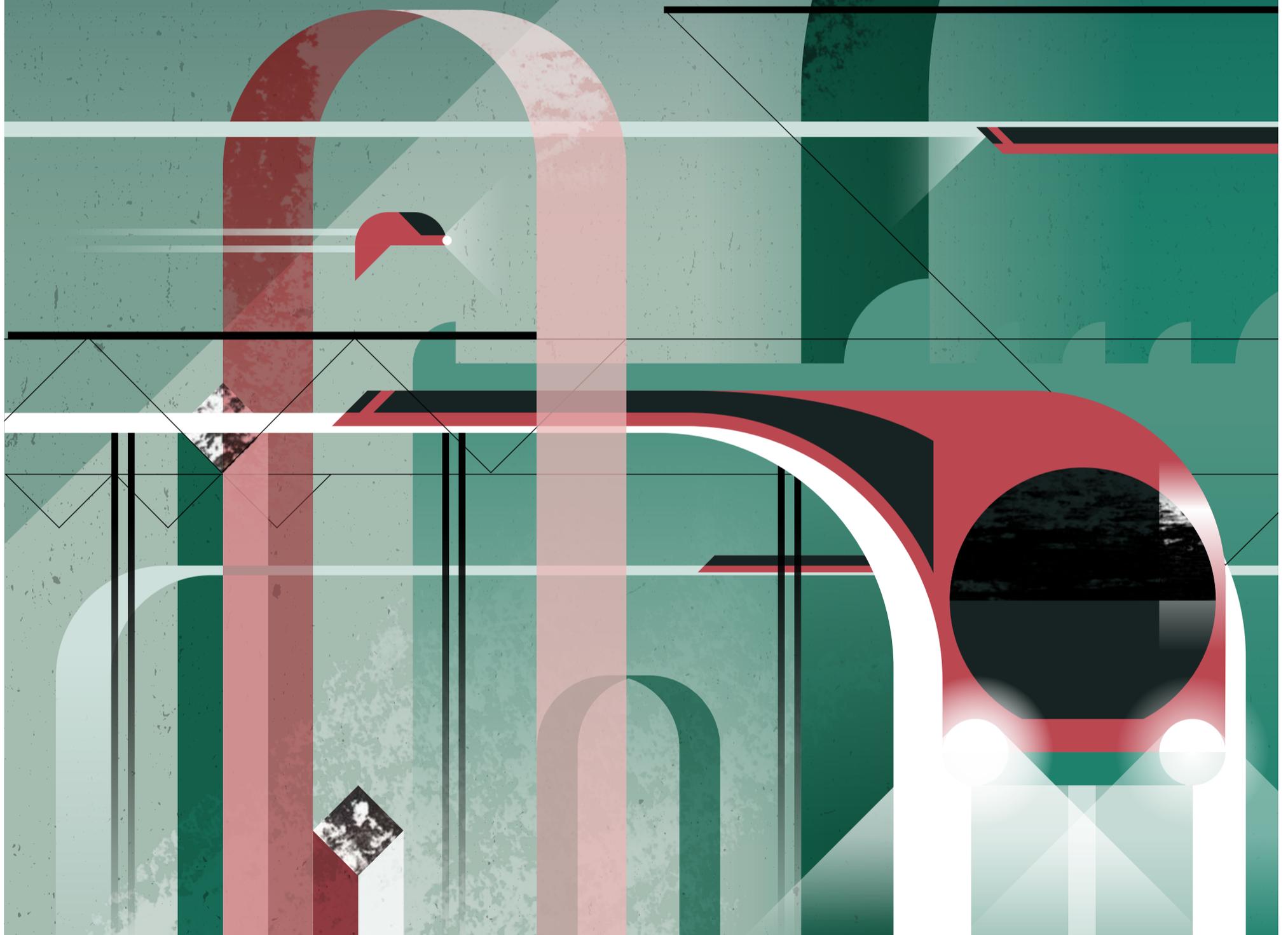


FUTURE OF INFRASTRUCTURE

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FUTURE OF INFRASTRUCTURE

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CONTRIBUTORS

TIM COOPER
Award-winning freelance financial journalist, he writes regularly for publications including *The Spectator*, *London Evening Standard*, *Guardian Weekly* and *Weekly Telegraph*.

OLIVIA GAGAN
Senior reporter at IJGlobal, she writes for *Euromoney Institutional Investor*, and was formerly with *Drapers* and *Infrastructure Journal*.

FELICIA JACKSON
Editor at large of *Cleantech* magazine and author of *Conquering Carbon*, she specialises in the low-carbon economy.

CHARLES ORTON-JONES
Award-winning journalist, he was editor-at-large of *LondonlovesBusiness.com* and editor of *EuroBusiness*.

NICK EASEN
Award-winning freelance journalist and broadcaster, he produces for *BBC World News* and writes on business, economics, science, technology and travel.

BRIAN GROOM
Freelance journalist, he has held senior positions at the *Financial Times*, including UK business and employment editor, political editor and Europe edition editor, and was *Scotland on Sunday* editor.

JIM McCLELLAND
Sustainable futurist, his specialisms include built environment, corporate social responsibility and ecosystem services.

BURHAN WAZIR
Award-winning journalist and editor, he has worked at *The Observer*, *The Times* and *Al Jazeera*.

Raconteur reports

Publishing manager
Flavia Brown

Production editor
Benjamin Chiou

Managing editor
Peter Archer

Head of production
Justyna O'Connell

Digital content executive
Elise Ngobi

Design
Samuele Motta
Grant Chapman
Kellie Jerrard

Head of design
Tim Whitlock

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POLICY

Investing in the fabric of the UK's future

Political division over how to finance badly needed new infrastructure in the UK should not get in the way of progress

BRIAN GROOM

Sixty metres below London, engineers are building a £4.2-billion, 15-mile super sewer, designed to prevent overflows of sewage from spilling into the River Thames. The project is one of hundreds of schemes, from broadband to high-speed rail and power stations, aimed at renewing the UK's creaking infrastructure.

The Thames Tideway Tunnel is controversial, not least because it is a test case for how private finance is used. The company is owned by a consortium of infrastructure funds, using money from pension schemes and other long-term investments, to keep it off the balance sheets of both Thames Water and the government, even though it is being paid for through higher consumer bills.

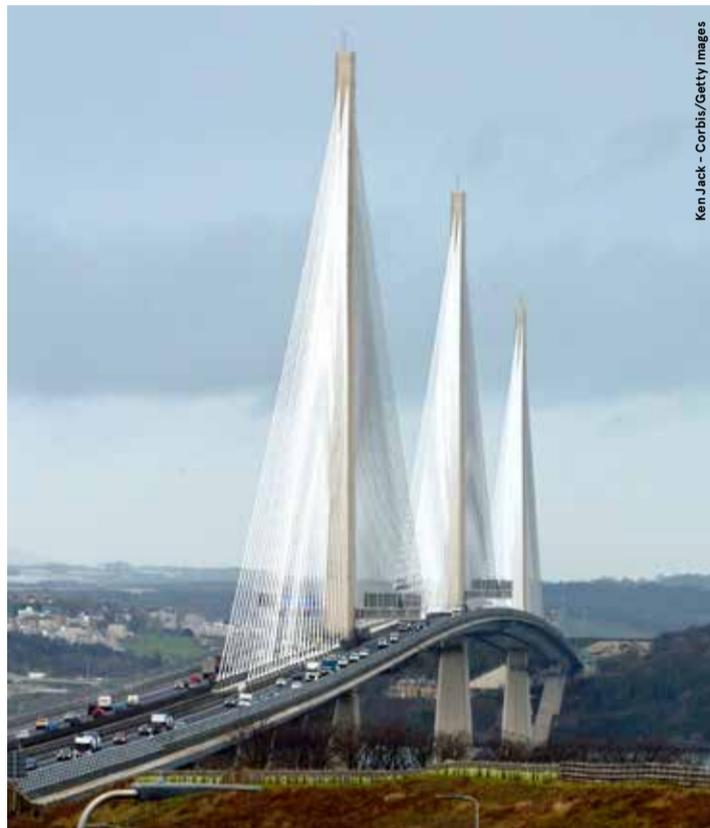
The government plans more than £460 billion of infrastructure investments over the next few years, with almost half financed by the private sector. That is ambitious, especially as the political climate has led to greater questioning of the value of private sector involvement in public services.

The UK pioneered privatisation and outsourcing 30 years ago. Now, however, the Labour opposition wants to renationalise energy, rail and water companies, halt the use of private finance initiative (PFI) contracts and bring some existing schemes back in-house. The collapse of Carillion, the construction company undone in part by overruns on PFI projects, has added an extra twist.

Even the Conservative government, which supports private finance, is sensitive to concern about excessive profits. It proposes, for example, a cap to end "rip-off" energy prices.

So far, political risk appears not to have significantly harmed infrastructure investors' willingness to invest if projects are structured attractively. The UK has prided itself on being open to the world. Foreign direct investment has brought benefits including capital, jobs, ideas, talent and leadership. But on top of Brexit, this adds another element of uncertainty.

Few doubt the UK needs to upgrade infrastructure. It has spent less on this than other developed countries over the past three decades, according to the Organisation for Economic Co-operation



Ken Jack - Corbis/Getty Images

and Development. The result is overcrowded trains, congested roads and choked airports.

"We're on a positive trend, but we have got a long way to go," says Richard Threlfall, global head of infrastructure at KPMG, the professional services firm. "We have an inheritance of roads and sewage systems and power systems, many of which date back to the middle of the last century and require significant amounts of investment."

The UK spent 2.2 per cent of gross domestic product (GDP) annually on infrastructure between 2008 and 2013, according to McKinsey Global Institute, below Japan, Canada, Italy and the United States, but slightly ahead of France and Germany. McKinsey reckons the UK needs to spend an extra 0.4 per cent

of GDP a year between 2016 and 2030 to meet its needs.

The government is raising its capital spending, but also needs private finance. Alongside state projects such as London's Crossrail and the High Speed 2 (HS2) north-south rail link, the private sector is expected to finance schemes such as fibre broadband, wind farms and subsea power cables.

Much of the planned investment is by companies in regulated industries including energy and telecoms. Also, more than half of water assets, all the major airports, most ports and all passenger rail rolling stock sit within specialist infrastructure investor vehicles, according to PwC.

The government's PFI scheme, once used extensively to build schools and

hospitals, now accounts for only a small number of new projects.

"Personally, I think the government will struggle to raise the capital, either public or private, to meet its objective," says Gershon Cohen, global head of infrastructure funds at Aberdeen Standard Investments, one of the largest managers of pension fund capital invested in public-private partnerships. He cites consumer resistance to higher user charges and taxes.

Investors need political and fiscal stability and the rule of law, Mr Cohen adds. "Right now, I don't think the UK is in a very good place, the main barriers being a lack of political and economic confidence."

Nick Davies, associate director of the Institute for Government, says the UK needs a more integrated approach. "To realise the full, transformational potential of HS2, you have got to think about the new stations, the housing to be built around those, and hospitals and schools. We have never had that."

He is optimistic, however, about the National Infrastructure Commission, created by the government to recommend long-term priorities that can command cross-party support. It is due to publish its assessment of what the UK needs for the next 30 years in the summer.

Infrastructure investors are mostly pension funds, life insurers, sovereign wealth funds and other funds acting on behalf of them, looking for long-term investments that provide a steady income stream.

"Private sector investment adds capacity because the government's balance sheet is constrained, but it also brings private sector skills," says Andy Rose, chief executive of the Global Infrastructure Investor Association. "You tend to have more consistent investment throughout the cycle."

What investors need from government, Mr Rose says, is clarity on priorities and the models of procurement it will support. He adds that the private sector needs to show evidence of how well assets have performed.

KPMG's Mr Threlfall says the main benefit of private capital is "the multiplier effect" on our ability to invest in this country's future. "We know that public finances are tight," he says. "If we remain constrained, the country will be much the poorer for it 30, 40 or 50 years out." ♦

£460 billion
of planned UK infrastructure investment in the pipeline
Infrastructure and Projects Authority/McKinsey

2.2%

of GDP spent annually on infrastructure in the UK between 2008 and 2013

0.4%

extra GDP needs to be spent between 2016 and 2030 to meet the UK's infrastructure needs

Backing the right tech is crucial

In an era of rapid technological change, how can investors be sure that new infrastructure developments will remain relevant?

OLIVIA GAGAN

The UK's national infrastructure – the roads, rail, runways, power stations, bridges and tunnels which underpin our daily activities and drive the economy – is expensive, often costing billions of pounds to construct a single asset.

