Off-site construction

to simplify the energy transition in social housing

Workshops Report

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Workshops Report

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Abstract

The contemporary era is characterised by an increasing scarcity of resources in all forms, prompting a profound reflection on the way in which we live.

In light of the increasing necessity to reduce the environmental impact of the construction industry, European legislation is requiring the implementation of new environmentally-friendly technologies and approaches to reduce the energy consumption and environmental impact of the building stock.
Furthermore, the progressive impoverishment of families and the scarce supply of affordable housing on the market have led to a real social emergency and crisis of living that is affecting numerous countries across Europe and beyond.
These phenomena are significantly influencing the construction sector, as the majority of European buildings must be renovated in the near future, particularly social housing due to its pervasive energy poverty.

Climate change and the housing crisis are two issues that are well-known, but how can architecture provide with innovative and sustainable responses?
The twofold reflection on the future of living and the ecological transition is encountered along this path, through a research project that analyses the potential of off-site architecture for collective housing retrofit and new construction.
The project proposes a turnaround to innovate the construction sector by establishing new professions, skills and roles to cope with a constant scarcity of resources and demographic issues such as the ageing population and the increasing life expectancy.

Mission & Vision

Looking at the ecological transition: the European context

The European legislation (2020 'Renovation Wave' and the newest 2023-24 European Performance of Buildings Directive) requires new environmentally-friendly technologies and approaches to reduce the environmental impact and energy consumption of buildings, also setting the goal of having zero-emission EU building stock by 2050. This will impact the construction sector, as the majority of European buildings must be renovated in the years to come, in particular social housing due to its widespread energy poverty.

The progressive impoverishment of families and the scarce supply of affordable housing on the market bring us to a real social emergency and crisis of living.
In addition, recent evidence has shown that low-income individuals and households tend to dedicate a larger share of their budget to fundamental goods such as energy and food, and they are the ones experiencing the highest rates of inflation with consequences in terms of poverty and inequality. Housing costs are part of this concern on the increasing cost of living. Expenditure on housing costs represents the highest share of household budgets in the vast majority of EU countries with an average 32.7% of total consumption expenditure.[1]
Moreover households account for 27% of final energy consumption in the EU and contribute to 21% of total greenhouse gas emissions.[2] Buildings are therefore the largest consumer of energy in Europe: heating, cooling and domestic hot water account for 80% of citizens' consumption.
The construction sector contributes significantly to global climate

1 Eurostat, "Housing, food & transport: 61% of households' budgets". Data referring to 2020.

2 Eurostat, "Greenhouse gas emission statistics - air emissions accounts". Data referring to 2021.

change, accounting for about 23% of global greenhouse gas emissions and 37% of energy and process-related carbon dioxide (CO2) emissions.

Off-site construction is the only technique that makes building projects' delivery faster, cheaper, safer and greener (less waste and emissions), delivering low-carbon prefabricated buildings and reducing the embodied energy of a building by up to 30%.
Promoting off-site since the first step of the construction chain is important to reverse this trend and create a network of skilled professionals that look at green and inclusive alternatives in architecture.

The increasing impoverishment of families and the scarcity of affordable housing on the market are creating a real social emergency and housing crisis. More and more households are exposed to energy poverty, especially low-income households living in energy-inefficient dwellings. This is compounded by other factors such as the loss of effectiveness of housing support policies due to a lack of public funding and inefficiencies in the management of existing assets.

One of the consequences of this is a progressive reduction in the supply of public housing, which has to contend with some critical factors such as the high percentage of owner-occupied homes that has always characterized the Italian property market.
However, the vast majority of houses, around 7 out of 10, are owner-occupied, which in Italy is considered a safe investment.
Nationally, public rental housing (Edilizia Residenziale Pubblica or ERP) is estimated to represent about 3.5% of the total housing stock in the country and is a permanent feature of our housing system.[1]

It includes about 900.000 units managed by public housing companies and municipalities. There is no centralized information on the energy performance of public housing, but the need to renovate public housing units is widespread - to the extent that an estimated 10% of the stock is currently vacant. In fact, more than half of the available EPCs are in classes F and G, indicating that the energy efficiency of housing in Italy is relatively low. [2]

Turin's social housing stock, most of which was built between the 1950s and 1980s (68% of the housing stock was built before 1981 and 14% after 1991), is spread over a large part of the urban

1 Istat, Population and Housing Census 2021.

2 Sistema informativo sugli Attestati di Prestazione Energetica (SIAPE).

area, with varying densities. There are 17.435 housing units, 63% of which are owned by ATC, 34.4% by the Municipality of Turin and the rest by the State Property Office, the Local Health Authority and the Ministry of Justice.[1]
This data confirms that around 35% of EU buildings are over 50 years old and almost 75% of the building stock is energy inefficient.

In terms of the labour market, construction remains one of the most vulnerable sectors in Italy. In 2022, construction is the sector with the highest number of fatal accidents, with 110 fatalities. Even for non-fatal accidents, the sector remains one of the most exposed, as confirmed by Inail[2] data.

In this context, it is clear how an innovative process could control the risk associated with work phases, drastically reducing work-related injuries and fatalities.
Inevitably, the need for human resources, which are increasingly scarce in the sector, would be reduced or redesigned.

The Italian off-site project landscape is mainly developed on new construction projects (both single-family and multi-storey buildings). The most commonly used technologies are timber or hybrid timber-reinforced concrete-steel, while retrofit technologies are still almost unexplored. Off-site architecture offers various possibilities for innovation in the construction chain, which in Italy is currently static and rooted in traditional technologies and methods.

The green and digital transitions are an opportunity to address the shortcomings of the construction industry and make social housing projects more inclusive, effective, safer, faster and more environmentally friendly. What's more, off-site techniques, with their lower costs, can help to reduce the financial burden on the beneficiaries of social housing refurbishment, who typically cannot afford large investments.

In Poland, the construction industry is experiencing a gradual shift towards the use of prefabrication methods.
Prefabrication involves the manufacture of building components in a factory and then transporting these components to the construction site for assembly. One of the most promising developments in this area is modular construction. This

1 Città di Torino, Osservatorio Condizione Abitativa XIX Rapporto - anno 2022.

2 National Institute for Insurance against Accidents at Work.

innovative approach involves the production of entire modules of a building in a factory, which are then transported and assembled on site. The potential of modular construction in Poland is considerable, as it can lead to faster project completion, cost savings and a reduction in environmental impact. However, despite its potential, the widespread adoption of modular construction in Poland faces several challenges. One of the main obstacles is the existing regulatory framework, which has not been fully adapted to this modern construction method. Regulations often lag behind technological advances, creating hurdles in the approval process and increasing the complexity of compliance. In addition, traditional construction practices are deeply ingrained in the industry, making it difficult to move towards a more modular approach.

On the other hand, in Poland, factories have sprung up near Toruń and Kraków to produce modular housing elements from wood or steel. Although their production is mostly exported to other Western markets, their location could be seen as a beacon and driver for change. With the right attention, they could be brought more into the domestic market, where they are not as widely used as in other countries where their customers are located.

In Poland, the use of prefabrication in construction is still somewhat limited and most prefabricated buildings are based on concrete wall systems rather than fully modular components. Projects that typically involve the use of prefabricated concrete walls, which are assembled on site to form the structure of the building, are being used in various residential and commercial buildings across Poland.
Although these methods improve durability, efficiency and quality compared to traditional construction techniques, they fall short of the full potential of modular construction. Unfortunately, there are currently restrictions in the law and building regulations that are very much in line with what is considered good practice. These are mainly related to adequate fire protection and the need to build lower structures, for example in timber. This is set to change in the coming years, as the government has recently launched a wider debate on the subject.
In summary, while Poland is making progress in integrating prefabrication into its construction industry, there is still a long way to go before the full potential of modular construction is realised.

Project objectives

The main objective of the project is to engage a group of Polish and Italian architects to stimulate debate, deepen their knowledge and develop innovative project ideas for off-site construction to facilitate the energy transition in social housing and to enable architects to adapt their professional profile to the changing skills arising from the renovation wave in Europe.
The architects will improve their professional practices and pave the way for a widespread greening and digitalisation of their work, comparing and learning from the experiences of Poland and Italy within the framework of best practices in the European context.
Building knowledge of off-site techniques will support its use in the partner countries, contributing to a faster green transition in social housing, where decarbonization and energy efficiency are more urgent given the higher obsolescence of building stock.

Site and company visits will allow participants to discuss with policy makers, contractors and professionals the off-site solutions used in the renovation and new construction of social housing and their strategic contribution to achieving inclusiveness, aesthetics and sustainability.

Starting from the analysis of different good practices, the project will identify and design new transnational training content and professional tools to empower architects in off-site design for social housing. In this way, their work will respond to the environmental and social challenges of the social housing context, combining digital and collaborative technologies with innovative and high-performance materials. At the design stage, equal access to housing will be improved through cheaper and higher quality solutions that meet people's diverse needs. Off-site design will allow architects to escape conventional methods and adopt more flexible techniques. Buildings that respond to housing shortages can be adapted to different needs and the use of modular/prefabricated components can help reduce costs and materials.

Following these statements, the project aims to build a community of professionals who will able to:

- Exchange good practices on off-site architecture for social housing as a first step towards its wider adoption;

- Promote the use of off-site construction among European architects;

- Increase the digitalisation of the construction process thanks to a better use of digital tools (BIM, 3D printing, drones and robots) in off-site practices for social housing;

- Support the digital and green transition in the construction sector by promoting off-site construction as a sustainable and inclusive approach to the construction and the retrofit of social housing projects.

The programme is organised by macro areas and will cover the following topics:

- **Political and socio-cultural context**

In light of the European housing crisis, the debate aims to explore and propose public policy solutions for public heritage to be upgraded and renovated. It will also explore the potential of collective and shared housing as architectural typologies and the benefits they can bring to urban management;

- **Environmental and socio-cultural context**

It focuses on energy poverty in the social housing stock and analyses the new trend of energy retrofitting according to the rules of the recent European Green Deal. Special attention is given to circularity in construction processes, material reuse and bio-construction;

- **Off-site design & processes**

Starting from the current state of the art, we will explore innovative construction technologies, materials and processes in off-site architecture and site management in the context of European best practice;

- **Digital design and industrialization**

What is process innovation?
The topic covers the role of process industrialisation and how established and emerging technologies in off-site construction, such as BIM technologies, 3D printing and robotics, can help to rapidly innovate the system.

Project partners

"Off-site Construction to Simplify the Energy Transition in Social Housing" is a project by Fondazione per l'architettura / Torino and Stowarzyszenie Laboratory for Urban Research & Education, funded by the European Union within the framework of the Vocational Training Partnership KA210-VET (Erasmus+).

Fondazione per l'architettura / Torino

Fondazione per l'architettura / Torino was founded in 2002 on the initiative of the Association of Architects of Turin, and it promotes architecture as a discipline at the service of the quality of life.

The organisation promotes interdisciplinary relations and acts as a bridge between the worlds of design, construction, technology and culture. Its aim is to investigate current and future social needs, to study innovative responses and to implement concrete actions in the field, stimulating change and seeking tools to face the challenges of the future with awareness and responsibility.
The foundation works in various fields: vocational training, social projects, cultural projects and architectural competitions.

Fondazione per l'architettura / Torino is a member of the New European Bauhaus Community and of Torino Social Impact, the platform that aims to experiment, together with companies and institutions, a new development strategy with a high social impact and technological intensity.

Social media:
Sito web

Laboratory for Urban Research & Education

LURE is an urban think tank focused on research, education and development to provide answers to the challenges facing cities and the Green Deal agenda. Its team consists of architects and researchers working on innovative projects for cities.
The group focuses on promoting susta inable urban development through innovative architecture and interdisciplinary perspectives in all urban dimensions.

LURE has experience in unleashing a new wave of innovative buildings and urban infrastructure focused on sustainable building materials, renewable energy solutions and water challenges.
LURE is part of the New European Bauhaus and a supporter of the Covenant of Mayors for Climate and Energy and has offices in 4 countries (Poland, Belgium, Romania and Spain).

Social media:
Sito web

Calendar activities

18–19 October 2024	Vocational training with conferences, construction site visits and workshop scenario TURIN (ITALY)
21–22–23 February 2025	Vocational training with conferences, construction and factory visits, and workshop WARSAW AND TORUŃ (POLAND)
3 April 2025	Public dissemination event with local experts and stakeholders TURIN (ITALY)
30 May 2025	Public dissemination event with local experts and stakeholders WARSAW (POLAND)

Project impact

Over **350** architects empowered thanks to project events

2 major events featuring conferences and workshops

2 dissemination events for broader outreach

40 speeches from sector experts

10 public and private stakeholders actively engaged in the debate

20 partners, both technical and technological

3 media partners

Turin workshop

Lectures and speakers

On 18th and 19th October we had the pleasure of hosting the first meeting of "Off-site construction to simplify the energy transition in social housing" in Turin, the project of Fondazione per l'architettura / Torino and Laboratory of Urban Research & Education, which will run until July 2025. A long journey with the aim of recalling the past, present and future of off-site construction related to architecture in social housing.

The Turin chapter was conceived to provide an overview of the European situation regarding off-site construction and social housing, with an insight into Italy's problems and opportunities. In particular, we focused on the cities of Turin and Milan, where it seems that the public debate on the issue is more heated and the implementation proposals are more numerous.

The training programme was organised with the contribution of several local guests with international experience and transversal backgrounds on the topics of off-site construction for social housing. The contribution of each guest was undoubtedly a valuable part of providing an up-to-date overview of the subject, with insights from academic research and universities, public administration and business.

It was a unique opportunity to meet the international working group of young architects and explore together what the near future holds for off-site architecture applied to the transformation of social housing stock.
Lots of food for thought, but we discovered that there is still a lot of work to be done, so here is how it went!

Friday 18th October

Thanks to the contribution of our guests, we tried to understand how off-site architecture can be linked to social housing projects and what the potential is today. During this chapter we have asked public actors and stakeholders involved in welfare or public policy today to understand some strategic arguments together:

- ***What strategies could be used to facilitate the energy transition in social housing through off-site applications?***
- ***What are the obstacles we have encountered to develop off-site construction in Italy?***
- ***What are the barriers to innovating social housing policy in Italy?***

Our guests gave us several project ideas and personal input on how off-site technologies can be applied and transformed in different application areas.
With **Chiara Rizzica** and **Piero Pelizzaro**, we outlined the state of social housing policy in Italy and the importance of innovation in public administration in order to carry out projects that look to the future.
Ingrid Paoletti shared the perspective of university research through the specific site of the Material Balance Laboratory (from Politecnico di Milano), which researches innovative materials to be applied to buildings and construction processes;
Marco Dal Mas presented the Energiesprong network, active in Milan through Edera, a European alliance that provides best practices and numerous applications for energy retrofitting in residential buildings, with a particular focus on public mixed-use buildings.

The second part of the day was dedicated to an in-depth analysis and discussion of off-site practices and technological applications.
Adriano Francescotti showed us the infinite possibilities of large wooden structures with an overview of recent projects carried out in Italy and abroad by Xlam Dolomiti, the leading manufacturer in this sector in Italy;
Alessio Colombo from the Rice House Benefit Corporation has extensive experience in the application of bio-building. Their efforts are rooted in the production of natural building

materials, which they use in energy retrofitting projects with high social innovation guidelines;
Giorgia Di Cintio shared with us her dual vision and commitment to social and community housing. Impact Housing Foundation and Homers are committed to exploring and creating opportunities for public and private investors to invest in a new housing model;
What supply chains are ready for prefabrication?
Giovanni de Niederhäusern and **Giuseppe Conti** from Pininfarina told us how automotive design and the DfMA approach now offer a clear opportunity to transform the prefabrication industry without having to build new factories or production systems.

Saturday 19th October

Engineer Flavio Nebiolo, architect Alberto Sordo and architect Francesco Tomatis from the dquadro design studio took us on a tour of an educational building site in Cuneo (TO).
The building, intended for offices and divided into seven floors of 300 square metres each, is designed as an open space environment and is made up of glulam columns and XLAM floors, which guarantee strength and durability. The facades are made of prefabricated modules that incorporate the windows and doors, reducing construction time and improving overall efficiency. The project will also reduce energy consumption through the use of advanced technologies and high quality insulation materials.

Panel #1

Chiara Rizzica

is PhD architect and Senior Advisor on Social and Collaborative Housing, Affordable Housing Policy, and Service Design in the field of Social Innovation and Urban Renovation.
She currently works as General Coordinator for Milano Abitare and also advises on social housing policies and projects for non-profit organizations.

"Do we still need to build?"

Chiara Rizzica provides valuable insights into the evolving landscape of housing, particularly addressing the causes and effects of the housing crisis we are experiencing today. Her work analyzes both the historical context of public social housing policies and their current state, offering a comprehensive view of the housing challenges that many countries are grappling with.

Housing inequality is as relevant as ever. Housing inequality in both the EU and Italy has become a pressing issue, exacerbated by a series of macroeconomic challenges that have had wide-ranging effects on the housing market. In particular, housing inequalities and income disparities are mutually reinforcing, meaning that the most vulnerable groups -those already struggling with lower income- are disproportionately affected by rising housing costs, while those with higher incomes continue to benefit from the market's capacity to adapt.

Worsening of the macroeconomic picture are the rising cost of raw materials and dependence on Russian supplies in war times, consumption is contracting, rise in interest rates on bank loans is slowing down demand for housing credit and the erosion of real household income affects the ability to pay mortgage-burdened households as well as rent. However, the real estate market is showing an extraordinary capacity to react to exogenous shocks with an increase in transactions and market values.

If we take a look at the current drivers of inflation in Eurozone, inflation is deeply exacerbating inequalities[1].
Since the beginning of 2021, inflation has been rising steadily, affecting categories of primary accessibility goods such as food/ beverage and household livelihoods, such as energy and heating.
In fact, the supply of housing is scarce and expensive: tenants spend more than 40% of their disposable income on rent and on a house that is not of good quality in relation to the current market price.[2]

1 Housing Europe The State of Housing in the EU 2023.

2 OECD Affordable Housing database, 2024.

Italy is not a country for young households. Italy is increasingly becoming a difficult place for young households to settle into, especially when it comes to housing affordability. The housing cost burden is disproportionately heavy for younger people, particularly those in the 25-44 age group. The housing cost burden faced by young people in the northern regions is double that of the southern regions and islands. This stark regional disparity is driven by various economic factors, including the concentration of wealth, education and job opportunities, and housing demand in the north, which drives up housing prices, especially in major cities like Milan, Turin, and Bologna.[3]

Italy's housing stock consists of around 30 million dwellings, with a high ownership rate (around 70%), which is one of the highest in Europe. Infact, Italy is also a "frontrunner" in ownership. Looking at the European tenure distribution Italy is the first country with the highest number of outright owners. However, this high rate of homeownership has implications not only in the rental market, increasing shortage of units, but also in the regulation about renovation and maintenance of the housing stock, which remains underdeveloped compared to other European countries.

