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INDUSTRIAL PREFABRICATION SOLUTIONS FOR BUILDING RENOVATION

Innovations and key drivers to accelerate serial renovation solutions in Europe

Authors
Jesse Glicker, BPIE
Rutger Broer, BPIE

Reviewed by
Sibyl Steuwer, BPIE
Mariangiola Fabbri, BPIE
Margaux Barrett, BPIE
Caroline Milne, BPIE

Graphic design
Luca Signorini, Distudio srl

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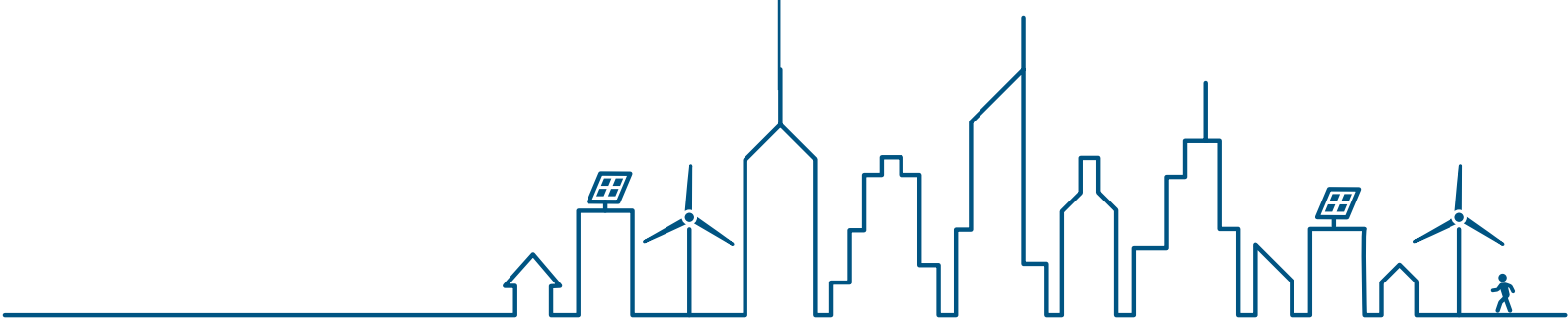

EXECUTIVE SUMMARY

Achieving society-wide decarbonisation within the EU has remained at the top of the European agenda for several years, with increased provisions to account for climate solutions in the European Green Deal and associated recovery measures. The publication of the REPowerEU plan underscores the importance of demand reduction and future-proofing the European building stock [1]. The plan calls for demand reduction, diversifying fossil fuel supply and accelerating the transition to renewable energy by 2027. Given the ambitious timeline in conjunction with existing European climate objectives, increased ambition, innovation and speed will be needed to achieve the goal to gain independence from Russian gas and further the European agenda of decarbonisation.

There is substantial potential within the building sector to achieve emissions reductions, while also future-proofing the building stock through renovation. However, innovative solutions are needed to increase the speed at which such gains can be achieved. One promising solution is industrial prefabrication for renovation, the construction method involving the production and design of structural building components or units in a factory environment, which are then installed on site, rather than being constructed on site. In some cases, industrial prefabrication can decrease construction time by 20-50% [2] and thus associated disruption, as well as create significant energy and cost savings.

However, despite current innovations in technology and process, significant innovation drivers and preconditions are needed to ensure the feasibility of implementing industrial prefabricated solutions. These include:

- The continued use and development of digitalisation, including facilitating building information modelling (BIM) solutions.
- Stability of the supply chain and adequate manufacturing facilities capable of supplying necessary components efficiently.
- Tailored financing solutions.

European, national and local action is needed, as well as support from private investors, banks, housing associations and industry. The following report outlines the technological and process innovations needed to facilitate the uptake of industrial prefabrication solutions in renovation throughout Europe to meet climate goals, reduce energy demand and contribute to future-proofing the building stock.

INTRODUCTION

The European Union is committed to achieving full, society-wide decarbonisation, with a pressing 2030 target of reducing greenhouse gas emissions by at least 55%.[1] Furthermore, the recent publication of the REPowerEU plan puts an increased emphasis on energy demand reduction and the future-proofing of European infrastructure. Buildings have a critical role to play as the sector accounts for about 36% of total energy-related greenhouse gas emissions. Around 75% heating and cooling of buildings is still generated from fossil fuels. The EU must significantly increase its rate and depth of renovations to improve the energy efficiency of buildings.[2] Despite a furry of policy initiatives over the last 20 years, the advancements have been slow.

A recent BPIE assessment concluded that the planned measures (under the EU Green Deal, Fit for 55 Package and Renovation Wave) will not achieve EU climate targets [1]. While the need for innovation in the construction sector is very clear, the sector has been classified as one of the least innovative in the EU [2]. Major transformation is needed to meet the European climate targets in the building sector. More ambitious policies, creative business models, and technical innovations and solutions are needed.

