



Energy efficiency in social housing: Opportunities and barriers from a case study in Brazil

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ABSTRACT

This paper investigates the energy efficiency in a segment of the building sector in emerging countries by analyzing and evaluating the energy efficiency of a social housing project in Brazil. Energy efficiency measures and bioclimatic design strategies are developed in order to improve thermal comfort in this social housing project and to reduce the energy consumption and expenses of their residents. The institutional barriers and constraints toward higher efficiency are described. The results of this study show that there is a high potential to increase energy efficiency in social housing in emerging countries like Brazil. The implementation and consideration of the energy efficiency measures and policy recommendations would contribute substantially to the goal to dampen the fast growth of energy demand in these countries. Moreover the improvement of energy efficiency in the social housing sector could be a driver for market transformation towards more sustainability in the whole building sector.

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1. Introduction

The awareness for energy efficiency in the Brazilian commercial and public building sector has risen during the last years as a result of governmental actions and research projects. However, building design in the housing sector has not been pushed towards energy efficiency, because of low interest from the public and private sector as well as lack of investment (Lamberts and Westphal, 2000). The social housing sector, as a solution to cope with the growing problem of high deficit of housing units in Brazil (FTD, 2010), is severely affected: a maximum number of housing units should be constructed with a limited amount of investment. Thus, an investment cost per housing unit is very low resulting in poor construction quality and renders it difficult to include an energy efficiency measure.

In Brazil 44% of the electricity consumption is consumed in buildings: 22% of that in the residential sector, 14% in the commercial and 8% in the public buildings (EPE and MME, 2005). Due to population growth, urbanization and higher income, electricity consumption in the residential sector is growing steadily from 4.7% in 2003 up to 6.2% in 2009 yearly (EPE, 2009). The social housing sector is dominated by public agents and investment. By considering aspects of building efficiency, the

public sector could be a major driver towards more energy efficiency in the housing sector. This in its turn could contribute to dampen electricity demand growth and, thus, lower investment needs in the electricity generation sector. Geller et al. (2004) has shown that policy choices toward more energy efficiency have a significant impact on energy trends, social progress, and environmental quality in emerging countries like Brazil.

Furthermore, the target group of social housing, the poorest strata of the population suffers eminently under increasing energy costs; paying a high portion of their income for energy services. For that reason, there is an urgent need for research in the field of energy efficiency in social housing to improve the sustainability of the people's livelihood.

The overall objective of this study is to develop technical design guidelines and present policy recommendation for the institutional framework that contribute to the improvement of an energy efficiency in the social housing sector in Brazil and Rio de Janeiro.

2. Methodology

This study first examines the social housing sector in Brazil and Rio de Janeiro, including the challenges of social housing policy and the involved stakeholders. Secondly, the context of energy efficiency is analyzed by focusing on policies and standards in Brazil and identifying barriers for implementation in the social housing sector. Thirdly, at project level a case study of a real social housing project in Rio de Janeiro (Mangueira housing project) is analyzed in order to examine the technological dimension as well as the institutional and socio-economic

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framework. For the project design analysis and evaluation of this case study, an analysis matrix is defined.

The first and second methodological steps are done by means of the literature review and expert interviews. The institutional conditions are surveyed by means of structured interviews with the stakeholders. In total, 16 structured interviews each of about 1.5 h were conducted, the sample consisted of experts in the field of energy efficiency and building efficiency from relevant governmental institutions and from universities and of the stakeholders of the social housing case study like the municipality of Rio de Janeiro, the financing institutions, the contractor and project developer as well as engineers and architects. The result of the qualitative analysis is a comprehensive image of constraints of energy efficiency and opportunities for energy conservation in the sector, and leads to recommendations and guidelines for a more energy-efficient social housing in Rio de Janeiro and Brazil.

For the project design analysis of the case study, further instruments are used. The ECOTECT software, a building design and environmental analysis tool, is applied to calculate the solar exposure of the building facades, to estimate the solar gains through the windows and to simulate the thermal performance of the buildings. Due to the simplicity of calculation algorithm for ventilation gains of the ECOTECT software, the accuracy of the results of the thermal performance is limited. Also, a simplified qualitative approach was adopted to estimate the potential for natural ventilation in the case study.

3. Situation of social housing in Brazil

3.1. The housing deficit

In Brazil, millions of families are excluded from the access to dignified housing. In 2006, the Brazilian housing deficit reached the number of 7.96 million housing units, 76% in the cities and 24% in rural areas (Salles, 2007).

