



**The Arcadis
Data Center Location
Index 2021**

Foreword

If there were any doubts, about how indispensable the internet and online services are for the global economy, COVID-19 has put them to rest. Demand for data infrastructure was already sky-high before 2020 but the pandemic has led to an additional surge. We're doing more online than ever before and this trend will only continue in the years to come.

On the whole, our global data network has proven to be quite resilient: able to cope with the digital step change the economy took over the past year. But this is on the heels of a decade of extraordinary growth in the number of data centers and it's clear that many more of these facilities will be necessary over the short, medium, and long term.

So, where should data center operators build new facilities?

In principle, digital infrastructure can be built nearly anywhere and used to serve customers anywhere in the world. But choosing a good location for a new data center is critical in terms of optimizing return on investment. Location determines a great number of factors that influence costs and how quickly a new data center can be switched on. The availability and reliability of renewable energy sources, the ease of obtaining construction permits, the price of electricity, cybersecurity, data protection and privacy regulations, all of these things can differ significantly depending on where a facility is located.



At Arcadis, we leverage our global capabilities and deep knowledge of local markets to help our clients optimize location decisions against operating costs, resilience, environmental impact, government incentives or any of the wide range of issues that a client might choose. We support data center operators with the extensive stakeholder engagement efforts associated with gaining the community buy-in that is often needed to build a large structure of any type, especially ones that use so much energy.

We also partner with our clients across the entire process from picking a location, to planning and permitting, construction and ultimately over the life of the new asset. Our due diligence and environment experts, designers and engineers, and project and cost managers help our clients avoid unexpected costs and delays, ensuring the predictability they need to stay focused on executing their business plans and serving their clients.

Perhaps more importantly, we know that choosing the right location and having predictability of outcomes across the entire process are essential components of how our clients can achieve their sustainability ambitions. With the confidence that comes from knowing how these construction projects will actually proceed, our clients can invest in things like low carbon building materials, smart energy management, and increased use of renewable energy.



Erik Blokhuis
Global Account Management
Officer

We've produced the Arcadis Data Center Location Index as a starting point for companies considering where in the world to place their next data center. Our experts have examined 50 national markets across eight supply and demand-side factors that will influence a company's ability to set up a new facility. Ultimately, anything we build, even infrastructure to support our digital lives, is rooted in a particular location. Making the right choice and securing a rightful spot within the community lays the groundwork for a resilient and sustainable investment.

Introduction

Our lives are rapidly moving online, creating ever-accelerating growth in data creation and consumption that is generating incredibly high demand for data centers. A data center is no more than a space that is used for housing switches, routers, racks of servers and other equipment to facilitate and ensure their proper functioning. This simple explanation of what a data center is belies the fact that the market for these facilities is incredibly dynamic and complex.

