International Federation of Consulting Engineers
The Global Voice of Consulting Engineers

Time to $Tn-vest

State of the World

/SOW2021

/A FIDIC report

Contents

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Foreword from the President and CEO

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President, FIDIC

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Chief Executive Officer, FIDIC

The world has changed in the past 12 months. That is probably the understatement of the last decade. Covid-19 has not only changed working patterns but it has also reduced economic activity in ways never seen before, with whole sectors effectively 'locked out' of the ability to operate. What has, however, become clear is that the role of infrastructure and engineers in delivering a future economy that is more resilient, be it health, broadband etc is probably greater than ever before.

We should, however, be cognisant that Covid-19 is not the only challenge in town. Infrastructure investment has been below the level required to meet current usage let alone future needs. Covid has challenged some of our assumptions as to where we should be investing as a priority but it has not changed the overall situation.

As we all know, there are two broad approaches to addressing the infrastructure investment gap – financing strategies and reduction of financial need. This first report is primarily focused on the former, which is appropriate considering FIDIC's significant interaction with financial institutions around the globe. Future reports will include discussion of the latter, since engineers will continue to play a critical role in developing innovative strategies to reduce the costs of infrastructure needs. This is also critical and consistent with goals set by other professional engineering organizations such as the American Society of Engineers Grand Challenge to reduce the life cycle cost of infrastructure needs by 50% by 2025. Perhaps lessons learned from working remotely and more use of technological innovation during the pandemic will help engineers make more progress toward this goal.

It has been shown that we can have a cleaner environment, that we can work remotely, that infrastructure such as broadband is vital, despite only a decade ago being considered an ancillary to infrastructure types such as road and rail and airports.

FIDIC therefore has also had to change and this report forms part of this change. As the president and CEO of FIDIC we are proud to announce that this report is not an annual *State of the World* publication like previous ones, but it will be one of a series of reports published each year that take a significant focus on an area, issue or challenge the world faces.

FIDIC will call on all its networks and expertise and facilitate global cooperation and discussion on a scale not previously used as part of the *State of the World* and learn from its use of technology during the Covid crisis.

It is therefore only fitting that this relaunch of *State of the World* starts with the scale of the challenge we face and, yes, given Covid, it just got a lot bigger.

We not only need to meet the current investment need, the UN sustainable development goals (SDG) investment need but now also the economic need of the Covid crisis. Infrastructure can provide such a stimulus if we are calculated, coordinated and importantly sustainable. This report therefore explores the challenge, competitiveness, risks and threats and proposes a stabilising mechanism to help us make this transition, which could not only be used from the move away from fossil fuels but also the economic impact of Covid-19.

This report makes three recommendations for creating investment certainty, to create an SDG capital envelope and to reinvigorate efforts to truly shift to holistic and sustainable investment. These will help our sector to move the industry forward and generate positive momentum.

It is therefore Time To Take The Trillion Task seriously, yes one T for every trillion that is estimated to be needed as a minimum to meet the SDG requirements. It is **Time to $Tn-vest!**

/Introducing the State of the World series

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The world and the challenges that are presented day by day, year by year, are ever changing and, in many cases, change is occurring at a faster pace. FIDIC has always engaged in leading the debate through its *State of the World* Reports.

Since 2009, they have highlighted the need for investment in infrastructure, the fact that such investment needs to occur in a sustainable manner and that the challenges in the water sector are far greater than anticipated.

- FIDIC State of the World Report 2009 - The status of the World's Infrastructure.
- FIDIC State of the World Report 2012 – Sustainable Infrastructure
- FIDIC State of the World Report 2015 - Water Challenges

FIDIC was therefore talking about infrastructure investment in the economy to boost growth out of the financial crisis before it became a buzzword, was championing sustainability before the climate crisis hit the global stage and highlighted the issue with pollutants such as microplastics in the world's oceans before governments considered measures to address plastic waste.

Whilst these messages have been heard by governments globally and there has been progress and the agreement of the Sustainable Development Goals (SDGs), it has become clear that FIDIC also needs to evolve to adapt to this faster pace of change.

State of the World will therefore going forward produce multiple reports per year that analyse, promote, and evaluate the issues facing countries across the globe.

/Introducing the State of the World series

This will create a longstanding *State of the World* series to produce more frequent digestible reports targeting specific areas, geographies, subjects, or technologies. The series will also bring together FIDIC, its member associations and the infrastructure industry's expertise to assist governments on meeting the increasing pace of change.

This is by no means a small task and so FIDIC will be using its extensive global network of experts across the fields of planning, finance, engineering, procurement, contracting, surveying, legal and politics to provide expert insight into the issues it discusses.

As part of this transformation, FIDIC's *State of the World* series needs to consider how the world has shifted, with technology, webinars and social media being a significant part of the step change.

This will help to ensure that FIDIC and its *State of the World* audience are engaged with the widest range of stakeholders possible to create a significant shift towards sustainable, quality-driven infrastructure that is delivered with integrity.

We welcome you to this updated initiative and look forward to engaging with the infrastructure industry, governments and stakeholders going forward.

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/Executive summary and recommendations

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/Executive summary and recommendations

This is the first report in the new *State of the World* series and is launched in unprecedented times. The Covid pandemic and its economic effects, combined with the continued lack of investment to meet our current infrastructure needs let alone the SDGs, has created the challenge of all challenges.

Never has the infrastructure sector faced such an extreme set of challenges concurrently. There is no longer just a gap of trillions of dollars in investment for current needs, but trillions more to meet the SDGs and trillions to repair and stimulate the economy following the impact of Covid.

The scale of the challenge

The challenge is significant, complex and larger than ever. To pick a few headlines we discuss in this report, we now have not just one but multi-trillion-dollar challenges.

- This report has explored that the global infrastructure investment needs to be $94 trillion between 2016 and 2040, which is 19% higher than the current trend ($3.2 trillion per year) and would need to average $3.7 trillion per year.
- Then there is the additional pressure of not only meeting the investment need of the current situation but ensuring we meet the commitments of the SDGs. This is estimated to be between $5 trillion and $7 trillion a year, significantly higher than the $3.7 trillion above.
- Then as discussed previously, 2020 saw a new risk to the global economy with the slowdown caused by Covid-19 likely to cost at least $1 trillion, however, the doomsday scenario in which the world economy grew at only 0.5%, would involve a $2 trillion hit to GDP.

As noted in the Foreword, there are two broad approaches to closing the infrastructure investment gap – improving financial and reducing the overall financial need. This report focuses on the former while future reports will include strategies to address the latter.

It is therefore Time To Take The Trillion Task more seriously, yes one T for every trillion that is estimated to be needed as a minimum to meet the SDG requirements. It is Time to $Tn-vest!

To highlight the scale of the challenge, below this report provides a number of statistics as to what $5tn dollars could purchase. As can be seen the numbers are significant:

- **2,370** single unit coal 1 megawatt coal power stations.
- **8,794** 1 megawatt combined cycle gas power stations.
- **405** 1 megawatt nuclear power stations.
- Enough four lane motorways to **circle the earth over 28 times** or enough road to **get us to the moon and back and then to the moon again**.

These are all big numbers, but if Covid, climate change and recent events have taught the infrastructure community anything, it is that it needs to be bold and not necessarily in ways that would have been anticipated five years ago.

The skills and expertise that go into providing such assets should not be underestimated, these vary from the visionary that has the concept or idea, through the engineers who envision innovative solutions to challenges and then design and actualise such visions to the constructors that make such designs tangible and ultimately the users and customers that derive benefit from the provision of such assets and infrastructure.

The trillion-dollar challenge is not only on the horizon, it has arrived and in this report we set the scene for a new series of *State of the World* that will put issues at the forefront of discussion on their own accord across an ongoing series of reports.

The industrial progress made over the last three centuries could not have happened without engineering expertise, but the global environmental problems that have resulted can now only be solved by engineers and engineering bringing the full range of their skills to bear with the ambition of the SDGs as their primary driver and properly constituted assessment mechanisms that take account of climate change, social equity, environmental protection, and human development.

The infrastructure industry must therefore work with governments across the globe to act and FIDIC is here to provide that platform for debate to secure progressive movement on this goal.

Recommendation 1: Given the evidence in this report, FIDIC recommends that there be a renewed global effort to improve infrastructure spending to meet the investment challenge facing the world.

Covid has certainly not made this easier but it has shown how expertise such as science and engineering in developing drugs, building hospitals etc, are vital to meeting the infrastructure challenge. Engineers will be vital in ensuring we deliver the infrastructure required in a way that is sustainable for the future.

Prudently moving from Covid, the burning of fossil fuels and towards sustainable infrastructure

Infrastructure plays a vital role in everyone's lives. It provides us with the water we drink and use to grow food, the health care we all need, the electricity that powers our technology, the heat to keep our homes warm, the transportation systems we need to allow trade and the tools we need to be able to effectively communicate and the list goes on.

This report therefore not only explores the investment challenge post-Covid but also considers how such investment adjusts to competitiveness, risks and threats including items such as Covid and how this will change investment preferences.

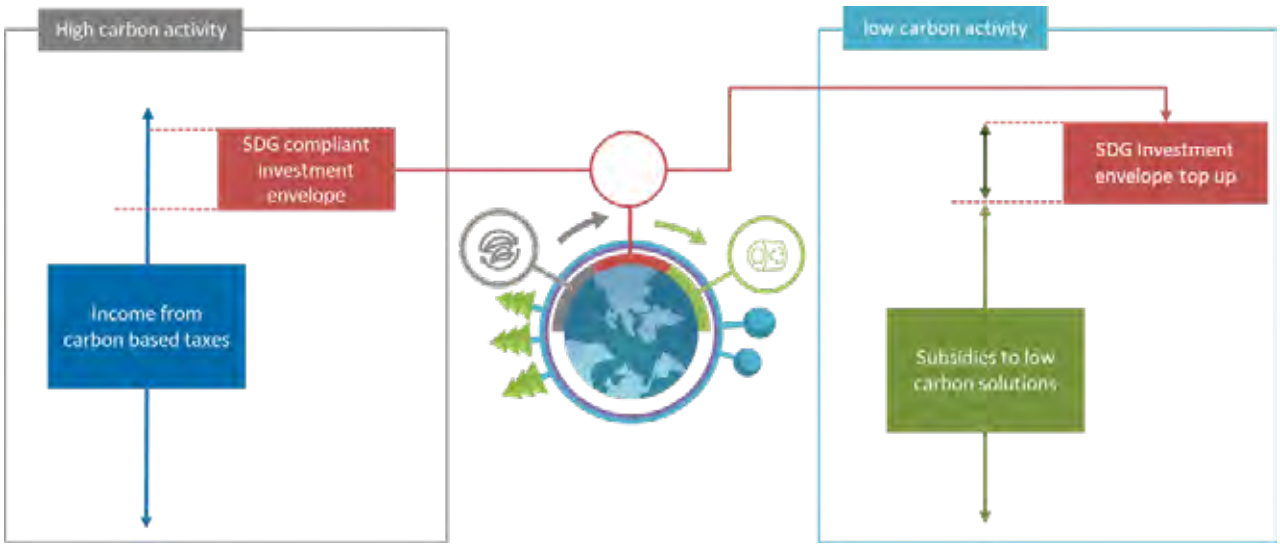
This preference to date has shifted towards one where the environmental benefits of lower activity and improved healthcare are high on the agenda and new ways of working are now inevitable in a shift that would not have occurred at such a significant pace towards remote working if it were not for Covid-19.

So, considering the above and the current situation of usages, resources and pricing in the burning of fossil fuels, do we need to support this monumental shift?

We discuss how, working with the wider infrastructure sector, a number of automatic investment mechanisms or principles could be agreed to transfer increased revenues when they occur through activities that involve the burning of fossil fuels into low-carbon technologies.

Such mechanisms could be set within a capital envelope to provide certainty and automatic stabilisers within hypothecated budgets based on the collection of wider revenues from activities that are related to the burning of fossil fuels. This could provide a significant boost and transfer towards meeting the SDGs.

Figure: 1 – SDG compliant capital envelope mechanism



Recommendation 2: FIDIC has suggested as part of this paper that governments learn from the concept of automatic stabilisers and hypothecation of funds that occur as part of economic conditions and general public expenditure to construct a mechanism to support sustainable investment and prudently shift away from carbon intensive investments and the burning of fossil fuels.

This mechanism would provide a capital envelope to support or enhance spending based on economic conditions, thus providing certainty and a clear commitment towards meeting the SDGs.

FIDIC would also like to see such mechanisms form a core part of policy and built into future commitments as we approach the negotiation of what replaces the SDGs in five to ten years' time.

Challenging perception so we invest holistically

There is much talk of whole life costs, holistic investment, skills retention, resilience, flexible and multi-use infrastructure. All these concepts are important and are essential for a well-operating infrastructure industry and more importantly for embedding sustainability into day-to-day living.

The challenge, however, is not only building new infrastructure but maintaining and upgrading existing infrastructure in a sustainable way. If there was a lesson to be learnt from the last 200 years of growth, it is not just that investment helps to facilitate growth but that if done in an unsustainable way it can result in consequences in the medium to long term.

This report analyses investment across several comparable countries considering their investment and maintenance infrastructure spending and finds some worrying conclusions given the need to move towards a more sustainable footing for infrastructure development and replacement.

The analysis in this report shows that over time the investment/maintenance ratio has fallen from investment being approximately three times the level of maintenance to it being just over two times the level.

Even more important is when you consider the trend going forward. By 2030, the time at which the SDGs and 'sustainable development' is due to be a priority, the ratio would only be 1.7 and if that is pushed out to 2050 the ratio would be 1.

This has two potential implications. The first is that, despite all the emphasis on using investment to grow out of the economic downturns, investment profiles appear to be going in the wrong direction when considered alongside maintenance spending. This suggests we have not seen progress towards the earlier discussed infrastructure needs gap.

The second is that when you consider 'whole life costs' and the aim of making infrastructure more sustainable, there does not appear to be evidence that maintenance costs are reducing because of infrastructure expenditure - in fact they appear to be increasing.

Whilst this may not seem positive, it can explain the issue the globe is facing, in that a lack of infrastructure investment in a sustainable manner is resulting in maintenance costs being higher as a ratio between the two than otherwise would be the case and the globe is not meeting its infrastructure investment need. So, we are still prioritising short-term solutions and fixes over long-term sustainable decisions.

Recommendation 3: Given the evidence in this report on the investment / maintenance ratio FIDIC recommends that there be a global effort to monitor such a ratio not only in the countries that could be analysed as part of this report but across all countries. The goal for example could be that maintenance spending remain stable, but investment spending rises to meet the investment gap thus improving the ratio and truly pushing towards whole life and sustainable investment.

