

# Smart building

How digital technology  
can futureproof UK  
construction



**green  
alliance...**



# Summary

“An approach that embeds low carbon thinking throughout the lifecycle of buildings is vital to support thriving, sustainable communities

Buildings shape communities and contribute to a sense of place. Ensuring valued buildings are preserved and futureproofed is vital to conserve historic heritage and reinvigorate communities across the country. Furthermore, the materials and processes used in construction and demolition are very carbon and resource intensive. An approach that embeds low carbon thinking throughout the lifecycle of buildings and views them as resources, to be designed and preserved for the long term, is vital to support thriving, sustainable communities.

As world economies gear up for a low carbon, resource efficient future, emerging digital technologies can facilitate the new business solutions that benefit people and nature. Green Alliance’s Tech Task Force of leading businesses and innovation organisations believes these new technologies could be truly transformational in the buildings and construction sector. In an earlier report, *A smarter way to save energy*, we highlighted the role of digital solutions in promoting better energy management in buildings.<sup>1</sup> But there is significant scope for low carbon, resource management improvements beyond better energy use, and digital technology will be an important enabler.

The construction of UK buildings is responsible for 36MtCO<sub>2</sub>e per year of embodied emissions, which is roughly equivalent to the emissions generated each year by half of all cars on UK roads. Of these, 21MtCO<sub>2</sub>e are generated within UK borders. We estimate that the emissions generated within the UK could be cut by 40 per cent by 2025 through better design, more intensive building use and material reuse. These measures would result in further savings along global supply chains.

Making the most of existing buildings and materials would also relieve pressure on the resources needed for construction, which currently account for 60 per cent of the UK’s total resource use. This could particularly benefit areas with high demand for new housing. For example, Greater Manchester and the West Midlands could meet between 14 and 18 per cent of their new housing demand up to 2030 through better use of existing buildings or refurbishment. There would be other

advantages too, like less congestion and improved air quality around construction sites, thanks to low carbon design and a greater emphasis on the longevity of buildings.

The enhanced connectivity, insight and efficiency enabled by digital technology can help to realise these opportunities and accelerate business action to futureproof the UK's buildings. Particularly, we believe it can help in the following three areas:

- **Improving design and resource efficient construction**, for example, the project Seismic has developed a user friendly digital design tool, combined with offsite advanced manufacturing, to support low carbon, adaptable school building design.
- **Better use, and upgrading, of buildings**, for example, through predictive maintenance, sensors used to improve utility, as well as the data enabled mass customisation of deep energy efficiency retrofit solutions, pioneered by Energiesprong. Through cutting costs and providing more tailored solutions, the UK could meet its fifth carbon budget target with deep retrofits to around four million homes by 2030. By contrast, to achieve the same level of carbon reduction through incremental retrofitting, over 15 million properties would need to have measures installed.
- **Greater reuse of buildings and materials**, using remote and embedded sensing to track and assess materials. This would facilitate the reuse of surplus and waste materials from construction and demolition, which currently accounts for a third of UK waste.

Digitally enabled, low carbon solutions could boost the UK construction sector's low productivity. For example, firms using advanced offsite methods for retrofit have improved labour productivity by 75 per cent, compared to conventional methods. By 2027, digital technology could add £38.2 billion to construction businesses' bottom lines, through resource efficiency and digitally enabled construction and asset maintenance. Developing the expertise and supply chains for these innovations is also central to ensuring that UK construction

businesses remain at the forefront of global low carbon markets. It will benefit local economies across the whole country and create new jobs in building upgrade and renovation.<sup>2</sup>

The UK is well placed to set the agenda on this, with a track record in new digital approaches and tools, such as Building Information Modelling and ongoing work to develop a National Digital Twin (ie a digital representation of built assets across the UK). However, digital adoption across the sector has so far been limited, especially for existing buildings and their reuse.

The government should take concerted steps to scale up business investment in digital solutions to make sure new and existing buildings are ready for a net zero world.

### Our recommendations

- **Provide a roadmap to include whole life carbon assessment and reduction targets** in planning and building regulations. Targets should be applicable to larger developments from 2025 and to all new buildings from 2030.
- **Establish a new building retrofit programme**, with £300 million support, to develop and scale up digitally enabled whole building energy efficiency solutions. This should be delivered as part of a wider energy efficiency programme, building on the £9.2billion for building efficiency promised in the Conservative Manifesto.
- **Bring VAT for building renovation and repair in line with that for new build**, to stop discouraging the upgrade of existing buildings.
- **Support better data on the built environment**, mandating pre-demolition resource audits and encouraging tracking through digital twin solutions and materials passports. New policy is also needed to encourage the use of digital technology to improve energy use in buildings, as we have previously recommended.<sup>3</sup>
- **Lead by example in public sector buildings**, using them to adopt low carbon building design, upgrade and reuse solutions, supported by digital technology.



# A new approach to buildings in the UK

“There is an urgent need to ensure all existing buildings are ready for a net zero world.”

The built environment plays a vital role in shaping communities. Buildings and their surroundings contribute to a sense of place and the way they are designed, built and preserved can have dramatic impacts on the health, social, economic and environmental well being of a community. Despite this, we often fail to value and futureproof buildings, or conserve the materials they are made from, with negative consequences for people and nature.

