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Housing Cost Affordability in social housing interventions: analysis of the operating variables impact on the housing costs of a temporary dwelling in Turin

ABSTRACT

Even though if social housing is characterised by the wide diversity of national housing situations, conceptions and policies across member states it is possible recognize a relative convergence in the defining elements of social housing across European Union (EU) member states, namely: i) the existence of specific missions of general interest; ii) the objective to increase supply of affordable housing through the construction, management, purchase, and letting of social housing; and iii) the definition of target groups (either in socio-economic terms or in relation to other types of vulnerability) (Czischke and Pittini, 2007). Moreover it is very difficult to agree on ameaningful common definition of social housing. However, there seems to be consensus on that *social housing is housing for those whose needs are not met by the open market and where there are rules for allocating housing to benefit households*[4].

In such a context the experience carried out by the *Programma Housing della Compagnia di San Paolo*, in close collaboration with the *Ufficio Pio*[5] since 2009, and in partnership with other external parties has promoted two experimental projects aimed at building two Temporary Dwellings in Turin. Temporary Dwellings can be defined as structures intended for subjects in a situation of housing vulnerability or who need transitory housing solutions; they are characterised by the temporariness of the guests' stay, by limited rent costs and by the opportunity, for people living there, of enjoying common services and spaces. These buildings may represent one possible response to the growing housing needs expressed by a segment of the population that is placed in the so-called "grey zone" of income, that is a range that does not allow access to programs of public housing, but at the same time it is not sufficient to cover the costs of the rent that characterise the market rent.

The paper discusses the results emerging from a research carried out since 2010 by *SiTI*[6] on a social housing intervention currently in progress. The aim of the research relays in defining a model useful to control the building integrated sustainability, especially regarding some operating variables such as plants typology, building technologies or inhabitants income burdens, all affecting housing cost components.

The emerging results evidence that it is effectively possible to balance the housing costs components (rent rates and operating expenses) with the energetic performances of the building, reaching up to -60% of energetic expenses and up to -10% on the housing cost variables as a whole. The results highlight the importance of defining flexible scenarios also for the Temporary Dwellings manager. The value of the analysis lies in showing how to take into account architecture, plants and relative impacts on housing costs, in order to define the best mix of technical and operating inputs, to foresee

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[4] See www.cecodhas.org

[5] Instrumental body of the Compagnia di San Paolo, an institution founded in the sixteenth century in Turin and addressed to support the vulnerable population.

[6] SiTI – Istituto Superiore sui Sistemi Territoriali per l'Innovazione (Higher Institute on Territorial Systems for Innovation) is a non-profit association set up in 2002 between the Politecnico di Torino and the Compagnia di San Paolo, to carry out research and training oriented towards innovation and socio-economic growth. See www.siti.polito.it.

and adjust the economic and social variables themselves, also in relation to a specific urban location and a peculiar *mixitè* of inhabitants.

Keywords: Social housing, Energetic performances, Income burdens, Energetic expenses, Housing cost

Introduction

According to the Second Biennial Report on Social Service of General Interest[7], *social housing provision encompasses development, renting/selling and maintenance of dwellings at affordable prices as well as their allocation and management, which may also include the management of housing estates and neighbourhoods. Increasingly, management of social housing can encompass social aspects: for example, care services are involved in housing or rehousing programs for specific groups or in debt-management for low-income households. In most cases, however, specific care institutions cover the acre component and collaborate with social housing providers*. Affordability and existence of rules for the allocation of dwellings (i.e. allocation by administrative means, as opposed to market mechanisms) therefore constitute the core common features of social housing in the EU.

An official definition of social housing in Italy has been provided for the first time in 2008. *Social housing consists mainly of dwellings rented on a permanent basis; also to be considered as social housing are dwellings built or rehabilitated through public and private contribution or the use of public funding, rented for at least eight years and also sold at affordable price, with the goal of achieving social mix*[8]. In the past social housing polices used to be implemented by public sector. Most recently, new operators have also entered the social housing scene, mainly Foundations for social Housing development (created by the bank Foundations in partnership with Regions, Municipalities and other private investors).

