SCALING UP INNOVATION IN THE CONSTRUCTION VALUE CHAIN

COMBINING VALUE CREATION AND CLIMATE AMBITION IN ONE OF EUROPE'S KEY INDUSTRIES

EXECUTIVE SUMMARY

MEGATRENDS AND INNOVATIONS IN THE CONSTRUCTION VALUE CHAIN (CVC) OFFER LARGE ECONOMIC AND DECARBONISATION OPPORTUNITIES FOR EUROPE.

The European Construction Value Chain (CVC) is a key industry, which accounts for 7% of European GDP while the built environment represents 36% of Europe's CO_2 emissions. Today, disruptive technologies, emerging business models and growing sustainability concerns are putting unprecedented pressure on the CVC to adapt to a changing economy.

These pressures can be turned into opportunities if all actors in the CVC embrace transformative innovation. While innovation is already happening in the CVC, increasing its scale and pace would create significant opportunities for Europe – whether for economic growth, employment creation, or emissions reductions.

POLICY LEVERS COULD DRIVE VALUE CHAIN TRANSFORMATION.

Targeted interventions from all actors of the value chain will be needed to break incrementalism and enable the take off and diffusion of more radical innovation.

There is a clear role for policy to create push and pull for transformative innovations, through transparent, clear and long-term targets, regulations, standards and public procurement. These will provide long-term visibility and predictability and help create market demand.

Policies at all levels must also encourage all actors to move away from fragmented innovations and towards integrated solutions to end users' needs and challenges.

A MULTI-STAKEHOLDER APPROACH IS NEEDED TO SCALE-UP INNOVATION.

While public authorities have a key role to play, transformative innovations will only be able to take off if they are supported by challenge-driven innovation ecosystems comprising both public and private actors.

From a governance perspective, this means that regulations at all levels need to be aligned, and private actors must be involved in the policy development if innovation is to be scaled up. Finally, the socially disruptive consequences of innovation in the CVC call for careful monitoring and management.

INTRODUCTION

The construction value chain (CVC) is a key component of the European economy in terms of GDP growth and employment. It also has a central role to play in achieving the EU's decarbonisation in line with the "well below 2°C" climate threshold agreed at COP 21.

The innovation underway in the CVC opens new opportunities for value capture, growth and employment, and has the potential to deliver significant emissions reductions. But, for this innovation potential to be realised and reach the necessary scale, active intervention is needed from a variety of actors in the CVC, including from policy-makers at all levels. This transition of the CVC will need to be carefully managed, in order to ensure a fair transition.

OUR APPROACH

In investigating the CVC, we focus on end-use functions delivered by an industrial value chain – in this case, shelter and comfort – rather than on traditional industrial sectors. In construction, this value chain stretches from the supply of raw materials to building operation and maintenance. A value-chain focus offers a full picture of an economic sector, and how it might shift as part of the forthcoming industrial transition.

We take a multi-stakeholder perspective, whereby we consider all the actors in the CVC ecosystems, each of whom have an essential role in enabling innovation and its diffusion, and we assess some of the cooperation models involving different sectors, businesses and cities in delivering innovation.

STATE OF PLAY

THE CONSTRUCTION VALUE CHAIN IN A CHANGING GLOBAL CONTEXT

THE CVC IS CENTRAL TO EUROPE'S ECONOMY AND SOCIETY AND HAS A KEY ROLE TO PLAY AS PART OF BIGGER TRANSFORMATION OF OUR ECONOMIES.

The CVC contributes 7% of Europe's GDP, and employs 11 million people, making it the EU's single largest source of employment. Shelter is the largest direct expense for European households, accounting for an average annual cost of €9,600, or 27% of direct annual spending.[1]

Meanwhile, the built environment is responsible for 36% of Europe's CO_2 emissions and 40% of energy consumption. The CVC also has an important role in each of the three pillars upon which Europe's economic future must be built if it is to meet international climate goals – namely, a very low-carbon energy system, low-waste value chains and a circular economy. To deliver the deep decarbonisation needed to hold climate change well below 2°C, buildings will need to be built and renovated in different ways, namely by using modular construction techniques and materials that can more readily be reused and recycled. Each building will need to be energy-neutral or energy-positive, and interact more with low-carbon energy systems, serving as a kind of "energy-hub".

MEGATRENDS AND INNOVATIONS SHAPING THE CVC OFFER VERY LARGE OPPORTUNITIES FOR EUROPE.

Innovation is already underway in the CVC, driven both by existing actors and new entrants, in response to megatrends such as demographic change, resource constraints and decarbonisation and digitisation. These megatrends are spurring innovation through the introduction of industrialised building processes and new higher performance materials, and the uptake of energy efficiency retrofits, domestic renewable energy technologies, smart-home technologies and reusable/recyclable building materials.

