



International Federation of Consulting Engineers
The Global Voice of Consulting Engineers

/SOW2021

State of the World

Building sustainable communities in a post-Covid world

The way we live will continue to change



Contents

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Foreword	2
Executive summary and recommendations	3
Sustainable communities	6
Planning and designing under climate change uncertainty: The Decision Tree Framework	8
Industry viewpoint	10
Is urbanisation still true?	13
Let's remind ourselves ... cities grew as did populations	14
Green items show improving environments and sustainability	16
Introducing the concept of a sphere of influence	18
Spheres of influence dependant on activities	20
Industry viewpoint	25
Covid means the sustainability and infrastructure question has changed	27
We were moving towards a hub and spoke model	30
Multicommunal spokes	31
Industry viewpoint	33
Communities and their local environment	35
Setting the direction - sustainable community principles	38
What does this mean on the ground, within communities and between hubs and spokes?	38
Standards exist and use will expand, but they are also becoming more detailed and progressive	41
Acknowledgments	44
About FIDIC	48
FIDIC 2020-2024 priorities	48
Recent FIDIC policy documents	49
Endnotes	52

Foreword from the President and CEO



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President, FIDIC



**Dr Nelson
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Chief Executive Officer, FIDIC

The newly launched State of the World series is now into its fourth report in 2020. So far, we have explored the investment requirement to meet the SDGs, which equate to approximately \$7 trillion per year, the need to tackle the global water crisis and the consequences of inaction and the solutions that will help us move forward.

This latest report continues with such ambition. The global Covid-19 pandemic put pressure on global healthcare systems, labour markets, capital markets and, possibly most importantly, communities. Before the world knew it, communities were forced online, separated and the traditional ways of working and living shifted. Green spaces were needed in crowded cities for exercise, flats were suddenly felt more confined and greater social distancing was needed in buildings, transport and day-to-day life.

FIDIC since the outbreak of the Covid pandemic has hosted many events to explore what this means for the new normal. Whilst some aspects of life will shift back towards what was considered the norm, in reality many aspects will not. Whilst there may be moves back to where we once were, more than two years of social change will inevitably change how people want and wish to live.

This report therefore explores this issue. How do we build sustainable communities? Yes, not just sustainable cities, but communities. Covid has shown that the interlinks between such communities are not only important, but they cannot and should not fail or be left to chance to the extent they were during the pandemic.

This report therefore explores these connections, how they develop and explores how Covid has affected views on what truly sustainable communities may look like. This is by no means a simple question, as we will discuss partly because the definition of sustainability will inevitably change over time. Substantiable today may not be tomorrow. Technology and social views will change, as will investment and political preferences.

As has been established since the launch of this series this report links its discussion to the UN Sustainable Development Goals (SDGs) which are an important tool for encouraging change.

Engineers can and should play a significant part in developing sustainable solutions to meet the challenges discussed in this report, but it is important to also note they are part of a much wider infrastructure, finance, volunteer and social sector - all of which need to play their role.





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/Executive summary and recommendations

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Over the past century there has been a general move across the globe from rural to urban areas. This is a trend which is likely to continue. These urban areas are not only containing and housing more individuals and activity, but in the case of a new breed of mega-cities, their economies rival that of countries.

As mega-cities evolve, they will present their own infrastructure challenges, but these challenges will also be exacerbated by the effects of climate change. This will present engineers with interesting choices to ensure that infrastructure is resilient and sustainable and also improves citizens' quality of life.

Mega-cities, however, are not the only part of the story. There are also increasingly a number of smart cities developing but are these the future? With the Internet Of Things, cloud computing and mobile working, as has been discovered during the Covid-19 outbreak, is the smart city now a thing of the past?

This does not, however, mean a smart city is a mega-city and vice versa. In fact, the scale of mega-cities can make the implementation of smart solutions more challenging, but if achieved they also hold the greatest potential for improvement.

A smart city can therefore be considered a region, multiplicity etc. where the use of information technology the internet and smart data allow for smart decisions or monitoring based on the information collected. This should in theory, help cities to become more efficient and sustainable.

Why should the concept of a smart city, however, be limited simply to the historical areas we would consider cities. The development of cloud based systems and improvements in internet access mean technologies can be extended to communities much further afield.

These sustainable communities would have similar aims to use technology and data to ensure that maintenance and operations are efficient and use resources to the best of their ability. These communities and smart cities could be interconnected, use big data and machine learning in an attempt to take a much broader approach to services such as water provision, transport etc. and ultimately meeting the SDGs.

In this State of the World 2020-2021 series we explore the evolving trends of these two phenomena to see how the most sustainable and holistic approach can be taken moving forward.

This report asks the whole sector to consider recommendations within the following categories:

Communities are essential. From the early days of their development for defence and policing through to more current recognition of their importance for human health physically, mentally, and socially. It is therefore important that actions going forward involve and are based on communities' needs and engagement with sustainability.

Connections are important not only within communities but also between them. Traditionally it has been simple to consider these as roads and railways, but increasingly these connections are online. There are plenty of examples of towns, cities etc that have gone into social decline and Covid has emphasised what isolation can do to communities. Therefore, these connections are more important than ever.

Commitment is essential. Without such ambition and drive and an understanding of not only sustainability but the environment and social needs, we will struggle to achieve not only what is needed but what is increasingly required to meet the SDGs.



Recommendation 1 – Spatial planning and spheres of influence as well as the effect of Covid can not be ignored. Within cities, sustainable communities need to become the norm and there needs to be a shift away from simply considering sustainable cities.

Recommendation 2 – People matter. The infrastructure sector needs to do more to engage with its customers' wants and needs, but also educate individuals more widely on what meeting the net zero agenda actually means for day-to-day life.





Recommendation 3 – Standards on building and infrastructure sustainability need to be harmonised across the globe. FIDIC would encourage and is happy to facilitate cooperation on this between the various bodies and industry representative to ensure this takes place.



Recommendation 4 – There needs to be greater consideration for the connections between sustainable communities it is no longer and is not effective to rely on hubs and spokes if we are to meet the SDGs and net zero challenges.



Recommendation 5 – FIDIC is committing to develop a Climate Charter. This will be released soon and FIDIC encourage member associations, companies and individuals to sign up and share it going forward. This document will develop over time and help to set a global trajectory for the consultancy and engineering sector.





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/Sustainable communities

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This latest edition of the FIDIC State of the World series explores in detail the concept of sustainable communities. This report begins with a very important clarification. The report uses the term sustainable communities instead of sustainable cities or sustainability generally. This is important as it recognises that to meet the SDGs across the globe, not only cities will need to be sustainable, but also rural areas, villages, towns etc. This will need to consider the location of individuals, activities linked to both work and social living, resources and any externalities such activities produce. We cannot afford to leave individuals or communities and territories behind if we are to meet the challenging targets set. If the recent events with flooding and fires across the globe have taught us anything, it is that the problem of climate change is here now and it is affecting communities on a global scale.

This report also puts an emphasis on the community aspect in a similar manner. It is not possible to become more sustainable if we do not consider the full social development of the population. This includes aspects related to their personal wellbeing, considering diversity, culture, gender, age and disabilities, among others, as well as aspects related to fostering co-existence, communication and social integration in a suitable environment in contact with nature whenever possible. Additionally, communities should be able to offer availability of support of individuals, families, groups and society as a whole. This is something that has been demonstrated by the Covid outbreak. The only true way to make progress and to meet such global challenges is to ensure the support of as many communities as possible.

Communities alone, however, will not deliver change. It is important to think about the future we want and focus clearly on making the future more sustainable. Solutions will have to be particularly adapted to the site and the specific characteristics of the societies involved.

Following this analysis, actions will be required at different levels of governance (nation, region, community) and in relation to different factors (territorial development, spatial planning, services, transport infrastructure, etc.) in order to work towards the objectives set. It is important to understand the scale of the challenge we face.

Covid has again called some of these assumptions into question. Remote working has not only been proven to be possible, it has actually provided resilience in challenging times such as a pandemic. It has also called into question commuting, the balance of time in office/remote working, family time, cleaner environments, the need for green space etc.

We also see one part of the population, those who work in an office environment and can move their activity into the home, contrasted with another section of the population, who do not have the enabling environment to support remote working for several factors including affordability, access for technology and jobs that do not lend themselves to be done remotely.



There are other parts of the economy where such a shift is not a simple. Activities may still involve face-to-face contact, but the scale and location may change. For example, if you have more individuals working from home, there will be more demand for cafes, shops etc within local communities rather than large central city areas. There are also other processes such as manufacturing, mineral extraction etc where location is a necessity for access to ports etc.

It would be reasonable to say that Covid maybe has shown and given the impetus that is required to reconsider what our societies may look like and perhaps behaviours can be more sustainable by making changes that were once dismissed as we continue through day-to-day life.

Let us begin by discussing the sort of mechanism that occurs when we develop infrastructure in the light of climate change. The question going forward is – is the mechanism still fit for purpose or have the inputs and importance of certain decisions simply changed.

Planning and designing under climate change uncertainty: The Decision Tree Framework

Many engineering projects have long payback periods and have significant uncertainties regarding the natural environment and other factors such as technology, population growth or economy.

There is no generally accepted methodology for assessing the relative importance of climate risks with respect to other risk factors affecting these projects. Current climate models are not capable of providing a probabilistic quantification of the uncertainty of the factors involved in an engineering project, just as models did not predict the rise of Covid and the subsequent social restrictions that were widely required.

Until recently, the most widely used methodology for assessing climate risks and defining adaptation plans has been scenario-based planning. The starting point are often the results of general circulation models (GCMs). These are numerical models representing physical processes in the atmosphere, ocean, cryosphere and land surface and are the most advanced tools currently available for simulating the response of the global climate system to increasing greenhouse gas concentrations.

While simpler models have also been used to provide globally or regionally averaged estimates of the climate response, only GCMs, possibly in conjunction with nested regional models, have the potential to provide geographically and physically consistent estimates of regional climate change which are required in impact analysis.

GCMs provide estimates of climate variables at a regional level in a context of possible future economic, technological and social situations and allow estimates to be made of future water availability and consumption. From these results, a down-scaling to the project's spatial-temporal domain is often made. However, this approach does not ensure that the full range of future scenarios is covered. Down-scaling may result in a cascading increase in uncertainty. A different approach is needed.

New methodologies can help engineers to plan resources and design water infrastructure projects. The Decision Tree Framework¹ is one such new tool. It is described as a scientifically defensible, repeatable, direct and clear method for demonstrating the robustness of a project to climate change. While applicable to all water resources projects, it allocates effort to projects in a way that is consistent with their potential sensitivity to climate risk.

The Decision Tree Framework is a pragmatic process for quantifying risk in projects that can be used as a decision support tool for planning projects in an uncertain environment. The process was designed to be hierarchical, with different stages or phases of analysis triggered based on the findings of the previous phase. Such methods are widely used and are discussed with regards to running companies, optioneering etc as can be seen by an example in the *Harvard Business Review*.¹

It is therefore fair to say that, whilst not perfect, the concept of a decision tree and multiple outcomes is likely to remain a method for assessing climate risks. If we consider this in light of changing views following Covid, it may be that these decision trees take on a greater emphasis for sustainability, local initiatives and production be it for food, water energy etc.



The important thing will be increasingly linking these decisions to the SDGs and communicating them with communities so that the greatest degree of utility and sustainability can be achieved going forward.

Such decisions will vary as will the primary priority for example:

1. The main priority may be the provision of water or wastewater services.
2. Connecting a community to the internet to enable remote working.
3. To reinstate green spaces.
4. To improve wetlands, forests and nature reserves.
5. To reduce poverty and provide sustainable housing.
6. To reduce inequality and improve education.

All of the above, however, to be effective will need to increasingly integrate sustainability at their core, throughout the whole lifecycle process. If this means that broadband provision reduces the need for transport networks due to remote working then so be it. This infrastructure, sustainability, community mix is vital if we are to achieve the SDGs.

For example, SDG 11 (Make cities inclusive, safe, resilient and sustainable) is directly related to Sustainable Communities². It includes few targets, between them:

- Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.
- Safe and affordable housing and basic services for all.
- Sustainable urbanisation.
- Sustainable transport for all.
- Air quality, water and waste management special attention.
- Sustainable and resilient buildings using local materials.