It is also important to recognise the role of engineering in the conceptualisation of cost-effective solutions to challenges followed by the design of infrastructure in meeting such a target, it is only by improving our approach to infrastructure design and procurement can such a goal be truly met.

/What could $5 trillion a year purchase?

2,370

single unit coal
1 megawatt
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8,794

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405

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nuclear power
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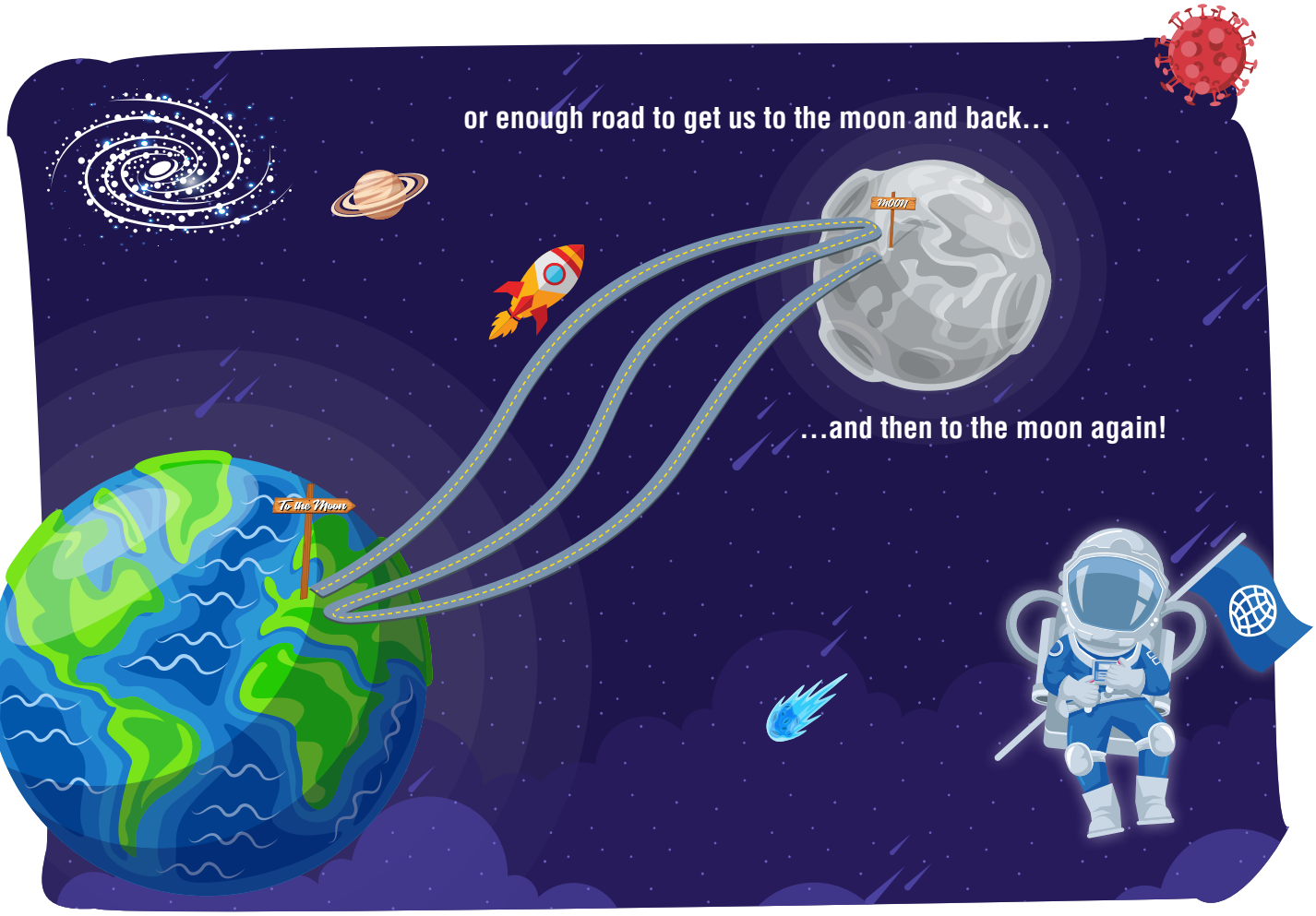

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/Infrastructure investment

/SOW 2021

Is infrastructure investment meeting our current and future needs?

In 2017 the Global Infrastructure Hub, an initiative between Oxford Economics and the G20, produced the *Global Infrastructure Outlook*[iii], which assessed the investment needs of 50 countries over seven sectors up to 2040.

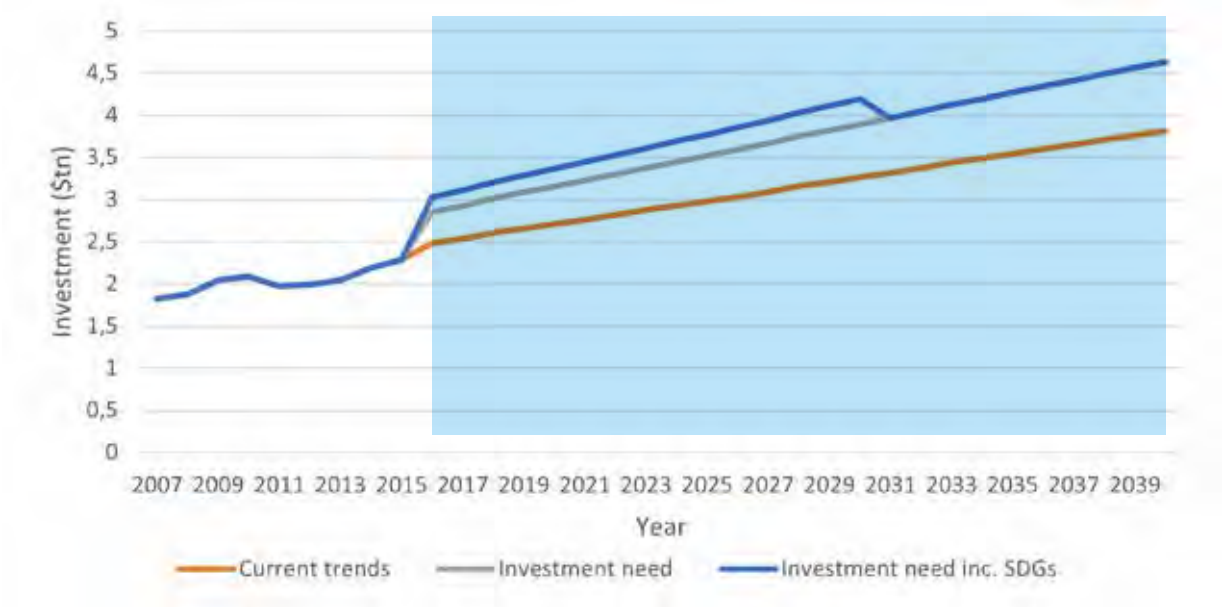
The report recognised the importance of infrastructure and attempted to quantify using other countries' peers the investment requirement going forward to improve people's wellbeing and quality of life. This type of analysis therefore fits quite well with international investment banks and organisations such as the World Bank in their efforts to achieve very similar goals.

They discovered global infrastructure investment needs to be $94 trillion between 2016 and 2040, which is 19% higher than the current trend and would therefore average $3.7 trillion per year. To meet this investment need, the world will need to increase the proportion of GDP it dedicates to infrastructure to 3.5%, compared to the 3.0% expected under current trends.

Within this they identified that Asia will likely dominate the global infrastructure market up to 2040 accounting for 54% of global infrastructure investment need. They also identified that the largest 'gap' between current trends and investment need occurred in the Americas (47% greater than current trend) and Africa (39% greater than current trend). Their analysis also looked at seven different sectors, concluding that electricity and roads account for more than two-thirds of global investment needs. The *Global Infrastructure Hub*[iv] also attempts to account for the UN Sustainable Development Goals[v].

Figure 2 shows the above findings as plotted in the *Global Infrastructure Hub*'s report and the extent of spending in trillions of dollars that is estimated to be required above and beyond the current trend to meet the investment need (in line with peers) and to meet the SDGs in the shorter term.

Figure: 2 – Yearly infrastructure investment at current need and trend



Source: The Global Infrastructure Hub

Interestingly, the *Global Infrastructure Hub* also provided an update in June of 2018 which focused on the countries in Africa within the G20, which they refer to as the Compact with Africa (CWA) nations. They found that "Infrastructure relative investment need for the 10 CWA nations up to 2040 is forecast to be almost US $ 2.0 trillion, when compared with best practice among their peer countries. This forecast increases to almost US $ 2.4 trillion to meet the United Nations' Sustainable Development Goals for electricity and water by 2030."[vi]

Whilst the infrastructure need could therefore be considered to be established, it is important to understand the mechanism through which such infrastructure investment is made possible. To do this it is necessary to consider the inputs that occur within infrastructure projects.

For example, if you wish to build high speed railway lines, depending upon their location in the world you would need to consider:

- The political environment and its stability - will the project reach completion?
- The economic environment - is there enough capital to complete the project? If your agreement is for maintenance or operation will the demand be there to meet projections?
- The risk profile of the project - does it reduce your portfolio risk? Is it a short- medium- or long-term risk? Is the risk premium sufficient?
- Is the rule of law sufficient that as an investor, constructor, or engineer you can enforce the terms of the contract if there are issues?
- Taxation and how the asset is being funded or part funded.
- Are international institutions involved and does this increase or decrease the political risk premium?
- Are there sufficient local skills and institutional capacity to make the project run smoothly or do skills have to be imported? If they must be imported how can this best be achieved?
- Are there local political and legal framework requirements to support such investment?
- What is the flexibility for innovation and in such innovation which party captures the innovative practices? Whose intellectual property is such innovation?

The above considers several factors but there are many that need to be considered and these vary between the investor, financier, the contractor, the engineer and the client (be they public or private).

As such, one of the drivers behind where international finance and investment ends up is based on the global competitiveness ‘or attractiveness’ to investors. Whilst it could be argued that there is a fixed degree of infrastructure investment that will take place in each economy ‘to keep it going’, there is a significant amount of liquid finance which is available to economies which are the most competitive and attractive to such capital flows.

For example, whilst the Covid virus has affected most of the globe, capital flows still exist and are able to be utilised if the conditions and risk profiles are considered sufficient for such investment to be unlocked. According to RICS Analysis of Preqin data[vii] shows there is currently over $220bn of dry power within unlisted infrastructure funds globally - capital that has yet to be committed to a project. A further $203bn is being raised.

Assuming a typical 40:60 equity-debt structure, combined with leverage, this would support the acquisition or development of more than $1trn of infrastructure. And based on current execution rates it could take seven to eight years for all this capital to be invested, before we account for additional impact of Covid-19.

The unlocking of such funds, however, does depend on economic, political, local conditions and risk profiles which now also include the additional risk premium of the Covid-19 outbreak.

International competitiveness is important in investment decisions

For this reason it is important that global infrastructure investment and its flows considers the relative competitiveness and attractiveness of various economies as global funds are directed by such influencers.

The World Economic Forum also produces a global competitiveness report which rates several pillars to judge global competitiveness and relative positions of countries among their peers. The *Global Competitiveness Report 2019*[viii] explores 12 categories of pillars as part of their analysis. These include:

- Institutions
- Infrastructure
- ICT adoption
- Macroeconomic stability
- Health
- Skills
- Product market
- Labour market
- Financial system
- Market size
- Business dynamism
- Innovation capacity

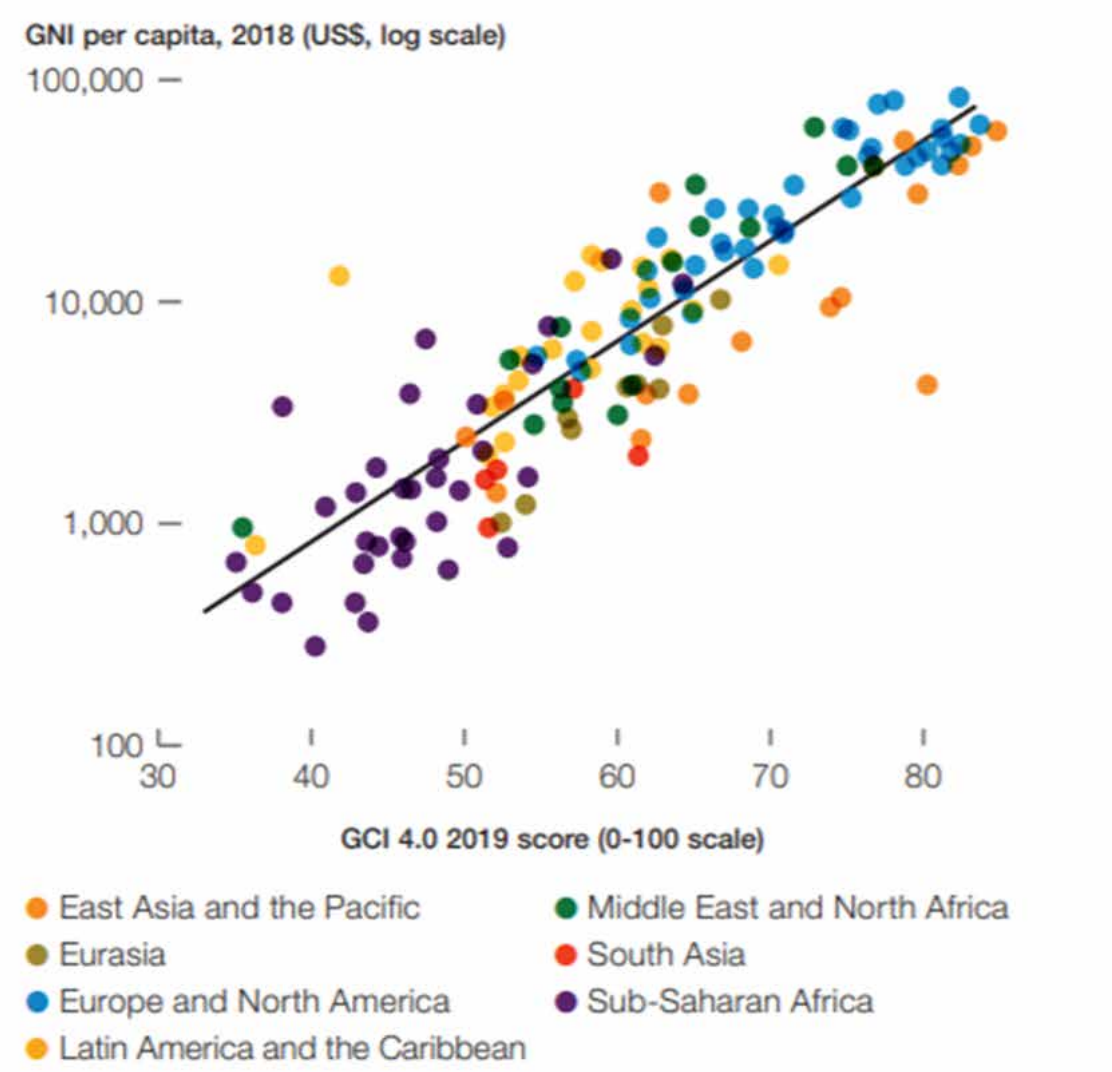
As can be seen from the pillars above, several the World Economic Forum categories (such as infrastructure, health, skills, macroeconomic stability, innovative capacity) align with the United Nations Sustainable Development Goals, such as decent work and economic growth, industry innovation and infrastructure, quality education, peace, justice and institutions.

