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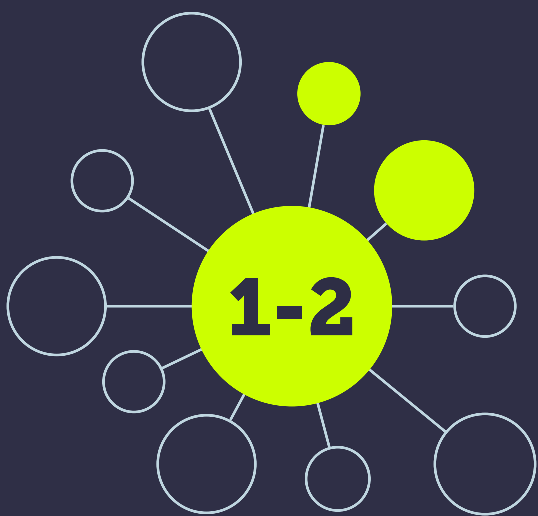
10 circular investment opportunities

for a low-carbon and prosperous recovery

Many voices from governments, businesses, and civil society have been calling for a response to the devastating impacts of the Covid-19 pandemic that does not turn attention away from other global challenges such as climate change, biodiversity loss, and plastic pollution. Yet, solutions from the past will not be up to the problems we face today, as the multifaceted nature of the crisis we are experiencing requires new thinking and the redesign of our current economic model.

In an unprecedented response to the Covid-19 crisis, trillions in economic stimulus are being unveiled all around the world. In the next stage of their recovery plans, governments will have to decide where these funds will be allocated. The circular economy, as an instrument to decouple economic growth from resource use and environmental impact, opens up the way for a resilient recovery and a next wave of economic prosperity. By fostering innovation and competitiveness, reducing resource dependency and environmental impact, and creating new jobs, the circular economy presents a promising way forward.

Building on the past ten years of research carried out on the circular economy, the Ellen MacArthur Foundation highlights in this paper how policymakers can pave the way towards a resilient recovery. As part of this, ten attractive circular investment opportunities that spread across five key sectors of the built environment, mobility, plastic packaging, fashion, and food, have been identified. Each sector is independently explored in a series of Insight papers, along with a piece offering perspectives on policy outlook. These individual papers, as well as the full combined paper, can be found at the Ellen MacArthur Foundation page: Covid-19: The economic recovery.



The built environment

Two circular investment opportunities for a low-carbon and prosperous recovery

The pandemic has laid bare the entrenched shortcomings of the built environment sector; underscoring the prevalence of low-quality buildings, issues around the affordability of decent housing, and the lack of adaptability of our current building stock. These issues, coupled with the growing concern around the industry's highly wasteful and resource-intensive nature, present a strong impetus for the sector's transformation. Renovating and upgrading buildings along circular principles to become more adaptable, comfortable and positive impact (low-carbon), can provide solutions to some of these issues. Additionally, increasing the availability of building materials reuse and recycling infrastructure would allow greater value circulation and effective use of resources that, in turn, can lower the industry's burden on virgin resource consumption. These circular strategies represent key investments that can help shape better and more resilient future built environments that are safe, comfortable, cost-effective, and aligned with environmental targets.

30 intensive care units built and **1,000 beds** added in just ten days

The pandemic has impacted the built environment sector abruptly and in profound ways. Global lockdowns instituted in over 100 countries by the end of March confined people to their homes and severely restricted the ability of construction supply chains to function.[1] Shortages and delays in retrieving necessary virgin materials, and the shutdown of many building sites, have left the industry cash-strapped.[2]

Existing problems surrounding constructions have also been laid bare, with those living in low-quality housing in the cities of high-income countries being confined to small, rigidly designed, and energy-inefficient buildings.[3] At the same time, inadequate access to sanitation facilities has impeded the ability of many people in low-income countries to follow guidance to help stop the spread of the virus.[4]