Links with SDG 7 (Affordable and clean energy) are also evident. Sustainable communities will need to reduce energy consumption, improve energy efficiency and utilise renewable energy.

As can be seen in the graphic, the core concept of FIDIC, its member associations and their member firms, cross the majority of SDGs and so if we do not engage the engineering community and wider societal communities, we have already lost the battle. It is for this reason that this report asks the infrastructure sector and communities across the globe to fully support the true nature of sustainable communities. FIDIC's Climate Charter outlines key principles that can be adopted at the industry (FIDIC and member association), company and individual level to embed sustainability into our operations and our thinking, so that we are collectively contributing to sustainable communities and the SDGs.





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Establishing engineering, circularity, and intentionality at the heart of sustainable communities.

According to NASA^[17], 2020 tied with 2016 as the hottest year on record for the planet. In recent years we have seen a growing increase in frequency of extreme weather events globally. We can see that the changing air and surface temperatures can indirectly lead to stronger tropical cyclones, hurricanes, and flooding. The IPCC^[18] supports that climate change is real and that there will always be uncertainty in understanding a system as complex as the world's climate. A look at how extreme weather events affect communities also extends to further than just human safety and to the provision of essential services. Health and well-being are a key component of these impacts. Extreme weather events affect water supply and sanitation systems. We have seen a direct link between hygiene and the fight against Covid 19. Interruption to supply of essential services have a detrimental impact on communities so our systems need inherent resilience. Equally communities that rely on agriculture for their livelihoods and food security is severely compromised. Sustainable communities are inextricably linked to supporting the hard infrastructure, the natural systems, and resources and for enhancing the way people live. A possible solution includes reviewing our infrastructure systems through the lens of mitigation and adaptation to climate change. This includes the use of more robust

and sustainable materials, construction and operational methods and embracing nature-based solutions where we design for working with nature instead of contrary to how nature works. This will enable us to better manage the disruption from extreme weather events and offer a level of flexibility to deal with unforeseen changes.

Sustainable communities also relate to disaster management protocols. Responses need to address the specific impacts facing the locale of the disaster and in response to the needs of the communities affected. For example, our responses for coastal communities versus inland communities. There are several factors that affect our responses related to the stability and continuity of essential services such as water and electricity supply, access via road and rail networks and safety in terms of vulnerable communities located near or in floodplains of rivers, pedestrians who must dangerously cross rivers and streams for access, and those who must traverse unsafe crossings. In the planning, design and construction of infrastructure, these extreme weather events need to be at the forefront of the design thinking to ensure that the range of needs of the beneficiaries of the infrastructure is met in all these conditions, foreseeable and unforeseeable as best as can be predicted.

The responsibility of collaborative and inclusive sustainable development rests equally on all stakeholders in the engineering and infrastructure value chain. The extent of infrastructure development and service delivery and the subsequent impacts on climate change acceleration, mitigation or adaptation encapsulates several complementary disciplines including policy makers, politicians, legal, finance professionals and most importantly the communities and end-users. This collective has significant power and influence and should be placing appropriate levels of pressure on the teams who plan, deliver, and operate projects and infrastructure. The link to engineering and infrastructure development has engineers as one critical part of the value chain - a very small part by cost but significant in contribution. Engineers are problem solvers but when commissioned to only have input into a very narrowly defined component of the life of the infrastructure/system being planned, designed, built, or operated, the significant impacts, across its life cycle, are often driven by competing interests.

Sustainable development, and sustainable communities, extends further than just to human development, the natural environment and ecosystems are critical components of the systems that engineering affects and integrates with. In this decade of action, we have seen an increase in the number of consulting engineering firms and engineers around the world practicing as advocates for responsible and sustainable development. They have incorporated these principles into the work they do. Likewise, DFI's and private project funders and developers have realigned their priorities to support projects that have multifaceted benefits and pass a complex array of considerations for sustainability. We know all too well the challenges that face us across the world. Vulnerability from climate change and future pandemics, inadequate investment in critical infrastructure, poverty, a lack of basic services and growing unemployment – all inextricably linked to economic growth and opportunities as the way to deal with these challenges.

UNEP reports that buildings and construction together account for 36% of global final energy use and that the energy intensity per square meter of the global buildings sector needs to improve on average by 30% by 2030. On this backdrop and acknowledging the key role of engineering in enhancing our daily lives, engineers are key advocates for the sustainable development goals and their commitment toward achieving them through their work and on the projects they deliver globally. Critical systems thinking^[19] in and for our sector requires a fundamental psychological shift. Due to the complex environments and conditions that we are facing, we need to get the right information to the right people at the right time and in the right way. As a traditionally grey infrastructure profession, migrating toward the integration of blue and green infrastructure, our focus toward circularity needs to be amplified and realigned. It is a matter of collaboration, agreement on interests and understanding of the interdependencies between differing purposes in order to add value for everyone.

Sustainable communities can only be realized when we prioritize sustainable infrastructure. This can only be done through creating an enabling environment within the infrastructure delivery space and through public awareness and education, mainly understanding that sustainable infrastructure aims to provide a service and value to the community. In other words, an outcome, rather than an edifice or solely infrastructure. These includes:

- Infrastructure developers in the public and private spheres to mandate a sustainability and circularity imperative as part of their projects at the master planning and feasibility stages of developments and cascading into individual building-level projects. This will enhance an enabling procurement environment.
- The teams who deliver the infrastructure including the suite of built environment professionals to prioritize responsible and sustainable development, as a matter of everyday business and to recode the blueprint of planning and design into how we do things every day than as an accidental occurrence.



- Planning with whole life cycle in mind including planning, design, construction methodologies, material selections and technology.
- Collaborative working including prioritising conversations between the built environment disciplines to break the silo mentalities – engineers, urban designers, architects and social scientists and environmentalists to work on holistic solutions that complement each other for a balanced triple bottom line and finally but most importantly,
- End users and beneficiaries of the infrastructure to demand sustainably developed goods and services. With the understanding that we've got structural societal challenges to address, we need to use this type of thinking to find equalising factors and mechanisms for the developed and developing worlds alike. This will go far to promote responsible global citizenry for communities to encourage building back better for a fundamental shift in thinking and thinking that epitomizes the circular economy.

A snapshot of the opportunities that sustainable communities bring, includes the leapfrogging of technologies to more appropriate, local, and complex systems to embrace the cradle-to-cradle approaches as it relates to all needs and not just basic infrastructure provision. Unlocking the potential and innovation of an engaged youth population will be our biggest differentiator in the built environment the world over.

This is particularly opportune for the developing world, for example in Sub-Saharan Africa where almost 60% of the population is under 25 years of age^[20]. The human capital availability when matched appropriately to infrastructure has a significant multiplier effect, and this extends to full enhancement of the value chain of goods and services particularly careers in engineering and the built environment across the economy.

Latin America, for example, is characterised for rapid growing cities and urbanization^[21]. On many occasions, with insufficient planning, which has created major implications for infrastructure, sanitation, housing, and public transport. Latin America in general is characterized by a lack of institutional framework and underinvestment by governments in public transport infrastructure, which has led to inefficient systems with poor quality and excessive informality. In recent years, there have been significant efforts to transitioning for sustainable, more connected, and more efficient transportation systems in the region. Further understanding on the great opportunities that public transport networks can generate in promoting sustainable growth has led to more than 50 cities in Latin America to invest (many are currently investing) in Bus rapid transit systems (Bogotá or Guadalajara), metro lines (Lima, Santiago, Sao Paulo) or Suburban trains (Monterrey) and Bi-National trains (Argentina-Paraguay).

The drive for sustainable communities through the ability to build back better is underpinned by prioritizing sustainable infrastructure and fully engaging the communities that are served. As custodians of infrastructure delivery, our role as consulting engineers and built environment professionals has never been more critical to achieving these audacious goals. It is a critical and challenging scenario, but our role is becoming more and more crucial. We are working towards better, more sustainable and more efficient sustainable infrastructure, which can allow us to have a cleaner, better working and more connected communities.





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/Is urbanisation still true?

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In short, yes. Whilst some of the latest indications are that people are considering moving out of cities to gain space, it is not known if this will continue. The question is, has the sustainable city concept lost its way?

As such, when considering projects, policies etc going forward, an assessment is likely to be needed to check if what is being delivered is really more sustainable and in which conditions would probably be useful. It may not be enough for such assessments to rely on the previous assumptions of the last decade, without some degree of stress testing. What can we do to use this change to arrive at a more sustainable world?

Prior to Covid, the growth of cities was unquestionable, the trend undeniable and whilst there was always movement to the suburbs or more rural locations, this was offset easily by the growth within cities.



Prior to Covid ... urbanisation was treated as inevitable

This phenomenon is not a new one. Cities have grown for hundreds of years and, with an increasing population, individuals are still attracted to them even today.

Let's remind ourselves... cities grew as did populations

There are many sources for global population projections. The United Nations has more recently projected a range of possible global population figures, ranging from a decline in population to less than eight billion by 2100 to a high in excess of 12 billion.

The UN Department of Economic and Social Affairs Population Division projects that population could peak at 11 billion around the end of the century before declining. Division director John Wilmoth said that this outcome "is not certain and in the end the peak could come earlier or later." ⁱⁱ In addition to the 'numbers', demographics are likely to change as well.

For example, it is estimated that globally more people live in cities now than in rural areas – the first time this has occurred in history. By mid-century, some project that the number of cities on the planet with populations exceeding 10 million people will increase from 28 in 2014 to more than 40.

If we look to China, it is easy to demonstrate the extent of this growth. There are now 35 cities in China where the regional city-scale economy is on the scale of some national economies. The data below shows the top ten.



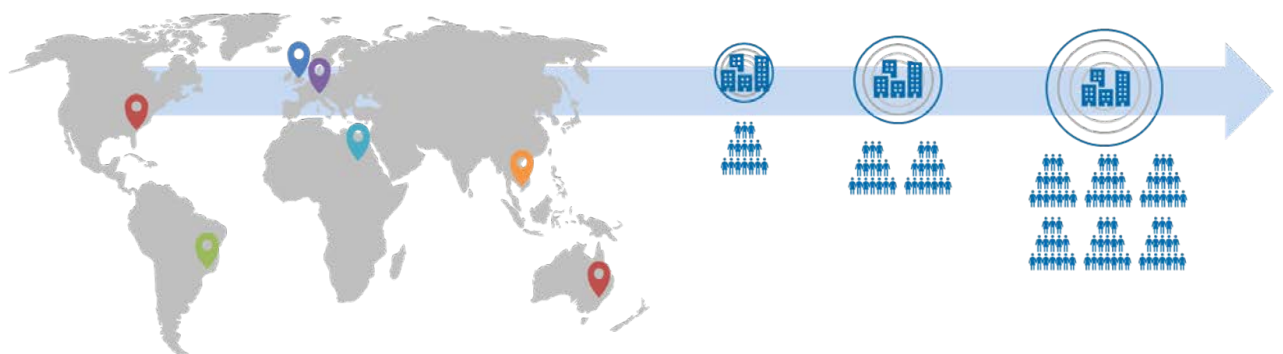
The rise of the mega-city, cities in China with economies the same scale as countries

Rank	Chinese City	City GDP (2015, PPP, in billions)	Comparable Country
#1	Shanghai	\$810	Philippines
#2	Beijing	\$664	U.A.E.
#3	Guangzhou	\$524	Switzerland
#4	Shenzhen	\$491	Sweden
#5	Tianjin	\$478	Romania
#6	Suzhou	\$440	Austria
#7	Chongqing	\$425	Chile
#8	Hong Kong	\$414	Peru
#9	Wuhan	\$324	Israel
#10	Chengdu	\$306	Norway

Source: Visual capitalistⁱⁱⁱ

These cities will increasingly face challenges due to climate change with threats from weather/disasters, but there will also be social challenges are profound if levels of inequality become significant. It is expected that as our global climate warms and sea levels rise, vulnerable populations impacted by flooding, droughts, fires and other calamities will be searching for new locations to inhabit. This will likely exacerbate other population demographic changes caused by social unrest and governmental policies. The challenges these trends will create are numerous and likely not completely known.

