Sustainable Cities and Society xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Sustainable Cities and Society

journal homepage: www.elsevier.com/locate/scs

Rethinking social housing: Behavioural patterns and technological innovations

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ARTICLE INFO

Keywords:
Social housing
Energy behaviour
Retrofit technologies
Occupants'
Training measures

ABSTRACT

The building sector accounts for 40% of energy use and 25% of CO_2 emissions, mainly due to inefficient building practices and energy consumption during the operational phase of buildings. Social housing accounts for a significant proportion of the European building stock and about 50% of the existing buildings are likely to require large-scale renovations in the coming years, meeting the current EPBD directive. This could represent an opportunity to renovate the affordable building stock, often characterized by premature disrepair, resulting in a bad perception from inhabitants and community. Significant European experiences have already shown the importance of an integrated approach finalized to the construction or renovation of social housing, leveraging on environmental sustainability, creating urban identity, adopting measures to face social disadvantage, offering at the same time quality housing standard. In this regard, it seems necessary to match technological advancements and knowledge in energy retrofitting with social needs and habits. The implementation of energy-efficiency improvements in social housing requests support and participation of the final energy consumer. The paper investigates how to deal with knowledge gaps in the relationship between retrofit technologies and users' behaviour and possible strategic measures to increase awareness between tenants through two case studies.

1. General framework

The built environment accounts for a significant share of anthropogenic greenhouse gas emissions, mainly due to inefficient building practices and energy consumption during the operational phase of buildings (Harvey, 2010). At the European level, buildings account for 40% of energy consumption and about 25% of CO_2 emissions (Tommerup and Svendsen, 2006; Uihlein and Eder, 2010).

The 2010 European Directive on Energy Performance of Buildings (2010/31/EU), implementing the previous 2002 Directive (2002/91/EC), is aimed at improving the energy efficiency of buildings to a nearly zero-energy standard by 2020 and is expected to reduce total EU energy consumption by 5% to 6%, as well as CO_2 emissions by about 5% (Anonomous, 2017a). The Directive involves not only new buildings, but also existing buildings liable to significant renovation, which is representing about 70% of the building stock by 2050 (Visscher, Sartori, & Dascalaki, 2016) and so a promising target to reduce the environmental impact of the building sector.

Research studies and applications demonstrate that retrofitting existing buildings could contribute to a significant reduction of energy consumption. For example, Ecofys explores the effects of the Energy Performance of Buildings Directive (EPBD) on the energy efficiency of the European existing building stock, in terms of heating energy savings, and demonstrates that the residential sector contributes for 77% through retrofitted single- and multi-family houses (Petersdorff, Boermans, & Harnisch, 2006). Recently, a study of the Joint Research Centre (JRC) shows that the main environmental improving potential is represented by single-family houses, followed by multi-family houses, that represent the 53% and 37% of the European building stock, respectively (Nemry and Uihlein, 2008).

Significant European experiences (BedZed in London, Hammarby Sjostad in Stockolm, Malakoff Neighbourhood in Nantes) show the importance of an integrated approach at the basis of the construction or renovation of social housing, leveraging on environmental sustainability of works, creating urban identity between the inhabitants, adopting measures to face ghettoization and social disadvantage, offering at the same time quality housing standard, higher comfort levels and affordable using/maintenance costs. (Table 1)

Despite the great efforts spent in developing effective technological solutions for retrofitting, a number of implications dealing with energy issues, climate changes, and economic development are still underestimated (Boeri, Antonini, & Longo, 2013). It has been observed that

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http://dx.doi.org/10.1016/j.scs.2017.05.015
Received 31 October 2016; Received in revised form 19 May 2017; Accepted 20 May 2017

Table 1
Housing models and related pilot cases (Gianfrate and Piccardo, 2016).