The World Economic Forum *Global Competitiveness Report* provides a detailed breakdown of each of these pillars and their constituent parts for each country and an overall competitiveness score. In their 2019 analysis their report covered 141 economies providing an overall score of between 1 and 100. Singapore scored highest in 2019 with an overall score of 84.8 and Chad the lowest with an overall score of 35.1.

Figure 3 show the extent of this differential and the variation across global regions given their levels of national income. It is apparent that whilst not all countries in a region are necessarily grouped together there is some degree of correlation with Sub-Saharan African countries generally appearing lower down the correlation, with Latin America and the Caribbean and East Asia and the Pacific grouping towards the middle and Europe and North America towards the higher end of income and global competitiveness.

This again suggests that the work of institutions such as the various development banks will be vital in reducing the relative gap if the UN Sustainable Development Goals are to be met.

Figure: 3 – Global competitiveness index

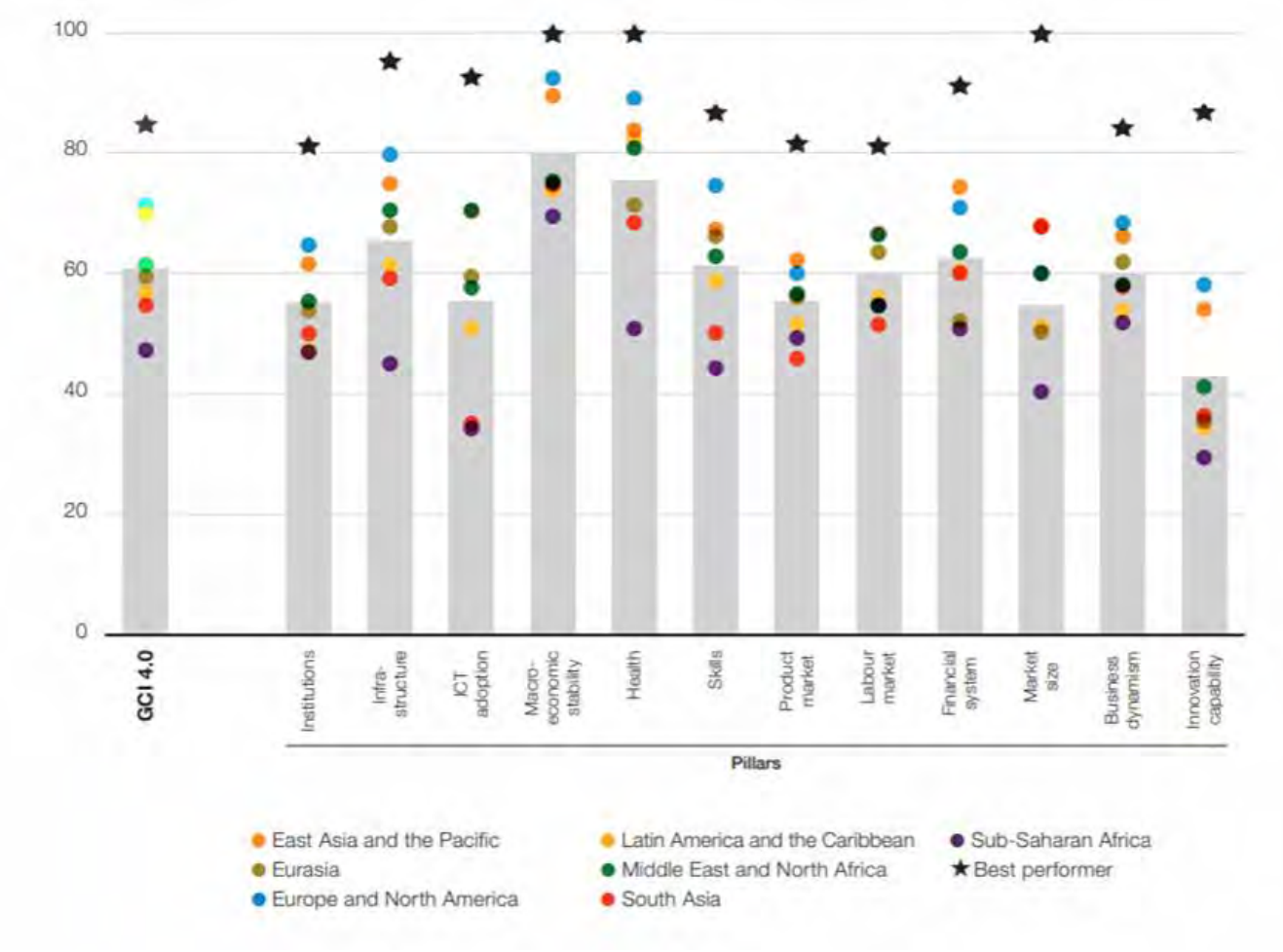


Notes: GNI = gross national income (Atlas method). Data for Barbados, Iceland and Iran is from 2017; data for Venezuela is from 2014. N=141, R2 = 0.81.

Source: World Economic Forum[ix]

Interestingly, the report also demonstrates the differential in each of the pillars mentioned previously. Whilst the gaps appear to be consistently wider than one would hope, institutions and labour markets are now one of the narrowest areas between countries' performance. Whilst this research was undertaken prior to the Covid-19 crisis, there should be some cause for concern looking back on these results. The largest differentials between best and worst performer occur in infrastructure, ICT adoption, market size and innovative capacity, all of which have been key fundamentals for economies to weather the current crisis. Without sufficient ability to use technology, broadband, and sizeable distribution, many countries would have suffered to a far greater extent than is the current case.

Figure: 4 – The state of global competitiveness



Source: World Economic Forum;[x]

The results above show the variation across their pillars but it is also important to understand how these differentials occur across regions. As such, the World Economic Forum also produce an analysis of the average scores in each of its pillars across its regions. As can be seen from **Figure 5** below, whilst varying in scale into the Covid-19 crisis, macroeconomic stability was one of the highest rated factors, with innovative capacity and ICT adoption being one of the lowest.

Infrastructure investment

Whilst infrastructure seems to be relatively well rated along with financial systems and macroeconomic stability, there is still a substantial factor of difference between the lowest and best performers. Closing such a gap should be the focus going forward given the vital role infrastructure plays in day-to-day life, but also in meeting measures such as the Sustainable Development Goals.

Figure: 5 – Regional performance

	Enabling Environment				Human Capital		Markets				Innovation Ecosystem	
Region (alphabetical order)	Institutions	Infrastructure	ICT adoption	Macroeconomic stability	Health	Skills	Product market	Labour market	Financial system	Market size	Business dynamism	Innovation capability
East Asia and the Pacific	61.6	74.8	70.3	89.6	83.8	67.3	62.2	66.6	74.3	67.9	66.1	54.0
Eurasia	53.8	67.7	59.5	74.9	71.3	66.1	56.1	63.5	52.0	50.3	61.9	35.5
Europe and North America	64.7	79.7	70.4	92.6	89.1	74.6	60.0	66.4	70.9	60.1	68.3	58.1
Latin America and the Caribbean	47.1	61.3	50.9	73.7	82.2	58.7	51.6	55.9	60.3	51.2	53.8	34.3
Middle East and North Africa	55.5	70.5	57.6	75.3	80.8	62.9	56.7	54.8	63.7	59.9	58.2	41.3
South Asia	50.0	59.2	35.1	74.7	68.4	50.1	45.8	51.5	60.0	67.7	57.8	36.3
Sub-Saharan Africa	46.9	45.0	34.3	69.4	50.8	44.3	49.3	54.6	50.8	40.4	51.8	29.4

Source: World Economic Forum;[xi]

The above provides a picture which covers a significant amount of the globe and suggests that, despite current efforts, more emphasis is needed on ensuring that countries and institutions target their efforts not only in countries and regions where the greatest improvements can be obtained, but also that such activities are as efficient and effective as possible to ensure that we obtain the maximum value for money and social value for the investment that takes place.

The challenge is significant which is why FIDIC is continually working to improve and promote its core principles of sustainability, integrity, and quality.

Having analysed the above, priorities have shifted since Covid-19 and the world will feel the effects of the pandemic health-wise for some time and economically for potentially a far longer period.

As such, patterns of investment and priorities will change and the risk/investment position will change as will the allocation of investment across the globe to different countries. To understand this better, this report will now look at the WEF global risks position prior to and during the Covid-19 crisis.

Mark Worrall
Chief Executive
Estates and Infrastructure Exchange Ltd

Tradeable and transparent – the way forward for infrastructure funding.

The numbers that come on a price tag for infrastructure do not get any bigger.

Let us start with $94 trillion. That is probably the largest sum of money quoted anywhere and it is the estimated bill for the required investment in infrastructure worldwide between 2016 and 2040.

That is 19% higher than the current trend and represents $4 trillion a year.

Our Covid-19 ravaged world is wreaking havoc among the world's economies with governments issuing debt as fast as they dare to keep abreast of an uncertain future.

These same governments have acknowledged investment in our infrastructure is also a vital part of that future – whatever form it may take – and so we could be on the cusp of a cash injection of unprecedented proportions.

Industry contribution

The revered British economist John Maynard Keynes was quoted in October by the IMF in its well-publicised clarion cry (2020 Fiscal Monitor) to the world's governments to invest in infrastructure projects.

Workers, said Keynes, should be employed to dig holes in the ground and to fill them back in again, simply as a means of providing employment and boost consumer spending.

No one is suggesting that, least of all the IMF, but the sentiment is clear.

Investment in infrastructure leads to economic recovery and prosperity – an epithet brilliantly tested by Franklin D Roosevelt's New Deal which dragged the United States from the Great Depression of the 1930s in less than a decade.

The current picture of infrastructure investment is, like many gigantic machines, characterised by illiquidity, slow pace and opaque money trails.

The path of vital cash from governments to projects has been long cluttered with inefficiency and lack of clarity.

We are the Estates and Infrastructure Exchange (EIX). EIX, regulated as an exchange in the City of London, exists solely to bring transparent pricing and a clear route to market as well as liquidity in the form of tradeable bonds.

Infrastructure is maturing and growing fast as an asset class, but until now it has not been tradeable on an open and transparent marketplace.

Our ethos too is strongly aimed towards renewable and sustainable projects which embrace the 'Build Back Better' motif.

The EIX process brings more speed – perhaps as fast as 16 weeks for the investor funds to reach a project – and reliable yield over a longer tenor than is currently available.

Though it comes with very big price tags, infrastructure is vital, and the world needs it fast.

But, as EIX's chairman Professor Ian Reeves says: "As far as infrastructure is concerned, it is not the price of it, rather what is the cost of not doing it?"

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/Risks, events and threats to infrastructure investment

/SOW2021

/Risks, events and threats to infrastructure investment

What is the current risk status when considering infrastructure?

Companies are used to managing various risks such as market changes, financial, personnel and skills, economic, political/governmental, technological including cyber security, regulatory/policy changes and significantly in recent times as shown by the Covid-19 pandemic, health and operational risks.

The shifting of risks between the various challenges does not negate or mean that risks completely disappear. For example, environmental risks including climate change, severe weather conditions such as flooding, droughts, natural/forest fires etc have not ceased due to Covid becoming more important or prevalent.

Such risks are also important for infrastructure investment in several ways, for example:

- Infrastructure investment generally takes significant time to propose, plan and gain private/political/government sign off and then design and deliver and so regardless of the delivery mechanism (public or private) the stability of the investment environment is important.
- To price and attract investment in infrastructure an understanding is required of the risks both within the project and in the wider economic/social/political environment. For example, demand risk if not understood correctly leads to a sub-optimal outcome for investments.
- Infrastructure investment embeds a relatively static way of operating in the short term. For example, no economy will just stop using railways overnight. Whilst there is some short-term flexibility most changes/adaptations would occur over the medium and long term, so it is important that investment decisions are made efficiently and sustainably.
- Infrastructure is a means of addressing and mitigating several risks that affect companies, governments, society and the economy. For example, the Covid crisis has highlighted the fragility of health and remote working infrastructure (such as broadband) in many countries.
- Social and economic activity and the productivity of capital and labour are linked to the quality of infrastructure.

The above, in combination with the previously outlined evidence that countries are not spending enough to maintain their current status quo let alone meet the SDGs going forward suggests that the investment environment needs to be considered in more detail. To do this we draw evidence from 2 key reports by the World Economic Forum.

One was published pre-Covid and the second presents their preliminary findings on risks during Covid and as economies plan to exit the crisis. The shift in perceptions is not only interesting but has significant implications.

/Risks, events and threats to infrastructure investment

The first report we consider (the pre-Covid position) is a report produced annually by the World Economic Forum in their *Global Risks Report*[xii]. The latest 2020 report reveals that the top five global risks in terms of likelihood are:

- Extreme weather
- Climate action failure
- Natural disasters
- Biodiversity loss
- Human-made environmental disasters

It is interesting to note that this is the first time since 2007 that the top five risks have all been in the environmental category. This demonstrates why initiatives such as the Sustainable Development Goals and ensuring engineering solutions are sustainable and resilient is so important.

It is also worth noting that since 2015 no economic factors have been considered in the top five global risks. Whilst there is some rationale to this, for example they featured heavily as the top global risks in recessionary periods but slowly fade away as economic conditions improve, it is interesting to consider their absence considering the investment that would be required to address such climate/environmental risks. Having said this, 78% of respondents were still expecting economic confrontations to increase in 2020, which could disrupt and create further uncertainly putting pressure on investment.

