

# RESILIENCE ON THE FRONT LINES

Healthcare

# Foreword:

During a TED talk in 2017, Microsoft founder Bill Gates warned of the potentially catastrophic impact that a viral outbreak could have on the world. We see now how correct he was. But despite the fact that public health experts had been warning of a coming pandemic for years, the global economy and most of our societies were unprepared for COVID-19. That lack of preparation was most notable in the very sector we most needed to be resilient, healthcare.

As the coronavirus spread around the world it created massive spikes in demand for critical care. This crippled the healthcare systems of many countries and unfortunately led to the deaths of thousands of people, who might still be alive today had we been better prepared. We have also seen how front-line medical staff have fought against COVID-19, in many cases placing their health and safety on the line to help others. We owe it these heroes, and the people we have lost, to bounce back stronger from this pandemic. We have to get better prepared for not only a similar event in the future but also for disasters we currently cannot imagine.

At Arcadis, our passion for improving quality of life drives our focus on resilience. It was the impetus behind our 2019 white paper, [The business case for resilience](#), and it's the reason that we have revisited this topic in the context of the COVID-19 pandemic.

In our discussion about what a more resilient, post-pandemic world would look like, it was immediately clear that the healthcare sector would be a focus area. Working together with our clients around the world, our resilience thinking is evolving and this report is about that evolution in thinking and how it applies to hospital systems, health clinics, pharmaceutical and life science companies or any other actors in the healthcare arena.



In this report you will find specific advice about steps health organizations can take to make their operations more robust and more adaptable, the two quintessential qualities of resilience. Perhaps the single most important lesson we've learned from this crisis is that we cannot afford to leave resilience challenges unaddressed. Yes, the future is all too often unpredictable and, from our vantage point now, unknowable. But that's exactly why we have to act decisively, moving from strategy to the implementation of specific projects that can make our health systems more resilient.

## Martijn Karrenbeld

Global Head of Private Sector Industries



---

# INTRODUCTION

---

All around the world, the healthcare sector has come under extraordinary pressure during the COVID-19 pandemic. While we have known for some time that a disease outbreak in one part of the world can affect people elsewhere, overall, people have viewed healthcare quality and availability to be local matters. This pandemic has been a vivid demonstration of the many ways health services in one location can be impacted by what happens in another, especially when it comes to supplies like testing swabs and reagents, medical grade face masks, ventilators and diagnostic machinery. As a result, ensuring undisrupted and safe health services has emerged as a preeminent resilience challenge.

Many healthcare systems around the world were under-equipped for the magnitude of the crisis. As new infections led to spikes in hospitalizations and deaths in many regions, supply shortages left hospital staff without the tools they needed to treat the sick and to protect themselves from contracting the virus. The healthcare system also struggled to protect our most vulnerable, with COVID-19 decimating nursing home and long-term care facility populations in nearly every country to which it has spread.

The pharmaceutical and life sciences industry is also facing major challenges from the pandemic. Pharmaceutical companies and other health laboratory facilities have had to simultaneously safeguard their workforces, while working to develop COVID-19 vaccines and treatments at unprecedented speed, with global supply chains disrupted and an over-reliance on just a few geographic locations for critical supplies.

The services, suppliers and industries that facilitate our healthcare systems are also under continual pressure to ensure their resilience, not only to deal with pandemics, but for future unexpected or unthinkable events as well.

In the post-pandemic world, new entrants to the healthcare sector will bring an increased focus on the customer experience to the delivery of health services, giving end users more and more choice, while increasing expectations of what healthcare can deliver. Existing healthcare providers will therefore need to find ways to absorb the costs associated with enhancing the way that they currently deliver services.