Projects can take decades to plan and approve, and once they are operational, we expect them to last. The Victorian sewer tunnels which snake underneath London, for instance, are only now being upgraded. The UK's biggest power station, the Drax coal plant in North Yorkshire, is 44 years old.

Yet even the most robust of designs eventually need to be replaced and there is little doubt that we need more efficient, upgraded infrastructure to cope with modern-day issues, such as climate change, a growing population and a more mobile workforce. The UK faces a large bill for keeping its infrastruc-



ture up to speed; the Institute for Government think-tank estimates £250 billion of investment will be made in the next five years.

With that kind of money at stake, and with much of it sourced from the taxpayer, investing in the right projects and technology is crucial. The creators of infrastructure designed today have access to technology which did not exist even a decade ago, but delays, cost overruns and abandoned projects, caused by investing in the

wrong technology, can be financially ruinous for developers and a nightmare for governments hoping to gain approval from the citizens footing the bill.

So how do lenders, developers and government decide which infrastructure projects and technologies to back? Mark Muldowney, who leads lending and advisory at global bank BNP Paribas in London, says investment decisions mean anticipating future changes in consumer behaviour and technology.

“You have to make very broad assumptions about what’s going to happen,” he says. “For example, no one really knows what our electricity system is going to look like in 15 years’ time. Are we all going to be driving electric cars? Will we move over to electric heating? In that case, there’s going to be a vastly increased demand for electricity assets and technology.”

Mr Muldowney says, in return for accepting the high levels of uncertainty presented by increasingly rapid technological change, inves-

tors may start to want faster and higher returns. “An issue that lenders struggle with is taking a lot of genuine market risk and understanding what the value of the technology they’re lending to will be in five years,” he says, citing the ever-shifting smartphone market as an example. “Today, no one expects to have the same iPhone in 15 years’ time. You look at it as a two-year investment. It could be the same for investors’ return expectations for new and emerging infrastructure technology.”

Instead of taking a high-risk punt on financing first-of-a-kind assets, more cautious lenders may instead prefer to fund projects that integrate new ideas into existing infrastructure. Engineer and author Roma Agrawal says the UK already has a highly developed infrastructure network and suggests, therefore, that technologies which improve existing assets could be strong contenders for investment. For example, self-healing concrete is currently being trialled by Cardiff University and meets a very pressing need in the UK as we spend around £40 billion a year repairing bridges, tunnels and roads.

As a crowded island, space is also an issue when deciding whether to upgrade old infrastructure or build anew. While other countries with more space are racing ahead in cutting-edge infrastructure programmes – Mexico, for example, is hoping to become the first to install the much-vaunted Hyperloop system to transport commut-

Case study

Renewable energy

One area where technological advances are mixing successfully with big business in the UK is renewable energy. As consumers become more aware of the need for low-carbon energy and businesses establish ambitious carbon reduction targets, some companies are choosing to build or buy their own forward-thinking energy infrastructure.

Rather than rely on existing power from the national grid, retail giant Marks & Spencer has built its own renewable power systems, installing solar panel systems atop nine of its UK stores and owning one of the largest rooftop solar systems in the country at its Castle Donnington distribution centre.

There is also a growing trend for businesses to buy their power directly from renewable power providers. Known as corporate power

purchase agreements, electricity-hungry businesses such as BT are inking deals with individual energy projects such as wind farms, geothermal and solar plants.

BT's annual energy bill comes to around £350 million and it consumes the equivalent of 1 per cent of the UK's electricity output to power its operations. It has signed deals with wind farms in Lancashire, Wales and Scotland to supply its power. Other major corporations have followed suit with Sainsbury's, McDonald's, HSBC and Nestlé all working directly with renewable power plant owners to guarantee their energy sources.

The trend for securing your own clean power supply is spreading from businesses to their customers. IKEA has developed its own solar and battery storage products, available off the shelf for £3,750, enabling UK homeowners to become self-sufficient, technologically advanced energy users too.

01 Prototype pods for the Hyperloop transportation system on display in California last year; the technology hopes to move passengers and freight up to 1,200km per hour, but is still some distance away from commercial development

02 Offshore wind farms have boomed under UK government planning support and subsidies



to survive

ers between cities at up to 1,200km per hour – the UK could instead become known as a knowledge hub for upgrading existing infrastructure. We already have form with such developments. The 132-year-old Blackfriars train station in London, for example, is now a railway station, a bridge, an Underground stop and a solar plant, all in one.

The UK's space constraints can also influence which new technologies find commercial success. For example, the UK is considered the world leader in offshore wind power, which powers around two million homes. The technology has flourished in the UK in large part, Mr Muldowney says, because we simply don't have the room for new

You have to make very broad assumptions about what's going to happen

power plants onshore. Offshore wind farms are largely out of sight and out of mind to the vast majority of the UK population, whereas "onshore power projects repeatedly run into space and planning disputes between residents and local councils", he says.

This is an example of another risk new technologies face: whether or not they find favour with the government of the day. Political backing can help some emerging technologies to

speed ahead, while others fail. Offshore wind has boomed under UK government planning support and subsidies, and manufacturing costs have fallen dramatically. Danish power company Ørsted built many of the UK's offshore wind farms. Their senior asset manager James Sun says UK state support has been crucial, with "any technological advances needing to go hand in hand with the market and regulatory reform to support them".

In contrast, efforts to develop cleaner coal technology have floundered without state backing. The UK government abandoned a £1-billion competition to develop carbon capture and storage technology in 2015. The competition saw companies such as Shell and SSE race to create methods to safely remove and store carbon emissions from coal plants. Once the government pulled the plug on the competition, the companies abandoned their research efforts.

As ever, building infrastructure, whether it is a road or a wind farm, is a complex interplay between citizens, businesses, lenders and the government. What is particularly challenging at the moment is the pace of advancement in technology. To make prudent investment decisions, financiers and government are increasingly being asked to adopt the forward-thinking attitudes of the engineers, scientists, architects and designers driving these rapid changes.

Doing business on a global scale requires citizens to have access to low-carbon, affordable means of energy and transport, so investing in the right infrastructure technologies to enable this could have a significant impact on the UK's competitiveness in the years to come. ◆



Ulrich Baumgarten via Getty Images



Digital technology shaping infrastructure

Emerging technology trends are opening the door to new ways of ensuring what we build today will still be economically viable, socially inclusive and environmentally sustainable tomorrow – a new world of infrastructure awaits

From the invention of the tunnelling shield, to the steam shovel, to more recently the advent of building information modelling or BIM, the infrastructure sector has always been disrupted by technology. Today, however, the sheer pace and breadth of technological development means the impact on infrastructure stakeholders and businesses is bigger than ever.

A range of digital trends, from cloud computing to 3D printing, to artificial intelligence (AI), to virtual reality, is converging to cause major transformations across the design, construction and operations of infrastructure.

Access to vast amounts of computing power via the cloud, the growing volume of asset data we're generating, and emerging technologies such as AI and smart algorithms are fundamentally shifting the nature of design.

"The historic approach to infrastructure design, where the focus has been constrained by the amount of resource available to solve a design problem, is going to go away," says Dominic Thasarathar, thought leader at software firm Autodesk, which provides tools that allow companies to respond to this disruption.

We will see a shift towards outcomes-based design, where the technology will do the heavy lifting

"Instead we will see a shift towards outcomes-based design, where the technology will do the heavy lifting, supporting exploration of thousands of permutations of design across multiple dimensions to achieve a particular outcome. The designer will be able to focus far more on the bigger questions of what social, economic or environmental outcome they're seeking."

Meanwhile the internet of things is beginning to disrupt the use and operations of assets. As the way we use our built environment evolves, ensuring existing assets can be kept relevant will be critical.

"Digitally lighting up our cities will unlock new ways to add value, ranging from connecting assets together to improve movement of people around a city, to dynamically repurposing a building for 24-hour use by different companies," says Mr Thasarathar.

"Understanding how assets are performing, through the collection of large amounts of sensor data, should ensure we undertake the right amount of maintenance, not too much, not too little, and give greater insight into how much value remains in an asset."

In construction, great potential lies in the opportunity to tap into historic project data, applying techniques such as machine-learning to improve the predictability of outcome, bringing more projects in on budget and schedule, and helping to unlock funding for projects by providing greater investor certainty.

Physical construction will change too. Trends around Industry 4.0, which is reshaping manufacturing, are already crossing over. "Digital fabrication technologies, for example 3D printing, offer intriguing possibilities," says Mr Thasarathar. "If we think about the

traditional manufacturing paradigm, complexity and uniqueness have been expensive traits. It's been cheaper to buy a standard off-the-shelf component than a bespoke one, particularly for small production runs.

"In 3D printing, complexity and uniqueness are essentially free. You're able to go from a design in a computer to a finished real-world object in a single touch, in a single machine, without having to retool in a growing array of materials. Most infrastructure assets are unique, many of the components are bespoke. Though it's still early days, the potential is vast."

The pressure is on the architecture, engineering and construction or AEC industry to cope with huge population growth in cities. Worldwide construction output in 2030 will be 85 per cent greater than it was in 2014, according to a study by Global Construction Perspectives and Oxford Economics. Much of that will be driven by infrastructure.

Fulfilling that pipeline will present new challenges in making the right decisions about what to build, how to build or whether to build, and in ensuring what's built is resilient, adaptable and relevant to the future.

"Technology is going to have a major part to play, not just for the infrastructure, but for the individual infrastructure firm," says Mr Thasarathar. "Embracing these new technologies is going to be as important an element of your competitive advantage as a strong balance sheet or social licence to operate. Being bold is the order of the day."

For more information please visit www.autodesk.co.uk or follow @Autodesk_UK on Twitter



Q&A with one of the world's leading investors in green energy

Edward Northam, head of Green Investment Group (GIG) in Europe, and **Leigh Harrison**, head of Europe, Middle East and Africa (EMEA) for Macquarie Infrastructure and Real Assets (MIRA), analyse the state of the green infrastructure industry

Are renewable energy and sustainable investments now mainstream?

Northam: Absolutely. I've lived this industry for 27 years, and I can say with certainty that it's no longer on the fringes. In the future we won't use the term "sustainable investment". It's redundant. All investment will have sustainability at its core. Two things are driving that. The first is the global agenda to decarbonise, starting with energy and moving through heat and transport. The second is the model to decentralise energy production. Low-carbon technology models contribute to that solution.

Harrison: Totally right. The proof is in the numbers. In terms of volume, almost 50 per cent of global infrastructure transactions in the past five years were in renewable energy. The government is helping with policies and subsidies, but as we see with technologies such as electric vehicles, industry is moving even faster than governments in many cases. It is clear that renewables and green infrastructure are now mainstream.

It used to be assumed that responsible investing came with lower returns. Is that true?

Harrison: We are a financial institution that seeks appropriate risk-adjusted returns for Macquarie Group and our investors. In the current market, we believe that responsible investments in renewable energy can deliver what

investors want without any discount for sustainability – far from it.

Northam: Our Energy Solutions business is a good example of how you can deliver environmental benefits, attractive financial returns and cost-savings. We offer finance to medium and large energy users so they can install energy-efficient technologies, such as solar power, LED lighting and battery storage at their facilities. We demonstrate the savings they can achieve on their energy bills. They repay us out of their savings. It is a model with global potential, used in the UK and United States, and increasingly popular in other parts of the world, including emerging markets.

The Macquarie portfolio is huge. What are the exceptional sustainable projects?

Northam: We have financed more than 100 projects and are passionate about all of them. But I would point to our role in offshore wind in particular. When we started out, the offshore wind industry was struggling to attract sufficient capital to fund its growth potential. As a financing model it works because of the long-term predictive nature of the revenue stream. These assets cost £1.5 billion to £2.5 billion to deliver. As a mechanism for attracting long-term capital to the industry, we packaged up a portfolio of offshore wind assets into a fund and offered it to long-term

investors. We raised more than £1 billion from a collection of pension funds and a foreign sovereign wealth funds that hadn't previously invested in the industry. It helped take the industry to a new level.

Harrison: That offshore-wind fund invests into a portfolio of assets that generate enough renewable energy to power approximately 900,000 homes in the UK. And projects such as Westermost Rough offshore wind farm off the Yorkshire coast supported larger turbines. We had the confidence to go from earlier vintage 3.6-megawatt (MW) machines to 6MW. Technology continues to improve with larger and more efficient turbines, and we now see 9MW in production. We really want to invest in the next evolution of the technology.

How are you innovating?