Looking at the top five risks in terms of impact the report rates the risks as follows:

- Climate change action
- Weapons of mass destruction
- Biodiversity loss
- Extreme weather
- Water crisis

Interestingly, three of the risks are not only likely but have a severe impact and that a water crisis is also now considered one of the top five, an issue that was raised in FIDIC's 2015 *State of the World* report and still features heavily in the 2020-2021 *State of the World* series due to its significance and importance for food, water, energy production and the environment.

The report also reveals that amongst the multi-stakeholder and global shapers (the Global Shapers Community is the World Economic Forum's network of young people) surveyed, the majority expected risks across a wide range of categories to rise in 2020 and whilst there were some differences from the overall result, the environment featured heavily across both sets of respondents.

Whilst not in the top five risks, both sets of respondents also identified cyber-related issues, such as cyber-attacks and data fraud or theft, in the list of top ten long-term risks.

The above demonstrates that the environmental, technological and infrastructure solutions are important to addressing the majority of global needs.

/Risks, events and threats to infrastructure investment

Covid has changed everything

Global uncertainty about the future is increasing. Indeed, the IMF's *World Uncertainty Index*[xiii], which covers 143 countries around the world with a population of at least two million, has now reached record levels. During the global financial crisis of 2009, the index was 340. The Iraq war saw it rise to 550 while the Covid-19 crisis has seen it rocket up to 820 – an all-time high.

This is reflected as you fast forward to May 2020 and the World Economic Forum's release of *Covid-19 Risks Outlook A Preliminary Mapping and Its Implications*[xiv] report. It is fair to say the concerns and risks from respondents highlighted paint a very different picture.

This time, the report explores the most likely fallout and risks of greatest concern. Looking at the top five global risks in terms of fallout there were:

- Prolonged recession of the global economy.
- Surge in bankruptcies (big firms and SMEs) and a wave of industry consolidation.
- Failure of industries or sectors in certain countries to properly recover.
- High levels of structural unemployment (especially youth).
- Tighter restrictions on the cross-border movement of people and goods.

And the top five in terms of greatest concern were:

- Prolonged recession of the global economy.
- High levels of structural unemployment (especially youth).
- Another global outbreak of Covid-19 or different infectious disease.
- Weakening of fiscal positions in major economies.
- Failure of industries or sectors in certain countries to properly recover.

To say there has been a significant shift is an understatement. In less than half a year, rather than being focussed on environmental risks, eight of the top ten most likely fallouts and concerns and risks are now economic.

The first environmental risk on both lists is now a higher risk of failing to invest enough in climate resilience and adaptation and features at 19th on the fallout list and 23rd on the list of concerns.

The report also clearly states:

"Pandemics have traditionally suffered from a panic–neglect cycle. Quiet periods see no action, early warnings of an outbreak tend to be overlooked, significant response and funding are late and uncoordinated, and valuable lessons from the crisis are not institutionalised." [xv]

This is another aspect governments will need to consider, as they strive to develop lessons learnt from the first global pandemic for approximately 100 years, which has affected the majority of countries. These lessons will inevitably factor into investment plans including those for infrastructure going forward.

What do risk and events such as Covid mean for infrastructure investment?

The shifting of risks towards those of economic-related issues, whilst significant as part of the Covid crisis, is not surprising. Such shifts have occurred within and during the period preceding previous recessions. Given the likelihood that Covid has reduced economic activity to the point it may trigger the next recession, it is natural for individuals, companies, and governments to react to such circumstances.

Looking forward, our reaction to this crisis will determine not only our future resilience to COVID type events but also the mix of risks that infrastructure investment faces are not only short term in nature.

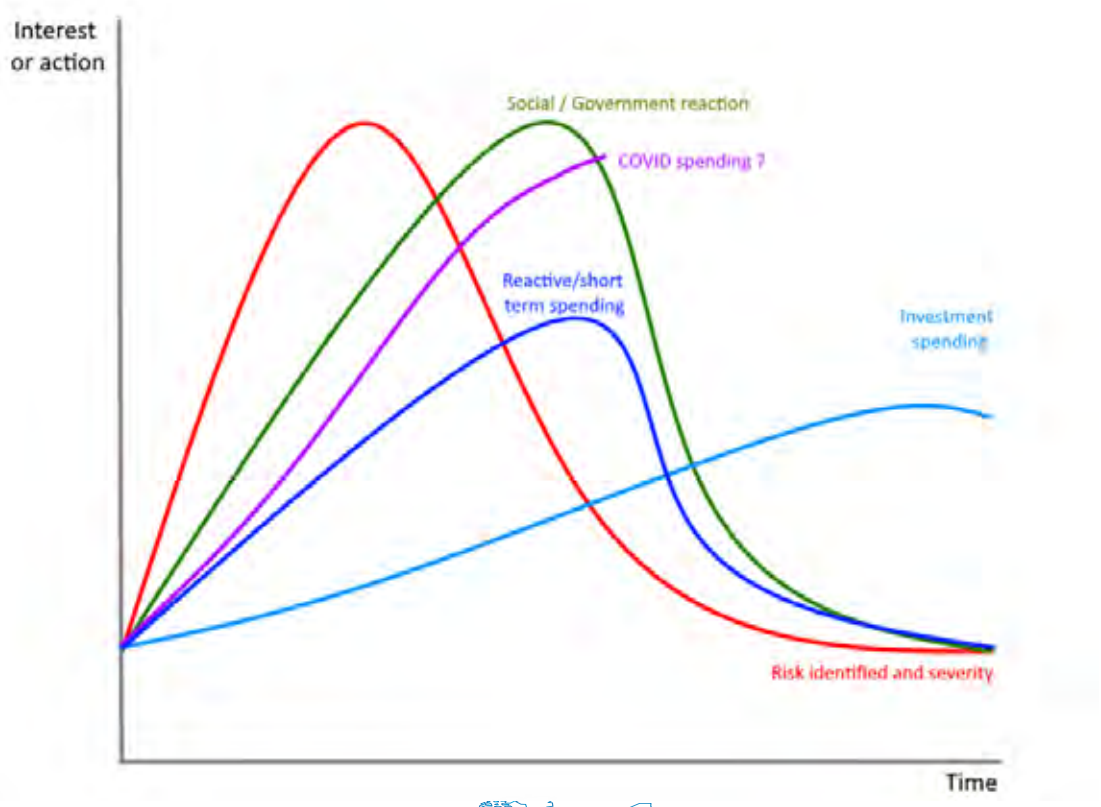
To demonstrate this, let us consider for a moment what happens within the process of identifying and reacting to risks more generally.

As can be seen from **Figure 6** below, the red line represents the emergence of a new risk, which emerges and reaches a peak then tails off. The response socially, individually or by governments etc, then lags the emergence of the risk and in this example the interest or action is proportional to the risk. In an ideal scenario you could argue that the response should be proportionate to the risk, but this may not always be the case. We use an example where it is for ease.

You then get the reactive spending which follows the reaction. This is because whilst individuals and policy will adapt, there will be a further lag until such spending, behaviour etc, takes place.

Reactive spending, however, is generally short term (e.g. in a recession it might be unemployment payments) but this spending does not constitute the full response to the risk that has emerged. The blue line shows the investment spending that then occurs over a longer period and is a result of lessons learnt or systematic failures to address the risk that occurred.

Figure: 6 – Illustrative risk response



/Risks, events and threats to infrastructure investment

Then there is the scenario that has not yet been discussed and potentially will change the investment landscape for infrastructure in a way that has not yet been considered, at least in the short to medium term. The Covid-19 reactionary expenditure, which to date it is fair to surmise is more significant than any economic crisis in the last 100 years, will have an effect going forward.

The rationale for this paper separating out the Covid-19 reaction compared to the generic risk profile is due to several factors which include:

- The scale of the shock to the global economy has been unprecedented with most industries and economies hit simultaneously.
- Global stimulus efforts to respond to the virus have been unprecedented in scale and most countries in a survey by the OECD have focused on relief measures rather than investment. For example, of the 109 countries the policy focus was on personal income tax (53%), Corporate income tax (66%), VAT (54%) and social security (36%)[xvi].
- Investment measures are being talked about but there will be a financing challenge given the unprecedented scale of the short-term measures that were put in place.

To put the scale of this short-term response in context, if we look at some of the economic figures to date and some early comparisons to the previous financial crisis, it is revealed that:

According to the UN's trade and development agency - the slowdown caused by Covid-19 is likely to cost at least $1 trillion, however, the doomsday scenario in which the world economy grew at only 0.5%, would involve a $2 trillion hit to GDP[xvii].

According to the UN, rich industrial nations have already announced a $5 trillion global rescue package plan but a $2.5 trillion Covid-19 rescue package is needed for world's emerging economies[xviii].

Central banks have moved far quicker than they did in the financial crisis[xix]. This should help to provide financial resources available to businesses on terms that are acceptable/achievable compared with the situation which plagued plagued the years following the financial crisis. Governments have moved to support such schemes.

Using the UK as an example, it was recently revealed[xx] that the deficit is due to potentially hit £337bn in the current year as the 'base case scenario'. That is the equivalent to 17% of GDP and is significantly above the £158bn (10.2% of GDP) that occurred in the financial crisis in 2009/10. This sort of projection is not unique to the UK, with many countries facing unprecedented rises in short-term and immediate spending in response to Covid-19.

As such, it is reasonable to assume that the Covid-19 response curve has occurred relatively faster and at a more intense extent to the normal response curve. Before we consider the potential investment profile out of Covid, let's first look in a bit more detail at purely the investment curve that occurs because of risks/events.

So far, governments have had to make decisions that most would agree have been appropriate in focusing on short-term spending, but they now need to begin to consider long-term investment, both as a way out of the economic crisis that is emerging but also to prepare for and counter the next crisis. Without this investment we also risk losing track of our commitments on SDGs.

The economic cycle, repeated risks and the investment curve

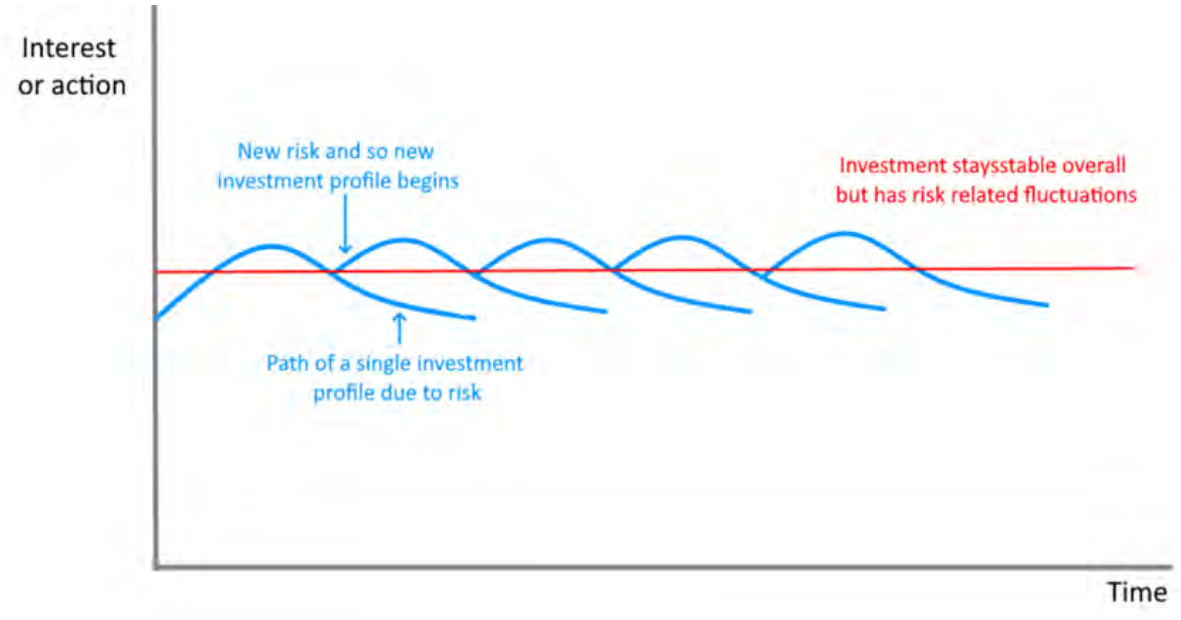
To understand the response investment response to the economic cycle and risks better, below we consider two scenarios.

The first in **Figure 7** shows the investment curve that occurs due to a risk/event that is repeated at equal intervals and so it would allow society/government to plan its investment profile out of such crisis to create an overall stable position going forward.

There are, however, several issues with describing the investment profile in this manner, such as:

- It is unlikely that risks/events are going to occur at equally spaced intervals.
- It assumes that when making investments society/governments are aware of what the 'right' level of investment should be over the longer term.
- Currently it considers 'investment' as a whole whereas each investment curve will be a combination of many investments and so no two curves will be the same.
- It ignores economic conditions.

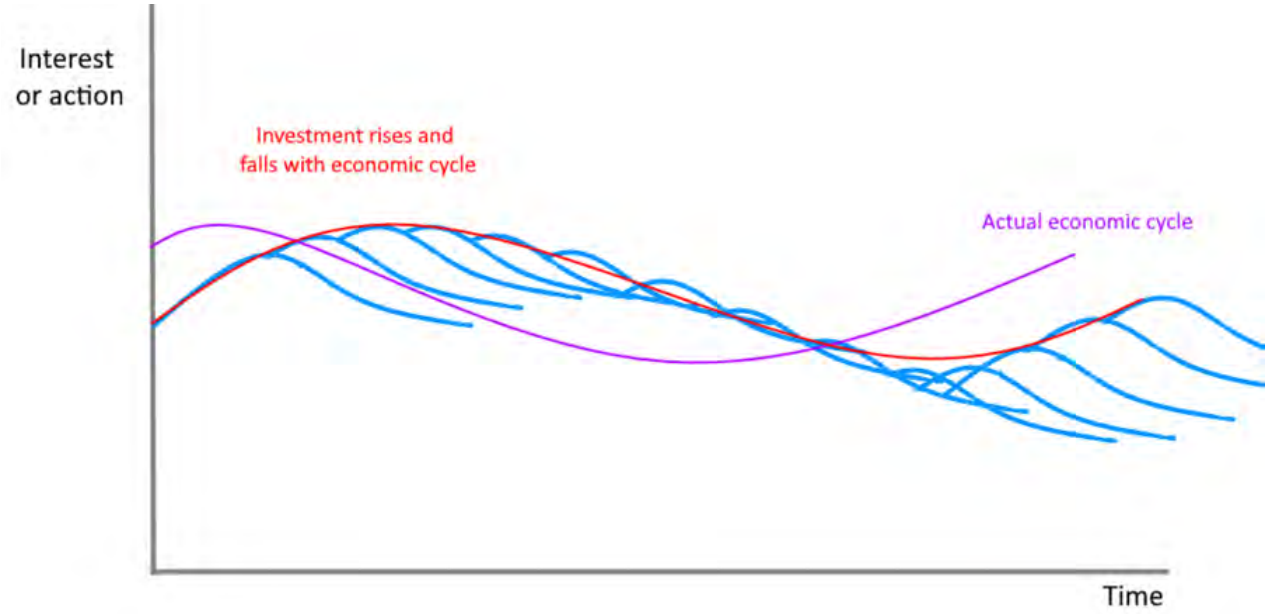
Figure 7 - Stability over the long run



Taking the last of these you could consider the profile in a similar way where individual risks/events result in investment profiles that follow an economic cycle. As such, you would end up with something that resembles the profile outlined in **Figure 8**.