## COMPOUND FRACTURES

The pandemic has compounded the resilience challenges that have been impacting the healthcare sector for a considerable time. Here is a list of some of what this industry was already facing:

- Funding as the main determinant of outcomes**  
 Many health decisions are made based on what is possible within a patient's insurance coverage, or upon the capacity or ability of the health service to deliver care. Despite the overwhelmingly positive support for the healthcare sector's critical workers, long-term funding of health services remains a resilience challenge, whether government-subsidized, private healthcare providers, or a mixture of both.
- Disruptive technologies and non-traditional healthcare provision**  
 These include large companies who are entering the health arena and providing a more retail-like customer experiences in the delivery of health products, medical insurance and associated health services. This transition towards caring for the overall wellbeing of patients is a market worth \$4.5 trillion dollars (USD) globally, and includes personal care, nutrition, wellness tourism and fitness of mind and body. Technology companies including Amazon, Apple, Google, IBM and Samsung, have moved into the health space, whether through developing wearables and personal health monitoring devices, or bringing technology business models – personalization, tailoring of health provision to an individual's needs – to the delivery of health. This is contributing to a mismatch between what end-users expect from health professionals, and what health professionals are set up to deliver.

The life sciences and pharmaceutical sector is facing similar resilience challenges.

- The need for continual innovation**  
 Of the 103 new drugs approved in 2018 in the US and the EU, only 44% came from traditional, big pharmaceutical companies. Innovation is being driven by smaller, more flexible and agile start-ups and life sciences spin-offs from universities.
- Tech companies gaining market share**  
 As well as entering the healthcare providers space, the big technology giants are taking major steps to enter the life sciences market, using digital solutions, artificial intelligence and blockchain technology to gain market share. Apple's Watch Series 4 gained FDA approval for ECG heart monitoring, and the technology wearables market is booming. 3D printing is allowing treatments to be customized to fit a patient's specific anatomy. These new entrants are set to disrupt the traditional life sciences product and therapy pipeline and supply chain. This is a major threat to traditional pharmaceutical players, but also a major opportunity.
- Rising costs in medicines**  
 The world's growing middle class is living longer, and can afford better access to healthcare. This is placing greater demands on healthcare systems, and also increases the need for cures to age-related conditions and rare or harder-to-cure aggressive diseases. Traditional life sciences companies are under pressure to drive down costs by focusing much more on digitalization and product-development efficiency, as well as entering new geographical markets and increasing the volume of drug products sold.



- Acquisitions and consolidations**  
 The demand for innovative medicines will continue to drive corporate transactions, as will the expansion of generic drugs. The larger life sciences organizations are teaming up with smaller innovative start-ups, to boost research and development.
- Restructuring to refocus on sales**  
 Outsourcing will continue in order to focus more on core and high value business, with major restructuring programs to streamline supply chains, reduce costs, close plants and divest poorly performing businesses. Companies will refocus on filling pipelines with promising new drug candidates through acquisition or re-enforced research and development.

Prior to the pandemic, conversations about resilience most-often took place in the context of risk management strategies: identify the risks, assess their likelihood, and make investment decisions based upon the most likely outcomes. The pandemic has now shown that it's time to move beyond framing resilience solely as risk, particularly given that more shocks will come – even if there is uncertainty about the form in which they will appear. This includes the very real likelihood of secondary catastrophic events (crises that occur simultaneously or in rapid succession) such as hurricanes, droughts, or civil unrest. Preparations for the future based solely within a risk framework, will likely lead to missed opportunities to truly enhance resilience.

### **UNDERPREPARED, UNDERPRIORITIZED**

The World Economic Forum's (WEF) [Global Risks Report 2020](#) demonstrates this point. The report was issued in January 2020, as the coronavirus was spreading largely undetected around the world. WEF surveyed an "extensive network of business, government, civil society and thought leaders," to produce its Global Risks Landscape. A global pandemic did not make the list of the top ten most likely risks for this year. In fact, not even a quarter of the respondents believed that the risk of a large-scale infectious disease outbreak would increase in 2020. With hindsight it becomes quite clear that our risk assessments can be woefully inaccurate.