Just one consequence of this unprecedented human migration is the potential number of city dwellers who receive only sporadic water service from their piped systems and as a result are challenged to protect themselves from the contamination they are exposed to due to the periodically empty pipes. Even now it is estimated that about 1.5 billion people are experiencing this problem.



Mexico City is one of the mega-cities challenged by population growth, which is exacerbated by climate change. As Arnoldo Kramer, Mexico City's chief resilience officer, said: "Climate change has become the biggest long-term threat to this city's future. And that's because it is linked to water, health, air pollution, traffic disruption from floods, housing vulnerability to landslides - which means we can't begin to address any of the city's real problems without facing the climate issue." Due to population growth, a significant percentage of the city's customers receive only periodic water service. In addition to the pollution issue, the over pumping of groundwater aquifers in the city is contributing to soil sinking problems in certain areas. ^{iv}

Part of the solution to this problem was the development of the concept of the sustainable city. This concept was not only important for the 'perception' of cities but also for their development. The rising popularity of buzzwords saw the media, developers and planners using terms such as smart transport, living buildings, smart energy etc.



This report has listed several of these below and the sustainable cities concept was created. The sustainable city was intended to include...



There is nothing wrong with the concept of a sustainable city. In fact, cities pose one of the greatest challenges for engineers in terms of sustainability, to give a few examples below:

7. Access is not always easy.
8. Traffic and travel often delayed.
9. Space is limited.
10. Existing infrastructure is already in place which is either not sustainable or in need of replacement.
11. Communities are complex and potentially transient.

In many ways, many of the items listed above are aimed at improving sustainability so the concept does hold true, but only to a certain extent and this goes back to the premise of this report and the rationale behind broadening its scope to sustainable communities.

Green items show improving environments and sustainability



Sustainable cities³ is to some extent predicated on the idea that the city's sphere of influence continues to increase and that by making its practices sustainable the sustainability of the communities that are consumed within the city's influence also improves. This is a concept we will now explore further, because Covid has posed the question - is the sustainable city actually sustainable?

Numerous challenges threaten the ability of cities to become viable pillars of sustainable development, as their dynamic continues to evolve. For example:

- Unequal access to, and inefficient use of public services
- Financial fragility and economic shocks
- Harm inflicted by natural hazards
- Demand management
- Integrated and coordinated response at the local, national and international levels.
- Population densities and the need for green spaces
- Supply chain management

Small- and medium-sized cities provides an opportunity to invest in green infrastructures, leapfrogging old energy technologies, and in social development, before social inequities become unsustainable.

Rural development is critical for an integrated approach to sustainability and for reducing poverty. Ensuring wider and inclusive access to public services can reduce rural/urban inequalities, disaster risk and food insecurity, as well as strengthening networks between cities and peri-urban and rural communities.





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/Introducing the concept of
a sphere of influence

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Introducing the concept of a sphere of influence

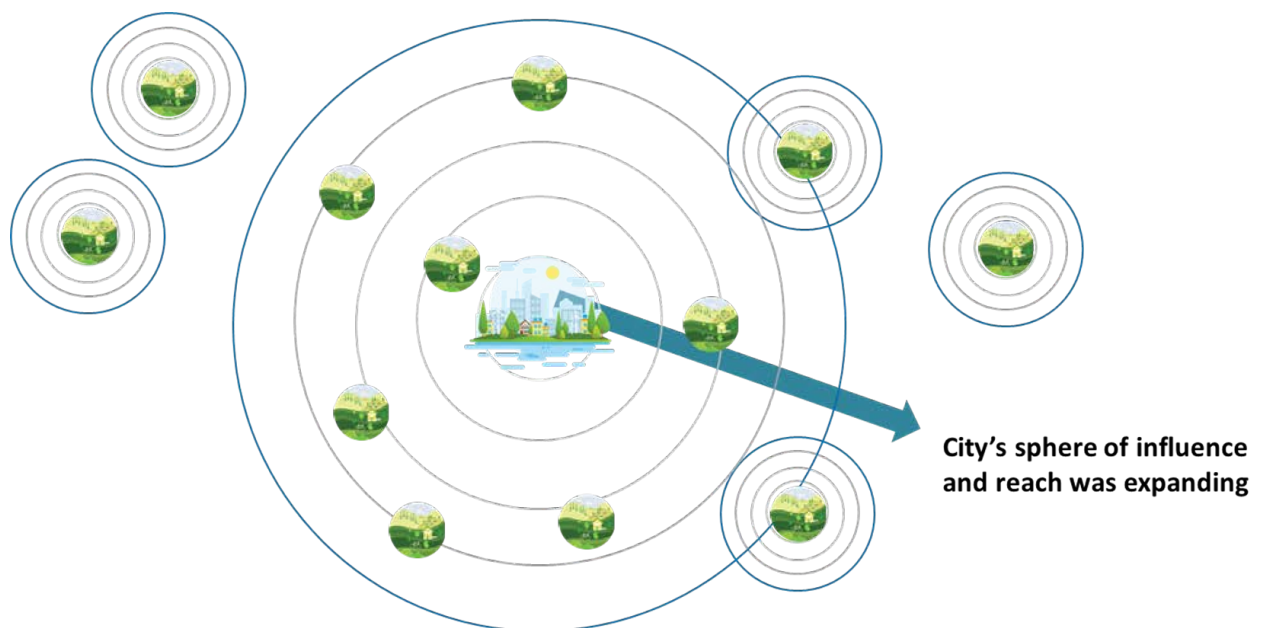
As discussed previously, cities have grown and in that process they have consumed communities and towns within their reach. Whilst in itself this is not the main issue, this report does ask the question about these spheres of influence - how big can they get and will we see this trend change?

When a city grows to the size of a country there has to come a point where it is either, not sustainable, desirable or simply impossible for that city to grow any further. Therefore beginning to consider and understand the sustainable capacity of a city and/or community is important.

Alongside this and perhaps more important is the political, societal and regulatory/planning mechanisms that will not only be needed to deliver sustainable development but encourage sustainable growth. Such shifts, however, require longer term thinking and are unlikely to align with shorter term political cycles or five to ten year plans, you almost need to start considering inter generational plans.

The diagram below tries to visualise this concept. As can be seen, a city has a sphere of influence as do surrounding local communities. It is human behaviour to group together where areas such as security, safety etc are provided as part of a group that is not possible as an individual. This is aptly demonstrated across the animal kingdom.

As cities grow, they pull into their significantly larger sphere of influence these smaller communities, which as they gravitate towards the centre, themselves become part of that city's sphere.



Whilst represented above in a very simplistic way, the sphere of influence for a city or community is in fact a complex web of infrastructure, social preferences, decisions, opinions and so on.

For example, whilst there are many areas to choose from such as health, education food production etc, in this report we consider three areas that have been affected by Covid and link them to size and density of cities, the movement of people and the shift to remote working. They are:

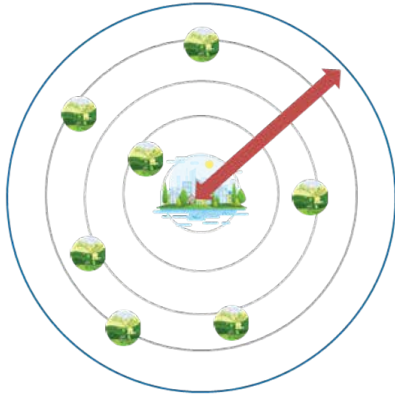
- Transport.
- Green space.
- Remote working.



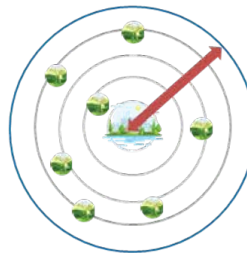
Introducing the concept of a sphere of influence

Spheres of influence dependant on activities

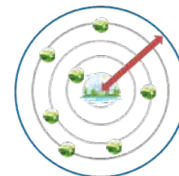
Transport



Green space



Remote working

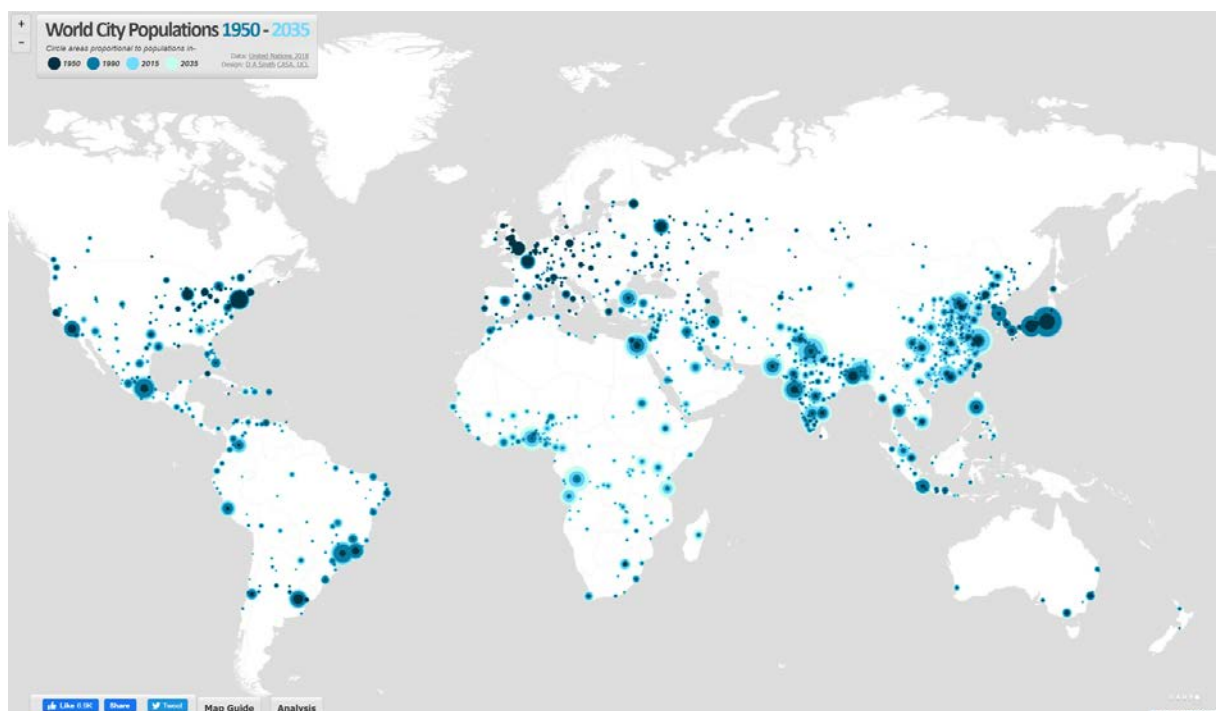


We have to recognise that spheres of influence are different and have changed due to Covid

The sphere of influence of a city on the transport is significant. With its infrastructure, cities can pull in thousands if not millions of people a day all commuting into areas where office space and commercial activity are the main priority. This means that the city has a huge reach. There are only certain roles, activities and venues that exist in cities and are not available in wider communities.

Now consider green space, where the sphere of influence for a city is reduced as those living in the suburbs are more likely to have gardens and greater green space (such as parks, fields) available to them.

To demonstrate the extent of this population growth and urbanisation due to this sphere of influence, if you explore world cities' populations plotted by Luminocity ⁴ you see that traditional European cities, whilst growing at a slower rate more recently, are dwarfed by the growth of cities such as Bangladesh (0.3 million in 1950, projected to be 31.2 million by 2035), Kinshasa (0.2 million in 1950, projected to be 26.7 million by 2035), Shanghai (4.3 million in 1950, projected to be 34.3 million by 2035).



