴ Law no. 60/2007. OJ (PT) no. 170, 4 September 2007.

²⁵ Decree-Law no. 26/2010. OJ (PT) no. 62, 30 March 2010.

²⁶ Decree-Law no. 78/2006. OJ (PT) 4 April.

performance improvements for buildings and their energy systems with regard to energy performance and indoor air quality. Within this system:

- 1) A central public agency qualifies and supervises private experts, and approves certificates issued by them.
- 2) Private experts declare the compliance of designs with the above regulations for building permit purposes, assess and certify the energy and indoor air quality performance before the use permit is granted, and analyse and certify the energy and indoor air quality performance in periodical audits.
- 3) The central government supervises the system.

Since 2007 more than 300,000 certificates of energy and indoor air quality performance have been granted within the scope of the national system of energy certification.

The "Regulation of the Thermal Behaviour Characteristics in Buildings"²⁷, the "Regulation of Energy Systems and Air Conditioning of Buildings"²⁸ and the "National System of Energy Certification and Indoor Air Quality in Buildings"²⁹ partially transpose into the Portuguese legislation the European Directive on the Energy Performance of Buildings (EPBD) adopted in 2002³⁰. Presently, these regulations and the system are under revision and will probably include the objectives set by the EPBD recast³¹.

5. Voluntary certification and labelling

Consumers are becoming more concerned about the environment. Therefore, they want to play an active role in the environment protection by choosing products that inflict less damage upon it. However, they are bewildered by and sometimes sceptical about the environmental claims made by manufacturers and retailers for their products. Eco-labels are 'brands' placed on certain products that help consumers to choose products, which have been recognised as less harmful to the environment. Eco-labels are voluntary schemes based on specific environmental criteria.

In several countries, specific eco-labels have been developed for buildings. Green building assessment and certification systems comprise a set of criteria, organized in categories, which assess different environmental aspects of buildings. Certification is granted, usually by levels, if certain performance thresholds are reached. Existing systems are voluntary since the belief is that construction sector adherence will be due to environmental commitment or to ensure buildings' competitiveness and differentiation.

²⁷ Decree-Law no. 80/2006. OJ (PT) no. 67, 4 March 2006.

²⁸ Decree-Law no. 79/2006. OJ (PT) no. 67, 4 March 2006.

²⁹ Decree-Law no. 78/2006. OJ (PT) 4 April.

³⁰ Council Directive no. 2002/91/EC of 16 December 2002 on the energy performance of buildings OJ (EU) L 1/65 of 4 January 2003.

³¹ Directive 2010/31/UE of the European Parliament and the Council of 19 May 2010 on the energy performance of buildings (recast). OJ (EU) L 153/13, of 18 June 2010.

In this section, we present a summary of the certification and labelling systems available in Portugal for environmental performance of construction materials and buildings.

Eco-labels

Several eco-label systems are used in Portugal for construction products. The water efficiency of products that consume water (e.g. toilets, showers and taps) may be certified by the ANQIP system (ANQIP, 2011). The certification of solar thermal equipment by the Portuguese Quality System (Certified Product or Solar Keymark), is a mandatory condition for State incentives being granted (ADENE et al., 2003-2011). There is the Portuguese system for certification of sustainable forest management, which is recognized by PEFC International (PEFC, 2010). Some products bear the EU Ecolabel, in particular products that fall into the following categories: hard floor coverings, heat pumps, paints & varnishes, and lightbulbs (Eco-label, 2002). Several products and construction materials sold in Portugal have marks awarded by international certification systems.

LiderA

"LiderA" is an assessment and acknowledgement system for buildings and built environment sustainability (LiderA, 2011). The system was originally developed in the framework of a Ph.D. in Environmental Engineering. The first version was presented in 2005 and the first certifications were issued in 2007. Based on experience gained with its implementation, a second version was presented in 2009.

The system can be used to assess and certify urban and building developments for different uses (e.g. residential, commercial, office and tourism) and applied at different phases, including planning, design, construction, operation and renewal. The evaluation is divided into 6 categories and 22 areas:

- 1) Site and integration: soil, natural ecosystems, and landscape and Heritage;
- 2) Resources: energy, water, materials and food production;
- 3) Environmental loadings: wastewater, atmospheric emissions, waste, noise emissions, and thermal and light pollution;
- 4) Environmental comfort: air quality, thermal comfort, and lighting and acoustics;
- 5) Socioeconomic experience: access for all, economic diversity, amenities and social interaction, control and participation, and life cycle costs;
- 6) Sustainable use: environmental management and innovation.

Results of LiderA are presented in a seven level scale (A to G), in which level E is the common practice. There are also classes for developments that undertake structural improvements (A+ and A++) or are regenerative (Class A+++). If the result is above level D, the building or built environment may be certified. Less than 20 developments have been recognized (design phase) or certified (work and operation phase) by LiderA until 2011, covering various types of developments: houses, apartment buildings, residential developments, resorts, schools, hotels, office buildings and commercial buildings. Buildings certified by LiderA are granted tax benefits or fee reductions, by some local authorities.