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In Italy only 3.7% of those who live in rent pay a "reduced" rent and 1.7 million households are at risk of arrears for rent or mortgage. Since 2017 private and social rent are significantly decreasing while the number of owners is increasing. In 7 years, between 2017 and 2023 they increased from 71.9% to 76.7% of the population[5].

In this scenario there is a growing awareness among citizens about the right to housing.

3 Nomisma on Eurostat 2020 database, Dossier Next Housing 2021 Legacoop.

4 OECD Affordable Housing database, 2024.

5 Housing Europe The State of Housing in the EU 2017, 2021, 2023.

Italy - scenarios: population and territory

According to some statistical experiments predicting the population in urban areas/ metropolitan cities between 2023 and 2043, in Italy over the next 20 years the population would increase by more than half in the northern areas[6]. These data show a strong regional inhomogeneity, where only large cities such as Milan, Bologna and Florence are expected to grow in terms of population, while all the other cities are predicted to have a strong downgrade.

Italy - scenarios: territories and stock

Housing stress remains high in large metropolitan areas where the economy and population continue to grow. According to a 2024 statistic comparing the housing situation between 1951 and 2021, it shows that the number of buildings has tripled in 70 years, just as the number of not occupied[7] buildings has increased dramatically (from less than one million to 9.50 million).
The buildings that remain unoccupied are mainly located in southern Italy and the islands, with a strong mark for mountainous and inland areas of the country.

A very simple question arises: do we still need to build?

Italy - scenarios: territories and mainteinance

The Italian housing stock is obsolete.
Looking at dwellings by construction period, we can see that 70% of them were built before 1980, during the economic boom; after this period, construction decreases significantly.[8] Mapping the actual opportunities can give us an insight into how and what to renew of the existingstock. This figure is in line with the European trend, where a large proportion of dwellings in each country were built before energy efficiency regulations came into force.[9]
Many of the homes in the EU have not yet undergone renovation to improve energy efficiency, meaning a large number of buildings still rely on outdated, inefficient heating and cooling systems that consume more energy and produce higher emissions. Households in the European Union still play a significant role in energy consumption and greenhouse gas emissions, despite ongoing efforts to reduce their environmental impact. With households accounting for 27% of final energy consumption and contributing 21% of total greenhouse gas emissions (specifically from heating and cooling), there are still considerable challenges to address.[10]

Italy faces several challenges when it comes to addressing housing issues and creating a more sustainable housing market. These challenges are compounded by both structural problems and systemic inefficiencies.

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6 De Panizza, A., ISTAT, Territori e persone in movimento. Scenari economici, profili abitativi, Relazione alla Assemblea congressuale di Legacoop Abitanti, Matera 26/09/2024.

7 Not occupied means: second houses, houses for vacations, or empty/abandoned houses.

8 De Panizza, A., ISTAT, Territori e persone in movimento. Scenari economici, profili abitativi, Relazione alla Assemblea congressuale di Legacoop Abitanti, Matera 26/09/2024.

9 Housing Europe The State of Housing in the EU 2023.

10 Ibid.

- **Lack of policy skil**l: there is a significant gap in the ability to design and implement effective housing and urban policies. Without the expertise to address the complexity of housing needs, Italy struggles to make necessary changes to the housing sector.
- **Low residential mobility**: the housing market in Italy is characterized by low residential mobility, which limits the ability of people to move for job opportunities or better living conditions.
- **Obsolete housing stock**: a large proportion of Italy's housing stock is outdated and inefficient. Many buildings were constructed decades ago and have not been renovated or upgraded to meet modern energy standards, contributing to high energy consumption and poor living conditions.
- **Stationary income and wage stagnation**: wages in Italy have not kept pace with inflation, particularly for essential goods like housing and rent. This has made it increasingly difficult for many Italians to afford housing or make investments in home improvement.
- **Increasing demand**: there is a growing demand for housing in Italy, driven by factors such as population changes, urbanization, and the need for affordable housing. This demand often exceeds the supply of well-maintained, affordable homes, exacerbating the affordability crisis.
- **No comprehensive housing policy**: Italy lacks a coherent, nationwide housing policy. While some regions and municipalities have specific initiatives, there is no unified national strategy to address housing affordability, quality, and sustainability, leading to fragmented efforts and inefficiencies.
- **Lack of public policy and investmen**t: public investment in the housing sector, particularly in the renovation of old housing stock, is limited. This lack of public policy focus results in missed opportunities for systemic change in terms of energy efficiency, affordability, and overall living conditions.
- **Unfair taxation system**: Italy's tax system is often seen as favorable to homeowners, with low or no property taxes on primary residences ("prima casa").
- **Low support for social housing**: social housing, or affordable housing supported by the state, is underfunded in Italy. This has led to a shortage of options for low-income households and marginalized groups, making it harder for vulnerable populations to access safe and affordable housing.
- **Residual turnover**: Aging Population and Youth Poverty: Italy has an aging population, and younger generations face financial challenges, including high unemployment rates and stagnant wages.

Focusing policies on the renovation of existing housing stock and the production of more social and affordable housing could have a profound impact on Italy's housing market and broader socio-economic landscape. Addressing these challenges will require a multi-faceted approach, with a strong commitment to both policy changes and financial investment.
Architects and professionals of the building sector will have a key role in preparing a common ground for new skills, training, and working standards for a new culture of architecture.

Housing models have changed and continue to change.
The regeneration of suburbs and low density areas and the development of new tourism models are both key strategies

for creating more sustainable, inclusive and economically vibrant communities. In addition, new housing models involving short-term tenancies, shared accommodation and shared services are becoming increasingly relevant as housing needs shift, particularly in urban areas where problems are most acute. Indeed, the shrinking of living spaces, the impact of ageing on accessibility, and new ways of traveling and working remotely are some of the causes of today's housing insecurity.

Where do we come from?

Social Housing in Europe: one need, many policy schemes

We are coming from a common European ground that is very diverse in terms of delivering, providing and controlling social housing.[11] In Europe there are very different policies for the management and provision of social housing: from national to private, from local to national, or a combination of both types of investor.

The common denominator in this complex scenario is that social housing projects are always dedicated to people in need, are subject to defined rules and are characterised by lower costs compared to general market housing. Social housing aims to provide affordable, stable living conditions for disadvantaged groups while adhering to policies that maintain its focus on social balance

Recent statistical analyses show us that Italy is still far from European standards with respect to social rent, showing a decrease of 2% in the period 2015-2023. In fact, social rent represents 5.5% of total rents, much lower than in other countries such as The Netherlands (33%), Sweden (22%), Austria (20.1%) and UK (18.2%). [12]

Italy – Social Housing over the last decades

The post-war period marked the beginning of mass public housing projects in many countries, laying the foundation for modern social housing systems and contributing to the improvement of living conditions and urban welfare strategies for large portions of the population. This was a significant shift from previous practices, where housing had often been left to the private sector or charities.

The INA Casa Plan - *Measures to increase working-class employment, facilitating the construction of houses for workers* - is the first and most relevant example of Italy's most significant and innovative public commitments to social housing, developed between 1949 and 1963. It was a key response to the widespread housing shortage in the aftermath of World War II, which had left many Italians living in poor conditions or without adequate shelter. The plan was named after the Istituto Nazionale delle Assicurazioni (INA), the national insurance institute, which played a central role in financing and administering the program. The plan spanned 14 years, and it was designed to build affordable housing for low and middle-income families across Italy. It was implemented in cities and towns all over the country, including both major urban centers and rural areas.

The INA Casa Plan was financed through a mixed system involving the State, employers and employees. The latter,

11 Social housing is a general term that varies from country to country. In Italy, for example, it refers to a project usually run by a public actor in partnership with local authorities.

12 Housing Europe report 2015, 2021, 2023.

through a deduction from monthly salary - "the equivalent of one cigarette per day".

The INA Casa Plan[13] was a massive action and a very impactful project, nicknamed as "*Una grandiosa macchina per l'abitazione*"[14]. Infact, the operation had impressive scale and impact during its implementation between the developing phase.
The plan spread across Italy, with housing projects in both large cities and small towns, addressing housing needs throughout the country in 20.000 sites.
The plan was highly productive, with 2,800 rooms being constructed every week, ensuring rapid progress in providing homes. This resulted in approximately 560 families receiving new homes each week, helping to alleviate the housing shortage.
The construction effort supported the employment of 40,000 workers annually, helping to drive economic recovery and providing stable jobs during a critical period.
By the end of the project, 335,000 units were provided, improving living conditions for families across the country. Of the 17,000 architects and engineers active in Italy during this time, approximately one-third worked on the INA Casa Plan, demonstrating its significance to Italy's professional workforce and architectural development.
These figures underscore the scale, speed, and societal impact of the INA Casa Plan in transforming Italy's housing landscape and contributing to its post-war recovery.
Starting in the 1990s, Italy experienced a "sinking phase" in the realm of public housing, a shift that can be attributed to several key factors and reversions. These included the financial difficulties of public housing institutions, the gradual regression of the central government's role in housing policies, and a transfer of responsibility to regional governments. This period marked the decline of the INA Casa legacy, with significant changes in how housing was managed and financed.

In 1993, Italy initiated the first plan to sell off public housing assets. This marked a significant departure from the previous approach, where public housing was maintained as a government responsibility. The plan aimed to reduce the financial burden on the state and its housing institutions by privatizing a portion of the public housing stock.
In 1998, the GESCAL tax was abolished. GESCAL (Gestione Cassa Nazionale per il Fondo di Assistenza e Beneficenza dei Lavoratori) was a fund created in the 1950s to help finance public housing projects, especially for low-income workers. The tax was a form of contribution from employers and employees to support the development and maintenance of public housing.
The 1993 sell-off plan for public housing and the 1998 abolition of the GESCAL tax were two critical turning points in Italy's housing policies. Both were part of a broader trend toward reducing state involvement in housing and relying more on market-driven solutions, which ultimately led to the privatization of some public housing assets and the reduction of financial support for public housing. These changes, while addressing immediate fiscal concerns, had long-term consequences for the availability and affordability of housing, particularly for lower-income families.

The 2000s in Italy saw the "floating phase" of public housing, characterized by significant challenges and changes in both housing policy and the broader socio-economic context. This period was marked by the impact of the global financial crisis, the

13 www.inacasa.org

14 Cit. "A great machine for housing", Giuseppe Samonà, 1949.

contraction of the welfare state, particularly in the area of public housing, and the growing marginalization of the rental market. These trends highlighted the need for more flexible tools to address housing issues and led to the introduction of new initiatives.
In 2006, the Fondo Abitare Sociale was established by Regione Lombardia, marking a significant development in Italy's approach to social housing. This regional fund aimed to address the growing need for affordable housing, particularly in the face of rising housing prices and limited state resources in the public housing sector. It was one of the first initiatives in Italy to focus on creating innovative funding models for social housing.

In 2008 the introduction of the "Alloggio Sociale" legislative tool represents a major change in policy design, sixty years after the INA CASA.
This was a key modification to previous housing laws, aimed at addressing the increasing need for affordable housing in the country. The "alloggio sociale" refers to rent-controlled homes, designed for low- to moderate-income individuals and families who would otherwise struggle to find affordable housing in the private rental market, and provided both by public, non-for profit, and private organizations. This is a breakthrough: for the first time in Italy, private developers are allowed to provide social and affordable housing.
In 2009, Italy introduced a major overhaul of its housing policies with the approval of a National Housing Plan and the Introduction of the Integrated System of Social Housing Funds (SIF), along with the Investment Fund for Housing (FIA). These initiatives were designed to address the increasing demand for affordable housing, improve the quality of housing stock, and foster a more sustainable and inclusive housing system engaging directly private limited-profit organizations through capped-return on investment financial schemes.
There was a big investment of the State toward funding: SIF is an hybrid system, it has raised a total of €3 billion from public and private investments and consisted of a national fund of funds, FIA, to the value of 2 billion Euros.

In-between Public Housing - intended exclusively for those belonging to disadvantaged social groups, financed directly by entirely public non-refundable contributions - and free market - intended ashousing that is financed and realized on market terms through the free initiative of operators - a third range of housing supply emerged: "the Italian social housing".
Social housing in Italy provides housing solutions for households that cannot afford to access the free market. It is intended for those who are in need of affordable housing but do not qualify for traditional public housing. These households benefit from allocation rules that help determine who is eligible for housing.
The goal of Italian social housing is to support people who, while not being able to afford market prices, can still manage to pay taxed rents or purchase prices that are lower than free market options. These households do not need entirely free housing (like in public housing) but still require assistance.
The social housing supply is financed through private or public-private investments, often using special real estate funds, referred to as "ethical funds". These funds are established specifically to finance social housing projects and are intended to provide affordable housing for eligible groups.
The emergence of Social and Affordable Housing schemes reflects distinct typologies, each with its own eligibility criteria, funding mechanisms, and policy objectives. While these terms are sometimes used interchangeably, they represent different concepts that involve

complex dynamics between various actors, including the public, private, and non-profit sectors. These actors operate within a landscape defined by the intersection of institutional/informal relationships, and public/private partnerships, which shape how these housing typologies are financed, managed, and allocated.

What do we get?

In 2013, Italy began seeing the first signs of change in its housing policies, thanks to the *Fondo Nazionale per l'Abitar*e. One of the prominent initiatives within this framework was a significant project in Milan. This development, designed with a strong "social mission", includes: 122 homes offered at social rent fees, 850 square meters of commercial space, 250 square meters dedicated to community services, 1,800 square meters allocated for local and urban services. The project was built using Xlam technology for sustainability and has an energy class A rating for environmental efficiency.
The development is open to the city, fostering integration with the local community.
The project includes a wide range of services designed to improve the liveability of residential spaces such as: local services (designed to enhance everyday living and meet the needs of residents), community services (encouraging interaction among users to produce a recognized benefit for the entire community), extension of living space (services that go beyond the home, offering additional communal spaces that extend the boundaries of private residences) and shops and commercial spaces.
In addition tenants are chosen by the municipality of Milan, with a focus on creating a diverse, mixed group, including elderly individuals, young people, couples, and families. A key feature of the project is the 10% controlled rent requirement, which ensures housing remains affordable for low-income residents.[15]

Milan's projects - followed up to Cenni di Cambiamento - are symbolic of a model of new SAH[16] strategies of development in Italy, including several aspects: ethical funds, PPP[17], architectural&urban design, social management and community start up process. The Social and Affordable Housing model is an ongoing process that started with the first ethical fund in Lombardy and the subsequent implementation at national level. Although the SIF did not reach its target (20,000 units by 2020), the initiative has strong points in terms of an innovative governance model and the creation of a network of stakeholders.
The scarcity of available land or buildings, different urban planning standards, low performance of the construction industry, low architectural quality are some of the critical points that did not allow a full coverage at national level.

In the framework of SAH initiatives, the Social and Collaborative Housing model developing in Italy represents a progressive approach to urban development that focuses on combining affordability, community-building, and collaborative living. This model blends private and non-profit financing with a strong emphasis on mutual engagement between tenants.
The process is driven by the Social Cooperative Manager, a new key actor that integrates different skills in the field of housing services. The SCM is able to

15 FHS - Fondazione Housing Sociale, Milano.

16 Social Affordable Housing.

17 Public Private Partnership for Affordable Housing.

keep together the dimensions of property, facility and community building, for example leading participatory community start up schemes with future owners. The community might participate in decision-making, maintenance, and organizing social or cultural events, which strengthens the social fabric and enhances residents' sense of ownership and commitment.

Does Italian SAH model drive Urban Renovation?

In today's world, many people may not fully recognize that sharing is an opportunity, especially in times when it feels like things are in a state of collapse - whether due to economic uncertainty, social fragmentation, or environmental crises.
The Italian Social and Collaborative Housing model can drive urban renovation, but only under specific conditions that align with broader goals of urban and social integration.

Not Just More Housing, But Comprehensive Solutions: the goal should not simply be to increase the number of housing units but to create integrated housing solutions that address the needs of both the individuals and the broader community. This approach goes beyond private dwelling spaces and creates environments where the social, economic, and cultural dimensions of urban living are woven together.

Housing as a Service, Not Just Property: the housing model should evolve from being seen as a mere immovable property into a service that contributes to urban development. A critical feature of the SAH model is transforming residents from passive beneficiaries of housing services into active co-producers of the urban environment and social services. This dynamic allows tenants to have a stake in the development and management of their neighborhoods, rather than merely receiving services.
For the SAH model to drive urban renovation, housing must become a place for partnerships between public authorities, private investors, and the community. The housing projects need to bring together different actors (municipalities, housing cooperatives, non-profit organizations, and developers) to collaborate and share resources and expertise. This kind of partnership helps ensure that housing projects meet the needs of the city while maintaining social responsibility and sustainability. By following these principles, the SAH model can indeed contribute to broader urban transformation and help to regenerate neighborhoods, create lasting social impact, and promote sustainable living practices.
We are currently at a pivotal moment in the housing sector, marked by a resurgence of interest in housing culture. Access to housing has become a top priority in both professional and public discussions at national and international levels. Housing has also emerged as a crucial topic in the broader sustainability debate. Architects are reconnecting with housing design, as evidenced by awards uch as the European Collaborative Housing Award[18] and the italian one Premio Europeo di Architettura Matilde Baffa e Ugo Rivolta[19]. These accolades celebrate innovative housing projects that challenge conventional design, promote sustainability, and prioritize community-centered solutions.

18 www.europeancollectivehousingaward.eu

19 www.premiobaffarivolta.ordinearchitetti.mi.it

Designers' dilemmas of nowadays

Designers have a significant role to play in contributing to societal change, especially in times of crisis or collapse. However, to be effective in addressing broader challenges, designers need to shift their approach from "traditional" methods of design toward ones that are more community-centered, sustainable, and socially responsible.The following statements represent key dilemmas and challenges related to housing design, which involve a broader understanding of the processes, social impacts, and ethical considerations involved in creating homes.

