

FUTURE OF INFRASTRUCTURE

06 TOWARDS CLIMATE-RESILIENT
CRITICAL INFRASTRUCTURE

10 THE BUILT ENVIRONMENT'S
EMBODIED CARBON PROBLEM

14 HOW SOLVENCY II COULD
BOOST INVESTMENT



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ARCHITECTURE

Watch this space: a greenprint for future-proof constructions

Adaptable buildings offer long-term value and environmental sustainability. But will developers follow the architects' lead?

Daniel Thomas

When construction began in 2010 on the Opus – the futuristic tower in Dubai designed by Zaha Hadid – the plan was for it to house offices. But at quite a late stage in the project, the developer's vision changed to reflect what it saw as a period of change in the emirate and instead adopted a mixed-use proposal, encompassing office space, residential apartments, retail spaces, restaurants and even a five-star hotel.

Changing tack was not without its challenges. But the result was a building far better equipped for the future. BSBG Group, the executive architect tasked with realising Hadid's vision, wrote in a recent blog that such mixed-use projects "have a far greater chance of standing the test of time" because they are set up for multiple functions from the outset.

"The success of architecture has to be connected directly to the degree of flexibility it presents in its use," wrote the design firm. "Architecture that doesn't respond well to change runs the risk of stagnation."

So-called flexible design is now a key component of modern infrastructure, with proponents arguing it allows buildings to be longer-lasting, better value and more sustainable. From hospitals to theatres, housing to offices, infrastructure is designed with adaptability in mind and Covid and the climate crisis have added fresh impetus to the trend.

Robert Kronenburg, emeritus Roscoe professor of architecture at the University of Liverpool, has been researching the topic for 30 years. He says that despite growing recognition of the trend, it's not a new one.

"There's no time in history when adaptability and flexibility haven't been an issue in architecture. It's just that some buildings have responded to it better."

Flexibility is not just about the form of a building, Kronenburg says, it's also about how it is made, the materials used, what the environment is like inside and how responsive it is to people's needs. It also takes a "huge amount" of work and planning, as developers are, to some extent, dealing with the unknown. "You can't predict the future for certain, but you can make allowances," he says.

The Dutch architect Franz Van Der Werf has been pioneering his principles of open building since the mid-1970s. One of his best-known projects is the Pelgromhof – a housing complex in the Netherlands for older



The Opus Tower, Dubai

Ola Shebedin/Alamy

people. Its 215 apartments are easily adaptable as residents age so that they don't have to move home because of health or mobility issues. Van Der Werf even went as far as calling them "lifetime guaranteed".

"You can move walls around easily to make the place more accessible," says Kronenburg of the scheme. "Or there might be a space you can use for a cupboard to start with, but in the future turn it into a lift so you can get up to the next floor more easily. It doesn't look like anything special or different on the outside, it's about subtle hints in the design."

Famous public buildings such as the Centre Pompidou in Paris and Japan's Sendai Mediatheque library were designed with flexibility in mind and have successfully served as multi-use event spaces for decades. Further back in the late Victorian era, architect Frank Matcham

pioneered the concept of flexible staging and scenery when he designed and refurbished some of Britain's most famous theatres, creating venues that could be easily adapted for different productions.

A major driver for flexible design today is the need to create so-called human-centred spaces that reflect the changing way we live, says Michael Lewis, group design director at BSBG Group. Not only has Covid driven many of us from office-based environments into remote- or hybrid-working patterns, but mental and physical wellbeing are also higher priorities than they were.

"Quality of life has been a critical factor in driving a movement in flexible environments, both in a physical sense at home and in the workplace, where the psychology of flexible working has positively impacted employees and employers," he says.

THE OPUS, DUBAI FACT SHEET

Area
83,345m²
Height
93m
Completed in
2020
Use
Hotel, luxury apartments, dining and leisure and corporate space



In office design, it has meant reducing the size of boardrooms and creating more space for hot-desking and social interaction, Lewis adds. While in homes, activity spaces and workspaces "are becoming crucial".

Peter Brickell is engineering director, head of innovation at WSP in the UK, an engineering professional services consultancy that has helped clients to build flexibly. He says the traditional view of flexibility was how well a building could accept different tenants and how quickly space could be let. But this is changing as developers focus on sustainability – something that will be a "driving factor in the design of buildings for the foreseeable future".

Unlike some standard designs, it is unlikely that a building designed flexibly will have to be demolished and rebuilt to change its use. That makes it less carbon-intensive and waste-generative in the long run. "There is much more interest in the circular economy of a building and the flexibility of buildings to change at a more fundamental level, extending the lifetime of the investment," Brickell says. "Can an office change to residential or another commercial use in future? Can the materials be deconstructed and reused?"

Designing flexibly comes with challenges and is not always viable. It typically takes longer, costs more, and can butt up against space or location constraints. There are also no legislative requirements to build flexibly as there are to build sustainably, leaving it up to the client and developer to take the lead. Lewis believes that most architects try to "do the right thing" but developers' interests can get in the way.

"The real question is, can you create a mainstream movement for future-proofing? Will developers pay for future-proofing in the long term, or are the financial pressures of ROI and capex the drivers in the mainstream design industry?"

Brickell acknowledges the challenges of flexible design but says the effort is worth it given the immense benefits. "The construction process always has limits but the key is to keep innovating," he says. "Designers and developers need to keep pushing the art of the possible and assess the risks on a building-by-building basis. What is a gamble on one project might not be on a future one." ●



Transforming infrastructure is key to the energy trilemma

Infrastructure has a vital role to play in delivering a secure, affordable and sustainable energy future, and so does private capital

Energy is the lifeblood of economies everywhere, yet humanity faces a trilemma, a three-pronged conundrum on how energy is delivered to communities worldwide in a way that is affordable, low carbon and reliable. At the same time, the energy sector is having to manage the reverberations from the war in Ukraine, the impacts of climate change and the global pandemic. All these challenges mean that our existing global energy infrastructure – and the energy suppliers of tomorrow – will have to deliver more. The whole system is transitioning to a low-carbon future, in which there is a greater reliance on renewables, wind and solar, a huge expansion in electrification, and a focus on transition fuels such as natural gas, which have fewer emissions. Delivering on the global energy transition, while trying to balance the trilemma, will require enormous amounts of capital directed intelligently and resourcefully. According to the International Energy Agency, by 2030 we will need to mobilise \$5tn a year if the world is to be on track for net zero emissions, with a \$1.1tn annual boost to clean power investments.

“Transforming the world’s energy infrastructure is both the greatest challenge and the biggest investment opportunity of our generation. Right now, we’re only at the beginning; everything is to play for. We are not just talking about what we transition to, but where we transition from. These parallel objectives are equally important – we need to continue to invest in, responsibly own, and manage existing energy infrastructure, and we need to invest in the clean energy assets of tomorrow,” explains Daniel Wong, head of Europe at Stonepeak, a global alternative investment firm specialising in infrastructure, with approximately \$50bn of assets under management. “Private capital has an important role to play in the energy transition. Responsible ownership matters. If our energy infrastructure is managed by people and companies who care about climate goals, COP26 and keeping in-line with a 1.5°C trajectory, we are more likely to achieve these ambitious targets.” Recently some investors with heightened ESG concerns have moved out of fossil fuel companies,

and related energy infrastructure, in the belief that if they sell hydrocarbon assets, their owners will be starved of capital and their portfolio will be cleaner and greener. Yet, this approach means that responsible investors forgo their ability to make the change they want to see from energy majors and incumbents. It also means there is less accountability for polluting energy infrastructure if it is in the hands of those who may care less about climate goals. “Investors face a complicated path forward as they embrace the challenge of the energy transition head on. The

“Transforming the world’s energy infrastructure is both the greatest challenge and the biggest investment opportunity of our generation

decarbonisation of a portfolio is very different to the decarbonisation of the planet. Investing in low-carbon generation and infrastructure is a given. But when it comes to carbon intensive businesses, we believe divestment is not the answer because it involves handing the problem to someone else. We believe private capital should own these energy businesses, manage them transparently and help accelerate their transition to net zero. Meanwhile, investors need to deliver attractive risk adjusted returns for their beneficiaries,” says Wong. “The other important consideration is that incumbent energy businesses provide huge pools of talent, distribution networks and established customer relationships. Blending our way towards a cleaner energy future off of these platforms will be faster and fairer than starting a green revolution from scratch.”

The private capital industry currently has almost \$2.5tn to invest in the coming years and a significant proportion will be directed into the energy transition. There is huge potential. “As a private investor, we usually control the companies we invest in, helping guide decisions at the board level, as well as assembling the management teams to deliver business plans in line with our net zero expectations and objectives. We align them with incentive structures to deliver these outcomes. This is a very powerful process for the energy transition,” explains Wong. “Tackling the energy trilemma is going to require a huge team effort between government, companies, consumers and investors – with infrastructure and private capital firmly at the centre.”

invested in a way that is consistent with the Paris Climate Accord and commitments to net zero. At the same time, consumer preferences and government regulation are aligning to the same targets and principles.”

The good thing about the activity of private capital in the energy transition is that it’s not distracted by short-term gains and the quarterly earnings cycles dictated by the public markets. The investment approach is taken over a long-term period, mirroring the long-term timescale needed to achieve the decarbonisation of the global energy infrastructure.

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Find out how we’re tackling the energy trilemma at [stonepeak.com](#)

Stonepeak

LITIGATION

Courting the transition to green energy

Climate litigation has doubled since 2015, with the impact of cases often stretching far beyond the final court verdict

Sam Haddad

Hawaiian children are suing their local transport department over pollution concerns. Transport Action Network has issued a legal challenge against the UK government for its road investment strategy. And Greenpeace Germany filed a lawsuit against Volkswagen AG for failing to protect the planet.

There is an uptick in litigation against fossil fuel-driven transport, driven by concerns about the planet’s climate. But do these legal actions affect transport strategies, and do they push businesses towards positive climate action?

