CIO Special
June 30, 2021

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Rethinking infrastructure: technology and ESG

Key take aways

- Infrastructure needs are massive across both developed and emerging economies. The UN Sustainable Development Goals 2030 illustrate the scale of the challenge. Infrastructure also needs to be put in a sustainability context.
- Traditional "physical" infrastructure is only one component: technological and other infrastructure is also key. Infrastructure development is also intertwined with other of our long-term themes such as artificial intelligence, smart mobility and cybersecurity.
- Three factors are important to meet major future infrastructure needs. First, improvement of the intersection between public and private financing. Second, the evaluation of projects within an ESG life-cycle scenario. Third, creative use of technology that is likely to have an increasingly important impact at all levels.

01 Introduction

With many parts of the world now reopening and with coronavirus vaccination campaigns making progress, many traditional infrastructure assets may have features that are attractive to investors in the current environment. Vaccines rollout and general economic reopening will have a positive effect on use of traditional infrastructure assets (and thus fees paid to owners); returns from such traditional infrastructure can often be tied to inflation levels, as contracts for fees paid by consumers of this infrastructure are often linked to inflation rates; and, finally, high barriers to entry, such as elevated start-up costs and associated regulations (concession contracts have long maturities) may protect existing players from new entrants. In the past, infrastructure has offered stable cash flows, even during market downtrends – with the coronavirus crisis the obvious exception.

But economic reopening also provides a broader opportunity to reassess long-term infrastructure needs in general. There has already been much discussion around changing infrastructure needs due to changes in working and living patterns, perhaps accelerated by the coronavirus pandemic. In our 2021 annual outlook, Tectonic shifts: looking beyond COVID-19, we identified one of the likely impacts of the coronavirus pandemic as "infrastructure rethought". Home working and online retail provide two examples of this.

Infrastructure is also a key issue in terms of **sustainability and the closing of gaps between developed and emerging markets**. The ninth UN sustainable development goal (SDG) in its 2030 Agenda for Sustainable Development is dedicated to innovation and infrastructure together with sustainable industrialization. Effective provision of transport, connectivity and utility services is seen as playing a part in building infrastructural resilience to the risks associated with climate and other disasters.

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02 Developing economy challenges

Developing economies face many challenges in meeting this innovation and infrastructure SDG. Some simple figures can help us understand the scale of the problem. According to the World Bank, 840 million people in the world live more than 2 kilometres from all-weather roads, 1 billion people lack electricity, and 4 billion people lack Internet access. Closing the infrastructure gap is interconnected with achieving the other SDGs, as identified by the World Bank. For example, rural roads and safe transports are needed for access to health and education facilities.

Physical infrastructure is only one part of the problem. Digital infrastructure is a second focus point within the UN's SDGs: leveraging technology to deliver future economic growth (e.g. through internet access, smart devices and mobility, the internet of things and 5G) will require a reliable physical network infrastructure and a hidden one (e.g. servers, smart grids, cloud computing and hosting services). Figure 1 shows some differences by country income group.

Physical and digital infrastructures are necessary to create effective logistics – what the World Bank calls "the backbone of trade". Building an efficient and resilient logistics infrastructure will be important for emerging and as well as developed markets. Requirements have changed radically because connectivity is not just physical (e.g. roads, rail, and sea) but also in terms of telecommunications, financial markets and information-processing. Inadequate systems of transportation, logistics, and other trade-related infrastructure can negatively influence countries' global ability to compete (e.g. around food production).

Infrastructure investment (in both emerging and developed markets) also needs to be considered in the context of the challenging target of **net-zero greenhouse gas emissions** by 2050 pursued by many companies and countries. The related themes involved in reaching this goal include decarbonisation, technology and different sources of power generation. Reaching these Paris Agreement requirements and the SDGs will be a particularly difficult task for Asia, which accounts for 60% of global population and is trying to combine reducing emissions with continued strong economic growth: it already accounts for 50% of energy production-related emissions[1]. Some progress has been made, helped by lower renewable energy costs but pollution remains an issue, particularly in South-east Asia[2]. Infrastructure proposals range from the small to the very large indeed – e.g. creating a pan-regional electric grid[3].

