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Comparing energy efficiency labelling systems in the EU and Brazil: Implications, challenges, barriers and opportunities

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ABSTRACT

In the last 30 years, voluntary and mandatory environmental or energy certification schemes have been introduced in the building sector in most developed countries. During the last decade, in Brazil, the document Energy Efficiency Rating Technical Quality Regulations for Commercial, Service and Public Buildings (RTQ-C) was introduced to classify buildings according to their energy efficiency level. This paper aims to assess how Brazilian RTQ-C could learn from the European Union (EU)'s experience of implementing the Directive 2010/31/EU. The implementation of the RTQ-C in Brazil has been examined and compared with the EU's Directive. Technical, economic and social issues as well as barriers and challenges behind the initial stage of the Directive 2010/31/EU implementation were examined. The difficulties and weaknesses of the calculation methodology, scope and labelling of the Brazilian RTQ-C regulations, and potential areas that require further research have been identified and summarised. In order to increase the impact of RTQ-C regulations, improvements to the existing calculation methodology and tools, provision of numerous supporting measures, such as an increase in training, education, public awareness and incentives, and enforcement through building regulations or standards are essential. The valuable experience from the EU's implementation of the Directive could be used to guide the development of energy policies and certification regulations in Brazil.

1. Introduction

Buildings as the main contributors to carbon emissions, account for up to one sixth of the emissions in the European Union (EU) (European Commission, 2011) or one third in the United States (US) (Department of Energy, 2012). In order to reduce carbon emissions from the building sector, voluntary and mandatory environmental or energy certification schemes have been gradually introduced in the real estate sector in most developed countries since early 1990s, which reflects the growing interest in reducing carbon emissions from the real estate stock. Prior to these schemes, energy efficiency labelling has already been implemented in household appliances in more than 50 countries globally. Such energy efficiency labels provide accurate energy consumption information for the appliances and are useful for consumers when making purchase decisions (Harrington and Damnics, 2004). Early research (Gilmer, 1989; Dinan and Miranowski, 1989) showed positive impacts of energy labels on the improvement of energy efficiency in residential buildings. A brief review of recent approaches to energy rating shows that, strategies for defining energy efficiency in buildings are essential for successful energy rating (Olofsson et al., 2004). The historic development of energy certification schemes in buildings, including the definition and scope of benchmarking process, energy rating and labelling was reviewed. Guidance was also proposed for implementing building energy certification (Perez-Lombard et al., 2009).

Various governments around the world have initiated energy rating systems to measure energy performance in both residential dwellings and commercial buildings (Brounen and Kok, 2011). The use of a range of voluntary and mandatory energy rating standards in up to 81 countries across the EU, North and South America, Australia and Asia have been gathered, critically reviewed and compared (Janda, 2009; Rajagopalan and Leung, 2012). The 'Energy Star' programme is a notable example of energy rating systems used in the US in buildings and also in domestic appliances (Olofsson et al., 2004; Miguez et al., 2006; Rajagopalan and Leung, 2012). Similarly, the 'Energy Smart' programme (Singapore), the 'Energy Smart' certification (Japan), the 'Energy Conservation Building Code' (India), the 'National Australian Built Environmental Ratings Scheme (NABERS)' and the 'Nationwide House Energy Rating Scheme (NatHERS)' (both in Australia) are energy rating systems used in other parts of the world (Rajagopalan

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and Leung, 2012). Fossati et al. (2016) present an overview of energy rating systems and regulations in the world, including the Brazilian energy efficiency and labelling scheme. Based on the actual energy performance for a given building for the previous twelve months, NABERS was firstly introduced in 1999 on a voluntary basis and has recently become mandatory for commercial buildings of more than 2,000 m^2, which cover more than 70% of floor area of qualified office buildings (Energy World, 2017). The success of NABERS in Australia has been driven by the use of different ratings for base buildings and tenants (Bannister, 2013).

In Europe, the efforts to classify the energy performance of the real estate sector actually originate back to Article 2 of Directive 93/76/EEC, with the purpose to limit carbon dioxide emissions (EC, 1993; Perez-Lombard et al., 2009). The Directive also required a collective effort by all Member States (MS) to limit carbon dioxide emissions and to promote the rational use of energy. Despite the non-mandatory implementation of energy certification in buildings under this Directive, Denmark became the first country to implement energy performance rating in buildings back in 1997, making it a reference point for other European countries (Miguez et al., 2006; Jensen et al., 2016). The need for a new legislation in the early 2000s led the European Commission (EC) to introduce Directive 2002/91/EC on the energy performance of buildings (EC, 2002), which made energy performance disclosure mandatory in all MS (Perez-Lombard et al., 2009). The Article 7 of the Directive makes mandatory the introduction of comparable Energy Performance Certificates (EPCs) across the EU. A typical EPC includes reference values, such as current legal standards and benchmarks for consumers to compare and assess the energy performance of a building (Fabbri et al., 2011). Even though Directive 2002/91/EC came into force in January 2004, it has only been formally implemented in January 2006 due to the time needed for every MS to transpose it into their national legislation. An additional period of three years was given for MS to fully adhere to the certification procedures due to the lack of qualified and/ or accredited experts (Hernandez et al., 2008; Brounen and Kok, 2011). A study was carried out showing differences and similarities among energy rating systems implemented in MS (Miguez et al., 2006). In 2010, the recast, Directive 2010/31/EU (EC, 2010) has expanded the scope of the Directive. It was required that EPC and its energy saving recommendations have to be included in all advertisements for selling or renting properties (Brounen and Kok, 2011; EC, 2013). All buildings at the point of completion, sale or rent should possess EPCs, which give information about their energy performance and are valid for ten years (Fuerst et al., 2015). This is followed by the introduction of the Energy Efficiency Directive (EC, 2012) in 2012, which requires more drastic measures to promote energy efficient buildings, including long-term national building renovation strategies in the MS.

