Building the New Normal
A knowledge sharing series for the built environment

More resilient, more sustainable, and more predictable:
the future of infrastructure

BTY Briefing Note

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OPERIS

Briefing Note Contributing Authors:

Marie Foley
BTY, Director,
Infrastructure Advisory

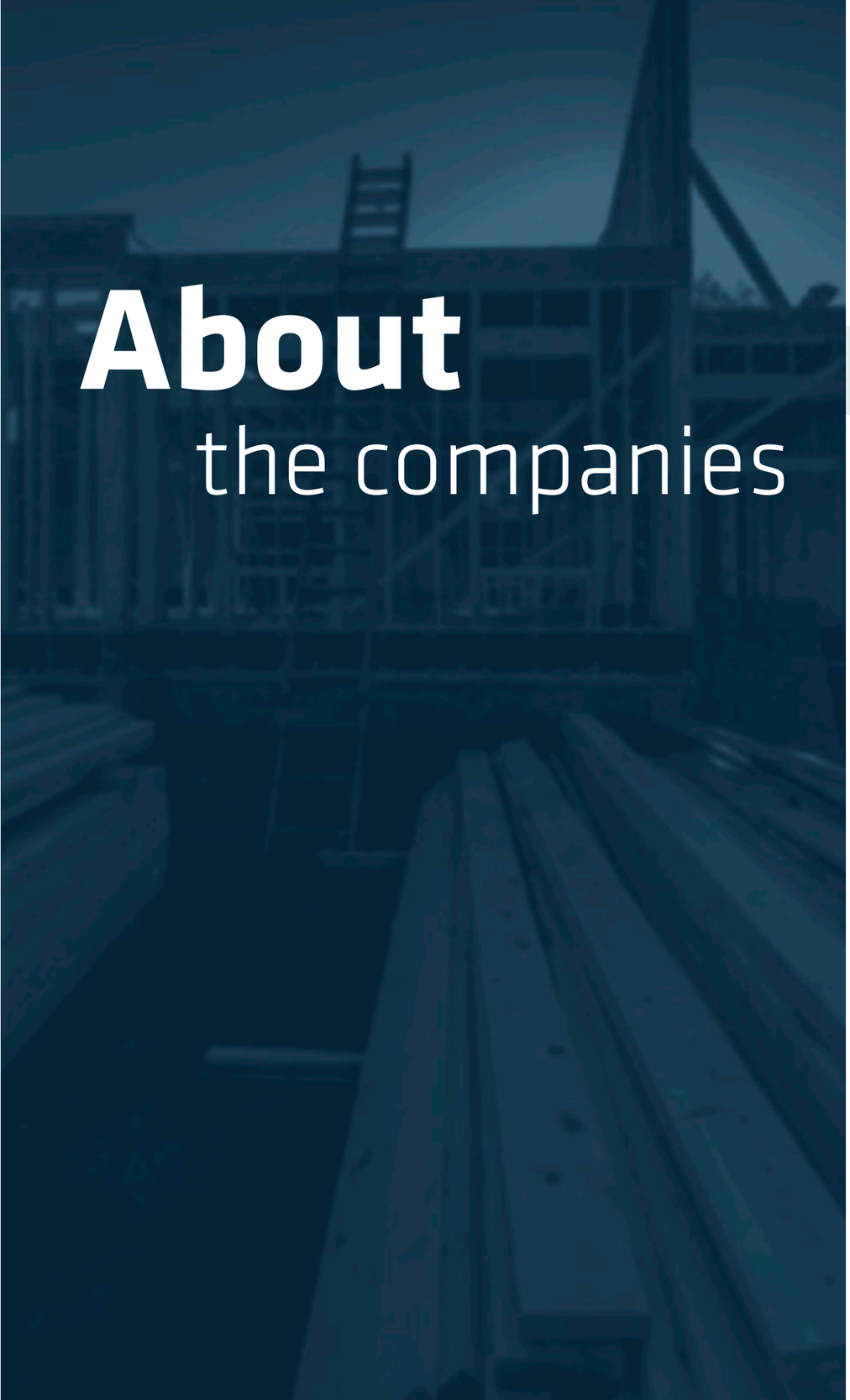
Michael Kennedy
BTY, Director,
Infrastructure Advisory

Sharlene Hay
BTY, Director,
Infrastructure Advisory

Tunca Ataoglu
BTY, Director,
Infrastructure Advisory

Erwan Fournis
Operis, Director and Head
of Advisory - London

Charles-André Gonthier
Operis, Associate Director,
Toronto



About
the companies

BTY is an award-winning professional consultancy providing Complete Project Solutions in real estate and infrastructure asset planning, development, operations and transactions.