The diffusion of innovation to the CVC could add large amounts of value to the European economy, and therefore to GDP. The value added by specialised construction activities, including renovation work and energy retrofits, was €283 billion in 2011, the biggest contribution (66%) to value added in the EU building sector.

Innovation in the value chain also promises to help address unemployment: for the same value added, specialised construction activities including renovation work and energy refits employ three times as many as are employed supplying energy to buildings.

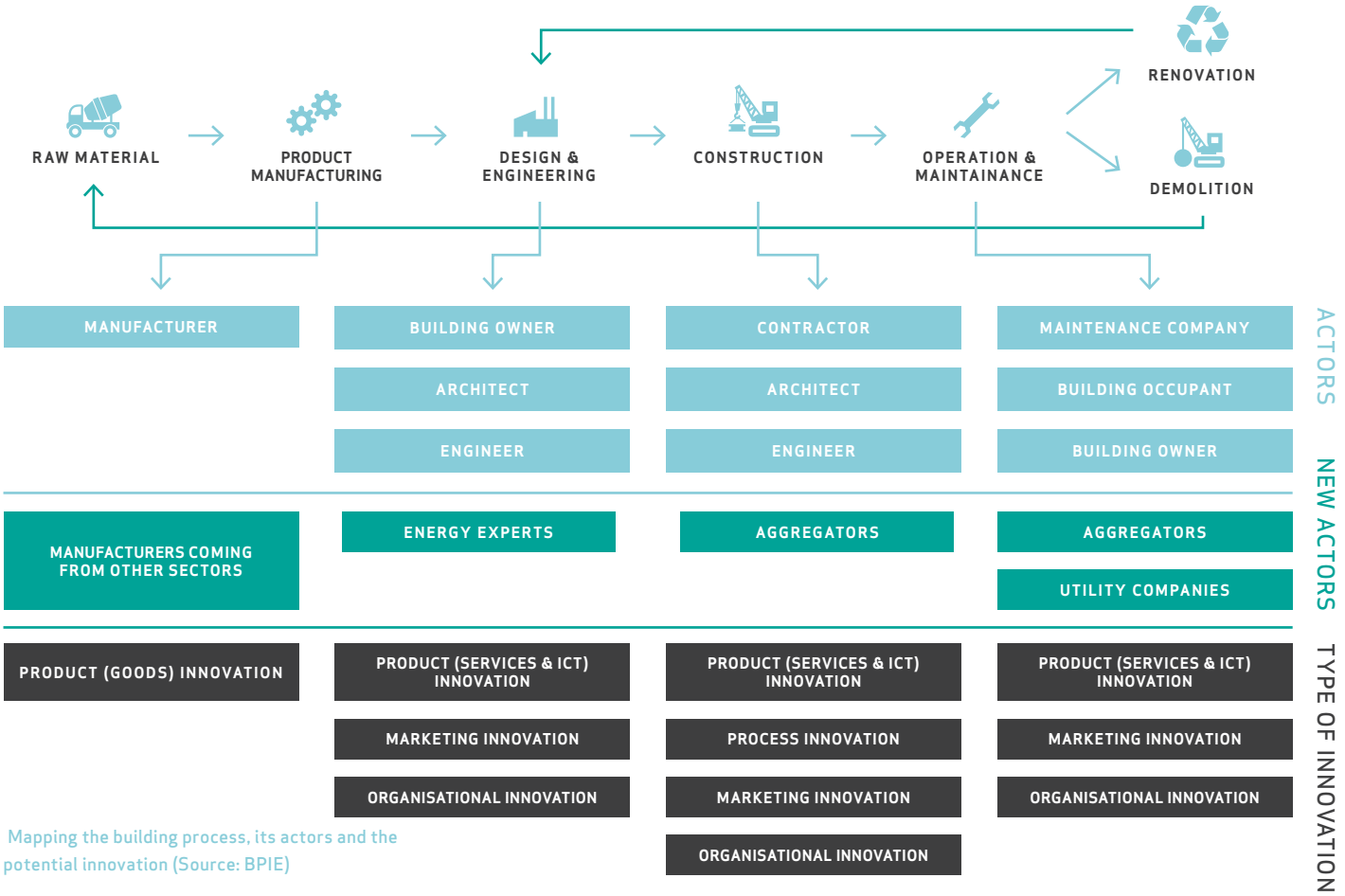
Innovation opportunities in the CVC are related to technology, organisation, marketing, services and products. They include:

- High-efficiency heating, ventilation and air conditioning;
- Industrialised off-site modular construction processes;
- Super-insulating materials;
- Integrated renewable energy production and decentralised storage technologies.