When production at Dewar’s Lane Granary in Berwick-upon-Tweed came to an end in 1985, the historic building was left abandoned and earmarked for demolition, and, along with the old granary, much of the surrounding downtown area also began to deteriorate. It was only years later, recognising the historical wealth embedded in the area, that the granary was carefully and sympathetically restored, and a beautiful new space emerged, using much of the materials that were already there. This, in turn, stimulated further regeneration throughout the lower town.

Unfortunately, the preservation efforts that benefited Dewar’s Lane Granary are an exception, rather than the norm. The result is not only the loss of buildings that have long been part of the landscape of local communities, but also a substantial impact on climate change and resource use.

Such challenges go beyond the preservation of iconic historical buildings. There is an urgent need to ensure all existing buildings are ready for a net zero world, cutting in-use carbon emissions while limiting the need for demolition and new build. But two thirds of UK homes have poor energy efficiency, with EPC band D or lower, and hundreds of thousands of buildings are sitting disused across the UK.<sup>4</sup> Meanwhile, thousands of new developments are being built using unnecessarily high carbon materials and processes. Their construction results in 36MtCO<sub>2</sub>e per year of embodied emissions, of which 21MtCO<sub>2</sub>e is generated within UK borders, while poor design locks in high carbon use and prevents adaptation to new functions.<sup>5,6</sup> Materials from building construction and demolition, which account for a third of UK waste overall, are mostly downcycled, with very limited reuse. These valuable resources could instead be repurposed for new construction, replacing new carbon intensive materials.<sup>7,8</sup>

Business as usual is no longer an option. Poorly designed, inefficient and unadaptable buildings present an increasing social cost that everyone is forced to bear. Instead, buildings should be seen as valuable resources that can support healthy and thriving communities for the long term.

There are many promising initiatives, such as Construction Declares, the climate emergency declarations by construction professions; the Better Building Partnership’s work on design for performance; the Major Contractors Group’s increasing interest in low carbon; and the *Architects’ Journal*’s RetroFirst campaign, to name a few examples.<sup>9,10,11</sup> These are signs that the industry is keen to play its part in tackling climate change. With the UK committed to net zero emissions by 2050 and a growing number of local authorities declaring a climate emergency, now is the time for the whole industry to take a net zero compatible approach to all stages of a building’s life.

## A whole life approach to building



**Design differently:** Design buildings to be lower carbon, using less carbon intensive materials, lower material input and more reuse; design structures to be adaptable and reusable, to facilitate resource efficiency at later stages of a building's life

**Use buildings better:** through the better use of spaces and renovating unused buildings; promote longevity through maintenance and adaptation, and retrofit buildings for low carbon performance

**Maximise reuse:** Promote refurbishment and material reuse from buildings that reach the end of their life.

This three pronged approach will benefit people, businesses and nature across the UK, as we highlight in the next section. The UK can capitalise on a wave of emerging digital technologies to support it. This report provides an overview of the major opportunities identified by the Tech Task Force and highlights where policy can help to speed up change.

The David Attenborough Building, Nicholas Hare Architects.  
Photograph: Alan Williams





# Four reasons why buildings need to be futureproofed

“A futureproof approach could reduce annual embodied emissions from building construction generated in the UK by 40 per cent by 2025.”