Designing the process

The need to focus on the broader context of housing creation—not just the physical building itself, but also the processes that shape its development. It questions how architects and designers can influence the social, economic, and environmental processes behind housing projects. The ongoing engagement of designers throughout the lifecycle of a housing project, rather than simply during the design phase. It involves being involved in the construction, occupation, and long-term evolution of housing, rather than seeing design as a one-time event.

Let the authorship go!

This dilemma questions the role of individual authorship in housing design. In collaborative and community-led projects, authorship becomes blurred, as the design process may involve multiple stakeholders, including residents, communities, and professionals.

Affordable or high quality housing?

There is an inherent tension between making housing affordable and ensuring high quality. Designers must navigate the challenge of providing quality housing while keeping costs low, especially in markets where affordability is a key concern.

Private vs Public needs

In housing projects, especially in collaborative or co-housing models, there's a balance between creating spaces that serve the collective needs of the community versus those that focus on individual residents' wellbeing and privacy. The debate between ownership and rental housing raises questions about the degree of customization and personalization possible. Ownership often comes with greater autonomy to customize homes, whereas rental housing tends to offer less flexibility in design but may be more accessible and affordable.

The charm of ownership

This dilemma looks at the trade-offs between private ownership of property and shared spaces or services. There's growing interest in communal living models where resources are shared, and mutualistic services are provided, challenging the traditional idea of individual property ownership, still prominent in Italy.

Whats collective housing today?

As society changes, what does "collective housing" mean in the contemporary context? This dilemma challenges the idea of collective living, questioning its relevance and what forms it takes in today's world. It prompts designers to think about how to create housing that serves both individual needs and the ambition towards Commons.

Clients as "common people"

This reflects a moral and ethical dilemma about the role of designers in working for different income groups. Are designers ready to focus their work on making housing accessible and functional for middle- and lower-income people, rather than exclusively serving wealthier clients with significant budgets?

Point of discussion fot the future

The dilemmas discussed above raised highlight some crucial discussions about how to strengthen and diversify housing solutions in urban areas. These questions reflect both the evolving needs of cities post-lockdown and the potential of community-driven models to improve housing outcomes.

How to strengthen the supply of rentcontrolled housing, which, after the lockdown, is confirmed as an essential hub of urban welfare?

How to diversify the housing solutions offer not only in relation to different emerging demand targets, but also in relation to potential community initiatives that in each urban context can extend the economic and social impact of the real estate initiative?

How to "use" the vision and knowledge offered by collaborative experiences and community management for the construction of the city and its improvement, or generation (and regeneration) of urban quality?

Ingrid Paoletti

is a Full Professor in the Technology of Architecture at the Politecnico di Milano. She is the founder of the research group in theoretical and design experimentation Material Balance, where she is involved in innovative technologies and materials to develop a new and responsible material culture.

"Optimizing innovation for construction with low environmental impact"

Material Balance Research Group[20], founded in 2018, is a research group operating in Politecnico di Milano, led by Prof. Ingrid Maria Paoletti, an innovative and multidisciplinary reality that aims to establish new methods and ideas in design and construction processes that favor/optimize innovation with low environmental impact by reducing waste. The research is focused on different areas of development/research, such as: digital design, bio-based materials, computational knitting, material agency, simulation-driven design, new acoustic ecology, sustainable façade system and habitat and anthropocene.

The concept of material balance encourages designers to rethink how materials are used, with a strong focus on sustainability and environmental impact. The aim is to consider the following key balances:

- Physical and Technical Balance: This refers to the physical properties of materials (strength, durability, flexibility, etc.) and how they can be optimized to perform with minimal environmental impact. For instance, using bio-based or recycled materials that maintain structural integrity while being low-impact.
- Psychological Balance: The emotional and sensory impact of materials on human well-being. Designers must consider comfort and perception, which involve tactile and visual qualities that influence human experience. For example, biophilic design and the use of natural materials can improve mental health and comfort in indoor environments.
- Performative/Functional Balance: Materials and systems need to perform specific functions, such as providing thermal insulation, soundproofing, fire resistance, and light permeability, while also contributing to energy efficiency and sustainability.
- Semantic/Symbolic Balance: The symbolic and cultural meaning of materials, which often influences societal attachment to certain materials or

20 www.materialbalance.polimi.it

designs. Rethinking these meanings and adapting them to contemporary needs and environmental challenges is a key part of designing for the Anthropocene.

The Material Balance Group's approach encourages designers to reconsider these aspects in tandem, ensuring that every material choice is evaluated not just for technical performance but for its larger social, cultural, geopolitical, and environmental implications.

Material Balance for Design is an innovative design theory that is arbitrary but very innovative, interprets the equation looking at which input we put in the world through design, what we do generate with the materials we use in architecture and its meaning, which purpose the systems that we build have and how can we can re-balance our impact on the earth.
In fact, all inputs used in the production processes are resulting in an equivalent residual or waste, derived from accumulation of outputs. Focusing on the anthropocene era the laboratory is deeply committed towards challenges that typically concern the building environment landscape like climate change and Co2 emissions reduction, scarcity of resources and material balance, urban health connected to smart living applications.

The laboratory seeks to systematize certain needs and to offer solutions of the architectural project and its potential for the use of new materials, new architectures and new production systems, in a circular perspective between the material and the product. In this way, the natural and the artificial are not so far apart, but are intertwined in a research path in which they find mutual aspiration and innovation, in a continuum between the natural and the artificial.

Designing for the environment also means designing for the cultures that live there and the natural world offers a rich source of inspiration for designing efficient, sustainable systems. Materials are rapidly evolving in terms of micro, meta and macro systems, they are no longer the only refuge for creativity and they are influenced by digital means. Artificial technologies can take their cue from the natural environment and offer innovation, speed up the process, compress time and simulate reality with great accuracy.
Infact, the intersection of nature-inspired design and Advanced Manufacturing can lead to the creation of novel materials and systems that replicate the efficiency found in natural structures being highly adaptable and resilient.

Our 'semantic capital' has difficulties to adapt to technological changes and remain linked to arketipical idea of building and living. Designing for extreme environments (where climate change and biodiversity has a deep alteration) is now possible with advanced manufacturing technologies by several enabling tools like:

- Digital Fabrication (manufacturing process developed in an industrial context where precision and direct production is requested);
- Computational Design (refers to a procedure which interprets mathematical data informing the design in order to give directional results);
- Materials on Demand (materials that can be customized up to their molecular structure to have functionally graded material systems).

Exploring the intersection of nature-inspired design and Advanced Manufacturing (AM), such as 3D printing or other additive manufacturing techniques, opens up a

world of innovative possibilities. By observing and mimicking natural processes and materials, we can create structures that are more efficient, sustainable, and adaptable, reducing the use of materials.

The Material Balance Research Group represents a cutting-edge convergence of sustainability, digital fabrication, bio-based materials, and human-centered design. By emphasizing a balanced approach that integrates the technical, psychological, functional, and symbolic aspects of materials and design, the group offers a comprehensive framework for rethinking architecture and construction in the Anthropocene. The work being done at Politecnico di Milano is not just about creating more efficient materials and systems; it's about creating a new design philosophy that is both technologically advanced and environmentally responsible—one that redefines the relationship between the natural and the artificial.

Marco Dal Mas

was an affordable housing developer and then a developer of innovative solutions for energy efficiency and decarbonization of buildings. He supported the creation of Edera[21], the Innovation Centre for large-scale decarbonization and regeneration of the built environment, where he is now Chief Technical Officer.

"Enabling deep regeneration"

The environmental-social challenges of our times showed a multi-faceted crisis in the construction sector, particularly in achieving decarbonization goals, addressing workforce aging, improving skills and productivity, and overcoming the limitations of small and undercapitalized firms. These issues are not only urgent from an environmental perspective, as they relate to climate change mitigation but also from an economic and social point of view, as they deeply affect the efficiency, quality, and sustainability of the built environment.

The actual situation in Italy shows that to achieve the decarbonisation targets for the built environment, it is necessary to triple the current retrofitting interventions.
What's more, companies operating in the construction sector are small and medium-sized or undercapitalised: 40% of projects are delayed and 50% are over budget. Today, 20% of the workforce is aged between 55 and 64 (this figure will rise to 30% by 2030) and there is a lack of training, resulting in a low level of skills and qualifications among the workforce, which affects the quality of interventions.

Edera was funded in 2020 by Thomas Miorin with italian private bodies such as: REDO, ANCE, and Fondazione Housing Sociale, supported by Fondazione Cariplo.

Edera is a non-profit organisation and innovation center based in Milan that develops, promotes, and disseminates new solutions for the built environment regeneration through an original path of innovation with leading companies and property owners toward change. The company drives a paradigm shift in the way we redevelop and build to arrive at solutions and interventions for offering more social and affordable housing:

- **More sustainable**, thanks to a more intelligent use of materials and the high energy performance of buildings;
- **Cheaper**, through economies of scale generated by the industrialisation of the construction process;
- **Faster**, thanks to the prefabrication of

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components that reduces time, risks and inconvenience;

- **More inclusive**, because the drastic reduction in energy and energy costs reduces energy poverty and improves the living conditions of inhabitants, especially in the suburbs.

Edera works in Italy and abroad on both new construction and renovation projects in the private, affordable, and social housing sectors. The support provided includes the study of a dedicated production process and associated factory, the development of a design concept, and the analysis of both economic viability and sustainability impact.

Edera is part of the Energiesprong Global Alliance[22] and is the Italian actor applying such a mission, coordinating the Energiesprong initiative in Italy[23].
Energiesprong Global Alliance is an international movement active in 6 countries all over Europe including 6000 homes retrofitted and 14000 homes in progress to be retrofitted. For its commitment, the alliance won the UN HABITAT Gold World Habitat Award 2024, as the international project with the highest impact on the housing emergency. The goal that drives the Alliance is to bring together several companies around the world, using different materials and technologies based on need and geography, for a collective investment that is far removed from any materials lobby.

The mission of the Energiesprong is to empower companies to design, manufacture, and deliver zero energy retrofits, enabling faster, affordable, and scalable interventions.
Energiesprong aims to promote a new approach to construction, based on the standardisation of solutions and processes, to evolve from the traditional way of building to a new way that can be faster, more efficient and fully integrated.
Energiesprong operates in different countries with independent teams that intervene in the market to bring together a sufficient volume of demand to develop new high-performance deep retrofit solutions.

The Energiesprong movement, which originated in the Netherlands, has developed with excellent results in several European countries such as France, Germany, the United Kingdom and Italy, as well as in the United States and Canada, countries that have recently shown interest in the initiative.
Energiesprong in Italy is the driver of a large open ecosystem of more that 50 realties, in constant evolution, which offers a meeting place for designers (architects, engineers, social sector), facilitators (finance and insurance companies, universities&research), market demand (property owners and managers) and market supply (companies and suppliers of products and solutions).

The business model shows that a deep energy retrofit carried out with the Energiesprong approach, compared to a light (not compliant with the 2050 target) or deep traditional retrofit, is able to offer several advantages regarding guaranteed savings & revenues and benefits. In fact, the approach is slightly more expensive regarding the initial intervention cost, but show a vantagius cost compression vantagius in its replicability and scaling up economy.
Tackling the housing crisis also means extending a new approach to retrofitting the building stock, with an innovative design

22 energiesprong.org

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for serial refurbishment solutions as a complete product.
By applying a simple energy retrofit intervention through a holistic approach, we can aspire to a more complex urban regeneration project in the neighbourhood. For example, the use of simple prefabricated facades brings with it the objective of implementing the architectural quality of the building itself, creating new private (balconies and terraces) and collettive spaces, and increasing the energy autonomy of the building. Here, this approach allows us to introduce additional factors - permeability of collective spaces, accessibility, functional mixité, NZEB or energy positive building, energy communities - that are integral to the transformation from building to neighbourhood.

The off-site construction supply chain requires an effort to re-programme the entire design cycle, where designers are called upon to control the entire process: from analysis to construction and management. The off-site process also offers advantages in terms of the building's end-of-life cycle, through partial reuse of elements or materials and systematic dismantling. One of the key aspects of energy efficiency work is long-term affordability: the initial investment is fully recouped by the energy efficiency and comfort that significantly reduce consumption and, consequently, utility bills, which in some cases are reduced to zero thanks to the cumulative effect of the installation. It follows that the cost of the intervention is financed by the energy and maintenance savings guaranteed in the long term.

The Italian case is specific because it presents some peculiar physical-technical characteristics. In fact, the widespread seismic risk and the wide range of annual thermal energy create a peculiar framework that prevents the systematisation of architectural solutions and requires specific design to ensure long-term maintenance and sustainability.

One of the latest projects developed in Italy is the energy refurbishment of the Aler Towers in Via Russoli, Milan. The 4 towers with 187 units are part of the public social housing stock and are owned by ALER Milano (Azienda Lombarda Edilizia Residenziale Milano), a public body, owner and manager of a public housing estate of 70,057 units in the Municipality of Milan.
The development of the project was carried out on two parallel levels: focusing on the energy requalification of the buildings and on the redesign of collective spaces on the rooftops.
The intervention included the installation of prefabricated and pre-finished facades designed using BIM tools, which were installed quickly (1 store per day by 4 workers) and without scaffolding for deep energy retrofitting. This was achieved by using fully recyclable or bio-based materials such as wood for the structures and natural products based on rice husks (produced by the company Rice House) for insulation and finishes. Prefabricated elements guarantee long life and high performance in the logic of design for disassembly.
Windows, doors, and shutters have been replaced and a photovoltaic system has been installed to light the communal areas and power the lifts. Thanks to this work, the blocks have been upgraded to class A+4 and are better protected against heat and cold. In addition, the energy needs are mainly covered by renewable sources (PV with storage) and the urban heat island has been slightly reduced thanks to the green roofs.
In addition, the cooperation and involvement of the tenants was almost total throughout the process. They were involved in the design and construction of the roof gardens,

kept informed throughout the construction phase, and are now responsible for the management.

The via Russoli case study is significant because it aims to open up the debate and provide a replicable example for public authorities. It does not make the refurbishment of public housing seem so impossible but rather helps us to focus on how much an intervention in a single housing complex can improve the quality of life for many of the people who live there. This case study also draws attention to the importance of how an energy refurbishment intervention can be a catalyst for a new sociality and the creation and establishment of new community groups, thereby extending the primary objective of the project.

Edera is currently working with the municipality of Milano to the Energiesprong Milano Project, a 3-year project to identify and implement deep retrofit and tactical housing models for social housing and schools in Milan. Off-site construction seems to be the optimal response to the housing emergency through fast and low-cost interventions, with modular, transportable and removable buildings. The Municipality of Milan estimates that the response time could be reduced from 6-7 years to 9 months, thanks to tactical housing.
The aim of the research is to provide the Municipality with a catalogue of technically and economically suitable solutions that can lead the public administration towards a large enclosure of its building stock.
A large and systematic collective effort that can clearly make the change and serve as an example for other Italian cities.

Piero Pelizzaro

has 15 years of experience in climate change policy, urban resilience planning, and urban innovation. He is currently the Director of the Environment and Heritage Sector of the Municipality of Vicenza. At the Agenzia del Demanio, he is also in charge of the Workshop for the Regeneration of Public Property, where he coordinates the drafting of the ESG Sustainability and Impact Strategy and the Innovation and Sustainability Presidium for Dditale. He is an advisor to the Italian Ministry for Ecological Transition on the National Adaptation Plan to Climate Change.

"How to drive innovation within the public administration?"

Through his professional experience, Piero Pelizzaro guides us in discovering innovation processes within public administration, emphasizing the potential benefits of off-site construction for public projects.
He discusses the evolution of off-site construction practices in recent years, noting a shift in public perception and acceptance. To find a common denominator for action, we analyze the cities of Milan and Vicenza, which are among the most dynamic in terms of industrial and real estate development and are committed to solving contemporary urban challenges. The conversation also touched on social equity, suggesting that improving the aesthetics of housing can contribute positively to communities facing inequality, public needs and environmental considerations.

In the early to mid-2010s, off-site construction wasn't widely discussed in Italy and wasn't the focus of public administrators and private investors. But in 2015-2017, with the recognition of initiatives such as Energiesprong in the Netherlands, the conversation around new construction techniques and energy-efficient retrofits began to gain traction. In this respect, the efforts of Thomas Miorin and his colleagues at Edera (which came into being a few years later in 2021) were instrumental in opening up the debate on the subject and drawing attention to the opportunities offered by off-site architecture.
Looking at the European context, off-site construction was already well developed in other nearby countries such as the UK, which was already on the way to developing public building refurbishment with a focus on social housing in the Greater London area.

At the end of the 1990s in London off-site construction was sparking engaging debates on a variety of fronts. Discussions ranged from resource allocation and materials management to the complexities of public and administrative procedures needed to regulate these new processes.

One of the most significant shifts, however, was the impact on the labor market and the workforce.
As innovative construction methods gained traction, attention was also drawn to the need for capacity building among workers. This meant providing training that would allow them to adapt to new construction techniques and technologies. The potential for these new methods to drive workforce development became clear: they not only promised greater efficiency and cost-effectiveness in construction but also offered a pathway to upskilling low-income workers and providing opportunities for small businesses.
This marked the beginning of a modern shift in the construction industry. By embracing off-site construction and similar innovations, the sector began to evolve, offering new prospects for job creation, workforce training, and economic inclusion. It also held the promise of transforming the way construction projects were conceived, executed, and managed, ultimately benefiting both workers and businesses through qualified training and enhanced job opportunities.

Milan

In Italy, the debate around innovative construction methods was still in its early stages, and the dialogue on the matter was a lengthy and often complex process. One of the most challenging aspects was convincing politicians to embrace new approaches and reconsider traditional methods for processing investments in the building sector.

The first real opportunity for change came with the pandemic in 2021. The global health crisis disrupted many industries, and construction was no exception. However, the pandemic also opened up a unique window of opportunity to rethink and modernise the construction industry, helping to put social issues and community engagement back on the agenda.
Milan, like many other cities across Italy, faced significant challenges during the pandemic in terms of managing the public health crisis while also addressing the immediate housing and shelter needs of its population. One of the most pressing issues was finding suitable accommodation for individuals who tested positive for COVID-19, as well as providing safe, high-quality spaces for families and workers who were either displaced or needed to isolate.

Could off-site have been an effective solution to deal with this emergency at the time?