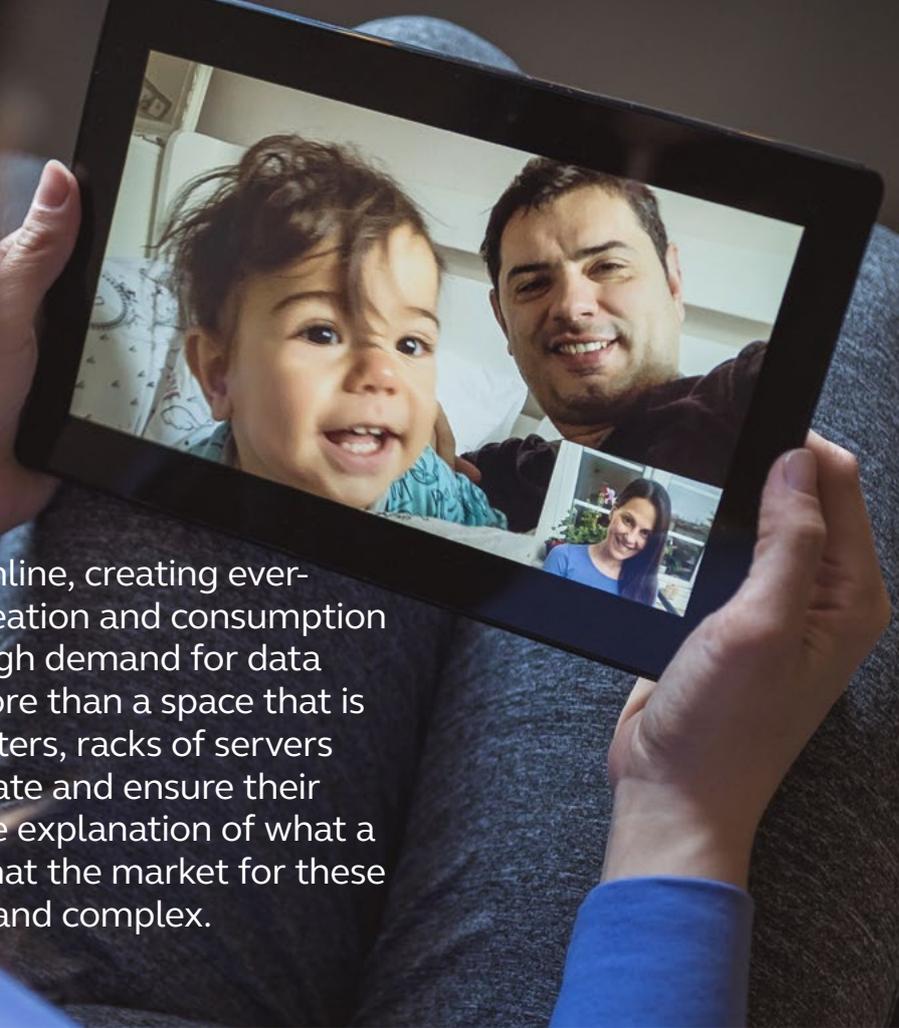
A data center can be located nearly anywhere. In fact, deciding where to place a proposed new facility is one of the first steps a data center operator has to make. It's a decision that affects all of the other stages in the process, from planning and design, to permitting, construction and delivery, and, ultimately, through the entire life span of the delivered asset. In other words, getting the location right is one of the critical factors that will determine how well a company's investment in a particular data center will perform.

Take planning for example. An important early consideration is the ease of obtaining any required permits. There are significant differences between markets with a direct and measurable impact on switch-on dates. Next to the administrative aspects, the availability and reliability of electricity infrastructure is another important decision factor. The data center industry currently accounts for around 1% of global electricity usage, and power is the single largest operational expenditure. Structural deficiencies in national grids and power supply systems can severely impact operations and ultimately the business case.

Finding the best location for a new data center is a critical part of how companies can maximize the performance of their investment in a new facility.

There are multiple factors to analyze when deciding where to place a new data center. Companies should consider both the supply and demand-side forces at play in the relevant markets. At a high level, this means that in each market under consideration, the company must develop a comprehensive understanding of the support in place for building and operating data centers, as well as the demand for services underpinned by data. This is no simple task.

We developed the Arcadis Data Center Location Index for companies that are considering where in the world they should build their next data center. The Index can serve to validate or call into question initial discussions about the optimal location for a new facility. We examined 50 national markets, a mix of established and emerging economies, and ranked them based on their performance across eight key criteria, that include both supply and demand-side factors.