In the Italy context Temporary Dwellings can be considered a specific type of social housing intervention. This project promoted by the *Programma Housing della Compagnia di San Paolo* - which *SiTI* is partner -, faces a complex and fragmented topic as that of the housing problems, representing a best practice on the national scene, because it shows the ability to activate - in practice - an interesting management process around the real estate development project. This process aims to achieve a high level of transparency in decision-making that requires continuous dialogue between all the experts who work around the implementation of the Temporary Dwellings: engineers, designers, building managers, community psychologists, entrepreneurs, actors in the territory. In this regard the reflections contained in this paper analyse in detail the level of housing cost affordability for users hosted in a Temporary Dwelling (TD) of social housing in relation to energy efficiency. It is a building located in Turin, known as San Salvario TD, whose construction works are still in progress. This is a case of renovation of a listed historic building. The renovation project has been drawn up to safeguard the architectural features of the building and focusing on to the achievement of high performance in terms of energy efficiency. Paying attention on the energy performance of the building has been also possible to perform simulations in terms of housing cost for the TD. Specifically, in the first part is proposed the construction of a threshold of housing cost, simulating changes in the energy efficiency of the building project used as a case study. The second dealt with the sustainability of the housing cost, setting

[7] European Commission – Commission Staff Working Document, *Second Biennial Report on social services of general interest*, Brussels, , 22 October 2010, SEC(2010)1284 final.

[8] Ministry of infrastructure, Decree 22 April 2008, Definition of social housing for the exemption from the notification of State aid pursuant to Articles 87 and 88 of the Treaty establishing the European Community Union (Official Gazette No. 146 of 24 June 2008).

thresholds of income limit for users to access to housing services offered by the TD. Finally further investigations have been processed to verify the relationship between housing cost of the accommodation provided by the TD and housing cost that characterises the market rent. In this regard has been verified the users' spending power who have an income sufficient for accessing to housing services offered by the TD, compared to the cost of living in a market rent that characterises the area in which San Salvario TD is located. In practice the gap of the specific real estate reference market has been determined.

The results obtained are to be considered as an hypothesis and suggestions for a good design and management of this type of buildings. The methodological approach used for the estimate of housing cost, starting from the level of energy efficiency of the building, it can be also applied for the definition of the input data useful for the implementation of a business plan in order to verify the sustainability of social housing dwellings management.

1. From the building energy efficiency to the housing cost

The European Directive 2010/31/EU of 19 May 2010, also known as Energy Performance Building Direttive (EPBD Recast), introduces the concept of nearly zero energy building (nZEB) to indicate a very high energy performance building characterised by a very low energy requirements or almost zero, covered significantly from renewable energy sources. In addition, Article 5 of Directive complements the concept of nZEB with those of cost optimal, actually optimal levels, depending on the cost, the minimum requirements for energy performance, calculated during the estimated economic lifecycle of the building or of the building element. For the implementation of this Directive in the Member States of the EU has been asked to define reference buildings for intended use, distinguishing between new construction and existing buildings, indicating energy efficiency measures and the relative costs (i.e. the Net Present Value). This cost is determined taking into account the costs of energy-related investment, maintenance costs and operative costs (including energy savings, those related to the type of building concerned, earnings from the production of energy) and any costs of disposal. The application of this Directive has subsequently led to the introduction of the concept of nearly net zero energy buildings (nnZEB) (Kurnitski et al., 2011), in order to combine the aspect of energy performance and the optimal level of cost.

Numerous studies have dealt with the calculation of the optimal level of cost for nZEB (Kurnitski, 2011; Kurnitski et al., 2011; Corgnati et al., 2013; Hamdly, Hasan, Siren, 2013; Panão Oliveira, Rebelo, Camelo, 2013) and two research projects in Europe, indicated by the acronym TABULA[9] and ASIEPI[10], focused respectively on the analysis of building types in EU Member States, related to the level of energy performance, and the implementation of the EPBD at Community level.

[9] The TABULA project (Typology Approach for Building Stock Energy Assessment) funded by the EUROPEAN Program called Intelligent Energy Europe, aims to create a European harmonized structure of the building types, with particular attention to residential buildings. Buildings-type are used in each EU Member State as a means to disclose the energy performance and the potential energy savings achievable through the upgrading of the building envelope and heating systems. The Italian contribution to the project TABULA was carried out by the Research Group of the Politecnico di Torino TEBE in December 2011. (http://www.building-typology.eu/).

[10] The ASIEPI project (Assessment and Improvement of the EPBD Impact) funded by the EUROPEAN Program called Intelligent Energy Europe, aims to support Member States in the implementation of the EPBD (Energy Performance Building Direttive) in relation to six different areas: comparing energy performance requirements across EU; impact, control and compliance of EPB regulations; effective handling of thermal bridges in the EPBD context; stimulation of a good building and ductwork airtightness through EPBD; the EPBD as support for market uptake for innovative systems; stimulation of better summer comfort and efficient cooling by EPBD implementation. The Italian contribution to the project ASIEPI was carried out by the research center ENEA and ended in March 2010. (http://www.asiepi.eu/home.html).