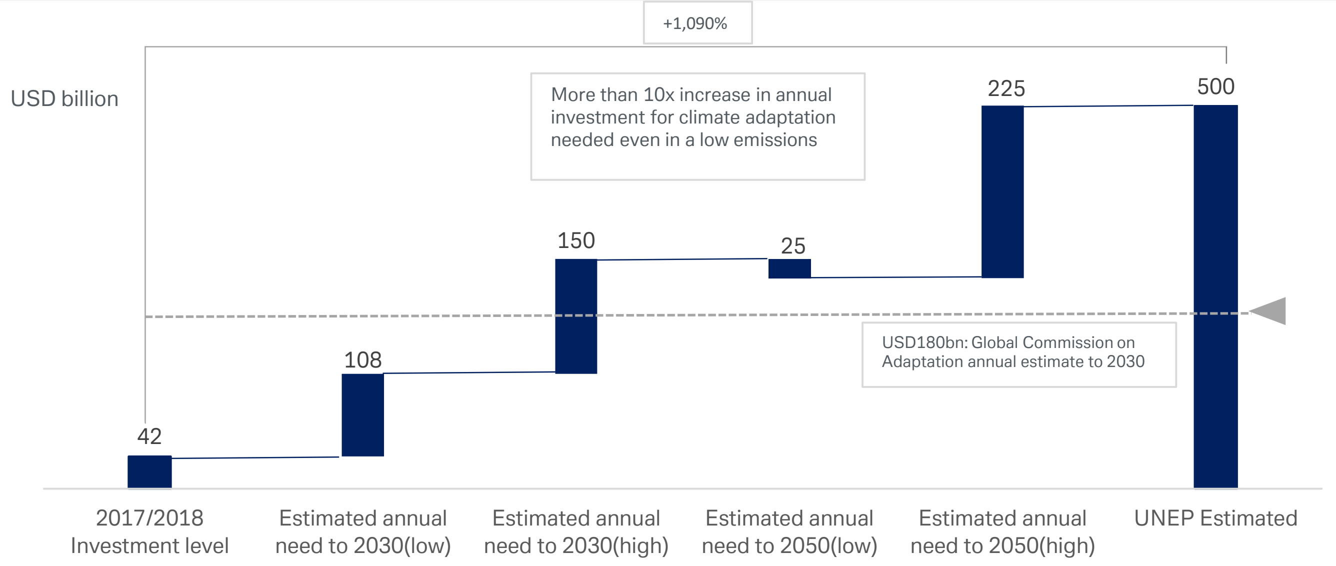
The case for hydrogen development shows how complex ESG considerations can be in assessing whether infrastructure is beneficial and/or viable – see box on the next page "Hydrogen – the environmental conundrum".

Figure 1: Digital infrastructure indicators by country income group

	Low income	Middle income	High income
Access to electricity (% of population)	41.8	93.6	100
Secure internet servers (per million people)	14	1,528	64,774
Mobile cellular subscriptions (per 100 people)	60	108	130
Fixed broadband solutions (per 100 people)	0.4	12.6	34.5

Source: World Bank. Data as of May 2021.

Figure 2: Developing economies' costs of ESG adjustment



Source: CPI, UNEP, Global Commission on Adaptation. Data as of December 18, 2020.

Hydrogen – the environmental conundrum

Research and development are enabling fuel cell makers and hydrogen producers to reduce costs and improve product efficiency (by also reducing transportation costs). But 95% of global hydrogen output is "grey hydrogen" made from natural gas and generating substantial unstored carbon emissions.