Making use of prefabricated building components produced at an industrial scale (a process known as industrial prefabrication or serial renovation) is one promising solution. It has potential to considerably accelerate deep renovation for a significant share of the European building stock (a French study estimated that 14 million homes in France are eligible for such renovations [3]). The digitalisation of the construction sector, incentives to invest in production capacity and innovate financing solutions are needed to enable the market penetration of industrially-prefabricated renovations.

[1] 55% compared to 1990 greenhouse gas emission levels.
[2] According to BPIE calculations, the rate of deep renovation must be increased to 3% annually, from the current 0.2%. “Deep renovation” refers to renovations leading to a decrease of energy need of more than 50%.

INDUSTRIAL PREFABRICATION IN CONSTRUCTION

Industrial prefabrication is a construction method for the production and design of structural building components or units (facades, roofs, floors, etc.) in a factory environment, which are then installed rather than being constructed on site [4]. While currently industrial prefabrication is used largely for new construction, the process also applies to renovation solutions.

Industrial prefab renovations include different construction and financing processes compared to the conventional renovation process, resulting in different benefits and limitations. The on-site production process of building elements is a major part of conventional renovations. Key benefits, challenges and differences in industrial prefabrication include:

- **Benefits –** higher precision and standardisation, improved quality control, reduction of waste and transport, potential to reduce costs if sufficient scale is achieved, among others.
- **Challenges –** the novelty of the process could mean higher lending rates [5], longer coordination time, high upfront investments, limitations in terms of transportation, unavailability of or highly expensive skilled labour force requirements [6].
- **Differences** from conventional renovations include the necessity for large upfront capital costs, different skill and knowledge requirements, lower design flexibility and changes in the supply chain.

For this paper, we use the term industrial prefabrication (in short, industrial prefab) to discuss industrial prefabricated solutions for building renovation. As many different definitions and terms are used for industrialisation processes within the construction sector, our definition is included in Box 1. Note that most of these terms can refer to both renovation and new construction projects.

Box 1: Industrially prefabricated renovation solutions

Industrial prefabrication refers to a construction method that involves the production and design of structural components or units (walls, roofs, floors, balconies, facades, kitchens, etc.) in a factory environment, which are then installed, rather than being constructed on site [4]. This process applies to both renovation solutions and new construction. Currently, many definitions and terms exist for the concept of industrially prefabricated solutions for building renovation depending on process specifics and location. These includes, among others [6]:

- Off-site manufacturing (Australia)
- Prefabricated housing (Japan)
- Off-site production (Germany)
- Industrialised construction (Sweden, China)
- Modular construction (Canada)
- Prefabricated preassembled modular offsite fabrication (PPMOF – USA)

Off-site prefabrication and industrialisation differ from on-site industrialisation and prefabrication, where new methods like lean construction and modern technologies like GPS, assembly of prefabricated solutions, robotic finishing and self-climbing formwork are applied on the construction side.

 **Industrial prefabrication**	 **Process optimisation**	 **Digitalisation**
Standardised components off-site manufacturing Individually adaptable products Modular and flexibly implementable	Standardised processes Opportunities for financing Innovative business models	Digital twin/BIM Machine readability of data Building monitoring

The lack of common terms underlines the need for a shared definition, especially to help policymakers and providers standardise and communicate processes.

Industrial prefabrication refers to a construction method that involves the production and design of structural components or units in a factory environment, which are then installed, rather than being constructed on site.

INDUSTRIAL PREFABRICATION INNOVATION - WHAT IS NEEDED?

While the industrial prefabrication for renovation process already includes key innovations, there is a need for further process innovation to accompany and further drive the technical advancements and digital solutions, summarised in figure 1.