In 2022, the IPCC recognised the role that litigation can play in affecting “the outcome and ambition of climate governance”. The number of climate-related lawsuits has doubled since 2015, with almost a quarter of those cases filed since the start

of 2020, according to *Global Trends in Climate Litigation*, an annual report by the Grantham Research Institute on Climate Change and the Environment at the London School of Economics and Political Science.

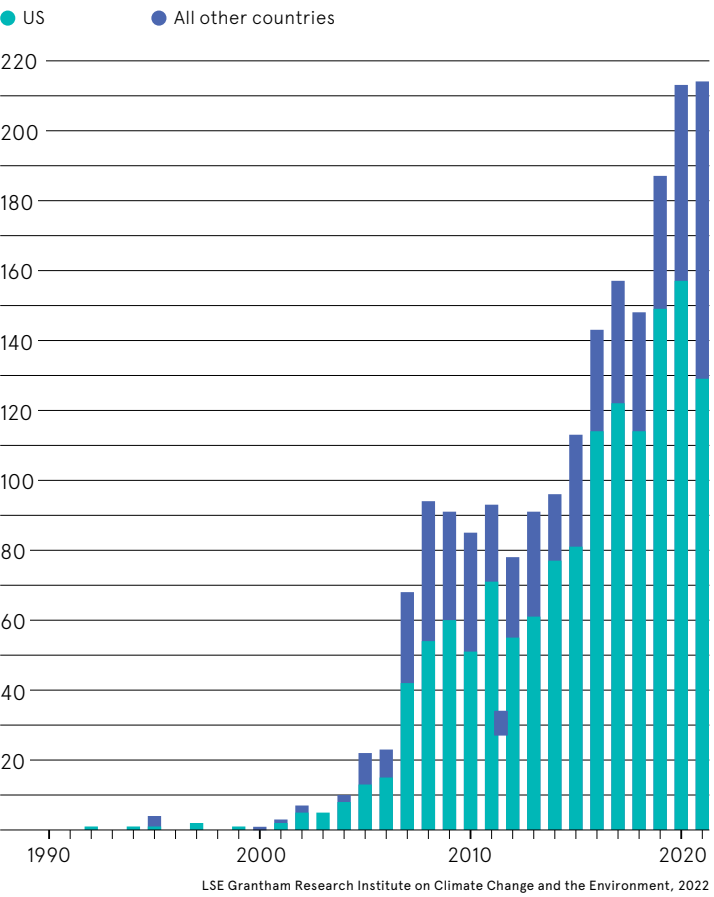
Joana Setzer is assistant professor at the institute and the report’s co-author. Much of climate litigation is against governments, she says, inspired by the landmark case between Dutch citizens and the Urgenda Foundation NGO versus the state of the Netherlands in 2015.

“The district courts of the Hague agreed that the government wasn’t doing enough to prevent climate change. It was the first time a court told a government to raise ambitions,” she explains. “The whole landscape changed after that.”

Globally, there are now 73 cases challenging governments’ overall response to climate change. And of

LEGAL CASES AROUND CLIMATE CHANGE ARE RISING

Total climate change cases over time, based on data from the Climate Change Laws of the World and the Sabin Centre for Climate Change Law



LSE Grantham Research Institute on Climate Change and the Environment, 2022



A protester during a demonstration outside the Royal Courts of Justice, where Friends of the Earth was making its legal case against the UK government’s funding of a major gas project in Mozambique

the eight where decisions have already been issued by the country’s highest court, six had favourable outcomes for climate action.

But Setzer points out that suits are no longer limited to the carbon majors but extending into other sectors. “In 2021, 16 of the 38 cases against corporate defendants were filed against fossil fuel companies, while more than half were filed against defendants in other sectors, with transport, food and agriculture, plastics and finance all targeted in multiple cases,” she says.

In her opinion, these claims are increasing partly as climate litigation cases have support from the wider community. “Climate change is widely discussed now, and there is more expertise among lawyers who are better prepared to bring these cases and judges who are more accepting of these cases,” she says.

Ugo Taddei leads the Clean Air team within the Strategic Litigation programme at the NGO ClientEarth. He believes that such suits are effective in bringing about environmental action. “Air pollution has been greatly affected by air pollution rising to the top of the health agenda in the past decade, with legal challenges to authorities that have failed to comply with regulations to limit air pollution across Europe.

ClientEarth has been involved in several of these cases, notably winning three national challenges on air pollution against the UK government. “In the final ruling in 2018,

the judge said good intention from the government is not enough. We need ClientEarth to keep putting pressure on the government so it will deliver,” he says.

“When I joined ClientEarth in 2014, more than one in two cars purchased in the EU was diesel. Last year, for the first time more electric vehicles were sold than diesel – more than 20%. I couldn’t have imagined such a quick shift. Clean air was hardly a topic in the media before,” he says.

In 2020, the UK government announced a ban on new petrol and diesel cars by 2030, which is 10 years earlier than it had previously committed to achieving. A 2035 ban on internal combustion engine vehicles is on the table at EU level.

Climate litigation with such strategic ambition is on the rise, according to Setzer. This refers to cases where the claimants’ motives go beyond the concerns of the individual case and seek to “bring about some broader societal shift”, be that climate action, raising public awareness or nudging the behaviour of government or industry actors.

An increasing number of suits are being filed in the Global South. Based in Nairobi, Mark Odaga is defending rights programme manager at Natural Justice, an environmental justice NGO. He says: “Litigation empowers communities and defends their rights. The process can be a path towards restorative justice for communities bearing the brunt of climate impact.”

Even when legal challenges are lost, the cases can significantly raise the profile of an issue. Transport Action Network didn’t ultimately stop the UK government’s £27bn road-building programme but, according to the NGO’s founder and

“Legal suits are extending beyond the carbon majors into other sectors

director Chris Todd, the action was successful in other ways. “It got lots of people in the industry and media talking about the impact of road-building on the government’s carbon targets,” he says.

“Ultimately, we got the government to accept there was a need to review the national policy statement afterwards, and it acknowledged the transport to decarbonisation plan was out of date and needed to be reviewed. We see that as a direct result of our badgering through legal challenge.”

One of the new trends in climate litigation is a shifting of cases from companies to individuals, observes Setzer. “Instead of suing the company, a case is brought against the CEO. Or against a minister instead of the government.” This is seen with ClientEarth’s current legal action against a FTSE 100 company’s board of directors for mismanaging climate risk, which could have a powerful effect on making individuals think twice before they plan.

“Litigation is a powerful storytelling tool,” says Setzer. “The more media coverage these cases get, the more cases there are and the greater the reputational damage can be for companies. It’s become a self-reinforcing mechanism – which encourages behaviour change.” ●

CLIMATE RESILIENCE

How critical infrastructure can be made more climate-resilient

Designing today’s physical networks with tomorrow’s weather in mind

Jon Axworthy

Whether it’s arrival and departure boards showing cancelled trains because of flooding, or images of submerged roads in rural villages, extreme weather events take their toll on infrastructure and the people who rely on it.

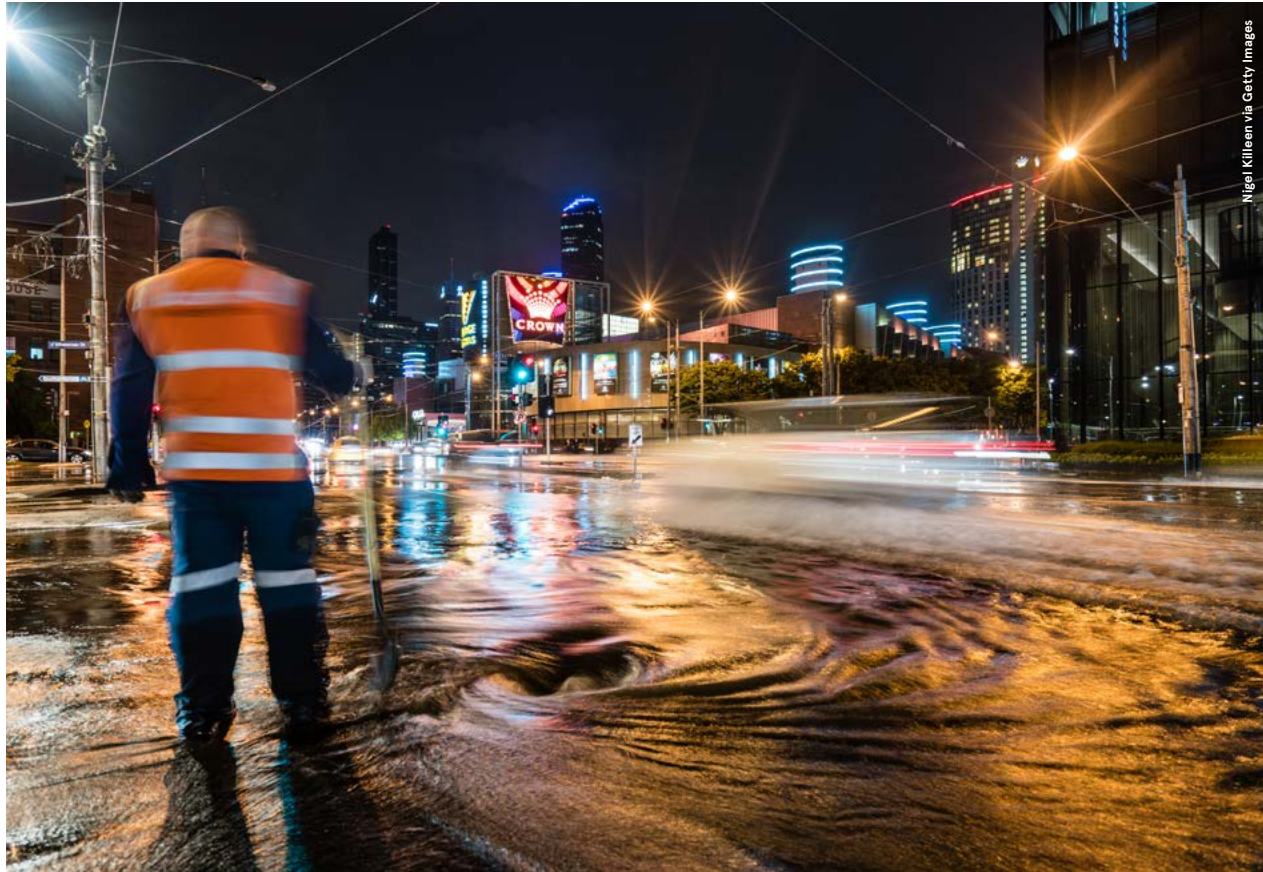
Globally, the narrative is a similar one, with heatwaves and unprecedented rainfall levels affecting everything from roads and railways to bridges and sewers, leading many analysts to describe infrastructure resilience in the face of climate change as a time bomb.