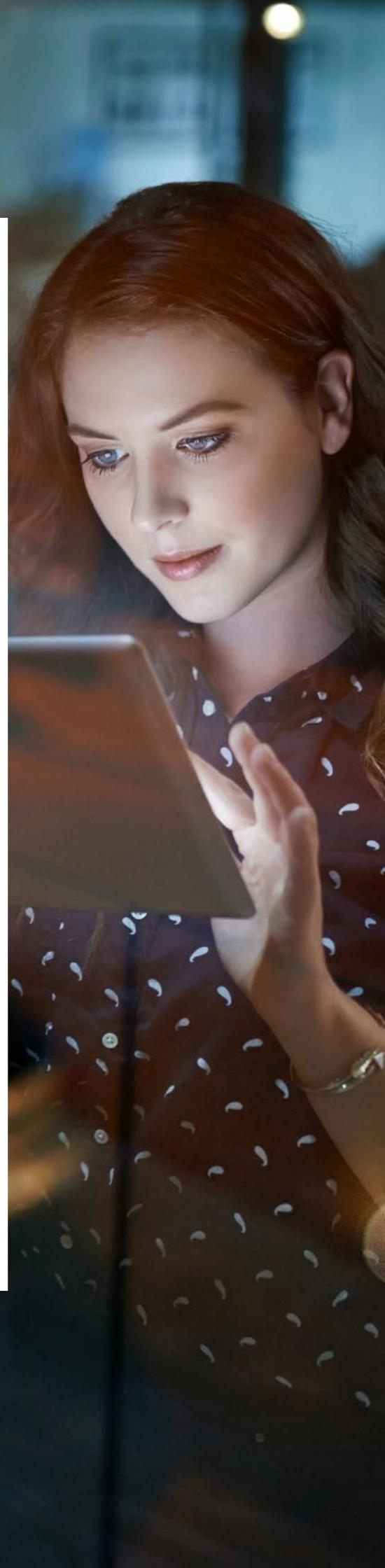
The global market for data centers

The number of internet users worldwide has doubled over the last decade, according to figures from the International Energy Agency (IEA). Over that same period, global internet traffic grew by roughly 30% each year and is expected to double between now and 2022. Nearly one billion more people will become mobile broadband users over the next five years. The COVID-19 pandemic has further supercharged internet traffic and the use of digital services. All of this has resulted in phenomenal growth in demand for data centers.

Big picture, three of the most significant current issues impacting the data center market are the global effort to reduce carbon emissions to address climate change, the continued effects of the COVID-19 pandemic, and the growing importance of hyperscale data centers.

Decarbonization and Sustainability

Data centers use massive amounts of energy. As a result, many have large carbon footprints, in particular in places that provide scant access to renewable energy sources. Most operators will want to comply with the net zero carbon ambitions, as set out in the Paris Agreement on Climate Change, before 2050. In 2019, data centers and data transmission networks were responsible for around 1% of global electricity use. Consequently, companies are exploring additional ways of decarbonizing their operations. The use of advanced solutions, such as immersion cooling and heat recovery, as well as limiting embodied carbon through new methods of construction can help decarbonize the build and operations. In addition, leading data center operators are using machine learning to improve the efficiency and energy consumption of their data centers. By optimizing cooling techniques and matching non-urgent tasks with periods of lower power prices and less grid usage, our clients are able to reduce energy consumption in their data centers by as much as 30%. Smart data center operators will continue pushing the boundaries of sustainable and resilient design and construction of their new facilities. They are also exploring locating facilities in colder climates, reducing the costs of cooling, as well as in places that offer ready access to an abundance of renewable energy.