Meanwhile, there has been an accelerated adoption of certain established circular design strategies, especially building modularity and adaptability, as these have demonstrated convincing solutions to some of the newly emerged issues. In some areas, modular building strategies have enabled rapid construction of vital structures to respond to the pandemic. For example, in Wuhan, China, an emergency hospital of 30 intensive care units was built and 1,000 beds added in just ten days using prefabricated units for its construction which, due to their modularity, could easily be deconstructed and reused in another structure later on.[5] This enhanced speed that modular building affords construction projects, may well increase the attractiveness of adopting such circular solutions in the future as the continued effects of the pandemic and social distancing are expected to reduce construction productivity, slowing projects down considerably.[6] Elsewhere, greater building adaptability has suddenly been required, as the shutdown of spaces like schools, offices, and entertainment venues has forced the home to absorb their varied functions. With some geographies gradually re-opening public areas, contingent on their ability to adjust in order to enable social distancing, the needs for space adaptability are only growing.[7]

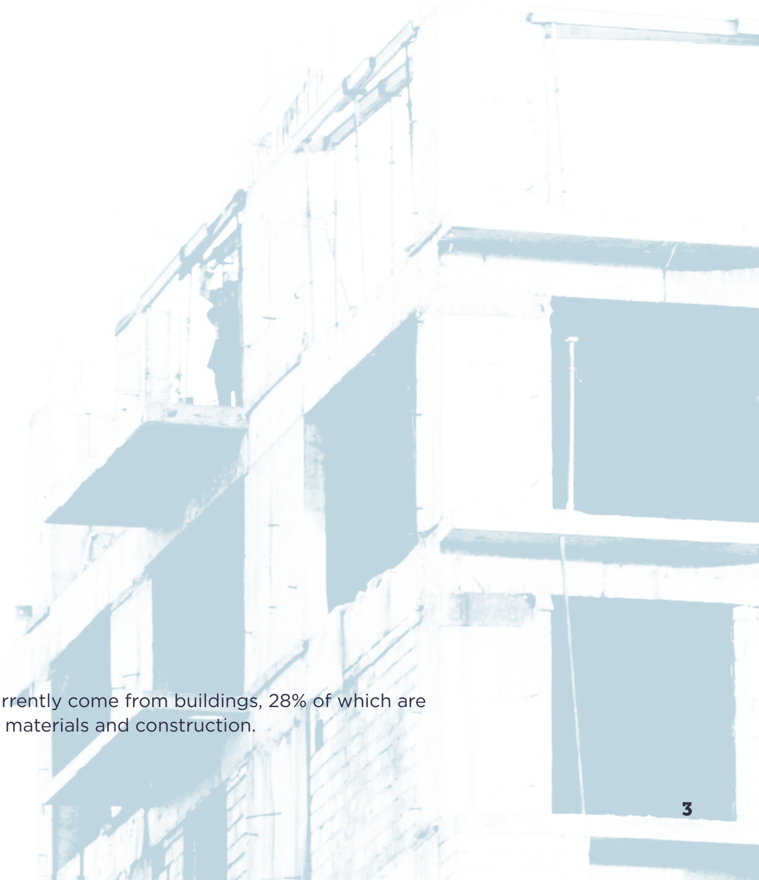
Though lockdown measures have, at the time of writing, eased in many places, a number of pre-existing trends are predicted to continue putting pressure on the built environment. Rapid urbanisation, with population growth and shifting demographics, will lead to an increasingly urgent demand for buildings. This will have especially strong impacts in Africa and Asia, with China's urban population expected to double by 2040 and 70% of the buildings to be used in India in 2030 yet to be built.[8] This will lead to an estimated USD 8 trillion growth of the global construction market by 2030.[9] At the same time, the current building stock continues to be in need of renovation, with improved energy-efficiency a key concern to lift people out of energy poverty, while helping reduce greenhouse gas emissions.[10] All of these needs come at a time when even before the pandemic, the gap between the global demand for infrastructure and the amount estimated to be spent on infrastructure, had been predicted to surge to USD 15 trillion by 2040.[11]

Changes in behaviour and attitude are also likely to create challenges for the built environment sector. With people projected to continue spending more time at home than in the pre-pandemic world, the amount of underutilised space in urban environments is expected to increase, while public and shared spaces like offices will have to adapt to enable greater social distancing, at least for the near-term.[12] In addition, with citizens becoming more environmentally conscious, and with the increased awareness of the construction sector accounting for about 40% of global resource demand and being a major contributor to climate change, greater pressure may well be put on organisations to address these issues.[i,13] More stringent rules and regulations around the industry's environmental impacts are also to be expected.[14]