That sense of urgency has been highlighted this year by *In Deep Water?*, a report by think tank Bright Blue, which examined how flooding endangers all types of infrastructure in the UK. Its conclusion was not optimistic and revealed that the UK is not adequately prepared for the increased risk.

“Flooding is the most serious climate-related risk to the UK in terms of the hazards it presents to community functioning,” says environmental and natural resource economist Helen Jackson, the report’s author. “Climate-resilient infrastructure is key for disaster response. And infrastructure which isn’t resilient can be unsafe and its failure can amplify the impacts.”

This year’s report by the Intergovernmental Panel on Climate Change reinforced the reality that climate change is already causing more frequent and more severe extreme weather events. It revealed that higher precipitation intensity could increase the risk of flooding and they identified bridges as one of the infrastructures most at risk.

Engineers and planners look at climate modelling at the outset of their projects and factor forecasts into



Heavy rain floods streets in Melbourne, Australia

their designs. Bridges are built to withstand higher magnitude flood events and sea-level rises, with reinforced foundations and greater height clearances from the waters below. Road construction is also changing to accommodate the damaging impact of flood water, as roads that are underwater for days can be impassable even after the waters have receded, causing continued disruption for communities.

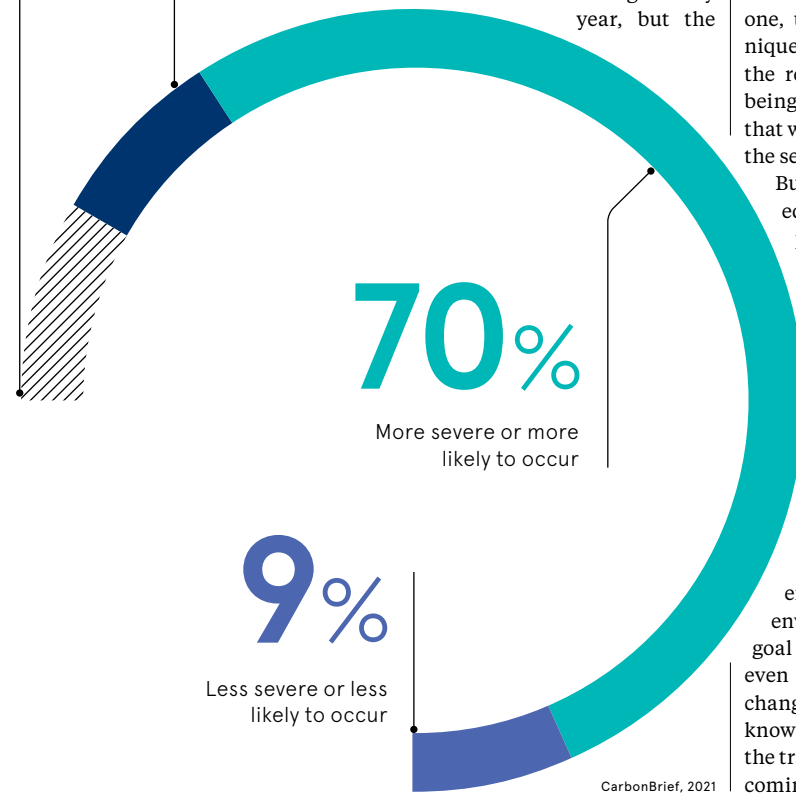
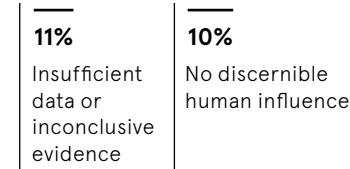
Engineers are finding a way to weatherproof roads after a harsh lesson learnt in Queensland, Australia. Over 2010 to 2011, the region experienced several extreme climate events that included extensive flooding, which damaged 19,000km of the state’s road network.

“Queensland used a process called foamed bitumen stabilisation,” says Caroline Evans, chair of the climate change and road network resilience committee for the World Road Association (PIARC). “The hot bitumen is injected with limited amounts of air and cold water, which forms a water-resistant layer within the road itself. The process was in place in Queensland by the time Tropical Cyclone Debbie hit the state in 2017 and when the waters receded, the roads were still intact and needed minimal maintenance.”

Not all critical infrastructure is above ground. The Thames Tideway Tunnel project, dubbed the Super Sewer, is in progress. A designated nationally significant infrastructure project, the 25km tunnel is being built to solve a historical problem that has been growing more

HUMAN INFLUENCE IS MAKING WEATHER EVENTS MORE SEVERE

Human influence over weather events that have been studied by scientists



acute every year, as London’s Victorian sewers fail to cope with the amount of material flowing through the network. Now, even drizzle can cause untreated sewage to spill into the Thames, creating combined sewer overflows (CSO) incidents. With the prospect of increased rainfall levels, engineers have taken steps to future-proof the tunnel to cope with Met Office climate projections that run to 2080.

“There are currently around 50 CSO discharges every year, but the

project is designed to restrict this to four or less,” reveals Roger Bailey, Tideway’s chief technical officer. “The future performance of the tunnel has been tested against rainfall predictions from the UK government’s median emissions climate projections for 2080. Parts of our new public realm are floodable and compliant with the Environment Agency’s predictions for rising sea levels.”

But the solution to London’s sewage problem presented planners and engineers with a fresh one: how to minimise the environmental footprint of the construction phase? Hundreds of lorry journeys would be required every day to transport materials to the site and embodied carbon from it. The operators turned to the Thames itself, relying on river barges rather than lorries.

A 1,000-tonne barge produces an average of 90% less carbon dioxide than the HGV equivalent and by the end of the tunnelling phase in April this year, more than one million tonnes of material had been transported by river, saving more than 115,000 HGV journeys. Tideway estimates that more than 200 lorry journeys have been taken off the road each day. This innovative thinking is critical for a project’s legitimacy and shows that the level of climate resilience can be established long before any ground is broken.

The same is true even for existing structures that require resilience to be retrofitted. Take Dawlish in Devon, where the sea wall collapsed after storms in February 2014, forcing a full line closure for eight weeks, cutting off the South West from the rest of the country by rail. It was decided that a new wall would be built in front of the old one, using new construction techniques. Defences were twisted into the rock like a screw, rather than being driven in, to achieve a depth that would withstand future rises in the sea level and tidal swells.

But before any of this work started, the height of the wall and profile of the capping were analysed extensively, with lab-based physical modelling used to verify the computer-based modelling with an outcome that predicted the project would be climate-resilient for 100 years.

The Dawlish and Tideway projects show how old and new infrastructure projects can be made climate-adaptive, shielding against the effects of rapidly changing environmental conditions. The goal is to remove the weak links, even though the course of climate change is unclear and we don’t know what’s coming down the road, the tracks or even the pipeline in the coming decades. ●

INSIGHT

Meeting societal and climate challenges will require significant investment

Lawrence Slade, CEO at the GIIA, discusses the scale of investment needed in UK infrastructure and to achieve it

Q The UK has ambitious infrastructure plans. How can the industry facilitate investment required while aligning with regulatory frameworks?

A Meeting the societal and climate challenges of the 21st century will require significant investment. The UK needs to invest around £600bn to meet its infrastructure needs over the next decade, with half of that expected to come from the private sector.

To achieve this, we need changes to the model of economic regulation of the energy, water and telecoms industries. Our *Regulating for Investment* report makes recommendations on the current policy and regulatory frameworks in the UK, focusing on how responsible investment can support the economy and environment while remaining sensitive to affordability concerns under these three broad headings: **Make sure the institutional arrangements are right.** We need clearer policy direction from the government and a simplification of regulatory duties.

Incentivise the delivery of high-quality infrastructure. The current system incentivises short-term efficiency improvements in operating expenditure. But investors need to have certainty and predictability to invest longer term. **Tackle the challenges of affordability.** Cost of investment should be spread equitably, while targeting support for the most vulnerable. We need regulators to build intergenerational fairness into their framework.

Q How does the industry balance public and private finance and ensure the government is aligned to the long-term vision?

A GIIA represents the leading investors in infrastructure from around the world. Our members have stakes in more than 2,000 infrastructure assets across 70 countries with an estimated value of \$1.3tn that are helping to address the economic, social and environmental challenges facing the world.

But more needs to be done. The global ‘infrastructure gap’ is measured in trillions of dollars. Governments recognise the need for investment in ports, airports, renewable energy, resilient grid connections, clean water and digital

infrastructure, but they don’t have the resources or, in many cases, the expertise to deliver. Governments can unlock the necessary investment to address net zero, levelling up and technological developments by working with private investors.

When deciding where to allocate their capital, investors are looking for a clear policy environment, stable and long-term regulatory conditions, and a visible pipeline of investable opportunities. There is also a role for government in the development of early-stage technologies, to provide targeted public financing support that helps de-risk the investment environment.

Q How do we ensure infrastructure investment is climate-resilient and can help achieve net-zero emissions?