Established in 1978, the firm's operations are based in North America, Europe and the Middle East, with a multi-sector global portfolio of projects valued at over $100 billion.

Operis is a leading advisor in project and infrastructure finance renowned for its expertise in the financial modelling of project finance transactions worldwide. Since its inception in 1990, Operis has built on this distinctive strength and developed an envied portfolio of services specifically focused on project finance including: Advisory, Model development, Model Audit, Tax & Accounting, Financial Modelling Training and Software.

Operis works by forging close collaborative partnerships to achieve effective and productive results for its clients. Its approach is to provide expert and personal attention that only an independent firm can deliver.

The firm's experience spans all infrastructure and energy sectors and covers over 1,150 projects and other funded transactions around the world.

Analysis of COVID-19's impact is showing that future infrastructure needs to be more sustainable in building, more resilient in operation, more equitable in value creation and more predictable – all of which can be achieved with innovation through more inclusive development and more collaborative partnerships, especially those that leverage technology and data.

The pandemic severely stressed infrastructure across sectors, types and countries.

It revealed critical vulnerabilities in demand-based models across sectors, including aviation, healthcare, education, tourism, and transportation, among others.

Severe decrease in oil demand -- in conjunction with production cutbacks -- destabilized oil pricing.

Expect shift in how projects are developed and who benefits from the value infrastructure creates

COVID-19 accentuated the need for more sustainable, resilient infrastructure that can effectively operate during acute and widespread disruptions.

It also brought into sharp focus the need for inclusive development that supports social equity while safeguarding the environment.

It has accelerated the need for collaborative partnerships leveraging technology and data to support infrastructure delivery and operations.

A higher bar for resiliency, sustainability and social equity could lead to either the repackaging or cancellation of projects that fail to measure up.

BTY and Operis have collaborated to create this briefing note to support our clients' understanding of the COVID-19-accelerated sea change we see coming to the industry. We look at how the infrastructure space needs to adapt in developing resilient projects going forward and what the impact can be on infrastructure investment across some key sectors.

Opportunities

to Change and Adapt

We believe the pandemic has the potential to become an inflection point in building a better world with more sustainable, resilient and adaptive infrastructure.

As a public health as well as a global economic crisis that touches every area of daily life in every area of the world, COVID-19 is providing lessons that no prior crisis could have.

Its impact impels us to reimagine not only the type of infrastructure we build but also our bankability and risk management models.

COVID-19 can serve as a proof of concept with far-reaching potential to inform how to:

Organize and coordinate globally in response to crisis

Adapt in the field to continue providing critical services

Respond under high risk situations to keep economies going

Accelerate adaptation and prioritize technological applications

Make infrastructure more affordable. Infrastructure tends to be more expensive and less accessible for lower-income households

At the project level, infrastructure will require revised selection criteria that raise the bar for defensibility.

Projects will have to be more sustainable in building, more resilient in operation, more equitable in value creation, and more predictable in performance.

They will also have to be more affordable because of the disproportionate impact the cost of accessing infrastructure, such as transportation and broadband, has on lower-income people.

These adaptations will most likely be first experienced in healthcare, educational and smart and green transportation infrastructure projects. [1]

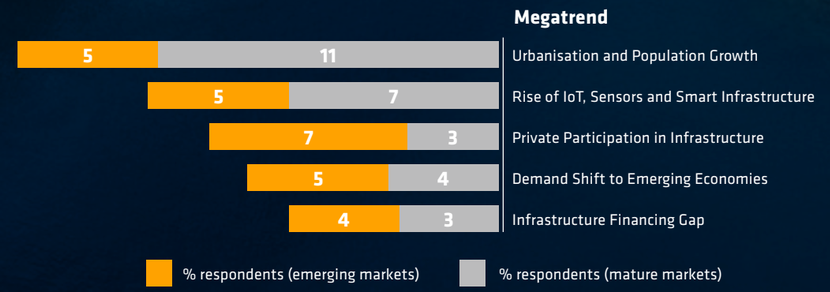
[1] *https://www.fdiintelligence.com/article/78180*