Harrison: Our UK Climate Investments business, a pilot project in partnership with the UK government, is helping foster the renewables revolution in emerging markets. In India, we entered a partnership with the UK company Lightsource and won a tender in Maharashtra state for 200,000 photovoltaic cells producing 60MW, generating enough clean energy to power 20,000 homes. It's all part of that business's objective to build renewables in emerging markets on a commercial basis, but also targeting a transformational impact on local communities and markets. I must commend the UK government for the vision to fund this kind of innovative venture to support long-term sustainable investment in renewable energy in emerging markets.

Northam: A recent example of innovation is the project we are funding in Sweden in a joint venture with GE. Together we are delivering Europe's largest single-site onshore wind farm, just south of the Arctic Circle. At 650MW it's huge. What is really noteworthy is a power purchase agreement, or PPA, with Norsk Hydro, where the project will supply electricity for Norsk Hydro's aluminium smelters in the region. The deal provides Norsk Hydro with certainty on its future energy price while



“In the future we won't use the term 'sustainable investment'. It's redundant. All investment will have sustainability at its core

also providing a predictive revenue stream for the wind farm. Corporate PPAs are the model of the future, proving projects like this can be viable in a post-subsidy world.

How important is renewable infrastructure for Macquarie?

Northam: I was part of the Green Investment Bank when it was acquired by Macquarie. It was important that we found a new owner that enabled us to continue with our mandate, provided us with access to deep pools of capital, and gave us the ability to expand our green remit geographically and across the sectors we cover. In Macquarie we could not have found a better owner. We have led more than €1 billion of new investment already. We are delivering on everything we said we would.

Harrison: From the Macquarie side, one aspect that is sometimes overlooked is that infrastructure and alternative energy are not tangential to our company. They are core to Macquarie. We have deep expertise across the whole group. We've been in this sector for more than 20 years and are wholly committed to the future.

And what excites you for the future of green infrastructure?

Northam: A lot remains to be done with established technologies, such as wind, solar and waste to energy. Beyond that, I expect to see the acceleration of the distributed energy model. Batteries and energy tech are an essential part of a decentralised energy model. A focus on decarbonising heat and transport will drive developments in technology. Hydrogen could play a huge role in this, so it's an area to watch.

Harrison: The entire energy landscape is evolving right in front of our eyes. The cost of production continues to fall making renewable energy even more competitive. And technology is constantly improving, whether that's in offshore wind, with larger and more efficient turbines or blades, or new emerging renewable technologies. It's an incredibly exciting sector and we're privileged to be a part of it.

Macquarie Group is a leader in green infrastructure. It has invested or arranged investment of more than £20 billion in green energy projects since 2010. MIRA is a long-term owner and manager of assets on behalf of its investors. GIG is a principal investor specialising in early stage investments in new projects.



Edward Northam
Head of GIG in Europe



Leigh Harrison
Head of EMEA, MIRA



CLEAN GROWTH



Dukai photograph/Seaty/Imagine

Fight is on to make urban spaces green

Ever-expanding towns and cities, too often strapped for cash, are the battleground for clean growth

JIM McCLELLAND

Caught in the crossfire between the forces of urbanisation and decarbonisation, cities are the clean-growth battlegrounds of the 21st century – where booming populations must have their demands met, but their impacts mitigated.

Clean growth is doable, but difficult. To meet climate goals, PwC has calculated carbon intensity of the global economy needs to fall by 6 per cent a year, twice as fast as ever before. With infrastructure always the solution, but often a problem, cities are where this war on carbon will be won or lost.

Cities consume over two thirds of world energy and account for some 70 per cent of global greenhouse gas emissions, yet they occupy just 2 per cent of land mass. With energy demand forecast to rise 30 per cent by 2035, the heat is on.

Furthermore, city footprints must accommodate ever-greater footfall. More than half the global population already lives in urban environments, with two billion more people due by 2050. Welcoming up to three

million new faces a week, cities shoulder a disproportionately large share of the burden.

All numbers associated with cities seem big, except those for infrastructure spend, says Christina Välimäki, vice president of research in segment markets at Elsevier. “Our infrastructure is old and expensive to change, meaning there is little budget for much more than incremental repairs,” she says. “We make do with patch-up jobs, rather than putting in serious investment to make cities greener and more sustainable.”

Despite £600 billion promised over ten years through the UK National

Infrastructure and Investment Pipeline, no clean-growth revolution appears imminent, Chris Fry, director of infrastructure and regeneration at consultancy Ramboll, concurs. “Smart Rome will not be rebuilt in a day,” he says. “There will be opportunities for big disruptive changes, but in established cities with finite budgets, it is more likely incremental innovation will succeed.”

Most efforts will be joint projects, adds Ben Smith, director of energy, cities and climate change at Arup. “City governments typically only have direct control over a small proportion of emissions. Effective collaboration is, therefore, essential to realise significant reduction,” he says.

Inconsistency in policy, though, presents a big barrier to effective decarbonisation, with lack of clarity around national standards slowing change, according to Dr Jacqueline Homan, cluster lead at Climate-KIC UK and Ireland. “We have high-level strategic targets – the Covenant of Mayors and UK100 – and no shortage of technical solutions,” she says. “We need devolution, both fiscal and regulatory, to make change effective.”

Last year, Climate-KIC launched the first finance innovation lab for accelerating climate action in European cities, with South Pole Group, Global Fund for Cities Development, Carbon Disclosure Project and Centre for Climate Finance and Investment at Imperial College, London. Offering incubation support, the City Finance Lab expects to leverage \$500 million in additional funds.

Access to finance is critical. The Cities Climate Finance Leadership Alliance estimates an extra \$1.1 trillion a year could ensure urban infrastructure is low-emission and climate-resilient. According to the World Bank, however, barely 15 per cent of global climate finance actually reaches cities.

Getting the money on the table can depend on loading the dice in favour of desirable outcomes, says Rick Robinson, Arup’s associate director of digital property and cities. “Our most challenging task is often to shape the financing and investment

Traffic congestion in the Chinese capital Beijing, home to almost 22 million people

vehicles that make projects possible, say by using the developer award or procurement process to incentivise smart infrastructure in proposals, when objectives are more complex than simply financial return.”

In a vicious circle of impecuniness, however, lack of finance is denying many cities the chance to save money. Nevertheless, cities powered by 100 per cent renewable energy are happening in the United States, the Climate Reality Project reports. First, in 2014, came Burlington, Vermont, with Ben and Jerry’s hometown set to save \$20 million over two decades. Even Las Vegas, capital of conspicuous consumption, powers all municipal activities with green energy, cutting emissions to 1950s levels and its annual electricity bill by \$5 million.

Most cost-constrained cities in urgent need of a clean-growth game-changer are pinning hopes

on digital, says Ramboll’s Mr Fry. “For the coming decade, the biggest gains may be unlocked firstly by analytics and artificial intelligence to make better use of existing data, secondly through digitalised design of new infrastructure-enabled development, and thirdly through next-generation sensors and control technologies,” he says.

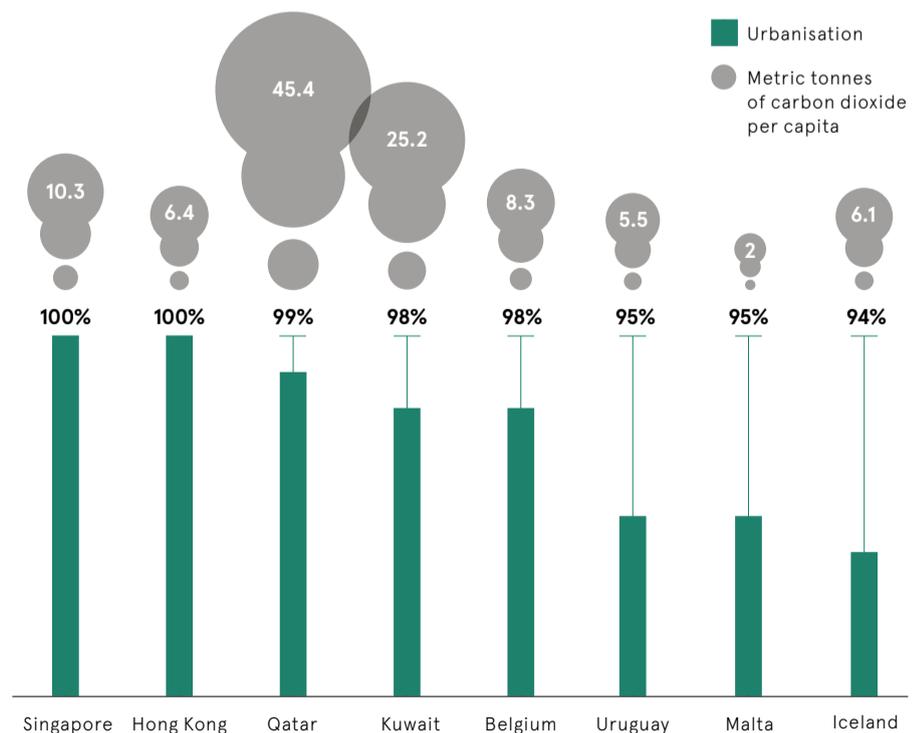
Application potential in urban infrastructure is widespread for sensors, says Andy Berry, vice president for Europe, the Middle East and Africa at Pitney Bowes Software. “Every city is a collection of assets from fibre cables to fire hydrants, parking meters to properties, street lights to traffic signals,” he says. “Only when city leaders can identify, track, monitor and manage these assets, does clean growth become viable. And it’s all down to data.”

Much data currently created and collected, however, is simply not being used at all, never mind leveraged at strategic level. When we start to understand relationships between people, places and things, via links within data, is when it transforms into meaningful, actionable intelligence, says Mr Berry. “Suddenly, number-crunching becomes easy with deep analytics and machine-learning,” he says. “Government agencies can identify trends and formulate strategies for sustainable infrastructure – strategies that lead a city to cope with and promote clean growth.”

Ultimately, tech alone is neither the issue here, nor the answer, says Alex Gilbert, managing director of Amey Consulting. He concludes: “Clean growth is as much about process and the way decisions are made, as technology. It is easy to fall into the trap of thinking smart cities are all about technology. The biggest challenge is in driving and supporting change in the way people work. ♦

Top urbanised nations and their carbon footprint

Percentage of populations living in urban areas and national carbon emissions per capita



United Nations Development Programme 2017/World Bank 2018

“We make do with patch-up jobs, rather than putting in serious investment to make cities greener and more sustainable

Smart, transparent decision-making

Smarter use of data and analytics is now needed to transform asset-rich businesses and boost performance

A 50-year-old water pipe is likely to be a water pipe in need of some attention. But determining the optimal investment schedule on these assets is a complex operation in any utility and requires a line of sight all the way from the boardroom to the man with the pneumatic drill.

Utility companies have traditionally not been good at keeping that line of sight unbroken, often with too much focus on reactive maintenance and forgetting the strategic vision. Strategic decisions are made in the boardroom, but then not clearly communicated to the operations teams, so it can be years before the asset performance, or lack of it, becomes clear.

Often reactive work is completed only for another incident to occur 100 yards down the road the following week. Furthermore, calculating the unit cost for such operations may be recorded insufficiently, making it impossible to determine the most efficient use of resources.

But big data and analytics are revolutionising decision-making, breaking apart the old departmental siloes and enabling companies to implement a much more effective investment management process.

"The key phrase in today's market is 'transparent and evidenced decision-making'," says John Phillips, client relationship director at SEAMS – an analytics company now part of consultancy firm Arcadis – which helps asset-centric organisations make better decisions.

Pivotal to SEAMS' work is its unique EDA – enterprise decision analytics – software, resulting from collaborative academic research at Sheffield and

Exeter universities, which can optimise multiple scenarios to provide more certainty about performance outcomes.

This sophisticated modelling can help to identify optimal investment decisions to work assets harder; the analytics is both predictive and prescriptive, answering questions ranging from "what's the risk asset X will fail in the future?" to "how can we prevent failure more efficiently?"

"It's critical that we make better decisions and better use of data to create knowledge," says Mr Phillips, who points to two drivers of asset investment. The first is an increasingly tough and rigorous regulatory framework, across industry sectors, which has driven companies to think in a different way about renewing or repairing infrastructure. Meeting the regulator's demands surrounding key performance indicators has forced smarter decision-making.

The second driver is an increasingly tight financial situation. Despite the need to spend on ageing infrastructure, governments are strapped for cash. Global investment in transport, power, water and telecoms stands at \$2.5 trillion, but needs to be \$3.3 trillion if we are to meet 2030 growth forecasts, according to a 2016 report from consultants McKinsey.

With different priorities competing for scarce resources, companies must find different ways of improving business performance, which include customer value and shareholder return.

"Our analytics and optimisations can make investments between 7 and 17 per cent more effective," says Mr Phillips.