Milan is indeed one of the most economically dynamic and prosperous cities in Italy and plays a central role in the country's economy. Milan produces about one-fifth (1/5) of Italy's GDP, making it an economic powerhouse not only within the country but also in Europe. In terms of population, about 5% of Italy's total population lives in Milan, but this small proportion contributes a remarkable 21% of the country's GDP.
Taking into account this situation and the resources provided by the National Recovery and Resilience Plan (2020-2026), many proposals have been made to address the situation. A number of public actors, private foundations, and investors in Milan, such as Fondazione Cariplo, have come together to launch initiatives aimed at solving the housing crisis using these modern construction techniques.

State Property Agency

In this brief sub-section, we take a look at how the State Property Agency maintains and transforms its property and the obstacles to innovation it faces.

The Agenzia del Demanio is a body part of the Ministry of Economy and Finance that manages 43,000 state properties. The Workshop for the Regeneration of Public Property (Officina per la rigenerazione dell'Immobile Pubblico) is a structure that works to accelerate innovation processes by creating an ecosystem of public and private actors, aiming to improve the liveability and functioning of all public property in the country. By 2024, the state owns nearly half a million public properties, of which 160,000 are managed by the state itself and 320,000 by regional administrations: an immense cultural heritage and a great opportunity for the country.

Inside this framework all those empty or abandoned proprietries represent a big opportunity but show some peculiarities. Off-site construction offers a wide range of applications that go beyond simple energy recovery and façade restoration, and also provides an opportunity for interior refurbishment. This approach overcomes the limitations imposed by heritage authorities and offers innovative solutions that are less constrained by restrictive regulations.

Why don't we look at the possibility of off-site for indoor use?

Facing a rapidly worsening housing crisis and rising poverty rates, the government has turned to the National Property Agency to address the urgent need for housing, particularly student accommodations.

Infact, abandoned buildings are multifaceted problems that go beyond just their physical decay. They represent significant security risks, social challenges, economic burdens, and missed opportunities, especially in the context of housing shortages.

This context highlights the difficulty of managing housing affordability in a time of rising costs and growing poverty. The increase in the poverty rate from 6.4% to 8.5% over just two years is particularly alarming, suggesting that the economic situation has worsened significantly. The government's focus on delivering new houses quickly, especially for students, underscores the urgency of the situation, as students often face particularly high housing costs in major urban centers, especially near universities.

The role of the National Property Agency in this context would likely be to manage public properties, potentially repurpose unused or underutilized buildings, and facilitate the construction of new housing units. However, delivering housing quickly would require overcoming challenges related to land availability, construction timelines, and securing sufficient funding or support from other government agencies.

The response of the Agency was repurposing military buildings for civilian use as innovative solution, especially in the context of rapid urbanization, housing shortages, and global crises that demand flexibility and speed. Military buildings indeed offer several unique advantages, making them strong candidates for adaptive reuse in civilian contexts, such as existing infrastructure, ample space, standardized design and similar building technologies, offering several simplification for off-site applications.

Never more than now we need to build resilient and plan housing that can adapt to rapidly changing societal needs, especially in the context of recent uncertainty, like war, pandemics, climate change, and migration. Off-site offers severals possibilities to quickly repurposed buildings for different functions as the world evolves.

Off-site construction is a way to be resilient and adaptable to change, as is the demand

for housing, which could change rapidly from student accommodation to retirement homes in a matter of years. With its sistemic approach, off-site construction offers a unique opportunity to drive innovation in policy and urban development. The public administration, which is by antomasia slow and static, must shift to innovation and reponse fast to the current and future needs of housing.

Vicenza

What does it mean to take care of a small city like Vicenza, after working in cities with more than 2 million inhabitants, such as Milan, and managing 43,000 properties on behalf of the State Property Agency? Piero Pelizzaro has recently returned to his home town and is now the director of the Environment and Heritage Sector for the City of Vicenza. Among other things, he is responsible for the maintenance of social housing in the area trying to face emergency with fast changes.

The problem of homelessness is a sensible issue for the city of Vicenza, which is facing the closure of one of its two city hotels. With the arrival of the Tav (high speed train) line to Vicenza, the municipal hotel in Via Giordano will be demolished and vacated by December 2024. In the meantime, the Municipality is looking for an alternative structure capable of accommodating at least 70 people, with space for accommodation and services.
Given the short timeframe (6 months) to relocate those who have lost their homes, off-site construction appears to be an advantageous solution. Building from scratch off-site is often quicker than carrying out maintenance, especially when routine maintenance has been lacking for years, exacerbating the adaptation situation.
The Veneto region has always had a strong industrial vocation and continues to be one of Italy's main economic drivers. The region is historically known for its excellence in manufacturing and production sectors, ranging from textiles to mechanics, design and high technology. In Vicenza, as in many parts of Italy, the private sector has the potential to play a significant role in revitalizing the building and construction sector, especially in the context of urban regeneration, housing shortages, and sustainability. However, the situation in the building sector is less active, with a lack of support from the public administration to pursue innovative processes and a lack of resources in the public sector, for example in the way the public administration's budget is allocated. It is well known that we have earmarked 1.2 billion euros for students accomodation, which has been in storage in Rome for two years now (2022-2024) without significant applications.

Despite the drive towards innovation, Italian public administrations also face major challenges. Bureaucratic slowness, lack of adequate training and resistance to change among some actors in the sector are still significant obstacles. However, there are positive signs in many local administrations that recognise the need to speed up decision-making processes, facilitate access to new technologies and support the adoption of modern construction practices, such as off-site construction.

In conclusion, Piero's view highlights how Italian public administrations, albeit with local differences, are increasingly oriented towards innovation and efficiency, recognising change in the construction sector as a key to meeting the economic, environmental and social challenges of the cities of the future. Off-site construction can deliver good quality architecture for more accessible and affordable houses, shifting the paragadime of housing from problem to opportunity. In addition, off-site construction is one of the few options possible for achieving carbon neutrality in construction and meet the EU's 2050 targets.

Panel #2

Adriano Francescotti

is engineer and the Technical Director of X-LAM Dolomiti[24].

"Why is retrofitting the existing heritage so important?"

XLAM Dolomiti S.P.A. is a leading company based in Trentino, Italy, specializing in the design, production, and construction of sustainable buildings using wood technology, particularly CLT (Cross-Laminated Timber) solutions. Established in 2012, the company has over 80 employees and has made a significant impact on both regional and global levels. XLAM Dolomiti is known for its strong commitment to ecological sustainability, offering innovative and environmentally-friendly building solutions that support the transition to greener construction practices.
The company stands out for its know-how in large wooden structures and aims to become a benchmark in the industry thanks to its specific technical skills and national and international experience in managing the entire process, from design to final construction. XLAM Dolomiti appears to be a company that specializes in providing complete structural and construction design services using innovative and advanced technologies (BIM) and CE certification (absence of formaldehyde).

References project for new construction

- Italian tallest wooden residential building with 9 floors in Rovereto (Italy). Design, supply and assembly phase;
- Fidia office square project in Milan with post and beam technology (Italy). Design, supply and assembly phase.
- "Living Alberione" residential complex in Trento (Italy). Design, supply and assembly phase;
- "Loyola" University of Chicago in Rome. Design, assembly and supply phase.
- Ombù office and headquarter by Arch Norman Foster in Madrid (Spain). Design, supply and assembly phase.
- First passive house in Melbourne (Australia); Design and supply pahse.
- Ballarat office Govhub in Australia with post and beam technology; Design and supply phase.
- Largest residential building in the southern hemisphere with 625 rooms in Melbourne (Australia). Design and supply phase.

24 www.xlamdolomiti.it

Retrofotting: why and how?

Retrofitting is becoming a crucial strategy for addressing pressing global challenges such as the housing crisis, resource shortages, ecological transition, and creating sustainable urban environments. Below, we explore how retrofitting intersects with these challenges, incorporating best practices, innovative solutions, and educating professionals to guide the future of public housing renovation and design proposals.

Advancing seismic retrofitting

In Italy, which lies in a seismic zone, there are critical challenges when it comes to balancing the need for new construction with preserving the use of soil and mitigating risks associated with earthquakes. The country's rich history, cultural heritage, and dense population in seismic-prone areas necessitate a thoughtful approach to both building and environmental conservation. Retrofitting, particularly seismic retrofitting, is a critical approach to strengthening and enhancing the resilience of existing structures.

Analysis of the effectiveness shows that wood joints and CLT panels can be used with different technologies to reinforcing masonry buildings or reinforced concrete structures and mitigating seismic risks. The outer CLT jacket acts as an additional enclosure, enhancing the seismic resistance of the structure and providing stability and rigidity against the lateral forces generated by earthquakes. This method can be applied in several ways: internally or externally, with or without insulation. There are no limitations to applying CLT to existing structures, and each case study is unique and different.[25]

Maximizing urban potential

Clt and pre-fab engineered wood show potential for a sustainable expansion and retrofitting of existing building avoiding the use of new soil. This statement follow the rules of the building on the built philosophy where urban density and new demands require space expansion without consuming additional land, encourage an holistic approach: energy improvement, seismic stability, preservation of green areas. o maximize the space, three types of interventions can be applied: parasitic architecture, rooftops, and exoskeletons.

In between the advantages of engineered wood we highlight the follows: high structural and architectural standards, increased energy efficiency and environmental sustainability, speed of installation and dry processing and reduced environmental impact and interference with the surrounding environment.[26]

Timber resilience

Despite wood has significant potential in terms of seismic resilience, it is not always the optimal solution for every scenario. Its durability can be a limiting factor, especially in environments subject to other natural hazards like frequent flooding. This is why the concept of hybrid construction, which combines the benefits of different materials, is increasingly being explored as a more flexible and resilient solution.

Hybrid Construction with XLam Concrete refers to a construction approach that combines XLam with concrete elements, creating a hybrid structure that takes advantage of the benefits of both materials and technologies. This method is part of a growing trend in sustainable and efficient

25 Sustersic I., Dujic B., «Seismic shaking table testing of a reinforced concrete frame with masonry infill strengthened with cross laminated timber panels».

26 Frunzio G., Rinaldi S., Guadagnuolo M., Massaro L., Di Gennaro L., «Use of engineered wood for the Retrofitting of existing structures».

building practices, often used in off-site and modular construction.

Elevating safety and sustainability

CLT is an innovative, sustainable building material that has gained significant attention in recent years, particularly in the context of high-rise construction. Although traditionally used in low- to mid-rise buildings, CLT has the potential to be an effective material for retrofitting high-rise structures, offering both environmental and structural benefits.
Researchers conducted a study on a high-rise building proposing the use of CLT for the seismic strengthening of a 110-meter tall reinforced concrete (RC) building in Huizhou, China. The building was selected for retrofitting due to its seismic vulnerability and the need to improve its structural resilience in the face of earthquake risks. The study aimed to demonstrate how CLT, a sustainable and innovative material, could be effectively integrated into a high-rise retrofit effort to improve performance, safety, and environmental outcomes while enhancing the architectural appearance. With the same retrofit intervention there would be was a significant reduction in overall energy requirements both for heating and cooling.[27]

Reserach Projects and special applications

Xlam Dolomiti is involved in several research project that investigate possibilities for resilience in construction development.
The MULTICARE project offer technical solutions for the structural and seismic retrofitting of existing buildings with CLT panels, GLT and AFC, thermal (integrated in the prefabricated façade) and architectural improvements (additional spaces, e.g. balconies).

The SU.PRE.MO[28] project, among other topics, analyses the potential of hybrid components in order to propose a catalogue of solution (cassette floor and composite walls) providing solutions for the retrofit of existing Building for the best cost-effecitve results.

One of the most recent project of Xlam Dolomiti are the infill walls of the Milan Cortina 2026 Olympic Village in Milan.
The company oversaw the entire process, from manufacturing to construction, including engineering analysis and fire testing. Thanks to the site manager's insight, a bespoke pneumatic manipulator was developed to meet the specific logistical and coordination challenges on site. This prototype machine was designed to install panels on the facade from the inside, overcoming the limitations of crane use. The system features a telescopic arm and precision clamp, allowing the panels to be accurately lifted, rotated and positioned. It is easily manoeuvrable using an electric pallet jack and is fitted with safety sensors to ensure it can only operate when fully stabilised. This innovative system represents a significant advance in timber construction practices, increasing efficiency in terms of time, cost and safety on site.

27 Contiguglia CP., Pelle A.,, Lai Z., Briseghella B.,Nuti C. Source: «Chinese High Rise Reinforced Concrete Building Retrofitted with CLT Panels».

28 Progetto SU.PRE.MO

Alessio Colombo

is a geologist, the COO, and Co-Founder of RiceHouse[29].
The company's mission is to build homes using rice by-products, creating sustainable living spaces that accommodate humans on all scales, from micro to macro. RiceHouse acts as a bridge between agriculture and architecture, connecting both industrial and artisanal practices in the region.

"In the burnt field, I saw a rice house: only if we look at the world differently we will have the opportunity to change it"

RiceHouse is a Benefit Company based in Biella focused on sustainability, developing a circular economy using rice by-products to create innovative construction materials for healthy building. By promoting environmental responsibility and technological innovation, RiceHouse offers a sustainable solution to the increasing demand for primary resources. Its mission is to make homes more sustainable, turning them into living organisms, while prioritizing eco-friendly practices.

Circular economy of rice supply chain

Nature and agricultural production foster a local, sustainable process that reuses secondary resources, creating economic value while benefiting the environment. This approach generates employment and profit through collaborative, multidisciplinary efforts, aiming to rebuild a balanced relationship between humans and nature. It promotes social responsibility and environmental sustainability in the construction of a better future.
The grain of rice serves as a powerful metaphor for transformation, symbolizing the deep connection between nature, society, and development. As a staple crop, rice represents nourishment, life, and growth—values that extend beyond farming. It also embodies social development, especially in marginalized or suburban areas, where communities face challenges but possess significant potential for innovation and positive change.

The building as a CO2 container

CO2 emissions are released not only during the operational life, but also during the manufacturing, transportation, construction and end-life stages of buildings. These

29 www.ricehouse.it

emissions, usually referred to as embodied carbon, have been largely overlooked in the past. However, they are responsible for approx. 11% of all global carbon emissions. CO2 emitted before the building is in use (also known as 'upfront carbon') will account for half of the total carbon footprint of new buildings by 2050 and threaten to consume a large share of our remaining carbon budget.[30]

In Italy, 230,000 hectares are used for rice cultivation where 93% of these areas are located in the north of the country. The annual rice yield is 1.6 million tons.
Currently, agricultural by-products of rice (straw and husk) are usually burned in Italy. However, burning them releases CO2 emissions and other harmful air pollutants into the atmosphere. If rice straw and husk are not burned but used as building materials, they can sequester significant amounts of CO2 in buildings. By involving various links in the supply chain for rice straw and husk, it is possible to create new opportunities for the production of innovative climate-friendly insulation materials for healthy buildings and contribute to mitigating climate.

A building should not be thought of as a source of pollution, but rather a structure that can store and contain CO2 emissions. The Ricehouse architecture projects, in which by-products from rice cultivation were used as sustainable insulation material for buildings, resulted in constant growth since 2021 and today is counting with 1200 CO2 tons which would be equivalent to the amount of carbon dioxide absorbed by approximately 228.571 trees.[31]
For a national overview, the estimated annually sequestered CO2 amounts to 2.440.000 tons (= 464.761.905 trees) if all available by-products of rice cultivation were property used in the construction sector.

Torri Risorsa, a project in Milan

The four residential tower complexes in via Russoli, built in the 1980s and owned by ALER (Azienda Lombarda Edilizia Residenziale Milano), underwent a renovation project between 2022 and 2023. The project focused on two main aspects: the energy requalification of the buildings with prefabricated climate-friendly insulation (made from rice husk and straw) and the development of social spaces on the flat roofs. The renovation covered 187 housing units, 15,000 square meters, and served 400 inhabitants.

Before the renovation, the façades of the four buildings were 12 cm thick and provided no insulation against the cold in winter or the heat in summer.
Prefabricated walls covering 5,935 m² have been installed, consisting of 341 panels with a wooden structure. These panels feature rice husk insulation and are finished with a windbreaker and fire protection layer made of non-combustible gypsum-fiber for the façade.
The installation of the prefabricated façades was quick and efficient, with two workers able to install six panels per day. This process did not require scaffolding, further streamlining the construction and reducing time and costs and improving the safety of the construction site.
This renovation significantly improved the buildings' energy efficiency, upgrading them from energy class G to class A4 (A++++),

30 The World Green Building Council et al. (2019): Bringing embodied carbon upfront. Coordinated action for the building and construction sector to tackle embodied carbon.

31 Eni Integrated Technical Study „Sustainable land use management and forest offsets" San Donato Milanese, October 2018; presentation of Alessio Colombo at SURF 'Renovation Lunch' on 20.02.2024.

meeting nearly zero-energy building (nZEB) standards. As a result of the renovation, the annual energy demand of the buildings was reduced from nearly 60,000 kWh/year to less than a tenth, approximately 5,000 kWh/year. This significant reduction highlights the effectiveness of the energy-efficient improvements, including the insulation and use of sustainable materials.

In addition to insulating the façades, the roofs of the buildings were also upgraded. Solar photovoltaic (PV) systems were installed on parts of the roof, and roof gardens were created. Converting the flat roofs into green spaces not only enhances biodiversity but also helps mitigate the heat island effect and provides new areas for the community. As a result, the project had positive environmental and social impacts on the neighborhood, promoting sustainability and improving the quality of life for residents.

The project offers several additional positive benefits. The roof gardens provide low-income tenants with the opportunity to grow their own food at minimal cost, creating a zero-kilometer production chain. This initiative fosters integration among residents and helps restore a sense of community and good-neighborliness. It also encourages citizens to respect and care for public spaces.

In terms of stakeholder engagement, the project involved a comprehensive co-creation and co-design process. Designers worked closely with a wide range of stakeholders, including universities, public and municipal institutions, and private companies, throughout the phases of inspiration, conception, and implementation.

Giorgia Di Cintio

has worked since 2020 with Homers[32] and Homes4All[33] as an architect, contributing to the development of innovative urban regeneration models through housing. Her work focuses on service and project design, research, and communication. In 2024, she became the General Director of Fondazione Impact Housing[34], where she leads efforts to create and promote new living concepts with a positive social, economic and environmental impact.