SBTool^{PT}

"SBTool^{PT}" is a system intended to assess and certify the sustainable performance of buildings and projects (SBTOOL-PT, 2011). It is based on the international system SBTool (Sustainable Building Tool) developed by iiSBE (International Initiative for the Sustainable Built Environment) in collaboration with a consortium of teams from over 20 countries (Europe, Asia and America). The SBTool^{PT} was adapted to Portuguese context by iiSBE Portugal in collaboration with University of Minho and Ecochoice.

The system can be used to assess different types of buildings (e.g. office, residential or other). It is divided into 3 dimensions, which cover 9 categories and 30 parameters. The 3 dimensions are subdivided into the following categories:

- 1) Environmental dimension: climate change and outdoor air quality, biodiversity, energy, material use and solid waste, and use of water and wastewater;
- 2) Social dimension: comfort and health of occupants, accessibility, and awareness and education for sustainability;
- 3) Economic dimension: life-cycle costs of buildings.

The values of each parameter are converted into a scale with six steps from "E" (conventional practice) to "A+" (best practice). The combination of partial results is done by a weighted average of the values of each parameter. The results are presented in two levels: a profile with the performance of the solution in different categories and an overall score of sustainability. The information available about the system only reports its application to two case studies.

DomusNatura

"DomusNatura" is a system intended to certify the sustainable performance of developments. It was developed by SGS Portugal and presented in 2008 (SGS SA, 1997-2011). This system aims to combine quality, environment and effective management of resources. The goal is to increase comfort and reduce running costs.

The DomusNatura includes a quality certification entitled DomusQual, which aims to monitor compliance with all legal requirements applicable to the project. DomusNature combines the quality factor of DomusQual with good environmental, social and economic performance. DomusNatura system is divided into 6 categories and 127 parameters, of which 21 belong to DomusQual. The 6 categories are:

- 1) sustainable location and safety;
- 2) rational use of water;
- 3) energy and air pollution;
- 4) materials and resources;
- 5) quality and comfort;
- 6) innovation and ecology.

Buildings that meet a certain environmental, social and economic performance are granted a certificate. The level of the certificate is determined according to scores achieved in various parameters. The information available indicates that this system has not been applied up to 2011.

Some consulting firms on environmental sustainability are qualified or certified to implement the international environmental certification systems BREEAM, LEED and *Bilan Carbone*. According to available information, the application of these systems in Portugal is uncommon.

6. Incentive programs and tax benefits

In order to reduce consumption and improve environmental performance it is necessary to change the characteristics of the building stock, whether through interventions in the physical envelope of buildings or through the acquisition of more efficient equipment. These changes require a financial investment that it is important to encourage. Incentive programs and tax benefits can be used for this purpose. In this section we present a summary of the main incentive programs and tax benefits used in Portugal to help improving the environmental performance of buildings.

There are several specific incentive programs to promote the efficient use of energy, to decentralize power production using renewable sources³², and to encourage the use of solar energy to heat water (ADENE et al., 2003-2011). Other programs pursue these objectives specifically in residential buildings (RE.NEW.ABLE et al., 2011), in buildings from small and medium enterprises (QREN, 2010), and in non-profit private organizations (InAlentejo, 2010). Some general programs that give financial support to renovation of residential buildings can also be used to finance construction works for improving the environmental performance of buildings.³³ Within these programs, subsidized loans or non-repayable funds are awarded. Incentives for building renovation contribute, indirectly, to a reduction of materials consumption and waste production. If energy is produced by private persons, the public network will take the energy (up to a defined limit) at a guaranteed and advantageous sale price.³⁴

There are funds to support projects that contribute to the efficient use of energy³⁵ and to reduction of GHG emissions.³⁶ Funds are financed with state budget allocations and revenues from fees and fines on energy issues.

Tax reductions are granted for the purchase of properties with high energy efficiency (i.e. 10% increase in the tax deduction for costs with housing loans, if the house is awarded an energy class A or A+ by the national system of energy certification)³⁷ and of equipment to produce thermal and electric energy from renewable energy sources

³² Decree-Law no. 363/2007. OJ (PT) no. 211, 2 November 2007. With amendments.

Decree-Law no. 34/2011. OJ (PT) no. 47, 8 March 2011.

³³ Decree-Law no. 39/2001. OJ (PT) no. 34, 9 February 2001. With amendments.

Decree-Law no. 105/96. OJ (PT) no. 176, 31 July 1996. With amendments.

³⁴ Order no. 1/MINIP/2011 of Directorate General for Energy and Geology (28 April 2011).