Opportunities

In Infrastructure Development

Three of the top five opportunities identified in an Infrastructure Futures report focus on trends in Technology (Rise of IoT (Internet of Things), Sensors, and Smart infrastructure) and Infrastructure (Private participation in Infrastructure and Infrastructure Financing Gap). The report from the Global Infrastructure Hub (GI Hub), World Economic Forum (WEF) and Boston Consulting Group (BCG) is based on survey responses from more than 400 respondents in 70 nations, with 35% of respondents from emerging markets, and 65% from mature markets. [2]

Percentage of Respondents Ranking Megatrend's Relative Importance

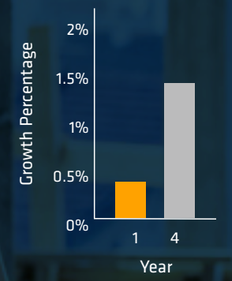


[2] *Infrastructure Futures: The impact of megatrends on the infrastructure industry*

New and Expanded Partnerships

In Funding and Technology

As governments seek to rebuild COVID-19 economies, there is now a global push to launch the biggest round of infrastructure investment since the post-2008 financial crisis stimulus measures.



It is a proven rebuilding strategy. On the supply side, when 1 per cent of GDP is invested in infrastructure, economic output rises by an estimated 0.4 per cent in the same year and by 1.5 per cent four years later. [3]

At the same time, unprecedented government spending in the initial responses to COVID-19 is expected to result in diminished infrastructure funding capacity.

Expanding public-private partnerships (PPPs), which have demonstrated their effectiveness in delivering value for money on projects across a growing number of sectors over the past three decades, can play a critical role in developing and delivering post-COVID-19 infrastructure.

[3] *https://www.weforum.org/agenda/2020/04/coronavirus-covid-19-sustainable-infrastructure-investments-aid-recovery/*

Infrastructure's Strengthening Appeal as an Asset Class

Investors had indirect exposure to infrastructure well before the Great Financial Crisis (GFC) through investments in the industrial groups that owned infrastructure assets, such as French motorway concession companies.

The sector's attributes and performance since the GFC have contributed to a significant inflow of capital seeking a more direct exposure to infrastructure assets through infrastructure funds or even through direct investments in the assets.

For investors who initiated, or increased their allocation in a supportive economic environment, the early stage of the pandemic will have been a true acid test of the rationale for infrastructure investment. There is significant evidence of the impact of the resulting economic crisis on infrastructure investment. Some assets, such as water crossings with no alternatives, have experienced only a temporary impact, vindicating careful investment selection by the fund manager. This will hopefully have a positive impact on the fund management industry by providing evidence of the resilience of disciplined investment strategies throughout economic cycles.

The current ultra-low or zero interest rate environment can be expected to make private investment in infrastructure even more attractive.

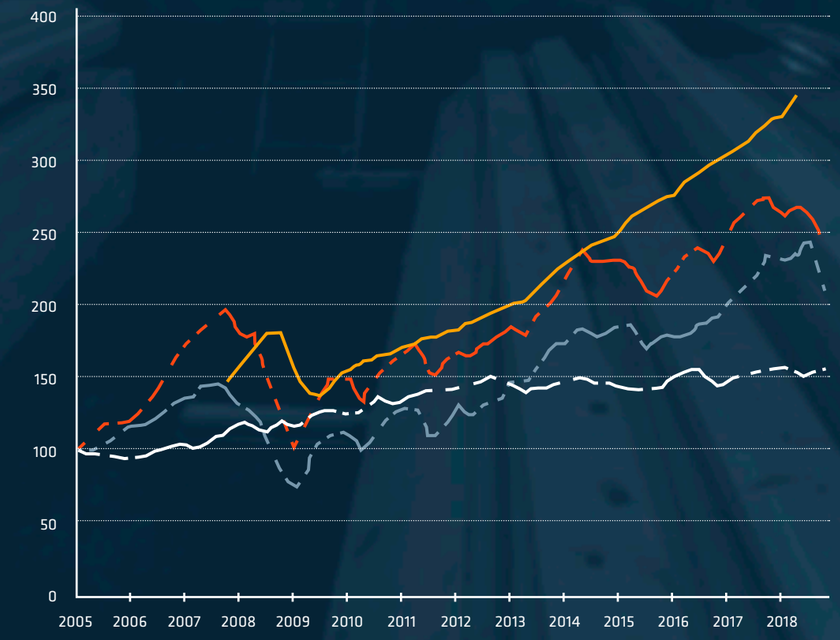
In the first half of 2020–during the height of the pandemic's spread–fundraising for unlisted, closed-ended infrastructure funds posted its strongest performance since 2008. [4]

Investors raised nearly $57 billion to fund unlisted infrastructure, with the largest fund accounting for $20 billion.