Brazil, along with other developing countries, is facing the issue of growing energy consumption. Official figures show that buildings accounted for 50% of the total electricity energy consumption in Brazil in 2014 (MME, 2015). Much of the electricity wasted due to energy inefficiency in commercial and public buildings reported are related to building envelope, air conditioning systems, lighting systems and hot water supply (Lamberts, 1996). During the last decade (2005–2014), energy consumption in the commercial and public sectors increased by approximately 40%, whereas consumption in the service sector increased by around 60% (MME, 2015). In 2001, the Brazilian government took the initiative to introduce the Law No 10.295 (Brazil, 2001a), which was published under Code-Decree 4.059 (Brazil, 2001b), as a result of Energy Efficiency Act on the National Energy Conservation and Use Policy in Brazil. The Law further strengthened Brazil's National Electricity Conservation Programme (PROCEL), which regulates the efficiency of appliances in Brazil and has been promoting several actions towards electric energy conservation since the 1980s (Nogueira et al., 2015). The PROCEL Edifica Programme was launched in 2003 by the Brazilian government through the Action Plan for Energy Efficiency in Buildings to reduce the electricity consumption in Brazilian buildings. It defines procedures required for Brazilian buildings, covering building certification, regulations and legislation on energy efficiency. Subsequently, the Federal Regulation for Voluntary Labelling of Energy Efficiency Levels in Commercial, Public and Service Buildings was developed and approved in 2006 (Lamberts et al., 2006, 2007; Pollis, 2013; Borgstein and Lamberts, 2014). Under the regulation, voluntary requirements for energy efficiency labelling were introduced to classify buildings according to their energy efficiency level thereby limiting and controlling energy consumption in buildings (Lamberts et al., 2006). Lamberts and colleagues from the Federal University of Santa Catarina, Brazil, have been pioneering the work in developing a technical base for the regulation since 2004 (Lamberts et al., 2007). In February 2009, the Energy Efficiency Rating - Technical Quality Regulations for Commercial, Service and Public Buildings (RTQ-C) and its supplementary documents (MME, 2009a; 2009b; 2009c; 2009d) were introduced, approved and published by the Brazilian Federal Government. Lately, Fossati et al. (2016) conducted a detailed review on energy efficiency rating systems for Brazilian buildings; whilst Lopes et al. (2016) compared the Brazilian system with both the US and Portugal systems and highlighted how the Brazilian system can be improved in methodology adopted and scope of calculation.

The aim of this research is to assess how Brazilian RTQ-C could learn from the EU's experience of implementing the Directive 2010/31/EU using a mixture of literature review, site visit, and detailed analysis of the RTQ-C calculation methodology. A thorough literature review has been conducted, whilst RTQ-C calculation methodology has been studied, analysed in detail and compared with the EU's Directive 2010/31/EU. During the initial stages of the research, visits took place and inside information was gathered as regards a number of RTQ-C certified Brazilian buildings, including the first RTQ-C certified building in Brazil (a bank branch located in Curitiba, State of Paraná). This was followed by detailed discussions and meetings held with Brazilian experts to understand the development and calculation method behind the RTQ-C regulation.

The paper presents the current state of the implementation of the Brazilian energy efficiency rating scheme. Barriers and opportunities are anticipated based on preceding introduction of similar rating systems in EU MS and more specifically in the United Kingdom (UK). Even though there are recognizable differences in context between realities analysed (GDP, concern for environment, degree of industrialization among others), globalization trends will play a role in the pressure needed for more efficient buildings. Indeed, presently in Brazil, many buildings are certified according to non-indigenous standards such as the North-American Leadership in Energy & Environmental Design (LEED) Certification with a rising trend (GBC 2017). Along with LEED certificates, which started to be issued from 2004, an adaptation of the French certification NF Bâtiments Tertiaires - Démarche (HQETM) was made for the Brazilian context within a collaboration scheme started in 2007. The 'AQUA' ('Alta Qualidade Ambiental') rating scheme is the adapted version of HQETM. It is recognized that adaptations of existing, foreign methods may prove insufficient to cope with context-related issues (Cole 2005); thus, the development of a national certification and the anticipation of problems arising from its full implementation are of utmost importance.

Fig. 1 describes the structure of the paper and scope of this research. We start off by describing the Brazilian RTQ rating system (components, calculation methods, certification, and the existing difficulties as regards the simplified method). EU experience is briefly commented and the UK system is more thoroughly detailed. From the EU/UK experience, implications of the full implementation of Energy Performance of Buildings Directives (EPBD) are reviewed thereby stressing the importance of having set standards for energy efficient buildings in terms of technical, economic and social aspects. Based on the key finding from the literature review, we list potential barriers and