As can be seen, whilst you now have a 'combined overall' risk profile it now also tracks economic conditions. Whilst this does not have the constant level of stability of the scenario above, it should better represent the reality of investment decisions that are made.

Figure 8 - Economic cycle

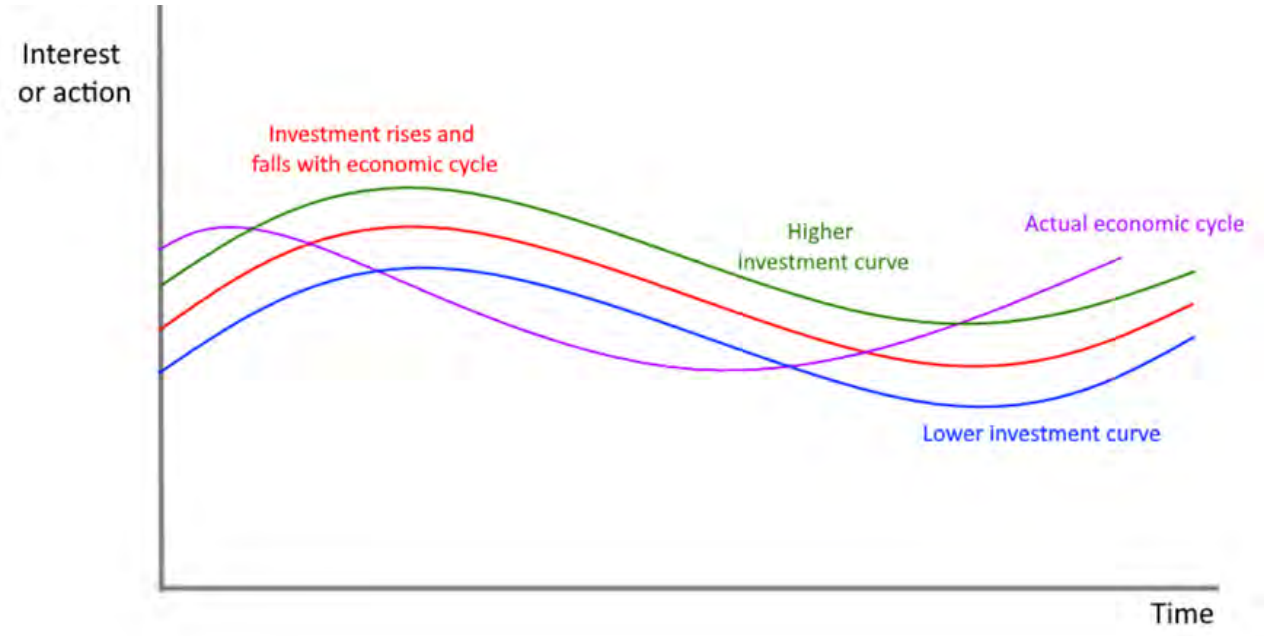


Having said the above, if you consider that government investment can be used as a stimulus tool and that there will be a lag between the economic cycle and the response and so investment cycle, you will end up with something like the red line for the overall investment profile tracking several periods behind the economic cycle. Over the long term, however, the investment curve even with government expenditure falling out of line with the economic cycle would to some extent follow the profile, given that investments made in times where stimuli are needed would need to be followed by times of lower investment when stimuli are not as necessary.

The above, however, does not yet account for the differential between short and long-term risk/events. Currently each of the investment curves are treated equally and so therefore in theory have an equal standing.

Below, if you look at only the aggregate positions, you can see that there will be many aggregate investment curves for each type of investment which, when combined, create the overall aggregated position.

Figure 9 - Economic cycle, multiple investment profiles generate the aggregate

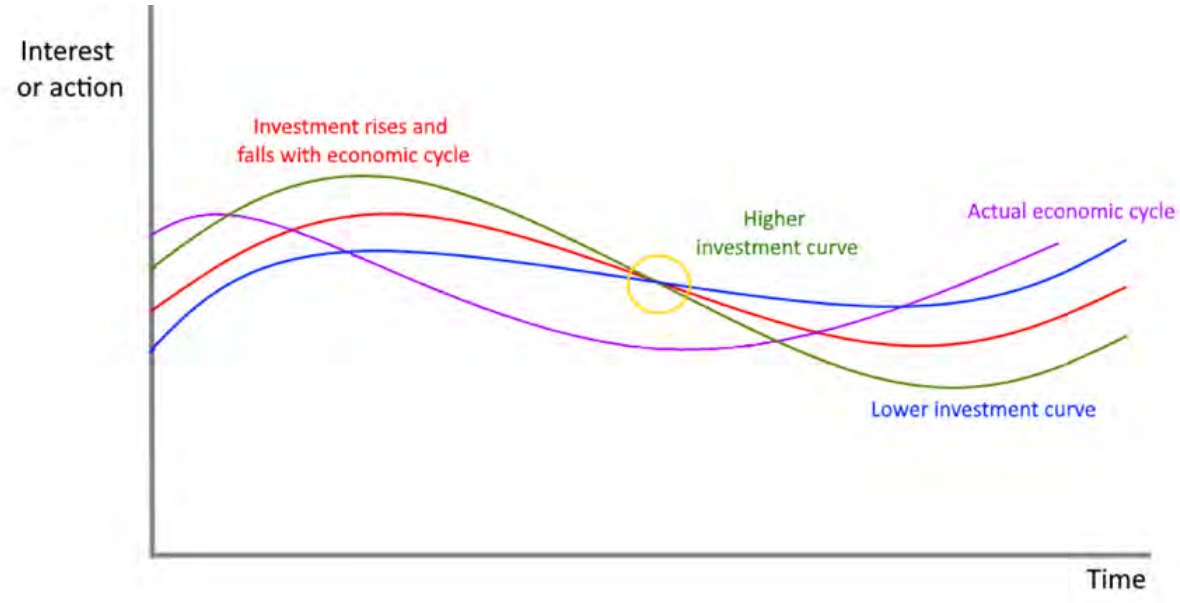


This is where it is important for individuals, society, companies and governments to prioritise the type of investments they are undertaking over time.

As is shown below in **Figure 10**, investment profiles that were previously considered important/essential as a result of risks/events can over time shift from being an important investment to a less important one – e.g., from above the aggregate position to below it and vice versa.

The nexus point of this shift is demonstrated by the yellow circle as one investment preference rises and one declines. Whilst the example below shows the trade-off between two investment decisions, there will be many of these decisions occurring simultaneously to produce the aggregate outcome.

Figure 10 – Switching investment priorities



This is where the current Covid crisis and the current views on global risks which were discussed previously are important, as the balance and shift in investment decisions is already occurring.

Since the financial crisis in 2007/08, there has not been a crisis serious enough to warrant a wholesale economic stimulus. Covid-19 is therefore not only one of the greatest health risks the globe has faced in the last century, but has the potential to be one of the most severe economic challenges the world has ever faced.

As the Covid crisis took hold it was understandable that emphasis was on combatting the spread of the virus. Whilst these concerns still exist, the gradual shift towards that of short/medium run economic concerns is understandable given the scale of the economic support packages that have been announced around the globe.

This should not, however, mean that investment in infrastructure that meet the environment concerns and the risks identified less than six months previously should not continue to be prioritised in terms of the investment mix going forward.

As can be seen from the images from around the globe, Covid has in fact raised as many questions as possible on the environment, despite in the short-term slowing investment.

For the first time some cities have lost smog clouds, ports and waterways are the clearest and cleanest they have been for decades and many individuals are using modes of transport less whilst still being able to work remotely.

This is where Covid has provided some useful insights. With lower economic activity and changes in behaviour there has been a glimpse into how much healthier and environmentally-friendly countries could become.

/Risks, events and threats to infrastructure investment

This is where the time element becomes very important within investment and risk consideration. Whilst it is currently anticipated that Covid will have an effect into 2021, the development of vaccinations should help to remove significant strain from healthcare systems around the globe. This does not, however, mean that individuals around the globe will not expect increased investment or provision of medical services given the effect of the pandemic.

Having said the above, it has also shown the extent and challenge we face in not only meeting the SDGs but the eventual target of net zero. Going forward, understanding this challenge will be vital. It is important to explore the scale of fossil fuel usage and the resources we have remaining and whether pricing is currently enough to drive the investment decision-making process towards meeting the SDGs.

One cannot, however, only approach the challenge of issues such as Covid and climate change in isolation of economic conditions. Covid like the last financial crisis, has and will affect the ability and scale of investment decisions going forward.

Adam Bialachowski
Chair, FIDIC Future Leaders Council
Vintage Consulting, Poland

The way forward for small and medium enterprises

In a world where the 'old' way of doing things theoretically revolves around common sense, one must consider whether the common sense of 'old' can handle the new challenges that have arrived due to past decisions using 'old common sense'. Today, people are burning their shoes as protest[xxi], luxury watch producers are destroying their inventory[xxii], clothes manufacturers are utilising their own products[xxiii] and it is predicted that in 30 years there will be more plastic than fish in the ocean[xxiv]. This is a pretty grim picture that requires a paradigm shift especially when it comes to infrastructure investment. Such a paradigm shift is offered by this *State of the World* report and just as this paradigm shift will occur, small and medium firms in the consulting engineering industry will have to react with their own change of how they wish to do business.

In order to adapt to the changing paradigm, we as engineering consulting companies, need to acknowledge it is Time To Take The Trillion Task seriously. We need to innovate, change the way we work and change our 'old common sense' - this will require investment of time and effort into our six Ts.

It is time to $Tn-vest into:

- The way we market our services.
- The way we deliver our services.
- The way we manage human resources.
- The way we interact with clients.
- The way we pick partners and alliances.
- The way we secure finances and cashflow.

The above list is a prerequisite for SMEs to be relevant and prepared for the next cycle of infrastructure delivery.

SMEs are agile companies by nature and can implement change quickly. Marketing our services by offering remotely delivered webinars, arranging sale pitches virtually, changing the way we identify potential clients and their needs using simple online news data mining are just a few low-cost paths. Using online cloud project management/delivery tools, whose prices have decreased significantly, can solve many problems, decreasing travel time, kilometers traveled, costs, efficiency, and account for the new normal of working from home and automatically leverage a different approach to human resources management. Implementing these changes automatically appeals to what is expected from Millennials and Generation Z employees – working from home or otherwise remotely, decreasing carbon footprint, measuring employee output by results, not time in office and flexible working hours. Due to travel restrictions and the increased availability of internet-based connectivity, this year has shown that finding alliances and partners has become cheaper and easier than ever before. Securing finances and cashflow for these changes can be difficult but some proposed solutions in the EU like country-backed warrantees, insurance and pandemic assistance programmes have been implemented and are there for SMEs. Securing finances and cashflow for SMEs is also something that can be part of partnership and alliance solutions.

The above requires action by owners and managers. If we want to be in business after the dust settles, in the new normal, we need to take charge and join the $Tn-vest paradigm shift and make it central for our decision-making processes.

International Federation of Consulting Engineers
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/Are we more sustainable?

/SOW2021

Did investment patterns change based on what was learned from the last crisis? Are we more sustainable?

The last financial crisis saw many countries promote the use of investment into infrastructure as a way of improving growth prospects via economic multipliers. Whilst investment did occur in many countries, as discussed earlier there is still a significant gap between current investment trends and investment need, even before the currently agreed SDGs are taken into consideration.

The investment case as discussed in this report is therefore clear. What is less clear, however, is what did we learn out of the investments out of the last financial crisis and will this help us during the exit from the economic conditions because of the Covid-19 pandemic?

So where does the world currently stand on investment? Infrastructure investment and political support for measures which help to improve economic performance whilst combatting climate change are still considered important. The Covid-19 crisis and the webinar series[xxv] run by FIDIC, which was attended by over 9,000 attendees, discussed on multiple occasions the need to ensure that investment decisions arising from Covid needed to ensure they considered the potential of a 'new normal' which may include to a varying degree allowing more remote working, upgraded health provision and lower fossil fuel use to improve the environment.

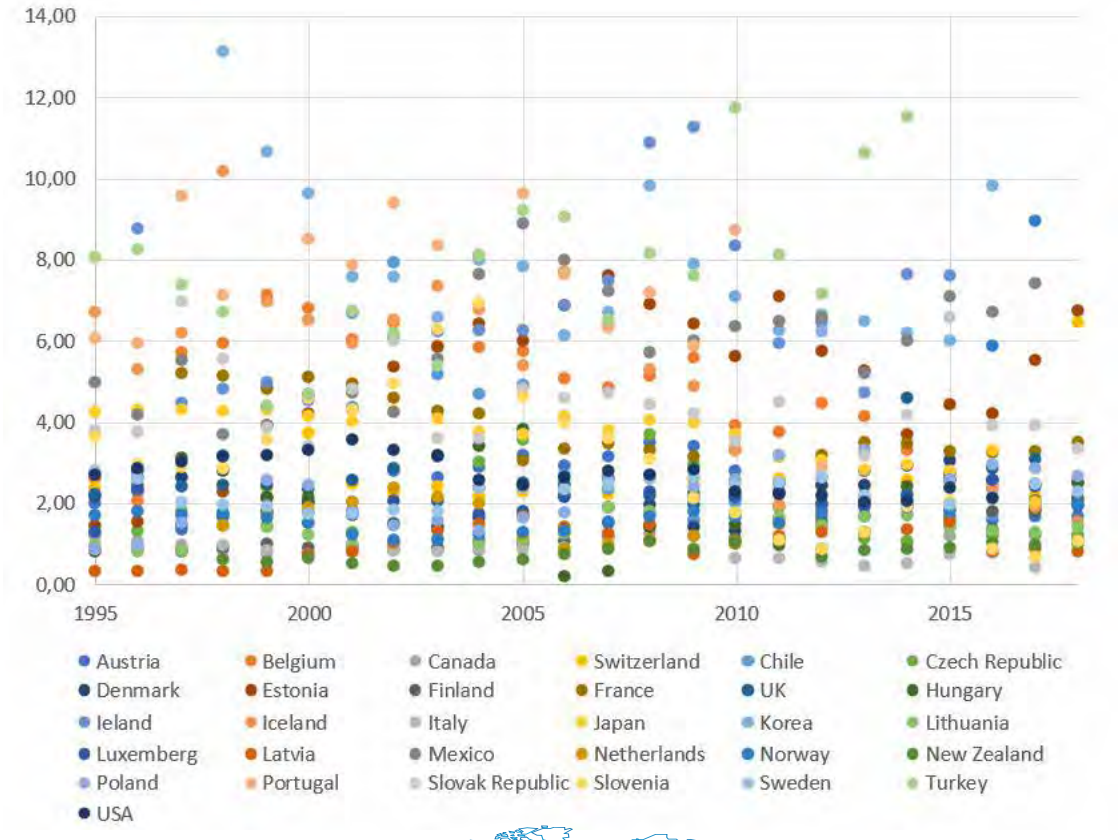
The issue going forward will be instigating such change, learning from the financial crisis and the currently under-trend investment levels and understanding how these can be addressed going forward.