A In PwC’s *Unlocking Capital For Net Zero Infrastructure* report, commissioned by GIIA, it is estimated that £40bn per year needs to be invested in new low-carbon infrastructure over the next 10 years. With private capital typically contributing around £20bn of UK energy and utility infrastructure financing, this is a doubling in capital requirements.

For example, rainfall patterns are already impacting the water sector, with greater pressure on storm-water drainage systems in some areas and greater risk of drought in others. Disruption caused by Storm Arwen has highlighted issues around the level of resilience we expect from our energy networks. The impacts of more extreme weather patterns are posing questions for policy-makers, regulators and operators. We need a public debate around how resilient we want our infrastructure to be and the implications for consumers in terms of funding that investment. ●



Lawrence Slade
CEO, GIIA

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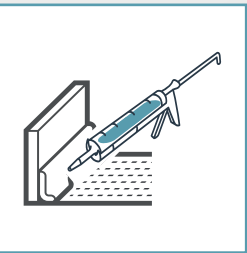
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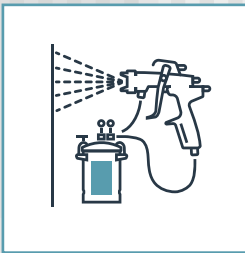
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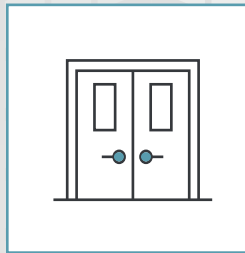
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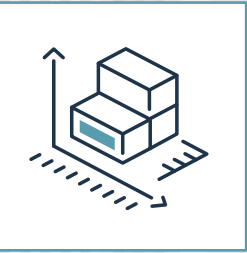
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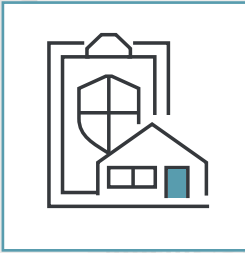
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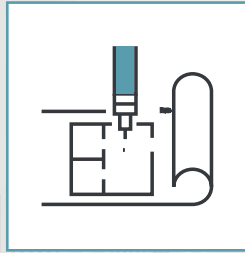
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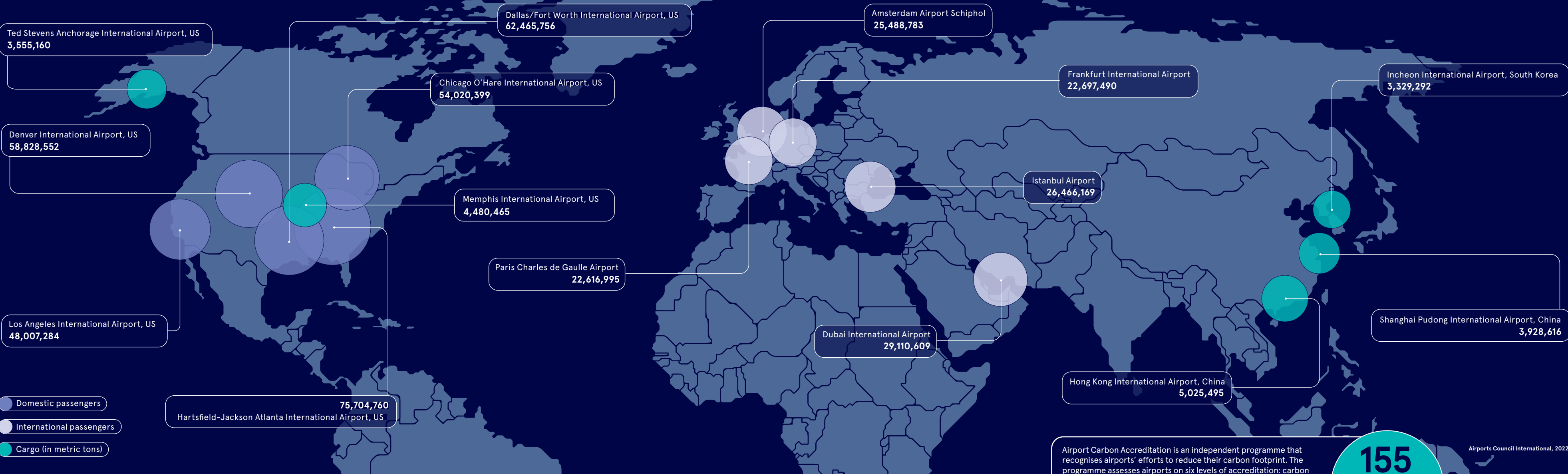
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AIRPORT INFRASTRUCTURE

Airports around the world are going through changes. As with any other business, airports are on a quest to transform themselves with innovative technology and processes aimed at greater efficiency and sustainability. But the industry is also facing shifting population trends worldwide which are creating unmet demands and massive funding gaps in emerging regions. How will the owners and operators of this key infrastructure adapt?

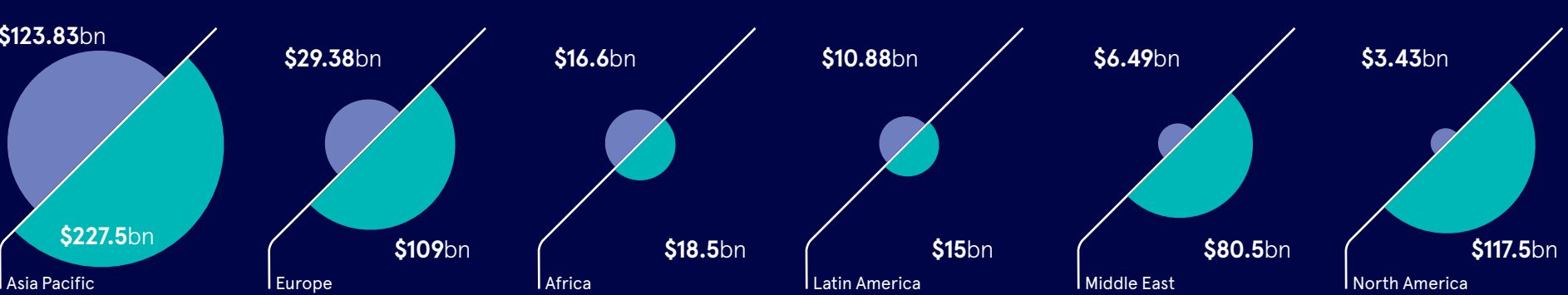
THE WORLD'S BUSIEST AIRPORTS

Busiest airports, by total passengers (domestic), total passengers (international), and freight handled



FUTURE AIRPORT INFRASTRUCTURE

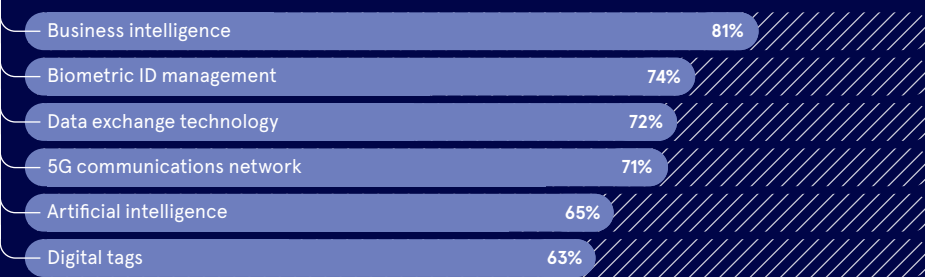
Airport development worldwide, by region



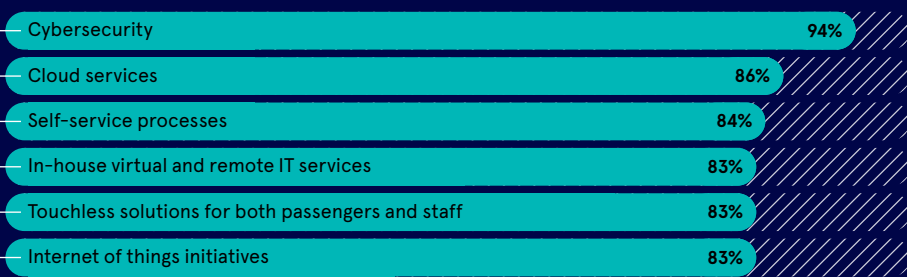
THE PATH TO AIRPORT 4.0

SITA, 2021

Share of airports worldwide expecting to trial new technologies by 2024, by type

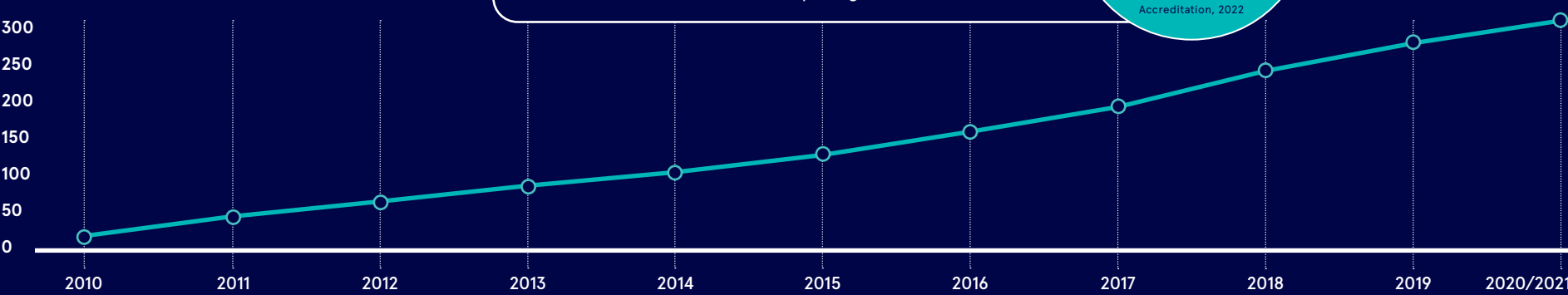


Leading investment opportunities for airports worldwide by 2024



CARBON-ACCREDITED AIRPORTS

Number of carbon-accredited airports worldwide



Airport Carbon Accreditation is an independent programme that recognises airports' efforts to reduce their carbon footprint. The programme assesses airports on six levels of accreditation: carbon mapping and measurement, the reduction of emissions through internal procedures, managing third-party emissions, the use of offsetting to achieve carbon neutrality, the development of long-term plans toward total-emissions reduction, and, finally, offsetting all residual emissions with internationally recognised offsets