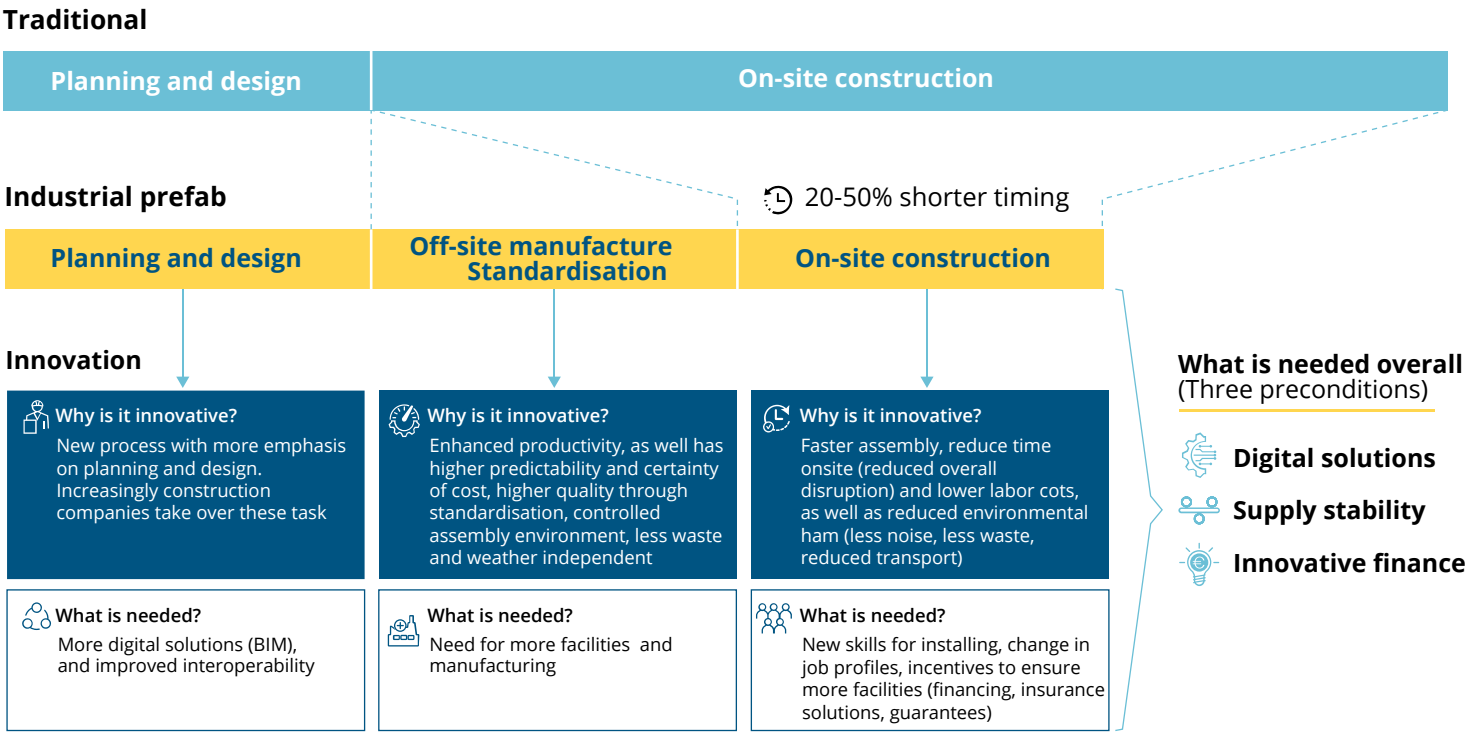

Figure 1 - Traditional construction vs. industrial prefabrication (including innovation needs)

The potential of prefabrication for new buildings has already been established in European markets [7]. However, its potential is not limited to new buildings. Applied to renovation processes, it can be part of the solution to increase the EU renovation rate and achieve climate targets [8], as seen in the success of the Energiesprong project in the Netherlands (Box 2). To produce these renovation solutions in factories, digitalisation [9], automation and robotisation [6] are expected to play a larger role.

Box 2: Energiesprong

Energiesprong, originally a project from the Netherlands, is the most successful industrial prefabrication model for net-zero renovation projects to date. The concept is based on integrated prefabricated façade and roof systems used to renovate predominantly social housing units from low-performance dwellings into net-zero or energy-positive dwellings. In 2013 a 'volume deal' was signed in which the initiators of Energiesprong set an ambition to create 10,000 net-zero social housing dwellings, ensuring a minimum volume of renovation projects. When combining newbuilds and renovations, the objective was reached with some delay. When only looking at renovations, significant progress has been made, with 5,700 dwellings having been renovated in the Netherlands [10].

Although the aim of involving several new actors from the construction sector was achieved, several other barriers complicated the implementation of the volume deal. The delayed implementation of legislation to allow landlords to charge an 'energieprestatievergoeding' (energy performance renumeration, which a tenant pays the landlord in return for guaranteed energy savings) slowed down progress. Once the legislation was implemented, not all social housing associations were making use of it, partially due to fear of high energy performance monitoring costs. A final reason for slower uptake of the solutions was the increase in prices for materials and labour [4].

THREE PRECONDITIONS FOR ACCELERATING INDUSTRIAL RENOVATIONS

The market for industrial prefabrication of renovation solutions is still in the development phase. Several external forces are driving the uptake of industrial prefabrication of renovations, such as the lack of qualified workers forcing companies to produce more with less personnel in factories or the invasion of Ukraine creating awareness about the importance of energy savings. There are, however, several innovation preconditions in the construction and public sector that enable upscaling of industrial renovation solutions. Our analysis focuses on digitalisation, stability in supply, and tailored financing.

DIGITALISATION

Several digital technologies have the potential to transform how we conduct renovations. In a report from 2019, the European Commission highlights technologies such as sensors, the Internet of Things (IoT), drones, 3D scanning, automated fabrication (prefabrication) using robotics, 3D printing and BIM. Most of these technologies have been deployed in the Dutch Energiesprong renovations (box 2). A more recent report from the European Construction Sector Observatory from 2021 analyses the maturity of each of these technologies and subdivides them in different categories (see figure 2) [11] .