"Shared living and social housing: an opportunity for urban regeneration"

The housing issue can be described as a situation of "demand without supply" and "supply without demand", specially in Italy. This means that there is a significant need for affordable and suitable housing, but the available housing options do not meet the demand in terms of quantity, quality, or affordability. On the other hand, there may be housing units built that do not align with the actual needs of the population, such as being unaffordable or poorly located, old and non-compliant with building regulation, leading to underutilized supply. This imbalance creates challenges in addressing housing shortages and ensuring equitable access for all.

Demand without supply

- 15% of families (3 million of people) are unsatisfied of their dwelling[35]
- 82% of families can't find adequate and affordable housing[36]
- 16% of families have relational difficulties[37]

Supply without demand

- 60 milions of unused assets in Italy[38] and 50,000 vacant flats in Turin
- 60 billions of euros of public distressed assets[39]
- 26 billions of euros of private distressed assets[40]

32 www.homers.co

33 www.homes4all.it

34 www.fondazioneimpacthousing.org

35 Federproprietà - Censis 2022.

36 Housing Europe 2017.

37 Nomisma 2022.

38 Riusiamo l'Italia 2014.

39 Invimit 2019.

40 Sole24Ore2014.

European overview

The data described above are confirmed at European level. In fact, the European overview shows that tenants are almost four times more likely to suffer from housing cost overburden than homeowners. Cost inflation does not only concern purchases and rents, but also and especially the maintenance of one's own housing. Indeed, some research has reported that 17.2% of the EU population live in overcrowded conditions, 9.4% of the EU population as a whole have a housing cost overburden, and 35.4% of those on low incomes have a housing cost overburden.[41] These data indicate that people on low incomes are often unable to find affordable housing, forcing them to spend a disproportionate amount of their income on rent, and that a significant number of people live in housing situations where several people share too little space, which can affect their health, well-being and quality of life. As a result, they may struggle to afford other necessities.
Over a decade, between 2011 and 2020, house prices experienced inflation of +30.2%, after a period of decline due to the crisis in 2012-2014, while rental prices rose steadily by +14.8%. This increase reflects the rising cost of housing, making home ownership and renting increasingly unaffordable for many and contributing to the housing affordability crisis.[42]

The housing emergency is a multifaceted matter that goes beyond monetary insecurity to include economic, energy and relational poverty.
Social issues (loneliness, lack of relationships and an ageing population), economic aspects (lower incomes making housing more unaffordable) and environmental implications (climate change making living conditions uncomfortable and increasing maintenance and energy costs) are very present and widespread across Europe.
Some statistics show that in 2020, an estimated 96.5 million people in the EU were at risk of poverty or social exclusion, representing 21.9% of the total population.[43]
In 2019, 6.9% of the EU population were unable to keep their homes adequately warm, rising to 18.2% among those at risk of poverty.[44]
Across the EU, 9.2% of the adult population (aged 16 and over) had no one to ask for non-material help in 2018, and in France 87% of private landlords experienced racial discrimination when renting a property.[45]
It is no longer acceptable to believe that the market can solve all "manageable" issues, leaving the responsibility for social emergencies to the public and the third sector. The expectation is shifting toward a more integrated approach, where both the market and public sectors must address the full scope of social and economic challenges.

In this context, the innovative Benfit Company B Corp Homes4All, based in Turin, aims to respond to housing needs by promoting urban regeneration processes and developing research-action projects at national level. H4A puts attention to several housing model such as: housing for homeless, social housing, and co-housing.

H4A started its activity of defending the right to housing through an innovative

41 Eurostat.

42 Iibid.

43 5th Overview on Housing Exclusion, FEANTSA and FAP - (AROP indicator).

44 5th Overview on Housing Exclusion, FEANTSA and FAP - (Eurostat - EU SILC).

45 Ibid.

Impact Finance project, led by the Municipality of Turin and financed by the Fondo Innovazione Sociale of Presidenza del Consiglio dei Ministri - Dipartimento della funzione pubblica, which intervenes in the issue of housing deprivation by developing a global system of taking charge of beneficiary households in order to strengthen their ability to achieve a stable housing solution. H4A *a home for everyone, with a yeld for you* is the company created to implement the project. Thanks to a network of private investors sensitive to the logic of sustainability and social impact, Homes4All finds, renovates and manages properties, renting them out t o families in temporary difficulty at an affordable price.

In 5 years of existence, H4A has been able to achieve several achievements and performances in terms of social and economic impact. They hosted 134 beneficiaries, they created 54 real estate units in property, they have over 35 real estate units under management and they installed a network of 164 stakeholders worldwide.
Over 5.6 million euros of funds have been raised to support operations, including several ways such as Equity raised in several rounds, member contributions for specific operations, bank financing and participatory financial instruments.

Homers is the Homes4All brand dedicated to identifying and dismiss assets for reimaging them as co-housing transforming elements of urban decay into opportunities for regeneration. The approach includes identifying and revitalising derelict properties, guiding future residents through the entire building process, creating communities of residents who co-design shared spaces and services and developing beautiful, environmentally and economically sustainable cohousing where everyone can find their own place.

Homers, as well as Homes4All, employs a circular approach and has the capacity and interdisciplinarity necessary to lead complex projects. This enables them to effectively manage the multifaceted challenges of urban regeneration, sustainable housing, and community development, ensuring comprehensive and lasting solutions:

- **Real estate raisin**g: property research, renovation of the existing heritage, market analysis, real estate valuations and fundraising;
- **Project design & management**: architectural design, real estate development, social design, service design and co-housing;
- **Energy efficiency**: replacement of systems and fixtures, thermal insulation, attention to the technical installation of products (i.e low-controlled taps and low-consumption lamps), photovoltaic that fulfills at least the requests for the common parts;
- **Property management**: building management, facility management, energy management;
- **Community management:** social accompaniment, social management, community gathering, group facilitation and energy communities.

In recent times, we are exploring new ways and models of living, moving away from traditional approaches. After the pandemic, people have rediscovered the value of living in homes with spacious rooms, green spaces, and enhanced social connectivity. The co-housing model has gained significant attention and is emerging as a key trend in the real estate market today.[46] This model promotes community living, shared spaces, and a more sustainable lifestyle, responding to the evolving needs of modern society.

46 Homers, Gabetti Home Value, "Il co-housing in Italia: un nuovo trend del real estate", 2024.

If we ask people, *What words would you use to describe the house of your dreams?* two factors emerge as particularly impactful: attention to the environment and living in an active neighborhood. For individuals aged 25-44, over 13% prioritize environmental concerns, while those over 45 place more emphasis on neighborhood, with over 14% choosing it as a key factor. This interesting data highlights the growing importance of a sustainable future and the need for human support, especially for older generations, who seek security and community in their living environments.
Cohousing is one of the most promising sectors in real estate, offering a way of living that emphasizes collaboration and mutual care. This model fosters stronger communities by promoting shared spaces and collective responsibility, allowing individuals to rediscover the values of cooperation and support in their daily lives.

Despite this promising attention to the cohousing model, it is not a very widespread practice in Italy. In fact, in Italy only 0.0003% (corrisponding to 28 on going projects - 21 of which are private co-housing) of the population live in cohousing[47], a very low number compared to Sweden or Denmark, where the percentage reaches 1%[48] and 2% respectively.
Co-housing presents a significant opportunity to promote and renovate Italy's housing stock, according to Homers. If the number of people participating in co-housing were to increase to 1% of the population, it would result in the construction or renovation of over 130,000 buildings as co-housing units. This could lead to a substantial transformation of the housing market, fostering more sustainable, community-driven living spaces.

Homes4All, DRC Italia, Comin and CEIS Genova founded in 2021 the Impact Housing Foundation to contribute to a revolution in the housing sector. The Impact Housing Foundation is a non-profit organization that advocates urban regeneration and social innovation, promoting impact finance for impact housing. The term "impact housing" refers to private innovative financial tools and investments in the housing sector, working in synergy with the public and non-profit sectors, aiming to generate positive, measurable social, economic, and environmental impact.
The Impact Housing Foundation aims to have an international impact and is the coordinator of the European Impact Housing Network. This community of practice leverages the collective experience and expertise within the network to implement practical applications, drive tangible changes, and develop innovative impactful solutions.

Since its foundation, Homers, Homes4All and Impact Housing Foundation have developed numerous projects through various forms of collective living, primarily in the North-West of Italy. These include 2 social cohousing projects, 1 student housing, 2 real estate trading initiatives, 14 social housing developments, 3 cohousing projects, and 1 special project.[49]

47 Experiment Days 2017- Housing Lab and ISTAT.

48 Cohousing -Jacopo Gresleri , 2015.

49 homers.co/progetti

Co-housing Borgo Rossini

The Borgo Rossini project in Turin is a prime example of a best practice for Homers, incorporating several key features that make it a standout model in sustainable and community-oriented living. Here's a breakdown of these features:

Intentional Community: The project is designed to create a strong sense of purpose and connection among residents. In fact, , people have deliberately chosen to live together and share the experience of co-designing their own spaces through a fairly lengthy process of co-designing. It is not just about providing housing, but about fostering a collaborative and supportive environment where individuals share common values and goals;

Dismiss Assets: A strategic aspect of the project is the way it utilizes a vacant manufacturing assets for the communal benefit. This could involve optimizing resources such as land, funding, or materials in a way that benefits all stakeholders and enhances community wellbeing;

XLAM Technology: The use of XLAM (Cross-Laminated Timber) technology is a key feature of the project. The inhabitants decided to invest in this construction technology, appreciating its benefits, as well as the speed of construction. This sustainable and off-site construction method reduces environmental impact by utilizing wood, a renewable resource, and enhances energy efficiency, making the building process more eco-friendly and sustainable;

Construction Site Visits: Transparency is a core principle of the Borgo Rossini project, which encourages community engagement through construction site visits. These visits allow residents and potential stakeholders to observe the progress, learn about sustainable building practices, and feel more involved in the process;

Common Spaces: The design includes numerous shared spaces that are central to the community's interactions. These spaces are intended to promote collaboration, socializing, and a sense of belonging among residents, helping to build a strong community bond;

Renewable Energy Community: The project integrates renewable energy solutions, such as solar panels or other sustainable energy sources, to reduce its carbon footprint and ensure long-term energy efficiency. Moreover co-housing Borgo Rossini intends to form renewable energy community, not only promoting sustainability but also helping in reducing overall energy costs for its residents;

Neighborhood Hub: The project should have some spaces that are open to the city and in a future they wish to serves as a hub for the local neighborhood, facilitating social, cultural, and economic activities.

The Borgo Rossini project features the following layout:
- Apartments: 613 m² (7 units including 2 studio flats, 4 three-room apartments, and 1 five-room apartment);
- Common areas: 150 m² allocated for shared spaces, including community areas for general use, wellness room dedicated to health and relax, kitchen/dining room for collective cooking and dining and bath facilities;
- Private terraces: 138 m² providing private outdoor spaces for residents;
- Common rooftop with a vegetable garden: 85 m²;
- Shared outdoor areas: 280 m² designated for social and recreational activities, including the courtyard, gardens, bike and

scooter storage, and pathways;
- Swimming pool: 31 m².

This layout integrates private living spaces with communal areas, fostering both individual privacy and community interaction, while promoting sustainability through green spaces and shared facilities.

The Borgo Rossini co-housing project boasts an Energy Performance Class A4, indicating it is highly energy-efficient, with a focus on sustainability and minimizing environmental impact. This classification reflects advanced insulation, renewable energy solutions, and efficient heating and cooling systems, in addition to the already mentioned use of XLAM.
Overall, the Borgo Rossini project represents a holistic approach to urban living that combines sustainability, community engagement, and innovative construction techniques, setting a benchmark for future housing projects aimed at fostering sustainable and collaborative communities.

L'isola che accoglie

The "L'isola che accoglie"[50] urban regeneration project is a transformative initiative aimed at revitalizing a historic area within the city of Taranto, Italy. The focus of the project falls on the "island"—the heart of the historic city center—which currently faces significant social challenges but holds great social, cultural, and architectural potential. This project, supported by Fondazione con il Sud, seeks to create a sustainable and replicable model for urban transformations that integrate social housing, free-rent market housing, triggering social innovation processes, new local economies and a stable community of inhabitants.

The centerpiece of the project is the former Convent of San Gaetano, a historically important building converted into a hub of social, cultural, and economic regeneration. The project preserves and reuses this space for community and cultural activities, helping to reintegrate it into the fabric of the city. Thanks to the engagement of local partners, the community, and public administration, Homers Activity is set to develop a renewal plan for some old neighborhoods near the San Gaetano center. The plan aims to create mixed-social housing using off-site construction methods.

Ultimately, "L'isola che accoglie" aims to serve as a replicable model for scalable and replicable urban regeneration projects that balance social inclusion, sustainable development, and economic revitalization. The integration of social housing, market-driven housing, and cultural and tourism infrastructure is intended to create a vibrant, dynamic community hub within the historic center of Taranto. By addressing both the physical and social aspects of urban transformation, this project seeks to foster a more inclusive, resilient, and culturally rich environment for current and future residents of Taranto.

We often view the housing crisis and social housing as issues that should be addressed by the public sector. However, it is clear that the public sector faces many challenges, such as time constraints and limited financing, that hinder the completion of such projects. Homers, Homes4All and Fondazione Impact Housing' work is an important example of how private-public cross-investment and impact finance can provide solutions to the housing shortage. These approaches enable the creation of a variety of housing products through collaboration among different stakeholders and clients.

50 "The island that welcomes". Additional information available here.

In addition, the social aspect of life heavily revolves around relationships—whether familial, romantic, or friendships. Humans are social beings, and fostering connections is essential for emotional, mental, and physical well-being. However, in today's world, there is often a lack of relationship or social isolation, which can lead to loneliness, mental health issues, and a decline in quality of life. This is particularly true in urban environments where people may live physically close but emotionally distant from one another. To address this social demand for relationships, one potential solution that is gaining attention is definitely collective housing.

Giovanni de Niederhäusern

is Senior Vice President Business Unit Architecture[51] at Pininfarina since 2019. His research work and proximity to Academic Institutions allowed him to drive his team to be at the forefront of architectural innovation.

Giuseppe Conti

is an Architect focusing on integrating creative design principles with advanced digital tools. He joined Pininfarina, the iconic Italian design firm known for its automotive design, in 2020. He is currently a Lead Architect, with the aim of bringing together creativity, the quest for innovation, and attention to detail quality.

"Can we build buildings the same way we build cars?"

Pininfarina is a renowned Italian design and engineering company founded about 95 years ago, known globally for its exceptional contributions to the automotive and design industries. The company embodies the perfect fusion of Italian style, creativity, and engineering expertise. It has significantly shaped the history of design, particularly in the automotive sector, with its iconic vehicles and visionary projects.

Pininfarina's evolution from an artisanal workshop into a global service group is a testament to its ability to adapt and innovate over time. The company has built a strong network of subsidiaries and offices across Italy, Germany, China, and the United States. This expansion has enabled Pininfarina to establish itself as a major player in various design disciplines.

Headquartered in Cambiano (TO), Italy, Pininfarina employs around 500 people who work across several industries, including automotive, architecture, nautical design, transportation, mobility, product design, and experience design. Over the years, the company has completed more than 1,950 projects, consistently pushing the boundaries of design and technology, and

51 pininfarina.it/it/settori/architecture

cementing its reputation as a global leader in the design world.
The values of Pininfarina can be summarized in the following equation:
Beauty + Technology = Impact.
This equation reflects the philosophy that combines timeless beauty with cutting-edge technology to create an economic, enviromental and social positive impact. The beauty aspect focuses on the evolution of style in automotive design, ensuring that the design enhances the wellbeing of the users. Meanwhile, technology plays a dual role -both in the design process itself and in the advanced technologies used in the construction and functionality of the car.
Pininfarina is traditionally known for its expertise in car design, these values extend beyond the automotive world.
Pininfarina's core expertise lies in the luxury automotive and architecture sector, there is no direct connection to social housing. However, their design principles and approach can still influence architecture, including affordable housing projects. The emphasis on DFMA [52]can be applied in the architecture industry to streamline the construction process, reduce costs, and improve efficiency. DFMA was originally developed in car manufacturing, and this approach to architecture can lead to lower costs and more efficient use of resources, making it relevant for low-budget or social housing.
Pininfarina's approach to design is rooted in a philosophy that emphasizes the transfer of knowledge and innovation across different project scales. While the firm is renowned for its work on high-end, large-scale projects, such as luxury automobiles and upscale architecture, it adopts a mindset that benefits a broader range of sectors, including affordable housing and socially responsible architecture. This concept mirrors the "Robinhood of architecture" idea where the advancements and resources garnered from luxury or high-budget projects are redirected to help lower-budget initiatives. By applying the research, technology, and design innovations from premium projects to more accessible sectors, Pininfarina aims to make a positive impact, proving that even in luxury design, the outcome serves a larger social purpose.

Over the years, Pininfarina has recognized that numerous competencies developed in the industrial and automotive sectors can be effectively applied to architecture. The firm's deep expertise in design, engineering, and innovation in these fields has allowed them to transfer knowledge and methodologies to the architectural world. Elements such as precision in manufacturing, materials technology, and advanced engineering processes are seamlessly integrated into architectural projectswith a cross-disciplinary approach. Pininfarina has successfully applied DFM principles in architecture, leveraging off-site and dry construction techniques to optimize both time and costs. This approach enables the creation of more complex geometries and fluid shapes, drawing on the firm's expertise from the automotive industry. The experience with car design, known for its dynamic and aerodynamic forms, has been instrumental in translating these fluid shapes into architectural designs.

DFMA as research core

The main objective of Pininfarina's research is technological shift (using advanced technologies to innovate projects) and technological transfer (from the automotive industry to architecture) in order to meet the global challenges of sustainability. The in-depth research on DFMA is one of the strategies to facilitate the design of

52 Design for manufacturing and assembly.

construction and identify design strategies to address global warming.
In fact, the mobility and AEC[53] sectors have the most significant impact on the built environment, particularly when it comes to the challenge of decarbonizing cities. Currently, 65% of the global population lives in cities, and this figure is expected to increase to 70% by 2050. Cities are responsible for a significant portion of global environmental and economic impacts, specifically: 80% of global GDP[54], 70% of global greenhouse gas emissions and largest share of global energy consumption. Indeed, both the mobility sector and the EC sector have a significant environmental impact. Infact, mobility sector is responsable for consuming 10% of global resources, producing 12 of global CO2 and 5% of global waste and EC sector is consuming 40% of global resources, producing 40 of global C'02 and 40% of global waste.