The circular economy presents robust solutions to address these issues and seize these opportunities in alignment with the future trends, by creating built environments that are safe, liveable, cost-effective, and contribute to achieving climate targets. In a circular built environment this vision is realised through designing out waste, keeping materials in use at their highest value for as long as possible, and integrating natural systems to buildings while also regenerating natural systems. A number of attractive circular investment areas could help attain this vision, including: renovation and upgrade of buildings for adaptable use, durability and positive impact (low-carbon); building material reuse and recycling infrastructure to enable value circulation for a more competitive recovery aligned with global challenges; online platforms to list existing underutilised building spaces for short-term use;[ii] and product-as-a-service models to provide access to, rather than sell ownership of, building services (e.g. lighting-as-a-service). Though all of these investment areas can help contribute to the creation of a better and more resilient future built environment, two especially attractive circular investment opportunities in the current scenario emerge:

1. Renovation and upgrade of buildings
2. Building materials reuse and recycling infrastructure

These selected opportunities highlight especially attractive areas that can help address both the short- and long-term goals of the public and private sectors. Together they provide solutions to key challenges created by the pandemic; meet governmental priorities for economic recovery; offer economic growth potential; and help reduce the risk of future shocks.



i In total, 39% of the world's energy related carbon emissions currently come from buildings, 28% of which are generated through their use, and 11% of which come from their materials and construction.

ii Providing the right regulatory framework is in place.

1 Renovation and upgrade of buildings

for adaptable use, durability, and positive impact (low-carbon)

The need for renovating has long been seen by public authorities as a priority—especially in Europe. Yet, even in the EU, less than half of member countries have concrete strategies for improving their building stock, at the time of writing.[15] With the pandemic having highlighted the varied shortcomings of the built environment, renovation has now become a measure that cannot be delayed any further if we are to achieve a resilient, low-carbon economic recovery.[16]

Every **EUR 1** invested in energy-efficiency renovations can yield **EUR 5** in public finance returns

Renovation is seen as a robust instrument to rapidly stimulate the economy while helping to achieve climate targets.[17] The renovation wave announced in the European Green Deal, for example, is being lauded as a vital instrument to deliver a climate-neutral economic recovery following the pandemic.[18] Compared to demolition and new construction, by simply repairing, refurbishing and retrofitting existing structures, renovations can offer more cost-effective, less resource-intensive and lower emissions-creating solutions to improving the building stock.[19] This is particularly interesting for OECD countries to note, where 65% of the projected building stock required by 2060 already exists, and is in need of 50% to 70% energy intensity improvements.[20]

However, to ensure that renovation projects lead to all the desired economic and environmental benefits, investments should be directed towards renovating and upgrading existing buildings in alignment with circular design thinking. Such circular renovation projects will ensure that building upgrades are made to increase their durability (e.g., by selecting longer-lasting materials), adaptability (e.g., by applying modular design), and energy-efficiency (e.g., by better insulating them), while using low-impact, reused, and recycled materials to do so.[21] As such, circular renovations will create built environments that are more liveable, less polluting, and easier to adapt to changing space needs, thus increasing buildings' lifespans while keeping materials in use for longer and designing out waste.

Circular renovation projects offer an attractive opportunity for boosting employment at a local level.[22] Following the pandemic, unemployment numbers around the world have soared. In Europe alone, 59 million jobs have been reported to be at risk,[23] while the International Labour Organization (ILO) found that almost half of the global workforce was in danger of losing their livelihoods in late April.[24] Investments in circular renovation projects can offer attractive solutions to curbing these unemployment issues, as these projects are by their very nature highly labour-intensive and localised, and the construction sector is relatively easily able to absorb workers from other industries.[25] In France alone, it is estimated that up to 93,000 new jobs over a period of ten years could be created through focused efforts to improve energy-efficiency in poorly insulated homes.[26] Meanwhile, a McKinsey study estimated that investing into retrofitting 2 million homes for energy-efficiency could create nearly 2 million new jobs in a European country of 50–70 million people.[27]

