Social Green
Interreg Europe

SOCIAL GREEN - REGIONAL POLICIES TOWARDS GREENING THE SOCIAL HOUSING SECTOR

The Energy/Comfort Nexus: Towards Adaptive Approaches in Europe

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The Social Green project in brief

Social Green is funded by INTERREG Europe and is scheduled to run between April 2016 and September 2020. It has received funding of 1.01m euros from the European Regional Development Fund (ERDF), which is distributed among eight partners in six countries: Tartu Regional Energy Agency (EE); Extremadura Energy Agency (ES); Regional Energy Agency North (HR); Regional Coordination and Development Commission of Norte (CCDR-N) (PT); Centre for Excellence and Innovation in the Automotive Industry (CEiiA) (PT); Alba Iulia Municipality (RO); South Muntenia Regional Development Agency (RO); and Nordregio – Nordic Centre for Spatial Development (SE). One advisory partner, Nordregio (Sweden), provides scientific and technical support to the consortium. The other partners, local authorities, energy agencies and managing authorities work jointly in the development of the main project's activities, namely preparation, implementation and monitoring.

Social Green promotes the greening of the social housing sector through mutual learning and the development of improved regional policies. It provides the opportunity to explore green building practices and significantly reduce greenhouse gas emissions through cost-effective means, while providing much needed housing in a healthy and sustainable manner. Through interregional cooperation, Social Green stakeholder regions identify, share and transfer innovative methodologies, processes and good practices in developing and implementing greener social housing sector policies, targeting new constructions or retrofitting existing buildings. In this context the project's sub-objectives are:

1. To understand the role of green building intervention in the social housing sector and the link with fuel poverty
2. To identify green measures for the social housing sector, specifically including energy efficiency and renewable energy development
3. To identify, share and transfer experiences and good practices and to develop joint policy tools and instruments related to innovative solutions for greening the social housing sector in the areas of fuel poverty and energy efficiency
4. To develop strategic guidelines and policy recommendations as an integrated toolkit for regional and local authorities
5. To improve regional/local policies by introducing best practices into EU mainstream programmes in order to contribute towards fostering the competitiveness, sustainability and social cohesion of cities, regions and the EU as a whole.

Introduction

Housing plays a pivotal role in the path to a sustainable future. Within the European Union (EU), buildings are responsible for approximately 40% of energy consumption and 36% of CO_2 emissions (European Commission, 2018). According to the Intergovernmental Panel on Climate Change, the housing sector has the most potential for improvement without extra cost in the near future (UN-Habitat, 2012). UN-Habitat estimates that energy consumption in buildings can be reduced by about 30–50% globally, and even simple retrofitting procedures can significantly reduce the environmental impact of many homes (UN-Habitat, 2015).

Building new energy-efficient dwellings is part of the solution. However, there has been significant fluctuation in the rates of building construction over the past decade, and new construction alone cannot solve the energy efficiency challenge (Eurostat, 2018a). It is estimated that to achieve Europe's energy efficiency goals, 97% of the current building stock needs to be upgraded to achieve high efficiency standards (BPIE, 2018).

To stop the increase of carbon emissions in the building sector, the Energy Performance of Buildings Directive (EPBD) (European Parliament, 2018) introduced the nearly-Zero-Energy-Buildings concept (nZEB) and established its mandatory implementation for new and retrofitted buildings, after the end of 2020. These buildings present very high energy performances with very low energy needs that are to be satisfied with renewable energy sources harvested on-site (BPIE, 2011).

But does this strategy work for every European country? And every building?

Existing buildings face several barriers when it comes to retrofitting and even more when the target is nZEB. This gets even more difficult when the building is part of social housing. Buildings belonging to social housing face severe economical, technical, legislative, social and organizational barriers to renovation (Diacon, 2013 in Almeida et al., 2013).