Source: Luminocity

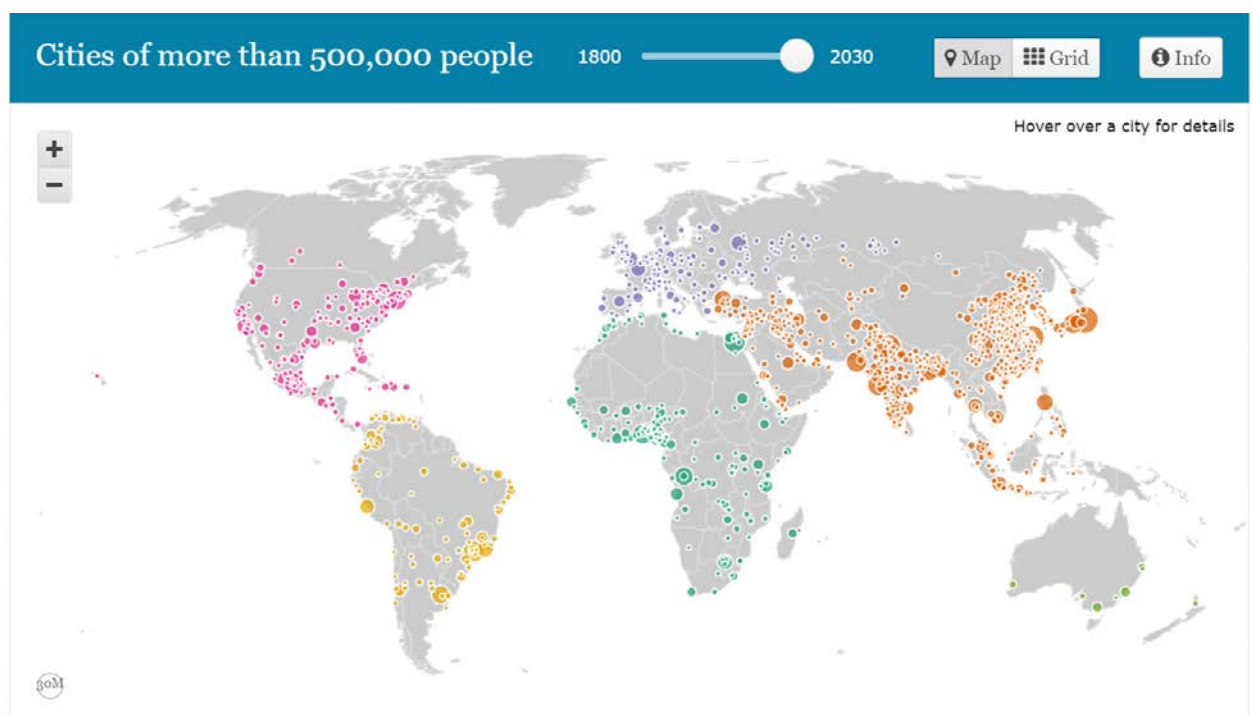


Introducing the concept of a sphere of influence

Also, using UN data and as outlined by the International Institute of Environment and Development, data from 1800 to 2030 means that:

*"If the projected populations of cities prove accurate, the world's seven largest cities will all be in Asia by 2030: Tokyo (37 million), Delhi (36 million) and Shanghai (31 million) are the largest. There will be no European city within the 30 largest cities. Many of the world's largest cities in 2010 will fall down the global ranking projected for 2030 including the four largest cities in Latin America. Most large cities in India and China will move up the ranking. In India, these include Chennai, Bangalore and Hyderabad. Lagos is said to become the world's ninth largest city and Kinshasa the 12th largest – but will these cities really develop the economy to support this by 2030?"*⁵

The trend outlined by the International Institute of Environment and Development can also be seen below and continues to show the extent of not only city expansion but the formation of new cities as the population grows.



This draws its statistics for 1950 to 2030 from United Nations, Department of Economic and Social Affairs, Population Division (2014), *World Urbanization Prospects: The 2014 Revision*, and from Chandler, Tertius (1987), *Four Thousand Years of Urban Growth: An Historical Census*, Edwin Mellen Press, Lampeter, UK, 656 pages for statistics from 1800 to 1900.

Source: International Institute of Environment and Development

Given the above, let's consider the recent elephant in the room following Covid: remote working. This has always been available and even before Covid and was increasing in popularity. This reduces the cities sphere of influence even further, why commute and waste valuable resources, earnings and create negative effects such as pollution if it can be avoided? There are also sometimes social benefits such as improved social cohesion and increased family time, but it also should be noted that there are also evidence of potential negative factors such as mental health and loneliness and increased domestic violence. As such, as remote working continues to evolve such effects will need to be considered.

As an article in VOXEU CEPR⁶ explores prior to the Covid-19 pandemic, the ILO estimates that 7.9% of the world's workforce (260 million workers) worked from home on a permanent basis with some countries reaching 93% (Argentina) as a result of the Covid response. Home working is, however, unlikely to stay at such extraordinary levels as conditions improve. Listing various studies, the article discusses how the actual potential of working from home in the longer term across various countries varies broadly between 20% and 30%, which is significantly above the 7.9% we were operating at before the pandemic.

This means that 'suburbs' that would in the other scenarios be considered part of the city suddenly again shift back towards being communities where their own sphere of influence is prioritised over that of the city.



Introducing the concept of a sphere of influence

It is, however, important to remember that such effects do not cover all workers or are even the same across different cities. All will have their own areas of influence for multiple reasons, but remote working could see the first significant shift of workers out of cities' regions.

When considering the above, this shift demonstrates that the emphasis for sustainability and achieving the SDGs has to be around communities, so that we capture and achieve the best outcomes in as many instances as possible shifting emphasis and the importance of thinking broader than simply sustainable, smart or mega-cities.

This is something that will become especially important as we head towards net zero and the marginal improvements become increasingly challenging and expensive to achieve.

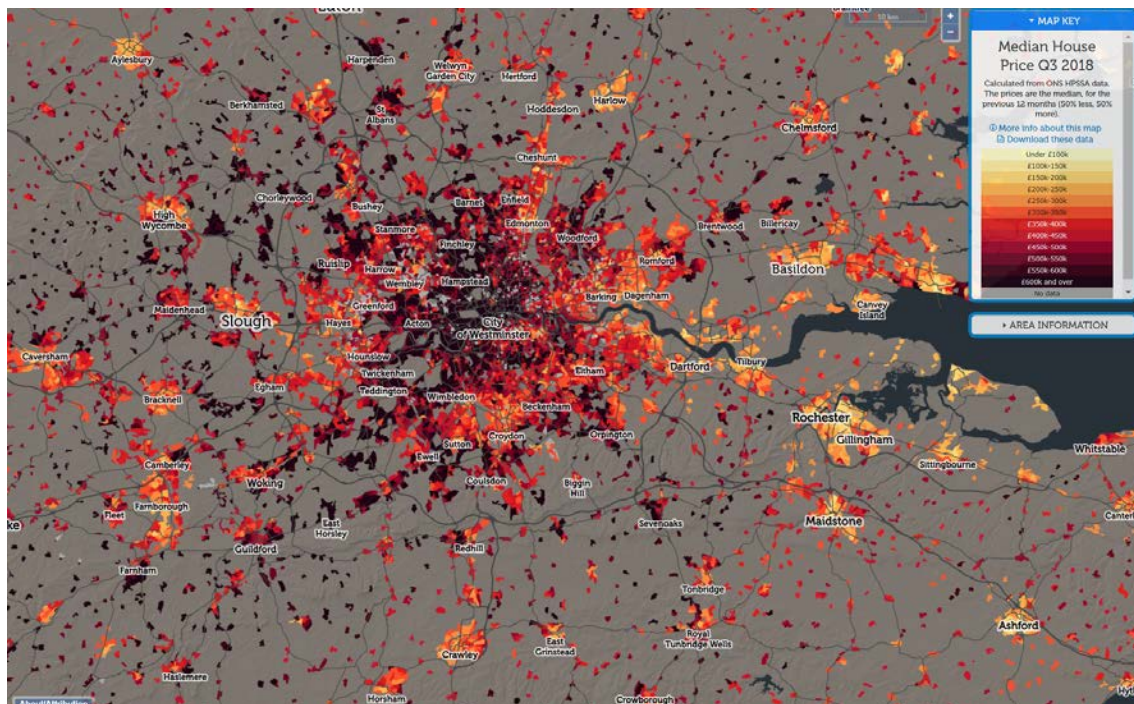
The issue is that as the above has highlighted there is no fixed sphere, they change over time and next, this report explores what has occurred, as it is reasonable that preferences change. Covid is possibly the extreme example of this, but in reality, changes have been occurring over decades.

So, do all of the assumptions we use for current city, project etc development still hold true? Has sustainability and the infrastructure question changed? Are we building the right infrastructure, in the right place, in the right way?

To understand this concept further we explore data that has been mapped by the Consumer Data Research Centre using various sources in the UK. The reason for this is the data is presented down to a level where you can start to see the expansion and the renewal of a city that has existed for a long period of time. The development and evolution of cities and their sphere of influence will not only face historical cities but also the ones that are growing rapidly in Asia and Latin America.

The plots of the data below for example show that house prices are significantly influenced by London as a city, as is the case in many major cities across the globe, with prices significantly higher in the centre or within areas that contain features such as good transport links, green space, river views etc.

Wider view of house price data London



Source: Consumer Data Research Centre

Looking at the age of dwellings also reveals some interesting results. London's sphere of influence has resulted in the building out of the suburbs, not only within their own sphere, but also to the extent that many have merged into what is now considered as simply being part of London.



Introducing the concept of a sphere of influence

This is, however, not only where the interest ends. Looking at the data below, it can be seen that London seems to be rebuilding itself from the inside out, with newer dwellings now being in the city centre and not in the suburbs, as growth of the city has slowed.

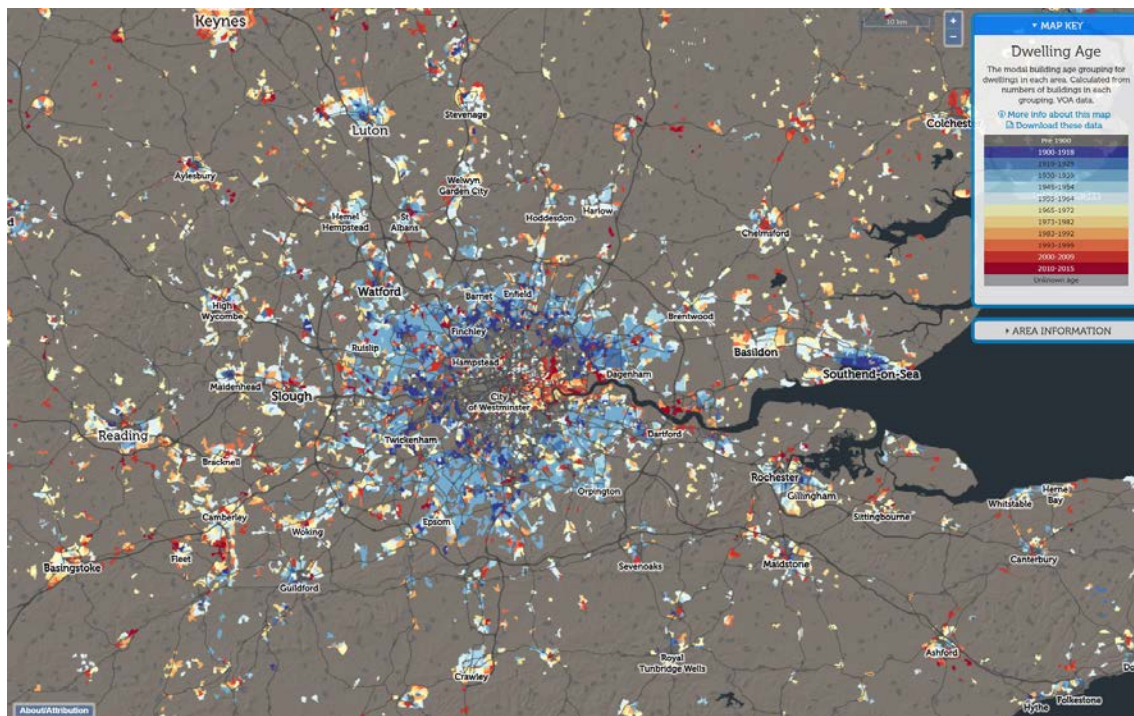
This suggests that spheres of influence not only exist, but they can actually grow and contract and radiate out from areas of new and improved infrastructure and development. This adds an additional layer of complexity to modelling and understanding how future communities and cities will work together.