The deepening health and economic crises caused by coronavirus underscore the importance of investing in resilience. In our 2019 report, [The business case for resilience](#), we explored how governments and industry should include healthy communities and societal resilience as a metric in financial modeling, to justify the business case for resilience-enhancing investments. The impact that COVID-19 has had on the health and wellbeing so many people in the world should make it easier to justify those investments.

### **THE QUALITIES OF RESILIENCE WITHIN HEALTHCARE**

What, then, are the qualities of resilience within the hospitals, pharmaceutical companies, and life sciences organizations? What does this mean for the broader global healthcare sector which includes associated suppliers and all other health providers? Why does the resilience challenge need to be embraced as part of post-pandemic planning?

Resilience describes the quality of being able to survive, adapt and thrive no matter the stress or the shock. Although it is impossible to be 100% resilient against everything, it is a quality to strive to attain. Continuous measurement and management of critical systems is needed, to be able to respond to changing circumstances over time. Within the context of healthcare, it's important to focus on making systems within the sector robust (strong enough to withstand varied and significant stress and shocks) and adaptable (capable of changing or being modified and updated as the world changes around them). Adopting this mindset and embracing the ongoing effort to prepare for an uncertain future is what we mean by becoming more resilient.

So, how can the healthcare sector go about increasing its resilience to pandemics or any other future shocks?



## **RESILIENCE WITHIN HEALTHCARE PROVIDERS**

After the initial shock of the pandemic, many healthcare providers have moved quickly to update disaster preparedness plans. The pandemic has driven home how important supply chain resilience is to frontline medical teams, who have had to cope with insufficient supplies of personal protective equipment and a lack of critical machinery including ventilators. But as healthcare systems work to become better prepared for future flare ups of COVID-19 or other infectious diseases, the key to success will be a sustained focus on robustness and adaptability.

Within this context, resilience is as much about business continuity as it is about how buildings can be made to better withstand shocks like flooding or earthquakes. By taking a systems-thinking approach – reviewing current processes and critical systems which impact on the delivery of services – healthcare providers can identify the weakest links and strengthen them, leading to resilience improvements.

Healthcare facilities are critical infrastructure, and healthcare workers and patients must be able to safely occupy these spaces no matter what happens. This is even more the case during a calamity, when large numbers of people need urgent, lifesaving care. Healthcare facilities also need to be adaptable, to respond to changing conditions. Single-use spaces will need to be adapted to become hybrid spaces, that can be easily converted to different uses. This might mean ensuring that the structural grids used in a hospital's design allow for spaces to be reorganized and repartitioned, or versatile air ventilation systems that be controlled to prevent sick people in one area from contaminating the air flowing to other parts of the building.



### **NIGHTINGALE HOSPITALS**

The United Kingdom has been coping with one of the largest and most deadly coronavirus outbreaks in the world. As authorities there came to grips with the scale of the COVID-19 crisis, plans were quickly made to expand hospital ward and bed capacity to treat the thousands of people who would become seriously ill from the virus. This involved converting existing spaces such as convention centers and hotels into hospital rooms that meet the mandatory requirements necessary for serving as intensive care units (ICU). The new facilities were called Nightingale hospitals, named after the British social reformer, statistician, and the founder of modern-day nursing, Florence Nightingale.

On the 27th of March 2020, Arcadis UK received the call to support in the delivery of a number of the Nightingale hospitals and 24 hours later a team of Arcadians had been mobilized. Working in partnership with NHS England, the armed forces, local NHS Trusts and KPMG, Arcadis provided project delivery assurance, commercial management, and planning and facilities management consultancy services to create the new facilities.

The 'Arcadis Nightingales' team engaged with a tier 1 contractor, Interserve, to support delivery of the NHS Nightingale Hospital Birmingham. The team also provided support for three other similar facilities across the United Kingdom, contributing to a vital effort that ultimately expanded intensive care bed capacity by around 5000 beds, in a very short period of time. The experience and know-how gained from converting these spaces into ICU wards has increased the adaptability of the NHS and therefore its resilience.