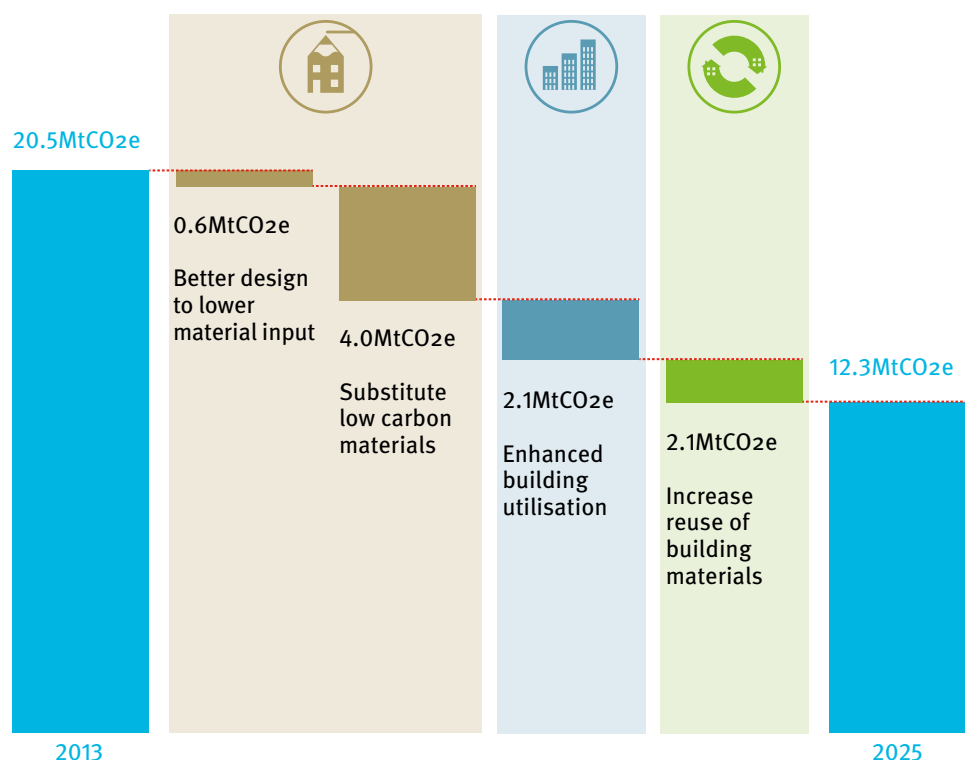
## 1. Cutting emissions

Embodied carbon, ie the emissions associated with building materials and construction, are a significant and growing issue. The Royal Institute of British Architects (RIBA) has set a Climate Challenge to cut embodied carbon in domestic and non-domestic buildings by 70 and 55 per cent respectively by 2030. This ambition is achievable if resource efficiency, lower carbon design and more intensive use of buildings is prioritised across the industry.

Existing examples show that substantial reductions are possible. For instance, the Enterprise Centre at the University of East Anglia has a quarter of the emissions of a conventional university building, thanks to the use of low carbon materials. By deciding to relocate one of their warehouses in Slough to a new site to avoid construction of a new one, developer SEGRO cut embodied carbon by 56 per cent. And the retrofit of the University of Cambridge’s David Attenborough Building saved 82 per cent of the embodied carbon by being refurbished rather than demolished and rebuilt.<sup>12</sup>

Building on previous analysis by the Centre for Industrial Energy, Material and Products (CIEMAP), we estimate that a futureproof approach, using the cost effective measures illustrated below, could reduce annual embodied emissions from building construction generated in the UK by 40 per cent by 2025.<sup>13</sup> Most importantly, it would move the construction industry from being a significant contributor to UK carbon emissions, to one that is taking the lead towards net zero. And, given that UK construction is also responsible for emissions from the extraction and manufacture of materials abroad, these measures will lead to additional carbon savings along global supply chains.<sup>14</sup>

A futureproof approach could cut UK construction emissions by 40 per cent by 2025<sup>15</sup>

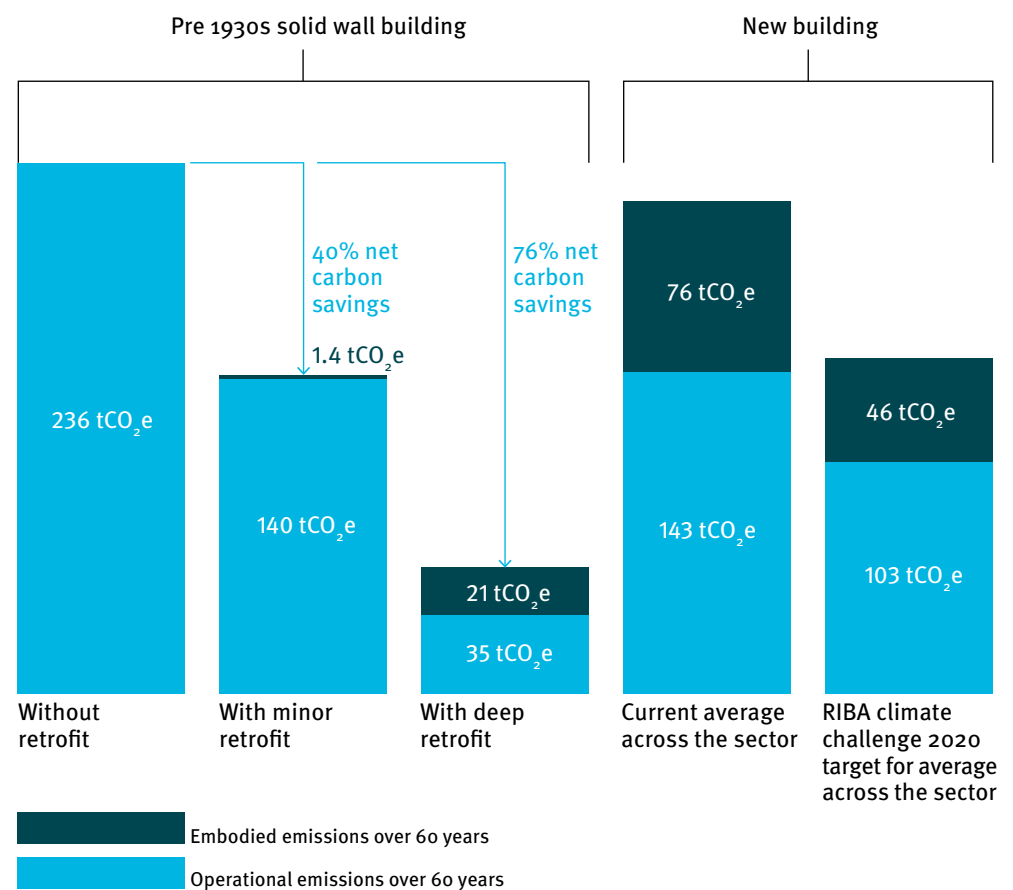


Embodied emissions generated in the UK  
(construction of domestic and non-domestic buildings)

“The largest net savings are achieved through deep retrofit interventions.”