These spheres will also have to increasingly take account of how they develop and the notion that simply doing 'less harm' will not make construction sustainable. This is discussed in a recent article in *Construction News* ⁸

The Amazon rainforest now emits more carbon dioxide than it absorbs is the latest worrying sign that we can no longer rely on natural systems to regulate our climate or compensate for our carbon emissions. The onus is on us to address the built environment and escalate its role in tackling the climate emergency. Our towns and cities consume vast quantities of raw materials and are responsible for generating huge volumes of pollutants and waste.

The discussion of refurbishment and the need for more radical thinking are needed and how these spheres change, interact with the environment and societies use of resources will become increasingly more important. This is where concepts such as the circular economy and resource efficiency are very important and are increasingly being explored in a great degree of detail for example by UNEP and the Sustainable Infrastructure Partnership.

Wider view of Dwelling age data London



Source: Consumer Data Research Centre

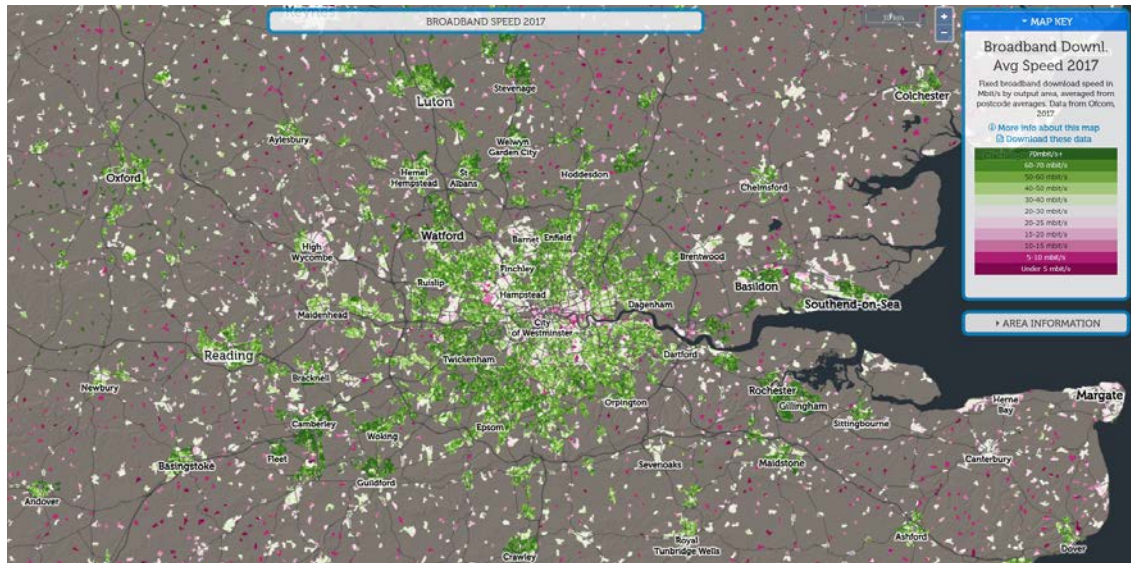
Interestingly, the opposite is true of broadband speeds, with faster speeds being available outside of the city centre. There is probably some logic to this as upgrading infrastructure in crowded city centres is difficult and considering that policies are generally aimed at improving household's internet access.

This does, however, raise a question, especially in cities such as London with high levels of service sector jobs, as Covid has made remote working not only more feasible but in many cases more productive, so will we see the movement of people change and working remotely become far more important within communities?



Introducing the concept of a sphere of influence

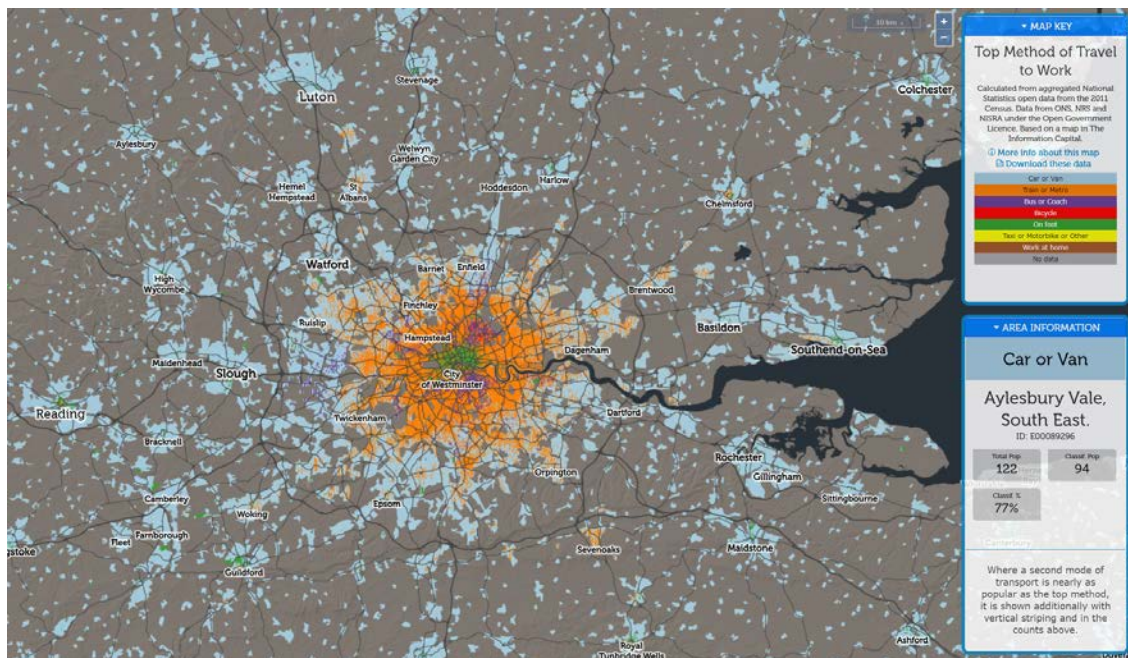
Wider view broadband speed London (2017)



Source: Consumer Data Research Centre

To demonstrate this, you can plot the method of travel to work and as seen in the graphic below, it shifts from walking to metro to car as you move out of the sphere of influence and journeys unsurprisingly involve using roads and longer distances. It should be noted, however, that this data is from the last census ten years ago and the question now has to be asked - will the current census say the same or will there have been a significant shift towards working from home in a post-Covid world.

Wider view top method of travel to work 2011



Source: Consumer Data Research Centre

This has been part of the discussions during FIDIC's Covid webinar series. What does the new normal begin to look like, how much will it differ and will it continue to stay that way or return to the status quo slowly over time?

Given the above this report will now look at what has changed and how this alongside the SDGs and many companies targets to meet net zero means for the development of sustainable communities going forward.





Joseph Daniels
Founder and Group CEO
Project Etopia

How can we change an industry overnight? How can we introduce products that enable such drastic change and meet such targets on such a large scale?

This FIDIC State of the World report continues to outline the challenge we face in delivering sustainable communities and sustainable buildings. It is a clear identification of processes that unlock the ever-discussed ESG financing in residential real estate relays across multiple variants. This comes in a combination of forms, such as certification and accreditations, larger scale frameworks and a city-based approach.

But the question is how do we get there? How do we get hundreds of thousands of buildings being built - unified? From our perspective, we are seeing the bi-lateral and geographical progress with regards to building accreditation in the form of EDGE. It shows a single unified way of really evaluating operational and embodied carbon whilst also considering water usage and occupational net zero.

We are also seeing huge alignments with the SDGS in core frameworks. Some of my work alongside the UKBCSD as part of

the WBCSD is evidencing that we can align our overall policies with those that sit within SDGs, allowing us the necessary futureproofing to save the planet.

However, the biggest questions when it comes to consumers are: How can we change an industry overnight? How can we introduce products that enable such drastic change and meet such targets on such a large scale?

For us, it took years of development and delivery to isolate the methods multi-nationally, whether that be in Namibia, the UK, the USA or the Middle East.

Time and resources were spent understanding, evaluating and deploying these approaches, but how simple is it going to be for developers, constructors, planners and consumers to understand these changes.

I think like the mobile data industries and the EV industry, the real estate industry is open for a wave of change that will be introduced by tech. But on a more complex scale, integrated planning technologies utilising data and gaming engines will help us make better informed decisions at a government and planning level. In addition, consumer based smart home technologies, aligned with these legislations will help consumers and users understand what it is they are doing to their home and their planet.

At Resi Con recently I made the following statement:

“We can see all the data we have by simply opening our providers app. We wouldn’t drive an electronic vehicle 100 miles with only 80 miles in the battery. So why do we leave our homes and buildings burning co2/energy/gas without being able to see just how much we are wasting. We may as well all pickup our paper cups in front of us and ignite them to see that impact.”

The acceptance of technologies is going to make all of this “noise” make sense. The terms of green ESG financing, clean growth, eco cities, placemaking and sustainability will all make sense when we can help people make sense of the things that are being used.

And even one step further than that: helping decision makers to make informed decisions based on live and current data/energy rather than reading from an aged process that building controllers of yesterday don’t yet understand. The problems we face are present-day and require our immediate attention.





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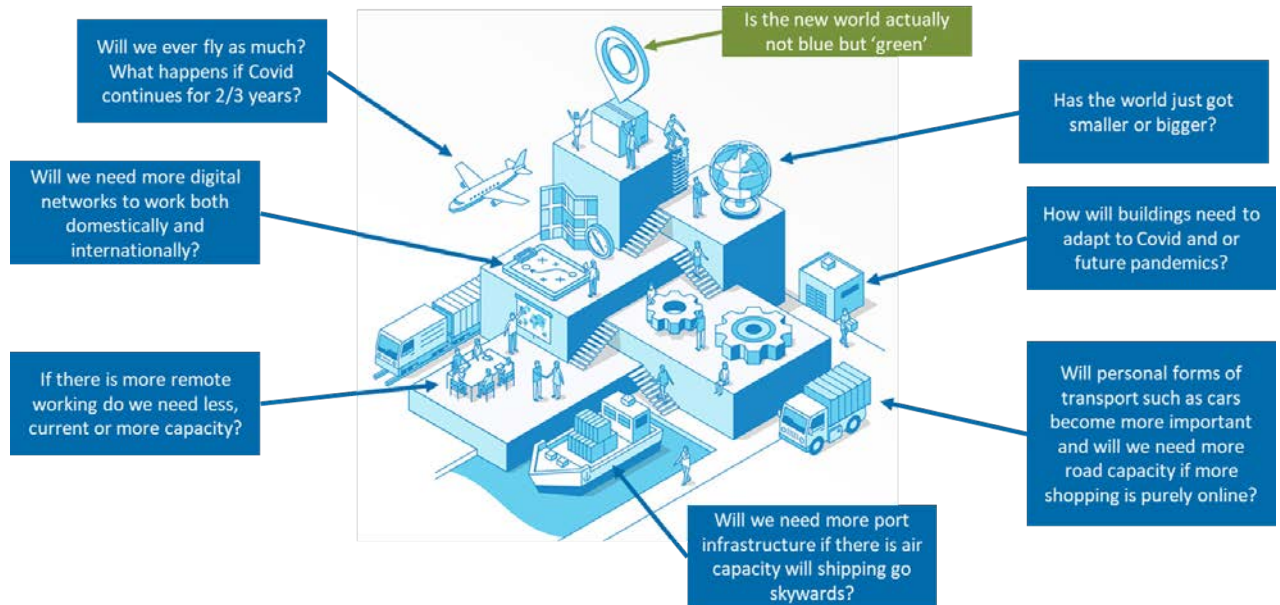
/Covid means the sustainability
and infrastructure question has changed

/SOW2021



Covid means the sustainability and infrastructure question has changed

The world has changed. There is a new normal. Or is there? Covid appears to have made communities consider changes that would not have been considered so long ago. People found themselves able to work without commuting, reduced their travel to meetings that can be conducted online, reduced office footprint, desired open spaces etc . . . the list continues.



The above graphic shows that even if change only effects a percentage of workers in some cities and many in others, the question around sustainability needs to shift from one of purely focusing on urbanisation to a more complex web of communities, where journeys can be avoided, spaces opened up and air quality improved as this will no doubt improve progress towards meeting the SDGs.