The appeal of infrastructure to private investors can be expected to continue its upward trajectory.

Comparison of Total Returns: Unlisted Infrastructure vs Other Asset Class Benchmarks

The strong showing in H1 2020 reflects a longer-term trend in Investment in infrastructure that has shown steady growth against other asset classes since the Global Financial Crisis. [5]



[4] *https://www.infrastructureinvestor.com/coronavirus-h1-fundraising-is-infras-best/?utm_source=Sailthru&utm_medium=email&utm_campaign=INFRA%20DAILY%20US%20BRONZE%202020-07-22&utm_term=INFRA_DAILY_US_BRONZE*

[5] *IFM Investors, Preqin (Note: Preqin Unlisted Infrastructure Index commenced December 2007), Bloomberg. To 31 December 2018 except Preqin (30 June 2018). Past performance does not guarantee future results.*

Focusing on people-first projects

In COVID-19's aftermath, strong public backing for social infrastructure that puts people first – including healthcare and education, and commitment to meaningfully addressing climate change with renewable energy – should make these sectors a top investment priority for governments.

The effects of lockdown on access to education among lower income groups has focussed attention on the need for universal broadband access and technology in education.

The continuing rise in renewable energy's cost competitiveness versus fossil fuels as well as its advantages in reducing climate change will add to its investment appeal.

One big challenge is the need for immediacy in developing the stimulus packages that will propel projects in these sectors versus the time needed to procure infrastructure.

New technology and data analytics offer promise in making the process faster and more effective in identifying and managing risk.

Covid-19 intensifies need to expand technology and data in infrastructure development

While new collaborative partnerships between infrastructure developers and technology companies were underway before Covid-19, the impact of the pandemic has accelerated the need to expand their role in enabling the development of the next generation of sustainable, equitable and resilient infrastructure.

The applications will vary by sector and technology, but all are rooted on robust digital infrastructure:

Healthcare delivery and infrastructure will see the integration of telemedicine, tele-triage, virtual care paths, virtual ICU, neighbourhood diagnostics and imaging

Transportation infrastructure will utilize drones, sensors, and Internet of Things (IoT)

Education infrastructure will incorporate elearning, mobile platforms, immersive learning (AR, VR)

All such digital applications are, and will be, generating massive volumes of data about real life experience – call it the wholesale digitization of real life.

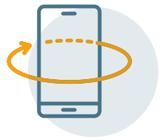
Advanced data analytics are expected to transform the complete life-cycle of infrastructure assets:

- Improving risk analysis
- Optimising asset management
- Modelling commercial revenue strategies
- Realtime demand forecasting
- Public procurement and network planning

Data analytics will drive digital models that enable better understanding of the way assets function, user behaviour and industry competition – all critical to informed infrastructure investment decisions.

The potential of digital twins for risk modelling in infrastructure

Wholesale digitization, in turn, is supporting the rise of digital twins in infrastructure development.



A digital twin "integrates artificial intelligence, machine learning and software analytics with data to create living digital simulation models that update and change alongside their real-life counterparts." [6]

A digital twin could provide comprehensive, almost real-time insight into a physical asset or service, allowing asset-owners to better test, plan, manage and predict asset performance. [7]

Such data-driven analytics with AI could reshape infrastructure risk event and recovery modelling ahead of building, through construction cycles, operation, and asset sale and purchase.

Such digital replicas are already widely used in industry to reduce uncertainty, and, by extension, risk.