In addition, the European Union itself with the Delegated Regulation No. 244/2012 of 16 January 2012 and the next document accompanying the regulation published on 19 April 2012, has defined a methodological framework for calculation of cost optimal levels based on the European Standard EN 15459. This rule provides a method of calculating the overall cost equal to the sum of the present values of the following types of costs:

- cost of the initial investment;
- operative costs (energy costs, operative costs, maintenance costs);
- costs for periodic replacement of building components;
- disposal costs.

Extending this reasoning on the optimal cost toward the green building certification programs it is important to highlight that some studies on the economic value of sustainable buildings assign for a green building an higher market economic value (Morri and Soffietti, 2012) compared to other non-certified buildings. Aspects of economic and financial sustainability of the interventions of social housing, like any real estate investment, can be evaluated in the definition and calculation of some performance indicators such as Net Present Value (NPV), Internal Rate of Return (IRR) and the recovery time of the invested capital (PBP). Moreover for such interventions is particularly important to consider not only the initial investment but also management costs by providing appropriate tools of verification. In the event that the managing entity is different from the constructor, as in the case of Temporary Dwellings under construction by the *Programma Housing della Compagnia di San Paolo*, it may be useful to consider separately the initial investment phase from the management phase.

In a social housing context the consumption reduction and the consequent impact on the housing cost, as a result of improved energy performance of the building is an aspect that deserves to be investigated. In fact, just in order to maintain a high quality of the housing service offered and low rent for users of Temporary Dwellings, the need to reduce consumption (and therefore operative costs) becomes particularly important.

In general, affordable housing cost is defined as the threshold housing cost where the impact on household income does not exceed 30% (Paris, 2007), although at the international level there is not a common agreement on the types of costs that must be considered in spending for the home (for example as regards the expenses for bills). According to EUROSTAT[11] (EUROSTAT, 2010) this threshold includes charges for the rent and operative costs in the service of the building.

The implementation of policies of social housing, in order to provide homes for families who live in a situation of housing vulnerability, have to forecast the control of expenses related to housing as a whole. In the rental market two cost items, in particular, have the greatest impact in the housing cost composition: the rent and expenses for bills. To coordinate effective action in order to reduce the housing cost, joint measures, should be taken into account: from a technical point of view, it is on the second variable (the one of the measures aimed at improving energy efficiency of the building) that is relevant today to deep operating margins of savings for families, considering the trade-off arising from the relationship between investment costs and obtained energy performance.

[11] The definition of housing cost provided by EUROSTAT is the following: *"Housing costs are measured to cover all the costs connected with the right of the household to live in the accommodation concerned, including the cost of utilities (water, electricity, gas and heating). For home owners, they include mortgage interest payments net of any tax relief, insurance on the house, mandatory services and charges (such as for sewage removal or refuse collection), and regular maintenance and repair costs. For tenants, they include rent payments (gross of housing benefits), any insurance on the house paid by the tenant, service charges where applicable and regular maintenance and repair costs, again if applicable. Any housing allowances received are deducted from the gross housing costs as defined above to give the net amount paid"*.

2. Housing cost for San Salvario TD

Built in the mid-nineteenth century, the building is located in San Salvario, one of the most interesting and lively area in the historic centre of Turin, near Porta Nuova train station. In this area, characterised in the 90s by degradation and social tensions, social and urban regeneration schemes have recently been successfully launched. The building overlooks Primo Levi square, facing the Synagogue. It is owned by *Istituto di Santa Maria* and now granted a loan for use to the *Ufficio Pio* for twenty-five years. The project involves the construction of a social housing TD, consisting of 24 apartments and communal areas arranged around a courtyard, the renovation of the nursery school, the nunnery of *Suore di Carità di Santa Maria* and commercial areas.

For the 24 apartments that characterise San Salvario TD, four type of users have been defined :

- apartments designed for families living in conditions of housing emergency;
- apartments designed for families living in conditions of housing vulnerability;
- apartments intended for city users (people who, for reasons of work, study, etc. ... need for temporary dwelling);
- apartments intended for social tourism (which are not involved in this analysis for the purpose of this paper).

In order to estimate the housing cost associated to the apartments, cost of heating, domestic hot water (DHW), energy for cooling, electricity and water consumption for domestic use, as well as those relating to the cleanliness of the accommodation have been considered. The estimation of this type of cost, particularly those related to the coverage of primary energy demand (heating, hot water, electricity) is calculated on the basis of the energy efficiency of the building.

In San Salvario TD the primary energy demand for heating and DHW is comparable to the values that characterise the energy efficiency category A, according to both national and regional legislation.