Upgrading UK building stock will also avoid emissions, especially from inefficient solid wall properties, while limiting the need to demolish and construct new buildings. In most cases, retrofitting reduces operational emissions and helps to keep embodied carbon low. The largest net savings are achieved through deep retrofit interventions. For example, whole retrofit of a typical pre-1930s building (which accounts for nearly a third of UK buildings) would cut overall operational and embodied emissions by nearly 80 per cent over a sixty year lifespan, compared to the 40 per cent carbon reduction that could be achieved by incremental retrofit measures.<sup>16</sup> Deep retrofit can also achieve lower overall emissions compared to the average new building today, with just over a quarter of the embodied carbon.<sup>17</sup>

#### Deep energy efficiency retrofit cuts more carbon<sup>18</sup>



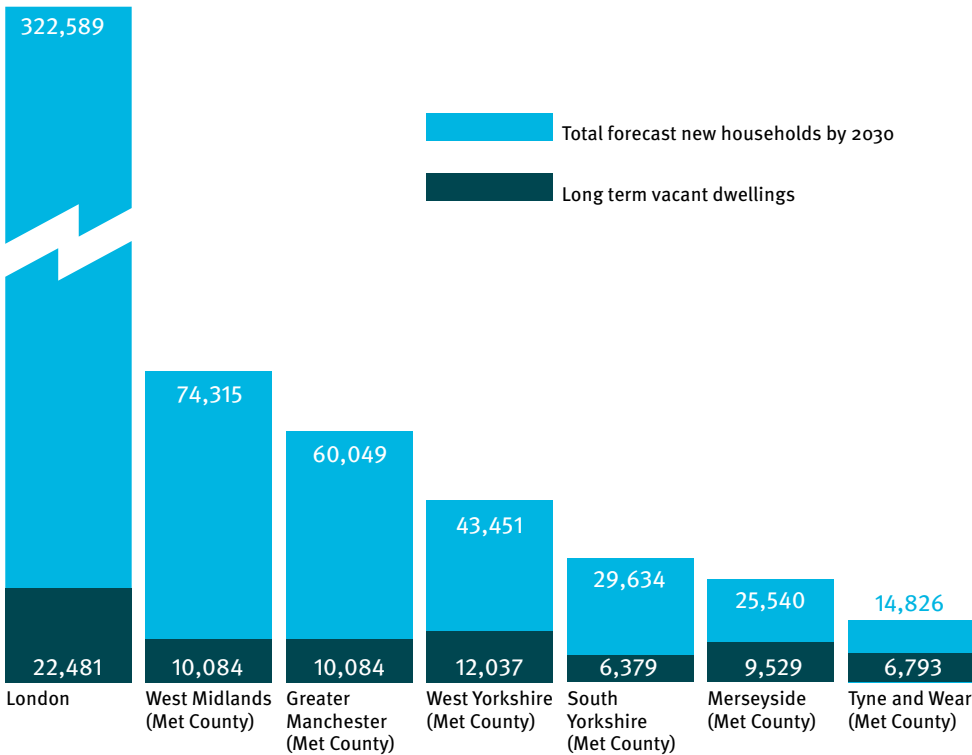
“There are opportunities to bring underused buildings back into full use, which can relieve pressure on resources for new building.”

## 2. Reducing resource use

This approach should limit the amount of resources wasted or downcycled, and instead provide access to valuable materials and components, providing a new bank of construction resources across the country. Similarly, there are opportunities to bring underused buildings back into full use, which can relieve pressure on resources for new building.

These moves could particularly benefit areas where new housing is needed. For example, we estimate that between 14 and 46 per cent of new housing needs to 2030, across metropolitan counties, could be met through better use, or refurbishment, of long term vacant residential properties. Similarly, in London, where on average 32,000 new homes will be needed each year to 2030, over 2,000 dwellings every year are being demolished. Here, greater emphasis on refurbishment, rather than demolition, and material reuse, where demolition is inevitable, could support a more resource efficient approach to providing new housing, also reducing the carbon impact.<sup>19</sup>

Better use of vacant dwellings could help areas to meet demand for new housing <sup>20</sup>



“A focus on building longevity and renovation will also preserve heritage and a sense of place.”

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### 3. Protecting communities and heritage

Construction sites have a substantial impact on local communities. In London, for example, it is estimated that they are responsible for 7.5 per cent of nitrogen oxide and 14.5 per cent of fine particulate (PM2.5) emissions.<sup>21</sup> Shorter project timescales, enabled by greater adaptation and refurbishment of existing buildings, in place of new build, would help to minimise air and noise pollution and congestion caused by construction. Where new build is still required, using alternative lower carbon materials, such as timber rather than steel and cement, combined with offsite manufacturing, leads to fewer site deliveries and reduces on-site excavation and heavy machinery.<sup>22,23</sup> By adopting these solutions, the building of Dalston Works in London, completed in 2017, required 80 per cent fewer site deliveries.