COVID-19

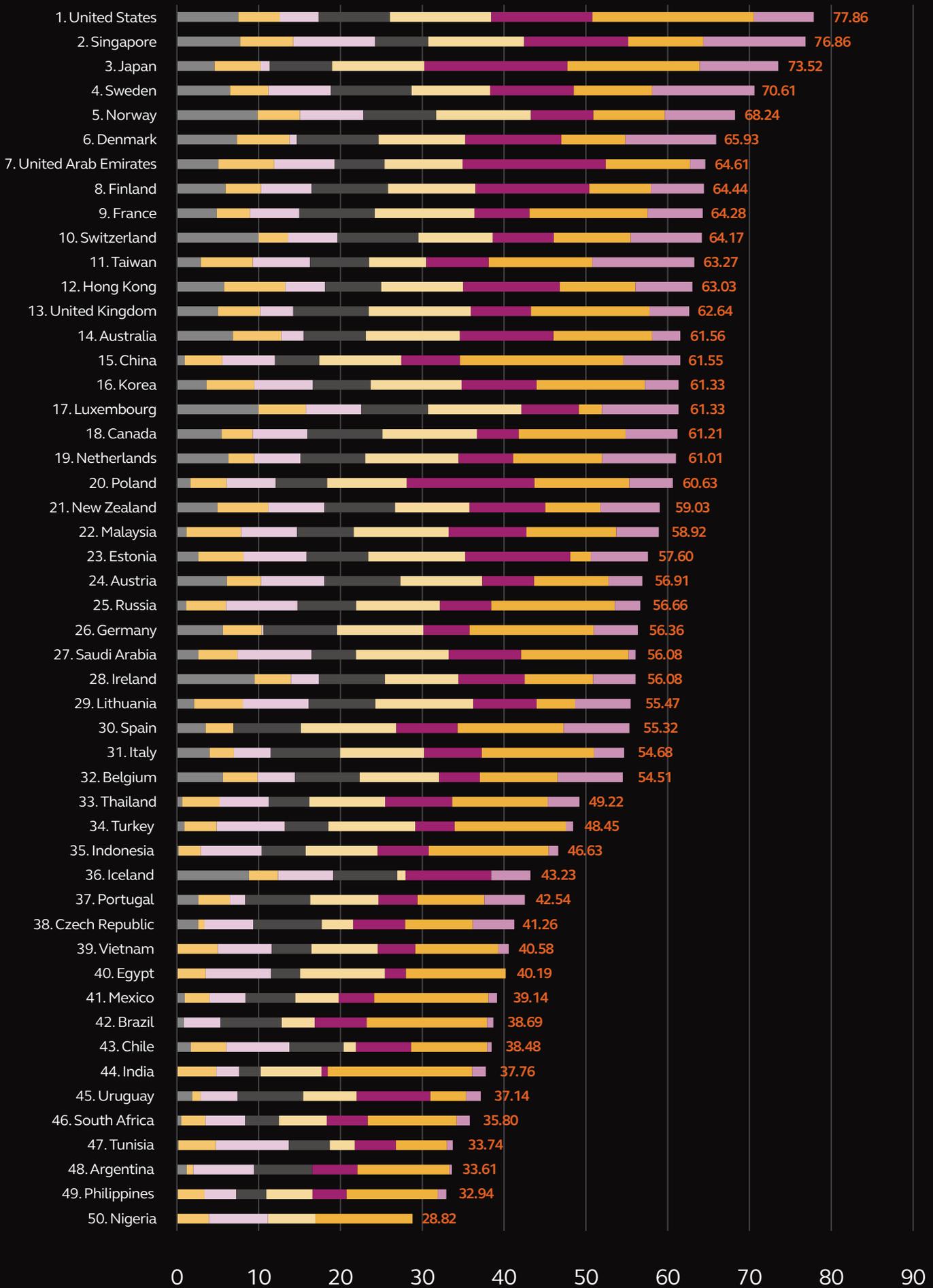
The COVID-19 pandemic has led to a massive surge in internet traffic, largely driven by the various lockdowns that governments have put in place to drive down infection rates. It has led millions of people to work from home and using digital means to purchase goods and services, and for social and entertainment purposes. Though this trend was well underway before the pandemic, COVID-19 has accelerated the advent of the digital economy. The surge in data consumption has put a significant strain on fiber networks and data centers, and it highlights how important it is for data center operators to build resilient facilities, as data centers have become critical societal infrastructure. As a result, developers are trying to accelerate construction of new facilities to meet the increased demand. At the start of the pandemic, there were fears that COVID-19 would have a lasting impact on global supply chains. So far, this has not been the case, as supply chains have proven to be resilient and the negative effect on data center construction was short-lived.

Hyperscalers

Counting facilities that are being planned, designed or are in the process of being built, there are now more than 650 hyperscale data centers around the world. That's more than twice the number in existence in 2015, when there were only 260. As the name suggests, hyperscale facilities allow operators to easily upscale capacity to accommodate increases in demand. The five largest hyperscale data center operators are Amazon Web Services, Google, Microsoft, Facebook, and Apple, closely followed by Chinese cloud giant Alibaba. While co-location centers tend to ramp up gradually over time, as rack space is leased out, and are constructed in expectation of future client demand, hyperscalers can reach almost full utilization within a short period of time. Hyperscale data centers need very reliable energy and fiber infrastructure, which can limit location options. At the same time, new hyperscale projects tend to form part of large campus developments that will accommodate more than a thousand people – a significant undertaking in many locations around the world. Hyperscale and cloud providers are bringing more capacity online at an unprecedented rate, pushing the boundaries of lean construction methods. Despite these companies' deep pockets, even they cannot account for projected growth and will instead look to qualified co-location providers to supplement their efforts to accommodate new demand.