Renovating using circular strategies can yield an array of economic benefits. For every EUR 1 invested by a government or local authority in renovations improving energy-efficiency, up to EUR 5 can be retrieved as returns back to public finances within one year.[28] A 2016 report by Dodge Data and Analytics also found that "green buildings—whether new or renovated—command a 7% increase in asset value over traditional buildings."[29] Additionally, increasing building durability by selecting longer-lasting materials, and enhancing adaptability by restructuring spaces to be multifunctional and flexible, can prolong the building's lifetime and increase its usage, while decreasing costs by reducing its long-term maintenance requirements.[30] For example, in China, the cost reduction potential of adopting circular building design for operation and maintenance (O&M) is estimated at 10% in 2030 and 28% in 2040, compared to the current development path.[31]

Circular renovation projects play a notable role in helping meet climate targets. Building construction and the production of building materials currently account for 11% of the world's energy-related carbon emissions.[32] Simply choosing to renovate rather than demolish and construct new buildings can lower these emissions.[33] Further reductions to the industry's emissions can be attained through specific circular renovations, such as improving energy-efficiency by conducting thermal insulation work. For example, in Europe, through renovating existing buildings to lower their energy usage by 40% by 2030, the building sector's overall GHG emissions would be reduced by 63% in the residential sector and by 73% in the non-residential sector.[34]

On the one hand, this enhanced energy-efficiency can improve the comfort and liveability of a building while lowering running costs for residents—an important factor given that globally one-third of urban dwellers struggle to financially secure decent housing.[35] On the other hand, since 30% of global energy consumption and 28% of the world's energy-related CO_2 emissions are linked to the use of buildings, the emission reductions can also play a pivotal role in helping meet climate goals, in line with political agendas and the demands of a growing proportion of the population.[36]

Reaching these benefits will require fast action and investment mobilisation, especially in Europe where 45% of buildings are more than half a century old and retrofitting them to improve energy-efficiency will need to happen at two to three times today's pace if climate targets are to be reached.[37]

Digital innovations should be increasingly incorporated into renovation projects to achieve further environmental benefits. The construction sector currently has a lower rate of digitisation than nearly any other industry, but in the future, the role of digitisation is poised to grow, with an expectation that it will disrupt the current ways of designing, operating, and constructing buildings.[38] Solutions provided by new technologies that enable the creation of 'smart' buildings, such as the internet-of-things (IoT), will become more widely demanded and further developed, while offering opportunities to reduce the environmental footprint of the industry.[39] A 2017 report by the International Energy Agency found that innovative digital solutions, such as smart lighting and smart thermostats, could lower a building's total energy use by 10% between 2017 and 2040.[40] This reduction could lead to a cumulative 65 PWh energy saving by 2040—the same amount of energy consumed in total by all non-OECD countries in 2015.[41]

Other technological innovations – such as digital material passports (discussed further later), laser scanning technologies that quickly create accurate 1:1 base models of existing buildings, and infrared surveys that can reveal any areas of a building from which heat or cooling is escaping – can also be employed to ease the work of design teams and enable more targeted and effective renovations.[42]

Renovations lowering energy use by **40%** can reduce GHG emissions by **63%** in the residential sector

Furthermore, by increasing investment in these digital innovations, the businesses producing them can grow and increase their supply, thus allowing the technologies to become more widely adopted, which in turn can accelerate the dissemination of their varied benefits across the built environment. As such, the role of digital innovations ought to be carefully considered in future renovation projects, to better enable their contribution to the creation of a more adaptable, durable and positive impact building sector.