DFMA is a consolidated methodology within the industralized building system that focuses on designing products in a way that makes them easy, cost-effective, and efficient to manufacture. The goal of DFMA is to optimize the design process to ensure that the product can be produced using the most appropriate manufacturing processes while minimizing potential production issues, costs, and complexity. DFMA combines the ideas of design performative components and their assembly. DFMA is commonly used in industries such as automotive, electronics, consumer goods, and aerospace, where precision, cost control, and manufacturing efficiency are critical.
The development of DFMA has evolved over three distinct generations.
The initial generation of DFMA was more qualitative in nature. It relied heavily on the experience and intuition of engineers and designers to create products that were easier to manufacture and assemble. This generation saw the transition to a more systematic and quantitative approach. Engineers began incorporating specific formulas, metrics, and analytical tools to evaluate the manufacturability and ease of assembly. The current generation emerged with the industrialization of design processes, driven by the development of advanced software tools. These tools not only evaluate manufacturability and assembly but also integrate cost estimation and material selection early in the design phase.

DFMA is indeed at the center of many conversations in research institutions today, as it has become an essential component in modern product design and manufacturing. One notable development is the RIBA (Royal Institute of British Architects) plan for DFMA implementation[55], which was drawn up in 2020. This plan is significant as it outlines the integration of DFMA into the construction and architecture industries.[56]

The three main pillars of DFMA can be summarised in the kit of parts (standardised, repeatable, common components), the suite of repeatable processes and the long-term and strategic relationship.
DFMA can be identified as a philosophy that emphasises the material side of architecture, but also as an evaluation system for analyzing and testing performance, and as a design process that uses specific digital

53 Architecture Engineering and Construction sector.

54 Gross Domestic Product, which is the total monetary value of all goods and services produced within a country's borders over a specific period.

55 The DfMA Report

tools such as BIM or other complex platforms.
DFMA therefore seems to be an easy process to implement, but it faces some obstacles and lack of application, especially due to intellectual property. Even if the process is very standardised, it is not shared between companies because it is the result of extensive research and a large human investment.
Pinifarina's research has focused on the evolution of the creation of standard shapes into unique ones, constantly addressing three different areas: material, design, and process.
One of the main objectives is to test the application of shapes from automotive design in the EC sector, applied to a niche market of buildings with a certain level of geometric complexity. In this regard, Pininfarina is working on a façade panel that integrates conventional construction processes (Glass Fiber Concrete) with cutting-edge technologies such as WAAM (Wire Arc Additive Manufacturing). However, I'm unsure how to connect this to the Social Housing sector, as our target market consists of a niche segment of buildings with specific geometric complexity. The introduction of advanced technologies can make it possible to go beyond standardisation and achieve mass customisation of specific components. Assembly OSM is a pioneering company working hard on these issues through supply chain integration and integration with additive technologies).
Skanska is a construction company that operates in selected markets in the Nordic countries, Northern Europe, and the United States. It applies and researches these findings to social housing and large residential buildings.
Skanska is a virtuous example because it uses prefabricated modular components for projects of various scales, including residential buildings, hospitals, and offices. This approach speeds up construction time, reduces costs, and improves quality control. The company applies methodologies inspired by industrial production, such as Lean Construction, to minimize inefficiencies and maximize value for customers.
Improving digitalization, design processes, and innovation to address underproductivity in the construction sector is a complex yet critical goal. The construction industry has traditionally faced challenges in terms of inefficiency, high costs, time overruns, and a general resistance to change. However, advancements in technology (3D printing, BIM, robots, and programs like Grasshopper and Rhino) and new methodologies present opportunities to address these issues by improving productivity, reducing costs, and enhancing overall project delivery.

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"Where is off-site architecture going today?"

The question of where off-site architecture is going today and how to overcome obstacles preventing its development in countries like Italy and Poland is highly relevant in the current architectural and construction discourse. The workshop aims to introduce these topics and tackle different modern methods for construction and off-site construction applied to social housing and residential building in the frame of the energy transition in the AEC industry sector.

The construction sector is undergoing a much-needed transformation, and the adoption of new strategies and processes is critical for making the industry more efficient, sustainable, and resilient. In the context of challenges such as time, cost, and resource management, off-site construction emerges as a promising strategy. It not only aligns with the growing need to preserve the environment but also addresses the economic and logistical inefficiencies associated with traditional on-site construction.

Off-site construction is not merely a technological process; it represents a comprehensive approach to building that encompasses various aspects of design, materials, and methods. It involves the prefabrication of elements outside of the final construction site, which can range from simple components to fully-assembled modules.

The change in the industrial sector in architecture and construction is a very big issue.

Above all we have to broaden our view of sustainability, one that goes beyond just the circular economy and Green Deal frameworks. Sustainability is indeed a multifaceted concept that requires a more nuanced approach to address the complexities of economic, social, and environmental issues, for a real reconfiguration of the construction sector.

In recent years, Europe and other regions have been seeking alternatives to transition their economies towards new avenues of revenue generation. A notable example of this is Toyota, one of Japan's most renowned car manufacturers, which shift from car manufacturing to housing production, exploring alternatives for revenue by utilizing its existing production processes in new ways. In 2019, Toyota launched a new division called Toyota Housing, signaling the company's intention to diversify beyond the automotive industry. The idea was to apply the same principles and processes used in car production to build homes, with a focus on efficiency, precision, and scalability. By

using the highly optimized manufacturing processes that Toyota developed for automobile production, the company aims to build affordable, sustainable housing in a streamlined and cost-effective manner.

Sustainability in architecture is indeed closely linked to the use of natural materials and off-site construction methods, with wood being a key material in this context.
While wood is a sustainable material, its use in architecture does require careful management to ensure that it contributes positively to environmental goals rather than causing harm. To balance the benefits of wood in architecture with environmental preservation its important to consider its geography.
The geography of wood refers to the study of where different types of wood, or timber, are sourced from around the world, as well as the ecological, climatic, and geographical factors that influence the growth and characteristics of wood. This encompasses the distribution of various tree species, forests, and the factors that impact the wood's quality and availability for use in construction, manufacturing, and other industries. Understanding this distribution helps in sourcing timber responsibly and efficiently, while also considering the environmental impacts of wood production and consumption.

Architecture is often seen primarily as the design and construction of buildings and spaces. However, the profession extends far beyond aesthetics and functionality; it is inherently connected to the broader social, political, and economic landscapes of society, according with specific geo-politycal ecosystems.
Across Europe, from Portugal to Poland, from Italy to Denmark, countries are grappling with similar challenges related to sustainability, housing emergency, and social inclusion. These challenges transcend borders, yet the responses -whether led by public institutions, private organizations, or grassroots movements- vary significantly.
The European Union, through various funding programs, encourages member states to experiment with innovative solutions to pressing issues. These initiatives not only provide financial support but also foster cross-border collaboration, allowing the exchange of knowledge and strategies between countries. Across Europe, public funds are essential to addressing the complex challenges of urban development and sustainability. However, private sector engagement is also critical for scaling solutions and bringing them to life.

Public-private partnerships (PPPs) have become increasingly common, allowing cities to leverage the expertise and financial capacity of private entities while ensuring that public interests—such as affordable housing and sustainability—remain at the forefront.

One of the most inspiring models for tackling housing and urban sustainability issues comes from grassroots movements, particularly in cities like Barcelona. In Catalonia, cooperative housing associations have emerged as powerful tools for creating affordable, sustainable housing that prioritizes community needs over profit.
In Barcelona, several projects showcase the effectiveness of a bottom-up approach, where citizens take an active role in shaping their living environments. These initiatives often involve the collective management of resources, fostering stronger social ties, and ensuring that developments are more aligned with local needs. By prioritizing cooperative ownership and democratic governance, these projects challenge traditional market-driven housing models, presenting an alternative to the commodification of urban spaces. Examples

of such projects include cooperative housing developments that aim to make the city more inclusive and sustainable. These initiatives focus on both environmental sustainability (through energy-efficient buildings and green spaces) and social sustainability (by creating affordable housing and promoting community engagement).

Despite the numerous advantages of off-site architecture for addressing housing precarity, there is still a significant gap in the academic and professional literature on the subject. This absence of comprehensive research and established frameworks means that the full potential of off-site construction to solve housing challenges has not been fully explored or implemented at scale. This "path still to draw" presents both a challenge and an opportunity for architects, urban planners, policymakers, and researchers.
The following list of projects is intended to show a promising step towards an ethical statement of architecture by means of off-site construction.

- **Sara Cultural Centre**
  Skellefetea, Sweden

  Housing venues for arts, performance and literature as well as a hotel, Sara Cultural Centre in Skellefteå is one of the world's tallest timber buildings to date.
  22-meter-long beams span the full length of majestic foyer space withsout the need for supporting column. Wooden struts fitted perpendicular to the beams are reinforced by a network of stell trusses.

- **Dalston Works**
  London, UK

  Dalston Works was the world's largest CLT building on completion, and a landmark project to roll out the use of timber construction in high-density urban housing, across London and beyond.
  The ten-storey, 121-unit development is made entirely of CLT, from the external, party and core walls, through to the floors and stairs, weighing a fifth of a concrete building of this size, and reducing the number of deliveries during construction by 80 per cent.
  In this building, the dry CLT panel construction system remains invisible due to the low level of prefabrication, demonstrating the technological potential of using wood as a material for the load-bearing shell, which is completely concealed by a real external masonry system as a second skin. It is an emblematic case that can demonstrate how it is possible to think about social housing with a non-visible wooden structure, leaving room for aesthetic creativity in its facades.

- **La Borda**

  Barcelona, Spain

  La Borda housing cooperative is a development self-organized by its users to access decent, non-speculative housing that places its use value in the center, through a collective structure. The idea of a housing cooperative was born in 2012 as a project of Can Batlló driven by the community in the process of recovery of the industrial premises, and the neighborhood and cooperative fabric of the Sants neighborhood of Barcelona. The project is located on a public land of social housing, with a leasehold of 75 years.
  Unlike previous projects, this one adopts a deliberate and modest approach to the use of the CLT construction system. The design emphasizes exposed structural and finishing timber, showcasing the natural material while ensuring that every detail in both the design and construction phases receives careful attention. This unassuming use of CLT highlights the material's potential for sustainable, aesthetically simple architecture, where the emphasis is placed on craftsmanship and thoughtful integration into the building's environment.

- **Programa Aprop - Alojamento de proximidad provisionales**

  Barcelona, Spain

  Provisional proximity housing (APROP), made with industrialised methods from recycled shipping containers, is part of the municipal commitment to innovate in order to address the housing emergency. Following the successful examples of similar projects in cities such as London, Copenhagen and Vancouver, it is a model of fast, sustainable and quality housing that aims to prevent the expulsion of neighbourhoods from their neighbourhoods.
  The APROPs provide temporary accommodation and socio-educational care for people and families at risk of social exclusion and cared for by social services while they do not have stable housing.
  In addition, it highlights the wisdom of reusing a 3D module with fixed materials and geometries, with the challenge of building good examples of architecture and taking care of the technical performance of the envelope, which fulfils aesthetic functions and thermal-acoustic comfort.

- **Westend Modular School Campus**

  Frankfurt, Germany

  In Frankfurt's Westend, a large modular timber school building has been completed, designed for both high school and elementary school students. The structure, which consists of about 350 prefabricated modules, was built in just 24 months to accommodate 2,000 students temporarily until a permanent school campus is ready. This case study is particularly interesting because the architectural project already included the assembly/disassembly strategy, which was designed to dismantle the entire building and reuse the modules elsewhere.

  The Adorno High School moved in during the summer of 2019, followed by the Holzhausen Elementary School in 2020. The compact, symmetrical design maximizes the small site,

creating a three-story structure with two internal courtyards. The layout ensures short distances between spaces while prioritizing quiet areas for classrooms, which face the west and east sides of the campus.
Made from around 5,000 cubic meters of wood from Central European forests, the building reduces carbon dioxide emissions to a quarter of what a conventional structure would produce. It also exceeds energy conservation standards by 30%. Modular construction allowed the project to be completed in 60% less time. The components were prefabricated in Switzerland, transported to the site, and assembled using a mobile crane.

- **University Student House**

  Trento, Italy

  The 5-story building (870 sqm) was constructed using a prefab modular system with CLT panels and GLULAM beams by the Essepi factory in Cavedine (TN). A total of 89 modules were fully produced in the factory in just 55 days, with each module representing one room. The student housing accommodates 130 rooms for a total of 200 students.
  The assembly time was 5 days per prefab module, completed by a team of just 3 carpenters. Special attention was given to the sourcing of wood. The project utilized 2,000 m³ of certified wood-based structural elements, and 3,000 m³ of spruce timber. The total regrowth time for the certified Trentino forests used in this project was calculated to be 21 days. [57]

- **Urban Splash Programme - Irwell Riverside housing development**

  Salford / Manchester, UK

  Irwell Riverside is a riverside community created on a disused site Set within acres of landscaping and within walking distance from Manchester city centre, the terraced Town Houses are arranged in parallel rows to maximise views to the established river walkway and two new streets. Existing mature trees have been retained to the perimeter of the site and supplemented with new tree-lined streets, a shared residents' garden and a new public route through the site connecting the surrounding housing with the river. Inspired by traditional terraced housing, the homes feature projecting balconies, bay windows facing the river and pitched roofs. Generous landscaping, shared surface streets and high-quality finishes give a coherent feel to the public realm. The houses at Irwell Riverside are the second iteration of Town Houses, which build on the success of those used on earlier sites, but with a host of significant improvements developed through our on-going research and development programme which seeks to improve the design of the house types and the construction process.

57 Approximate simulation by CNR-IvalsaTrees and Timber Institute Trento.

- **Rigot Collective Centre**

  Geneve, Switzerland

  Located in Rigot Park near the Avenue de France and Sismondi school, this project was designed to accommodate 370 migrants as a temporary and urgent solution. The development consists of two symmetrical, five-story buildings made from 230 prefabricated wooden modules. The layout includes an external gallery that leads to a public courtyard, connecting to the Sismondi streetcar stop and Rigot Park.
  The buildings are designed for relocation within ten years, with foundations crafted from wood, ensuring that materials can be reused in the future. The foundation system, using wooden piles and footings, minimizes environmental impact and avoids contamination of the surface water network. The project also prioritizes local timber resources, reducing "grey energy" and the volume of raw materials needed.
  This project responds to the needs of vulnerable populations displaced through migration. It offers a solution to housing challenges with diverse apartment typologies, accommodating a wide range of family structures and anticipating high turnover. The modular design allows for adaptable unit sizes, ranging from 2 to 8 rooms, to meet varying demands.
  The construction process involved local timber manufacturers, ensuring the use of timber from Geneva's forests for both the foundations and the building envelope. The project used an estimated 3,200 m^3 of certified "Label Bois Suisse" wood. The financial plan accounts for the assembly and disassembly of the project, with expected savings from the durable, modular system ensuring a positive balance in the first cycle of the project.

- **Y:CUBE Mitcham**

  London, UK

  Y:Cube Mitcham is an affordable housing scheme which provides self-contained flats for 36 people in housing need where half of the residents have moved on from YMCA St Paul's Group's accommodation.
  The Y:Cube units are 26m2 one-bed studios, for single occupancy, that arrive on site as self-contained units. Each unit is constructed in the factory with all the services already incorporated. Therefore, the water, heating and electricity can be easily connected to existing facilities or to other Y:Cubes already on site. This 'plug and play' approach results in a modular, demountable system of apartments that are perfectly designed for brownfield sites. Additional units can be added if needed and whole developments can be taken apart and rebuilt in new locations. This modern method of construction makes for a neighbourly, clean and quiet site.
  Each unit is constructed from high quality, eco-efficient materials (primarily renewable timber) and can achieve the Code for Sustainable Homes Level 6. The factory conditions in which the pods are assembled ensure tolerances of 2mm, creating accommodation that is so well insulated that they require little or no heating, even in winter months. This presents further valuable savings as the cost of energy rises. Y:cube Mitcham is the first Y:Cube development, made up of 36-units and the first residents moved in to their homes in September 2015. Every resident is either referred by the London Borough of Merton or a previous resident of the YMCA. The Y:Cube provides an alternative to poor quality shared accommodation managed by private landlords and can offer a better solution for those in

housing need within the community. The rent is set at 65% of market rate and in addition to low energy bills the Y:Cube is genuinely affordable for those who live there. Y:Cube Housing offers a real opportunity for social investment, providing a solid return to investors whilst at the same time meeting a huge need.

- **Bremer Punkt**

  Bremen, Germany

  The Bremen-Cube project is a forward-thinking initiative focused on sustainable, adaptable, and affordable housing in urban spaces. It integrates four-storey wooden prefabricated cubes (14x14m), seamlessly into green areas, preserving their character while upgrading 1950s housing stock. The modular system allows for a range of flexible layouts tailored to site-specific needs, ensuring adaptability for diverse residents and individual demands.
  Each Bremen-Cube accommodates multiple apartment typologies, ranging from 30 m² to 138 m², offering living spaces with a high standard of living despite their small size. The timber construction, large windows, and south-western orientation provide natural light and integration with outdoor spaces. The design promotes a variety of living experiences, such as dining, working, and gardening, through adaptable rooms and open-plan spaces.
  The Bremen-Cube project emphasizes social equity, with intergenerational living and high adaptability for diverse groups, including young people, elderly, disabled individuals, refugees, and low-income families. The modular construction system uses prefabricated elements for quick assembly and minimal disruption, fulfilling the "KfW Effizienzhaus 55" energy standard. Initially launched in 2017 with prototypes in GARTENSTADT SÜD, the Bremen-Cube is expanding across Bremen in various districts, offering an affordable, sustainable housing solution that combines modern architecture with a strong social impact. The project supports a high social mix and provides a model for future urban housing developments.

D-quadro - Engineering and Architecture

D-quadro[58] is an engineering company established in Cuneo, Italy, in 2015, formed by combining the expertise of several professionals. Its mission is summarized in integrated design, beginning with the study of strategies for the entire project. The process then specializes through progressively defined levels of detail to achieve optimized solutions.

"Bridging lightweight design and deep prefabrication"

On Saturday, 19 October 2024, the designers gave us a tour of the construction site for a new office building, which will also serve as the new headquarters for d-quadro. It was an extremely educational visit, during which we examined the design choices, structures, and façade system.

Architecture and structure

This innovative project focuses on the construction of a multi-storey timber office building designed for modern efficiency and flexibility. This seven-floor structure offers a forward-thinking approach to urban office spaces, integrating cutting-edge technology and environmentally responsible materials.