The EDA software developed by SEAMS can solve complex problems too big for the human brain to calculate and provide answers at a level of detail unimaginable a couple of decades ago.

Should you spend £1 billion on new assets and £1 billion on repairs? Or £0.5 billion on new and £1.5 billion on repairs? Should it be the tracks running under Piccadilly in London or those affecting the Victoria Line? If you are digging up a city road in one area, what other work could be completed at the same time? If you've got one department working at a particular location, could there be work for another department in the same place?

The minutiae of such decisions have previously been written off as simply impossible to achieve, but the magic of today's modelling capabilities means that is no longer the case. With the power to model confidently the

£2.5trn

current global investment in transport, power, water and telecoms

£3.3trn

current investment needed to meet 2030 growth forecasts

7-17%

more effective investment using our decision analytics software

“It's critical that we make better decisions and better use of data to create knowledge

effects of variables such as weather, geography, human activity and traffic, decision-making can be optimised for the benefit of customers, consumers, shareholders and regulators alike.

The software allows organisations to differentiate between risks, balancing between acceptable and unacceptable issues, and provide the evidence to explain such decisions to investors or regulators. It is a transformative process that is fast becoming not merely nice to have, but critical to profitability and sustainability.

For more information please visit www.seamsltd.com

SEAMS
AN ARCADIS COMPANY



John Phillips
Client relationship director
SEAMS

Five lessons Carillion can teach us all

The collapse of construction and support services giant Carillion has rung alarm bells, but there are lessons to be learnt

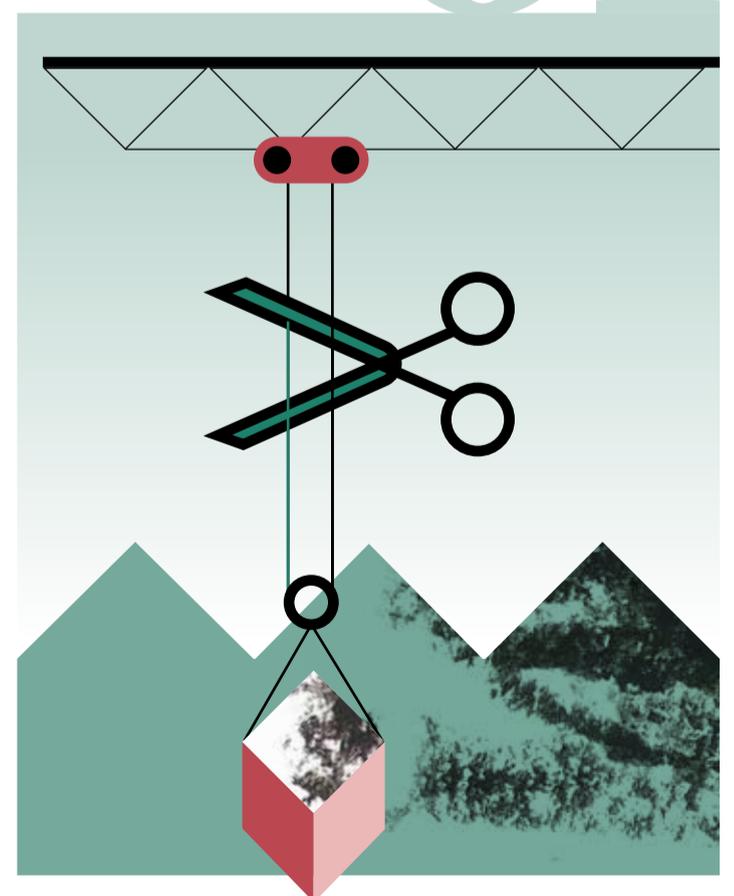
CHARLES ORTON-JONES

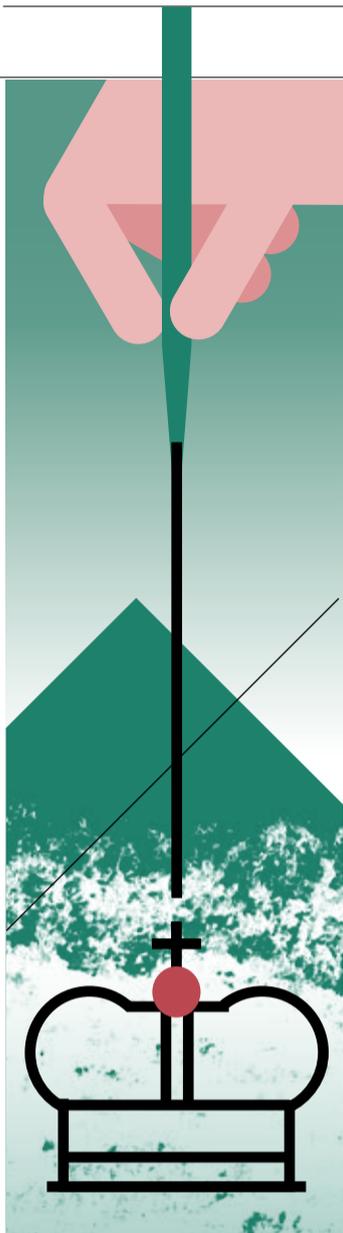
Margins matter

How much is a good margin? In the rail industry the privatised operators run at an average of 3.4 per cent going back to 1997. Wafer thin. Serco chief executive Rupert Soames, grandson of wartime leader Sir Winston Churchill, reputedly keeps a lavatory brush on his desk to remind him not to bid for work with a margin lower than a cleaner's 5 to 6 per cent. As the *Financial Times* poetically put it: "He calls it his 's***ometer'." But if former Carillion boss Richard Howson had something similar on his desk, he ignored its proximity to the fan... the former hit the latter."

Carillion in the first six months of 2017 posted profits of £11 million on revenues of £627 million, a margin of just 1.6 per cent. After an £845-million write-down of contracts, these tiny operating profits became an unmanageable loss. Carillion's slimline margins made it a hostage to fortune. Even slight increases in costs would push a project into the red. Off-the-record comments by executives suggest the company was prepared to gamble on costs staying low. The gamble failed. The margins were too thin for Carillion to survive.

Lesson: underbidding is roulette





Crown Commercial Service

It used to be easy for contractors to fleece the government. A big reason was the cluelessness of some civil servants. They had no idea how to write contracts. In 2010, the new coalition government set about changing this. Francis Maude at the Cabinet Office and civil servant Bill Crothers developed the Crown Commercial Service. This trains civil servants in the art of commercial deals and swoops in to help departments that need an injection of brainpower when dealing with contractors.

The impact has been huge. Over-generous and poorly written contracts are now harder to come by for contractors. This is noticeable in the period or length of contract. The old system awarded stupendous deals, such as the 25-year contract for a Liverpool school, which closed after a decade in 2014 and is still costing Liverpool council £12,000 a day. Barts Health NHS Trust in London signed a 40-year contract. Serco UK and Europe boss Kevin Craven has been blunt about the challenges to his company as a result of tighter procurement. Carillion may also have felt the pinch.

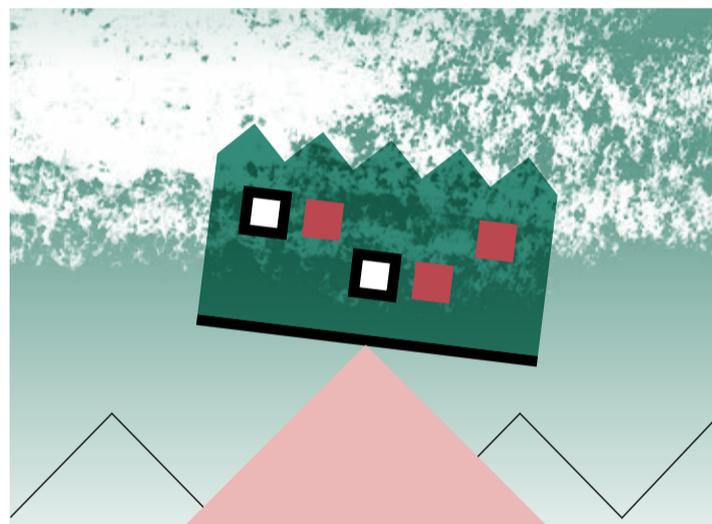
Lesson: expect haggling on government contracts

“Events, dear boy, events”

Harold Macmillan’s quote about what blows governments off course applies perfectly to the infrastructure sector. Carillion was hammered by events. The Aberdeen bypass was budgeted at £550 million. The light went green in 2008, but it took six years to cut turf. A legal campaign went to the Supreme Court, argu-

ing the route-selection process was “flawed and unjust”. Farmers complained of damage to their land. Earthworks took longer than scheduled. As a result more work took place in the freezing Scottish winter than planned. The final cost rose to £850 million. The consortium of Carillion, Balfour Beatty and Galliford Try did nothing wrong. Events, as Super Mac denoted, were the culprit.

Lesson: bids must put a price on invisible risks



Size is no guarantee of stability

Infrastructure is a game for the big boys. At least that was the assumption until recently. Huge contracts

went to huge bidders. Carillion’s meltdown proves that the correlation between size and stability is

Does capitalism work?

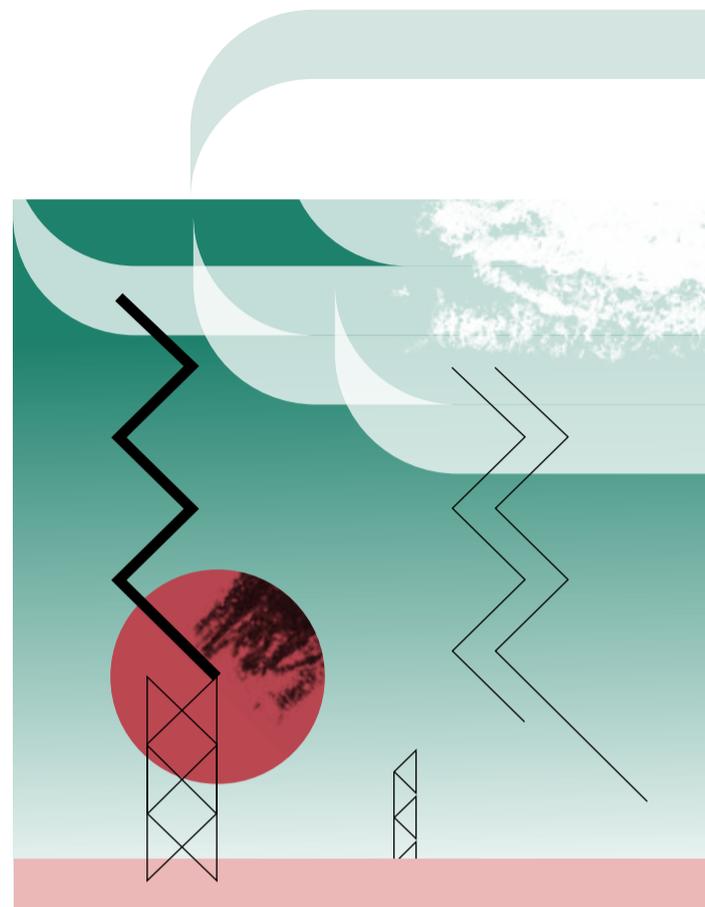
For some, the collapse of Carillion shows that capitalism isn’t working. Grace Blakeley of the left-leaning Institute for Public Policy Research think-tank argues: “In the wake of the collapse, the contradictions at the heart of neoliberalism are acutely visible.” Capitalists, however, are unruffled. In a competitive marketplace, it is essential for badly run companies to go bust. They free up resources for better organisations.

Carillion was ripe for termination. The autopsy is exposing a variety of poor practices. It was a habitual user of “reverse factoring” wherein a bank agrees to pay creditors earlier than Carillion could manage, to address cash-flow problems. There was a cloud of obscurity over Carillion’s accounts: it raised £112 million in German private lending, known

as the *Schuldschein* market, a move which avoids scrutiny of its debt position. Another accounting practice saw Carillion declare early profits £130 million in excess of “cumulative cash”, not illegal, but certainly optimistic and not helpful to shareholders who want a clear view of profitability.