155
of the world's 304 carbon-accredited airports are located in Europe



Peter Vahersvik via Getty Images

SUSTAINABILITY

The elephant in the infrastructure room: embodied carbon

We need to do a lot more to tackle the carbon embodied in infrastructure to meet net-zero targets by 2050

Nick Easen

Every lump of concrete, every steel beam and every piece of glass we use has a carbon footprint. So much so, that the built environment is responsible for a quarter of all the UK's greenhouse gas emissions; more than shipping and aviation combined. While a significant amount of this carbon footprint is from operating our ageing infrastructure, a significant amount is emitted when we produce, use and transport materials. So-called embodied carbon – that's the cradle-to-grave emissions

from infrastructure projects – is consequently under greater scrutiny. A recent parliamentary report stated: "There is no government policy requiring the assessment or control of embodied carbon emissions from buildings" and "as a result, no progress has been made in reducing these emissions within the built environment". These are damning words, since the UK has lofty ambitions to achieve net-zero emissions by 2050. "Accounting for these emissions is a complex task," observes Gillian

Charlesworth, CEO of BRE, the Building Research Establishment. "The sustainability of infrastructure assets needs to be a key consideration for the industry." A carbon-intensive cycle of demolition and construction, even though revamping costs can exceed the infrastructure's value, is not the answer. Embodied carbon doesn't matter only for new projects, it matters for existing ones also. Otherwise, we might want to flatten much of Britain's old, inefficient, heat-leaking buildings and construct new,

efficient ones in their place. We need to start thinking of the carbon embedded in our existing infrastructure and the amount emitted throughout the life cycle of any building, road, car park or shopping mall. After all, by 2050 the majority of the built environment – 80% – will already have been constructed. "We're in a position where we have to start facing up to the challenges. Embodied carbon requires greater transparency, that is the biggest one," says James Low, global head of Responsible Business at Mace, a global construction company. These issues will need to be tackled as pension funds, investors, private equity and financiers demand more from the assets they invest in, same for governments and public bodies. The three major questions of how to measure embodied carbon, how to tackle the high costs of sustainable construction, and how to make the process carbon neutral – are now in the spotlight. Measuring embodied carbon reliably is the first step. The industry needs to know the exact CO₂ emissions wrapped up in any infrastructure project, when to retrofit, what's worth demolishing and rebuilding and what low carbon materials can be easily procured. 'If it's not measured, it won't be managed' is the new mantra where full building life-cycle assessments are key.

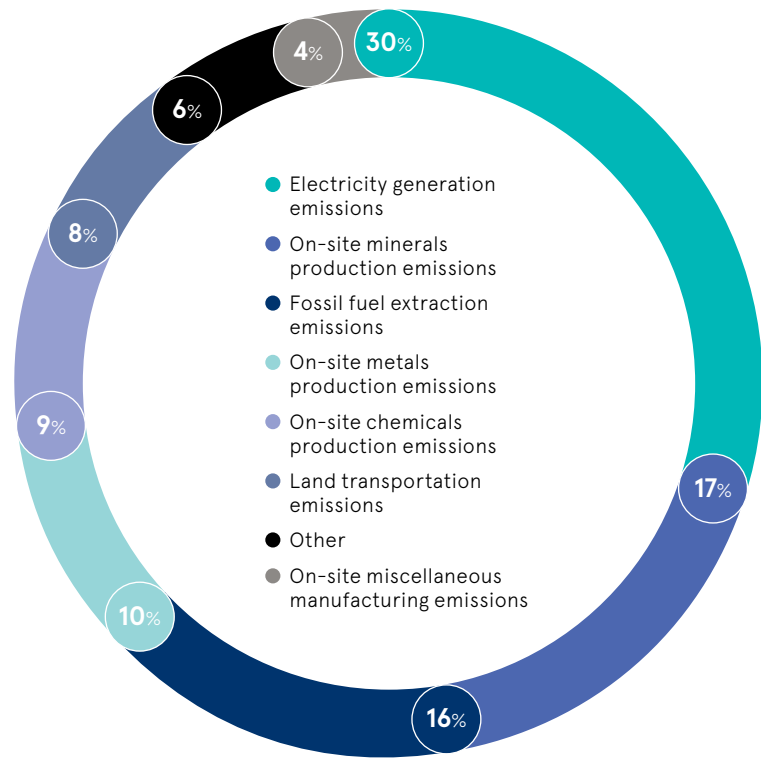
Existing buildings contain huge amounts of embodied carbon, making demolishing them a contributor to emissions

For instance, around 50% of the whole-life emissions of a building can come from the carbon that is generated during the construction and demolition process, according to a recent report by Arup and the World Business Council for Sustainable Development. "Embodied carbon results must therefore be analysed and shared. Sharing is important to make it clearer what best practice is. It's also critical for benchmarking," explains Dr Rupert J Myers, senior lecturer in sustainable materials engineering at Imperial College London. "Benchmarking makes it clearer which types of infrastructure projects are lower carbon than others, and these can be used as reference cases in the future. It is much easier and practical to do things based on use cases than starting afresh." A case in point is the refurbishment that Mace has been working on of Hylo, a 1960s high-rise office block near London's Old Street. It retained as much concrete as possible from the existing structure by cutting and carving into it, as well as building around it, rather than knocking it down and starting again – thus preserving the embodied carbon in situ. This saved 35% of the carbon footprint when compared to a new build. "Retrofit will certainly be key for many buildings. Knowing the whole-life carbon impact of a solution enables us to make informed decisions on whether a new build, retrofit or hybrid solution is the right approach," Low explains. Robust and widely accepted tools are vital in this process. BRE is instrumental in this, working with other industry organisations to develop the UK Net Zero Carbon Buildings Standard for existing and new infrastructure. Then there is the RICS Building Carbon Database and BRE's Environmental Assessment Method (BREEM). "Initiatives like this give developers greater transparency and enable them to make smarter decisions on

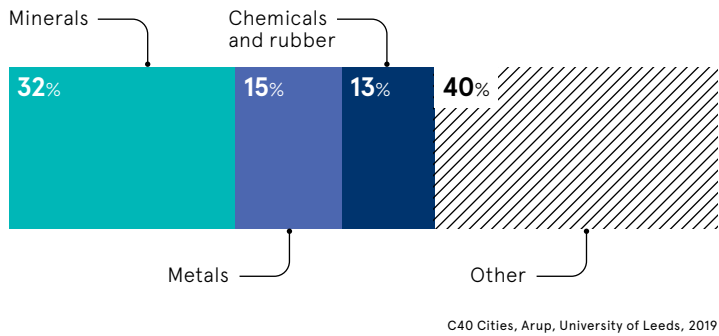
“The built environment is responsible for a quarter of all the UK’s greenhouse gas emissions, more than shipping and aviation combined

HOW BUILDING PRODUCES EMISSIONS

Source emissions of buildings and infrastructure from 2017 to 2050



Emissions from key materials



C40 Cities, Arup, University of Leeds, 2019

sustainability. We need to develop the tools for the entire industry so we can deliver more informed decisions about emissions and drive improvement on a much larger scale," Charlesworth explains. With land expensive and the need for developers to make a profit, there is a focus on efficient building and the bottom line. "Currently, the procurement of products is likely to be based on cost rather than factors like sustainability. The way to change this is through tools that provide procurement officers with a clear and usable methodology for evaluating tenders based on their added value, including carbon," Charlesworth says. Procuring low-carbon construction materials verified by third parties will help, as will recognised embodied carbon databases that identify the most sustainable materials and where to source them competitively. Knowing whether steel transported from Shandong, China or from Port Talbot in Wales is better to use when sourcing low-carbon materials matters. Recognised corporate commitments such as Steel-Zero and ConcreteZero are also part of this process. "Embodied carbon emissions for infrastructure are dominated by materials production, so it is most important to reduce these, or to avoid new infrastructure entirely. The key

thing is to use low carbon or end-of-life concrete. For steel, we could reduce emissions by using hydrogen as an energy source to make it or renewables," details Myers. "In reality, we should only be building quality infrastructure that people and society will want to continue to use. If not, it will too easily be demolished in the future because people don't like it, or it will lead to more construction because people want something better. China's 'ghost cities' are a good example of wasteful construction." Looking forward, the focus for infrastructure providers should be on clever refurbishments that source low-carbon materials, use low-emissions processes and deliver high standards of operational efficiency and carbon-free heating. This approach has the best chance of keeping emissions down. It helps that the number of low-carbon materials available has rapidly increased over recent years. Carbon pricing and taxation have been vaunted but are yet to prevail. A private member's bill in Westminster is currently being touted, which would make reporting of whole-life carbon mandatory when a building is applied for, with the expectation that this would lead to legal limits on carbon for infrastructure. Then, embodied carbon could take centre stage. ●

Q&A

Twenty-one years and counting: lessons from investing in uncertain times

Amid a fast-evolving economic backdrop, infrastructure investments can offer reliability and support portfolio diversity. **Martin Lennon** and **Ed Clarke**, co-founders at Infracapital, discuss the opportunities in the space



Q How has Infracapital changed over the 21 years it has been in infrastructure investment?