The Arcadis Data Center Location Index 2021

The Arcadis Data Center Location Index provides an indicative ranking of suitability for data center investment, based on the aggregation of eight data sets for 50 markets across the Americas, Asia Pacific, Europe, and the Middle East. These markets are ranked based on their performance across five supply-side and three demand-side criteria.



*Weighting

Supply

- GDP per Capita (Normalized) *0.2
- Dealing with construction permits (Normalized) *0.15
- Price of electricity (Normalized and inverted) *0.2
- Energy Security (Normalized) *0.2
- Global Cybersecurity (Normalized) *0.25

Demand

- Mobile-broadband subscriptions per 100 pop (Normalized) *0.35
- Domestic Market Size (Normalized) *0.4
- Mean download speed (Normalized) *0.25



When deciding where to place their next data center, companies need to consider two significant variables: the existing infrastructure and regulatory regime, as well as current and future demand for data. With a few exceptions that can be found at the top of this year's ranking, markets often excel at one or the other. Whereas many wealthy nations showcase well-developed energy infrastructure and favorable policies, they generally do not represent the highest growth markets of the future, but often offer access to large markets such as the European Union. Certain developing markets show improvement potential in the ease of obtaining permits, energy security, and their approach to cybersecurity. When deciding where to place a new data center, companies need to balance location-specific strengths with a market's future potential.

Perhaps not surprisingly, many of the most appealing places to build data centers are in Europe. Nearly half of the top 50 are national markets in Europe. Half of the European markets on the list rank in the top half of the index. Europe scores well across GDP per capita, energy security as well as mobile-broadband subscriptions and mean download speed, explaining why many of its largest cities have long been prime targets for data center construction. The European Union is the single largest economic market, boasting a diverse set of 27 countries with stable democratic governments and some of the wealthiest populations in the world. Politically, access to renewable energy is of increasing importance, with Northern Europe a leader in wind and hydro technologies, while Southern Europe is well positioned for solar power generation.

Asia-Pacific is also very well represented in the index. Thirteen Asian markets made the list and nine of them are in the top half, with strong performances by Singapore, Japan, Taiwan, and Hong Kong. Asia-Pacific is amongst the fastest growing regions of the global economy but there are large differences between markets in terms of GDP per capita and energy security. Historically a destination for major IT outsourcing projects, Asia has increasingly become a leader across many cutting-edge industries. A significant share of the largest technology companies is now based in China, not surprising given the size of the market and its highly skilled workforce. In addition to domestic providers, Asia-Pacific is undergoing significant data center growth driven by large-scale international cloud providers, as they expand aggressively across the major hubs in the region.

Though the four South American markets (Brazil, Chile, Uruguay, and Argentina) are all towards the bottom of the index, the region shows great potential for growth as internet access continues to expand there and because the cold climates in parts of these countries can significantly reduce energy costs for cooling servers. To increase the region's attractiveness for international data center investments, governments in South America have pushed for significant tax incentives. Brazil and Chile both boast large domestic markets and relatively cheap electricity prices. Chile has been investing heavily in digital infrastructure and inviting foreign cloud companies to locate there. A key concern amongst companies is the relative lack of investment in new international cable links, either to the United States or across the Pacific to Asia.

The data center market in the Middle East is in the earlier stages of development, with only a select number of data centers available. Nevertheless, increased government support for the digital economy, coupled with growth in cloud adoption and smart city initiatives will likely spur on demand for data and storage. This will drive developers to invest in new projects. As a consequence, investors are now demanding innovative and cost-effective cooling techniques to counteract high operations costs due to the region's hot weather.



Top 10 Data Center Markets



INDICATORS:


GDP per Capita


Dealing with construction permits


Price of electricity


Energy security


Global cybersecurity


Mobile-broadband subscriptions


Domestic market size


Mean download speed

1. United States

The United States is the world's second largest internal market and has the seventh highest GDP per capita. The country is home to many of the leading global technology giants. The US has long been an attractive market for the construction of data centers, underpinned by its mature approach to cybersecurity, high mobile broadband penetration, and high download speeds. Reliable electricity supply in combination with the increasing availability of renewable energy sources also make the US particularly attractive, especially for co-location data center operators. The US is well connected to Asia-Pacific and Europe via submarine cables and has strong political ties to both regions. Nonetheless, high prices for electricity remain a challenge. This can be partly offset by choosing locations that are suitable for the use of free cooling technologies, which can reduce electricity costs by up to 30%.