Hydrogen's potentially large contribution to the global transport infrastructure could therefore be undermined by environmental considerations. There are hopes that "green hydrogen", which uses electrolysis to separate hydrogen from water, could in future account for the 8% of global energy demand[4], replacing fossil fuels especially in countries where carbon pricing is an established practice (e.g. Europe). But many obstacles remain to be overcome before hydrogen can substitute other energy sources, including the building the transportation and distribution infrastructure. This in turn requires technology: hydrogen liquefaction can be very helpful in transporting it over long distances, but deployment of this technology at a local level is piecemeal and still in its early stages. Safety and cost hurdles also remain a hurdle in terms of distribution to clients.

Scale is important for hydrogen usage. If 600,000 hydrogen-powered vehicles were produced per year, this is predicted to reduce the total cost of ownership (TCO) by circa 45% compared to today's levels[5]. Scaling up the hydrogen supply chain is also crucial, as more than 70% of the total cost of ownership (TCO)[6] for the non-transport applications is related to the hydrogen supply[7]. Lowering costs will require several years. Governments worldwide are setting goals on hydrogen usage/research: Germany, for example, in June 2020 decided to invest EUR9bn to support the development of its own hydrogen industry, with the aim of creating a production and transportation supply chain.

03 U.S. and European plans

U.S. infrastructure plans are focused on the 2021 "American Jobs Plan", initially costed at around USD2tn over the next decade, but now likely to amount to around USD1.2tn over the next eight years but this figure includes existing planned baseline spending. Infrastructure improvement is needed: the World Economic Forum ranks the U.S. only 13th in the world when it comes to the overall quality of the infrastructure. At present (negotiations continue) the largest planned spend is on highways, bridges and surface transportation (USD109bn) , followed by the electricity grid (USD73bn), passenger and freight rail (USD66bn) and broadband (USD65bn). Substantial amounts are also directed towards water infrastructure (USD55bn), public transport (USD49bn) and infrastructure resilience (USD47bn) in addition to spending on airports, electric vehicle charging and environmental clean-up.

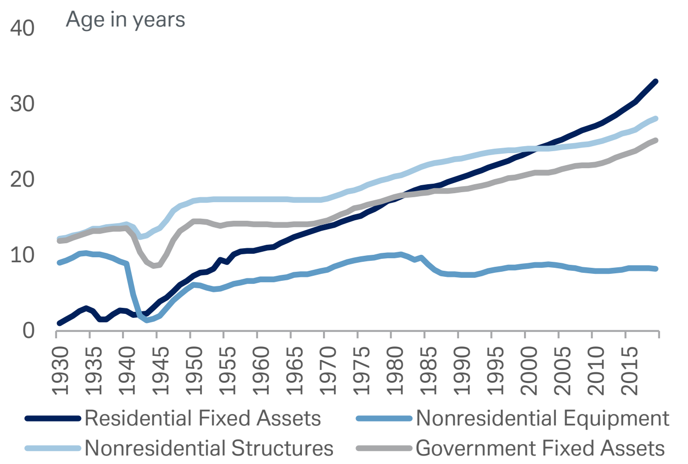
The plan also initially had significant allocations to so-called human infrastructure, with large allocations for the care of the elderly and people with disabilities, the development of affordable housing, the improvement and renovation of public buildings, reviving the U.S. manufacturing sector and job training programs. These have now been split off from the "physical" infrastructure and are likely to be pursued via separate legislation.

European infrastructure needs are addressed via national plans, the USD750bn Next Generation EU fund (sometimes referred to as the European Recovery Fund) and longer-term green objectives.

Figure 4 shows how (based on available spending plans), much NGEU spending is likely to have a digital or green component.