ML Infrastructure as an asset class has changed dramatically since we founded Infracapital. Our first fund was focused on public private partnerships (PPPs), but since then the nature of what investors are looking for – and the returns they expect – has moved on. Today we have two main strategies. These are 'brownfield', where we invest in existing essential infrastructure businesses, and 'greenfield', where we invest in construction projects and manage those assets through to their completion and beyond. In every case, we look for three things: essentiality, resilience and sustainability. We support the changing needs of people and the environment, whilst also seeking to deliver attractive returns to our investors.

Q What are some of the advantages and challenges that you see?

EC Infrastructure investment is a key tool for maintaining economic momentum in challenging times. However, we have seen a huge number of new funds enter our sector, making it more competitive. Our transaction teams are always assessing new sectors as the asset class evolves, but we remain hyper focused on essentiality. We are more naturally cautious and assess how businesses would respond in a downturn. This was well demonstrated during Covid-19 in the fibre sector, which has established its position as a true utility.

Q Given the increased focus on impact investing, how do you meet clients' ESG expectations?

EC ESG is central to our investment strategy and the businesses we support in the infrastructure space aim to make a very real impact. For example, we've recently backed companies such as Recharge Infra, the largest electric vehicle charging point operator in the Nordics, and BCTN, a barge operator in Benelux that is helping to decarbonise supply chains. ESG is embedded across our management process and this year we've made significant progress in our carbon disclosures in order to meet our net-zero target. We are consistently reporting the CO₂ emissions of our investments, alongside financial performance.

Q Are you seeing any change in the profile of infrastructure investors?

ML Infrastructure as an asset class has a longer-term investment horizon, so the majority of our investors are pension funds and insurance companies. We have a strong UK core, but our investor base has expanded globally over the years. We are increasingly seeing infrastructure investors allocate capital to 'impact' allocations, given the critical role the sector is playing in delivering the energy transition. There is also a growing interest from retail investors seeking to access sustainable private assets, which is something we expect to evolve in the coming years.

Q Infracapital has so far managed more than £6bn across six funds*. What are some of the key lessons you've learned?

EC You can't sit back and wait for things to happen. There are always new opportunities that come along but you have to be proactive to

have success. We have invested through several very difficult periods, including the global financial crisis and most recently Covid-19. Through this we have learnt that if you have businesses that are absolutely essential to the customer, then you can survive those seismic shocks; that is the key strength of this asset class. The ultimate lesson is to stick to our principles and be selective.

Q What excites you for the future of infrastructure investment?

ML Even though the marketplace and the macroeconomic conditions are constantly changing, in our industry it's not about being first to find the big disruptor. What matters is finding solid opportunities that make a real difference. We take pride in the change our assets make, whether connecting rural communities or decarbonising transport, or whether they are new build or transforming existing businesses onto a more sustainable footing. Our focus is on delivering for investors, alongside positive and measurable outcomes for societies. It's a fantastic and important space to be in.

To find out more about impact investing in infrastructure, visit infracapital.co.uk

*New investors cannot invest in those six funds. DISCLAIMER: The value of investments will fluctuate, which will cause prices to fall as well as rise and investors may not get back the original amount they invested. The views expressed in this document should not be taken as a recommendation, advice or forecast.



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Savvy investors find opportunity and purpose in the transition to renewables

The path to a more sustainable economy and planet has been laid out, and investors now have an opportunity to accelerate the journey while also enjoying some attractive returns

Climate change is the principal challenge of our time. The severity and urgency of the problem is now widely understood, and among the many ways people, organisations and governments can help facilitate the move to a zero-carbon economy, there is one solution that will have a greater impact than any other: transitioning to renewable energy.

This, of course, is easier said than done, but the wheels are firmly in motion. The biggest barrier previously – the cost of renewables in comparison to fossil fuels – is now well in the past thanks to rapid advancements in technology. And this has fuelled an explosion in the development of renewable assets that will underpin a more sustainable economy.

It's the financing of these infrastructure assets, however, that is the most intriguing aspect from an investor standpoint. Clearly, a lot of investment is required to create and manage the infrastructure assets that will sustain populations and economies for the decades to come. And since banks largely retreated from infrastructure lending in the wake of the 2008 global financial crisis, private and public investors have stepped in.

"Our goal is to support the transition to a clean energy mix," says Leire Perez, director of investor relations at Atlantica Sustainable Infrastructure, one of the companies leading the way in managing and investing in renewable energy. "Our target is to invest around \$300m per year. In 2021, we actually did more than that, closer to \$500m."

"Sustainability is one of our core values. We invest in assets that are environmentally sustainable and we manage them in a sustainable manner. And this also means investing in assets that are sustainable from an economic perspective. For example, sectors with higher GHG emissions may have a limited life or may have to bear higher costs for those emissions in the future. Renewable energy, in contrast, is clearly sustainable in the long term."

Despite being less than a decade old, Atlantica already manages approximately \$10bn in assets, with revenues of over \$1.2bn in 2021. Its current portfolio includes 2,048MW of aggregate renewable energy installed generation capacity. More than 71% of this is solar energy, while last year the sustainable infrastructure firm also acquired a 49% interest in four wind assets in the US with a combined capacity of 596MW.

In 2021 Atlantica was one of the first recipients of the Terra Carta Seal. Created by Prince Charles, the award recognises global corporations that are demonstrating their commitment to, and momentum towards, the creation of genuinely sustainable markets.



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The development of energy storage is also key for the transition to become a reality

But transitioning to renewable energy successfully means accepting that it can't happen overnight. While the cost of renewable energy generation has plummeted in recent years, there is still a way to go when it comes to storing the energy. This is essential considering renewables are intermittent sources of energy, when the sun is shining and the wind is blowing. For the moment, back-up sources are needed.

With this in mind, Atlantica's current asset portfolio also includes 1,229 miles of transmission lines and 17.5 million cubic feet per day of water desalination, as well as 343MW of efficient natural gas-fired power generation capacity. The latter is important in smoothing the transition to using more renewable sources, as are Atlantica's investments in geothermal plants, which provide crucial baseload capacity.

"Though renewable energy is the core of our business, we have one natural gas

asset, along with a robust plan to reduce our emissions by 70% by 2035, a target that was approved by the Science Based Target initiative," Perez adds.

"We expect some huge developments in the renewables space in the upcoming years. This requires better transmission infrastructure, to support the intermittent nature of wind and solar generation. Atlantica is present in the sector and expects to continue investing. We recently acquired a transmission line in Chile and we continue to see very attractive opportunities."

"The development of energy storage is also key for the transition to become a reality. Atlantica currently has three assets with storage and we expect to continue investing in this sector, where we see very attractive growth prospects."

The capital intensive requirements of advancing renewable energy to where it needs to be for nations to meet their ambitious net-zero goals will drive significant activity in this burgeoning market in the coming years. Yet the appeal to investors stretches beyond the likely appreciation in value of such assets. Sustainable infrastructure also presents significant opportunities for robust and steady income over a very long period of time.

Infrastructure ownership has traditionally come with strong, predictable cash flows, even more so among energy assets which provide essential services to communities. This concept doesn't change in the transition to renewables,

making it a valuable asset class before even considering the rise in popularity in purpose-driven ESG investments.

Atlantica focuses on long-life facilities as well as long-term agreements expected to produce stable, long-term cash flows. This strategy is already paying dividends, with a significant range of contracts providing stable cash-flow. Equally, however, the company has ambitious plans to grow further, and fast, with a number of growth prospects already identified in renewables in the US, Europe and South America.

"Our strategy is to continue growing ambitiously in the renewables space," says Perez. "Sustainable investing is here to stay because the climate change problem is not going to disappear. Investors are increasingly seeing the opportunities not just for asset appreciation but also better returns over the long term, and all the while participating in solving the single biggest issue of our time."

For more information, visit atlantica.com



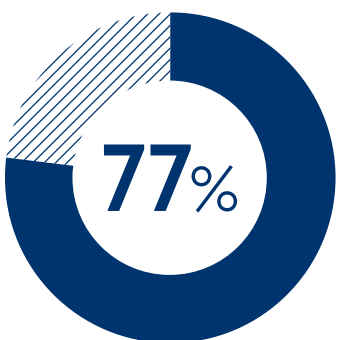
ATLANTICA AT A GLANCE:

\$1.2bn

revenue in 2021

\$10bn

total assets in 2021



revenue from renewables in 2021

2,048MW

renewable power generation of total installed capacity of Atlantica-owned assets

1,229

miles of transmission lines owned by Atlantica

17.5million

cubic feet of water capacity per day

2022 Corporate Presentation

AIR QUALITY

Air quality is the next net-zero challenge

Can we make buildings sufficiently energy-efficient to reach net zero by 2050 when the need for air quality has become so important?

Sophia Akram

As we move towards making homes energy-efficient, looking back may not be intuitive. But Graeme Fox, who is head of technical at the Building Engineering Services Association, suggests that is exactly what we should do.

Fox points to homes that were built decades ago as having resonance in the design of today's heating systems. The house he grew up in, for instance, had a central cupboard containing a warm air furnace, with ducts shooting off to different rooms: a central system that provided warm air from the building's core.

After boilers and electric heating systems, technology has replicated something similar to that older design in mechanical ventilation heat recovery (MVHR). This more efficient system can provide around 3-3.5 kilowatts of heat for every kilowatt of electricity consumed. At the same time, it brings in new air from the outside and extracts stale, moist and polluted air, which improves indoor air quality. It significantly reduces energy used for heating as

up to 91% of the heat from the extracted air can be retained and transferred to the incoming fresh air.

This is fundamental because buildings have ramped up energy-saving insulation, becoming more airtight and a lack of ventilation can have serious health implications. That's why, on 15 June 2022, an update to Approved Document F of the Building Regulations came into effect, overhauling the UK's rules on air quality and ventilation. Also updated was Approved Document L, which relates to the conservation of fuel and power.

The two updates go hand in hand, as better insulation will be essential to reach net zero. To address its challenges, some businesses are investing in their infrastructure, whether that means MVHR, heat pumps or water recovery systems. And while the significant cost of such systems can't be disregarded, adopting the long-term approach is a spur to boost efforts to achieve net zero.