The building consists of seven floors, each spanning 300 square meters, providing ample space for open-plan office environments. The flexibility of this design allows tenants to customize their workspace layouts without structural limitations. The use of glulam pillars and XLAM floors ensures both strength and durability, making the structure resilient while maintaining the aesthetic appeal of natural timber. A reinforced concrete elevator core, stairwell, and ground-floor slab provide an additional level of stability against seismic forces. These materials, along with the modular approach, reduce construction time and enhance the overall efficiency of the project.

The hybrid structure of the building, which combines different materials, offers a number of advantages. This approach leverages the strengths of each material, resulting in a more efficient and versatile construction method. Additionally, the hybrid structure helps balance costs, considerably reducing the thickness and section of the structure, while preserving it in case of flooding.

The façades are made of prefabricated modules that integrate windows and doors, further accelerating construction and improving the building's efficiency. The modular design not only speeds up the construction process but also contributes to a minimalist and modern aesthetic. The exterior features alternating window panels and sloping façade coverings, offering a dynamic, geometric appearance. The façade is finished with high-performance concrete cladding (UHPC), which offers both durability and a sleek, contemporary look.

58 www.d-quadro.it

Sustainability is central to this project, with energy efficiency being a key consideration. The building incorporates state-of-the-art technology and high-quality insulation materials to reduce energy consumption, ensuring that the building is environmentally responsible and cost-efficient in the long term. Natural light plays an important role in this design, with large windows strategically placed to maximize daylight intake, reducing reliance on artificial lighting and promoting a brighter, more welcoming work environment. This focus on natural lighting not only improves worker well-being but also lowers energy costs.

The building is designed to meet diverse business needs, with each of the seven floors available for office use, medical facilities, or professional spaces. The open-plan layout provides flexibility, allowing tenants to design their spaces according to specific requirements. The ground floor features space for commercial activities and includes an outdoor area that can be used as a private garden or terrace, enhancing the work environment and offering a connection to the outside.

The rooftop floor is dedicated to meeting rooms, small conferences, and events, providing an excellent space for networking and collaboration. This area can be shared between tenants or rented out to external organizations.

This project combines modern timber construction with cutting-edge sustainability features, flexible office spaces, and a central location, creating an ideal environment for businesses in need of a modern, energy-efficient office. The building stands as an example of how new technologies and sustainable practices can be combined to create functional, beautiful, and efficient commercial spaces.

Façades system

When designing a façade, especially for large-scale buildings or complex structures, modularity can significantly streamline both the design and construction processes. Using pre-designed panels that can be repeated, adjusted, or rotated allows for both aesthetic variety and logistical efficiency.

The “rules of 8” likely refer to a guideline in modular façade design, where each façade is considered to be composed of at least 8 unique modules. This principle applies to how the façade panels are arranged or customized, particularly in relation to the corners and sides of the building. Corners and edges are often treated differently in façade design because they are focal points of the structure and technological assets. These areas may require special panel designs to create a sense of continuity and coherence while also addressing functional considerations such as structural integrity, sunlight exposure, or privacy.

When determining the size of panels for a building façade, several factors must be considered to ensure the panels meet structural, aesthetic, and logistical requirements, such us:

- **Panel weight;**
- **Panel size;**
- **Method of transportation and truck size;**
- **Façade orientation;**
- **Façade repetitiveness;**
- **Building use**

The panel sizing must carefully consider several factors, including weight, transportation constraints, and how the panels will interact with the building’s

orientation, overall design, and function. Each of these factors plays a significant role in ensuring the panels are not only suitable for the building's structural requirements but also feasible to transport, handle, and install without causing damage.

The weight of the panels is a critical factor in the overall design of the building's facade. Heavier panels can affect the structural integrity of the facade, as well as the load-bearing capacity of the building's frame. If the panels are too heavy, the building may require additional structural support, such as reinforcements in the frame or modifications to the foundation, in order to handle the extra weight.
One of the key risks of not properly considering panel weight is the potential for damage during installation. If the panels are too heavy to be safely handled, there is a risk of breaking glass or damaging the frame during the application of the panels to the facade.

Transportation is one of the most significant logistical considerations when determining panel size. Panels must be sized appropriately to fit within the legal dimensions of the trucks that will transport them, ensuring safe and efficient delivery to the construction site. Standard truck sizes vary slightly across Europe, but they typically adhere to maximum allowable dimensions: 2.5 meters in width, 3 to 4 meters in height, and up to 12 meters in length.If the panels exceed these standard sizes, special transportation arrangements must be made, which often involve doubling the price.

A typical vertical panel size can range from 1.5 meters to 2.5 meters in width and 3 meters to 5 meters in height, depending on factors such as the building's height, architectural design, and structural needs. Vertical panels are often chosen for their ability to complement the building's height, offering an aesthetic alignment with the overall structure. These panels are commonly used in high-rise buildings, commercial offices, and residential towers where the focus is on maximizing vertical space and creating a modern appearance.
In contrast, for horizontal facades, you typically see longer panels that may need to be wider, but are generally shorter in height compared to vertical panels. Horizontal panels are often favored for their ability to create a sense of horizontal continuity and can be ideal for lower-rise buildings or structures where the emphasis is on spreading the visual weight across the façade.
When it comes to materials, offices and hotels typically opt for vertical facades made of aluminum, due to its durability and low maintenance. On the other hand, horizontal facades are often constructed using wood frames, which provides a warmer, more natural appearance. Wood is chosen for its versatility, sustainability, and aesthetic appeal, especially in buildings where creating a welcoming and comfortable environment is a priority.

Facade repetition is very important in architectural design and construction, particularly when maximizing efficiency and reducing costs. If you are able to use the maximum number of repeated modules, you can significantly lower your overall expenses. For example, by utilizing a consistent module design across the entire facade, you can reduce costs by as much as one-third. This is because repetitive modules simplify the manufacturing process, reduce material waste, and streamline installation. Additionally, using a standardized module across the project allows for bulk purchasing of materials, which often results in discounts.
The benefits of facade repetition go beyond cost savings. It also allows for greater

consistency in the design, creating a uniform appearance for the building's exterior. This strategy is particularly effective in large-scale projects, such as office buildings, hotels, and residential complexes, where uniformity in the facade can enhance the overall aesthetic while improving the construction timeline.

When dealing with positional tolerance in architectural or engineering design, particularly for facade paneling, it's essential to account for dimensional tolerances that accommodate variations in manufacturing, transportation, and installation processes. Facade modules are typically large and heavy, making the installation process with cranes or manipulators challenging. It is ambitious to expect that humans can install these pieces with very high precision. Tolerances of around +10/–13.5 mm are necessary to ensure the panels fit accurately into their designated positions, despite potential deviations in manufacturing or handling.
A test mock-up can serve both visual and technical purposes, especially when applied to facade design to compensate for tolerances, ensure correct alignment, and achieve the desired aesthetic. A visual mock-up is primarily used to assess the aesthetic qualities of the facade. It allows you to evaluate how the panels will appear in real life, especially in terms of proportion, color, texture, and finish, when installed within the context of the building's design. This mock-up provides insight into the appearance and visual impact of the facade before final installation. A technical mock-up, on the other hand, focuses on testing the practical and structural aspects of the facade system, ensuring it functions properly under real-world conditions. This mock-up allows you to test not only the dimensions and tolerances but also how the system performs in terms of installation, safety, and durability.

When designing and installing cladding systems, the connection gap and tolerances play a critical role in ensuring that the facade functions correctly, both structurally and aesthetically. A gap between cladding panels can affect a wide range of factors such as thermal expansion, water management, aesthetic uniformity, structural integrity, and long-term performance. The gap between cladding panels refers to the space left between adjacent panels to allow for movement, ease of installation, and proper sealing. These gaps are typically intentional and need to be carefully designed to accommodate factors such as thermal expansion, moisture drainage, and building movement.

The Scandinavian model and the Central European (Middle Europe) model for facades represent two different architectural approaches that reflect the distinct cultural, climatic, and historical contexts of the regions.
In Scandinavia, a typical facade is an "open stratigraphy" designed to manage water flow, with designers ensuring that water flows away through gaps or channels, or conveying any possible seepage to prevent damage. In contrast, in Central Europe, we tend to design closed systems that limit, as much as possible, the entry of water into the cladding facade.

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Vision and scenarios

The workshop aims to find a creative and 'visionary' response to the problem of energy poverty in Italian and Polish social housing and the implementation of the production chain for sustainable off-site technologies, exploring the emerging ones. With the help of case studies and the analysis of international best practices, professionals will have to contribute to innovative proposals for the diffusion of off-site, the retrofitting of social housing with off-site technologies, and aspire to provide public administrations with innovative and affordable applications and methodologies.

Thanks to the contribution of Paolo Simeone we drove into a diverse show of case studies with considerable architectural quality giving us an overview of innovative off-site projects all around Europe.

After two days packed with content on the subject, we asked our 10 architects to give us their points of view. What emerged as limitations and opportunities for large-scale off-site use became design challenges that our architects tried to intuit and then solve.

During the workshop, participants collaborated in international groups to explore several in-depth topics, with a primary focus on the potential of off-site construction in various sectors. Key questions addressed included:

- **Strategies to shift stakeholder perspectives and promote the adoption of off-site construction for architecture and social housing projects;**
- **How modular and adaptable design models can reshape traditional concepts of property ownership and living arrangements;**

- **The impact of off-site construction methods on sustainability, efficiency, and the effective use of materials and labor.**
- **The potential of off-site construction to address community needs and improve living conditions;**
- **The discussions aimed at understanding and enhancing the role of off-site construction in shaping future urban and rural landscapes.**

How can we open up the mindset of local stakeholders towards off-site construction?

Housing inequality is as relevant as ever while building technology is improving daily.
The challenge of applying advanced building technologies, such as off-site construction, to social housing in the foreseeable future is multifaceted but not insurmountable. Several factors will determine whether this shift can help bridge the gap and meet the European Union's (EU) 2030 and 2050 deadlines for sustainability and energy efficiency.

Off-site construction should be considered in social housing projects as an alternative to traditional building methods. This approach allows for more flexibility and innovation, moving away from the conventional, often repetitive practices that have defined social housing development. Traditionally, social housing is associated with low-cost construction using conventional techniques, which sometimes results in cheap and aesthetically unappealing buildings. By embracing off-site construction methods, such as modular or prefabricated systems, housing projects can achieve better design quality, faster construction times, and potentially lower costs, all while breaking free from the constraints of traditional practices. This shift offers the opportunity to create more attractive, functional, and sustainable living spaces for communities in need.
This result does not seem to matter because social housing belongs to categories of citizens who have fewer resources than others. In fact, they don't own their homes, and they don't have much knowledge or economic resources, so they basically have no right to complain. However, these people should be the target of this approach in order to reduce suffering and social injustice.

Off-site architecture may encounter some resistance from both local authorities and developers, who have always made

decisions in terms of money. This reluctance to change can be overcome by gathering information on how much efficient and beautiful off-site solutions would cost and how many benefits they would bring in terms of project timescales, costs and even positive environmental outcomes.
For example, research shows that the world's cities are responsible for 75 per cent of carbon emissions and more than 60 per cent of energy consumption, despite occupying only 2 per cent of the Earth's land area. Once the data is collected and analysed, it will be easy to demonstrate that approaches other than the traditional ones can minimise the carbon footprint of social housing.
Municipalities as well as universities, builders' associations as well as architectural firms are the areas where the first step towards change is needed. All these stakeholders should be involved in a new process that leads to virtuous environments in which people can live happily and comfortably. Some specific training for architects and architecture students must be improved by universities and professional associations in order to disseminate a different way of doing architecture.
Most vulnerable people may not be able to afford to renovate, but that doesn't mean they don't deserve quality and beauty in their homes. Building more efficient homes would benefit society as a whole. A happier society should be a goal for each and every one of us, because it brings feelings of belonging, sharing and security, and ultimately leads to a much fairer world.

Alberto Artuso, Martina Bertani,
Karolina Dziengo, Barbara Michalska e Silvia Porciatti.

How can off-site construction be a tool to re-think the concept of ownership and flexibility related to living?

The workshop, part of the program on off-site construction in social housing, focused on tackling the complex challenge of using innovative construction methods to address housing shortages and energy transitions. Our group approached the task from a broad perspective, reversing the usual inquiry to ask, "How can off-site construction positively influence social housing?" The critical issue identified was the growing housing crisis, particularly for individuals who cannot afford their own apartments. This led us to question whether off-site construction could provide a viable, standardized solution to these challenges, bringing into discussion also the perceptions

of ownership and flexibility of use.

We focused on the potential of modular construction, which offers significant flexibility and adaptability. Specifically, we explored how off-site methods could be applied not only to new projects but also for the retrofit and implement existing structures, such as old buildings or vacant spaces. The adaptability of modular construction was seen as a key strength, especially in a rapidly changing world where uncertainty demands versatile living solutions.
One of the conclusions we reached was that off-site construction could provide cost efficiency, which is crucial in addressing housing shortages. We considered that if the process could be standardized and implemented effectively, it could reduce costs significantly. However, we acknowledged the complexity of achieving such goals, as off-site construction involves multifaceted considerations, from technical execution to social and economic impacts.
In conclusion, this workshop emphasized that the key to addressing housing shortages and energy transitions lies in exploring off-site construction's potential. While the answers remain complex, the act of asking these questions, generating knowledge, and sharing expertise brings us closer to viable solutions. This iterative process is crucial for adapting construction methods to meet the needs of a changing world, ultimately benefiting a broader spectrum of society.

Roberto Carlucci, Radosław Szafran, Laura Muñoz Tascon, Fabio Vignolo e Dagmara Zarnowiec.

How does off-site contribute to a true optimisation of resources?

Off-site construction presents a range of challenges, both in terms of inherent issues within the system or its implementation, and the problems that can be addressed through the adoption of off-site construction methods. After a brief discussion, we agreed that the widespread application of these methods could significantly enhance overall efficiency in resource usage within the construction sector.
However, the challenge is two-fold. For off-site construction methods to be sustainable in terms of labor, non-renewable resources, and capital, they must be widely adopted. Without this, the method may become irrelevant due to its high individual costs. One way to ensure its popularity is by taking

responsibility for educating ourselves and raising awareness.

If implemented on a large scale, off-site construction can offer a climate-driven, sustainable approach to creating better architecture and living environments. By saving resources (e.g., impactful construction materials like concrete and steel, as well as labor), we may be able to produce higher-quality architectural solutions within the same budget.
In particular, structural elements or refined execution strategies can be repeated and improved over time, enhancing the process with each iteration. This approach is similar to car production—quality achieved through quantity.
Off-site construction methods should be incorporated during the early stages of a project, as this is the most viable phase within the timeline of an architectural project. Introducing them later in the process could be too late to achieve maximum effectiveness.

Joanna Bokuniewicz, Anna Claudia Dionne, Michał Hondo, Lionella Piva, Chiara Stanghini e Magdalena Walczak.

How can off-site construction be a tool for community improvement and enhancement?

Off-site construction holds potential for multi-generational communities, catering to diverse inhabitants ranging from children to the elderly. This inclusive approach fosters environments where individuals of different ages and backgrounds coexist, supporting mutual respect and shared learning experiences. The aim is to create spaces where inhabitants can support one another, exchange experiences, and foster mental well-being.

Off-site construction offers a transformative opportunity to improve community life. By reimagining communal spaces, this approach promotes social interaction, reduces isolation, and encourages a culture of respect and cooperation. It also supports sustainable development goals by leveraging efficient building technologies to reduce environmental impacts and optimize resource use.

By retrofitting older buildings and applying a "parasite" approach—adding adaptable structures to existing frameworks—

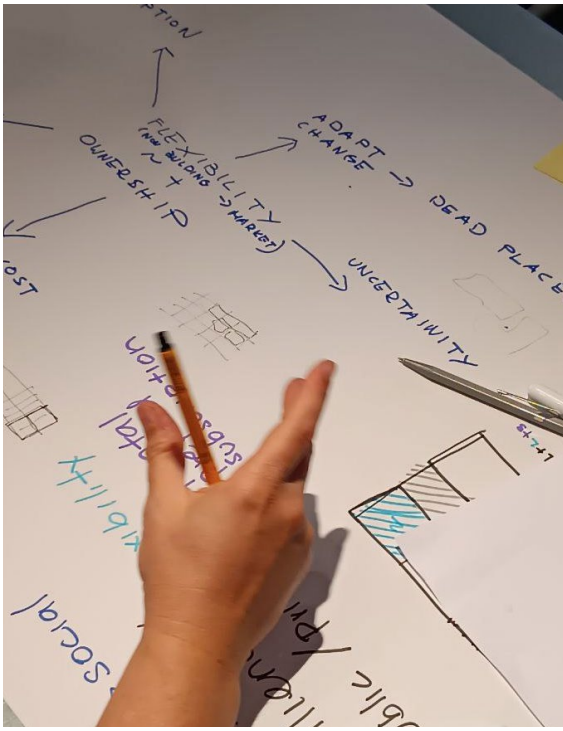
off-site construction integrates modern techniques with existing urban fabrics. Special attention is given to accessibility, environmental sustainability, and the creation of high-quality communal spaces.

Potential sites for off-site construction include public abandoned buildings or plots, existing private structures, and small-scale private neighborhoods. By focusing on underutilized spaces, this method revitalizes communities while minimizing land use and optimizing urban development.

The result is the creation of mixed-use, multi-generational spaces that cater to the needs of diverse inhabitants. These spaces blend practicality with a sense of community, providing shared areas for socializing, learning, and collaboration, while promoting sustainability and inclusivity.

Łukasz Barej, Samuel Contestabile, Alessia Copelli, Małgorzata Lipień e Karol Wyrzykowski.