But there are other factors influencing the applicability and effectiveness of energy efficiency solutions in housing. The behavioural dimension of energy efficiency is often overlooked at the expense of the technological one. Analysing the first official definition of fuel poverty[2], the defined threshold is fixed and does not move as the spending and behaviour of households in general changes. However, many households that spend more than 10% of their income on household heating and cooling do not feel energetically poor, and not everyone who feels energetically poor spends more than 10% of their income on household heating and cooling (Henriques, 2018).

The behavioural dimension of energy efficiency has the ability to establish a relationship between the energy-related behaviour of occupants and the way they use energy efficiency technologies. Adopting conventional energy efficiency standards and retrofitting solutions with little integration of this dimension can be detrimental and can often lock-in inefficiencies for the life of buildings.

[2] United Kingdom's (UK) definition: 'A household is said to be in fuel poverty if it needs to spend more than 10% of its income on fuel to maintain an adequate level of warmth' (Department of Energy and Climate Change, 2010 in Thomson et al., 2016).

Through Social Green project collaboration, specific barriers to improve energy efficiency of social housing in the southern European countries have emerged. In this paper, the examples come from the partner regions in Portugal (Region Norte) and Spain (Extremadura), where the behavioural dimension of energy efficiency became especially relevant. These findings show that passive thermal interventions should be prioritized over active systems in social housing retrofitting projects implemented in southern European countries. In this paper, we detail the challenges and potential solutions identified through the work in the first phase of the Social Green project.

Then, the methodology of our research is presented, followed by the key barriers to social housing retrofits in southern European countries, supported by practical examples identified in Portugal and Spain. The final section presents the proposed solutions and opportunities for actual implementation (policy making). Ultimately, this paper is intended to support knowledge-sharing with local and regional authorities from southern European countries facing similar challenges and to highlight the importance of considering adaptative approaches to energy efficiency across Europe.

Methodology

Coupled with the review of key EU policy documents and other relevant bibliography, this paper is based on the empirical findings from a series of Social Green project activities. These include the integrated self-assessment, partner workshops with local stakeholders, good practice selection and the local action plans. The results were subsequently used to identify the barriers and solutions detailed in this article.

Local stakeholder group meetings

Once Social Green began, each local partner initiated a local stakeholder group (LSG) and planned a series of six meetings. These groups include public authorities, private actors, NGOs and social housing residents, and they contributed directly to making self-assessments and drafting each local action plan. By bringing together an array of stakeholders who don't necessarily interact regularly, the workshops also promoted tacit knowledge exchange and collaboration.

Integrated self-assessments

Regional self-assessments were used to collect data and knowledge about the state of the social housing sector and green building in each partner area. The self-assessment reports were drawn up in close cooperation with local stakeholders, making it possible for Social Green partners to access important data and information through their stakeholders, while simultaneously increasing stakeholders' awareness of the state of social housing in the area. The joint analysis of the regional self-assessment added a comparative dimension to the individual assessments, putting the knowledge of the partner regions into a wider territorial context.

Good practices

As part of Social Green, each partner proposed at least four potential good practices from their local, regional or national contexts. Nine principles[3] were used to evaluate the good practice proposals. The principles were based on a review of articles, papers and catalogues, within a range of fields, with a focus on building energy efficiency, social housing and community building. To balance the creation of holistic solutions, variation in local context and opportunities to highlight context-specific strengths, good practices were not required to fulfil all principles, but had to demonstrate excellence in at least three of them.

Action Plans

Over the course of the first phase of the project, Social Green partners have worked together in identifying, sharing and transferring excellence in the policy and practice of energy efficiency in social housing. Based on the lessons learnt from such cooperation, as well as on the outcomes of an active involvement and participation of multiple regional actors, each partner has developed a regional action plan aiming the improvement of the existing instrument of regional policy.

One-size does not fit all: the problem with conventional approaches

According to Eurostat (2017), the heating degree days (HDD) in Portugal and Spain (approximately 1 055 and 1598 HDD, respectively) are significantly lower than the European average (approximately 3 032 HDD). Correspondingly, Portugal (second lowest) and Spain (fourth lowest) are among the lowest consumers of energy per dwelling in Europe (EEA, 2016). Although these countries have a Mediterranean climate and, therefore, expected lower energy needs for heating and cooling, there are other important influencing factors to note.