A focus on building longevity and renovation will also preserve heritage and a sense of place. Some iconic examples across the UK have shown how buildings can be lovingly transformed for a new purpose, retaining the aura of their own, more permanent, identity while helping to reinvigorate surrounding areas in the process.

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### 4. Benefiting the economy

As economies decarbonise and urban populations grow to nearly 70 per cent of the global population by 2050, up from 55 per cent today, there will be greater demand for low carbon construction solutions and more effective use of buildings in the UK and abroad.<sup>24</sup>

New technologies, business models and policies to enable better design and use, and repurposing buildings will also support growth in the construction industry, with the development of new supply chains, expertise and business models. These will range from resource efficient offsite construction to digital solutions for building management and from performance contracts retaining ownership of construction materials and equipment, to low carbon architecture and urban design.<sup>25</sup>

The construction sector accounts for around nine per cent of the UK's GDP and supports around 3.1 million jobs.<sup>26</sup> As a national industry in the post-Brexit era, retaining its position at the forefront of emerging markets will be vital to build global competitiveness and resilience. It would also ensure that the country's professional services remain in high demand, while greater reuse of building materials could help to decrease the sector's trade deficit (at present UK imports of building materials are over twice the value of exports).<sup>27</sup>

It will also benefit local economies across the country. Construction employment is dispersed across the regions, employing one in 14 people in some areas.<sup>28</sup> A net zero compatible approach will support more secure low carbon jobs as well as creating new employment in retrofit and renovation.<sup>29</sup>





The Enterprise Centre, University of East Anglia, Architype.  
Photograph: ©DennisGilbert/VIEW

# How digital technology can accelerate change

Artificial intelligence, remote and embedded sensing, and advanced manufacturing all have the potential to be transformational in addressing barriers that businesses have identified.<sup>30</sup> These include the tracking and managing of building materials, providing information on building features and in-use performance, and supporting more sustainable design and construction methods.<sup>31,32,33</sup>



## Design differently

Novel technologies can influence design right from the start, strengthening the business case for low carbon building management and reuse, and enabling resource efficient construction.

### New design tools

Some companies already make use of Building Information Modelling (BIM) to support better project planning and delivery. This is a platform used to manage building design and project data in a digital format. While applications have so far taken a static view of buildings, the use of BIM, or similar digital twin tools, could be extended to understand a building's whole lifespan, avoiding design that locks in poor adaptability and limits reuse. This includes factoring in changes in building use and design for disassembly.<sup>34,35</sup>

Collaboration, similar to that trialled by the Manufacturing Technology Centre through its virtual reality CAVE system, has been used to improve understanding of what kind of functions the building should meet over its life. Similar tools could be adopted to enable greater public engagement in urban planning.<sup>36</sup>

### Better footprinting

Data on the embodied carbon of different construction materials currently allows approximate identification of emission hotspots in construction.<sup>37</sup> But appropriate product data can be difficult to source, while information on other lifecycle stages, such as the emissions from construction and demolition, is hard to come by, in part because of difficulties with capturing and organising data on-site.

Initiatives such as the Carbon Mark aim to exploit advances in machine learning, coupled with better data, to improve the carbon footprinting of a wide range of products along global supply chains.<sup>38</sup> A similar initiative could be applied to the construction sector, building on existing product environmental data, such as that compiled by the Building Research Establishment (BRE), to enable better decision making based on information about materials' durability, reusability and carbon footprint. Information from sensors and analytics about materials in buildings, will also help to improve the predictability of performance.

### New construction methods

Offsite construction is well suited for low carbon building materials, such as cross laminated timber, as well as modular design, which can support greater building adaptability and reuse. Built in a factory, this type of construction can benefit more from advanced technologies than traditional approaches. It helps to lower energy and resource inputs, and cut waste by around half compared to conventional construction. This can also be supported by design tools which combine manufacturing requirements with spatial planning rules, to help decision about building design and minimise errors and waste. Furthermore, thanks to standardisation and economies of scale, it also helps to lower costs and scale up deployment.<sup>39</sup>

## Modular school buildings<sup>40</sup>

Project Seismic is using a standardised offsite construction framework, coupled with a user friendly design tool, to make it easier to build schools quickly and adapt them for changing needs.

The platform allows users to design spaces using a range of standardised components, saving time and money, and allowing tailoring. The design also relies on engineered solutions to connect the frames that make up a module, so that the space can be changed and re-configured more easily, while lower carbon design has reduced the amount of steel, cutting the construction emissions by a quarter.<sup>41</sup>



The Seismic school app, developed by Bryden Wood, is part of a project funded by Innovate UK (seismic-school-app.io)





## Use buildings better

Much of the building stock that needs to be net zero compatible by 2050 has already been built. Digital technologies can support the better use of these buildings, limiting the need for new construction and helping to ensure long term, low carbon performance.