Score:
77.86 /100

 **75.2**  **70.7**
 **67.5**  **98.8**
 **47.3**  **58.4**
 **87.3**
 **99.0**

2. Singapore

A major financial center and one of the largest shipping ports in the world, Singapore ranks sixth in GDP per capita. Despite the country's leading position in internet connectivity and low energy prices, it scores relatively low on energy security and domestic market size, making it heavily reliant on good relations with its neighbors. With its well-educated workforce and stable government, Singapore continues to attract major investments from the technology industry, making it a natural co-location hub for serving markets across Southeast Asia and India. That said, the availability of renewable energy sources is a problem the country needs to address. Due to its small size, land availability remains a key concern for investors. Interestingly, the government has mapped out space beneath the city as it wants to move urban infrastructure like data centers, bus depots, and sewage systems underground.

Score:
76.86 /100

 **77.5**  **72.7**
 **86.5**  **45.9**
 **100**  **100**
 **65.1**
 **93.7**

3. Japan

Japan has a high rate of data consumption, as a result of the country's essentially complete mobile broadband penetration, significant internal market size, and by early and large-scale adoption of digital technologies by global and local enterprises. These features create a landscape in which many of the major hosting and cloud providers are present alongside large-scale domestic suppliers. Nevertheless, an aging population, corresponding lack of available labor and high energy prices are driving up operating costs. There are concerns about the availability of sufficient power in the future. In addition, many data center providers are including secondary locations, outside of Japan, into their business continuity plans due to the country's relatively high risk of natural disasters.

Score:
75.52 /100

 **46.1**  **100.0**
 **75.0**  **80.7**
 **11.2**  **76.9**
 **76.2**
 **90.3**





INDICATORS:

 
GDP per Capita


Dealing with construction permits


Price of electricity


Energy security


Global cybersecurity


Mobile-broadband subscriptions


Domestic market size


Mean download speed

4. Sweden

Sweden ranks second in average download speed and energy security, making it a prime target for data center investment. The government offers significant incentives to attract new development, having reduced the electricity tax rate by 97% in 2017. A growing share of renewable energy sources and reliable infrastructure further adds to the country's attractiveness as a data center investment destination. Despite Sweden's overall score being lowered by its small domestic market size and the International Telecommunication Union's low ranking of the country's approach to data security, its EU membership means Sweden is also a gateway into the largest economic zone in the world.

Score:
70.61 /100

-  **65.1**
-  **58.3**
-  **62.7**
-  **48.0**
-  **76.1**
-  **100.0**
-  **98.7**
-  **76.9**

5. Norway

Driven by its natural resource wealth, Norway ranks third in global GDP per capita. The country has access to a significant share of renewable energy in the form of hydropower, leading to high scores across the price of electricity and energy security. As a consequence, Norway has gained increased international interest as a destination for data center construction. A political push for favorable changes to property tax rules, as well as a high score on internet speed and the availability of land, make up for its relatively small domestic market. Despite not being part of the EU, new international fiber connections between Norway and mainland Europe have come online.

Score:
68.24 /100

-  **98.6**
-  **43.6**
-  **69.0**
-  **43.6**
-  **77.6**
-  **68.8**
-  **89.1**
-  **92.6**

6. Denmark

Known for its reliable power grid, Denmark ranks third in energy security, the ability to deal with construction permits and internet speed. The country boasts a high GDP per capita and good mobile broadband penetration, which, in combination with its proximity to larger EU countries, compensates for a relatively small domestic market. This also explains the country's recent success in attracting new data center investments. Despite more than 30% of its energy being generated from the renewable sources, electricity costs in Denmark are a key challenge.