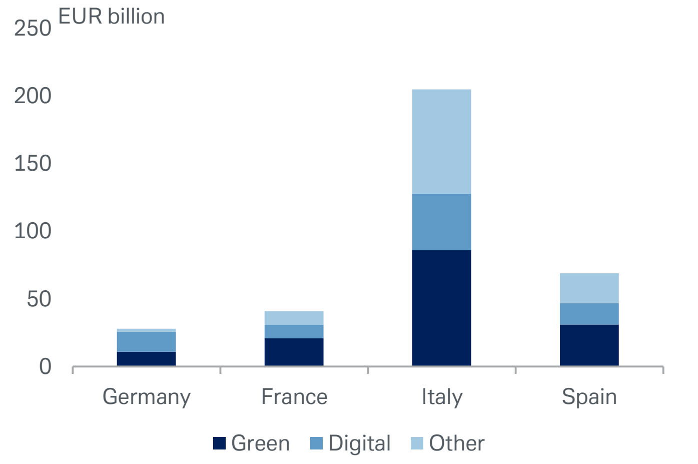
The NGEU runs until 2026 whereas the pre-existing EU Green Deal has in focus the transformation of the EU into a "fair and prosperous society", with no greenhouse gases emissions by 2050. Steps are being taken to speed up the decarbonisation process. For example, in October 2020 EU Member States agreed on a EUR998mn project to improve the electricity markets in Estonia, Latvia, Lithuania and Poland and to develop a smart electricity grid connecting Hungary and Slovakia[8].

Figure 3: U.S. government capital stock



Source: Haver Analytics, Deutsche Bank AG. Data as of May 2021.

Figure 4: Intended use of NGEU funds (grants and loans)



Source: European Commission, Deutsche Bank AG. Data as of April 30, 2021.

The **efficiency of buildings** is also a focus: buildings consume 40% of total energy, but the pace at which they are being renovated to make them more efficient is too slow to achieve EU's climate objectives[9].

Digitalisation has many different dimensions – e.g. in terms of monitoring and analysing air pollution levels but also across the manufacturing sector more broadly. An EUR50bn plan aims at boosting digital innovation, creating production line for next-gen electronic components, and sustains the European Cloud Initiative[10].

More than 25% of total greenhouse emissions are from **transportation** (both private and commercial), and a staggering 90% reduction is needed by 2050 if emissions targets are to be achieved. Pricing the environmental and health related impacts of different transportation methods is key here. From one standpoint, no more fossil-fuel subsidies should be created, but from the other standpoint, recharging and using low or zero emission vehicles should be easy. That is why by 2025, the number of recharging and refuelling stations on European roads is expected to be around 1 million[11].

04 Closing the infrastructure gap: three key requirements

Closing this global infrastructure gap will need different solutions in different areas. Three points seem key:

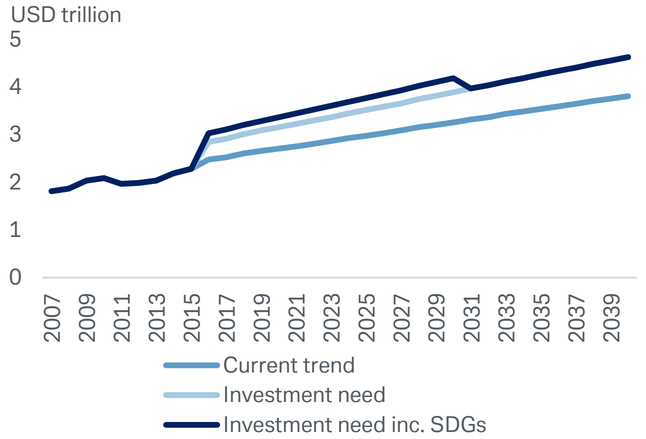
First, **improving the intersection between public financing and private financing.** Financing needs for developing economies are estimated at between USD 1-1.5 trillion per year, as part of a global gap of USD 3-5 trillion annually[12]. One additional problem is that public finances in many economies are already under additional stress, due to extra spending (and thus debt) to deal with the impact of the coronavirus crisis.

Second, **evaluation of infrastructure using an ESG life-cycle scenario** must take into consideration climate change in order to better estimate project costs and potential returns – which, in turn, means better estimation of future infrastructure utilisation, costs of conversion or decommissioning, and the environmental impacts more broadly. One estimate (Figure 2 above) puts the associated additional costs of climate change adaptation at an extra USD500bn.

Third, **creative use of technology** which will have an increasingly important impact on the sector – not just in terms of the infrastructure projects themselves, but also in terms of how they are initially assessed and then managed. Big data analysis, 3D scanners, drones, architectural software can help in creating a more solid business case and analyse the cost / benefit scenarios in a more detailed way optimizing them, and consent to better identify and solve environmental and social issues.