Design is a key enabler in attaining the vision of a more adaptable and durable built environment. This is true not only for new builds, but for existing buildings in need of upgrades too, with careful consideration required for how renovation projects are conducted from the outset. For example, by selecting locally sourced and reused secondary building materials for renovations, the GHG emissions and amount of finite resources used in a project can be notably reduced.[43] These materials should also be non-toxic, regeneratively sourced, and designed for circulation for maximum benefits to be attained. Similarly, by deliberately upgrading spaces to make them more adaptable to changing needs, such as by including movable walls, they can become more intensively used, or can change use overtime, therefore reducing the amount of dead space and increasing the building's lifespan.[44] Therefore, design decisions—such as material selection and space adaptability—should be carefully considered to ensure the greatest benefits of a renovation project may be realised. Moreover, it should be noted that if a building is initially designed in alignment with circular strategies to be, for instance, more adaptable, energy efficient and easily deconstructed, then the future renovation needs of that building could be reduced and the ease of carrying out upgrades increased.[45] Beyond renovation, this is particularly relevant for newer economies, such as in Asia and Africa, where large additions to the overall building stock are still needed in the coming years.[46]

2

Building materials reuse and recycling infrastructure

to enable value circulation and effective use of resources

Building material reuse and recycling infrastructure offer another attractive circular investment opportunity that could contribute to ensuring a more competitive and clean post-pandemic recovery, while creating jobs.

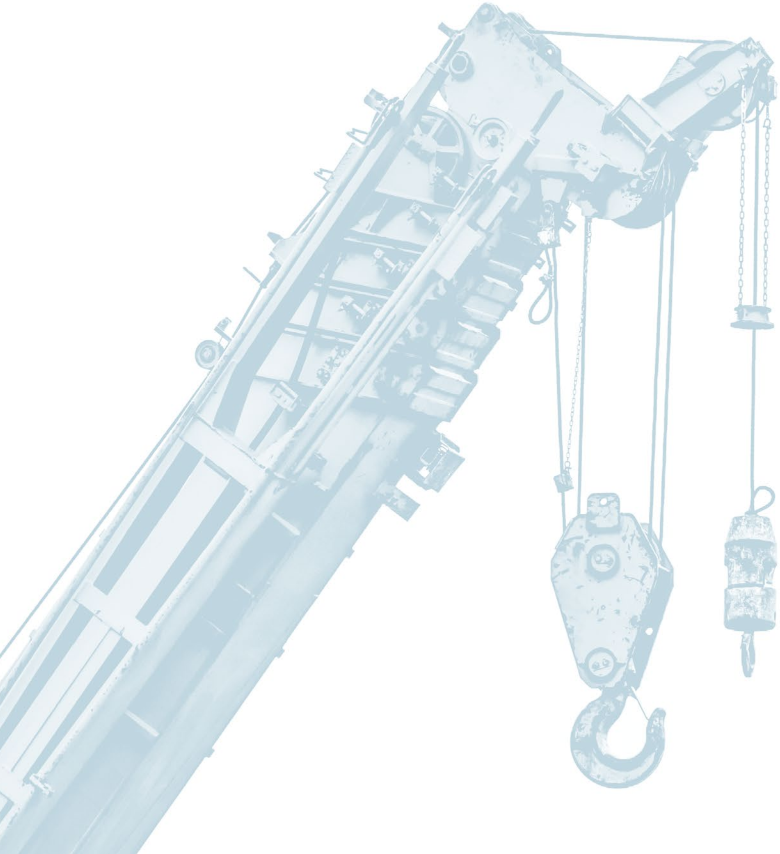
Investments in developing building materials reuse and recycling infrastructure can create substantial cost savings. The construction industry is currently the single largest global consumer of resources and raw materials, and it is also extremely wasteful.[47] By 2025 it is expected that 2.2 billion tonnes of construction waste will be generated around the world, and in places like India, construction and demolition waste already account for about one-third of the country's total solid waste.[48] If these materials were not considered as waste but instead retrieved and kept in use, their value could be captured and overall construction costs reduced. For example, an ARUP study estimated that designing steel for reuse could generate environmental impact- and resource-use savings of 6–27% for a warehouse, 9–43% for an office, and 2–10% for a whole building, as well as up to 25% savings on material costs per tonne of steel.[49]