The behavioural dimension of energy efficiency has been widely debated in the LSG meetings that have been carried out by the Portuguese and Spanish partners of the Social Green project. In Portugal and Spain, unlike many other European countries, households appear to be culturally more prone to adapt to the thermal discomfort in the indoor environment, either by increasing the clothing level during wintertime or by forcing the natural ventilation of indoor spaces during summertime.

Portugal and Spain have some of the highest mortality rates in winter (EuroMOMO, 2015). Both countries have an aging housing stock and reduced percentages of social dwellings where green retrofits have been carried out (Nordregio, 2018). In low efficiency scenarios, thermal comfort depends heavily on the active response of residents when outdoor conditions are unfavourable. Active measures imply energy consumption, which entails costs (in Portugal and Spain, these are borne by the residents). In Portugal and Spain, GDP is below the European average (Eurostat, 2018b), while the price of electricity (Eurostat, 2018c) and

[3] The principles were: resource efficiency in building and operation; achieve a sense of place and community; high quality public engagement; smart financing that supports tenure ship; context-sensitive socio-economic development; resilience to change; access to mobility; scalable and transferable concepts; and effective implementation of strategic policy and governance.

natural gas (Eurostat, 2018d) is above. To reduce spending, households can avoid expenditures on heating, consequently endangering their comfort and health.

In Spain, two forms of fuel poverty appear. One is a classic form well represented by indicators such as the energy effort rate, late payments, and high bills. These households, regardless of their income, spend significant amounts on their gas and electricity bills. With an average of Euro 80 per month, their expenditure corresponds globally to the primary energy consumption modelled by the energy certification process. In other words, these households consume exactly the energy needed to access the thermal comfort standards required by Spanish law. In contrast, other households are invisible to a policy that would rely on these indicators to identify priority cases. Their energy effort rate is well below the 10% threshold established in the UK's definition of fuel poverty. These households do not declare late payments or particularly high bills (average of Euro 35), and yet consume five times less than required by energy certification (Desvallées, 2018).

In Portugal, the situation is similar to the latter with an average energy expenditure around Euro 70 per month in the residential sector (INE & DGEG, 2011). Energy consumption in the residential sector represents around 18% of the total energy consumption. Heating and cooling are responsible for less than one quarter of the energy consumption in this sector (INE & DGEG, 2011). In the social housing sector, the socioeconomic profile of households anticipates a level of heating and cooling costs even lower.

As previously mentioned, unlike other countries in Europe (e.g. France) where the fixed rent already includes utility costs, in Portugal and Spain these are borne by the social housing residents (to whom a subsidy can be applied). In cases like France, social housing managers benefit from the reduction of energy consumption, but not in Portugal and Spain. In fact, in these countries, with energy consumption already close to zero, there are no financial benefits resulting from energy retrofitting projects, not even for residents, as efficiency measures result in theoretical consumption reductions, but not in actual ones. This said, project promoters (being private or public) may not have any incentive to incorporate energy efficiency solutions in their projects as they do not get paid back for their investments. Furthermore, when project promoters are the managers of social housing, renovation projects risk pushing vulnerable households even more into fuel poverty by raising rents.

Applied to all climates, cultures and building types

The concept of fuel poverty is on an unprecedented agenda in the Iberian Peninsula. These situations are being addressed by public authorities, who see it as a social problem calling for solutions. However, the approach continues to be conventional, universally applied to all climates, cultures and building types. This situation was highlighted within the LSG meetings carried out by the Social Green partners in Portugal and Spain.

Efficiency standards

Within the LSG meetings that have been carried out by the Portuguese Social Green partner (Region Norte), the behavioural dimension of energy efficiency has often been referred to as one of the main factors explaining the meagre impact of energy efficiency technologies on energy savings and GHG emissions reduction, in social housing contexts. This group noted

that the transposition to Portugal of the EPBD was not the most appropriate, as there is lack of alignment between the high efficiency standards set out in the European Directive and the sociocultural and climatic reality of the country. Related to this is the unsuitability of energy-active solutions. Even if there are funding instruments available to promote energy efficiency in housing, and specifically in social housing, contributing to the reduction of the upfront costs, achieving a high-energy class entails requirements in terms of equipment to be installed with associated high maintenance costs, which are not eligible when applying for financial support or recoverable through energy savings.