This report has already discussed the possibility of mechanisms to automatically respond and bolster a shift back to trend, but is this enough?

Using OECD data on infrastructure investment and maintenance, the chart below tracks the investment/maintenance spending ratio over time of countries[xxvi] where consistent data points over time were available and removing seven outliers where the ratio was significantly above 20 and not representative within the dataset.

Figure 11 below show the results for individual country plots to demonstrate the range and variance but also the overall outcome.

Figure: 11 – Investment/maintenance spending ratio – countries



As can be seen from the individual country plots, there is a gathering of data points between the 1.5-4.0 ratio band and that over time the number of countries with points above this level have decreased.

It should, however, be noted that several countries in more recent years do not have data for investment and/or maintenance and so their data point is excluded. This is to ensure that we can look at the most up-to-date picture possible, but the results should be considered in this light.

We therefore then plot the average considering the above and it shows that over time the investment/maintenance ratio has fallen from investment being approximately three times the level of maintenance to it being just over two times the level.

It is important to consider that the data point in more recent times that are not included could if at a higher ratio improve results. This does not, however, mean that such an overall trend is not relevant because if you consider the period excluding the last four years where there are some missing data points in 11 countries (up to four years most missing one or two) that the trend is still lower than at the start of the period.

This can be seen in **Figure 12** below, as can the potential impact of economic cycles and conditions with the ratio experiencing a rise with a subsequent fall in the period around 2001, 2009 and 2015. The 2001 period was around the emergence of the technology bubble, the 2009 period the financial crisis and the 2015 period a time of increasing global uncertainty with pressures on international trade.

Figure: 12 – Investment/maintenance spending ratio - overall

The important thing to consider is, what can we learn from the above? Below, this report provides some observations:

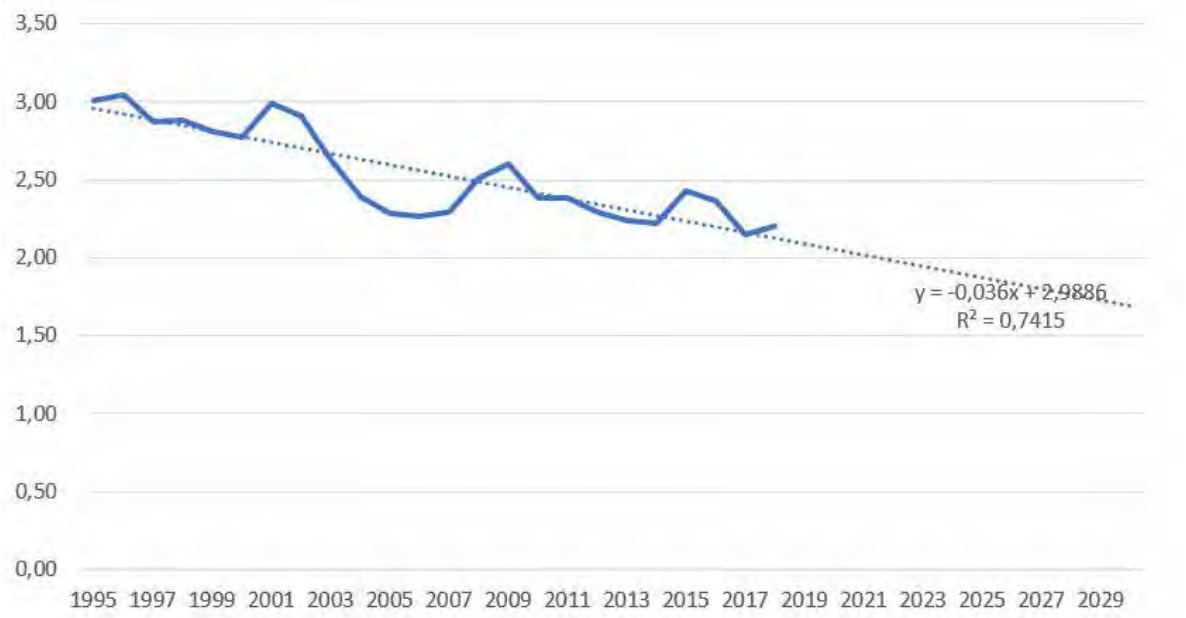
Maintenance spending as a proportion of the investment/maintenance spending has increased.

Investment spending as part of the investment/maintenance spending has decreased.

Both have decreased or increased but to a differing extent.

The above, however, is even more important when you consider that trend going forward. As can be seen from the **Figure 13** below by 2030, the time at which the SDGs and 'sustainable development' is due to be a priority, the ratio would only be 1.7 and if that is pushed out to 2050 the ratio would be 1.

Figure: 13 – Investment/maintenance spending ratio – overall forward projection



Source Data from OECD[xxix]

To help explore the above further, analysis was done on the maximum spend across the period, the minimum spend and the variation between the two compared to the average for both investment and maintenance spending.

The result of this is that the variation and scale of changes in infrastructure and maintenance expenditure were very similar, with a 90% variance on investment expenditure and an 88% variance on maintenance expenditure.

This suggests that whilst in the shorter term there are movements due to economic circumstances towards a ratio where investment is not significantly outpacing maintenance, there is a valid question to be asked as to why maintenance is not reducing if we are acting more sustainability.

This has two potential implications. The first is investment profiles. Despite all the emphasis on using investment to grow out of recessions, its spending compared to maintenance is relatively stable and linked to maintenance. This suggests we have not seen progress towards the earlier discussed infrastructure needs gap.

The second is that when you consider 'whole life costs' and the aim of making infrastructure more sustainable, there does not appear to be evidence that maintenance costs are reducing as a result of infrastructure expenditure, in fact they are increasing.

Whilst this may not seem positive it can explain the issue the globe is facing, in that a lack of infrastructure investment in a sustainable manner is resulting in maintenance costs being higher as a ratio between the two than otherwise would be the case and the globe is not meeting its infrastructure investment need. We are still prioritising short-term solutions and fixes over long-term sustainable decisions.

Given FIDIC's global reach and network, we believe it is important to explore and work with all stakeholders across the globe to collate project and investment information and to investigate these findings further and their potential implications on how the infrastructure sector can support a shift towards a more sustainable future to meet or even outperform the SDGs.

Given the evidence in this report on the investment/maintenance ratio, FIDIC recommends that there be a global effort to monitor such a ratio, not only in the countries that could be analysed as part of this report but across all countries. The goal for example could be that maintenance spending remains stable, but investment spending rises to meet the investment gap thus improving the ratio and truly pushing towards whole life and sustainable investment.

Danny Alexander
Vice President and Corporate Secretary
Asian Infrastructure Investment Bank

AIIB: Infrastructure for Tomorrow

The Asian Infrastructure Investment Bank (AIIB) is pleased to contribute to this report that highlights the multi-trillion dollar challenge the infrastructure sector is facing not only in light of meeting current needs, but also in light of the Sustainable Development Goals (SDGs) and the potential new challenges caused as a result of governments taking proactive action against Covid-19, possibly the worst pandemic of several generations.

In January 2016, the AIIB started operations as the first new multilateral development bank of the 21st century. Five years on, the bank has evolved from “a new kid on the block” to a thriving international financial institution working together with various institutions to meet this $1.7 trillion annual shortfall in funding for infrastructure in Asia. We have strong multilateral governance, an AAA credit rating and we maintain high international standards in our rapidly growing project portfolio. We have over $23bn of approved loans and investments in 112 projects across 28 members.

Tackling climate change and ensuring sustainable economic growth is the most pressing medium-term challenge for the sector and for humanity and will also be a major focus for AIIB over the next decade. Global efforts are very encouraging including the cooperation we have with other MDBs. Indeed, there is a global momentum in investments in low-carbon, climate resilient infrastructure, but the actual volume of investment is still well below the needs envisaged in the Paris Agreement to enable mankind to avoid irreversible catastrophic consequences due to climate change.

We are therefore encouraged to see FIDIC creating debate about mechanisms to shift capital envelopes and investment towards a more sustainable future. To play our part, AIIB has set an ambitious target of ensuring that 50% of our approved financing will be directed toward climate finance by 2025. This target is one of the most ambitious among international institutions and was agreed as part of our new Corporate Strategy "Infrastructure for Tomorrow" (I4T) that was unveiled in September 2020. I4T reflects AIIB's firm commitment to sustainability by requiring that all investments be environmentally sustainable in terms of addressing direct and indirect impacts on the physical and biological environment such as water and air quality, biodiversity, local pollution, climate change and land and water use.

The Covid-19 pandemic has forced a rethink of investments and how we do business in the future to ensure growth, durability and sustainability. This means that incorporating environmental, social and governance (ESG) standards in business activities is now an absolute necessity. Greater and more strategic investments in the health sector are needed if we are to safeguard ourselves and our families against the next pandemic. Fortunately, MDBs, policymakers and leading thinkers recognise this urgent need and are responding to it. AIIB understands that we can only improve our health systems by addressing climate change simultaneously. We need to probe the intricate emerging pattern of the relationship between climate and health outcomes. Left unchecked, it will exacerbate the challenges to our health, social and economic systems whose boundaries have already been overstretched by the impacts of Covid-19. At the same time if we also have to successfully overcome the infrastructure gap and reboot the globally economy, we must deploy a more innovative approach and solve all these challenges holistically. This will include using the latest technological innovations, both in terms of how we solve these challenges and the solutions we adopt and importantly, that they are environmentally and ecosystem smart.

As highlighted, however, the question that always arises is "how are we ensuring that the infrastructure we create, is actually sustainable?" The investment/maintenance ratio analysis in this report shows that whilst we may have improved, much more needs to be done. Technology will play a role in helping us all meet this challenge so that we shift to investing sustainably and importantly maintaining infrastructure more efficiently and cost effectively.

New technologies can also level the playing field for low-income countries - enabling them to leapfrog on their development journey - areas where our financial assistance can make a remarkable value addition to their economies in both the infrastructure and healthcare arena.

Importantly we also need to monitor and maintain the infrastructure we invest in, given our focus on sustainability and the use of artificial intelligence. AIIB is currently piloting the use of various remote sensing approaches across our diverse portfolio. Leveraging the highest commercially available satellite imagery with resolution of 30cm, we have the unprecedented ability to remotely monitor progress, evaluate change and conduct due diligence. This cost-effective approach provides us with timely updates from our projects at a fraction of the cost and carbon footprint, compared with traditional field missions. We are also looking into the wider use of unmanned aerial vehicles, or drones, to see beyond what is visible to the naked eye. Cutting-edge technologies, such as LiDAR, enable quick and cost-effective analysis of infrastructure quality. As the youngest MDB, we are committed to continuous innovation and improvement and we are excited about using artificial intelligence to turn information into knowledge. We expect that these innovative solutions will contribute to our lean, clean and green commitment to building I4T.

The way forward is green infrastructure with sustainability, innovation and connectivity – all intricately intertwined at its core. AIIB is glad to work with organisations such as FIDIC and will continue to be at the forefront unlocking new capital, new technologies and new ways to address climate change and connect Asia with the rest of the world.

International Federation of Consulting Engineers
The Global Voice of Consulting Engineers

/The risks of inaction remain very real

/SOW2021

/The risks of inaction remain very real

Despite Covid and recent events, climate change has not disappeared and the risks of inaction remain very real

The burning of fossil fuels continues to be a major contributor to climate change. There is, however, some reason to be optimistic about the possibility that we may be able to effectively address the issue.

The UN Sustainable Development Goals and the Conference of the Parties (COP) initiative demonstrates an increasing resolve to find a solution to the issue of climate change. This change including the demonstration and development of alternatives are all moving the world in the right direction. The only question that remains is are we moving in that direction fast enough?

In this respect, there are reasons to consider that 2019/2020 could be a turning point. A big reason for the optimism is that people, especially the younger generation openly demanded actions on climate change to the extent they expected governments to declare a climate emergency.

Millions of people took to the streets[xxx] throughout the world to protest and reignite the spark of climate change activism, which had in relative terms taken a back seat to politics since the recession of 2017-18 except for the agreement of the Sustainability Development Goals. It is fair to say that these protests could represent a shift in environmental terms that has not been seen since the term global warming was first coined around 1975[xxxi].

While there have been significant negative consequences from the pandemic, it has also resulted in a greater understanding of our environment and the degree to which fossil fuels are still embedded into elements of economic activity such as transportation and the resulting negative effects on the environment.

For example, many countries have seen air quality in most cities improve and water quality in some ports has improved to the extent you can see the seabed from space for the first time ever. Individuals have also been encouraged to exercise and have been required to seek forms of transport which are less carbon intensive or work remotely.

The engineering community has improved its skills substantially when working remotely through this crisis and even events and meetings which traditionally would have required air transport are now taking place remotely. This learning and shift in ways of working is not limited to just the engineering sector, as many parts of the economy have had to adapt and utilise technology to continue to operate.

If such lessons continue after the effects of Covid-19 subside, significant reductions in pollution could result from activities such as reduced air travel and commuting as individuals continue to utilise the tools and lessons from the crisis, including reducing pollution due to remote working.