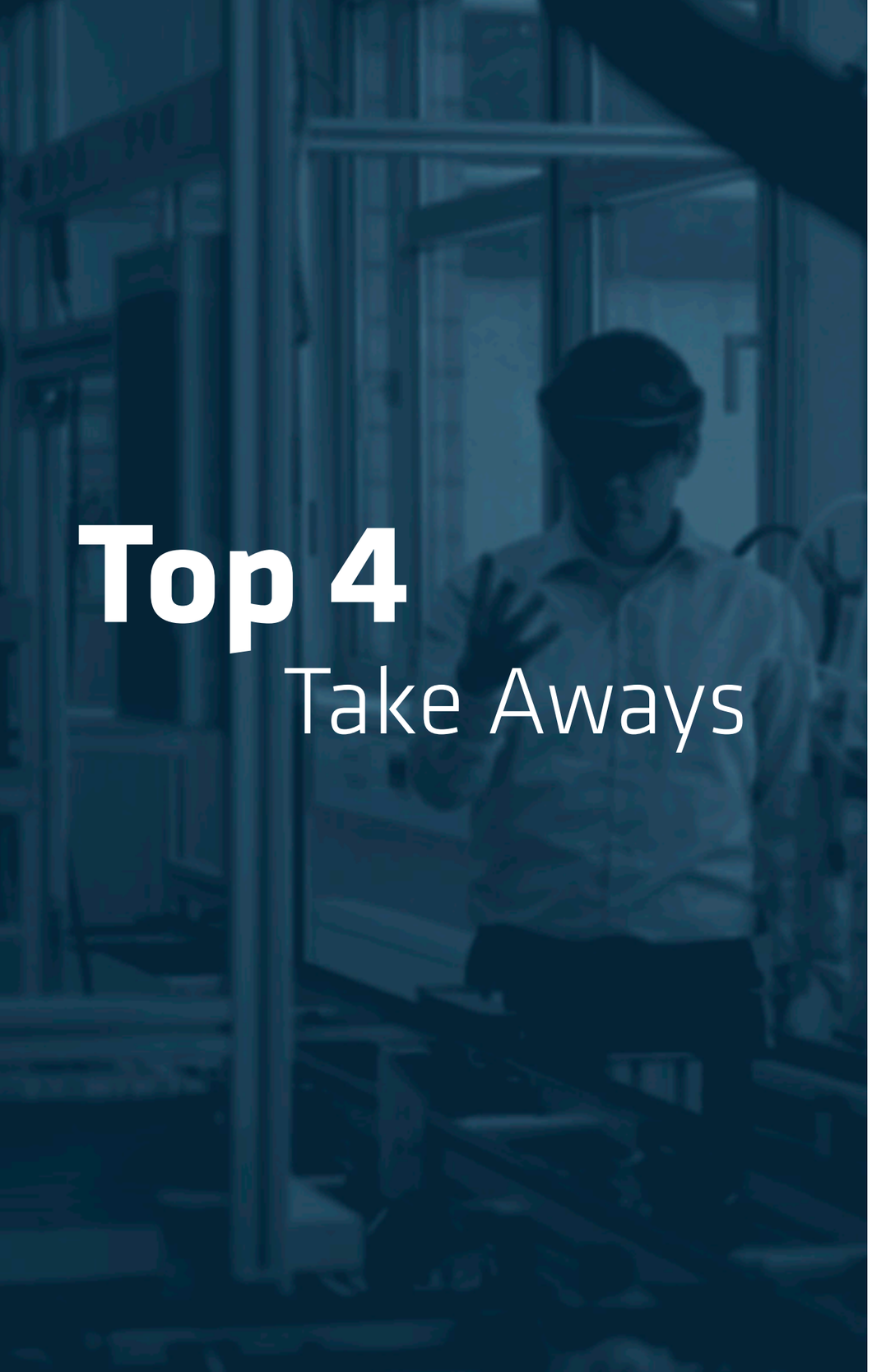
Digital twins enable optimal wind farm turbine operation while precisely predicting the asset's exact life-span – saving money and reducing waste.

Singapore has created a digital twin, Virtual Singapore, that allows designers and planners to test real scenarios in a digital space. [8]

Virtual Singapore has given the city many advantages, including the ability to predict the impact of disasters, manage town planning with greater efficiency, and enhance the efficiency of energy consumption. [9]

The UK has proposed creating a digital twin of the whole nation's infrastructure, processes and systems.