### Information on building use

Easy wins can be achieved through more intensive use of space, without needing to adapt buildings. Forty per cent of workspaces are estimated to be empty at any point during the core working day.<sup>42</sup> The Internet of Things can make the use of space more visible and manageable. For example, Deloitte's The Edge building relies on smart sensors and an app to manage the desk use and spaces. Thanks to this, the building can accommodate 2.6 times as many people as the number of desks available.<sup>43</sup> This will benefit those parts of the country with high demand for office space.

There are also opportunities to radically improve energy use. Our report, *A smarter way to save energy*, recently outlined the opportunities for digital technology to improve understanding of buildings' energy use and drive investment in efficiency.<sup>44</sup>

### Facilitating upgrades

Extensive retrofitting is necessary to reduce the emissions and energy demand of older buildings. It will also be important to adapt buildings easily so they remain functional. Currently, upgrading buildings can be expensive, particularly if interventions have to be tailored to different features and where buildings are old and inefficient. Technology can limit costs and the time it takes, and enable targeted solutions.<sup>45</sup> A digital model, based on building information gathered through embedded sensors or remote diagnostics, could help to reveal the implications of different options, speeding up decisions and delivery.<sup>46,47</sup> The industry led initiative i3P aims to develop a building lifecycle management tool capable of modelling architectural design data, combined with lifetime inspection data. This could make adapting and retrofitting buildings easier.<sup>48</sup> New construction methods can also be used to enable mass customisation and better performing and lower cost interventions.

### Support maintenance and longer life

Improved monitoring and maintenance using technology can extend a building's life. Applications are emerging that increase the knowledge about systems and individual working components of a building (including heating, ventilation and air conditioning, and elevators), as well as on structural components. Examples include ultrasonic inspection and thermography, to inspect the health and properties of hidden steel and concrete elements. Sensors can also be used to monitor vibration and stresses, a technique already used in larger infrastructure, such as the Queensferry Crossing in Scotland, as well as to monitor equipment energy use and indicate preventive maintenance needs.<sup>49,50</sup>

Data gathered through these applications can be integrated into digital models of the building (such as BIM) to help designers, manufacturers and architects improve the design and performance of products and materials.



## How digital technology can help to scale up deep retrofit

Energiesprong is a method of whole building energy efficiency retrofit that combines a set of emerging technologies. It uses laser measurements and drones for detailed building assessments, to improve the accuracy and efficiency of interventions. Components are mainly produced offsite, achieving optimisation through economies of scale and advanced manufacturing methods.<sup>51</sup>

Improving the cost competitiveness of such deep retrofit solutions would help the UK to decarbonise faster. For example, only about four million buildings would need to have an Energiesprong retrofit to meet the UK's fifth carbon budget, which requires 13 MtCO<sub>2</sub>e annual reductions by 2032, and only 4.8 million homes would need retrofitting to meet the Committee on Climate Change's more ambitious emissions reduction target for 2030.<sup>52</sup> Continuing to retrofit through incremental measures would involve over 15 million buildings to achieve the same level of carbon savings.

Energiesprong solutions also support the use of sensors and analytics in retrofitted homes. Along with the 30 year energy service contract given to each household, these enable better ongoing maintenance.



Energiesprong Nottingham City Homes, solution provider: Melius Homes & Studio Partington.  
Photograph: Tracey Whitefoot



## Maximise reuse

### Mapping available materials

Lack of data about material stocks limits the opportunities to co-ordinate deconstruction and new build activities to maximise reuse. Laser scanning, coupled with object recognition algorithms, makes it possible to create digital stocks, so called ‘scan-to-BIM’, of materials from existing buildings. This technology could help to improve understanding about the materials available in a building, ahead of its demolition, and support the reuse of the valuable resources it contains.<sup>53</sup>

For example, Metabolic has developed a model for a ‘geological’ map of greater Amsterdam. This shows where valuable metals are concentrated and helps to identify where future extraction of second-hand materials might be profitable.<sup>54</sup> Material mapping is also planned in London as part of the CIRCUIT project.<sup>55</sup>

### Tracking material flows

Technology can be used to track materials. For example, sensor tags linked to ‘material passports’ (digital records of component characteristics) provide information about availability and condition. This can facilitate the recovery and repurposing of materials extracted at the end of a building’s life. It can also help to understand their value, strengthening the business case for reuse.<sup>56,57,58</sup> For example, the 2.6 million tonnes of building materials released each year through renovation and demolition in Amsterdam are estimated to be worth €688 million.<sup>59</sup>

Information from material passports and BIM can be combined on material exchange platforms to facilitate a market for reuse. Examples are already used in the Netherlands. This type of platform has been highlighted as a priority in the UK by the Major Infrastructure Resource Optimisation Group, which brings together large infrastructure businesses including National Grid, Highways England and Anglian Water.<sup>60</sup>

## Embedding product traceability in redevelopment

Alliander HQ in the Netherlands is based on the redevelopment of an existing cluster of buildings. Resource efficiency was core to the entire project: over 80 per cent of the building's materials are from the original structures, new features were designed for disassembly and material passports were assigned to all building components to facilitate traceability, maintenance and reuse.<sup>61</sup>