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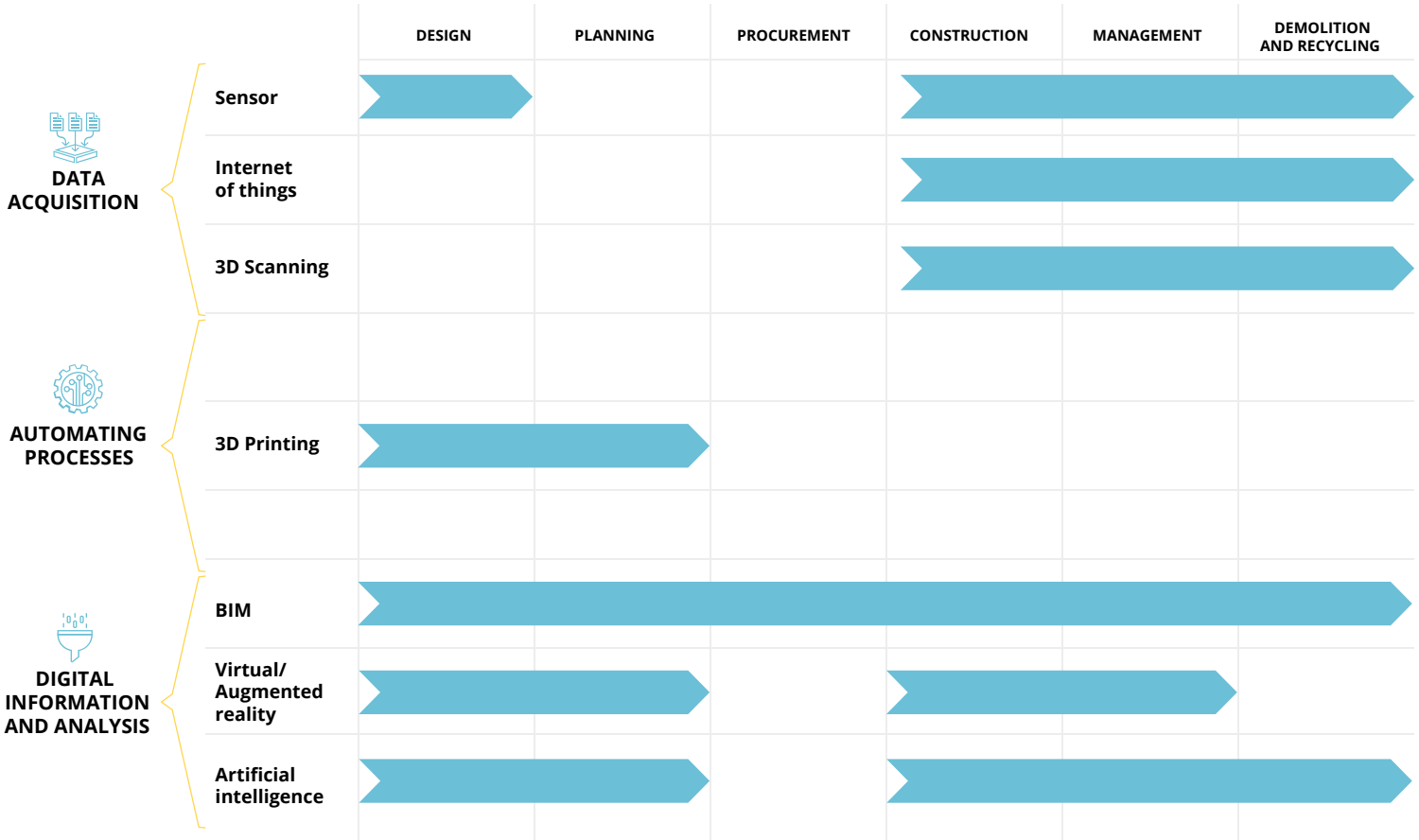

Figure 2 - Types of digital technologies transforming construction (Source: ECSO, 2021)

Despite the fact that technical innovations in digitalisation already exist and are being deployed, innovation is needed in terms of interoperability between solutions. Tools like BIM and a **digital building logbook** can help create synergies between technologies, keeping all data and information in a central, easy-to-access location. In addition to technical solutions, emphasis is needed on process innovation, especially since most of the coordination for industrial prefabrication happens in the planning and design stage.

Since digital solutions are not evenly deployed throughout countries or even projects, there is a need to understand and help implement new processes for utilising digital solutions. This can be done via trainings and sharing of best practices.

While there is a need to further improve and develop innovative technologies, policy support is needed for the implementation and integration of digital solutions to incentivise and revolutionise the process of building decarbonisation.

BIM DEPLOYMENT

BIM is an essential enabler for the overall transformation of the construction and renovation sector. BIM creates a 3D digital model of a building, combining several information 'layers' concerning construction materials, HVAC systems, water systems and wiring. These models are used by architects and construction professionals to develop the building design, streamline the construction process, and improve communication between different actors. BIM is already widely used in the construction sector (see box 3) and has been shown to be of particular relevance for renovation projects like **Bertim**, **BIMSpeedplatform** and **BIM4EEB**.