The refresh may help the UK deliver net zero by 2050 but the Covid-19 pandemic has had more than a minor role in pushing for

better indoor air quality. It is also a step toward the Future Homes and Buildings Standard 2025.

This new set of standards will ensure that homes built from 2025 will produce 75% to 80% less carbon emissions than under current regulations: the requirement is 30% this year. But some non-profits, such as the New Economics Foundation, say the benchmark has come too late after the scrapping of the zero-carbon homes standard in 2016, which would have forced net-zero carbon homes to be built by 2020.

Others believe the 2025 regulations for fabric performance should be set at or close to the Passive House standard, which aims to make heating and air conditioning systems obsolete. A renewable heat requirement for new builds, with a balanced retrofit target involving fabric improvements for existing buildings, would also be welcome.

"Such a target, plus financial drivers such as an energy-saving stamp duty allowance, should also be announced now and implemented by 2025 so that the enormous task of improving all of the UK's existing buildings can proceed in time to meet our 2050 net-zero targets," says Jon Bootland, chief executive of the Passivhaus Trust. Within industry, the new regulations are generally welcome, says Fox, as they provide needed clarity for the various applications of ventilation systems.

In a welcome addition to MVHR, heat pumps are currently advocated with the government introducing a



zero-rated fee. Fox explains that heat pumps have had a reputation for having high upfront costs but could be implemented more cheaply with split-level pumps. "Outside of the sector, split-level pumps went under the radar. But they could still be important in future home building," he says.

Projects such as the Manchester Engineering Campus Development and the Devises NHS Medical Centre are building smart, sustainable buildings. They will include energy efficiency and ventilation in their designs.

The Manchester development has technology-assisted window control to provide natural ventilation. It uses machine learning for automation and adapts according to occupant and energy needs. The Devises medical centre is one of the UK's first net-zero health facilities and uses heat pumps and solar panels for heat and electricity, saving around 25 tonnes of carbon a year. Its anticipated payback was 15 to 20 years, but the current energy crisis makes this likely to be sooner, according to a spokesperson for the project.

But retrofitting is a difficult ask, explains Richard O'Brien, design director of housebuilder Northstone. This is because additional work is often required to adapt an older building, such as potentially adding more radiators. To manage this, Northstone explored how every material used in a home could be made to work to maximise sustainability.

"Anybody interested in how buildings work, how you design them – should be looking at ways to make our buildings more efficient," he says. "And it's a continual process. Benchmarks are there as a guidance – never use them as the minimum."

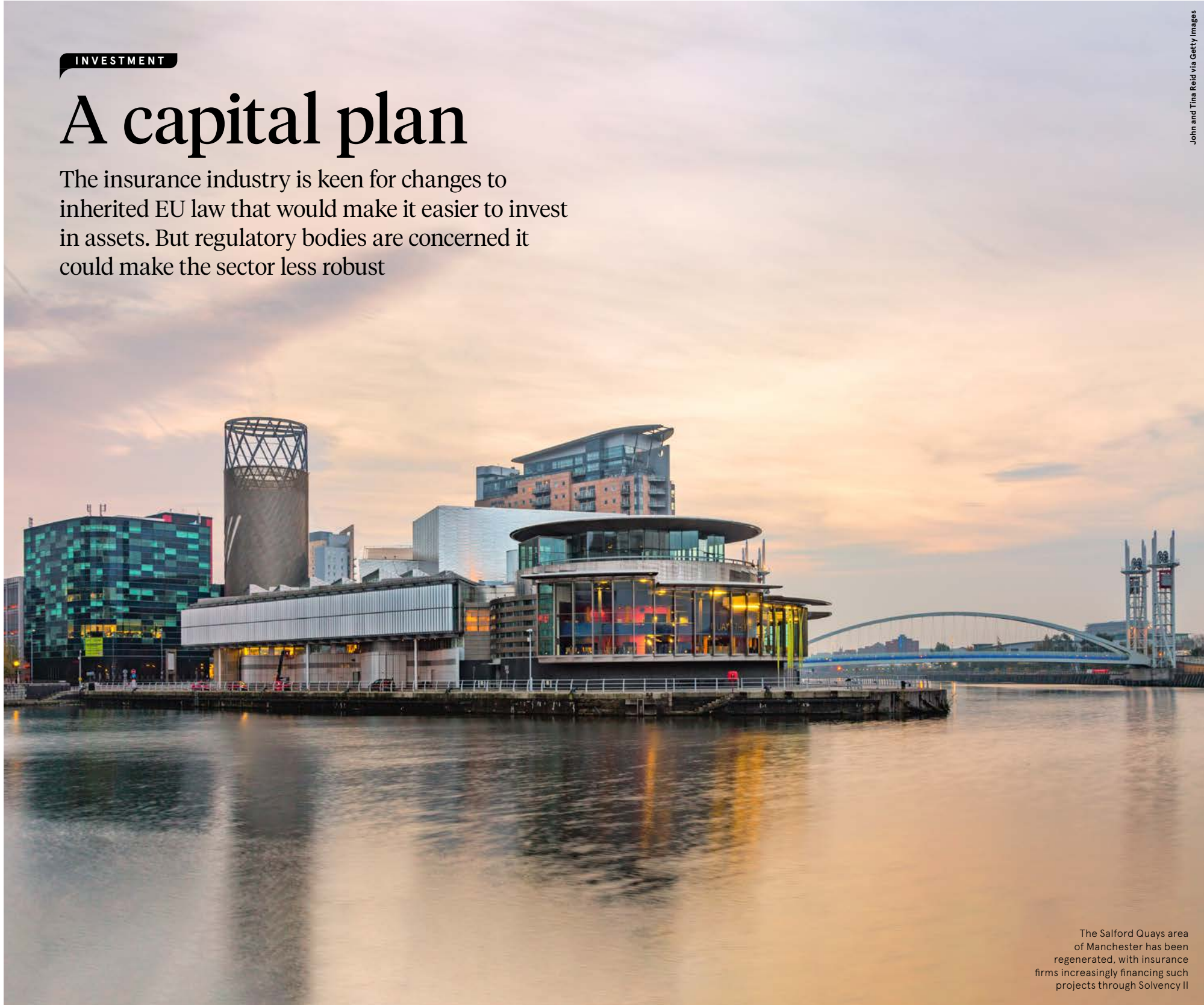
In a time when people are increasingly at risk of needing to choose between either warmth or food, working towards the principles of a passive house could be powerful, observes O'Brien.

"Businesses are competitive by nature, so step changes need to be incremental to avoid a massive impact on your business financially," he reasons.

For now, advocacy is needed to get all the different parties in the construction chain – from contractors and specifiers to manufacturers – on the same design page, so that these relatively new standards and features work together holistically.

While the technology evolves, flexibility can be useful. That way, when the next set of targets makes sustainable design even more urgent, a degree of built-in adaptability could make retrofitting less of the conundrum it is today. ●

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Anybody interested in buildings – how they work, how you design them – should be looking at ways to make them more efficient



John and Tina Reed via Getty Images

The Salford Quays area of Manchester has been regenerated, with insurance firms increasingly financing such projects through Solvency II

Simon Brooke

Earlier this year, Legal & General pledged to invest £4bn into urban regeneration and the construction of new homes in the West Midlands. Working in partnership with the West Midlands Combined Authority (WMCA), L&G, which manages £1.4tn as the UK's largest investor, has financed more than £30bn of regeneration projects in UK towns and cities outside London. It has already invested £2bn in the WMCA region, with the £210m Birmingham Health Innovation Campus and a number of housing projects. "The West Midlands economic plan, resources and skills make it an attractive destination for trade and investment from across the world," said Sir Nigel Wilson, CEO of L&G at the time of the announcement. "Our role in this is to put UK

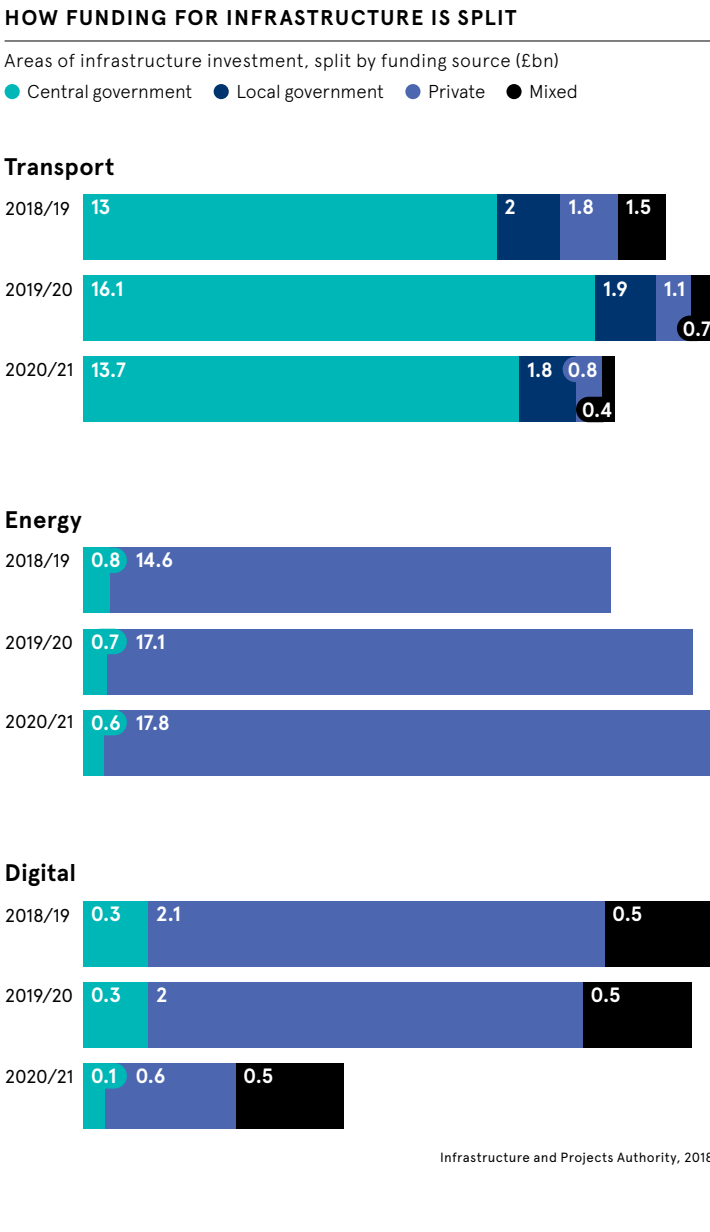
funds, including pension savings, to work here so UK savers benefit from UK prosperity." The deal is one of a growing number of major infrastructure projects financed by insurance companies. In June, Amanda Blanc, the group CEO of Aviva, told the *Financial Times* that the firm is considering investing funds from both policyholders and shareholders in infrastructure. It's thought that a deal could be done as early as this year. Blanc has spoken elsewhere about using the funding to promote green, low-carbon projects in particular. The government and the insurance sector believe that such announcements could herald the unleashing of billions of pounds of investment by insurance firms in capital projects across the country. The key to unlocking this potential,

however, is to amend the current Solvency II requirements. Inherited from the UK's membership of the EU, the regulation is under review, including a consultation that closes in July. Insurers have