Models	Pilot cases
Collective housing: Addressed to specific target, satisfying housing needs of short and very short period (temporary workers, facilities users, etc.). The collective housing can host public services at urban or neighbourhood scale. It is usually funded by public investments, but not always the promoter is the building owner.	- Social Housing a Vallecas http://www.archdaily.com/643384/social-housing-in-vallecas-vazquez-consuegra - Social Housing for mine workers, Asturie http://www.archdaily.com/153189/social-housing-for-mine-workers-zon-e-arquitectos - Edificio Residenziale Ex Berardi http://www.premioinarsind.it/edizione-2010/de-appolonia-botticini-edificio-residenziale-area-ex-berardi/
Rental brokerage services: The service is direct to improve housing people independence. It include individual or community projects, or offer economic assistance to support inhabitants in their inclusion process, in a short-medium term project (from several months to two years)	- Quayside Village Vancouver, CA http://cohousing.ca/places/canada/british-columbia/north-vancouver/bc_cohousing/quayside-village/ - Progetto Stessopiano Torino http://www.stessopiano.it
PPP (Public-Private Partnership) − based social housing: The PPP promotes an housing project at local level, with the aim to attract investments on developing urban areas, in the renovation of derelict neighbourhood, with interventions at building/district scale. The final objective is to improve rental and for sale dwelling provision, with affordable prices and good quality solutions. (Gianfrate, Antonini, Longo, & Copiello, 2016)	- Cenni di cambiamento, Milano www.cennidicambiamento.it/ - Parma Social House, Parma http://www.comune.parma.it/comune/Pages/pagina_generica.aspx?ID=0ef7b1a9-8362-46be-8ed4-4cb6f58eb2c6 - Abitiamo Insieme Ascoli, Ascoli Piceno www.abitiamoinsiemeascoli.it/ Luoghi Comuni, Torino http://www.luoghicomuni.org
Community housing: Direct construction of residential complexes, by inhabitants communities, joint by the common desire to obtain a home. This category collects self-construction initiatives, co-housing, self-refurbishment. The promoter is usually the community. All the inhabitants involved after the construction have to accept the living programme, with a formal commitment of the community housing rules.	- Coin Street London www.coinstreet.org - Cohousing NumeroZero Torino, http://www.cohousingnumerozero.org - La corte dei girasoli, Vimercate http://www.lacortedeigirasoli.it

Table 2
Non technological barriers in the retrofitting of the existing building stock (Source: Barriers and possibilitiesfor a more energy efficient construction sector − SECURE Project).

Non technological barrier	example
Legal	• Contractual • Guarantee period • Business agreements • Local building plants • Directive on energy performance
Financial	• Life-cycle cost • Investment cost • Pay-off time • Impact on tax assessments • Energy price
Organization of the sector (building sector, market)	• Organization of the sector • Dialogue understanding between partners • Availability of technological solutions • Customer demand • Esthetics • Cultural values
Social	• Social planning • Public or individual energy supply provider • General or individual measurements of energy performance • User behaviour/comfort • Cultural aspects • Social aspects • Age/generational aspects

the most critical factors that can reduce the actual number of efficient renovation initiatives are non-technical barriers related to legal, financial, social constraints (see Table 2) strongly limiting the feasibility of the interventions much more so than the technical obstacles.

The implementation of energy-efficiency improvements in all key sectors requires the support and participation of the final energy consumer. Behaviour and local cultural factors can drive basic energy use practices (I.P.C.C., 2014): end-users involvement is based on the consumers' knowledge on energy issues and on their awareness on the possible energy efficiency improvement and their understanding of the costs and benefits involved in the different options.

The factors and their relations that influence behaviour and consumption practices are dynamic, strongly dependent by human elements: they change over time, conditioning consumer behaviour, so the process of consumption practices becomes somewhat irrational and to some extent unpredictable (EEA, 2013). Shove argues that there is a close relationship between behaviours and infrastructure (Shove, 2010): energy infrastructure (e.g. smart grids, heating & cooling systems, mobility and transport systems) plays an active role in people life, but the interaction with new energy technologies and their comprehension presents lacks and delays.

One of the cause of this "lag" consists in the stressed recourse to hi-tech energy efficiency measures, especially in residential sector, where the variability of requirements, habits, motivations, awareness and financial liquidity of tenants is more evident. This aspect weights on the refurbishment interventions of the built environment and on new housing constructions, considering the limits in the technological choices and their affordability.

The possible solutions consist in a combination of technical and social measures, through the adoption of user-friendly energy efficiency systems that could facilitate the use by tenants and increase their environmental and energy awareness.

The investigation of the dimension and the value of end users behaviour, before design stage, helps to identify the best strategies to forecast and minimize negative impacts of tenant's habits on the good use and functioning of dwelling technologies, in the achievement of good performance of buildings.

The introduction of public participation strategies and user's awareness in the design process, as well as design tools and support measure for users for improving a better relationship between user and technological system (and so a better housing quality), can support more functional and contextualized choices about the technologies employed. This integrated approach support energy access strategies in the residential sector, and especially in Social Housing, which require an effective use of energy with the minimum purpose of economic and technological resources.