[6] *https://www.smartcitiesworld.net/opinions/opinions/why-the-uk-needs-a-national-digital-twin-*
[7] *https://www.computerworld.com/article/3427986/uk-tech-sector-urged-to-collaborate-ahead-of-proposed-national-digital-twin.html*
[8] *https://www.forbes.com/sites/bernardmarr/2019/04/23/7-amazing-examples-of-digital-twin-technology-in-practice/#24219a316443*
[9] *https://www.ns-businesshub.com/technology/digital-twin-examples-formula1-singapore/*



Top 4 Take Aways

1

COVID-19 has accelerated demand for more resilient, sustainable, equitable and predictable infrastructure.

2

Private participation in infrastructure development is seen as one of the top opportunities in the industry, especiallly in emerging markets.

3

Overall, infrastructure's appeal as an asset class continues to increase despite severe challenges in some sectors, e.g., aviation and oil and gas.

4

Digital twinning will strengthen risk modelling capability critical to developing resilient, sustainable, equitable and predictable infrastructure.

Outlook *by* Sector

Healthcare

Trend

A major shift is underway from efficiency model to resilience model with flexibility to meet elastic demand. Infection prevention and control is becoming a healthcare infrastructure design principle. There is also a rapid expansion/evolution of digital delivery of healthcare.

Outlook	Greenfield	Brownfield
Short-term	**NEGATIVE** Agencies redirect resources from existing tenders to other procurement areas such as testing capacity. Funders pause or pull back.	**NEGATIVE** Potential purchasers wait for COVID-19 impact to work through contractual structures, and there is better understanding of economic impact on counterparties such as FM providers and builders.
Medium-term	**POSITIVE** Agencies seek to increase resilience of healthcare systems but lack financing capacity.	**NEUTRAL** Appetite for PCT (Primary Care Trust) or acute hospital PFI (Private Finance Initiative) should remain unaffected; crisis should act as the ultimate test of risk allocation in standard PPP contracts.

Ports

Trend

Global GDP projected to shrink by 6% in Q2 2020. GDP was down just 2% at height of Global Financial Crisis. [13] Merchandise trade projected to drop by between 13 to 32%, weighing heavily on new port infrastructure development. [14]

Outlook	Greenfield	Brownfield
Short-term	**NEGATIVE** World trade slow to recover; second wave of COVID 19 outbreaks, weaker than expected economic growth, or widespread recourse to trade restrictions.	**MIXED** Immediate, drastic fall in global GDP; but ports also investing in temporary measures (expanded storage for unshipped cargo) and climate change resilience.
Medium-term	**NEGATIVE** Potential post-pandemic world with more regional integration of supply chains creates challenges for funding port investment. [15]	**POSITIVE** Increased e-commerce makes ports key supply chain links for companies in digital ecosystem with seamless trade, requiring more automation and storage. [16] Also shift in capital allocation from physical infrastructure to automating processes. [17]

13 https://www.iata.org/en/pressroom/pr/2020-04-14-01/
14 https://www.wto.org/english/news_e/pres20_e/pr855_e.htm
15 https://www.portstrategy.com/news101/port-operations/planning-and-design/the-post-covid-19-new-world
16 https://www.porttechnology.org/news/what-will-ports-look-like-after-covid-19/
17 https://www.strategyand.pwc.com/m1/en/articles/2020/gcc-ports-surviving-the-covid19-crisis

Rail

Trend

U.S.: Multi-billion high-speed rails projects are advancing. Rail (electric or diesel) uses far less energy per passenger mile than air travel. [18] Pandemic-related stimulus funding could spur further rail improvement or expansion projects, which would create millions of jobs and reduce U.S. transportation emissions, which represent more than a quarter of the national carbon footprint.

E.U.: Boosting rail travel is part of Next Generation Recovery Plan, which adds an additional €750bn on top of the €1.1 Tn Multiannual Financial Framework budget for 2021-27. The Connecting Europe Facility supports financing sustainable infrastructure and a shift to clean urban travel. [19]

Outlook	Greenfield	Brownfield
Short-term	**POSITIVE** Domestic rail should benefit as cleaner means of transportation than air. However, reduced demand for inter-city travel, will mean less revenue, less capacity (and need) for expansion, although on a less dramatic scale than aviation.	**MIXED** Mix of impacts. Electrifying existing lines and digitalising the networks could be accelerated. Drop in demand will lower revenue.
Medium-term	**POSITIVE** Significant need to electrify and digitalise rail networks existing track, lay new ones, improve signaling technology and replace trains.	**POSITIVE** Investment to integrate technology and automation in public transit systems to minimize queues, human interactions, and shared surfaces. [20]