Box 3: The status quo of BIM deployment across Europe

To date, the UK has been the pioneer of BIM usage, introducing the technology in the 1980s. It took two decades for other countries such as Germany and France to establish their own systems in the early 21st century. During the 2010s, Central and Eastern European states including Austria, Poland, Russia and Croatia followed their example [12].

Although the use of BIM technologies is relatively widespread today, there is a wide variation between market maturity. The application of BIM is still often limited to architects and designers (70% of large construction companies use BIM) [12]. Smaller companies specialising in renovations still tend to rely on conventional methods.

Even the UK faces a significant discrepancy in the use of BIM between large and small businesses. Indeed, while in 2020 80% of large companies used BIM technology in their projects, only 62% of small businesses had similar BIM experience [12].

German companies have adapted to BIM relatively quickly, with 70% of large construction companies and almost 60% of small businesses using BIM technology. However, the rest of Europe is much farther behind. In France, less than 60% of larg e companies have switched to BIM, and numbers are lower still in Poland (43%) and Croatia (25%) [12].

An important factor is the level of government intervention and investment in BIM. In the UK, the government mandated that all state-funded projects must use BIM technologies from 2016 onwards. A requirement for using BIM for public projects over €100 million was then gradually established in Germany (2017), Austria (2018), Italy (2019) and France (2022) [12]. In the Netherlands, Spain and Scandinavian countries, BIM is increasingly deployed, and the technology is becoming the form for important architectural projects [13].

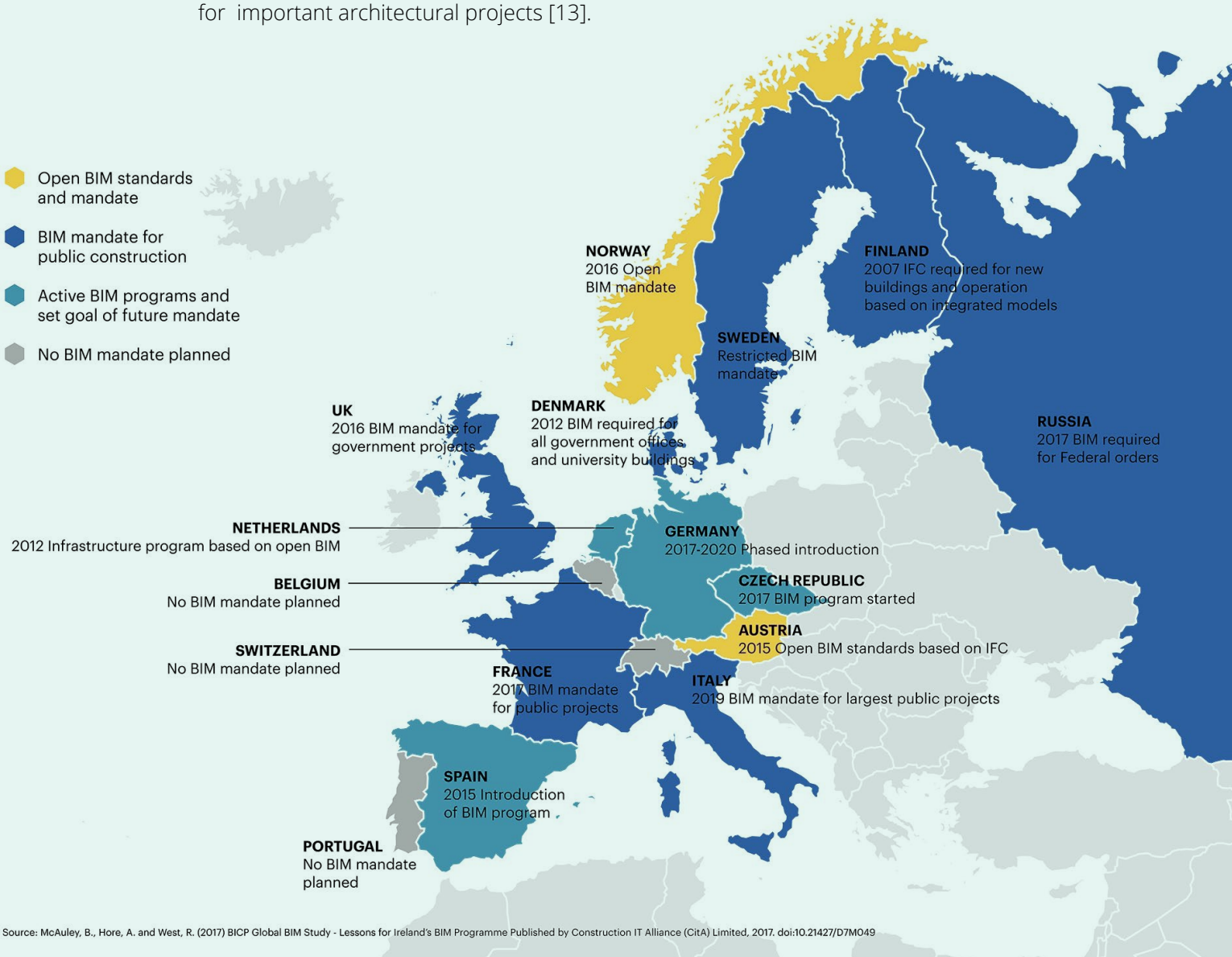

Figure 3 - BIM deployment throughout Europe
Source: https://www.magicad.com/en/blog/2020/03/bim-adoption-europe

Currently BIM is mainly used for the new construction; BIM for renovation is not yet widespread, being mainly limited to the design phase of larger projects. Digital measurement and the digital building model are a starting point and requirement to produce prefabricated building elements for renovation.