The Brazilian housing deficit has major regional disparities, reflecting the general regional socio-economic inequalities (IBGE, 2008). The federal states São Paulo and Rio de Janeiro have the highest deficit in absolute terms, with 1.5 and 0.8 million lacking housing units, respectively. In relative terms, the largest deficits are in Maranhão (38.1%), Amazonas (33.7%) and Pará (33.5%). The lowest housing deficit was recorded in Santa Catarina (8.8%), Paraná (8.9%) and Espírito Santo (9.8%) (Salles, 2007). The highest concentration can be found in the urban areas of the metropolitan regions in the North- and South-east. Related to the income, the poorest share of the population (up to three minimum wages, a total of 1.1 million) is highly affected by the housing deficit, compared to only 200,000 missing housing units in the income share above three up to five minimum wages (IBGE, 2008; Larchner, 2005).

The Brazilian housing deficit surfaces in precarious housing, cohabitation of families and the excessive financial burden through renting (Fundação João Pinheiro, 2006). The cohabitation is the largest component in urban areas, independently from the region, and corresponds to 60.8% of the total housing deficit in the Brazilian cities. In contrast, precarious housing is more present in rural areas, especially in the North-east and North region. The component of the excessive burden through rent payments is examined only in urban areas and has its highest share with 37.3% and 28.9% in the South-east and Centre-west regions of Brazil.

3.2. Federal housing policy

In 2000, the Brazilian national housing policy started to be reformulated by the “Ministério de Cidades” (Ministry of Cities)

and is now known as “Sistema Nacional de Habitação” (National System for Housing). The main strategy of the new housing policy is to extend the private housing construction sector that, until now, was limited to the luxury market in the middle class. Federal financial resources focus now on the low-income classes up to 5 minimum wages,¹ where the highest housing deficit at no less than 92% is concentrated (Maricato, 2005).

The National System for Housing, established by the law N° 11.124 in 2005, has a subsystem for social housing called “Subsistema de Habitação de Interesse Social”. The involved entities of this subsystem for social housing are governments and housing councils on federal, state and municipal level, promoters, funding agents and technical agents.

Several funds are provided by the government for the implementation of social housing programmes that are mostly administrated by the Caixa Econômica Federal (CAIXA), the most important financing agency in the housing sector in Brazil. In 2005, the CAIXA was responsible for financing 86% of new housing units. In 2006, 408,325 new housing units were constructed by different public housing programmes, whose funds are administrated by the CAIXA (CAIXA, 2008). Until today, only the CAIXA is participating in large scale credits programs for low-cost housing, as private or investor-owned banks shy the risk of underfunded credit lines (FTD, 2010).

The social housing system of Brazil consists of 12 different social housing programmes that differentiate between individual or collective initiator, public or private person, new or existing housing, income bracket and funding conditions (Ministério das Cidades, 2008). The PAR programme (Programa de Arrendamento Residencial) is one of those social housing programmes, designated for the population with currently a maximum family income of four minimum wages and has been responsible for the production of 259,898 housing units since 1999 (Ministério das Cidades, 2008). In 2006, the PAR programme was responsible for the construction of 10% of the new housing units (CAIXA, 2008).

3.3. Social housing in Rio de Janeiro

The Secretaria Municipal do Habitat (SMH) or Municipal Secretariat of Housing is the institution that coordinates the housing policy at municipality level in Rio de Janeiro. Created in 1994, the SMH focuses on the upgrading and regularization of the shanty towns (called “favelas”) and site development as well as on the promotion of new housing construction for the low-income population in areas with existing infrastructure. The mission of an SMH is to ensure the access to legal housing and urban infrastructure as a basic social right, using an integrated participatory process of urban planning. In contrast to the CAIXA as national public bank, the SMH is a small institution on municipal level with relatively low budget. The SMH has mainly a coordinating function within the implementation process of social housing projects.²

For the new construction of social housing estates in Rio de Janeiro, four principal players are identified: the municipality with the SMH, the promoter, the funding institution (e.g. CAIXA) and the beneficiaries (Fig. 1). With the identification of possible plots for social housing, the SMH is in most cases the initiator of a project contacting the promoters. These may be the public housing company (in Rio de Janeiro: Cehab-RJ) or a private constructor which is contacted by the SMH and elaborates the

¹ 1 minimum wage = R\$ 510 (Ministerio do Trabalho e Emprego, 2010).

² Personal interview with Heloui, N., Programme manager “Novas Alternativas”, Secretaria Municipal de Habitat de Rio de Janeiro (SMH), Rio de Janeiro, 8 May 2008.

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