### **RESILIENCE WITHIN THE LIFE SCIENCES AND PHARMACEUTICAL INDUSTRY**

Pharmaceutical companies and their supply chains are immersed in the COVID-19 crisis. Even prior to the global pandemic, these businesses were facing challenges as a sector on multiple fronts. This includes maintaining an innovation pipeline, the arrival of new players within the healthcare space – such as Apple, Google and Amazon – and the challenge of optimizing the size of operations and deciding where and how to outsource those elements of their business that are commoditized. The resilience of many of these companies has already been tested as they work to develop a cure for COVID-19 or medications to slow down the infections, while also ensuring the safety of their workers and their suppliers.

To overcome this, many pharmaceutical companies are collaborating in new ways to find a vaccine. These established, collaborative relationships will help in the event of future infectious disease outbreaks. Having and maintaining those connections will enhance resilience within the sector. Regulators will need to keep pace and ensure that any market competition concerns are addressed. But this new way of working – strengthening bonds between pharmaceutical companies, research institutions, governments and the healthcare sector – will help the industry to be better prepared to confront another infectious disease outbreak or some other, currently unknowable, health crisis that will require a coordinated global response.

Critically, supply chains in the global pharmaceutical industry need to be redesigned to be fit-for-purpose in a post-pandemic world. The impact of politics on the availability of supplies from different geographic regions means pharmaceutical companies need to understand the vulnerabilities in their critical supply chains and spread the risk as far as possible. In the short to medium term, pharmaceutical companies will embrace reshoring and nearshoring of supplies for important treatments and therapies. Organizations will need to find the right trade-off between the obvious advantages of global trade and the increased security of sourcing critical supplies closer to home.

### **THE RESILIENCE OPPORTUNITY**

Although we have yet to fully emerge from the COVID-19 crisis, it's critical to use the pandemic as an opportunity to significantly enhance resilience. Resilience cannot be achieved if organizations dally too long in the strategy phase – “what can we do to be better prepared”. Real resilience – like sustainability – can only be improved by implementing and completing projects that make a difference – “here's how we've achieved it”.

# FRAMING THE RESILIENCE DISCUSSION WITH HEALTHCARE

In our work with private and public sector clients around the world, we focus on the following five means of enhancing resilience:



## PEOPLE

Societies, cities, communities and organizations are only as resilient as their people. After the pandemic, we must focus on improving the health and wellbeing of people wherever they live, work or play.



## DESIGN

Resilience will be enhanced by embracing new ways of designing and retrofitting buildings, facilities and urban spaces in a post-pandemic world.



## PLANNING

Resilience thinking must be placed at the heart of business continuity planning. Collaboration must also be embraced, between communities, organizations, industry sectors and supply chains.



## DIGITAL

Digital tools and platforms are essential for gathering and analyzing data which can inform smart decisions that can ensure business continuity and lead to competitive advantage.



## SUSTAINABILITY

Resilience and sustainability go hand-in-hand. By implementing projects that improve sustainability performance, reducing resource consumption and protecting the environment, organizations enhance long-term resilience.



### RAPID RESPONSE AIRBORNE INFECTION ISOLATION ROOMS

One of the ways in which COVID-19 has stressed hospital systems is the demand the virus has created for isolation units for alternate healthcare facilities for treating patients. In many cases these units need to be constructed rapidly as demand surges during spikes in infection rates. To help address this problem, CallisonRTKL worked with the facilities and infrastructure firm Patriot on a collaborative, design-build project for the U.S. Army Corps of Engineers. This project uses PODS to develop containers that can be repurposed into these isolation units for coronavirus patients.