BIM has several advantages including a lower risk of cost overruns on public infrastructure projects, improved project understanding and transparency, and greater stakeholder engagement. It supports better coordination, and generates accurate, timely and reliable information to improve decision-making and the quality of outputs (see Annex I BIM4EEB of this report). For the public sector, this translates to economic benefits, such as better value for public money during the delivery phase and improved quality of public goods and services during the use of the built asset.

Box 4: SmartBim NL – digitalisation for renovation

Dutch company Greenhome is using BIM to promote renovation by developing a smart twin – a digital copy of a building that offers possibilities to speed up and simplify renovations while increasing their quality. Building owners can create a model of their building in a digital environment, and the model is linked to the national energy performance calculations. Construction and installation companies can view the digital model of the building to analyse the dimensions, check calculations and provide tailored technical offers and prices. The model even allows semi-automatised offers to be provided. The model can be saved in a digital building logbook that can be transferred to new owners once a building is sold. On the 1 October 2022 the 3D module will be launched on the housing improvement platform from the Dutch Ministry of Internal Affairs.[4]

BIM can help building stakeholders understand and plan how a project will be executed, as well as track preventative maintenance, predict errors in design and identify incompatibilities. The data collected by sensors and lasers, like information from the model, can be centrally stored to improve the overall data availability and transmission of data between the different actors. See Annex I for more BIM examples.

The application of BIM ties in with the EU agenda to develop and promote an EU-wide digital building logbook to standardise and improve data collection. Digital building logbooks are digital data repositories that allow the storage of different types of relevant building data over all phases of a building's life [14]. In practical terms, digital building logbooks can store a BIM model, building renovation passports, building material passports, energy performance certificates, manuals for building installations or data about the indoor environmental quality [15].

There are already a variety of public and private functional digital building logbooks available on the market, such as the Woningpas in Belgium and Madaster in the Netherlands and Germany [16]. Uptake of digital building logbooks, BIM and other digital technologies in the construction sector will accelerate the modernisation of the construction and renovation sectors and generate synergies that support the uptake of industrial prefabrication of renovation solutions.

[4] https://www.linkedin.com/pulse/tech-innovatie-digitale-gebouwmodellen-tbv-reinier-schneider/?trackingId=yp3xmS5Gl9NaNMCCDF5aTw%3D%3D

LONG-TERM SUPPLY STABILITY

Since industrial prefabrication requires different manufacturing processes, stability in the supply and manufacturing facilities is essential to improve efficiency and increase scale to ensure projects are cost-effective. Moreover, large volumes or work pipelines are required to achieve the benefits of industrial prefabrication in construction, causing a dilemma for solution providers who are unsure whether they can tap into reliable demand pipelines [7]. However, in terms of labour costs, roughly 80% of conventional labour can be moved to manufacturing facilities [7].

Creating demand for industrial prefabrication solutions is an essential precondition for ensuring their success [7]. Bundling demand, project aggregation and other measures to stimulate demand can encourage manufacturers and practitioners (who might already have the capacity or potential capital costs) to pursue industrial prefab solutions. Such efforts can be carried out by local governments as well as NGOs and associations familiar with the housing stock. As pilot projects continue to prove the potential energy and time savings of industrial prefab for renovation, it is necessary to continue to drive demand and tailor finance so that supply can meet it. Programmatic working for social housing companies or other larger building owners has large potential to drive such demand bundling, because it involves switching from a short-term planning cycle focussed on single renovation projects to a multi-year planning strategy with larger number of projects keeping the complete portfolio in mind. This allows sufficient volume and predictability that enable profitably establishing renovation production lines in factory environments. Programmatic working does require a fundamentally different way of working and a shift from projects to programmes [17].

A good example of demand aggregation is the 'Buyer groep Circulaire Bouwmaterialen' (circular renovation big buyer group) in the Netherlands that bundles the purchasing power of several housing associations to set out tenders for circular renovation solutions [18]. This includes solutions for kitchens, bathrooms and roofs [19]. Bundling expertise and capacity of municipalities and larger building owners provides synergies and allows the sharing of costs and risks and the creation of performance-based tenders. In another example, eight housing associations in the Dutch province of North Holland bundled their purchasing power in 2020 in the North Holland Sustainability Coalition (NHDC) to insulate 3,000 social housing dwellings in five years [20]. Two construction companies will implement the work and renovate dwellings to achieve a maximum net annual energy demand of 70kWh/m^2/year [21].