Solvency II reforms could represent a unique and significant opportunity to ensure more private-sector capital can be directed by insurers into long-term infrastructure assets in the UK

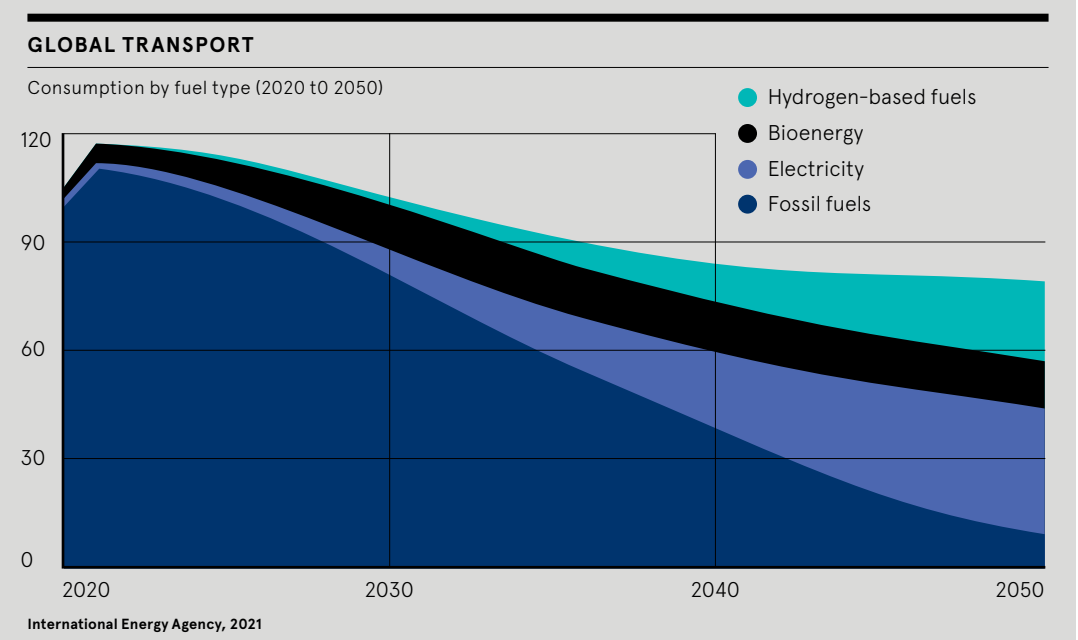
long argued that this regulation requires them to hold too much capital and applies too many restrictions on the type of investment they can make. The government and former prime minister Boris Johnson have made it known that they're impatient to make this regulatory change. The Prudential Regulation Authority (PRA), which oversees the insurance sector, is broadly in favour of measures to promote investment by insurers. But it is concerned that excessive relaxation of Solvency II could put policyholders at risk and damage the financial stability of insurance firms. Among individual insurance companies arguing for change is Phoenix Group, the largest long-term savings and retirement company in the UK with around £300bn in assets under investment. "As an insurer, we're a

long-term investor looking for stable returns over decades," says Andy Briggs, group CEO, Phoenix Group. He points out that insurers are already some of the largest asset owners in the UK. "Solvency II reforms could represent both a unique and significant opportunity to ensure more private-sector capital can be directed by insurers into long-term infrastructure assets in the UK," he says. "Critically, these reforms can and should be made in a way that doesn't compromise on policyholder protection – as that remains the core priority for us as a business. With the right regulatory and policy changes, Phoenix could potentially invest up to £50bn in illiquid and sustainable investments in the UK, which will support and accelerate the decarbonisation and levelling-up agendas."



The Pension Insurance Corporation specialises in pension insurance buyouts and buy-ins to the trustees and sponsors of UK defined-benefit pension funds. In January, it revealed that it could have almost doubled its infrastructure investment, from £10.9bn to £20.9bn, since 2016 if it hadn't been for Solvency II. According to the corporation, if the regulations were reformed then its planned investment in what it calls productive finance could increase from £30bn to £50bn by 2030. The Association of British Insurers (ABI) recently called on the insurance industry to strengthen its role as key investors in net-zero infrastructure. The aim, according to the ABI, is to put more of insurers' capital into green investments and to ensure that they are "central to the conversation about how green infrastructure is developed and funded". It wants to "unlock the significant investment potential from the insurance and long-term savings industry through a meaningful reform of the Solvency II regulatory framework". At the same time, the aim is to bring investors into the "heart of the decision-making process on green infrastructure and technology development". Infrastructure companies and finance firms should note that insurers will require granular detailed information about the performance of the project in question. So says Bob Haken, corporate finance partner at law firm Norton Rose Fulbright. "Particular to infrastructure, insurers will also need to be satisfied as to the expected cash flows, especially any volatility," he says. "Depending on the particular structure, it may also be necessary to obtain a rating for the debt." He adds: "The regime is intended to facilitate and encourage investment in infrastructure projects. If the qualifying criteria were to be relaxed, we may see much greater investment by insurers, to the benefit of communities relying on the infrastructure. So far, the PRA has been reluctant to single out green projects for preferential treatment but policymakers may well see this as an opportunity." The government is expected to introduce changes to Solvency II with a new financial services bill to be brought forward in the autumn. The resulting legislation could be introduced as early as next year. So far, the PRA's suggestions have been relatively modest. If, though, the Treasury and the insurance industry win the current argument about the balance between ensuring solid foundations for insurers on the one hand and allowing them to realise the full potential of their considerable financial clout on the other, infrastructure across the UK might be on the verge of a new golden era. ●

Commercial feature



Why transforming infrastructure is key to achieving net zero

Investors are looking at how they can decarbonise infrastructure at scale and pace, which could be a gamechanger on the path to net-zero emissions

Infrastructure has a significant role to play in helping to navigate the path towards net-zero emissions. Now private capital is moving in at pace, the aim is to decarbonise current assets, fuel the energy transition, ramp up electrification and repurpose infrastructure so it is fit for a climate-friendly age. That is the case whether it is focused on energy, transport or the built environment – all sectors that need to be tackled. Since half of the global infrastructure that will exist in 2050 has already been built, is under construction or is in the planning process, it means that governments, as well as the public and private sector, need a comprehensive plan to slash emissions for our current material environment. There are many opportunities and challenges. The task is complex, and the regulatory and legislative environment is evolving. The situation is fuelled by Covid-related stimulus packages for infrastructure to the tune of \$3.2tn globally. Short-term changes are complicated by the war in Ukraine, which is

driving up energy prices and creating geopolitical instability. Yet, the long-term goal is still to slash emissions from infrastructure around the globe. "Decarbonisation of the economy is presenting significant opportunities in transitioning infrastructure assets over the long term," explains Deepa Bharadwaj, executive director, infrastructure at IFM Investors, which is owned by pension funds and invests on behalf of more than 120 million pension fund members globally. "Importantly, divesting assets forgoes these opportunities and does not achieve the emissions reductions that are possible through responsible asset stewardship. We are making infrastructure investments today that our investors expect to hold for decades. If these investments are to generate strong, sustainable returns, we need to ensure they continue to play an important role in society as it transitions to a net-zero economy." It helps that some asset managers are taking a decades' long view of the infrastructure landscape for the transition to net-zero emissions. This is vital since there are no short-term fixes. The transition to a low-carbon future is likely to be uneven and involve larger step changes, as opposed to a smooth, gradual shift. There will also be emerging business models and fresh opportunities, particularly in renewable energy generation, as humanity innovates in its pursuit of lower greenhouse gas emissions across many sectors. "We believe that long-term pension capital is ideally placed to partner with governments in investing in new and transformational infrastructure

projects, helping create jobs and drive economic growth," says Bharadwaj. Opportunities abound, IFM, which has set an interim 2030 emission reduction target for its infrastructure portfolio as it targets net zero by 2050, has identified four key themes for investors to watch. These are decarbonising existing portfolios; brown-to-green alternative energy sources, such as sustainable aviation fuels; greening digital infrastructure; and increasing scope for public-private partnerships to build back better – from US president Jo Biden's Infrastructure Investment and Jobs Act to the European Green Deal. Through one of its funds, IFM has recently invested in ERG, one of the largest independent green power producers in Europe. IFM is also supporting its infrastructure assets globally to implement emission-reduction programmes. These include developing Austria's largest solar farm at Vienna Airport, which is expected to generate 30,000 megawatt hours of clean energy annually. "We're confident that the measures we are putting in place are real, achievable and in the best interests of our investors and their beneficiaries, which include millions of working people globally," says Bharadwaj.

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