By increasing the looping of building materials, disposal fees could be reduced, and new revenue streams obtained from developing a market for secondary materials.[50] At the same time, the fluctuation of building material prices could be addressed.[51] Developing a secondary material market may also increase resilience in the face of future shocks by reducing supply chain disruptions through the diversification of material supply. Given the shortages of virgin building materials, and low cash flows among construction businesses following the pandemic, cost-effective and readily available recycled or remanufactured materials may offer attractive opportunities.[52] Design will play a critical role in enabling this greater material looping, as without ensuring that building materials are from the outset designed to be fit for circulation, i.e. more easily retrievable from buildings after their first use and able to retain their value, they cannot be effectively circulated.[53]

Greater material circulation can significantly lower GHG emissions in the construction industry.[54] The processing of recycled aggregates compared to virgin ones, for example, can reduce GHG emissions by 40% or more, with a 2018 report by Material Economics having found that recycled steel can cut emissions by 90%, if also using largely decarbonised electricity.[55] In fact, research has shown that GHG emissions in the G7 countries could be reduced by 14–18% in 2050 by improved recycling of construction material.[56] This reduction could have a significant impact on lowering the risk of a future climate crisis, given that today the carbon emissions from construction materials and processes alone account for 11% of all carbon emissions in the world.[57]

Investments into physical infrastructure, especially in the form of recycling premises and deconstruction facilities, is crucial in enabling building material circulation and creating additional jobs.[58] There are many existing examples of such premises already. In Canada, the city of Vancouver gained funding for the creation of its 'Deconstruction Hub' where salvaged materials from disassembled buildings can either be restored, repurposed, or resold for use.[59] Meanwhile in Europe, Copenhagen, Hamburg, the Vantaa region of Helsinki, and Greater London have received funding for creating Circularity Hubs, where materials from dismantled buildings can be sent for reuse or transformation and refurbishment, through the Horizon 2020 Circular Construction In Regenerative

Designing steel elements for reuse could generate savings of **2–10%** for a whole building and up to **25%** savings in material costs



The European Commission is launching a new strategy to promote **building lifecycle circularity**

Cities (CIRCuIT) project.[60] Placing these facilities in cities, close to their inputs, makes them more accessible and thus helps facilitate greater reuse and exchange of building materials.[61] In addition, for these facilities to have their desired impact, technology supporting the creation of online markets where the reused building materials obtained can be bought and sold, must also be developed. Globechain and Oxara are examples of existing innovators in this space.[62]

Digital infrastructure, especially in the forms of tracking technology and digital modelling, accelerates the transition to a circular built environment. Digital material passports that enable end-to-end tracking of building materials, can help identify materials for reuse as they come to the end of their (first) life, thereby retaining material value over time and encouraging tighter looping.[63] Through increasing transparency and aggregation of material data, digital material passports can also heighten knowledge about material and component composition. The increased and eased access to material information can in turn enable constructors and building designers to create healthier indoor environments by allowing these professionals to more easily select building materials which are, for example, non-toxic.[64] These digital passports are also mentioned in the EU's new Circular Economy Action Plan as important factors for mobilising the potential of product information digitisation.[65]

The use of other digital innovations—such as building information modelling (BIM) which create virtual models of buildings, or digital 3-D 'twins', that precisely depict every component used—will also grow in prominence.[66] These digital twins can help track and trace materials across the supply chain, predict material performance, and enable preventive maintenance, thereby increasing reuse and recycling efficiency while reducing maintenance costs.[67] By using these digital doubles, renovators can easily and quickly experiment with different upgrade and refurbishment options for a building, selecting the ones which provide the best value in terms of cost-effectiveness and carbon footprint, for example.[68] In addition, as these solutions are digital, they can be utilised even remotely. As such, BIM became more widely adopted within the industry during the pandemic lockdown, when designers would not have been able to meet in person.[69]

Material circulation is increasingly supported by policy and may in future become a legal requirement. In some areas, this support is given in the form of direct financial means, like for the CIRCuIT project funded by the EU's Horizon 2020 programme.[70] In other cases, this support may take on the form of strategy and vision setting, or even the creation of legislation. For example, the EU's new Circular Economy Action Plan mentions a new 'Strategy for a Sustainable Built Environment' with the aim of reducing climate impacts and increasing material efficiency, which is said to possibly include the "introduction of recycled content requirements for certain construction products, taking into account their safety and functionality".[71]

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