In particular, the aspect on which we focused, albeit with a theoretical approach[12], is the relationship that exists between the costs of building energy management and the energy efficiency of the same. The basic assumptions on which the valuation model it has been built are that a better energy efficiency of the building means low bills expenses to the users. The estimate of these costs is carried out taking into account the parameters of energy efficiency category of buildings required from national legislation, introducing in this case a simplification compared to the models used to estimate energy consumption according to Italian national standard 11,300[13]. Several national energy performance certificate categories (A, B, C, D and E)[14] have been taken into account in order to monitor the progress of the application of energy to the decreased level of the building energy efficiency (Table 1).

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[12] From the operational point of view, *SiTI*, has launched (in May 2013) a research project to monitor the management phase of the Temporary Dwelling, which will be developed through desk analysis and field activities (measurements of actual energy consumption and analysis of the behaviors of users).

[13] The UNI TS 11300 was born with the objective of defining a calculation method for the unambiguous determination of the energy performance of buildings. It is divided into four parts:

- UNI / TS 11300: PART 1: Evaluation of energy demand for space heating and cooling;
- UNI / TS 11300: PART 2: Evaluation of primary energy demand and of system efficiencies for space heating and domestic hot water production;
- UNI / TS 11300: PART 3: Determination of the primary energy demand and yields for summer air conditioning;
- UNI / TS 11300: PART 4: use of renewable energy and other methods of generation for space heating and domestic hot water preparation.

[14] Ministerial Decree June 26, 2009, National guidelines for energy certification of buildings.

In the calculations for the assignment of the energy building category only the services of space heating and domestic hot water[15] production have been considered. The parameter related to the consumption of electricity for summer cooling has been kept constant for a simplification of the calculations[16]. To determine the overall energy consumption of the building, to the energy requirements shown in Table 1 those related to the additional supplies, which are not affected by the variations related to the energy category,[17]. Transforming, according to the variation of the energy efficiency categories, the energy requirement for heating and DHW[18], electricity and water for domestic use in management costs, theoretically, ranges of variation of costs related to energy efficiency of the building have been defined (Table 2).

Based on the results obtained by the calculations carried out at the scale of the building, it is clear that the costs of heating and domestic hot water are almost quadrupling in the transition from the design values to the E energy category.

Considering the cost related to the energy requirements and water of the entire building it is possible to define a parametric cost calculated on the heated floor area of 2,025 sqm. Also this cost varies, according to the variation of the energy performance of the building, passing from 0.88 €/sqm per month for San Salvario TD to 1.41 €/sqm per month for the E energy category. Table 3 instead shows, always depending on the performance energy, the change in operative costs for housing typology (from studios with one bed, to four room apartments with 4 beds). Adding up the expenses for bills and the monthly rent, can be analysed not only the change of the housing cost in relation to the energy performance of the building but also the impacts of bills on the total costs for different types of users. The rent used to estimate the housing cost is obviously not a market rent, considering the specific social purpose of the building, but it refers to the values of the agreed rent adopted by the City of Turin[19] in application of national law[20]. In addition, the value of the agreed rent, equal to 6.2 €/sqm per month, has been differentiated for the different types of San Salvario TD users, as shown below:

- in the case of apartments for people in situations of housing emergency, reference has been made to the agreed rent decreased by 20%;
- in the case of apartments for households in a so-called *"stress abitativo"* (housing vulnerability) has been considered the agreed rent;
- in the case of apartments for city users has been applied an agreed rent increased by 40% (always less than the market rent).

[15] Ministerial Decree June 26, 2009, National guidelines for energy certification of buildings, Annex A.

[16] In fact, according to the variation of the physico-technical and plant characteristics that determine the request of energy for heating and production of DHW it is also connected a variation in energy consumption for cooling in summer. Since, however, the latter value is not required by Ministerial Decree June 26, 2009 for determination of the overall energy performance of the building, and not having indications relating on energy classes for this indicator, it is preferred to opt for a simplification of the calculations.

[17] It is estimated, in particular, consumption relating to the following utilities:
- consumption of electricity for summer cooling, based on the contained of the report annexed to the design of the building for a total of 4,535 Kwh;
- consumption of electricity for domestic use, it can be assumed an average value of 1,000 kWh / year per each users, plus a 15% of the total attributable to common areas, for a total of about 61,000 kWh;
- water, assuming a consumption of 50 cubic metres / year per each user, more than 300 cubic meters / year for the common parts of the RT for a total of about 3,000 cubic meters.

[18] It is assumed the methane gas as the primary energy source for heating and DHW.

[19] It refers to the values of the agreed rent adopted by City of Turin, showed in the following document: *Renewal of the territorial agreement in accordance with Law 9 December 1998 No. 431 and the decree of Minister of Public Works 30 December 2002,* (http://www.comune.torino.it/urbanistica/locazioni/pdf/RINNOVO%20ACC%20TERRIT.pdf).