Score:
65.93 /100

-  **73.5**
-  **67.0**
-  **85.8**
-  **39.1**
-  **8.8**
-  **88.8**
-  **100.0**
-  **84.9**





INDICATORS:



GDP per Capita


Dealing with construction permits


Price of electricity


Energy security


Global cybersecurity


Mobile-broadband subscriptions


Domestic market size


Mean download speed

7. United Arab Emirates

A well-established fiber broadband network secured the United Arab Emirates (UAE) the top spot in mobile broadband penetration, while the ease of obtaining construction permits and a plethora of new smart city initiatives make it an emerging location for data center investment. The UAE is centrally located in the Middle East, ensuring good proximity to submarine cables connecting it to the rest of the world. That said the energy and carbon costs to cool servers in such a hot climate needs to be considered. The UAE is also working to address energy security and cybersecurity. In response, the government is looking to introduce a new data protection law to support its national cybersecurity strategy.

Score:
64.61 /100

-  **50.7**  **100.0**
-  **91.1**  **51.14**
-  **73.7**  **15.0**
-  **61.2**
-  **76.3**

8. Finland

Finland provides a high-quality digital infrastructure, ranking fifth globally in energy security and fourth for mobile broadband penetration. Good global connectivity through strategically placed cables, as well as a cool climate further add to the country's attractiveness. The government has recently announced plans to reduce tax rates to stimulate new data center development and companies have access to a highly reliable power supply, drawn from a range of renewable sources. Obtaining construction permits can be cumbersome in Finland and the country has a low score for domestic market size.

Score:
64.44/100

-  **59.6**  **79.5**
-  **57.7**  **37.7**
-  **62.0**  **51.8**
-  **93.3**
-  **85.7**

9. France

France is the third largest information and communications technology market in Europe and ranks tenth globally in domestic market size. The combination of the country's high scores across its approach to cybersecurity and its reliable energy grid offer an ideal environment for the expansion of the data center sector. Existing investment is heavily centered in its capital, with Paris accounting for over 70% of the country's current data center footprint. The French government is focused on the digitalization of its economy, including a €20 billion (EUR) investment in high-speed broadband coverage, to reach every household in France within the next ten years. Despite the positives, the country does not score well in terms of mobile broadband penetration, nor in the ease of obtaining construction permits.

Score:
64.28 /100

-  **48.8**  **38.5**
-  **53.8**  **72.1**
-  **60.5**  **53.9**
-  **92.2**
-  **97.5**

10. Switzerland

A well-developed electricity grid, a leading position in energy security, the second highest GDP per capita, and a stable democratic system underpin Switzerland's position as an attractive destination for data center investments. Switzerland's low reliance on imported electricity helps ensure relatively stable energy prices. Challenges remain though, as Switzerland scored relatively low for cybersecurity, which is at odds with the focus its legislators have historically given the topic. In addition, labor costs remain high, it can be difficult to obtain construction permits, and the price of land is very high, in and around cities.

Score:
64.17 /100

-  **100.0**  **42.7**
-  **47.8**  **46.9**
-  **60.5**  **69.6**
-  **99.0**
-  **72.7**

Markets to keep an eye on

INDICATORS:



GDP per Capita



Dealing with construction permits



Price of electricity



Energy security



Global cybersecurity



Mobile-broadband subscriptions



Domestic market size

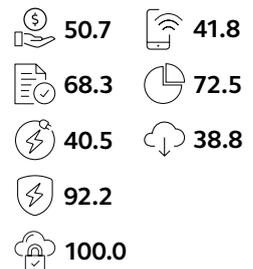


Mean download speed

13. The United Kingdom

The United Kingdom ranks first in cybersecurity followed by high scores for energy security and a decent domestic market size, making it a prime target for data center investment. The UK is a critical interchange and communications hub between North America and Europe with over 50 undersea cables. London is one of the prominent global financial centers and has the largest data center market in Europe. At the same time, the UK is beginning to roll out FTTP (fiber to the premises) and catching up with many of its neighbors, which will likely increase data consumption in the future. Leaving the EU will have an impact on the data hosting and media streaming market that may now need to build additional capacity in both the UK and Europe.