³⁵ Decree-Law no. 50/2010. OJ (PT) no. 98, 20 May 2010.

Ordinance no. 26/2011. OJ (PT) no. 6, 10 January 2011.

³⁶ Decree-Law no. 71/2006. OJ (PT) no. 60, 24 March 2006.

³⁷ Decree-Law no. 442-A/88. OJ (PT) no. 277, 30 November 1988. With amendments (Law no. 55-A/2010. OJ (PT) no. 253, 31 December 2010).

(i.e. VAT at an intermediate rate of 13%)³⁸. To counterbalance the impact of energy inefficient light bulbs on the environment, there is an additional tax on these light bulbs.³⁹

Some local authorities adopt measures similar to those identified at national level, including tax benefits (e.g., reduction in property tax and reduction in fees over construction works) and funds to support local projects (e.g., municipal energy efficiency fund).

7. Training, information and public awareness

To improve the environmental performance of buildings, it is not only necessary to adopt effective policies in terms of regulations and investment, but also to promote a change in consumer behaviour, increase the technical capacity of professionals and stimulate the update and progress of scientific knowledge. In this section, we present a summary of the main actions regarding support and information carried out in Portugal to help improving the environmental performance of buildings.

Public sector plays an active role by adopting measures to improve the environmental performance of buildings. For example, a "Strategy for the green public procurement"⁴⁰, a "Program for energy efficiency in public administration"⁴¹ and a "Regime for public procurement of energy services"⁴² have been approved.

There are training programs on sustainable construction for the different agents in the construction sector. For example, universities and professional associations organize postgraduate courses on sustainable construction for designers, training on building regulations concerning energy performance of buildings is mandatory to experts qualified under the "National System of Energy Certification and Indoor Air Quality in Buildings", and there are training courses for installers of renewable energy and water use equipment.

Demonstration buildings have been built to show both the potential and the feasibility of new architectonic, technologic and constructive solutions, which improve the environmental performance of buildings (e.g. *Aveiro Domus*⁴³, *Solar XXI*⁴⁴). The buildings are also used to study and monitor the performance of new systems and products.

Frequently, campaigns to raise public awareness for environmental challenges are conducted. The campaigns are promoted by central authorities, local authorities, service providers and non-governmental organizations (NGO's). Some consumer protection and nature conservation NGO's develop information and public awareness projects to

³⁸ Decree-Law no. 394-B/84.OJ (PT) no. 297, 26 December 1984. With amendments (Decree-Law no. 102/2008. OJ (PT) no. 118, 20 June 2008).

³⁹ Decree-Law no. 108/2007. OJ (PT) no. 72, 12 April 2007.

⁴⁰ Resolution of the Council of Ministers no. 65/2007. OJ (PT) no. 87, 7 May 2007.

⁴¹ Resolution of the Council of Ministers no. 2/2011. OJ (PT) no. 8, 12 January 2011.

⁴² Decree-Law no. 29/2011. OJ (PT) no. 41, 28 February 2011.

⁴³ <http://www.aveirodomus.pt>.

⁴⁴ http://repositorio.lneg.pt/bitstream/10400.9/1322/1/BrochuraSolarXXI_Maio2010.pdf.

encourage a more moderate consumption of resources and to demonstrate how to make daily consumption more efficient (e.g. *Ecocasa*⁴⁵, *Biosfera*⁴⁶).

Some local authorities have counselling services for citizens on methods to reduce consumption on a daily basis and on construction works to improve the performance of buildings. Several simulation tools are available online that enable users to characterize their home and lifestyle, to assess the environmental impacts and to learn from the suggestions made by the system. Such tools are usually provided by NGOs (e.g. *DECO*⁴⁷, *Quercus*⁴⁸) or service providers (e.g. *EDP*⁴⁹, *EPAL*⁵⁰).

Abundant technical documentation on sustainable construction adapted to the Portuguese context has been published. Some manuals on sustainable construction are geared towards technicians and others to consumers. To update knowledge of professionals, technical magazines are regularly published on sustainable construction as a whole or on specific aspects. On the Internet, some sites are dedicated solely to disseminate information on good practices in sustainable construction and rehabilitation. In addition, sustainable construction is an issue that arises repeatedly in the general technical documentation of the construction sector.

National Awards are granted to recognize buildings and building developments for their sustainable performance, and companies for their energy efficiency practices.

Meetings on sustainable construction are held frequently, and there are many research and development projects on sustainable construction.