CallisonRTKL helped design modifications to existing PODS containers so they can be used as a rapid response airborne infection isolation rooms (AIIR), which enhance healthcare personnel protection during care for infected patients. The AIIRs provide additional protection to personnel by isolating the patients in an enclosed space, while providing maximum patient visibility via a front wall which incorporates a full-glass door and sidelights. This decreases the need for healthcare workers to enter the room. The HVAC systems are also designed to provide horizontal air flow, introducing air from the front of the container and discharging air directly behind the patient at the rear of the container. This helps to prevent expectorated viral particles from hanging in the air inside the isolation room. The exhaust fans are also fitted with HEPA filter. The AIIRs also have seamless flooring and easy to wash walls, as per sanitation guidelines from the Centers for Disease Control. Each container has individual electrical panels and condenser units mounted to the back of the container to simplify installation and commissioning of units within an alternate care site.

For more information please contact CallisonRTKL:

**Jim Henry**

Senior Vice President, Health Practice Leader

E: [jim.henry@crtkl.com](mailto:jim.henry@crtkl.com)



## People

Prioritizing healthy workforces, and healthy workplaces, to improve resilience within the healthcare sector.

**Make the health and wellbeing of workers a top priority.** Around the world, outbreaks of genuine warmth and appreciation have been shown to healthcare workers who have sacrificed so much in the battle against COVID-19. Many of these critical workers have been working without safe levels of personal protective equipment and vital equipment shortages. After the pandemic, it would be fitting to honor their efforts with appropriate investments in critical healthcare conditions, and ensuring they are all paid living wages. This will go a long way towards increasing the resilience of the healthcare sector.

**Cultivate a resilient workforce by promoting and incentivizing healthy lifestyles.** Across the business world, the 'back to work' process is well underway, but it will likely be several years (and a successful vaccine) before we see the full workforce return to offices. Organizations should proactively create the infrastructure across their facilities to improve the health and wellbeing of their workforce. This includes healthy food in work cafeterias, subsidizing gym and fitness center memberships, designing healthy workspaces (good ventilation and comfort, flexible workstations), and promoting a healthy work-life balance for employees.



## Design

A thorough assessment is needed of how the facilities can be made more robust and adaptable

**Healthcare providers should design adaptability and additional safety precautions into healthcare facilities.** This means creating spaces that can host patients and staff without them being crowded together, flexible patient pathways, and enabling surge capacity in times of crisis, along with flexibility in how spaces can be used under normal operating conditions. A more resilient hospital environment includes having mechanical services that can adapt quickly to isolate portions of the facility, halting whole-house infection. Healthcare environments will also become more secure – with clear triage systems and access controls to keep patients and healthcare professionals secure and free from infection or danger in their treatment areas. Design changes will also need to be made to nursing homes and facilities for the elderly, with an increased emphasis on the dignity of patients while they are in care.

**Life sciences organizations should upgrade or repurpose the most appropriate facilities to enhance production capacity.**

A thorough asset assessment program will help identify those facilities that are critical, and those that can be enhanced by embracing the use of modular and podular facilities (inherently flexible manufacturing shell structures that can adapt to fit whatever operating equipment is needed) and autonomous shells (prefabricated equipment platforms). As part of robust business continuity planning, organizations should contemplate setting up entire standalone production facility for redundancy purposes, in which infrastructure and production capacity could be quickly scaled up.



## Planning

Planning processes will need to be overhauled to include more holistic stakeholder engagement, and collaboration throughout the sector, not just in supply chains.

**Healthcare providers should develop comprehensive and inclusive stakeholder engagement plans.** Proactive engagement with suppliers of critical equipment and services will greatly increase transparency and ensure healthcare companies have disaster and emergency plans that aren't rendered ineffective because of a lack of critical supplies. This requires engagement throughout multiple tiers of supply chains, but this will increase the resilience of the healthcare sector.

**Prioritize relationships and collaboration across the healthcare and life-sciences sectors.**

The life sciences sector must ensure that the unprecedented level of trust and collaboration that has been created in the quest for a vaccine continues after the pandemic. This collaborative approach between pharmaceuticals, research organizations, government and healthcare providers will increase overall resilience but also enable adaptable and robust capabilities within the sector. Collaboration has existed before, but not on such a large scale. Maintaining these relationships after the pandemic will make the sector more robust and more capable of adapting to the next global health crisis.