The red areas highlight issues and realisations from covid that may have changed views on how sustainable cities work



The graphic above also shows the effect of the sphere of influence of urban areas we have discussed as part of this report. If remote working is higher, the city could have a smaller sphere of influence. Alternatively, if people only have to work in an office three days a week the opposite could also be true and on the days that people do travel, they may be willing to travel from further, thus expanding the sphere.

What is clear, however, is that if work/home practices change, infrastructure and support systems for individuals, families and society will need to improve in a way where provision at the place of residence is as important as provision in business districts.

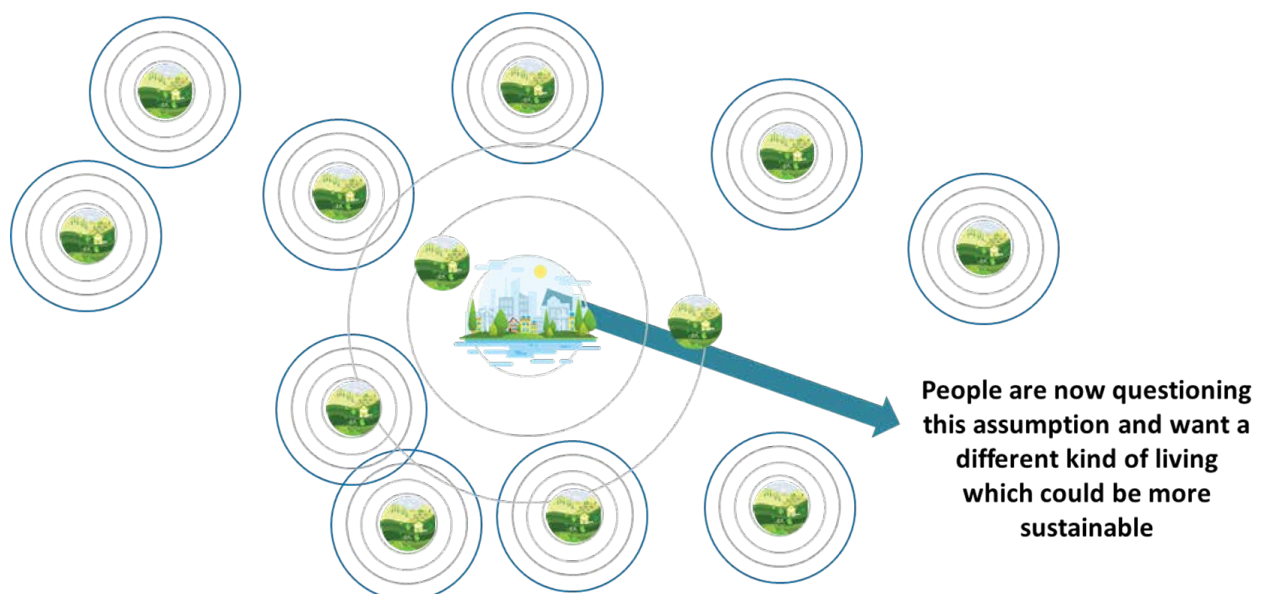


Covid means the sustainability and infrastructure question has changed

There is also the behaviour and human factor that is important. Covid has raised awareness of the importance of open and green spaces and that changes in behaviour can result in environmental improvements such as air quality. There are also co-benefits of green/natural infrastructure in areas such as coastal wetland buffers or forested areas near waterways as they provide flood risk reduction as well as daytime recreation and exercise opportunities for locals.

As such, the shift will not be one based solely on working practices. There will be individuals that still wish to work and live-in town centres and there will be those that now wish for something different. What is clear is that the connections between urbanisation, spheres of influence and local communities are now of greater importance than ever before.

Likewise so have spheres of influence



The above raises many questions. For example, during Covid many professions and industries were able to work from home. This now seems to slowly be reversing and with many individuals and firms considering the extent to which there is still a need for people to come into an office, could working two or three days a week with connection and collaboration online be sufficient, thereby saving office space, time and commuting costs?

But, jumping even further ahead, what happens in a VR/AR world where you can 'sit' next to someone, walk into a virtual coffee lounge or staff kitchen and almost get a similar experience to being in the office? Does the need to be in an office reduce further? So is our human need for personal connection really actually face-to-face, or can virtual face-to-face work if it is via VR/AR style technology?

Similarly, will automation, robotics and technology mean that some professions that can't currently work from home will be able to in the future? Instead of having to physically be somewhere, workers may be able to 'remote in' and use AR to control robots performing their specific function. This is something that whilst we start to explore it in the sense of communities will form part of the next State of the World report on technology.

As highlighted in FIDIC's *Time to \$Tn-vest* report ⁹ this is not a million or even a billion-dollar question, in fact it is a \$7 trillion a year question. So, how is the situation likely to change?

The first possibility is that communities could shift further towards a model which is similar to the hub and spoke model operated by airlines across airports over the globe. This would give rise to the following:

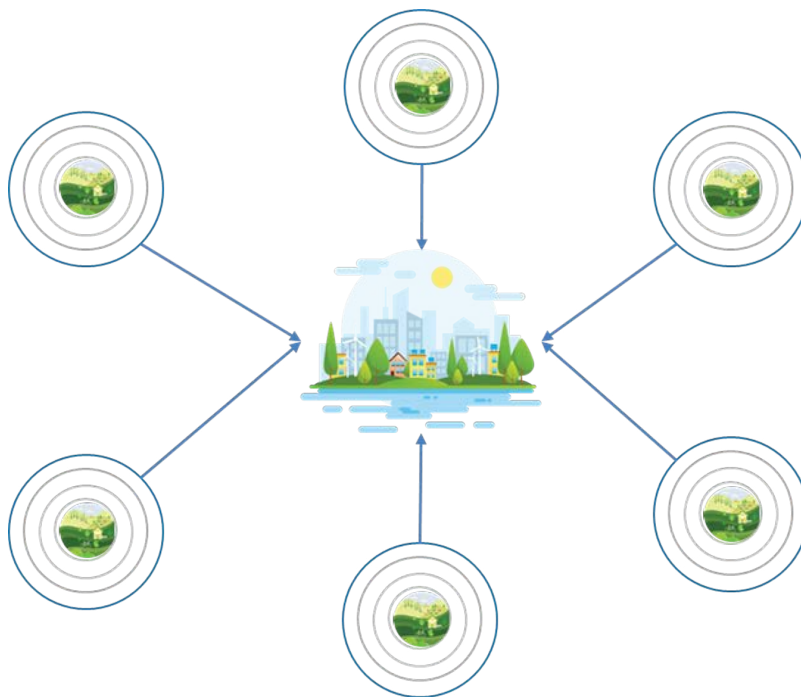
- A significant urban centre.
- The development of significant spokes which are well connected to the urban centre via transport links such as high-speed rail and high-speed broadband.



/Covid means the sustainability and infrastructure question has changed

- This would allow travel and working in the centre but also a preference for working in significant and well-connected offices, sites buildings etc in the spokes which are connected.
- The spokes would target those looking for shorter commutes and flexibility in working, open space etc.
- Both would aim to facilitate an improved standard of living for those seeking something different from the urban centre to the spokes.
- Remote working (from home) would still be possible but would not be the preferred method for the majority.

We were moving towards a hub and spoke model



The main aspect within this model is that the hub as the urban centre, like cities, is the driving factor. Given changes in the new normal however, sustainable approaches and improvements would focus on creating and improving the spokes.

This is already happening with concepts such as garden cities, but the focus may now be more important than ever following the new normal that evolves out of Covid.



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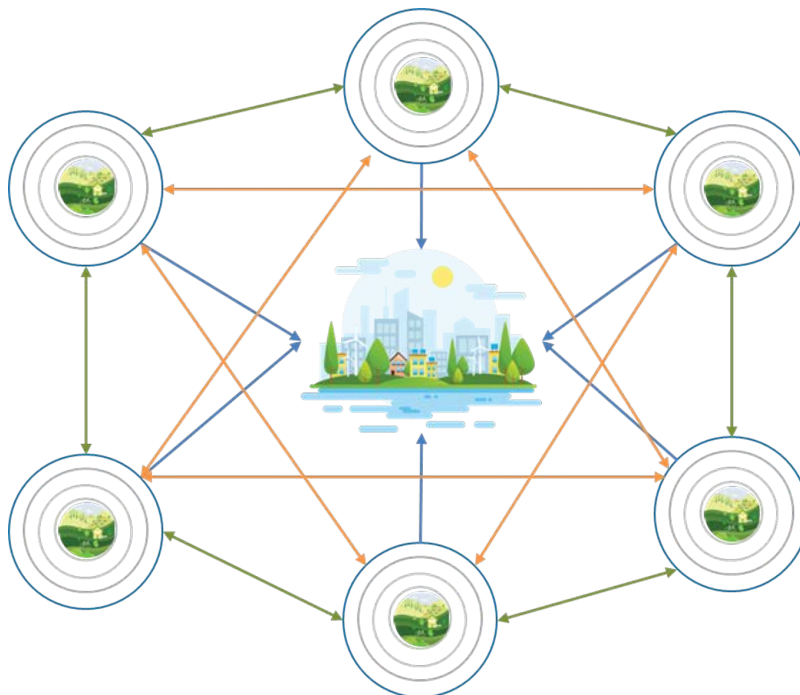
The issue with this model is that Covid has shown that with the advent of remote working and with a shift in individuals' opinions and perceptions towards their work-life balance, commuting, open space and the environment, this model may not be possible going forward.

Are we therefore moving beyond the hub and spoke model to multicommunal spokes where, whilst the urban hub remains important, there is improved and greater links between the spokes? This would mean that:

- Whilst the hub remains important, activity can occur without interaction with it.
- The spokes talk to each other with greater transport links and connectivity, including broadband, to allow them to operate with each other.
- The hub would inevitably have a smaller sphere of influence, possibly resulting in the rise of a greater number of spokes.
- Remote working or working within the sphere of influence of a spoke is more likely.

This kind of model, whilst being more complex, potentially allows for a greater degree of sustainability with resources sourced closer to spokes, interactions occurring between the shortest routes for efficiency but also allowing for specialisation where resources, capital and labour allow.

Multicommunal spokes



The above, however, would mean that sustainable communities are considered to a far greater extent than the previous urbanisation model. The focus is not only on the centre but the spokes and the connections between them.

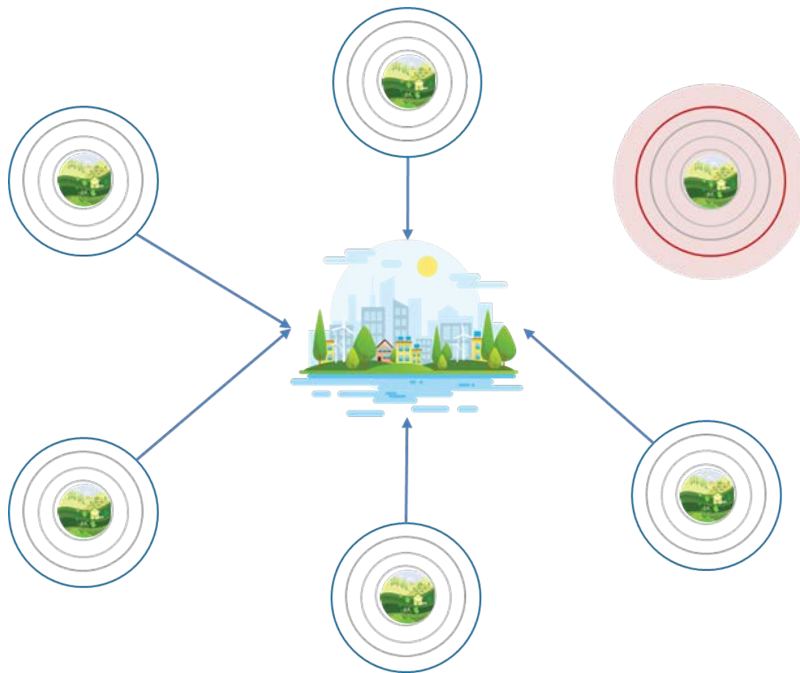
To build a truly sustainable society it is important to consider what happens when items fail as well as succeed. If Covid has taught the world anything, it is that the systems and processes we had in place and believed were resilient were proven not to be. At the same time, it also demonstrated the potential for quality of living to improve, pollution to be reduced and the environment to improve as a result of changing the way we live, work and operate.