Now that Carillion is bust, its contracts are being retendered to more reliable operators. It’s arguably a vindication of the capitalist system. As Adam Smith Institute senior fellow Tim Worstall puts it: “Any economy, any system of human organisation, needs a method of clearing out those doubleplusgood [really, really bad] ways of doing things. The market does this by people going bust. People going bust isn’t market failure; it’s the point of the market system.” ♦

Lesson: listen to the market

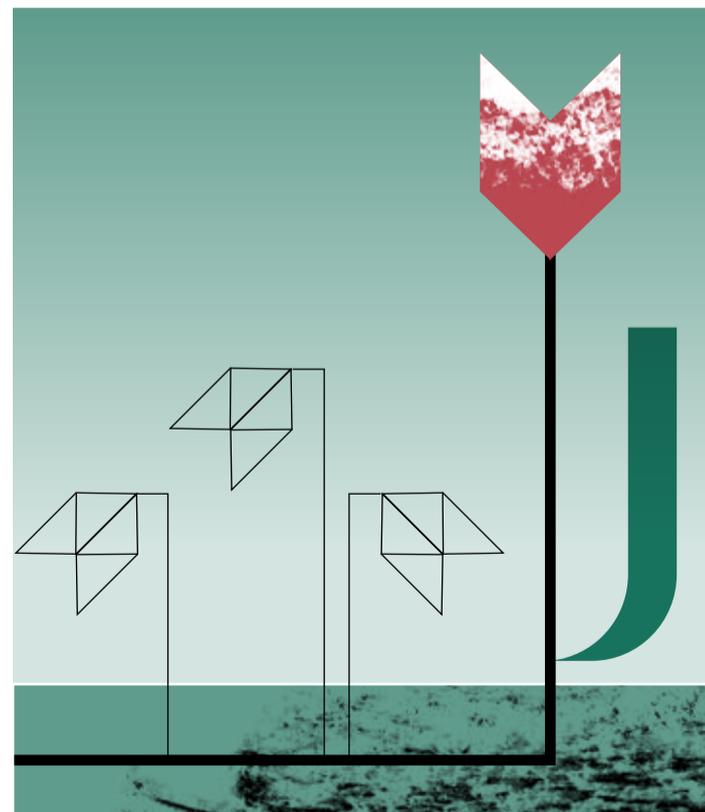


uncertain. No one is too big to fail. To be fair, the government acted a few years ago to move away from mega-bidders. The web portal Contracts Finder was launched in 2011 to help small and medium-sized enterprises (SMEs) win government deals. The portal is booming in popularity. The latest data shows more than 200 companies are signing up a week.

The goal is for a third of state procurement to come from SMEs by 2022, admittedly two years later than originally planned. G-Cloud, the government’s technology procurement

portal founded in 2012, reports that to July 2017, 73 per cent of all sales by volume went to SMEs, that’s 47 per cent of sales by value. The systemic risk posed by giant contractors like Carillion is now a political issue; around 30,000 SMEs may be owed money by Carillion. Smaller bidders are now in favour.

Lesson: smaller firms can aim for larger contracts with confidence



[ONE BELT, ONE ROAD] 一带一路

Pegged as the most ambitious infrastructure megaproject of all time, China's One Belt, One Road initiative (OBOR) will stretch from the very edge of East Asia to East Africa and Central Europe, connecting nearly two thirds of the world's population. Through continuous networks of highways, railways, ocean routes and ports, the scheme will open up cross-border connectivity and encourage a further integration of international markets.

Aside from kickstarting economic growth across China and many developing nations, many have questioned the true political intentions behind Beijing's masterplan, fearing potential renminbi internationalisation to world domination. Whatever happens, with \$1 trillion-worth of infrastructure works planned or already underway, OBOR will transform the Eurasian land mass and reshape global trade as we know it. How China will fund the works still remains to be seen, but a need for private capital involvement is certain, along with co-financing with member governments along the route.

KEY INVESTORS

- ◆ Asian Infrastructure Investment Bank (multilateral organisation)
- ◆ Asian Development Bank (multilateral organisation)
- ◆ China Development Bank
- ◆ Bank of China
- ◆ Other state-owned banks
- ◆ Silk Road Fund (funded mainly with Chinese capital)
- ◆ State-owned companies
- ◆ World Bank

65 countries affected

35% of global trade



31% of global GDP



62%

of the world's population

\$4-8TRN estimated capital needed for the project



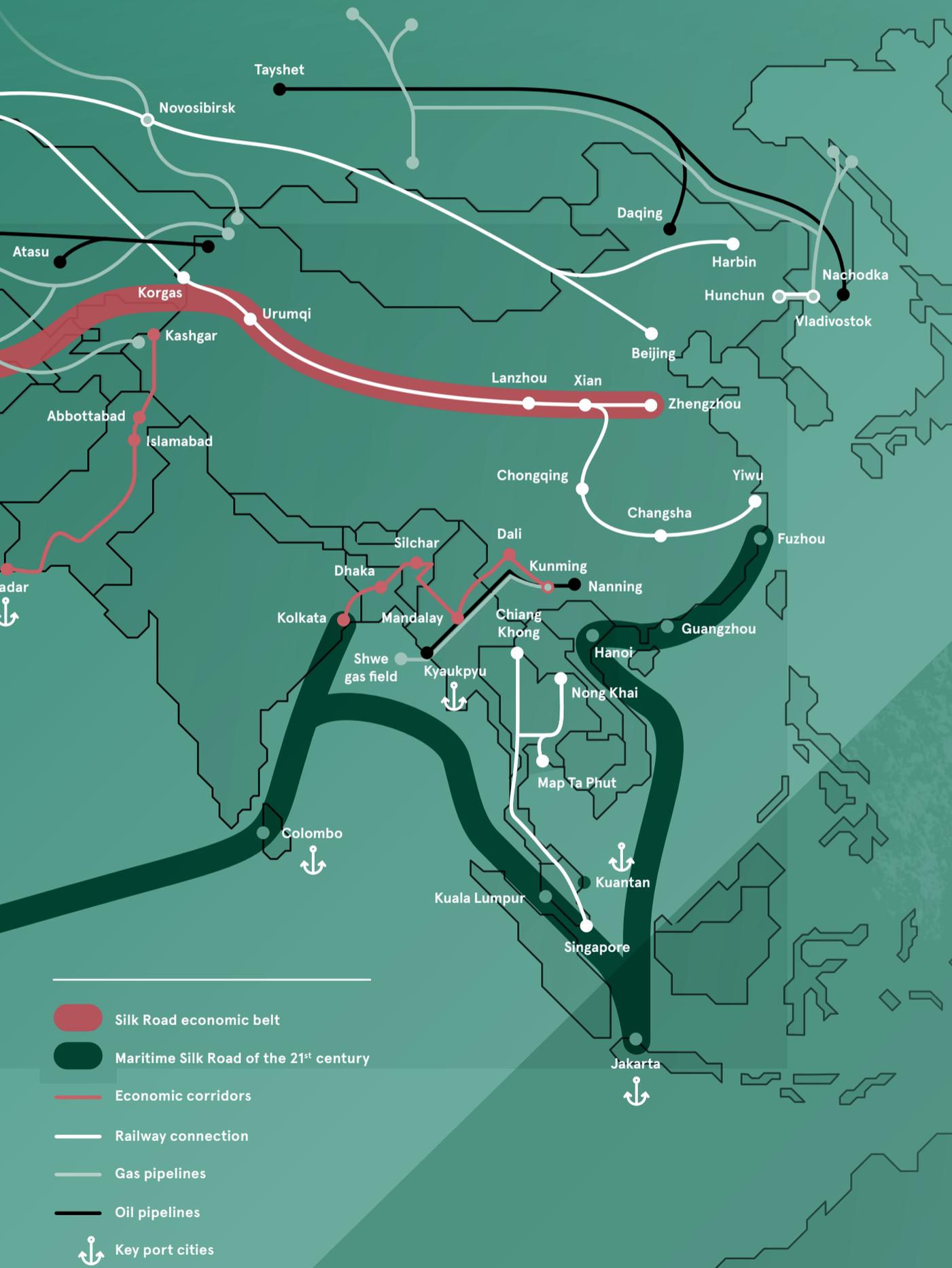


“The glory of the ancient silk routes shows that geographical distance is not insurmountable. If we take the first courageous step towards each other, we can embark on a path leading to friendship, shared development, peace, harmony and a better future”

Chinese President Xi Jinping



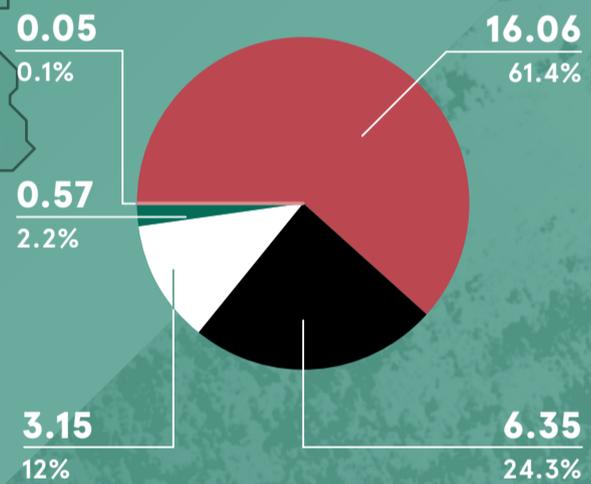
Indian prime minister Narendra Modi has been an outspoken critic of the plan, notably the China-Pakistan Economic Corridor passing through the disputed Pakistan-occupied Kashmir. India has labelled the project “a colonial enterprise, leaving debt and broken communities in its wake”, and was a notable boycotter of the OBOR summit last year



ASIAN INFRASTRUCTURE NEEDS BY REGION

Economic infrastructure investment needed between 2016 and 2030 by region (\$trn)

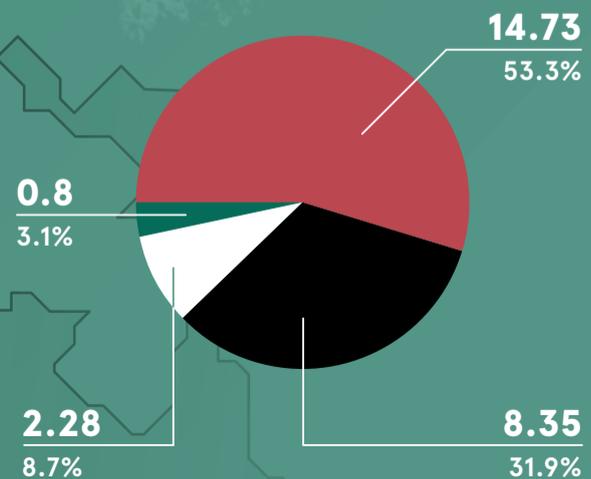
- East Asia
- South Asia
- South-East Asia
- Central Asia
- Pacific



ASIAN INFRASTRUCTURE NEEDS BY SECTOR

Economic infrastructure investment needed between 2016 and 2030 by region (\$trn)

- Power
- Transportation
- Telecommunications
- Water and sanitation





Investment that capitalises on fast infrastructure evolution

The infrastructure industry is evolving rapidly worldwide and specialist investment firms are taking bold steps to be ahead of the changes

Smart investors have long recognised the infrastructure sector's relative stability and reliable growth potential, and therefore its quality as an asset class. Yet the infrastructure environment has changed radically in recent decades and this presents challenges the industry must respond to.

"Infrastructure is a much more complex place to invest than it was 20 years ago," explains Boe Pahari, managing partner and global head of infrastructure at AMP Capital, an investment firm with tens of billions of dollars placed in the industry.

"Every asset class goes through a process of maturation and that's certainly happened in infrastructure investing. As you acquire new assets and generate returns for investors through active management, the assets are derisked and over time move from privatisation to direct investors," he says.

"The cycle is repeated as the asset class continues to evolve with new categories of risk. This means you need the right sector expertise to respond to the changing pace of infrastructure as it continues to represent essential assets and services in contemporary urban living."

There are four distinct causes of continued disruption in the infrastructure space, globalisation, urbanisation, digitisation and demographics.

Globalisation has meant a huge surge in the use of air travel, particularly in emerging markets, as well as strong demand for the creation of regional airport hubs, which in many cases are now also created as large-scale retail and commercial real estate destinations. Train services have also seen increased demand, bolstered by environmental awareness.

Meanwhile, urbanisation has resulted in significant shifts in demand for industrial-scale energy storage and localised power generation. In essence, with cities seeing their number of inhabitants swell year on year, energy demands are increasing and supplies need to be managed in the most economically and environmentally viable ways.

At the same time, the trend towards digitisation is strong, and demand is relentless for services based on fibre-optic and wireless connectivity. "Across the world, bandwidth has increased forty five times in the last ten years. The impact has been enormous on infrastructure, in terms of

telecoms towers and mobile technology," Mr Pahari says.

Meanwhile, global demographic changes are extensive, including quickly ageing populations in many countries. "By 2035, around 20 per cent of the population of the world will be 65 or older," Mr Pahari explains. "That represents a significant burden of responsibility for the public sector to look after the more senior sections of its populations."