A similar initiative in the province of Brabant saw two social housing agencies procure together, starting with 378 dwellings and aiming to achieve 4,500 between 2020 and 2025 [22]. Other social housing associations were invited to join this process.

These shared procuring projects in Brabant and North Holland were concluded with support from the national 'renovation accelerator' programme, which includes a focus on aggregating demand, optimising the supply chain by creating the conditions for scaling and industrialisation, and supporting innovation [23].

In the Netherlands the NGOs Renovatiegolf (Renovation Wave) and Stroomversnelling, together with a large group of other market players, are advocating for a national programmatic approach to give all housing owners, also outside the social rent market, an offer to make their building as carbon neutral as possible [24].

Box 5: A programmatic approach - example from the Netherlands

Key success factors driving the Energiesprong project implementation included the increased use of a multi-year 'programme-based working approach' (Programmatisch werken). Rather than investing in single building renovation projects, housing associations invest in renovation programmes that cover several projects over several years, guaranteeing a constant demand for industrial prefabricated renovation solution providers.

Housing provider DeAlliantie (The Alliance) achieved good results with programmatic working after four years of careful process and trust-building with two selected construction companies and a set of newly developed internal tools. The results included a doubling of the buildings being renovated (3,000 annually – 1,500 preparation and 1,500 execution), personnel savings, better risk calculations and reduced time for decision-making. The housing agency takes a modular approach, focusing on specific building parts (roofs, facades, installations), and allows smaller housing associations to participate in the programme. The director of sustainability at DeAlliantie believes that a minimum of 500 buildings spread out over several years is enough to start a programme [17].

Dutch construction companies are anticipating this new way of working. Royal BAM, one of the Netherlands largest construction companies, is now offering renovation production pipelines that housing associations can buy, rather than standard tenders [17].

This approach is starting to become more widespread in the Netherlands, where social housing associations start to bundle their efforts and procurement processes to generate economies of scale and give clear signals to the market.

TARGETED FINANCING

Prefabrication and prefab facilities require large upfront investment, as is common in most energy efficiency solutions. Attracting funds is a critical challenge to scaling solutions. As a relatively young and still largely in the pilot phase, prefabricated renovation solutions need to build trust to guide investment and drive demand. This is a crucial area for support not only from government, but also financial institutions and investors.

There are several areas in need of support, specifically among building owners and along the supply chain. Building owners who are not aware of industrial prefabrication or its benefits might not be interested to pursue such solutions, especially if (i) there is no policy directly driving it and (ii) costs are higher than for shallower renovations. The establishment of targeted funds to cover the full cost (including a mix of grants and loans) or additional cost would address this barrier, making industrial prefabrication solutions more attractive. Such funds can be targeted at building owners or solution providers to incentivise and promote the market.

Among manufacturers, support for new facilities is essential, especially if demand is not yet creating the incentive. Tailored finance is needed for building out facilities, especially in markets where industrial prefabrication is less established.

In the Netherlands the NGOs Renovatiegolf (Renovation Wave) and Stroomversnelling, together with a large group of other market players, are advocating for a national programmatic approach to give all housing owners, also outside the social rent market, an offer to make their building as carbon neutral as possible [24].

PUBLIC SUPPORT

Public funds have been the primary support for industrial renovation projects carried out to date. However, in addition to the important role of policy support, further and more extensive funding is needed from public authorities. An innovation programme focused on the intermediate stage between pilot and mass market could be useful to ease market entry of certain solutions.

Box 6: Tailored finance for serial renovation production facilities in Germany

The German Federal Ministry of Economics and Climate Protection (BMWK) has established a funding programme to support the roll-out of industrial prefabrication solutions for building renovation. Financial support is available in three areas: funding to conduct feasibility studies, support for pilot projects, and grants to build production facilities [25].

- **Feasibility study:** The programme supports studies of the technical, legal and economic feasibility of industrial prefabrication for specific properties and buildings.
- **Pilots:** Moving a step further from feasibility studies, BMWK provides support for the research, development and implementation of industrial prefab projects along several points of the value chain.
- **Production facilities:** Finally, the programme provides support for the construction of new production facilities or for the expansion of existing facilities in order to adapt to the new process or products.

This level of direct support, in particular related to production, addressees the risk incurred by manufacturers when entering the market.

Specifically, subsidies for demand bundling could support larger building owners or homeowner associations to start investing in renovations. Demand bundling is essential for industrial prefab yet needs tailored support. In the Netherlands, several subsidy programmes for homeowner associations foster demand bundling by targeting energy saving measures within a building complex.

GUARANTEE FUNDS

The establishment and use of a guarantee fund could address the need for de-risking in this young market. Given the long payback time and long-term contracts associated with industrial prefabrication, a guarantee fund (external from solution providers) would remove the financial burden/risk of entering into a long-term contract for both the provider and the building owner. Given the security of such a guarantee, housing providers can invite outcome-based tenders, which state a required level of performance rather than the specifics of a retrofit. This gives solution providers the freedom to innovate and de-risks the investment from the lender's side.