[18] *https://www.huffingtonpost.ca/entry/coronavirus-trains-travel-climate-change_n_5ef08f5fc5b627efb3967e23?ncid=other_email_o63gt2jcad4&utm_campaign=share_email*
[18] *https://www.portstrategy.com/news101/port-operations/planning-and-design/the-post-covid-19-new-world*
[19] *https://www.railwaygazette.com/policy/boost-for-rail-travel-and-clean-mobility-in-eu-recovery-plan/56618.article*
[20] *https://www.ibtta.org/sites/default/files/documents/2020/Coronavirus/A%20Collection%20of%20Articles%20on%20Transportation%20in%20a%20Post%20Covid-19%20World%202020.04.28.pdf*

Renewables

Trend

The proposed E.U. Green New Deal aims for net-zero greenhouse gas emissions by 2050, requiring massive investment to ensure energy efficiency, decarbonised electricity and phase out of gas and diesel vehicles. [21]

Renewable investment is very favourable for economic recovery. Scaling-up public and private energy spending to US$4.5 Tn per year would, on an annual basis, boost the global economy by an additional 1.3 per cent, creating 19 million additional energy transition-related jobs by 2030. Jobs in renewables alone could triple to 30 million by 2030. Every million dollars (USD) invested in renewables would create three times more jobs than in fossil fuels. [22]

Outlook	Greenfield	Brownfield
Short-term	**POSITIVE** Multiple governments have indicated need for green recovery, which would entail their funding to support it.	**MIXED** Greater need for capital to finance greenfield renewables could initially reduce valuation of operating renewables assets. Falling electricity prices will also have negative impact on valuation. Difficult to assess degree of offset due to liquidity created by central banks' QE (Quantitative Easing) measures.
Medium-term	**POSITIVE** Renewable energy projects seen as more stable investments during the crisis. [23] Continued cost declines for renewables and greater reliance on electricity will result in greater use of renewables to produce that electricity. [24]	**POSITIVE** Increased M&A opportunities as project sponsors look to sell projects, and power purchasers are focused on securing power at attractive prices to meet climate goals, which remain in place despite economic uncertainty. [25]

21 *https://www.climatechangenews.com/2019/12/12/eu-releases-green-deal-key-points/*
22 *https://www.utilities-me.com/news/15656-irena-outlines-agenda-to-put-energy-transformation-at-heart-of-sustainable-economic-recovery*
23 *https://www.ubs.com/global/en/asset-management/insights/asset-class-research/real-assets/2020/impact-covid-19-on-infrastructure.html*
24 *https://www.blackrock.com/ca/institutional/en/insights/market-pulse/renewable-power-market-resilience*
25 *https://www.blackrock.com/ca/institutional/en/insights/market-pulse/renewable-power-market-resilience*

Electric Vehicles (EV)

Trend

By 2025, EVs are projected to account for 10 per cent of global passenger vehicle sales, rising to 28 per cent in 2030 and 58 percent in 2040. [26] These estimates for EV adoption would require 12 million public EV charging points globally by 2040, up from fewer than 1 million today. That will require a worldwide investment of about $111 billion. [27]

Outlook	Greenfield	Brownfield
Short-term	**POSITIVE** Multiple governments have indicated need for green recovery, which would entail their funding to support it. Oil companies and utilities are already investing heavily in charging station infrastructure. [27]	**POSITIVE** This is a corporate rather than a public core style infrastructure investment opportunity, so liquidity is in a different segment.
Medium-term	**POSITIVE** Steady transition to EV strengthens, led by Europe and Asia, which both have stronger government regulation and policy supports to pave way for widespread EV and needed infrastructure.	**POSITIVE** Such transactions will likely gain traction and emerge in the P3 market as brownfield deals in the medium-term. Funds with higher risk tolerance will invest early In EV schemes, then sell as more similar deals come to market and more risk-averse funds such as pensions make secondary market purchases.

[26] *https://bnef.turtl.co/story/evo-2020/page/3/1*
[27] *https://about.bnef.com/blog/electric-vehicle-sales-to-fall-18-in-2020-but-long-term-prospects-remain-undimmed/*