It is also important to remember that with governments across the globe burdened with high levels of debt, fewer infrastructure projects are being publicly funded. Private capital is stepping in.

All these changes mean a significant new world for investors. Asset allocation is shifting increasingly towards platforms and away from more traditional core

“You need the right sector expertise to respond to the changing pace of infrastructure



Boe Pahari
Managing partner and global head of infrastructure equity

infrastructure. Taking the emergence of Uber as an example of a broader trend, Mr Pahari says that for infrastructure investors, the value is moving away from physical assets, such as taxi businesses, towards the digital platforms that underpin popular services. "Being part of the platform is the way we need to go forward," he says.

Understanding such driving forces is critical for investors as they look to minimise risks and identify value, investing in both listed equity and private debt. In no small part, the challenge is to assess the fast-changing dynamics of infrastructure markets accurately to seize the opportunities, predict where they are going and invest with eyes open to the future.

AMP Capital's "truly global" presence, with offices in Sydney, Delhi, Dubai, London, New York and Los Angeles, gives it a strong basis for getting as close as possible to a comprehensive appreciation of all the pertinent trends, Mr Pahari says.

But having a global network of offices is not enough for any investment manager. "The next thing you have to do is go out there, experience the changes yourself and spend time talking to people, trying to understand where the

world is headed," he notes. For investment management firms of the scale of AMP Capital, it is essential to be deeply entrenched in the infrastructure sector and offer real expertise to secure consistently correct decisions.

"The group of people we have working on our assets, from origination to management to board members to governance, is highly extensive, it's comprehensive and their ideas are very carefully thought through," says Mr Pahari. "Investors rely on this, so we pay close attention to building and retaining our expert skills base."

By doing so, the company can aim to bring "genuine sector expertise into sharp focus in all these different locations and environments", he says. Underlying all that, though, Mr Pahari insists: "You need to value your own people and listen to them very carefully. They're out there in the markets listening and coming back to you with myriad ideas about opportunities and potential threats."

AMP Capital is extensively invested in the major areas of disruption, from its presence in local airports, such as Newcastle and Leeds Bradford, to local power, wireless connectivity, and the provision of care for elderly people.

But even an operation with the scale and local presence of AMP Capital cannot sit back and expect routinely to predict the future. "Being ready for what lies ahead, against a backdrop of profound and constant change, is a challenge we always need to rise to," says Mr Pahari. "The only response is to be fully embedded in the infrastructure industry, to see the changes coming, and to have the skills to respond and invest well."

To find out how to invest successfully in the new infrastructure and be ahead of disruptive trends please visit ampcapital.com

Leading the charge of electric cars



Horacio Villalobos - Corbis/Corbis via Getty Images

Electric vehicles are the future, but there is still a long way to travel in providing a nationwide infrastructure of charging points

BURHAN WAZIR

Visitors to cities like London, Paris, Oslo and Beijing have grown accustomed to the ubiquity of charging points for electric vehicles or EVs. Cars sit silently, plugged into charging stations with sleek designs and unobtrusive neon lights. The stations look minimal and discrete. They are also set to become omnipresent.

The global market for EVs and related infrastructure has seen a major boost in the last 12 months. According to new research from EV Volumes, which monitors global sales, around 1.2 million EVs were registered worldwide in 2017, a 57 per cent increase on 2016. These figures include sales of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). China was the global leader with a 72 per cent year-on-year increase, representing nearly half of all sales; the UK ranks modestly at number 13.

In 2018, EV Volumes expects sales to increase by 1.9 million units, resulting in more than five million plug-in cars and light trucks worldwide, owing to the mass production of Tesla's Model-3 and deeper adoption in China.

"All these new cars will need charging points and infrastructure," says Viktor Irle, consultant and market analyst at EV Volumes, which is based

in Sweden. "In Europe, you can see that countries like Norway, Belgium, Switzerland and Finland are doing well in adapting to electric vehicles."

While 90 per cent of all EVs are charged at home, drivers living in apartments or those reliant on street charging require developers and local authorities to provide charging points. "As people increasingly move into mixed use communities, these new developments will need to be future-proofed," says Mr Irle. "One idea is that residents could be able to join together and demand charging points from developers. At the end of the day, future-proofing also adds value to properties."

The necessity of replacing internal combustion engines has been backed by targets from governments which has caused a related increase in infrastructure investment. Last summer, both the UK and France ruled that any cars reliant on diesel or petrol would be illegal by 2040. The falling price of EVs, prompted by subsidies and an increase in competition – an entry-level Volkswagen e-Up is priced at less than £10,000 – has also helped.

A rise in sales has also seen countries including the UK, Germany,

Holland and Norway launch a number of schemes to boost access to public charging. London recently announced plans to roll out 1,500 new charging points by 2020. A number of local authorities have also fitted charging adaptors to street lights.

Infrastructure is one of the most challenging aspects of building an electric vehicle network

Last year, Shell opened its first EV charging points in ten filling stations in London, Surrey and Derby; the points can charge most EVs in around 30 minutes. By the end of this year, China will have installed an additional 800,000 public charging points, including those

for workplaces, taxis and commercial vehicles.

Fears over a lack of EV infrastructure, combined with the distance travelled by EVs on one charge, were once summed up by the phrase "range anxiety", the dread that an EV might run out of power before reaching its next charging point. This trepidation has been a little assuaged by an increase in the number of public charge points and EVs which now range up to 300km.

Last year, Daimler, BMW, Volkswagen and Ford said they would work together to install a total of 400 public charging points in Europe, delivering 350 kilowatts, which will charge a small car to three-quarters full in four minutes and a large vehicle in 12 minutes. At the same time, user research has also provided some comfort to drivers. The average daily distance covered by cars in the UK is less than 40km or 25 miles; Americans travel around 70km a day.

Lee Feihn, UK business developer at NewMotion, Europe's largest electric charging partner, says: "Infrastructure is one of the most challenging aspects of building an electric vehicle network." His company launched

Mobi.E electric charging point in Porto, Portugal

in 2009 and became a subsidiary of Shell in October 2017. NewMotion designs, builds and supports electric smart charge services, including charging points, a mobile app and charge cards which allow access to 63,500 charging points in more than 25 countries. The company's first charging points were unveiled in December 2011 at the headquarters of Opel in Holland.

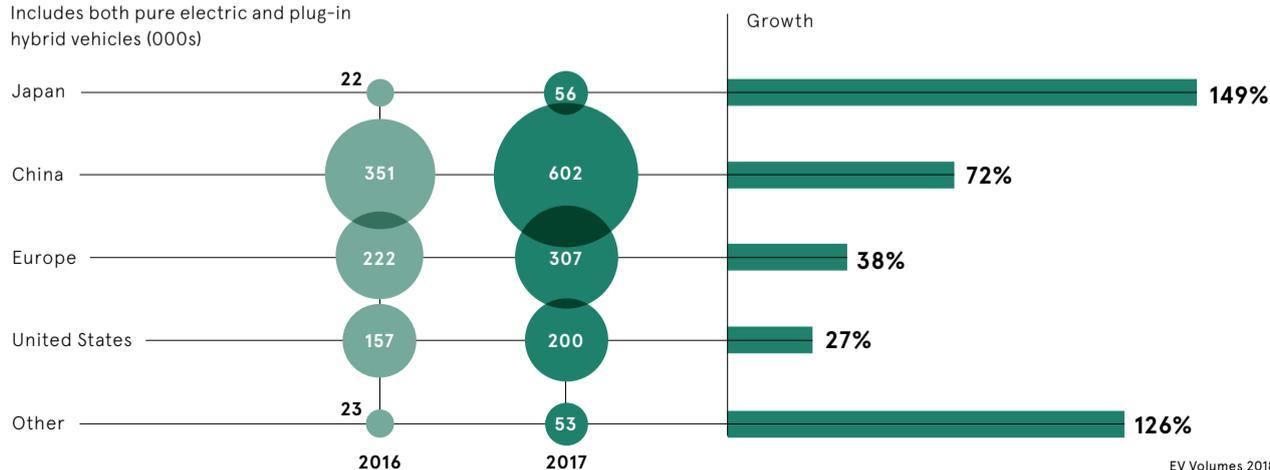
"Infrastructure needs are overwhelmingly on the side of electric cars," says Mr Feihn. The latest research from NewMotion, which surveyed more than 8,500 EV drivers across Europe, shows many companies have room to improve on EV engagement as only 10 per cent of surveyed EV drivers charge their cars at their workplace. "Homes will need additional charging points, streets require a variety of charging points and traditional fuel suppliers will need to adapt their businesses to lean towards a rise in demand for clean fuels," he says.

One additional hurdle concerns the cost and maintenance of super chargers on public land. An individual unit can cost around £22,000 to purchase and £45,000 to £50,000 to install. Super chargers also require maintenance from wear-and-tear, the elements and, occasionally, vandalism. "It is an additional complication in cities where most people don't have a private garage or a driveway," says Celine Cluzel, associate director at Element Energy, which specialises in providing analysis of low-carbon energy for industrial uses in transport, power generation and buildings.

"If a company buys land and installs chargers, that is relatively easy to do. But if the land is publicly owned, then you have to go into negotiations and tenders, which can be time consuming. For companies that specialise in EV infrastructure, access to electricity isn't always the challenge – access to land can be harder to negotiate." ♦

Plug-in sales in selected regions

Includes both pure electric and plug-in hybrid vehicles (000s)



Weigh up the risks and spot an opening

Infrastructure can be an attractive high-yield investment for private investors armed with an emerging database of risk-adjusted returns

TIM COOPER

The world economy needs to invest \$3.7 trillion a year until 2040 to keep pace with profound economic, environmental and demographic changes, according to the G20's Global Infrastructure Hub. This should create huge opportunities for investors to own infrastructure assets with attractive, stable returns.

By 2040, the global population will grow 25 per cent and the urban population by 46 per cent. Mean-

while, the United Nations sustainable development goals decree that everyone should have clean water, sanitation and electricity.

These changes will trigger massive demand for new infrastructure, with much of it built and managed by the private sector. But institutional investors, such as pension funds, are not satisfied. Current investment is 19 per cent behind the G20 target, and many say there are not enough infrastructure investments available with the right price and risk-return level that they need.

This problem is especially acute in the UK, where the pipeline of suitable infrastructure projects seems to have dried up. Mike Weston, chief executive of the Pensions Infrastructure Platform (PIP), says demand for infrastructure investments is growing.

"As defined benefit pension schemes mature, they want to de-risk their investments, typically by investing in index-linked gilts," he says. "But gilt yields are currently poor value. Infrastructure is the next place to look. It generates good cash flows that can pay pension schemes' regular outgoings and it tends to have low correlation with other assets."

Mr Weston says a typical UK scheme's allocation to infrastructure is around 2 per cent. But in Can-

ada and Australia it is more like 10 per cent, so there is significant scope for UK schemes to invest more. One reason UK allocations are lower is that Britain has large equity markets, so it has been easier to invest in them compared to alternatives such as infrastructure, he adds.

So Yeun Lim, investment consultant at Willis Towers Watson, says that demand is increasing because, in addition to higher yields, infrastructure features low volatility returns, linked to inflation or gross domestic product, which are perfect for liability matching.

Infrastructure investment initially focused on lower-risk assets, such as toll roads, utilities or regulated energy companies. But as private investment in the sector has more than doubled in the last ten years, competition for these has inflated prices, making it harder to achieve desired returns, says Ms Lim.

Fund managers have, therefore, targeted higher-risk infrastructure assets from different sectors, such as healthcare clinics, and geographies, such as emerging markets. "These assets still have attractive characteristics, such as a monopolistic position and 'sticky' income base," she says. "The investor might not want the extra risk. But if you do, you need certainty about how the manager plans to get the targeted return. You might have to question them more."

Better data brings greater transparency and opens the decision about where to invest

Engineer undertaking tunnel maintenance beneath Kings Cross Station in London

Annabel Wiscarson, head of Europe – global relationship group at IFM Investors, a fund manager set up and owned by pension funds, says: "We are keen on UK infrastructure, but we don't see much deal flow here. There are more opportunities elsewhere. The UK government's infrastructure projects are not sharing risk nor providing reasonable returns in a way that works for the private sector."

"Uncertainty around Brexit is also not inviting to investment in UK projects. Our diversification into global infrastructure has, therefore, been popular with UK funds. For example, we have invested in Mexican toll roads. But it takes nimbleness, resources and patience to understand the risks."

Three of the main risks of investing in infrastructure relate to the economy, regulation and contracts. The economic risk is that there will not be enough demand for your



Chris Henderson/Getty Images

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asset. For example, some toll road investments have struggled because traffic flow was lower than projected. If a government or regulator changes the rules in your investment's operating environment, it could affect returns. Any long-term contract with a single or small number of customers or suppliers creates a risk. So you need to research the strength of the counterparties.