For the Social Green partner in Extremadura (Spain) the main barrier to retrofitting social housing is that high investment is required and not recoverable. Despite the existing programmes and policy instruments, there is shortage of funds allocated for these tasks.

Technical solutions

Discarding high efficiency standards alone does not guarantee success for project promoters or benefits for residents. Region Norte emphasised the ineffectiveness and unsustainability of supporting standardized types of intervention in social housing in face of the diversity of situations that can be found in the region (as reflected in characteristics such as location, size and age of buildings and the related construction technologies).

The most highlighted example during this partner's LSG meetings is related to limitations in the eligibility criteria of the Region Norte Operational Programme (ROP) concerning the support of building materials alternative to the External Thermal Insulation Composite Systems (ETICS). This solution is often used in Europe since the 1970's in the insulation of walls, both in new buildings and in retrofitting. ETICS guarantee the reduction of the thermal bridges and greater thermal comfort at low cost. However, past applications of ETICS have revealed some problems, particularly low impact resistance and the cladding defacement due to biological growth (Barreira & Freitas, 2014). The social housing providers that are part of the LSG from Region Norte complained about performance gaps between design intents and actual performance of ETICS, resulting in considerably shorter than expected durability, leading to unexpected maintenance costs.

Within Norte ROP, standard costs are exclusively defined for ETICS making it difficult to apply alternative solutions, namely the use of materials and building systems appropriate to specific situations in which ETICS solutions do not work correctly, thus "blocking" the adoption of more technically adequate and cost-effective solutions in a medium and long-term basis.

Result indicators

A related challenge refers to the lack of knowledge on these specificities. The exchange of experiences between Social Green partners during the interregional learning events has led them to conclude that, in most regions, there is a lack of evidence on energy performance data in social housing dwellings and buildings prior to and after green renovations. Even though some of the partners have reported the implementation of pilot projects for monitoring energy performance in social housing dwellings and testing different monitoring systems, the group has highlighted the need to further these procedures.

In Extremadura, no green renovations were made in social housing and in Region Norte, in most cases there is no real impact evaluation of these interventions (Nordregio, 2018). In the absence of established practices of real data monitoring, the effectiveness of existing policies supporting green renovations in social housing is measured using standard indicators that do not provide relevant information on the country sociocultural and climatic reality.

In Portugal, within the application for financial support for energy rehabilitation of buildings, an initial audit of the building to be rehabilitated is required and financed. However, this is purely an energy audit (no comfort parameters are assessed) and a theoretical one (energy needs are measured, not actual consumption).

Within the ROP of the Region Norte, the output indicator that has been set out to monitor the implementation of this kind of intervention is the number of households with improved energy consumption classification. In turn, the result indicators are the number of positions climbed in the rank of energy labels in green renovations and the number of social housing dwellings with an improved energy performance score. The target value for 2023 is of at least 15% in the share of social housing dwellings with an improved energy performance score. The LSG noted the lack of alignment between these indicators and the sociocultural and climatic reality of the country. In general, the model of rehabilitation set out in the EPBD, which is based on the definition of energy classes in accordance to the nominal performance of buildings, loses relevance as it is not tuned with existing territorial specificities.

The municipalities represented in the LSG of Region Norte showed interest in extending the scope and depth of local monitoring practices, but affirmed that they have no resources to streamline the process.

Case studies

In Region Norte, deeper diagnosis and monitoring is currently carried out on a limited scale, mainly by universities within the scope of student theses. One of these studies was carried out within the scope of a retrofitting project in the Vila d'Este neighbourhood, one of the good practices[4] highlighted within the first phase of the Social Green project. This study was carried out by the University of Minho, which participated in an LSG meeting of the Social Green project, held in collaboration with another Interreg Europe project (FINERPOL).