But beyond these specific innovations, their interconnectedness and their aggregation as "solutions" are driving transformative innovation in the CVC and promise to better meet the needs of end-users, whether businesses or home owners. One such "challenge-led solutions" – which take as their starting point the societal challenge that needs to be met – is the combination of solar power systems with battery storage and automated controls.

As described by the Building Performance Institute Europe (BPIE) in *Driving transformational change in the construction sector value chain* report, new alliances are emerging, such as those between architects, structural engineers and manufacturing companies to enable prefabricated energy retrofits. New entrants – such as IT companies and energy technology providers – are entering the value chain and becoming central actors of existing or new ecosystems.

1. Shelter/housing includes both residential, commercial and industrial buildings, and all the products and services that go into modern shelter, such as water, appliances, lighting, heat and electricity.



Mapping the building process, its actors and the potential innovation (Source: BPIE)

INNOVATION IS UNDERWAY

BUT IT NEEDS TO BE ACTIVELY SUPPORTED, REINFORCED AND MANAGED

INNOVATION IS NOT HAPPENING AT SUFFICIENT SCALE OR SPEED THROUGHOUT THE ENTIRE VALUE CHAIN – AND ITS DEPLOYMENT REQUIRES CAREFUL MANAGEMENT.

There are obstacles to delivering and diffusing innovation within the CVC at the speed and scale. These threaten to undermine the ability to meet the outcomes required in terms of value and employment creation, and reductions in emissions and resource use.

The value chain is highly fragmented, and is characterised by a high number of micro-enterprises. Low building demolition and renovation rates mean innovations can take decades to penetrate at scale. Also, those Member States where the construction of new buildings made the largest contribution to the economy were the ones most affected by the economic crisis.

Other barriers include:

- The large number of actors within the CVC;
- Potential incumbent advantage and inertia;
- The existing skills base, which is not geared towards new technologies and business models;
- The immaturity of some technologies;
- Industry standards lagging behind innovation; and
- The lack of defined markets for innovative products or services.

Essentially, industrial innovation in the construction value chain faces a number of interlinked challenges.

These fall into four main groups:

- An uncertain economic and policy outlook that can make it difficult to justify investment in innovation;
- The need to manage risk inherent to innovation projects because they aim to develop and deploy new processes or products;
- The need to balance collaboration to protect knowledge; and
- The conservative mind-set of those involved in the buildings' construction or renovation, servicing and regulation.

The challenges related to deployment require particular attention. Successful small-scale development and demonstration do not necessarily guarantee large-scale deployment of a cost-effective low-carbon technology or solution, as non-financial barriers can stall their uptake.

This means that identified innovations cannot be guaranteed to reach their potential market value. Intervention is therefore needed from policymakers and other concerned stakeholders.

Policymakers also need take a managed approach to the transition. While innovation in the CVC will create employment overall, some jobs will be destroyed (as a result, for example, of efficiencies from prefabrication).

CASE STUDY 1

BUILDINGS' INTERACTION WITH THE ENERGY SYSTEM

The EU's electricity market is transitioning from a centralised, fossil fuel-fired national-based system towards one that is **decentralised, renewable, interconnected and variable**, where buildings could become active participants.

Developments in renewable power generation technology, IT, power storage and smart appliances, metering and grids will change a one-way system into one that will see buildings interact with the power market, including by helping to deliver power system stability through demand response services. Technology and services will have to evolve to **manage demand in an efficient and responsive manner, and integrate storage**.

OPPORTUNITIES EXIST IN THE CONSTRUCTION VALUE CHAIN FOR:

Third-party business models, with aggregators, agents or energy service companies (ESCOs) aggregating and managing demand response, storage and on-site power production.

- Developing **communication interfaces and steering programmes**, allowing building occupants to provide demand response to the grid.
- **Smart controls and household appliances** enabling building users to temporarily modulate their energy use.
- **New storage technologies**, such as those linked to water heating systems.

In terms of potential value available, the Rocky Mountain Institute calculates that, in the US residential sector, customers can cut their electricity bills by 10–40% at existing rates and with current technologies. Widespread implementation of residential demand response could save 10–15% of potential grid investment costs.

THE MEASURES TO ENABLE THIS TRANSITION ARE:

Comprehensive and integrated policies to promote electrification of heat (and transport), and more specifically on the integration of demand response, renewable energy production and storage in buildings.