Technology both facilitates infrastructure provision and is a part of it. Much has been discussed about the "internet of things", cloud computing, smart devices, homes and mobility and the recent lockdowns have accelerated some of these trends. But it is also important to consider digital transactions unrelated to payment and involving the public sector – e.g. online schooling which requires a reliable broadband and/or mobile network. 5G is a good example of how technology is changing digital infrastructure needs, through both providing rapid access and also facilitating big data analysis – which in turn feeds back into decision-making processes. Here, intangible infrastructures can prove as important as physical infrastructure: data protection and privacy are examples of factors that projects have to take into consideration in order to build robust and socially-acceptable infrastructures.

Figure 5: Infrastructure trends and needs



Source: G20 Infrastructure Outlook. Data as of May 2021.

05 Conclusion

Both developing and developed economies face enormous challenges in building infrastructure adequate to current needs. Their plans will need to address future physical, digital and other intangible infrastructure needs within tightening environmental constraints. Technology is likely to provide many solutions, but we also need a continuing discussion on how best to coordinate public and private infrastructure spending in the years ahead.

Looking at infrastructure sectoral trends, the transportation sector has been badly hit by the worldwide lockdowns triggered by the outbreak of the Coronavirus, with airports and toll roads being the worst hit assets. The speed of the vaccine roll-out and subsequent economic reopening should be very supportive for the sector.

Energy assets started seeing prices recover at the end of last year and performed strongly in the first quarter of 2021. Governments are intensifying their focus on improving and developing a less polluting and more sustainable energy complex (both the EU Green Deal and the U.S. infrastructure plan now under discussion include investments that could benefit the sector).

Other developments accelerated by the Covid-19 crisis could sustain the long-term development of the communications sector: infrastructure is needed to support the digitalization and the technological changes our society is facing. As industries shift to new technologies, investments in telecommunication towers, data centres and fibre optics networks are needed (in the U.S., the Biden Administration infrastructure plan initially allocated USD100bn to "broadband access").

Such powerful trends in the age of COVID-19 will shape the future of our society. Infrastructure assets will remain crucial in driving innovation and sustainability.

Bibliography

1. Asian Infrastructure Investment Bank, “The Green imperative”
2. IEA, Southeast Asia Energy Outlook 2019
3. https://www.aiib.org/en/news-events/asian-infrastructure-finance/articles/a03-green-imperative.html
4. DWS – European Infrastructure Update Hydrogen, August 2020
5. Hydrogen Council, “Path to hydrogen competitiveness, A cost perspective”, January 2020
6. TCO is defined as all the costs the customer pays in the lifetime of a product
7. Hydrogen Council, “Path to hydrogen competitiveness, A cost perspective”, January 2020
8. European Commission, “Investing in new energy infrastructure”. October 2020
9. European Commission, December 2019
10. European Commission, Digitising European Industry, October 2020
11. European Commission, December 2019
12. Global Infrastructure Outlook, Oxford Economics

Glossary

ESG stands for Environment, Social, Governance, and is the acronym most commonly used for sustainable investments. They measure the sustainability and societal impact of an investment in a company or business.

Governance (corporate governance) involves the processes of governing – whether undertaken by the government, firm, market, network – over a social system and whether through the laws, norms, power or language of an organized society.

Next Generation EU fund (NGEU) is a EUR750bn temporary recovery instrument to help repair the immediate economic and social damage brought about by the coronavirus pandemic.

Sustainable Development Goals (SDGs) were set in 2015 by the United Nations General Assembly and are intended to be achieved by the year 2030. They are a collection of 17 interlinked global goals designed to be a blueprint for achieving a better and more sustainable future for all. Sustainable Development Goal 9 is about industry, innovation and infrastructure, 13 is about climate action, 14 about life below water, 15 is about life on land and 17 is about partnerships for the goals.

USD is the currency code for the U.S. Dollar.

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