So, let's take the two models above and look at what happens if a connection is broken. As can be seen below in the hub and spoke model, the importance of the hub is the connection. As such, when issues occur with the transport link or the internet connection etc the spoke fails. It was reliant on the hub.

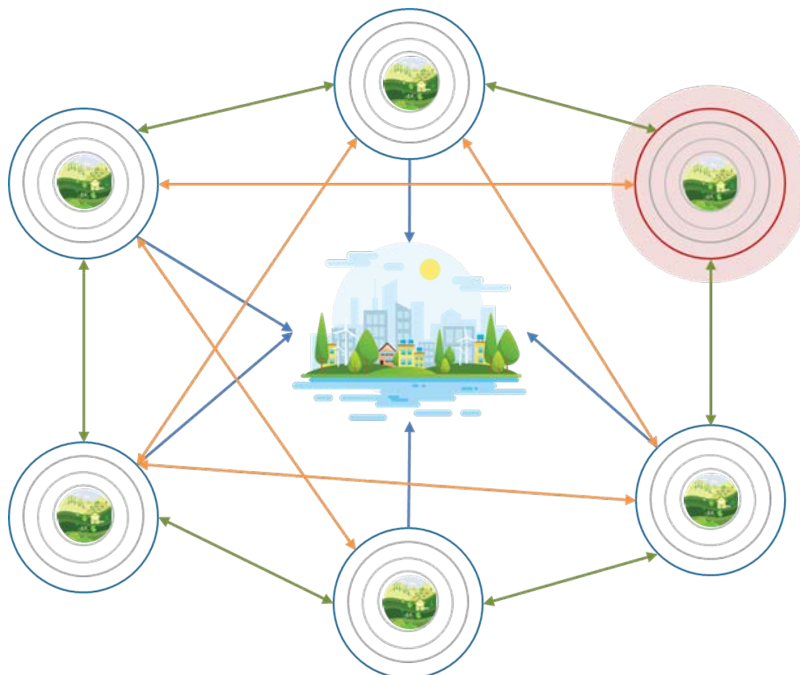


Covid means the sustainability and infrastructure question has changed

What happens if connections fail, or areas are left behind



Whereas, if we look at the multicommunal model and break the connection between the hub (with the same spoke highlighted in red) the difference is that whilst the main connection has failed it is still operating with other spokes and so can continue activity despite a significant disruption.



The above demonstrates in a simplified way the entire concept around resilience, durability and sustainability. Communities cannot and will not be sustainable if behaviours drive a hub model where the goal is the consumption of land, resources and labour around its entire outcome. It is therefore not only important, but necessary that in the development of communities going forward we consider such items if we are to become truly sustainable.





Maria Rózpide
Typsa

As an industry, we must lead these transformations by introducing the perspective of sustainable development in our daily work, propose new solutions to better tackle climate change and to promote a global sustainable future.

Human settlement are, in general, the result of a more or less long historical evolution. Additionally, urban areas and their associated infrastructures often have development implications that last for generations. However only in recent decades environmental, social, and governance factors has begun to be taken in consideration in their development. This underlines the importance of acting decisively to transform human settlements into truly sustainable communities in line with the UN's Sustainable Development Goals (SDG) and the urgency to act to tackle the climate change actual crisis.

It is a major challenge that provides very interesting opportunities for our industry and involves a transformation of the problems approach. An innovative and holistic response at local, national and international level that integrates all sustainable aspects is necessary at planning, design, construction and operation of urban areas and their associated infrastructures.

At a large scale perspective, rural development and strength its network with urban areas is critical to reduce social inequalities and the population tendency to move to cities suburbs. It will probably require national and regional planning that highly promote positive economic, social and environmental links between urban, peri-urban and rural areas.

Mobility (seasonal and daily) and existing transport systems will certainly have to be reviewed. The energy shift towards renewable energy sources seems also inevitable to contain the growing air pollution problems in urban areas and it is equally important the sustainable management of water with a broad territorial perspective and integrated consideration of availability and quality.

From another point of view, the scarcity of certain natural resources will undoubtedly condition waste management under circular economy principles. New management systems and infrastructures will probably be required to ensure not only recycling capacities but also segregation, storing and materials reuse.

On a smaller scale within urban areas, these trends will increase challenges and opportunities for our industry. We will need to develop innovative solutions in relation to all the above-mentioned aspects (mobility and connectivity, energy and water efficiency, local resource availability and waste to resource management) taking into consideration local environmental, social and cultural particularities. This local specificity will probably make it difficult to replicate solutions into other contexts. However, concepts of successful experiences and technologies must be transferable to other geographic areas through transparent and agile mechanisms if we are to achieve results in relation to the SDGs.

At this level it is also particularly relevant to provide solutions that improves quality of life of the entire urban population. Sustainable communities must not only provide the traditional services (housing, work, education, health, etc.) but also they should adequately address other concepts related to social welfare. Urban solutions must incorporate safe and adequate spaces for social interrelation both from an economic and leisure activity perspective. These spaces must meet the needs of minorities with an inclusive and tolerant approach as well as integrate the cultural particularities of all members of society. Many of these concepts are already being considered by our industry and there are already multiple examples of good practices. In many cases success has been conditioned by the active participation of society in the processes of design, construction, maintenance, and management of these spaces. This is undoubtedly a key factor when we talk about transforming our cities into sustainable communities.

Finally, it is important to strengthen the environmental links between urban, peri-urban and rural areas as it has been mentioned before. We cannot continue to expand our cities to accommodate the world's growing population at the expense of natural resources destruction. Communities must enhance the environment and support local biodiversity while ensuring their sustainability. There are already many good examples that suggest creativity and innovation can transform current urban concept to a more sustainable perspective (green and brown roofs, green façades, green corridors along infrastructures, natural ecosystems patches in open spaces, urban vegetable gardens, etc.).

As an industry, we must lead these transformations by introducing the perspective of sustainable development in our daily work, propose new solutions to better tackle climate change and to promote a global sustainable future. Challenge is huge but so is our sector's capacity for future transformation.





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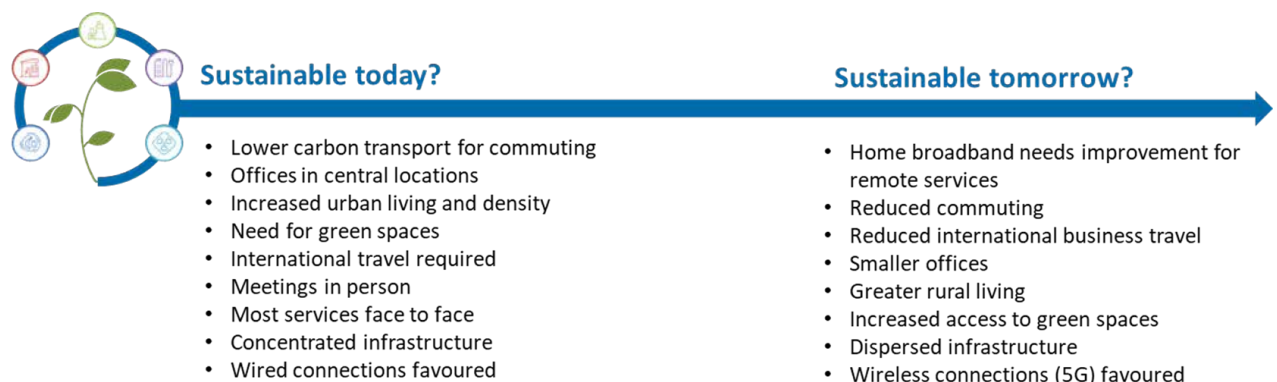
One of the key aspects that need to be considered across all communities is their local environment and importantly how this environment is linked between communities be they a main hub or a satellite community.

This report outlines a variety of environmental issues that will need consideration and we also identify where Covid is likely to have shifted either actions or opinions. For example, pollution, ecosystems and environmental protection were all highlighted as a result of the crisis as things which can improve significantly with lower levels of human activity.



This, alongside a greater appreciation for outside and green spaces for exercise and recreation, means that individuals' expectations have shifted. As a sector which will be significantly involved in sustainable thinking and sustainable infrastructure moving forward, it is important that such shifts in expectations are not only recognised, but also where necessary utilised, to help improve the shift towards sustainable communities.

The aspects above show a variety of considerations, but we also must consider that sustainability as a concept and a deliverable will also change over time. This change has never been as laid as bare as has been the case following the Covid-19 pandemic. The graphic below shows an example of how some opinions have shifted.



This in itself leads to another important consideration for the development of sustainable communities, namely, what impacts this change and given the complexity of the above how do we ensure that a direction is set to achieve the SDGs?



First let's consider some of the influences on how the 'sustainable' goal may change over time. For example:

- **Labour, skills and education** will be vital to the view of sustainability. If there are shortages as a result of insufficient education systems or lack of applicants, this will impact on the quality of what can be delivered within the concept of a sustainable community.
- **Finance mechanisms** need to be in place and focus on sustainable communities and outcomes. Such shifts are beginning to occur with decisions to diversify portfolios away from traditional energy sources and with the development of ESG and sustainable finance.
- **Societal views** will also impact what is considered sustainable and what will be delivered. For example, younger generations are increasingly more aware and concerned about climate change and going forward as they move through businesses and governments will increasingly drive the specification and delivery of projects.
- **Government and international co-operation** will also continue to be important. The agreement of the SDGs was a significant step forward, but such momentum needs to be maintained through to attaining and exceed all 17 of the SDGs.
- **Improved data and artificial intelligence** over time will help communities in planning and understanding such complex environments and will influence outcomes based on data.
- **Technology and processes** will influence what is possible in delivery and operation of infrastructure buildings etc.
- **Failure of existing infrastructure or buildings**, especially in countries with older infrastructure provided under a legacy of carbon intensive investment, will also be a key influencer of societal shifts.
- **Unforeseen circumstances** such as Covid, flooding, fires and extreme weather events (which may or may not be as a consequence of climate change) will impact the priorities of individuals and will feed through into political decision-making.

The above continues to demonstrate the complexity of developing such communities, but examples such as the SDGs and inflation targets etc demonstrate the importance of linking such complex systems to a direction of travel.

It is therefore important that we define a set of key principles that guide the development of sustainable communities. For example, in FIDIC's first *State of the World* report in 2021, *Time to \$Tn-vest* ¹⁰ FIDIC suggested as part of its report that governments learn from the concept of automatic stabilisers and hypothecation of funds.

Such mechanisms set expectations and so act in a similar way to inflation targets, as 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 and manage the impact and transition.



Setting the direction - sustainable community principles

Building sustainable communities requires investment and coordinated approaches in:

- **Renewable and community**-based energy sources.
- **Efficiency in the use of resources** such as water, energy etc.
- **Design and implementation** of connected communities, with mixed and interlinked land use and social/community facilities.
- **A joined-up approach to streets, open/green spaces, density** and the retrofitting of buildings.
- **Fast, reliable and affordable public transportation** and the installation of green transport infrastructure including the consideration of aviation and high-speed rail.
- **Improved waste and recycling** systems so as to maximise recycling and minimise waste (i.e. under-utilised resource).
- **Communities need five- and 15-year plans** that outline five key priorities considering their local environment and five additional priorities that improve various links with other communities and hubs.
- **Climate change and sustainability should form the starting point** of the direction of plans, with each referencing a base line and the proposed trajectory to helping countries to meet the SDGs in 2030 and beyond. This should include the use of decision-support or planning tools as a key element of ensuring sustainability is integrated into systems thinking.

What does this mean on the ground, within communities and between hubs and spokes?

Green and localised energy production

Sustainable energy is going to be a key part of meeting the SDGs going forward. The challenge that exists varies across countries, from those with significant legacy systems that were not designed with localised production in mind to countries where investment in providing energy production in the first place is the key priority and localised production is sometimes preferable.