For example, a recent article revealed that: "Daily global CO^2 emissions decreased by 17% (–11 to –25% for ±1σ) by early April 2020 compared with the mean 2019 levels, just under half from changes in surface transport. At their peak, emissions in individual countries decreased by 26% on average."[xxxii]

The above, however, does highlight an issue. Despite significant reductions in economic activity because of the pandemic and a significant decrease in daily CO^2 emissions because of this, the challenge to get to carbon zero is not going to be an easy one and will require significant economic shifts in behaviour and investment.

The extent to which such change will continue following the protests and the Covid-19 pandemic will be debated for years to come, but such was their impact that that there have already been shifts with countries such as the UK declaring a climate crisis[xxxiii] and an increased interest in economic policies which promote sustainable growth out of the pandemic.

Unfortunately, some of the response to the pandemic whilst necessary is not as conducive to the future investment that is required. A combination of how institutions performed during Covid, the monetary consequences and increased debt levels across the economy, increased trade tensions and the speed at which policy has had to change due to the pandemic, could all contribute to less stability and certainty in the future and so put pressures on investment and project delivery.

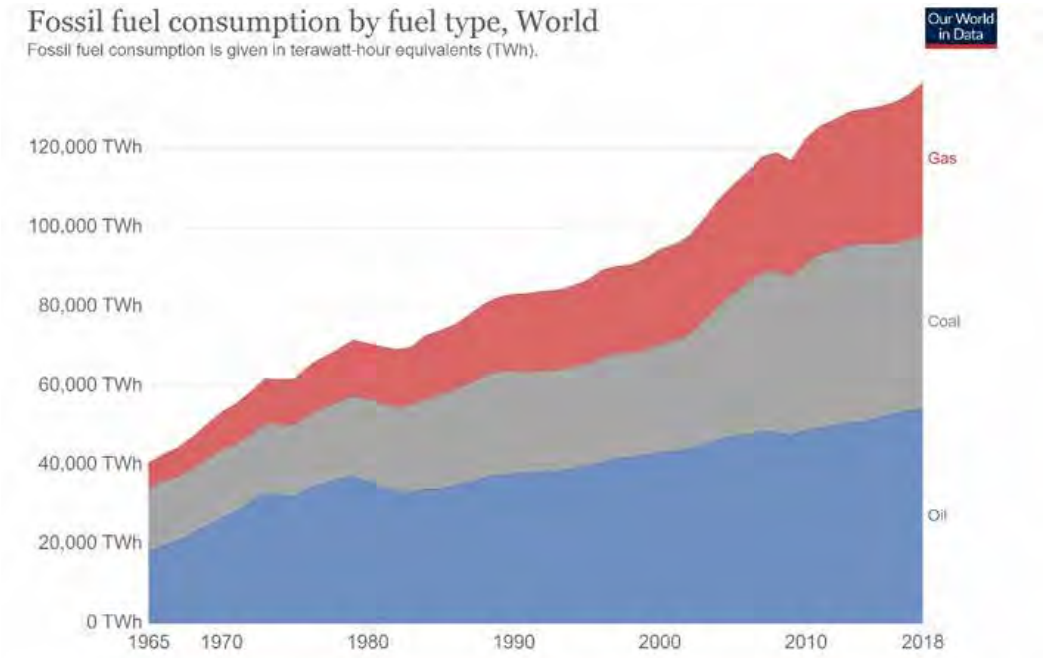
The fossil fuel dilemma

Let us consider fossil fuels in this context. Whilst there are positive messages about reducing usages, compared to 1990, 1995, 2000 etc, fundamentally how has consumption changed?

Looking at the **Figure 14** below, which plots fossil fuel consumption by type globally, whilst changing in composition from oil and coal towards gas which combusts with fewer emissions, fundamentally fossil fuel usage is still on an upward trajectory.

It is noticeable that the only periods where usage has undertaken any kind of reduction is around the times of economic recessions. Clearly it is undesirable to reduce usage by reducing growth to that seen in recessionary periods, with the negative impacts on wellbeing that would bring. This therefore is the challenge - to achieve reduction whilst also maintaining if not improving economic performance.

Figure: 14 – Fossil Fuel consumption by fuel type, World



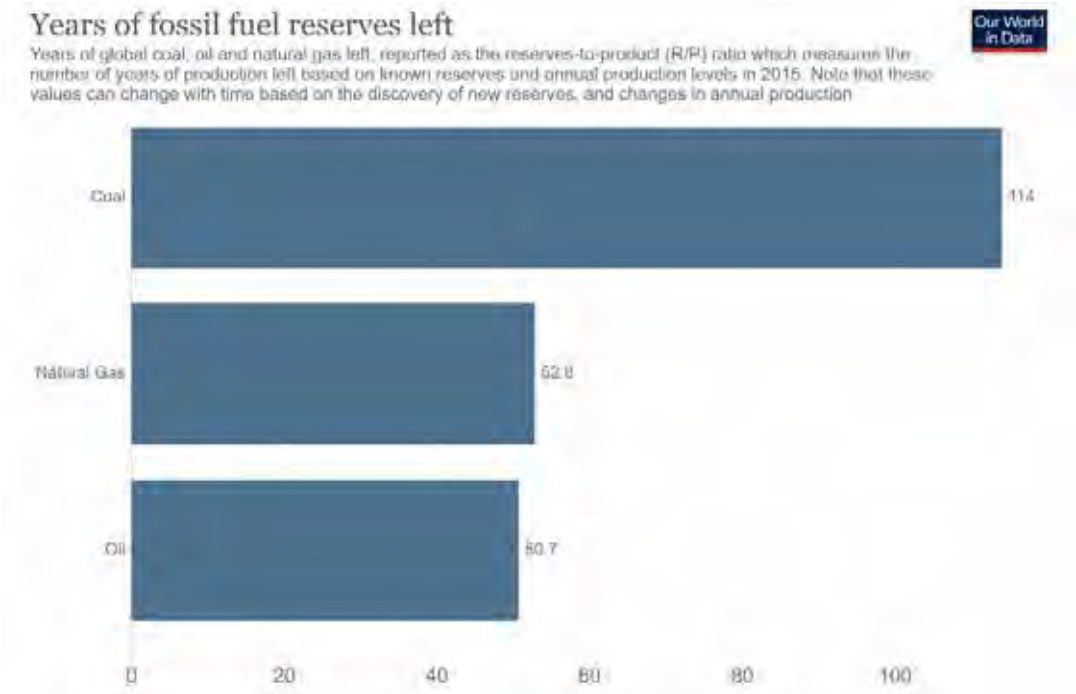
Source: data various, chart from Ourworlddata[xxxiv]

The burning of fossil fuels is a major contributor to global climate change and their long-term use for energy production, transport, and other purposes such as plastics and makeups is not sustainable without significant mitigation strategies.

Likewise, further attention is also required when looking at waste and the emissions and effects of burning it to generate power. Across various sections of the economy the discussion needs to shift to one of these items being considered a limited and underutilised resource, which therefore need to be used in a sustainable manner.

Figure 15 below demonstrates this point. Currently it is expected there are 114 years of coal, 52.8 years of gas and 50.7 years of oil left. Now granted, whilst technology changes and extraction and new sources are discovered, we are being severely impacted by the continued burning of fossil fuels.

Figure: 15 – Years of fuel consumption by fuel type, World



Source: data various, chart from Ourworlddata[xxxv]

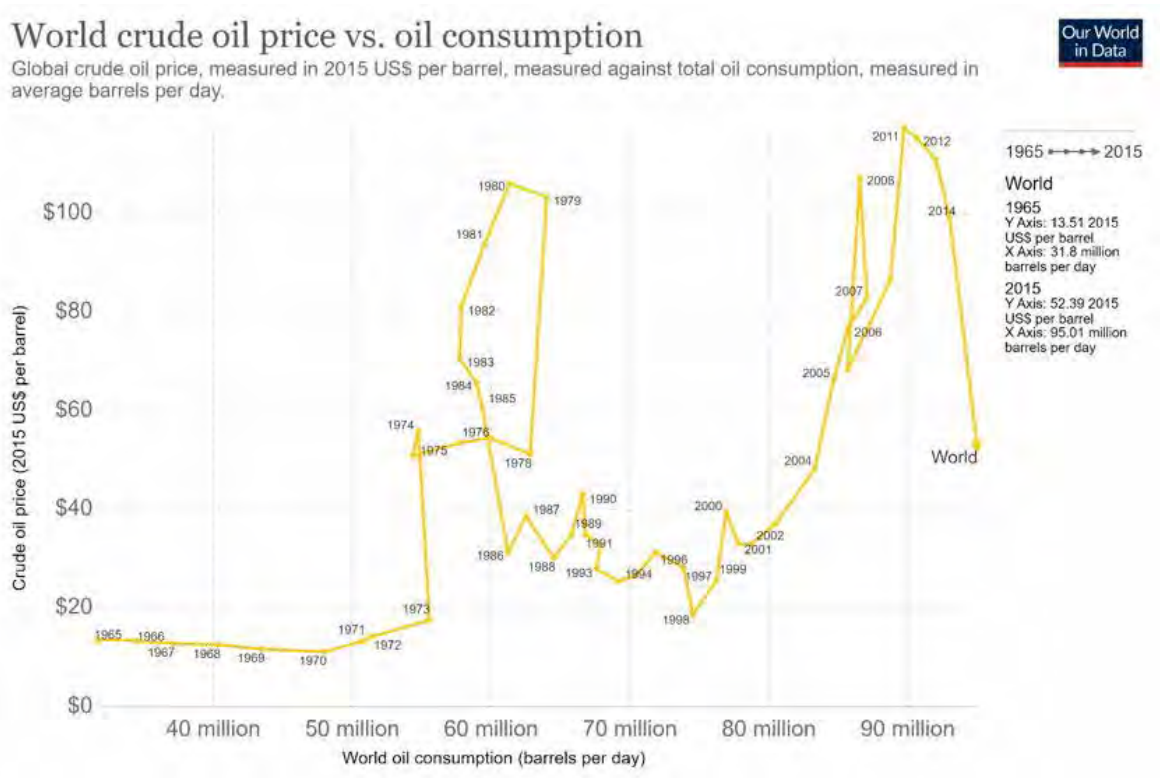
Given the negative affects we have discussed though, why has there not been a faster shift away from the burning of fossil fuels? Surely with a limited resource and given the negative effects, investment and price signals will adjust according to supply and demand and help to resolve the issue?

In theory, yes if markets account for all positive and negative effects of what they are producing. Then price signals should reflect the true cost and investment would flow into greener and more sustainable projects and technologies.

The evidence for markets reacting in such a way is less clear. Figure 16 below, plots world oil prices against consumption. Whilst there are many aspects which influence price it would be reasonable to expect some of the following:

- prices rise over time due to inflation.
- prices rise and the scarcity and reduction of resource available.
- prices vary with economic conditions.
- prices reduce as demand falls.
- prices affected by the recent increases in green technologies.
- prices vary with monetary conditions and access to capital for investment.

Figure: 16 – World crude oil prices vs oil consumption



Source: data various, chart from Ourworlddata[xxxvi]

The above, whist the resultant outcome of many factors, is important because a large degree of global investment both public and private rely on price signals. It is these signals which dictate the benefit/loss of investing in one asset class versus another.

How this then is distributed across individuals, localities, regions, countries and globally may differ and as the recent protests have shown may not necessarily be what wider society is expecting.

Price signals therefore will only form part of the solution if we are to shift investment away from the burning of fossil fuels.

The UN SDGs, the Millennium Development Goals, then the Sustainable Development Goals and the actions of individual governments form another part of this investment question. Initiatives and international cooperation are important, as it attempts to consider wider societal needs and where required correct distortions in market outcomes where negative effects such as climate change have not been fully considered (priced).

How policies, pricing etc interact is important. For example, if you look at schemes such as emissions trading schemes (ETS), which tax carbon to increase the price, or feed in tariffs (FITs) which subsidise renewable options, these are driven by the price of their constituent parts and political/societal views at the time of what incentives/taxes are affordable/needed.

Even considering the above, creating a stable and sustainable investment environment is a complex mix of various tools and policies. For example, subsidies to oil producers still outweigh the subsidies to develop renewables in many countries such as the UK which spends €12bn Euros to support fossil fuels compared to €8.3bn for renewables[xxxvii].

It would, however, be unfeasible to simply withdraw from all investment into fossil fuels in a short period because as we discussed earlier and as has been demonstrated by the Covid crisis, fossil fuels are still integrated into significant levels of economic activity.

The above demonstrates the complex environment in which infrastructure investments occur and whilst there is a consensus that we need to prudently shift away from fossil fuels, governments must consider

energy policies that focus on a degree of differentiation to ensure stability and security of the generation and transmission system to avoid intermittent supply.

It is, important, however, that the climate emergency demands radical action, as it is fair to say that more significant action is necessary, and the globe will continue to play catch up for at least the next few decades to meet various goals including the Paris Agreement target of a 1.5degree C increase in global surface temperatures.

This may also require adapting the ways in which we assess infrastructure, for example by changing the discount rates to place more emphasis on the future effects of climate change and to account more holistically for carbon emissions.

Where next?

The engineering sector can and should work more proactively with governments and decision makers to help the global infrastructure community to invest sustainably and meet the SDGs.

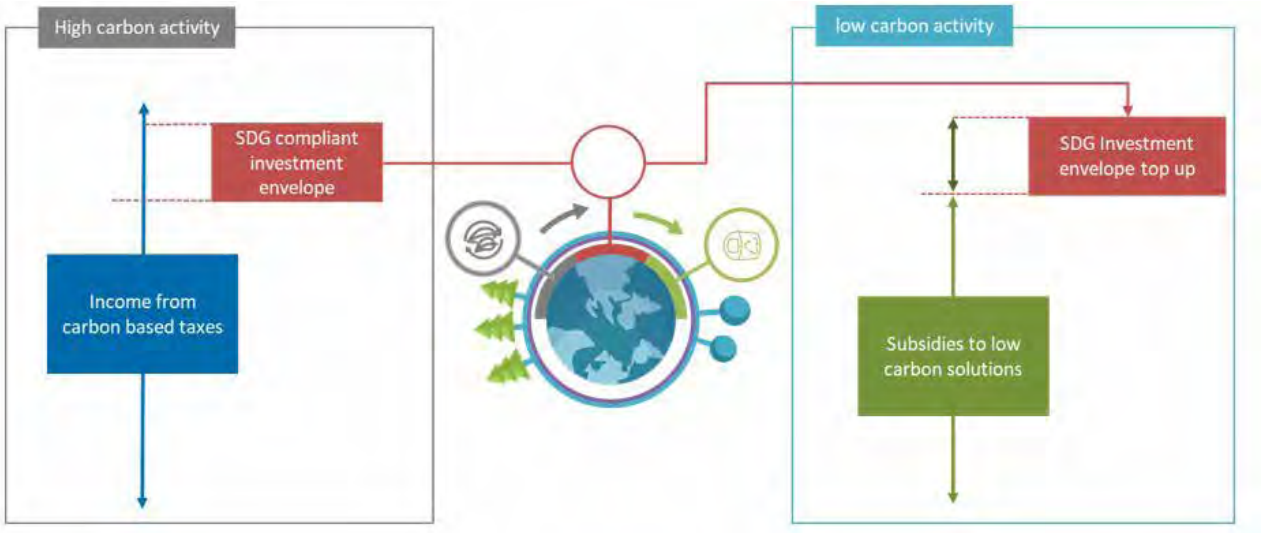
This is where the engineering solutions need to work with policy frameworks and the capital envelopes they set, creating a more reliable and stable transition towards less fossil fuel intensive activities.