Some see illiquidity as a risk because it is hard to sell your stake in a major infrastructure project before it ends. But Ms Wiscarson says: "I put liquidity risk down the list because investors understand that infrastructure is illiquid. Investing in a fund with a portfolio of projects also spreads this risk. Don't forget, the investment pays higher returns to compensate investors for these risks."

Complexity is also an issue. Mr Weston says: "Building a tunnel or power station is immensely complicated, so you have to understand all the inherent risks to invest. You need lots of resources for that, which makes infrastructure investing expensive. PIP was set up to reduce those costs and those barriers to entry."

Marcus Ayre, co-head of infrastructure transactions at First State Investments, says UK projects have reduced because private sector development has fallen out of favour politically. "But other markets have found ways of matching institutional capital with quality projects, so it can be done," he says. "Europe has been consistently the most active market for infrastructure. Australia has punched above its weight. The US has always promised a market, but that hasn't materialised."

Robert Love, head of research at Asset Intelligence Research, recommends diversifying to infrastructure investments related to new technologies, such as datacentres,

fibre optic cables and mobile phone towers. "Sticking to older infrastructure types is a risk because it might be less prevalent in 20 years," says Mr Love. "But early adoption of new technology is also a risk as these markets evolve quickly."

Another barrier to investment has been the lack of standardised performance data enabling comparison between investments. Mr Ayre says: "Getting comparable data is not straightforward though indices are appearing. But infrastructure investment has shown itself to be resilient, even in economic downturn, and delivered dividend yield plus capital appreciation over the last decade."

New comparison data emerged recently from the Edhec Infrastructure Institute, supported by the Organisation for Economic Co-operation and Development, G20 and the World Bank. It published European benchmarks that enable investors to measure risk-adjusted returns and compare investments within the sector and with other asset classes. It also plans to publish global data by early-2019.

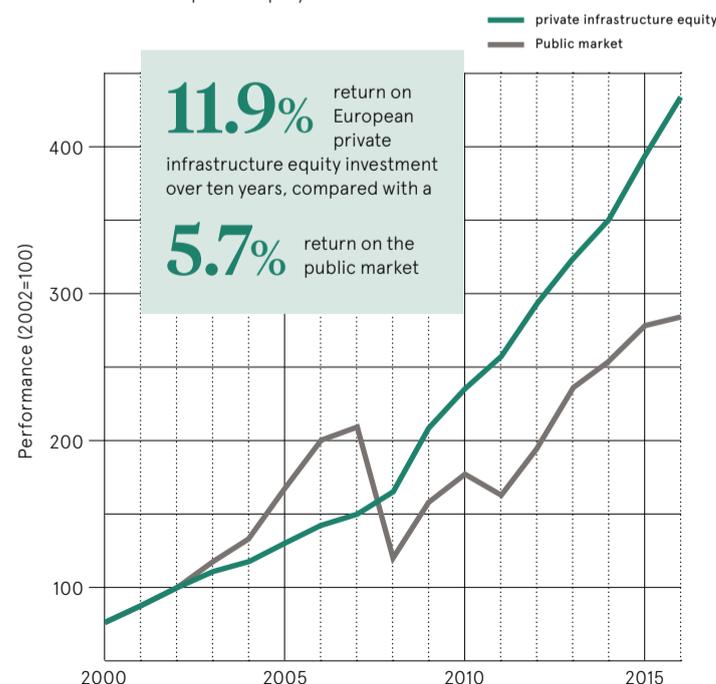
Sarah Tame, associate director at Edhec Infrastructure Institute, says: "Although infrastructure is illiquid, our research shows that if you can measure the risk-adjusted performance effectively, investment becomes much less challenging."

"You do see negative returns on some assets. But our benchmarks give a portfolio view and indicate that risks reduce considerably as they spread across the portfolio. The research also shows that infrastructure provided greater performance and lower risk compared to the stock market between 2000 and 2016."

"There is an influx of institutional capital chasing the same trophy assets in Europe. But better data brings greater transparency and opens the decision about where to invest." ♦

Private infrastructure returns surpass the wider market

Comparing the performance of European private infrastructure equity investments and the public equity market



The EDHECinfra All Infrastructure Private Equity Index represents the average market performance of the infrastructure sector in 14 European countries

EDHECinfra 2017



Euro-investment boom is set to continue

Opportunities for institutions to invest in European infrastructure projects continue to grow rapidly, with the market expanding from €34 billion in 2008 to €88 billion last year

Government policies are pro-infrastructure. For example, the European Union's Juncker Plan earmarked €315 billion to invest in infrastructure between 2015 and 2017. Many private sector projects continue to benefit from these cash injections.

Meanwhile governments and private investors are responding to wider societal changes around demographics, decarbonisation and digitisation that require major infrastructure upgrades.

For example, a study by the International Energy Agency showed that in the period to 2040, 60 per cent of new electricity generation plant will be renewable. This requires huge changes to the way power networks are managed.

It comes down to applying your experience to find good assets, allocate time and resources appropriately, and identify and manage the risks

Demographic changes will also be significant. On current trends, more than 60 per cent of the population will be of non-working age by 2040, according to Eurostat. This, together with the changing consumption patterns of millennials, will lead to far-reaching changes in infrastructure demand, from transport to telecommunications.

Many of these changes are being facilitated, or even accelerated, by the rapid advances in digitisation and data. The world's data is set to grow ten

times between 2016 and 2025, according to analyst IDC, requiring significant investment in data infrastructure.

European opportunity

Infrastructure investment opportunities are particularly established in Europe due to the predominant model of private sector funding. In contrast, the United States tends to rely more on public funding and ownership.

Many European projects from toll roads to wind farms offer stable, long-term returns to institutional investors. They create annual yields, often linked to inflation, helping investors to match their liabilities closely.

This makes infrastructure a sought-after alternative to bond investments, especially in the recent environment of low bond yields.

Predictability and low volatility are fundamental features of infrastructure investments underpinned by high barriers to entry, high customer retention and hard-to-replicate, asset-intensive business models with ownership of large physical assets.

Governance risks

Simon Gray, co-managing partner of Arcus Infrastructure Partners, highlights regulatory change and poor corporate governance as key risks in infrastructure investing. "Regulatory approach and policy direction are important, but changes in regulation are a risk for any business," he says. "You also need strong governance arrangements in place with, for example, quality management, clear responsibilities, and alignment between business and investors. High-quality motivated people are key to investment success."

Market segmentation

Arcus' co-managing partner Ian Harding says there are many projects seeking billions of euros of investment in Europe over the next few years. "The public sector can't fund it all; it needs private

capital," he says. "Toll roads, utilities, gas grids, rail and many other infrastructure assets are built, owned and run profitably by private companies."

Mr Harding says the increasing specialisation of infrastructure asset managers is also helping investors. "As the sector evolves, it is segmenting risk-return profiles from different offerings," he says. "The lowest risk-return is in public-private partnerships and private finance initiatives, but we focus on the higher-return end where we see the most attractive opportunities."

"We focus on three sectors – telcoms, transport and energy – and grow mid-market companies, usually by becoming the majority shareholder. These businesses are dynamic – we need to be nimble. But our team has many years' experience creating value through good and bad economic times."

Exciting times

Mr Gray and Mr Harding say it is an exciting time in the asset class as trends such as mobility, high-speed data and smart energy will provide huge opportunities.

"Government policy is mostly conducive to expansion in these areas," says Mr Gray. "Politicians are still committed to developing green energy. In data, EU policy is to expand broadband access and 5G, for example. In transport, policy is to move towards rail, improve transport corridors and switch from carbon fuels to electricity."

"There is no shortage of opportunity. It comes down to applying your experience to find good assets, allocate time and resources appropriately, and identify and manage the risks."

For more information about Arcus and European mid-market infrastructure please visit www.arcusip.com



Opportunities in the 'last golden land'

Despite Africa's huge potential, there is a lack of expertise and investment in infrastructure, leaving millions languishing in poverty

NICK EASEN

The numbers speak for themselves. If Africa is to unleash its true economic potential, \$170 billion is needed every year in infrastructure investment, according to the African Development Bank. The continent is rapidly urbanising, its workforce is growing by 12 million a year. Six of the world's fastest-growing economies in 2018 are forecast to be African.

Yet this story of progress is occurring despite its poor energy, water and transport networks. "The size and scale of the need is beyond imagination; the challenge is enormous," says Miguel Azevedo, head of investment banking for the Middle East and Africa at Citigroup. "Africa needs a lot of infrastructure right now if it's to make the most of its demographic dividend."

The share of Africa's working-age population is rising faster than any other region globally; 70 per cent of the populace is under the age of 30. By 2034, it will have a larger potential workforce than either China or India. Only accelerated infrastructure investment will harness this growth.

"If it does not happen it will be dramatic for Africa and traumatic for Europe since people will start migrating north for a better life; something must be done. African countries are starting to realise that

many issues stem from a lack of infrastructure," says Mr Azevedo.

Currently power is the lowest-hanging fruit in terms of return on investment. Sub-Saharan Africa is starved of electricity; two out of three people lack a domestic supply and there are many studies showing that a lack of basic infrastructure slashes productivity, as well as growth in gross domestic product.

"Many millions use generators for electricity costing 50 cents for one kilowatt. If you build a power plant the price comes down to ten cents. It's a no brainer. The demand is there. People will pay," says Mr Azevedo.

It's not that there's a lack of money either. Institutional investors have more than \$100 trillion in assets under management globally. A small fraction could easily plug Africa's financing gap. The list of investment hotspots is also getting longer, with seven visible leaders including South Africa, Rwanda, Kenya, Ethiopia, Egypt, Morocco and the Ivory Coast. Yet chronic issues linger.

"The actual hurdle is 'bankability', and the challenge that investors face in identifying and structuring bankable projects," explains Ibrahim Sagna, director for advisory and capital markets at Afreximbank.

"The second set of challenges relates to government aptitude. In most cases they own the jurisdiction and the asset, so they need to guide the regulations and concessions, as well as kickstart the agreement. All too often political agendas create hurdles for transactions."

There is a third challenge, which is lack of technical expertise. The critical mass of consultants, project managers, legal advisers, skilled staff and other service providers is sorely lacking across Africa.

"Experienced and well-capitalised private sector infrastructure developers are beginning to emerge from Egypt, South Africa and Nigeria. They will cascade into the continent as its wealth and growth make it more attractive, yet the current supply side is very limited," says Mr Sagna.

Those schemes that are bankable do well. Infrastructure projects have default rates of 16 per cent across the globe. In Africa the rate is under ten.

"Once an African project gets checked as bankable and doable, and gets to financial close, the chances of losing money are very limited because lenders go the extra mile of caution, and hedge to make sure that if anything goes wrong there's a mechanism so they will be paid, even if there is some delay," adds Mr Sagna.

The traditional project finance model is common, but raises challenges in Africa since there are often issues with drawn-out timelines. Also many projects are complex in terms of their structure, documentation and the number of parties involved. It's why there are many public-private partnerships.

"The criteria for project finance are not very flexible, nor is it suitable for smaller projects," explains Raj Kulasingam, senior counsel at global law firm Dentons. "Chinese financing is also becoming more prevalent, although this comes with its own set of rules including the use of Chinese contractors and equipment."

China has stepped into Africa where other foreign direct investment has feared to tread, offering up its hand as an alternative investment partner. This Asian giant takes the long-term strategic view, helping it overcome challenges faced by short-term Western investors.

\$170bn

is needed every year in infrastructure investment for Africa to unleash its true economic potential

African Development Bank

"Africa is regarded as the 'last golden land' by many Chinese," explains Dr Jing Gu, director of the Centre for Rising Powers and Global Development at the Institute of Development Studies. "Important ports and other coastal cities are hotspots for infrastructure. These developments are also complementary to China's Belt and Road initiative [recreating the ancient Silk Route]."

One solution offered by Mr Azevedo is the formation of an Africa Infrastructure Investment Bank, mirroring China's Asia Infrastructure Investment Bank. Backed by Europe, this could step in to fill the infrastructure gap. "Europeans have a lot of expertise. It would be in their strategic interest. They would also ensure the effective use of funds," he says.