- An **enabling regulatory framework** to encourage buildings' interaction with the energy system.
- **Promotion of aggregators** for residential, commercial and industrial demand-response services
- The **facilitation of dynamic price signals** from the power market
- **A universal communication protocol** for smart and user-adapted metering and control systems
- **Strategic planning of the grid**, both at transmission and distribution levels, to encourage decentralisation and decarbonisation.

CASE STUDY 2

INDUSTRIALISING DEEP ENERGY RETROFITS

Improving the energy efficiency of housing stock is an urgent priority if the EU is to meet its climate change goals. An increase in the EU's current renovation rate of 1% to 3% would reduce energy demand in existing building stock by 80% by 2050 compared to 2005 levels. However, the costs of and disruption caused by deep energy retrofits – which can deliver energy savings of 60-90% – currently deter uptake.

An opportunity therefore exists to develop a market for customised, prefabricated external façades.

INNOVATION OPPORTUNITIES EXIST IN:

Robotics, 3D scans and simulations to accurately measure the existing building, allowing customisation of prefabricated elements;

- New cooperative business models that see architects, designers, manufacturers, assemblers and customers share information and work together; and
- Municipalities, builders and property owners aggregating renovation projects and deliver economies of scale.

Combining new technologies and business models with existing processes (e.g. for the industrialisation of new-build construction) would enable module manufacturers and home owners to capture value: pilot projects show a potential cost decrease from €130,000 (2010) to €60,000 (2014), from reduced person hours, lower transportation and on-site logistics costs, and economies of scale.

BPIE's research estimates potential value-add from pre-fabricated renovation modules of around €200 billion/year, creating up to 2 million construction sector jobs plus a ripple effect of 5 million additional jobs in the wider economy.

A NUMBER OF ENABLING MEASURES WOULD BE REQUIRED.THEY INCLUDE:

Policy regulation and support measures based on building performance.

- **Legislation on urban planning and architecture** that allow **more flexibility** in the expansion and external appearance of houses due to energy retrofits.
- **Support** by (local) governments or other bodies, such as social housing organisations, **in aggregating renovation projects and mediating with building owners and users.**
- The introduction and further implementation of **Building Information Modeling** and other standardised protocols to allow for harmonised collaboration between value-chain actors.

WHAT DOES IT MEAN FOR EUROPE?

LEVERS OF CHANGE

PUBLIC AND PRIVATE ACTORS IN EUROPE HAVE A WIDE RANGE OF LEVERS AT THEIR DISPOSAL TO UNLEASH SYSTEMIC INNOVATION IN THE CONSTRUCTION VALUE CHAIN.

Governments at European, national, regional and local levels can support innovation and its widespread diffusion. There is a clear role for policy on a number of fronts. At the high level, clearly setting out the societal challenge – through high-level policy – can help encourage the technology and solutions "push" from new materials or modes of production and deployment. Also, setting transparent, clear and long-term targets and regulatory requirements, drawing up minimum standards, codes and protocols, and using public procurement to create market demand can help provide long-term visibility and predictability.

Meanwhile, the contribution of the private sector is vital. Through industry bodies have an important role to play in helping to draw up standards and codes.

At the same time, the public sector needs to ensure that its workforce has the skills needed for a transformed CVC, and it has a vital role in raising awareness of the value proposition in innovative CVC technologies and services – through case studies, demonstrations and consumer outreach.

In addition, there are a number of specific challenges that require cooperation between policymakers and the private sector. These include electricity market reforms allowing for appropriate, dynamic price signals to be sent to encourage demand side response, and strategic planning of electricity grid investment.

The BPIE report offers a more detailed breakdown of these levers and the actors that need to be involved.

The public sector also has an obligation to monitor and manage the socially disruptive consequences of innovation in the CVC. Measures such as targeted social security and retraining will be needed to support those who lose out from the transition.

CONCLUSION

To move beyond the incrementalism that has characterised the CVC in recent decades, and enable its embrace of radical innovation, European policymakers need to take a hands-on approach and engage in targeted intervention. Cross-sector and even cross-border collaboration must be encouraged. Such interventions need to be focused on fostering challenge-led innovation ecosystems in the value chain, with the aim of encouraging disruption and breaking inertia and silos.

WHAT WILL SUCCESS LOOK LIKE?

Delivering innovation in the CVC will result in:

- New materials, processes and business models adopted by market, with a commensurate increase in added value;
- The involvement of a range of actors, including external disrupting companies and players;
- A strong asset base in Europe, with the construction industry boasting the right skills to deliver innovative solutions to societal challenges, with the potential to export technology and services beyond the EU; and
- Innovations that emerge from orchestrated ecosystems.