As an example of how such frameworks need to evolve, if the oil price rises, tax receipts of many countries also rise but this does not necessarily link to schemes to help a transition away from fossil fuel reliance.

Working with the wider infrastructure sector, several automatic investment mechanisms or principles could be agreed to transfer increased revenues when they occur through activities that involve the burning of fossil fuels into low carbon technologies.

FIDIC has suggested in this report that governments learn from the concept of automatic stabilisers and hypothecation of funds that occur as part of economic conditions and general public expenditure to construct a mechanism to support sustainable investment and shift away from carbon intensive investments and the burning of fossil fuels. This could the provide a significant boost and transfer towards meeting the SDGs.

Figure: 17 – SDG compliant capital envelope mechanism



Such mechanisms set expectations and so act in a similar way to inflation targets and are bands of acceptable change. These policies would therefore allow industries to plan investment and yet still account for price signals and variation and use of fossil fuel as economies manage the impact and transition.

They would also start to make significant contributions to closing the gap between current infrastructure investment levels, investment need and the SDG investment requirement.

The risks of inaction remain very real

Currently, there are several alternatives to fossil fuels with varying potential depending on location, awareness, technology, and public accountability, such as:

- Wind.
- Solar.
- Hydroelectric.
- Biomass.
- Hydrogen fuel cells.
- Ground source heat pumps.
- Geothermal.
- Improved battery technology.
- Nuclear fission.
- Nuclear fusion.
- Demand management/reduction.
- Improved and more efficient technology.

The answer will ultimately be a combination of the above, but the potential of demand management, conservation and education will be important. Increasingly, people are becoming aware of the need to reduce their energy consumption and these measures directly affect the impact of the operational and the day-to-day running of infrastructure assets including housing. Part of the solution will involve energy storage and better managing troughs and peaks in demand more effectively using technologies such as battery storage.

Regarding improvements in technology, there is an increasing number of emerging solutions and innovations. For example, smart plugs can now monitor energy usage, be turned on and off remotely and smart thermostats can automate use, without instantly having to make significant capital investments replacing meters, boilers etc at significant cost.

It is also noteworthy that organisations such as the United Nations is increasing its advocacy, recognising that improving sustainability and the use of fossil fuels ranges from local to global actions, everything from an individual updating their light bulbs and installing solar to a country installing renewable power stations and creating interconnections to create regional and global resilience and sustainability.

Whilst the above continues to show the importance of reducing the use of fossil fuels to improve the overall sustainability of our infrastructure, the effects of Covid cannot be underestimated on individuals, societal and governmental preferences for investment. This profile will change going forward and alongside this the challenge we face will be one of the economic circumstances that emerge from the Covid-19 crisis and as such we need to learn from the financial crisis and assess the likely impact going forward, which includes the significant trillion-dollar question.

Tracey Ryan
Managing Director
Aurecon, New Zealand

Time to $Tn-vest

The trillion-dollar infrastructure challenge has opportunity written all over it. As an industry, we have an amazing opportunity to shift the dial on sustainability by directing the investment towards more sustainable infrastructure solutions.

For infrastructure owners, the opportunity is to think about the legacy you want to leave from this infrastructure boom. The speed of investment and economic recovery necessary will provide a temptation to simply do things how we've always done them. But engineers are entrepreneurs, problem solvers and inventors. All we require is sufficient time, latitude and the right policy framework and solutions can be redefined, new options can be identified which take us towards a more sustainable, net zero future.

For the engineering industry, we need to rise to the challenge. We need to dream, we need to believe, we need to push to make our voices heard and be creative with solutions that drive a better future. It's all within our hands, and we need to grasp the opportunity for the sake of future generations.

This *State of the World* report outlines the challenge. The FIDIC Sustainable Development Committee looks forward to working with our member associations to address this challenge and support the change that is needed.

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/The trillion-dollar questions

/SOW2021

/The trillion-dollar questions

Having discussed the infrastructure gap, Covid, competitiveness, risks and investment profiles, out of such events we come back to not just one but in reality, many trillion-dollar questions.

This report has explored that the global infrastructure investment needs to be $94 trillion between 2016 and 2040, which is 19% higher than the current trend. That is almost $4 trillion a year needed.

Then, there is the additional pressure of not only meeting the investment need of the current situation but ensuring we meet the commitments of the SDGs. This is estimated to be are between $5 trillion and $7 trillion a year.[xxxviii] So the additional pressure equates to potentially between $1 trillion and $3 trillion a year.

Then, as discussed previously, 2020 saw a new risk to the global economy with the slowdown caused by Covid-19 likely to cost at least $1 trillion, however, the doomsday scenario in which the world economy grew at only 0.5%, would involve a $2 trillion hit to GDP[xxxix]

Never has the infrastructure sector faced such an extreme set of challenges concurrently. There is no longer just a gap of trillions of dollars in investment for current needs but trillions more to meet the SDGs and trillions to repair and stimulate the economy following the impact of Covid.

It is therefore **T**ime **T**o **T**ake **T**he **T**rillion **T**ask seriously, yes one T for every trillion that is estimated to be needed as a minimum to meet the SDG requirements. It is **Time to $Tn-vest!** It is also time, as noted at the beginning of this report, to use engineering and scientific innovative skills to reduce the overall cost of our infrastructure needs.

The challenge is not small, and it is not simple to communicate such investment requirements. As such, we attempt to highlight the scale below making some simple comparators. What would $5 trillion a year buy?

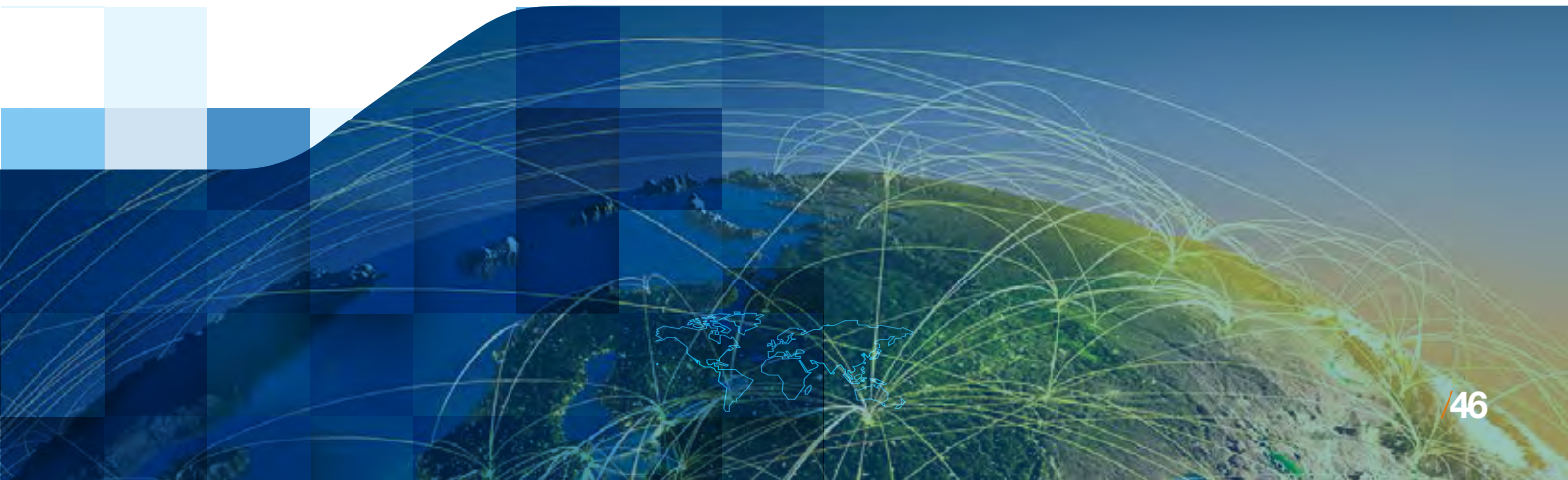
- **2,370** single unit coal 1 megawatt coal power stations.
- **8,794** 1 megawatt combined cycle gas power stations.
- **405** 1 megawatt nuclear power stations.
- Enough four-lane motorways to **circle the earth over 28 times** or enough road to **get us to the moon and back and then to the moon again**.

These are all big numbers, but if Covid, climate change and recent events have taught the infrastructure community anything, it is that it needs to be bold and not necessarily in ways that would have been anticipated five years ago.

For example, the World Bank estimated that raising internet penetration to 75% of the population in all developing countries (from the current level of approximately 35%) would add as much as $2 trillion to their collective gross domestic product (GDP) and create more than 140 million jobs around the world[xl].

Given Covid and the risks that have faced companies and their operations because of such pandemics and the improvement we have seen to the environment of remote working, such investment is now more essential than ever.

It is therefore essential that the infrastructure challenge and its potential to improve economic conditions as well as the environment and people's health and social wellbeing, is taken seriously. It is important to learn the lesson from the last crisis and the Covid pandemic and ensure that today's investment is done in a way that is not only sustainable but provides a significant shift towards a better future for the entire planet.



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FIDIC in the production of the State of the World series would like to thank the following groups and individuals for their contributions to this publication.

The FIDIC board

As with all documents and research produced by FIDIC, the board plays a vital role in ensuring that quality, integrity and direction of such publications and as such we thank the board members for their contribution to this publication.

The secretariat

FIDIC is only possible because of the hard work of its team and this report would like to recognise the efforts of the individuals within the FIDIC secretariat that made this report possible. The FIDIC board will continue to support and endorse the actions of the secretariat to deliver for its members and the wider infrastructure sector.

Reviewers

FIDIC's research is important and covers a global stage so that research is peer reviewed by several independent individuals and a selected board member to help ensure its quality. FIDIC would therefore like to take this opportunity to thank:

- **Peter Guthrie**, Professor of Engineering for Sustainable Development at the University of Cambridge.
- **Matthew Oakley**, Director, WPI Economics.
- **William Howard**, President, FIDIC.
- **Dr Nelson Ogunshakin OBE**, Chief Executive Officer, FIDIC.

Contributors

FIDIC's reports do not only focus on FIDIC's objectives, but by their nature are a culmination of industries' expertise and professionalism and as such there are always contributors to FIDIC's reports and in this one we wish to recognise the following:

- **Mark Worrall**, Chief Executive, Estates and Infrastructure Exchange Ltd.
- **Adam Bialachowski**, Chair of the FIDIC Future Leaders Council and Vintage Consulting, Poland.
- **Danny Alexander**, Vice President and Corporate Secretary, Asian Infrastructure Investment Bank.
- **Tracey Ryan**, Managing Director, Aurecon, New Zealand.

/Acknowledgments

FIDIC's full partners

FIDIC partners are an important part of its presence and the effectiveness of the industry and help to ensure FIDIC can deliver services for the improvement of the industry. These partners go above and beyond to help support, promote, and engage with FIDIC and we thank them for their support and continuing engagement.

UN environment programme

SIP

/Acknowledgments

Thanking our member association partners

Finally, but by no means least, FIDIC is a product of its member associations without which FIDIC would not exist. Whilst all member associations can be found on the FIDIC website, in this and future State of the World reports we have engaged with FIDIC member associations on the detail of our work and we would like to thank the following member associations for their support for our research.

/About FIDIC

FIDIC, the International Federation of Consulting Engineers, is the global representative body for national associations of consulting engineers and represents over one million engineering professionals and 40,000 firms in more than 100 countries worldwide.

Founded in 1913, FIDIC is charged with promoting and implementing the consulting engineering industry's strategic goals on behalf of its member associations and to disseminate information and resources of interest to its members. Today, FIDIC membership covers over 100 countries of the world.

FIDIC member associations operate in over 100 countries with a combined population in excess of 6.5bn people and a combined GDP in excess of $30 trillion. The global industry including construction is estimated to be worth over $22 trillion. This means that FIDIC member associations across the various countries are an industry are worth over $8.5 trillion.

Mission and vision for the future

FIDIC's key role and that of its member associations around the world is to improve people's quality of life through the promotion of quality, integrity and sustainability in the infrastructure industry and the projects and services it delivers on a global scale.

FIDIC 2020-2024 priorities

Lead the consulting and engineering industry visibly and effectively:

- Being the industry's credible global voice
- Providing the nexus for all stakeholders
- Facilitating improvement and growth in business
- Addressing global challenges

All of the above is for the benefit of society, FIDIC members and their member firms.

/Recent FIDIC Policy documents

FIDIC Strategic Plan 2020 - 2024

FIDICs has produced its new Strategic Plan for 2020-2024, it summarises FIDICs activity the results from the various appendices and the goals and approach from FIDIC going forward.

The plan includes a summary of the ten key areas identified and the five goals that FIDIC has set in these areas, including its ambition, targets and current performance.

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FIDIC Annual Report 2020

FIDIC's latest annual report was published in September 2020 and highlights the federation's work and activities during the financial year 2019-2020.

As well as a financial report, the annual report includes updates from the FIDIC president and chief executive and reports on the work of the various FIDIC committees.

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FIDIC MDB overview document

This briefing note has been written to assist both FIDIC member associations and their members in understanding the significance and opportunities available because of the partnership between Multilateral Development Banks and FIDIC.

This briefing note explores the scale of the infrastructure challenge governments, the private sector and multilateral development banks face and their role in infrastructure investment

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What the FIDIC-AfDB contracts agreement means for members

This briefing note has been written to assist both FIDIC member associations and their members in understanding the opportunities and processes that are in place as part of the agreement between FIDIC and the African Development Bank Group (AfDB).

It outlines the scale of project opportunities that are available via the AfDB and what kind of sectors and geographic regions they cover.

Importantly the document then provides details to members about how to access the AfDBs project pipeline and the processes and expectation the AfDB has for firm that wish to apply for its projects

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Disclaimer

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