As mentioned before, in Extremadura, no green renovations were made in social housing. The case study highlighted here refers to a project implemented in Catalonia (Spain). This project was introduced to Social Green partners by a PhD student in Social Geography and Urban Political Ecology from Laboratoire Techniques, Territoires, Sociétés (LATTS). This student contacted the partnership to collect outputs from the Social Green project to prepare her thesis.

These case studies perfectly demonstrate the diagnosis (described above) that resulted from the LSG meetings carried out by Social Green partners in Portugal and Spain.

[4] For more information about the good practice please visit https://www.interregeurope.eu/policylearning/good-practices/item/940/highly-improving-the-quality-of-life-of-7-500-people-with-one-project/

Vila d'Este neighbourhood retrofitting (Vila Nova de Gaia, Region Norte, Portugal)

Built in the 1980's, this large district (2,085 dwellings) of the Porto metropolitan area had become host to a concentration of social issues. To avoid demolition, while combatting energy poverty, the neighbourhood was retrofitted with focus on social cohesion, community amenities and resource efficiency.

With a total investment of Euro 12,000,000, funded through an urban retrofitting policy promoted by the Portuguese government (80% ERDF through ROP 2007-2013), the retrofitting project included the insulation of facades and roofs, glazing of balconies and installation of shading elements.

A significant reduction of more than 40% was achieved in the building heating and cooling needs (now averaging 75 kWh/m² per year), with an associated annual saving of approximately Euro 850,000. The payback period was estimated to be less than 12 years.

But does it make sense to use heating and cooling needs as a result indicator in a social housing project and specifically in southern European countries? And to calculate energy and financial savings? What is the accuracy of this payback period?

The University of Minho closely followed the retrofitting of the Vila d'Este neighbourhood and carried out a life cycle cost analysis to evaluate if the solution to be executed corresponded to the most cost-effective one. This analysis concluded that the improvement measures to be executed represented an important improvement in the energy performance of the building. But when compared to deeper and more comprehensive retrofitting scenarios, those were found to be well away from optimal levels of profitability. The resulting difference in energy performance between the applied retrofitting solution and the scenario with optimal profitability level was significant, reaching 177 kWh/m² per year. In terms of overall cost, the difference between the optimal variant and the solution applied in the building exceeded 183€/m² (Almeida, M. et al., 2015).

Once again, this analysis was based on the needs of the building. If based on household real consumption, no savings would be achieved. Moreover, all the solutions considered for this analysis included ETICS for the insulation of facades… It is indeed essential that retrofitting options are made by analysing the cost-effectiveness of solutions regarding specificities of each building and considering the life cycle of materials and technologies. However, it is contradictory to want to customize projects to the scale of each building when considering a limited range of solutions and its theoretical durability values.

In addition to the optimum levels of profitability, the University of Minho tested retrofitting scenarios for almost zero primary energy needs, combining measures of energy efficiency with the use of renewable energy. In a life cycle perspective, these proved to be clearly profitable when compared to the pre-retrofitting scenario and even with the retrofitting scenario that was underway. Comparing these scenarios of almost zero primary energy needs with optimal levels of profitability, it also appears that from a macroeconomic perspective where the cost of greenhouse gas emissions is considered, differences in overall costs are not very significant (Almeida, M. et al., 2015).

But how unrealistic is it to consider the cost of greenhouse gas emissions in cost-benefit analyses in social housing in southern European countries, where there are no energy savings or emissions reduction? And why raise project costs including renewable energy solutions that will not be used?

RELS project (Barcelona, Catalonia, Spain)

In 2011, the Catalan Housing Agency launched the RELS project, under the European Neighbourhood and Partnership Instrument (ENPI-CBC Med), aiming the creation of knowledge and dissemination of a methodology for energy retrofitting in social housing, in the relatively mild climates of the Mediterranean basin.