Alliander HQ, RAU architects.  
Photograph: Marcel van der Burg

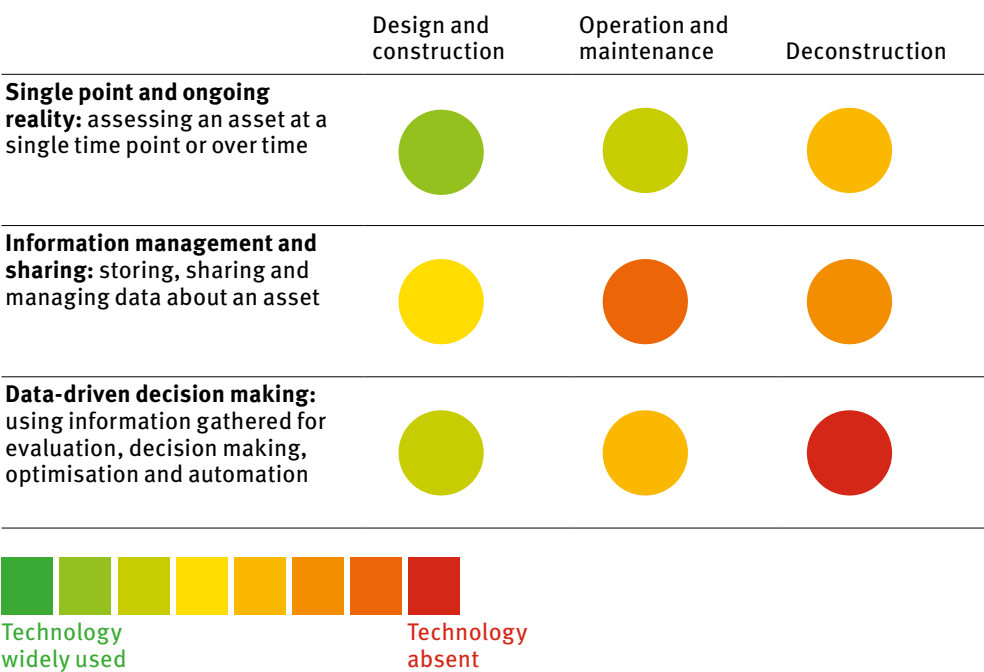
# Uptake of digital solutions is limited

“Most applications are focused on the early stages of construction, while opportunities during use and for repurposing are being overlooked.”

While these new technologies could be transformational, progress to adopt them has been limited. This is partly because the construction industry has a lower level of digital adoption compared to other sectors.<sup>62,63</sup> The strong focus on new build has also limited efforts to use digital solutions to futureproof existing buildings and support reuse. And not much has been done to tackle embodied carbon in buildings.

The table below, based on analysis published by Cambridge Architectural Research, provides an overview of the extent to which digital technology is currently in use throughout the lifecycle of buildings. It shows that most applications are focused on the early stages of construction, while opportunities during use and for repurposing are being overlooked.<sup>64,65</sup>

Digital technology is not widely used for better building use and reuse








# Policy can change the game

“New policy is needed to ensure the industry can capitalise on digital solutions.”

The UK is well placed to lead on a new approach to constructing and managing buildings. It has a track record in innovative digital solutions, such as BIM, and can build on the digitalisation work underway as part of the government’s construction sector deal and the National Digital Twin programme, led by the Centre for Digital Built Britain.

New policy is needed to ensure the industry can capitalise on digital solutions to futureproof UK buildings, and build expertise and supply chains. Specifically, it should address the barriers holding the sector back and encourage investment in new design practices, the better use of materials and buildings, and the digital solutions essential for their delivery.

We recommend that the government tackles all stages of the building lifecycle through the following policy actions:

	 Design differently	 Use buildings better	 Maximise reuse
Address embodied carbon	✓	✓	✓
Promote innovation in energy efficiency retrofits		✓	
Reduce VAT for building renovation and repair		✓	✓
Support better data	✓	✓	✓
Lead by example	✓	✓	✓

## 1. Address embodied carbon

The government should set out a roadmap for mandatory embodied carbon reporting and carbon reduction targets for construction projects. Such requirements already exist in other countries. For example, the Netherlands requires developers to report on the embodied carbon of developments larger than 100m<sup>2</sup> since 2013. It has recently introduced regulation to set a maximum environmental footprint for buildings to accelerate emissions reductions.

In the UK, London is leading the way. The new London Plan demands that developers produce circular economy statements and whole life carbon assessment for projects referable to the mayor.<sup>66</sup> But action by London alone will not make this common practice elsewhere. The government should mandate whole life carbon assessment for all building projects as part of the Future Homes Standard and new standards for non-domestic buildings, to provide incentives for lower carbon construction, design for disassembly and reuse. Assessment requirements should apply to all buildings from 2025 and be combined with increasingly ambitious targets for whole life carbon reductions, applicable to larger developments from 2025 and effective for all buildings from 2030.<sup>67</sup>

Local authorities should also ensure that planners first consider using existing buildings to meet the demand for new housing and business space, before new build.

“Whole building retrofit solutions have the potential to deliver larger overall savings than incremental measures.”.