[20] National law No. 431/98 "Discipline of leases and the release of the buildings used for residential purposes", regulates the mode of execution and renewal of leases for buildings for residential use.

On the basis of data showed in Table 4, it is possible to notice that the increase in cost related to the energy consumption impacts on the housing cost, as much as the rent is kept low. Even though for energy and water consumption estimated costs theoretical data on consumption related to energy certification categories, have been used, it can be noticed that besides a decrease of the energy performance of the building there is an increase of the share of this type of cost, and inevitability of the housing cost. For example for the same type of apartment for people in a situation of housing vulnerability in the transition from an energy category A towards a category E, there is an increase of 8% in housing cost according to the variation equal to 60% of the energy and water consumption cost (Table 3). The incidence of this cost on the housing cost increases with decreasing energy building performance. It passes, for example, from a percentage equal to 14% for an apartment wide from 75 to 86 square metres in energy category A, up to an incidence of 21% for the same apartment in energy category E. In this regard it would be of paramount importance to be able to verify these data in a real context, monitoring the actual energy consumption costs of the TD once it comes into operation.

3. Housing cost affordability for San Salvario Temporary Dwelling

On the basis of the discussions presented in the previous paragraph, to assess the "maximum cost" for living, sustainable for users of San Savario TD, housing cost data related to apartments which are intended to families in a condition of housing vulnerability, have been compared with the availability of income of families themselves. In this respect it is recalled that EUROSTAT defines as housing cost overburden rate[21] the percentage of the population living in a household where total housing costs represent more than 40% of the total disposable household income. Not being estimated to users of San Salvario TD a contribution to cover the costs of maintenance and insurance, it can therefore be assumed that a housing cost so called "sustainable" does not exceed 35% of net income available to families. The income threshold taken as a reference for the case study has to be high enough not to allow access to programs of public housing for users. Table 5 defines the limit of income from employment or retirement laid down for admission to public housing for the City of Turin. Based on the data shown in Table 5, Table 6 shows the maximum of housing cost for the income thresholds considered "limit" in relation to the composition of households, for access to public housing programs. It has also been made a further elaboration, more cautionary this time, lowering the threshold for affordable housing cost to 30% of net income available to families. The results are included in Table 7.

Focusing on apartments for families in an housing vulnerability situation, maintaining the assumptions about the rental indicated above, it is possible to verify the sustainability of the housing cost according to the variation of the building energy performance with the limit values set out in Table 6. As it can be seen in Table 8, the housing cost value for the case study apartments is less than the maximum sustainable by families as defined in Table 6. Generally it can be observed how starting from the decrease of the building energy efficiency, the housing cost calculated for several types of apartment are no longer sustainable. For example, the four-room apartment with 3 beds becomes already untenable in the case of buildings included in the energy category B, while the two-room apartment with 2 beds is no longer tenable in the case of buildings in energy category E.

[21] The definition of housing cost overburden rate provided by EUROSTAT is as follows:: *"The Housing cost overburden rate is defined as the percentage of the population living in a household where total housing costs (net of housing allowances) represent more than 40% of the total disposable household income (net of housing allowances)".*

In these cases, to bring the housing cost below the threshold identified in Table 6, (i.e. below the 35% of the net income) it is necessary to reduce rents.

Considering instead the cautionary hypothesis, i.e. with the threshold of housing cost affordable calculated in Table 7, it is possible to notice how the cost related to housing for San Salvario TD is sustainable only for users who live in a two-room apartment with 1 bed and for a three-room apartment with 4 beds. The data are shown in Table 9. Obviously, the situation gets worse with a decreasing energy performance of the building. In fact there is an increase in the gap between affordable housing cost and housing cost calculated according to the energy building efficiency.

The validity of the obtained results, as previously indicated, should be tested by monitoring the real consumption of the TD once it comes into operation, in order to define precisely the threshold of sustainable housing cost for households. Concerning the assumptions made in relation to income of the users who could potentially hosted by San Salvario TD, it should be notice that in Table 5 has been defined as a threshold of net income below which users are able to access to public housing programs. Taking into account an income threshold higher than the limit values indicated in Table 5, the availability to bear the costs of accommodation for families of San Salvario TD will inevitably increase. In this regard it would be appropriate to define a range of income referred to the so-called "grey zone" of the population who is living in a situation of housing vulnerability. The definition of this interval must be consistent with the value of the real estate market that characterises the area in which the TD is inserted, as highlighted in the following section.

4. Housing cost affordability by adopting a market rent for San Salvario TD

Finally, it is interesting to examine the spending capacity of the users compared to the housing cost calculated by applying a market rent that characterises the area in which the building of social housing is situated, or check the gap of the specific real estate market of reference.