An energy diagnosis and a simulation of consumption according to various scenarios were developed in two social housing pilot sites in Barcelona. The results of the consumption modelling showed that the initial target of the project - 20% reduction in these household primary energy consumption and CO_2 emissions, increasing the share of renewable energy to 20%, and improving energy efficiency by 20% - was unrealistic. This represented a turning point in the perception of the problem by the technical engineers of the Catalan Housing Agency (Desvallées, 2018).

Solutions

Within the RELS project, the Catalan Housing Agency's strategy was to test all technologies available by applying these to the pilot sites, opposing active systems to passive measures, for future decision making. With a reduction in the fuel poverty rate from 67% to 0%, the operation was a success. But the total cost amounted Euro 20,000 per dwelling, a sum that is not financially feasible without EU support.

Conclusions dictated that solar thermal and photovoltaic panels should be discarded: tenants consume too little, or too much, making the flow management complex and increasing the investment necessary for maintaining this equipment. Heating and cooling systems in dwellings were also discarded, based on their inadequacy for household incomes. Passive measures, which mainly correspond to improvements in the insulation and ventilation of the buildings, revealed to be the most appropriate means for the promotion of thermal comfort.

The findings of the RELS project resulted in the Catalan Housing Agency setting a new indicator to be achieved by projects tackling energy efficiency in social housing: instead of directly measuring efficiency gain in dwellings, a minimum interior temperature of 17 °C should be achieved, without this being reflected in household expenditure. It is therefore a question of reducing the theoretical consumption demand so that it corresponds to the actual demand.

This case study perfectly sums up the previously identified challenges and proposes a very structured and viable strategy to reverse them. Based on this example, suggestions that have arisen from the LSG meetings in Region Norte and Extremadura and actions included in these partners' action plans, a series of solutions to these barriers are introduced.

Define the strategy

In the context of social housing, and especially in southern European countries, intervention strategies should focus on passive thermal comfort and the correction of anomalous situations (construction and environmental pathologies), in a perspective of absence of energy consumption for heating or cooling.

Territorial specificities imply the development of an appropriate legislative framework that clearly sets out the benefits of green interventions, emphasising the refinement of comfort considerations rather than requiring major technological shifts. Policy instruments should also be adapted, and in this matter the regional scale is an interesting reference for the alignment of the various instruments. One possible approach would be to create incentive models for projects that promote increased comfort (e.g. better financing conditions).

The partner in Extremadura is planning on including in its Social Green action plan an action promoting structural changes in the standards to be met by social housing projects when applying to the ROP's support.

Weigh solutions

Spending money on designing passive solutions instead of including active ones is a reasonable budget balancing method. There is a crucial need to raise awareness of costs and benefits of each solution in social housing units, as well as identifying the readily-available, low-cost and most cost-efficient market solutions. Diagnosis must be conducted with all stakeholder groups to understand which solutions might be appropriate to the budget, timing, site, and cultural characteristics of the project. Some basic considerations when choosing sustainable materials are local availability, durability, workability, structural capacity, embodied energy, thermal performance, affordability, disaster risk (fire, flood, and earthquakes), impact on indoor air quality and health, recyclability, installation and maintenance requirements (UN-Habitat, 2015).

Retrofitting options must be taken by analysing the life cycle of buildings rather than looking for measures with low upfront costs. Buildings should be built to be more durable and require less maintenance. The use of more lasting materials and components is a technique that saves materials (and costs) through avoided maintenance and replacement. Additional up-front investment in a more durable design can lead to cost savings through the life of the building and should be quantified as best as possible (Bradshaw et al., 2005).

Furthermore, in the same way that the standards must be customized, the technical and technological solutions to be applied must be flexible, given that diversity is evident not only on a regional scale, but also locally and even in each building.

Policy instruments, specifically support programmes, should consider either the flexibility needed when selecting the solutions to be implemented (eligibility criteria should include a wider range of solutions) and the possible increase in eligible upfront costs.