Box 7: Private Finance for Energy Efficiency Fund (PF4EE)

Although not specifically for prefab renovation projects, the PF4EE fund is a good example of a guarantee fund supporting energy efficiency projects. The €80 million fund provides credit risk protection and expert support services to enable long-term financing for energy efficiency projects. PF4EE provides three forms of support:

1. A risk-sharing facility (portfolio-based credit risk projection via cash collateral)
2. Long-term financing by means of a European Investment Bank loan
3. Expert support for the project

A similar multi-support programme could help cover and de-risk investment in serial renovation.

CONCLUSION

Industrial prefabrication for renovation poses an excellent opportunity to help reach net-zero goals in the building sector and accelerate renovation. However, several preconditions and innovative process updates must be met to realise its full potential. Key drivers of innovation are:

- Digitalisation in construction, and promoting the uptake of digital solutions
- EU policies fostering renovation, to ensure demand and supply chain capacity
- Tailored financing solutions to support digitalisation and renovations

It will take a combination of actors, including private sector financers, public authorities, and industry to successfully implement and scale industrial prefabrication solutions for building renovations.

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ANNEX I

1. Digitalisation and the user experience in building renovation

The VR-Renovate project is focused on helping equip the residents of social housing units to make informed decisions regarding renovation works in their building. VR-Renovate aims to increase trust and transparency by using interactive virtual reality (VR) enabling residents to see the positive impact of the renovation on their apartments. As they "walk around" they see the impact of the renovation and better understand certain interventions. The project partner, Mateboer Bouw BV, decided to include virtual reality in its projections and conduct one of the first VR pilot projects. The project took place in Swifterbant, NL in 2019-2020 and yielded a series of positive outcomes. Thanks to using virtual reality, more residents involved in the project opted for sustainable measures (an increase from 15% to 50%).

Additionally, residents were more curious and eager to try new technologies. As a follow-up to the successful pilot, a new project started in Tilburg, NL by KnaapenGroep on an apartment building with 144 apartments. As with the previous example, virtual reality helps residents to better visualise their renovated apartment to make better-informed choices.

2. BIM-Speed Platform – Simplifying deep renovation projects

BIM-SPEED is an EU-funded project run by a consortium of 24 organisations from various disciplines. The project aims at accelerating renovation and making it more efficient thanks to a combination of methodologies and tools with BIM at its core. The main purpose of BIM-SPEED is to determine the most energy efficient alterations for buildings, with the aim of reducing their energy usage by 60% and reducing the renovation time by 30%. By adopting BIM-SPEED technology, it will be possible to store all building information in a central hub and use this information to digitally plan and test the performance of renovations on virtual 3D models before undertaking them on the physical structure. BIM-SPEED solutions will be supported with evidence from 13 real demonstration cases, covering all of Europe´s climatic zones and varying BIM experience levels in different countries.

The BIM-SPEED competition, facilitated by the European Construction Industry Federation, will be held in September 2022 – focusing on the best renovation design concepts using BIM. Projects achieving most time and cost savings, improved collaboration between stakeholders and integration of sustainability aspects and indoor environmental quality aspects will be rewarded with the prize.

3. More-Connect

More-Connect is an EU-funded project focused on the development and advanced prefabrication of innovative and multifunctional building envelope elements. Retrofitting technology and the components for building renovation were successfully tested and applied in six countries located in five geo-clusters across Europe (Portugal, Netherlands, Denmark, Czech Republic, Estonia, and Latvia).

The Estonian pilot project aimed at renovating a typical Soviet-style five-storey multi-apartment building (80 apartments) constructed in 1986 with prefabricated concrete large panel elements. The renovation process began with on-site 3D scanning that produced data later converted into a 3D model of the multi-apartment building. Based on this model, a construction company fabricated a series of multifunctional panels that were afterwards mounted on the building in the period up to three weeks. The main strength of the Estonian pilot project is its high dissemination potential thanks to the architectural similarity of the renovated multi-apartment building with a vast number of residential buildings constructed in the Soviet period not just in Estonia but also across several other Central and Eastern European countries.

4. BIM4EEB

BIM4EEB is a project aimed at streamlining the usage of BIM technology. The goal of the project is to develop a powerful BIM management system that could be used in the design and planning phase as well as providing attractive solutions for building retrofits. BIM4EEB targets to reduce the renovation time by at least 20%, the average renovation cost by 15% as well as net primary use for a typical residential apartment by 10%. During the project, the methodology and the BIM management system will be validated in three demonstration buildings in Italy, Poland and Finland by two public administrations and two general contractor companies. Inhabitants will benefit from the increase of building performance, quality and comfort.

BUILDINGS
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INSTITUTE EUROPE

Rue de la Science 23
1040 Brussels, Belgium

Sebastianstra§e 21
D-10179 Berlin, Germany

www.bpie.eu