In this regard it is fundamental to define specific values of the real estate segment market according to San Salvario TD position. Referring to the database of Real Estate Market Observatory consultable in the Agenzia delle Entrate[22], it is possible to check data both for rents and sales prices, minimum and maximum values, in the district in which San Salvario TD is situated. In particular, the market rent is included in a range from 7.8 €/sqm per month to 11.5 €/sqm per month.

Considering the apartments gross floor area of San Salvario TD it is possible to estimate the rent for each on the basis of market values. Adding to the value calculated the cost for operative expenses estimated in the previous paragraph, it is possible to define the housing cost for different types of apartment adopting a market rent. Data are represented in Table 10. Instead, as can it be seen from Table 11, the housing cost, estimated by applying an agreed rent, remains well below the average cost that families would be forced to deal to meet their housing needs by paying a market rent. In fact, the housing cost estimated by applying an average rent of market far exceeds the availability of household expenditure that is placed in a situation of housing vulnerability.

[22] The Observatory for the property market takes care of the collection and processing of information of a technical and economic relating to real estate values, market rents and annuity rates and the publication of studies and statistical. The database Observatory constitutes an important source of information on the national real estate market, serving as a useful tool for all operators in the market, for researchers and scholars in the real estate industry, for public research institutes and private, for public administration and, more generally, for the individual citizen.

5. Conclusion

In Italy the redevelopment of existing buildings, in particular those historical and protected, such as the case study presented, are a topic of great interest especially with regard to the restructuring of asset for purposes of social use. In general, in the project of renovation of existing buildings, the design choices can also influence a lot of what will be the activities related to the management and maintenance of the building. In particular, the design of technological systems and solutions aimed at improving the energy performance is an aspect that has the greatest effect on operative costs.

The first part of this paper introduced some topics related to the buildings energy efficiency and in particular the relationship between the energy performance of the building and costs of energy management. It has analysed the impact of these costs on the housing cost, appearance of great importance especially when referring to social housing buildings designed to respond to housing needs of people in a situation of housing vulnerability. The case study presented, i.e. a TD intended to provide apartments to people with limited income but unsuitable to access programs of public housing, however, it is not an exception in terms of housing supply in the national context. In fact, many projects have been completed or are in progress in our country aimed at this specific target, belonging to the so-called "grey zone" of the population. Rather, the case study represented the information base from which the data for the analysis conducted have been derived. These analysis treated systematically key elements that revolve around the economic and financial management of social housing buildings. The energy efficiency of the building, the cost of utilities, the rent, the household income, the characteristics of the real estate market into which the building is inserted, are all variables that must be considered in order to build an effective management model for interventions of social housing. Although the results obtained are to be considered in the specific context of the application in which they have been calculated, and therefore cannot be generalized, the paper presents an evaluation methodology that can measure the impact of these variables on the housing cost. The study presented is, in this sense, a pilot project aimed at establishing an information base representative of the urban area of Turin. The goal has been to deepen the local scale mechanisms that regulate and influence the choices with regard to good design and management of this type of building, especially in relation to the social purpose for which they are built.

This paper shows the results of the research named "Sviluppo di modelli e processi integrati di progettazione: applicazione di metodologie per la verifica della sostenibilità degli interventi edilizi di social housing" (development and design of integrated processes: application of methodologies for the verification of the sustainability of social housing interventions), conducted at SiTI - Higher Institute on Territorial Systems for Innovation (workgroup: Ingaramo L., Bagnasacco M., G. Baù, Bodano F., Sabatino S., A. Talarico, K. Zavaglia).

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Table 1 – Energy demand of the project compared to energy performance categories for San Salvario TD

	Energy performance category									
	Project value - A (kWh/m^2 a)	**threshold from A and B (kWh/m^2 a)**	**Average B (kWh/m^2 a)**	**threshold from B and C (kWh/m^2 a)**	**Average C (kWh/m^2 a)**	**threshold from C and D (kWh/m^2 a)**	**Average D (kWh/m^2 a)**	**threshold from D and E (kWh/m^2 a)**	**Average E (kWh/m^2 a)**	**threshold from E and F (kWh/m^2 a)**
Energy performance index for winter heating	**31.5**	**32.27**	40.34	48.41	56.47	64.54	72.61	80.675	96.81	112.95
Energy performance index for the production of domestic hot water	**8.75**	**9**	10.50	12	15.00	18	19.50	21	22.50	24
Index of overall energy performance	**40.25**	**41.27**	50.84	60.41	71.47	82.54	92.11	101.68	119.31	136.95