The partner in Extremadura is planning on including in its Social Green action plan a pilot project to study the use of different local materials in buildings to reach a higher efficiency

without increasing construction costs. The plan is to monitor the construction of four social houses by the regional government to draw conclusions on the used materials (benefits, price, energy improvements, etc.). The decision on the materials to use in each house will be based on the results obtained on the previous one.

Measure results

Monitoring is a transversal dimension to the definition of strategies and identification of solutions and, therefore, the key to the success of the whole. To make the transition between a policy focused on the energy a building needs and one that prioritizes comfort, it is essential to obtain field data. Costs and benefits of this strategy must be clearly demonstrated and tested. To this end, it is important to monitor and evaluate all aspects of sustainable housing including social, economic and cultural (UN-Habitat, 2012).

An occupancy review is essential to assess the operation of the building and to understand how the building performs compared to expectations in terms of energy consumption and thermal comfort. Campaigns should be developed to monitor the real conditions of use of social housing buildings and the range of currently measured parameters should be broadened. Important lessons are learned from parameters such as the real energy consumption of the household, humidity, temperature and air quality inside the dwelling, as well as immaterial parameters of comfort seized from listening to occupants' experience.

A specific technical reference to assess the impact of energy efficiency actions in social housing in southern European countries should be developed, tested and disseminated. Current evaluation tools of public policies focused on the green retrofitting of social housing should be adapted. On one hand, alternative indicators should be considered, which directly assess the behavioural dimension of energy efficiency (e.g. immaterial indicators measuring comfort). On the other hand, existing policies supporting green renovation projects should require (and support), right from the application phase, the completion of a broad diagnosis of the pre-implementation situation and result monitoring.

The partner in Region Norte is planning on including in its Social Green action plan an action that encompasses the establishment and implementation of a monitoring and evaluation framework that measures the impact of green renovations in social housing that have been supported by the ROP. The plan is to monitor the real energy consumption in social housing dwellings in which green renovations have already taken place. Based on the analysis of the data collected in the selected dwellings, the task also involves the assessment of the impact of the energy efficiency technologies supported by the ROP on energy savings and GHG emission reduction in social housing. Also planned is the definition of alternative and more suitable result indicators and the development of technical references for increasing the cost-effectiveness of public investment in greening social housing.

Conclusion

There is an urgent need to find housing solutions that do not adversely impact housing affordability and truly enhance residents' well-being. For a sustainable approach to be successful, it is important to have a clear idea about the habits, lifestyles and preferences of a society and define applicable solutions and realistic responses to actual needs. Design of green housing to fulfil environmentally sustainable objectives requires careful sociotechnical consideration of the site, building form, material selection, and technical services selection. Energy demand, for example, is a dynamic three-way interaction between climate, people and buildings.

Social housing buildings are a very particular case in the context of residential buildings to be retrofitted: the socioeconomic situation of the resident population must condition the retrofitting strategy to be implemented. It is widely recognised that the most efficient and sustainable way to deal with fuel poverty is to reduce the energy demand of the building through renovation. But even more relevant is the fact that these projects need to be designed with long-term affordability in mind, placing beforehand the health and economic needs of social tenants.

The obligation to consider conventional standards and, consequently, to use construction technologies and techniques that require high maintenance and associated costs was the main challenge to the energy rehabilitation in social housing, both in Portugal and Spain.

In southern European countries, the evidenced reduced energy consumption implies that the reduction of energy demand in social housing should aim at improving thermal comfort, as a contribution to improve tenants' health and quality of life, but without the expectation of saving either energy, emissions or money. Thus, in these countries, passive energy efficiency solutions are more relevant and entail less life-cycle costs than active ones.

The conclusions reached by the Social Green partners in Portugal and Spain should set an example not only for other countries in Southern Europe but for all countries and regions. The diversity of situations in the housing sector (size, age, ownership, geographical distribution, resident profile and regional climate) requires flexible and adaptative responses. Since the core concept of thermal comfort is more of a state of mind (reflecting different cultural, class and geographical conditions) than a technical certainty, if an exhaustive analysis of adaptability is not performed previously, the adoption of conventional standards or benchmarks for comfort should be vigorously discouraged.

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