La forza
di chi progetta
qualità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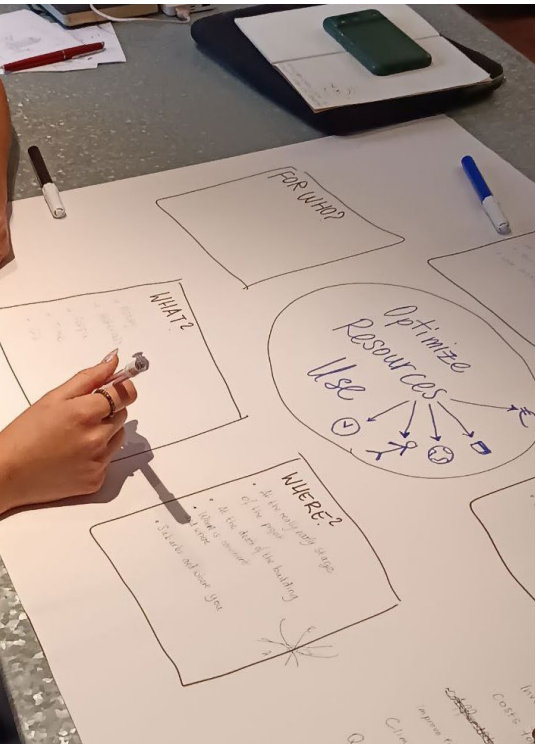
FOR WHO?
WHAT?
Optimize
Resources
Use
WHERE?

Warsaw workshop

Conferences

The second stage of the project "Off-site Construction to Simplify the Energy Transition in Social Housing" took place in Poland from February 21 to 23, 2025, unfolding between the cities of Warsaw and Toruń.
This part of the journey focused on exploring how off-site construction can become a practical solution to accelerate energy transition in the context of social housing and emergency architcture. The discussions, site visits, and expert exchanges were all framed around a central theme: Off-site Construction in Poland – Developmental Roadmaps for the Prefabrication Sector.

Throughout the three days, we engaged with local stakeholders, analyzed the current state of prefabrication in Poland, and identified both opportunities and challenges ahead. It was a rich and insightful experience, highlighting the potential of off-site methods but also revealing how much work is still needed to overcome structural, regulatory, and cultural barriers. In short: a journey full of inspiration, reflection, and the clear realization that progress is possible, but it will take continued effort and collaboration.

Friday 21st February

The conference - held on the 21st of February at the Creative Industries Development Center in Warsaw - provided a comprehensive platform for examining the current state and future prospects of prefabrication in Poland. The event was meant to be as broad and open to many different fields as possible and brought together professionals from the architecture, construction, finance, and public sectors to explore how off-site

technologies can contribute to more sustainable, efficient, and inclusive urban development. Discussions extended beyond theoretical considerations, grounded by presentations of completed projects implemented using prefabricated systems. The entire event, including the discussion panels, was professionally moderated by Artur Celiński the editor-in-chief of "Architektura-Murator" - Poland's leading architecture magazine.
Titled Off-site Construction to Simplify the Energy Transition in Social Housing, the conference focused on the application of prefabrication in addressing systemic challenges such as the housing crisis, rising energy costs, and climate change.
The event commenced with a keynote address by architect Maciej J. Zawadzki, President of LURE, who outlined the increasingly critical role of designers in advancing and implementing innovative construction methodologies—particularly those associated with off-site manufacturing and prefabrication. In his remarks, Zawadzki emphasized the urgent imperative for systemic transformation within the built environment sector, driven by the accelerating impacts of climate change. He drew attention to the disproportionate environmental footprint of the construction industry and underlined the shared responsibility borne not only by contractors and developers but also by architects and design offices, whose decisions at the earliest stages of planning have long-term consequences for material use, energy consumption, and carbon emissions.

Zawadzki proposed a set of unconventional strategies aimed at shifting investor mindsets and client expectations toward more sustainable alternatives. His suggestions centered on the necessity of reframing off-site construction as not merely a technical option but a fundamental tool for ecological responsibility and innovation. Speaking not only as the initiator of the conference's agenda but also as a co-author of the Off-site Construction program developed jointly by LURE and the Fondazione per l'architettura / Torino, he stressed the importance of convening a broad, interdisciplinary group of stakeholders. Rather than limiting the event to a closed circle of industry professionals—where consensus is often high but impact is limited—Zawadzki advocated for inclusive dialogue across sectors. Only through open, critical discussion with all parties involved in the construction process, he argued, can meaningful change be achieved and systemic barriers to sustainable transformation be effectively addressed.

Panel #1

Round table discussion with:

Kinga Baroń - pWC

Jan Kucza-Kuczyński - TBS Południe

Dr. Eng. Marcin Gawroński - PLGBC / Sweco Polska

"Community Housing and the Energy Transition"

The first panel emphasized the strategic role of industrialized construction in the development of community-based housing models, including student accommodations and co-housing schemes.
Experts — including representatives from the consulting and financial sector (Kinga Baroń - pWc), Warsaw's municipal social housing agency (Jan Kucza- Kuczyński -TBS Południe), and organizations focused on sustainable development in construction (Polish Green Building Council and Sweco Polska) — discussed the challenges facing the industry and the potential for leveraging EU funds to support the transformation of the built environment.

The dialogue revealed a notable discrepancy between investor interest and industry readiness. While prefabrication is widely adopted in industrial and logistics facilities, its application in residential construction remains limited. This disconnect is attributed largely to insufficient familiarity among designers and contractors with the operational and design implications of modular systems.

Round table discussion with:

Piotr Prokopowicz - MOD21

Bartosz Dąbrowski - Pekabex

Ewelina Woźniak - Szpakiewicz - DMD Modular

"Material Technologies: Wood, Concrete, and Steel"

Dedicated technology-focused sessions examined the comparative advantages of prefabrication in wood (MOD21), concrete (Pekabex), and steel (DMD Modular). Companies specializing in each material presented their modular construction processes, highlighting speed of execution, precision, and scalability as key benefits. The debate centered on whether modular systems represent a temporary trend or a foundational shift in the construction sector.

The presenters also addressed the challenges of adapting regulatory frameworks and urban planning models to accommodate prefabricated typologies. Emphasis was placed on integrated workflows and the importance of early-stage coordination between architects, engineers, and manufacturers.

Beyond material considerations, several speakers emphasized Poland's structural potential to become a central node in the European prefabrication ecosystem, regardless of the dominant material platform. The country offers a combination of logistical, spatial, and economic conditions that are particularly conducive to the growth of industrialized construction.

Poland's geography is one of its greatest assets. Large swathes of flat terrain, particularly in central and eastern regions, provide ample opportunities for the development of expansive production facilities. These conditions allow for economies of scale in manufacturing, efficient factory layouts, and the potential for technological clustering—where different actors in the value chain (from materials suppliers to robotic assembly developers) can co-locate and collaborate.

Moreover, Poland's position as a key transport hub—bridging Western Europe, the Baltics, and Eastern markets—ensures excellent connectivity via road, rail, and sea. The growing intermodal infrastructure further facilitates the movement of prefabricated units across borders, making it feasible for Polish producers to serve not only domestic demand but also international clients seeking reliable and cost-effective solutions.

Importantly, Poland was shown not only a manufacturing base but also a market with urgent internal demand. With pressing housing shortages, the need to modernize public infrastructure, and ambitious energy transition goals, the domestic construction sector presents fertile ground for innovation. Modular systems would respond directly to these challenges—offering scalable solutions for student housing, senior living, healthcare facilities, and social housing programs.

Taken together, these factors suggested by the presenters that Poland holds strategic advantages that transcend individual materials or technologies. If aligned with supportive policy frameworks and investment in workforce development, the country could establish itself as a leading European platform for sustainable, prefabricated construction.

Panel #2

Round table discussion with:

Wiktor Kowalski - Buro Happold

Dr. Eng. Arch. Marta Promińska - STRABAG

Jacek E. Szymański - Łukasiewicz Research Network

"Implementation Frameworks and Economic Viability"

The second panel which was more technical explored the operational integration of prefabricated technologies into design and construction workflows. Experts from engineering companies (Wiktor Kowalski - Buro Happold), contractor firms (Marta Promińska – STRABAG) and research institutions (Jacek Szymański - Łukasiewicz Center) discussed the role of digital modeling, data-driven carbon assessment, and performance monitoring in optimizing prefabricated solutions. Contrary to the perception of prefabrication as a singular technique, panelists emphasized the heterogeneity of available systems and approaches.

Economic viability emerged as a recurring theme. Panelists presented planning strategies that position prefabrication as not only competitive but often more cost-effective than traditional construction. With increasing labor shortages and underutilized public funding streams, such as allocations from the National Recovery Plan, prefabrication was positioned as a solution to systemic inefficiencies in the Polish construction market.

Round table discussion with:

Szymon Kasprzyk - Łukasiewicz Research Network

Łukasz Latawiec - Holcim

Adrian Krężlik - Dosta Tec

"Innovation and Climate Intelligence"

The conference concluded with a series of presentations on emerging technologies in low-carbon construction. Topics included advancements in low-emission concrete inspired by ancient Roman formulations (Szymon Kasprzyk - Łukasiewicz Center), and integrated climate consultancy in early-stage project development (Adrian Krężlik - Dosta-Tec) where a Portuguese firm presented a methodology for embedding carbon impact analysis into conceptual design phases, promoting proactive approaches to energy and resource efficiency.

During the final presentation, 3D-printed structural components were showcased (Łukasz Latawiec, HOLCIM; COBOD). This emerging technology in construction could also aid the energy transition, particularly in public investments. As an example, a water tank for the Water and Sewage Plant in Barczewo, Poland, was highlighted as part of a "design and build" contract. The project was made possible through collaboration with Holcim Polska, Globtank, and COBOD from Denmark, a global leader in 3D concrete printing technology. The tank marks a significant advancement in concrete construction automation and sustainable development.

The key advantages of 3D printing technology included a 25% reduction in material usage, automation of the building process, and a substantial decrease in project completion time. The printed structure also features an innovative design that enables variable wall thickness, optimizing material usage while ensuring structural integrity. The tank was completed in just 38 hours of active printing over five days, demonstrating the time-saving potential of this method for other applications, such as housing.

The use of 3D printing in the construction of the tank demonstrated its potential to revolutionize projects in general, offering a more sustainable and cost-effective approach to construction while underscoring the technology's ability to reduce environmental impact and material waste, paving the way for its broader adoption in future projects.

Outlook: Toward a Prefabricated Housing Future

The discourse surrounding prefabrication in Poland is evolving from speculative interest to structured inquiry. As this conference demonstrated, the integration of off-site construction methods into mainstream housing delivery presents both a challenge and an opportunity. With continued investment in technological capacity, workforce development, and regulatory alignment, prefabrication has the potential to become a foundational pillar of sustainable construction in Poland.

Saturday 22nd and Sunday 23rd February

An integral part of the event was also the practical component – 20 Polish and Italian architects present during the conference were invited; the next day they visited a timber-prefabrication factory of MOD21 near Osztaszewo and an active construction site of a primary school near Toruń, where a modular wooden building is currently being assembled.

The factory visit was a valuable opportunity to understand and follow the entire production chain step by step, while also observing possibilities for detail and finishing enhancements. At the same time, we had the chance to explore the showroom, where various environments such as office, residential, and hospital rooms were recreated. These setups demonstrated the potential for module customization in response to urgent housing needs and the delivery of diverse products within short timeframes.

Here they could see live what they have been presented during the conference. The interconnected site visit was supposed to underscore the operational maturity of prefabrication in real-world contexts.

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Off-site trends in Italy and Poland

The Polish moment ended in a moment of collective reflection to conclude and summarise the findings of this comparative research. It was an opportunity to deepen engaging discussions and perspectives that had emerged in previous meetings, bringing together diverse expertise from academics, architects, researchers, public administrators, companies, and investors.
The objective of this concluding workshop was the analysis of the potentials and criticalities as well as similarities and differences between the two countries towards a widespread off-site in the construction sector and for the retrofit of private and public residential buildings.
In recent years, off-site architecture has gained popularity worldwide, bringing numerous benefits in terms of speed, sustainability and quality of construction. However, its adoption varies significantly across national contexts. In this comparison between Italy and Poland, differences emerge in both the practices adopted and the challenges each country faces in integrating this innovative model. In fact, we have to consider off-site construction as a complex undertaking that involves several key factors, including ownership structures, funding and investment models, public policies, the intersection of demand and supply, technological advancements, architectural culture, and innovation.

Off-site construction is gaining ground in both Italy and Poland, albeit at different rates and with different approaches. Looking ahead, there are several common challenges that both countries will face, including demographic shifts, climate change, labor shortages, and evolving cultural mindsets of architects and clients.
The latter point is especially crucial within the context of this project for the architectural profession.
In fact, it's still common for designers to perceive off-site construction as lacking creativity, often associating it with cost-cutting measures and a stereotype of poor quality and minimal aesthetics. There is also a historical context to consider.

In Poland, prefabrication carries a political connotation, with prefab architecture often linked to the communist era and associated with cheap, unattractive buildings that lack architectural value. In Italy, the situation is shaped by the country's rich architectural heritage, which can make renovation projects more complex. Bureaucratic hurdles and the involvement of heritage conservation authorities (Sovrintendenza) frequently complicate these processes, adding further challenges.

In Italy, the adoption of off-site construction is still in its infancy but is gaining momentum through several initiatives and pilot projects. Despite growing interest, large-scale adoption is hindered by factors such as industry fragmentation, lack of standardization, and a traditional construction culture that is still entrenched.

Moreover, the construction market is in decline, and the traditional building sector continues to be dominated by conventional construction techniques, which are tied to the traditions of craftsmanship and design. Off-site architecture is beginning to gain ground, although it is still limited to mid-scale interventions and remains linked to a traditionalist market. The scarcity of available land for construction, along with geographic challenges and seismic zones, constitutes one of the main hurdles to the adoption of innovative construction models. In many Italian cities, logistical complexities for on-site renovations increase the difficulty of traditional construction interventions.

Furthermore, Italy has a vast stock of social housing that requires retrofit interventions, but recent public policies are still limited, focusing mainly on renovation and improving energy efficiency rather than introducing entirely new solutions like off-site construction. Additionally, building laws vary from region to region, creating further challenges in implementing uniform techniques.

Despite these difficulties, Italy is making progress through sustainability initiatives and government incentives that promote the adoption of more modern and sustainable techniques, including the use of natural materials and technologies to improve energy efficiency. However, companies operating in the off-site sector are still few, and the market is primarily focused on small to mid-scale solutions, such as retrofit projects. Off-site solutions are primarily concentrated in Northern Italy, particularly in the Northeast, where they are mostly applied for small-scale projects and the renovation of existing buildings.

At the same time, private property represents a significant portion of the Italian building landscape, with many residences and buildings not belonging to the public sector, which may slow the adoption of cutting-edge solutions. The aging population and workforce in the construction sector, with many workers

and managers nearing retirement, could lead to a shortage of specialized skills. However, this situation also represents an opportunity to transform the industry, pushing toward more modern and safer solutions, such as off-site construction, which reduces physical labor and optimizes the management of innovative projects.

In Poland, off-site construction is already an established reality and is growing rapidly. The reasons for this success include rapid urbanization, a housing shortage, rising material costs, and a shortage of skilled labor.
The construction market is growing rapidly, with the main goal of making a profit, and less attention is given to sustainability or the use of natural materials. Polish companies have been more open to adopting prefabricated and modular solutions, particularly for the construction of new residential buildings and commercial infrastructure.
This is also encouraged by the fact that building regulations are uniform across the entire Polish territory, ensuring a certain consistency in construction practices and promoting the replicability of projects.
Another factor that has driven the adoption of off-site practices in Poland is the wide availability of land for construction, without strict regulatory restrictions on land use, which has facilitated rapid building. Moreover, Poland has also benefited from greater support from the European Union, which has encouraged the adoption of sustainable and innovative practices in the construction sector. Although the adoption of off-site architecture is growing, the number of companies operating in this sector is still limited, and over 75% of off-site production is exported to neighboring countries, where labor costs for this type of production are higher.
In summary, while Italy and Poland share a growing interest in off-site architecture, each country has taken a different path in adopting it. Italy faces greater resistance to change but is making progress through an approach that emphasizes sustainable innovation. Poland, on the other hand, has demonstrated a quicker ability to adapt, driven by economic needs and European policies, but continues to face challenges related to product quality and standardization. Both countries, however, are likely to benefit from adopting these techniques, especially if they can overcome challenges related to the perception of prefabrication as synonymous with poor quality and aesthetic shortcomings, as well as increase public investment in social housing renovation.

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OFFSITE CONSTRUCTION
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Conclusion

After this extensive research into off-site construction, we discovered a wealth of opportunities, yet also faced several significant barriers, especially when it came to implementing these methods within the housing supply chain. The potential for off-site construction to enhance efficiency, reduce costs, and improve sustainability is evident, particularly in terms of faster build times and reduced on-site disruption. However, these advantages are often tempered by the challenges of standardizing designs, aligning stakeholders across the supply chain, and addressing regulatory and logistical hurdles. Additionally, the need for skilled labor and the upfront investment in technology and infrastructure remains a critical consideration. While off-site construction methods hold great promise, overcoming these obstacles will require coordinated efforts, innovation, and long-term commitment from all involved parties in the housing sector.

In the following section, we aim to identify the key opportunities and obstacles that remain largely unresolved and which could form the next phase of this extensive research. While we've made significant progress in understanding the potential of off-site construction within the housing supply chain, there are still critical barriers that need to be addressed. These include issues related to technological integration, the scalability of off-site methods, regulatory frameworks that hinder flexibility, and the alignment of various stakeholders within the supply chain. By focusing on these unresolved challenges, the next step of our research will seek to uncover viable solutions and strategies to overcome them, paving the way for more widespread adoption of off-site construction in the housing sector.

Opportunities

- Off-site construction is more than just a building method. It also serves as educational opportunity for the younger generation of architects, helping to address the lack of specific training for professionals and workers in the field;
- Off-site construction can foster social, economic, and digital innovation among various actors within the construction industry;
- Off-site construction is a resilient and effective response to the rapid societal changes, addressing both housing demand and resource scarcity;
- Off-site construction offers a safer and less strenuous working environment, aligning well with the needs of an ageing population;
- Off-site construction reduces resource consumption and waste throughout the entire life cycle of buildings, thanks to its dry assembly methods, the potential for reusing materials and components, and its suitability for integrating natural materials;
- Off-site construction has the potential to drive a transformative shift in public policy by encouraging public investment in the renovation and improvement of existing social housing.

Challenges

- In off-site construction, there is a lack of certifications, specific building regulations, and clear guidelines, which makes its widespread application more difficult and slower;
- In social housing, off-site construction is used much more extensively for new buildings than for energy retrofitting;
- Off-site construction is often perceived as a method that compromises architectural quality and challenges the creative and authorship role traditionally held by architects;
- Transportation costs can be significant in off-site construction, especially when moving large prefabricated components to remote sites or locations with limited access;
- Although off-site construction is cost-effective in the long run, it typically demands an important upfront investment in manufacturing facilities and logistics;

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