Source: Authors' processing based on SiTI data

Table 2 – Estimated costs of the annual consumption of energy and water according to different energy categories for San Salvario TD

	Energy performance category				
	Project value - A	**Average B**	**Average C**	**Average D**	**Average E**
	€/year	**€/year**	**€/year**	**€/year**	**€/year**
Total costs	**21,404**	23,119	26,461	29,803	34,209
Costs referred to winter heating + domestic hot water	**6,519**	8,234	11,576	14,918	19,324
Percentage change of costs on the project value calculated on total	-	8%	24%	39%	60%

Source: Authors' processing based on SiTI data

Table 3 – Estimated cost of the monthly consumption of energy and water for type of apartment for San Salvario TD

	Gross floor area	**Energy performance category**				
		Project value - A	**Average B**	**Average C**	**Average D**	**Average E**
		operative costs				
Type of apartment	**sqm**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**
Studio (1 bed)	29	**26**	28	32	36	41
Studio (2 beds)	35	**31**	33	38	43	49
Two-rooms apartment (1 bed)	46	**40**	44	50	57	65
Two-rooms apartment (2 beds)	58	**51**	55	63	71	82
Three-rooms apartment (3 beds)	64	**56**	61	70	79	90
Three-rooms apartment (4 beds)	69	**61**	66	75	85	97
Four-rooms apartment (3 beds)	75	**66**	71	82	92	106
Four-rooms apartment (4 beds)	86	**76**	82	94	106	121
Percentage change of costs on the project value	-	-	8%	24%	40%	60%

Source: Authors' processing based on SiTI data

Table 4 – Housing cost for type of users for San Salvario TD

Type of users	Rent	Energy performance category									
		Project value - A		Average B		Average C		Average D		Average E	
		operative costs	housing cost	operative costs	housing cost	operative costs	housing cost	operative costs	housing cost	operative costs	housing cost
Housing emergency	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**
Two-rooms apartment (2 beds)	248	**51**	**299**	55	303	63	311	71	319	82	330
Three-rooms apartment (3 beds)	278	**56**	**334**	61	339	70	348	79	356	90	368
Percentage change of costs on the project value		-	-	-	1,4%	-	4,1%	-	6,8%	-	10,3%
Incidence of the housing cost of utilities (on two-rooms apartment with 2 beds)		-	17%	-	18%	-	20%	-	22%	-	25%
Housing vulnerability	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**
Two-rooms apartment (1 bed)	248	**40**	**288**	44	292	50	298	57	305	65	313
Two-rooms apartment (2 beds)	310	**51**	**361**	55	365	63	373	71	381	82	392
Three-rooms apartment (3 beds)	347	**56**	**404**	61	408	70	417	79	426	90	437
Three-rooms apartment (4 beds)	372	**61**	**433**	66	438	75	447	85	457	97	469
Four-rooms apartment (3 beds)	403	**66**	**469**	71	474	82	485	92	495	106	509
Four-rooms apartment (4 beds)	465	**76**	**541**	82	547	94	559	106	571	121	586
Percentage change of costs on the project value		-	-	-	1,1%	-	3,4%	-	5,6%	-	8,5%
Incidence of the housing cost of utilities (on four-rooms apartment with 3 beds)		-	14%	-	15%	-	17%	-	19%	-	21%
City users	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**
Studio (1 bed)	217	**26**	**243**	28	245	32	249	36	253	41	258
Two-rooms apartment (1 bed)	347	**40**	**388**	44	391	50	397	57	404	65	412
Two-rooms apartment (2 beds)	434	**51**	**485**	55	489	63	497	71	505	82	516
Percentage change of costs on the project value		-	-	-	0,8%	-	2,5%	-	4,2%	-	6,3%
Incidence of the housing cost of utilities (on two-rooms apartment with 1 bed)		-	10%	-	11%	-	13%	-	14%	-	16%

Source: Authors' processing based on SiTI data

Table 5 – Threshold of income from employment or retirement laid down for admission to public housing programs in 2012

	Threshold for access to public housing programs		
	Gross income	**Taxation**	**Net income**
Components for the household	**€/anno**	**%**	**€/anno**
1 o 2 people	20.646	36%	**13.214**
3 people	25.189	36%	**16.121**
4 people	29.318	36%	**18.764**

Source: City of Turin, Informacasa

Table 6 – Maximum sustainable housing cost from families with incomes above the threshold to access to public housing programs (assuming 35% of net income)

	Threshold for access to public housing programs (net income)	**Housing cost**		
Components for the household	**€/year**	**% net income**	**€/year**	**€/month**
1 person o 2 people	13,214	35%	4,625	**385**
3 people	16,121	35%	5,642	**470**
4 people	18,764	35%	6,567	**547**