Something needs to change if Africa is to reach its full potential; the continent must industrialise to generate employment and end poverty. Infrastructure investment is paramount, whatever model is used. ♦

Experienced and well-capitalised private sector infrastructure developers are beginning to emerge from Egypt, South Africa and Nigeria



Installation of a hydroelectric plant gave the Congolese town of Bugara electricity for the first time in 2016

‘We must demonstrate how private investors have improved the performance and efficiency of infrastructure’

The UK has long been recognised as a leader in innovative approaches to the use of private capital in the provision of our infrastructure. As I travel abroad and engage with governments, I am often struck by the many comments on how much the UK has achieved through our ambitious, strong, fair and transparent regulatory and contractual frameworks, pioneered over the past 20 to 30 years.

Yet, when I return to these shores, I find that we have a loss of self-confidence with privatisation and public-private partnerships (PPPs) increasingly being presented here as a betrayal of the public. Our younger generations were not around to see the improvements that privatisation brought to the UK, business has stopped making the case and very few politicians are standing up for an approach that has worked well, and the UK economy will need going forward.

To disagree, you must believe the public sector is more efficient at the delivery of infrastructure, that sustained investment in upgrading our infrastructure is more likely when investment decisions are made in a political environment, which emphasises short-term decision-making, and that the money tree does indeed exist. To those who do, I say be careful what you wish for.

The need for continuing investment is clear, with the latest assessment of the UK's future pipeline being £600 billion. High-quality infrastructure makes our lives better; it stimulates economic growth and creates local jobs. Now more than ever we need to demonstrate that the UK is an attractive destination for international companies and high-quality infrastructure is a critical element of this.

In theory, we can make this investment without private capital, but only through a massive increase in direct taxation and government borrowing, as infrastructure has to be paid for somehow. And so we should be very clear on the adverse implication of a negative message to international investors about how welcome their money is.

Critics of the use of private capital should also consider where the funds actually come from. In many cases, it is UK pensioners, put-

ting their savings into long-term stable investments that provide an income stream for their retirement. We should promote this.

My argument is not public sector bad, private sector good. The public and private sectors have and should have different skill-sets. The public sector has an important role in setting policies, prioritising projects, making the rules and pricing mechanisms. The government has a significant toolkit in how to deliver our infrastructure, including direct procurement, privatisation, PPPs and joint ventures.

It is critical these options are better understood, that the decision-making process is clear and there is a robust evaluation of what has been actually achieved, something I think is profoundly lacking at the moment.

But the private sector must do more to demonstrate, with a real evidence base, the benefits of private sector skills, the use of its capital and ownership. The failure to do this well has left a void that is being filled with great effect by critics. As a sector, we must demonstrate clearly how private investors have improved the performance and efficiency of the infrastructure they own and operate, while responding to challenges set by regulators on behalf of consumers.

The industry must show that it manages public assets effectively, demonstrate good governance, and identify where it has invested in new and upgraded infrastructure. In return, it needs a fair and consistent framework and political support. If these things are in place, the public and private sectors can build a better Britain together.



Andy Rose
Chief executive
Global Infrastructure
Investor Association

Growth markets are compelling opportunity

Glen Matsumoto, partner and head of infrastructure at Actis, shares insight into infrastructure investment opportunities in emerging markets

Investing in the infrastructure of emerging or growth markets presents a compelling opportunity.

There is a significant supply-demand imbalance, and meeting the massive need for capital investment can be transformational for countries, cities and communities, while generating impressive risk-adjusted returns for institutional investors.

Economic and urban population growth in these markets is outpacing that of the developed world. Populations are rapidly urbanising; three quarters of the world's urbanites live in growth markets compared with only 40 per cent in 1950, while gross domestic product (GDP) is projected to be 3 per cent higher than the developed world for the foreseeable future. When you combine these macro elements, it is clear the need for infrastructure is huge.

A recent McKinsey report estimated that \$3.7 trillion of investment in economic infrastructure alone is needed every year from now until 2035 to keep pace with projected GDP growth globally. Almost two thirds of global infrastructure investment in this period is required in the growth markets.

Since inception in 2004, Actis has attracted \$13 billion into growth markets and established itself as a leading investor across Africa, Asia and Latin America, in energy, private equity and real estate.

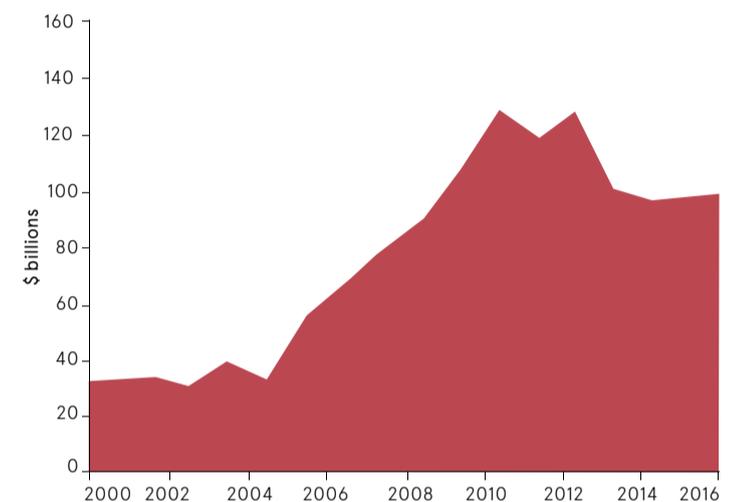
When I joined Actis to build the infrastructure business, the firm was in the final stages of raising its fourth energy fund with close to \$3 billion of capital commitments, reflecting the appetite that institutional investors have for the growth market opportunity and the confidence they have in Actis to realise it.

Historically, institutional investors have perceived growth markets as high risk. Therefore, they have demanded a high return, and as a result have focused more on the development and construction stages of infrastructure assets. This means that today there are derisked operating assets in the hands of owners who have little appetite for longer-term operational improvement strategy. In our view this provides a new, exciting and growing investment opportunity.

I was involved throughout the 1990s when the initial private sector

“We focus on basic infrastructure that will drive future economic growth”

Private greenfield infrastructure investment, 2000-16



World Bank Private Participation in Infrastructure (PPI) database based on developing countries

infrastructure investment in emerging markets occurred and back then it was like the Wild West. Private investors were naive; they thought that they could solve big problems by simply throwing money at them and make outsized investment returns.

There is now significantly less risk in certain emerging market countries than there was 20 years ago. Governments in growth markets know they're competing against other emerging economies for private capital. They know their internal budgets cannot fund all their needs. If they don't adjust their regulatory and legal structures (in our experience many have), and make it compelling to bring in private infrastructure investment, then they're going to fall behind and not keep up with that growth.

Private capital finds its way to those countries that take the necessary steps to provide an attractive investment environment for long-term investment in infrastructure. In emerging markets, some countries have been successfully attracting long-term private infrastructure investment for the past ten to fifteen years.

We focus on basic infrastructure that will drive future economic growth. Our firm understands the power sector extremely well; we know power generation, distribution and transmission, and infrastructure that services the sector. By driving operational improvement in these assets, with support from the community and the local government, great value can be created in this space for both investors as well as the local communities which the infrastructure serves.

For example, Actis' energy business invested in Ostro, a 1,000-megawatt



Glen Matsumoto
Partner and head
of infrastructure at Actis

renewable power generation company with operations in Rajasthan, India's second-largest state and one of the driest where there is severe need for safe drinking water. In addition to providing vital access to power for numerous businesses and households, the management team has also installed water facilities for the local communities where the generation facilities are located.

As a firm we have repeatedly seen that investing responsibly creates businesses that are better able to manage risks and opportunities; they are more resilient, more innovative, more able to deliver societal benefits – and ultimately more valuable for investors as a result.

To learn more about investing in growth markets please visit www.act.is/





Oil rich invest in infrastructure for low-carbon future

The world's oil-producing regions are looking to a low-carbon future without "black gold"

FELICIA JACKSON

Despite its role as a major provider of low-cost oil and gas, in addition to its position as the world's eighth largest emitter, the United Arab Emirates (UAE) is successfully diversifying its economy through the deployment of low-carbon infrastructure.

By 2016 oil revenues constituted less than 50 per cent of the UAE's export receipts. It recently announced plans that, by 2050, 44 per cent of the country's energy usage would come from renewable sources, 38 per cent from gas, 12 per cent from cleaner fossil fuel and 6 per cent from nuclear power. By 2035, it expects to deliver 61 gigawatts (GW) of additional solar, which is a remarkable goal given that installed capacity in all of Saudi Arabia was 61GW in 2016. And the funds are available to support the rhetoric, with a commitment of £134 billion to achieve these aims.

While much of the region's push into low-carbon infrastructure has been in the power sector, it is developing new heating and cooling projects, desalination combined with renewables, future city planning, electric vehicles and exploring best ways to finance such approaches. One of the most important projects for effecting such change has been the Abu Dhabi-based Masdar Initiative. It was instituted to act as a developer of clean energy power projects, and sustainable urban planning and development, and drive innovation across a range of clean technologies.

One example of the scale of change is the recent announcement by Masdar of the launch of construction on the 800 megawatt phase three of the Mohammed bin Rashid Al Maktoum Solar Park in Dubai. Through Shuaa Energy 2, a joint venture between Dubai Electricity and Water Authority (60 per cent), Masdar (24 per cent) and EDF Energies Nouvelles (16 per cent), when complete this

Mohammed bin Rashid Al Maktoum Solar Park, south of Dubai

will be the largest single solar plant in the world, providing 5GW of solar power by 2030.

The Masdar-led consortium won the project after offering the lowest recorded bid for a solar plant at the time, valued at 2.99 US cents per kilowatt hour. It's the achievement of this goal that is transforming the infrastructure playing field around the world. Bader Saeed Al Lamki, executive director of clean energy at Masdar, says: "The way we generate and consume power is expected to change; we're on the verge of a new paradigm. The fundamentals of the sector are so strong that it makes commercial sense."

“Its vast, uninhabited land strips create the perfect place to build large-scale low-carbon energy generating plants

low-carbon infrastructure in the Middle East and North Africa (MENA). This stems in part from security over assets and the promise of long-term income streams. As the cost of deploying low-carbon technologies goes down and international pressure to commit to climate change agreements jumps up, the stage is set for low-carbon infrastructure to take flight.”

What matters is how these developments are connected and can provide knowledge, experience and the potential for industrial learning. Improvements in district cooling efficiency, an increasingly important requirement for a warming world, are being trialled. Renewables-powered desalination is contributing to the region’s overall water security with the Ghantoot project and Abu Dhabi has built a huge storage system under the Liwa Desert to ensure that water is preserved. In case of emergencies, the reserve can provide about 100 million litres of water a day to the country’s residents. Dubai’s new solar park is even intended to print its own 3D lab.

What makes the UAE special is quite specific to the region. As Mr Hellmund points out: “Its vast, uninhabited land strips create the perfect place to build large-scale low-carbon energy generating plants. Large solar plants are able to harvest more energy from the sun due to the more favourable angle of the sun rays than similar plants located further away from the Equator.

“Finally, many countries in MENA are blessed with the ability to construct new, innovative energy transmission and distribution networks, rather than having to upgrade older existing ones.”

This doesn’t mean that other regions may not be well placed to take advantage of the opportunity to bypass infrastructure development, from telecoms to power, rail, water, roads and more. One of the key questions surrounding the continuing development of renewables is the speed at which energy transition will take place as this will drive investor interest in new opportunities. There are strong disagreements between experts regarding dates for peak oil consumption, which range from the International Energy Agency’s projection of 2040 to some as soon as 2021. The speed of energy transition will be key to changes in infrastructure as a whole.

There are analysts who see what is now happening with energy as a structural shift in the way the economy works. As Carbon Tracker’s Kingsmill Bond says: “The ‘business as usual models’ favoured by incumbents are simply wrong.” He points out that the last time we saw such a shift in energy was from biomass to hydrocarbons after 1800 and that once the “foundation technology” changes, so does everything else.

Markets are driven by tipping points, which means they are driven by incremental changes; they look to where new growth lies. With the dramatic fall in the cost of wind and solar over recent years, it’s possible investors may soon lose interest in high-carbon infrastructure altogether. ♦

“We are optimistic for the future. Renewable energy fundamentals have been established quite strongly – it’s a viable economic choice on the table, driven by technological evolution and R&D, reduced price and regulatory frameworks for investors that have matured.”

Masdar’s approach goes far beyond energy and the linking of utilities needs with generation options. The company has not only shown a strong focus on providing energy security, while offsetting carbon emissions and diesel use, but has also worked to develop Masdar City, which offers a visionary “greenprint” for sustainable urban development. Indeed, according to Yousef Baselaibthe, executive director of Masdar Sustainable Real Estate, the cost of operating within Masdar City is now equal to anywhere else in the region.

Christian Hellmund, partner in the energy and renewables team at law firm DWF, says: “Investor confidence is key to driving the development of



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