**Pharmaceutical companies should develop or accelerate plans to invest in the operational effectiveness of critical assets.**

Assets should be evaluated, not only on their own facilities but also throughout their critical supply chains. Resilience will come from robust operate-and-maintain plans to keep facilities up-to-date and operational in a crisis. Pharmaceutical companies should also rethink supply chain dependencies. Supply chains for critical, active pharmaceutical ingredients may need to be redesigned with secondary sources in place – as much as 80% of active pharmaceutical ingredients are produced in India and China, for example. Generic drugs are likely to remain in the major current production hot spots, but strategic patented products may need to be sourced locally. This could result in nearshoring or reshoring as organizations will need to find the right balance between these approaches in order to become more resilient.



## Digital

Accelerate digitalization plans in order to deliver new ways of working, new products and services, and enhance resilience

**Healthcare providers should adopt and expand the use of digital technology for telehealth.** The expansion of broadband-enabled (or even mobile broadband) telecare and assisted living has the potential to significantly reduce demand on hospital facilities and healthcare professionals. This could lead to an overall reduction in hospital bed occupancy rates and have a profound impact on the economics of healthcare. The ability to support patients away from the hospital could also enable better outcomes for those who can continue to live supported in their own homes and communities. Connected care options will be essential for the world's aging populations.

**Collaborate with large and small technology companies to create new tools, new ways of working and to deliver services to end users.** Already, some of the world's biggest technology players are providing COVID-19 screening tools or contact tracing infrastructure to help public health agencies contain the spread of the virus. By exploring new ways of providing individual and tailored technology services in healthcare, the overall resilience of the sector will be enhanced.

**Pharmaceutical companies should fully adopt the use of data and analytics in processes for developing new vaccines and treatments.** Already a growing number of pharmaceutical companies are using artificial intelligence to speed up the drug development process. Algorithms can analyze much larger data sets than ever before, including from preclinical studies, clinical trials, health records and genetic profiles. Artificial intelligence will create insights at a much faster rate than researchers can do alone and will shorten the time needed to develop new drugs.



## Sustainability

Use the window of opportunity provided by the pandemic to re-focus business investments that enhance sustainability and resilience.

**An earnest and genuine focus on sustainability is crucial for the resilience of pharmaceutical companies,** who are under intense public scrutiny. By embedding sustainability into the heart of everything they do – a critical element of securing their license to operate and reducing their environmental impact – pharmaceutical companies will enhance their resilience to shocks, including from negative public sentiment. In the post-pandemic period, economic pressures may increase the temptation to slow or stop sustainability-related business activities, but the sector will become more resilient over the longer-term by adopting sustainability. The sector is already a global leader in embracing sustainability targets, and there are well-defined programs in place already. The sector will need to continue focusing on reducing impacts around resource consumption, energy use, water use, and on reducing the environment impacts of the products they produce.

**Embrace carbon reduction strategies throughout all operations and supply chains.**

The resilience of the healthcare sector will be enhanced by embracing low or no-carbon strategies – including the use of geothermal heating – to reduce dependency on fuel-based energy systems. When redesigning supply chains, greater effort is needed to source more sustainable supplies and services, as environmental impacts and carbon emissions can be greatly reduced across the board, including within the generics and active pharmaceutical ingredients space. The healthcare companies should invest time and resources in developing a thorough knowledge of the risks, vulnerabilities and opportunities within their total supply chains, not just the immediate supply chains for their own business

**Leverage the power of digital to enhance the sustainability of the sector.** Virtual models and digital twins of facilities can be used to retrofit existing or design new buildings, creating efficiencies in reducing waste, minimizing energy use, and using sustainable building materials. Digital twins are also applicable in the development and testing of new products, presenting a sustainability opportunity to reduce waste, and minimizing the materials being used.