8. Conclusions and discussion

8.1 Synthesis of results

Guidelines set by national and local strategies and plans

Strategies and plans set goals and actions for an adequate management of energy, water, materials and waste in the context of climate change and sustainable development. The actions established in national strategies and plans that apply to buildings are mainly focused on increasing energy efficiency and energy production from renewable sources. The strategies and plans also include measures aimed at raising awareness and mobilizing citizens to adopt a more responsible environmental behaviour, including moderating or reducing the consumption of water and energy and promoting recycling. Almost 40% of Portuguese municipalities have a Local Agenda 21 for sustainable development and 20% of them joined the "Covenant of Mayors". These figures reflect a growing commitment of local governments with the implementation of the EU and national policy for environment and energy. Although the commitment of municipalities is voluntary it is framed and encouraged by EU policies aimed to the local level.

⁴⁵ <http://www.ecocasa.pt>.

⁴⁶ <http://www.quercustv.org>.

⁴⁷ <http://www.deco.proteste.pt/ambiente/s316081.htm>.

⁴⁸ <http://www.ecocasa.pt/simuladores.php>.

⁴⁹ <http://www.edp.pt/pt/particulares/bemvindoaedp/Pages/SimuladordePotenciaeConsumo.aspx>.

⁵⁰ <http://www.epal.pt/epal/novosim.aspx>.

Environmental provisions set in the regulatory framework

The "General Building Code" does not set general requirements on energy saving and environmental protection. There was a positive development in building regulations on energy efficiency and indoor air quality. The national system of energy certification has contributed to a better compliance with energy regulations. Building regulations do not include provisions on efficient use of water. Several separate building regulations set provisions on use of dangerous substances, waste from construction or demolition and labelling of products that have an impact on energy consumption. No changes were introduced in the building regulations in order to meet the need to increase protection against extreme weather conditions. Most changes in the building regulations regarding energy and materials were due to the transposition of European directives into the Portuguese legislation.

Voluntary certification systems available for construction products and buildings

There are Portuguese eco-label certification systems for some products and materials (e.g. products that consume water, wooden products and solar thermal equipment). The EU Ecolabel is also being used for other products. Several construction products and materials sold in Portugal have marks awarded by international certification systems.

There are three systems of green building assessment and certification especially adapted to the Portuguese context, but only one has had some minor applications. International systems of green building assessment and certification can also be used in Portugal, but their implementation is also insignificant. Therefore, adherence to date of the construction sector to green building assessment and certification systems is reduced. Even the tax benefits and fee reductions granted by local authorities seem to be insufficient to boost the application of these systems.

Incentive programs and tax benefits

Although all measures foreseen by plans and strategies were not implemented, there is a wide range of incentive programs to encourage rational use of energy in new and existing buildings. These programs cover up the main types of private buildings: residential, small and medium enterprises, and non-profit private organizations. Renewal of public buildings is being supported by other programs. No incentive programs to promote a better use of water, materials and waste in buildings were identified. However, incentives for building renovation contribute indirectly to reduction in material consumption and waste production.

Training and awareness initiatives

There are many initiatives about sustainable construction in order to: ensure the training of professionals (postgraduate and professional courses), raise awareness among consumers (campaigns, counselling, demonstration buildings), produce and disseminate knowledge (research projects, meetings, books, magazines and sites), recognize best practices (awards), and lead change by example (public leadership programs).

8.2 Discussion

As described, in Portugal there is a set of initiatives to improve environmental performance of buildings. These initiatives pursue the objectives set by the policies on environment and energy and are coordinated in plans and strategies organized by resources (energy, water, materials & waste). The initiatives that have been carried out cover the main domains (Table 1): building regulations and control; certification and labelling; incentive programs and tax benefits; as well as training, information and public awareness.

The initiatives to improve environmental performance of buildings aim to: change the characteristics of the existing building stock, improve the performance level set for new buildings and encourage more responsible environmental behaviours. Some of these initiatives set mandatory command and control regulations (e.g. building regulations and control) but most of them are incentives for voluntary improvements (e.g. some certification and labelling schemes; incentive programs and tax benefits; as well as training, information and public awareness).

Table 1. Initiatives to improve environmental performance of buildings

	Energy	Water	Materials & waste
Plans and strategies	✓	✓	✓
Building regulations and control	✓	✗	✓
Certification and labelling: Products	✓	✓	✓
Certification and labelling: Buildings	✓	✓	✓
Incentive programs and tax benefits	✓	✗	✗
Training, information and public awareness	✓	✓	✓

Energy is the resource on which more initiatives are focused. The enforcement of building regulations on energy performance is ensured by the participation of private experts who check design compliance and carry out site inspections. Certificates and permits are still granted by central authorities.

Despite the numerous initiatives to improve environmental performance of buildings, questions arise about their actual effectiveness. Therefore, in future studies we intend to analyse the effectiveness and efficiency of these initiatives. Other developments will be the analysis of initiatives concerning the use of soil and the comparison of initiatives carried out in Portugal with those operated in other European countries.

9. Acknowledgments

The input of António Cabaço, Joana Mourão, Jorge Saraiva and Rodrigo Rodrigues during the development of the study is gratefully acknowledged.

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