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## 2. Promote innovation in energy efficiency retrofits

Upgrading existing buildings should be a priority to cut operational and embodied emissions and meet UK carbon reduction targets. Whole building retrofit solutions manufactured offsite have the potential to deliver larger overall savings than incremental measures, while boosting the industry’s productivity and creating new high skilled jobs. For example, firms that use high tech, modular offsite building manufacturing in retrofitting have achieved up to 75 per cent higher productivity, compared to conventional construction methods. But more innovation is needed to reduce costs and develop customised solutions suitable for the wide range of UK building types.<sup>68</sup>

Government support for digitally enabled, offsite construction has focused on new build, mainly through the Construction Innovation Hub and the Home Building Fund, which have received £72 million and £236 million respectively.<sup>69</sup> To promote a greater focus on upgrading existing building stock, the government should establish a dedicated programme to develop and scale up digitally enabled whole building retrofit approaches, such as Energiesprong. This should be supported by a level of funding comparable to that made available for new build, ie around £300 million. This could be allocated on a ‘commit and review’ basis, with future funding conditional on the industry bringing costs down to an agreed level as it scales up, eg towards a target of £35,000 per property.<sup>70</sup> Importantly, funding for digitally enabled whole house retrofit should be delivered as part of a wider energy efficiency programme, building on the £9.2billion for building efficiency promised in the Conservative Manifesto.

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## 3. Reduce VAT for building renovation and repair

The UK’s VAT system is biased towards new build: refurbishment is generally taxed at 20 per cent, while new build is exempt. This undermines efforts to conserve and upgrade valuable existing buildings. A VAT change in the Netherlands has increased demand for building upgrade and led to new jobs in the sector; and previous analysis for the UK estimated that lowering VAT for renovation to five per cent would boost demand for reviving existing properties and could create nearly 100,000 extra jobs in the UK construction sector and wider economy.<sup>71</sup> As highlighted by a number of influential bodies, including the Home Builders Federation, Historic England and the *Architects’ Journal*, and the fact that nearly two thirds of builders are supportive and think it would help boost their business, the government should end this imbalance and bring VAT for building renovation in line with that for new build.<sup>72</sup>

“Policy to promote better data use should include new requirements to monitor and disclose in-use energy performance.”

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#### 4. Support better data

Poor information about current material stocks is one of the main barriers to greater resource efficiency. As a first step, the government should require pre-demolition audits.<sup>73</sup> But it should go further than this, to harness the full potential of digital technology. In particular, it should encourage the use of material passports and work with industry to introduce (first voluntary, but ultimately mandatory) submission of digital twin models of new and refurbished buildings, as part of planning applications and the verification for regulatory compliance.<sup>74</sup>

Similar steps have been taken by other countries. For example, the Netherlands has introduced tax incentives for developers using material passports (the Dutch government is considering whether to make adoption mandatory for all new developments) and it has made participation in this scheme conditional on the information being provided on a dedicated online platform.<sup>75,76</sup> Singapore requires developers to electronically submit digital models for larger buildings as part of its planning and regulatory compliance process.<sup>77</sup> A similar scheme in the UK would support the work ongoing to develop a National Digital Twin, providing comprehensive data about built assets. This could also be used to aid greater public engagement in planning.<sup>78</sup>

Finally, government policy to promote better data use should include new requirements to monitor and disclose in-use energy performance, as we have previously recommended.<sup>79</sup>

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#### 5. Lead by example

The public sector is one of the largest procurers of buildings. This is a prime opportunity to increase the roll-out of novel technologies across the construction sector. The mandatory adoption of BIM in public procurement has already led to three quarters of the wider industry using it.<sup>80</sup> This success in driving up adoption should be replicated, with the use of more digital solutions that can support the long term competitiveness and resilience of the sector.

# Endnotes

- <sup>1</sup> Green Alliance, 2020, *A smarter way to save energy*
- <sup>2</sup> Green Alliance, 2019, *Reinventing retrofit; the Made Smarter Review 2017*, estimated that resource efficiency could save £9.3 billion, while digitally enabled construction and asset maintenance could save businesses £28.9 billion between 2017 and 2027.
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Dewar's Lane Granary, now YHA Berwick Hostel  
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**Green Alliance**  
11 Belgrave Road  
London SW1V 1RB

**T 020 7233 7433**  
**ga@green-alliance.org.uk**

**www.green-alliance.org.uk**  
**blog: www.greenallianceblog.org.uk**  
**twitter: @GreenAllianceUK**

**The Green Alliance Trust**  
**Registered charity no 1045395**  
**Company limited by guarantee**  
**(England and Wales) no 3037633**

## **Smart building**

How digital technology can  
futureproof UK construction

### **Authors**

Caterina Brandmayr, Jonathan Ritson and  
Imogen Cripps

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Tech Task Force members:



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**Green Alliance**  
11 Belgrave Road  
London SW1V 1RB

**020 7233 7433**  
**ga@green-alliance.org.uk**

**www.green-alliance.org.uk**  
**blog: www.greenallianceblog.org.uk**  
**twitter: @GreenAllianceUK**

**The Green Alliance Trust**  
**Registered charity no 1045395**  
**Company limited by guarantee**  
**(England and Wales) no 3037633**

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