---

# CONCLUSION

---

As we emerge from the pandemic, it's crucial to place resilience at the heart of the entire healthcare sector. The challenges for the industry that have been exposed by the pandemic are very real, but there is a huge opportunity to build a new level of resilience in the sector. This will come from building robustness within all of the critical systems and supply chains within the sector, and also embedding a high degree of adaptability into the system, so that there is enough flexibility to be able to deal with an uncertain future. And by taking a systems-thinking approach – reviewing current processes and critical systems which impact on the delivery of services – the weakest links can be identified and strengthened, leading to resilience improvements.

At Arcadis, our experience shows that there is usually a short window of just a few years following shock events – floods, hurricanes, superstorms, terrorist attacks – within which steps towards greater resilience are taken. The high degree of goodwill that currently exists towards the healthcare sector should help to make and embed long-term changes, and the needs of the sector should be aligned with a more supportive regulatory and operational environment.

At a policy level, the opportunity also exists to promote preventative policies which prioritize healthy lifestyles and wellbeing, as the basis for improving our ability to fight infections. Healthy living and healthy environments, with access to clean drinking water and healthy food, will lead to a more resilient society, considerably more robust and adaptable. The sector should now have the confidence to invest in the resilience of their people, their assets, their important operational systems, and their communities. It is time to move away from the notion that returns on investments in resilience are only obtained when and if a shock occurs, to a new state where it's understood that resilience is an inherently valuable goal to pursue.

# About Arcadis

Arcadis is the leading global Design & Consultancy firm for natural and built assets. Applying our deep market sector insights and collective design, consultancy, engineering, project and management services we work in partnership with our clients to deliver exceptional and sustainable outcomes throughout the lifecycle of their natural and built assets. We are 27,000 people, active in over 70 countries that generate €3.3 billion in revenues. We support UN-Habitat with knowledge and expertise to improve the quality of life in rapidly growing cities around the world.

## Contact us



**Martijn Karrenbeld**  
Global Director of Private Sector Industries

E [martijn.karrenbeld@arcadis.com](mailto:martijn.karrenbeld@arcadis.com)



**Jean-Luc Van den Eede**  
Global Life Sciences Sector Leader

E [jeanluc.vandeneede@arcadis.com](mailto:jeanluc.vandeneede@arcadis.com)

## Find out more:

 [www.arcadis.com](http://www.arcadis.com)

 [@ArcadisGlobal](https://twitter.com/ArcadisGlobal)

 [@ArcadisGlobal](https://www.instagram.com/ArcadisGlobal)

 [@ArcadisGlobal](https://www.facebook.com/ArcadisGlobal)

 [Arcadis](https://www.linkedin.com/company/Arcadis)

## DISCLAIMER

This report is based on market perceptions, research, and insights from by Arcadis, a design and consultancy firm for natural and built assets. This document is intended for informative purposes only and should not be construed or otherwise relied upon as investment or financial advice (whether regulated by any financial regulatory body or otherwise) or information upon which key commercial or corporate decisions should be taken.

This document may contain forward-looking statements within the meaning of potentially applicable securities laws. Forward-looking statements are those that predict or describe future events or trends and that do not exclusively relate to historical matters. Actual results could and likely will differ, sometimes materially, from those projected or anticipated. Arcadis undertakes no obligation to update or revise any forward-looking statements, whether the result of new information, future events or otherwise. Additionally, statements regarding past trends are not a representation that those trends or activities will continue in the future. Accordingly, no one should rely on these statements for decision-making purposes. Arcadis is not liable for any loss or damages associated with the use of the information in this report for decision-making purposes.

This document contains data obtained from sources believed to be reliable, but we do not guarantee the accuracy of this data, nor do we assert that this data is complete. Please be advised that any numbers referenced in this document, whether provided herein or verbally, are subject to revision. Arcadis is not responsible for updating those figures that have changed. This document should not be relied upon as a substitute for the exercise of independent judgment.