Source: Authors' processing

Table 7 – Maximum sustainable housing cost from families with incomes above the threshold to access to public housing programs (assuming 30% of net income)

	Threshold for access to public housing programs (net income)	**Housing cost**		
Components for the household	**€/year**	**% income**	**€/year**	**€/month**
1 person o 2 people	13,214	30%	3,964	**330**
3 people	16,121	30%	4,836	**403**
4 people	18,764	30%	5,629	**469**

Source: Authors' processing

Table 8 – Comparison of maximum housing cost for families to the housing cost calculated in different scenarios of energy efficiency of the building (assuming 35% of net income)

		Energy performance category									
		Project value - A		Average B		Average C		Average D		Average E	
	Maximum housing cost for families	housing cost	variance	housing cost	variance	housing cost	variance	housing cost	variance	housing cost	variance
Housing vulnerability	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**
Two-rooms apartment (1 bed)	385	**288**	**97**	292	94	298	87	305	81	313	73
Two-rooms apartment (2 beds)	385	**361**	**24**	365	20	373	12	381	4	392	-6
Three-rooms apartment (3 beds)	470	**404**	**67**	408	62	417	53	426	44	437	33
Three-rooms apartment (4 beds)	547	**433**	**115**	438	110	447	100	457	90	469	78
Four-rooms apartment (3 beds)	470	**469**	**1**	474	-4	485	-15	495	-25	509	-39
Four-rooms apartment (4 beds)	547	**541**	**7**	547	1	559	-11	571	-24	586	-39

Source: Authors' processing based on SiTI data

Table 9 – Comparison of maximum housing cost for families to the housing cost calculated in different scenarios of energy efficiency of the building (assuming 30% of net income)

		Energy performance category									
		Project value - A		Average B		Average C		Average D		Average E	
	Maximum housing cost for families	housing cost	variance	housing cost	variance	housing cost	variance	housing cost	variance	housing cost	variance
Housing vulnerability	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**	**€/month**
Two-rooms apartment (1 bed)	330	**288**	**42**	292	39	298	32	305	26	313	17
Two-rooms apartment (2 beds)	330	**361**	**-31**	365	-35	373	-43	381	-51	392	-61
Three-rooms apartment (3 beds)	403	**404**	**-1**	408	-5	417	-14	426	-23	437	-34
Three-rooms apartment (4 beds)	469	**433**	**36**	438	32	447	22	457	12	469	0
Four-rooms apartment (3 beds)	403	**469**	**-66**	474	-71	485	-82	495	-92	509	-106
Four-rooms apartment (4 beds)	469	**541**	**-72**	547	-78	559	-90	571	-102	586	-117

Source: Authors' processing based on SiTI data

Table 10 – Housing cost affordability by adopting a market rent for San Salvario TD

			Housing cost (market rent minimum)			Housing cost (average market rent)			Housing cost (market rent maximum)		
	operative costs (project value)	gross floor area	rent		housing cost	rent		housing cost	rent		housing cost
Housing vulnerability	**€/month**	**sqm**	**€/sqm month**	**€/month**	**€/month**	**€/sqm month**	**€/month**	**€/month**	**€/sqm month**	**€/month**	**€/month**
Two-rooms apartment (1 bed)	40	46	7.80	359	399	9.65	444	484	11.50	529	569
Two-rooms apartment (2 beds)	51	58	7.80	452	503	9.65	560	611	11.50	667	718
Three-rooms apartment (3 beds)	56	64	7.80	499	556	9.65	618	674	11.50	736	792
Three-rooms apartment (4 beds)	61	69	7.80	538	599	9.65	666	727	11.50	794	854
Four-rooms apartment (3 beds)	66	75	7.80	585	651	9.65	724	790	11.50	863	929
Four-rooms apartment (4 beds)	76	86	7.80	671	746	9.65	830	906	11.50	989	1065

Source: Authors' processing based on SiTI data

Tabella 11 – Comparison of the housing cost calculated by applying a market rent and the housing cost, estimated by applying an agreed rent for San Salvario TD

	housing cost (project value)		housing cost (average market rent)
Housing vulnerability	**€/month**	**% (*)**	**€/month**
Two-rooms apartment (1 bed)	288	-40%	484
Two-rooms apartment (2 beds)	361	-41%	611
Three-rooms apartment (3 beds)	404	-40%	674
Three-rooms apartment (4 beds)	433	-40%	727
Four-rooms apartment (3 beds)	469	-41%	790
Four-rooms apartment (4 beds)	541	-40%	906
(*) percentage change from the average market rent			

Source: Authors' processing based on SiTI data