The recent IPCC report on climate change widely reported that it has put the world on a code red ¹¹ as the effects of climate change are not just an issue for future generations but are a very real problem for current and future decades. As the OECD has noted whilst “This transition is well underway in the US and Europe – but in the developing world, where energy demand is rising, the gap between coal-fired electricity and renewables is barely closing.” ¹²

The above, as highlighted by FIDIC in its *Time to Invest State of the World* report ¹³, will require significant investment amounting to approximately \$7 trillion per year across all infrastructure to meet the SDGs.

It is not sufficient that such spending occurs but that it also has to occur in a way which meets the SDGs and improve sustainability.

This may mean increases in localised energy production such as with solar cells on housing, local CHP plants or even localised battery storage as the market and technology continues to develop. Where large scale installations still occur such as offshore wind, tidal, nuclear plants creative ways will need to be found to reduce emissions or to store energy. For example, using wind to create green hydrogen to replace the use of natural gas (methane) or the use of renewables to store energy in batteries or pumped water solutions or even using excess heat from such operations to heat local communities.

This is where the concept of sustainable communities and not just cities become important. Whilst locally solutions may work and be appropriate in some sites, like more centralised approaches, there will be instances where different technologies or methods of production are better suited to a location with its environmental surroundings.



It is also important to consider that natural monopolies and economies of scale can still hold true, so distributed energy may still be the most appropriate solution, or alternatively harmonisation the delivery/type of local solutions which can be repeated in multiple areas improve not only the environmental but economic case.

Society's use of energy, devices and production

A shift towards renewable energies and optimised distribution systems is undoubtedly important. It is equally important to consider consumption reduction factors. In this respect, urban planning and building design have a lot to contribute with aspects related to the orientation of the elements, insulation, facades, etc. This also includes the devices we utilise in the day-to-day operation of buildings.

Washing machines, televisions, mobile phones etc over time will need to be produced to be even more energy efficient and recycling rates and the processes around the use of raw materials will need to become cleaner.

Demand management may, however, not be enough. There may also need to be societal changes. If we take two extreme examples the first from large scale productions and the second from the point of view of an individual.

The creation and use of concrete are a source of emissions and are used extensively around the globe with many buildings, rail projects etc all using significant amounts within development. As we move towards net zero more building structures will need to utilise materials such as engineered timbers, bamboo and in more creative and structural ways. For example, the Mjøstårnet has recently opened in Norway and is a 280-foot-tall timber framed structure that is pushing the limits of engineering and architecture and setting a path for the sustainable cities of tomorrow.

If we now look at individuals sustainability in relation to demand management, for example, televisions have become more efficient as they have moved from CRTs through plasma screens to LEDs and OLEDs but whereas in the past a house would have one or two of these devices, they are becoming increasingly common in most rooms. Thus, the potential gain of more efficient devices can be lost and offset as individuals have more of them. A similar story is also true of mobile phones etc.

Again, this requires us to ask, what devices do we need? Are we recycling the devices we no longer use? Such trends are well established in developed countries, and it is reasonable to expect similar expectations to exist amongst consumers as developing countries expand their infrastructure to try and meet the SDGs.

The balance of all these interactions will be important in assessing projects and needs. It still may prove to be more efficient to have multiple efficient devices than a lower number of poorly efficient ones. Similarly, more buildings may be required or need to be refurbished but a greater number of efficient buildings is likely to result in a better outcome than that of the current inefficient building stock. That is why it is important engineers and experts assess and are involved in developing the sustainable communities of the future.

Water, wastewater and sustainable communities

Water scarcity is one of the top five potential disasters in terms of impact in the World Economic Forums Global Risks Report^v. It is now becoming more imperative than ever to act.

Several countries in all continents now have water shortages as well as, in some cases, deterioration of the quality of the supplies they do have. Climate change is exacerbating this situation via more intensive weather events, sea level rise and global warming.

Despite how intricately water is linked with our lives and livelihoods, water literacy amongst the global community is mixed at best. Few appreciate the true value of water. Many take fresh water for granted and there is little understanding of the water footprint of the foods, goods, and services that they consume. This is despite there being several websites available such as the Water Calculator^{vi} and Water Footprint Network.^{vii}

While long-term planning of wastewater management usually centres around assumed increased flows and loads proportional to planned future growth, consideration should also be given to situations of reduced flows, because of demand management measures implemented due to drought or longer-term water conservation programmes.



Due to the effects of climate change, it can be expected that cities will be exposed to more precipitation extremes, more incidences of reduced rainfall, as well as more flood events. As such, there is already pressure on many city systems to reduce demand and improve their resilience to extreme climatic scenarios. Reducing water use could assist in managing such extremes and this potentially could reduce wastewater which would leave excess capacity of wastewater management systems to essentially function as emergency 'overflow' situations.

According to a recent South African Water Research Commission study on the effect of the 2017 drought experienced by City of Cape Town, South Africa,^{viii} reduced water usage decreases water that flows into the wastewater transmission and treatment systems of the community, thereby decreasing the overall water volume, but not the waste load.

Since wastewater most often flows using gravity from the point of origin to the treatment plant, decreased flows travel more slowly than usual, allowing solids such as sand, plastics, rags and strings to fall to the bottom of the pipes and accumulate at pipe joints and in junction boxes, resulting in solids build up and blockages in the system and causing corrosion of pipes.

It is also important to consider catchment areas and nature-based solutions within the context of the above and wider water ecosystems. FIDIC in its *Tackling the global water crisis*¹⁴ report explored such solutions and approaches in detail and these will form an important foundation in the development of sustainable communities.

Nature-based solutions such as SUDS to increase sustainability

Sustainable Drainage Systems (SUDs) are natural-based solutions for a smart and more sustainable management of rainwater. Their objective is to redress water balance and manage surface water runoff within the urban environment encouraging its infiltration, attenuation and passive treatment whilst maximising amenity and biodiversity opportunities.

They constitute a strategy for adaptation to climate change in the urban environment, by increasing the resilience of drainage systems to cope with extreme weather events and reducing flooding and drought risks. They also protect both surface water and groundwater quality by introducing adequate measures to reduce risks to acceptable levels.

Moreover, SUDs improve the quality of the urban landscape, providing green spaces that can introduce multiple community benefits when well designated. Public spaces may be used for amenities, recreation or sport purposes but can simultaneously be designed to increase biodiversity by reproducing natural habitats and promoting presence of flora and fauna species on urban environments. They may also be a useful tool for educational and communication purposes. From a more general point of view, they also contribute to reduce the urban 'heat island' effect.

Circular economy and resource efficiency

As communities are centres of consumption and also centres of concentration in the generation of urban waste, the consideration of the circular economy for the sake of sustainable communities is also important.

Introducing concepts of reduction in the use of natural resources not only in the construction sector but also in the domestic, business and wider economy will be of vital importance. This will include the need of facilities for the reuse of waste or part of it, recycling etc. should also be among the priorities of sustainable communities.

From a consultancy and engineering perspective, designing and building with the transformation of waste into resources, taking into account the totality of the project cycles and maximising the durability of projects will need to become an integral part of not just sustainable projects but all projects.

Such thinking does already take place but needs to be front and centre of developments and communities going forward if we are to have a chance of meeting the SDGs and net zero targets.





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/Standards exist and use will expand, but they are also becoming more detailed and progressive

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Standards exist and use will expand, but they are also becoming more detailed and progressive



Around the globe there are already efforts to develop various standards for sustainable developments and infrastructure. The first we will discuss as part of this report are the ISO 37101:2016 - *Sustainable development in communities — Management system for sustainable development*.¹⁵

These standards establish requirements for a management system for sustainable development in communities, including cities, using a holistic approach, with a view to ensuring consistency with the sustainable development policy of communities.

This is very much in line with the discussions in this report and they are likely to become increasingly important if we start to see the process of urbanisation slow or even reverse in some locations.

According to the website for the standards, the intended outcomes include:

- Managing sustainability and fostering smartness and resilience in communities, while taking into account the territorial boundaries to which it applies.
- Improving the contribution of communities to sustainable development outcomes.
- Assessing the performance of communities in progressing towards sustainable development outcomes and the level of smartness and of resilience that they have achieved.
- Fulfilling compliance obligations.

Some of the processes that are described, such as the intention being for an organisation designated by a community to establish the organisational framework and to provide the resources necessary to support the management of environmental, economic and social performance outcomes, is very much in line with the plans and process we discuss that need to occur as communities become more multicommunal.

The above is not to say there are not also other standards across the globe, there are sustainability certification activities and bodies such as BREEAM, LEED etc which are traditionally more focused on buildings and urbanisation and there are also the development of new specific standards for infrastructures such as ENVISION, CEEQUAL etc. Awareness of such standards is also increasing, for example, a comprehensive list of standards and a description on their purpose can be found on the Sustainable Infrastructure Tools website.¹⁶

The development of such activities is important and inevitably there will be some links to local or national markets where they are developed. What will be important, however, is that there is a sufficient degree of harmonisation between the development of such standards to ensure they are developed in the most effective and efficient way if we are to meet the SDGs where time is running out fast.

The exponential growth of sustainability certification systems is occurring, but when considering the harmonisation point above it's important to consider items such as those outlined below as we develop these further going forward.



Standards exist and use will expand, but they are also becoming more detailed and progressive



- The use of a system of achieving a sustainability score or rating. Can we make such ratings comparable, understandable to customers and stakeholders more widely?
- Awareness of the standards and where and how they are best applied.
- Many standards are particularised for different types of projects (buildings, urbanisation, infrastructure) and in different geographical areas with specific challenges. Is there, however, a core that can be developed to embed a minimum level of sustainability regardless of project specifics?
- Although their requirements are based on practically the same concepts, their results are not comparable.
- There are linkages between sustainable building standards and sustainable infrastructure standards and how these interact.
- Can we make the use of such tools standard in policy development?

It can be seen that this is a sector in growing development and that in the not-too-distant future it is possible that sustainability specialists will be required to select best certification and to manage evidences that assure to achieve the sustainability certification objectives required by clients.

Given all that has been discussed as part of this report, it is important that sustainability is not only considered as part of sustainable cities or one off sustainable projects but also within wider interconnected sustainable communities and in every single day to day project.

Covid has demonstrated how societal opinions and action can change and if we are to meet the SDGs and develop the sustainable future that is required to limit climate change political, business and societal resolve will need to be nothing short of the efforts that were made as a response to the pandemic. This change, however, will need to be considered, consistent and planned. This is where the role of engineers will be important as they can guide and develop the infrastructure to deliver tomorrow's sustainable communities.





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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.

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Contributors

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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.



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.



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, in the furtherance of its goals, publishes international standard forms of contracts for works and for clients, consultants, sub-consultants, joint ventures and representatives, together with related materials such as standard pre-qualification forms.

FIDIC also publishes business practice documents such as policy statements, position papers, guidelines, training manuals and training resource kits in the areas of management systems (quality management, risk management, business integrity management, environment management, sustainability) and business processes (consultant selection, quality-based selection, tendering, procurement, insurance, liability, technology transfer, capacity building).

FIDIC organises the annual FIDIC International Infrastructure Conference and an extensive Programme of seminars, capacity building workshops and training courses.

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.





Tackling the global water crisis - State of the World 2020-2021

Water, it falls from the sky, runs in our rivers, fills our lakes, waters our crops and flows through our infrastructure, yet it is more than a monetary product. Yes, having explored the value of water in our second State of the World report, we explore the flip side of this equation. The environment we live in, the pollution that has historically occurred and minimising such pollution in the future, is becoming more important day by day. The SDGs make this clear, but how can industry stand up and lead the way.

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Establishing the value of water - State of the World 2020-2021

Water is vital to so many aspects of life, but investment into the infrastructure, environmental mitigations and resilience aspects of this sector for the wellbeing of humans, the environment, food production, energy etc are not sufficient.

This State of the world report therefore asks a very important question what the value of water is, is it valued incorrectly, how this will change and will this finally drive the investment required to meet the SDGs.

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Time to Tn-vest - State of the World 2020-2021

FIDIC as part of 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 industry 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

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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 2021

FIDIC's latest annual report was published in September 2021 and highlights the federation's work and activities during the financial year 2020-2021.

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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Important note: Classifications are an average across the local area, rather than for individual houses, therefore the colour coding on a building is not necessarily indicative of that building.

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