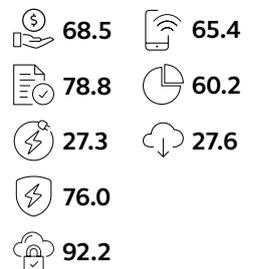
Score:
62.64 /100



14. Australia

In 2010, the Australian government introduced its Data Center Strategy 2010-2025, focusing on policies and regulations for increased cloud adoption and driving investments in the industry. Its success is clearly evidenced by Australia's high scores across issuing construction permits, energy security, and global cybersecurity. Due to its size, Australia has one of the longest electricity networks in the world, which contributes to high prices of electricity. Geographically, Australia is well connected to Asia-Pacific, via submarine cables across the region. As such, Australia continues to be an attractive investment location for further expansion in the area.

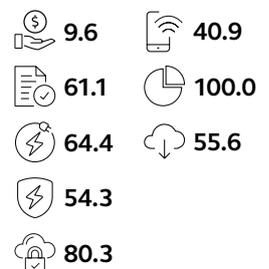
Score:
61.56 /100



15. China

Its population and economic growth over the last decades make China the world's largest internal market for data technology and services. It is in the midst of a digital transformation on a massive scale. China is a pioneer in the adoption of smart city initiatives, which has increased use of cloud-based services in the country. The hi-tech sector is experiencing phenomenal growth. More than 70% of the population is using e-commerce for commercial and non-commercial activities. All of this is driving high demand for data centers. Ultimately, China remains a challenging market, especially for foreign investors, due to the difficulties in obtaining construction permits and the country's relatively low score on energy security.

Score:
61.55 /100





INDICATORS:

 **GDP per Capita**

 **Dealing with construction permits**

 **Price of electricity**

 **Energy security**

 **Global cybersecurity**

 **Mobile-broadband subscriptions**

 **Domestic market size**

 **Mean download speed**

19. The Netherlands

The Netherlands ranks very high in both energy security, connectivity, and cybersecurity, partly due to its excellent digital infrastructure, and the fact that the country hosts a number of important internet exchanges (AMS-IX, NL-IX). In particular, Amsterdam is a highly attractive location. It also has proactive state intervention in fiber expansion as the backbone for providing a stable and solid digital platform. The country offers a favorable climate, has one of the most reliable energy networks with low prices relative to other markets, has a stable political environment, and a supportive government and ecosystem of suppliers. Adding to the country's attractiveness, the Netherlands is home to key European transportation hubs such as Amsterdam Schiphol Airport and the Port of Rotterdam. In 2020, a temporary ban on the development of new facilities in and around Amsterdam was lifted. The ban had been put in place because of concerns about the availability of electricity as well as questions about how data centers are impacting the environment. All of these advantages make the Netherlands a desirable location for future data center investment.

Score: **61.01** /100

-  **63.1**  **38.1**
-  **42.1**  **54.5**
-  **56.6**  **72.1**
-  **79.1**
-  **91.2**

23. Estonia

Estonia is one of Europe's most wired nations and will soon be home to the largest data center in the Baltic States. Despite being hindered by its small domestic market and its location away from major trading routes, Estonia's position in the index is buoyed by its fifth highest score for cybersecurity capabilities and mobile broadband penetration. In addition, Estonia scores relatively high in terms of internet download speed, companies' ability to secure construction permits and energy prices. Estonia was also the first country to allow its citizens to vote online in national elections and offers one of the most competitive and advanced tax systems in the world. Estonia has the potential to benefit from both further growth in digital markets throughout Eastern Europe and its leading IT integration capabilities.

Score: **57.60** /100

-  **26.3**  **73.3**
-  **73.8**  **12.5**
-  **76.6**  **55.9**
-  **75.7**
-  **95.0**

26. Germany

Germany, Europe's economic powerhouse, its largest economy and the world's fifth-largest digital economy, offers high levels of energy security. The country is also at the forefront of renewable energy adoption, although it still relies heavily on coal power generation. At the same time, energy prices are high, commanding a significant premium when compared to its peers. Germany scores well on mobile broadband use and cybersecurity. Though there is no clear government strategy for promoting data center locations, German data centers are among the most energy-efficient in the world. The highest density of data centers lies in Frankfurt, the world's largest internet hub, where data transmitted through the DE-CIX node averages more than six terabits per second. Additional locations gaining investment are Berlin, Munich, and Hamburg. Overall, the country remains one of the main investment destinations in Europe.

Score: **56.36** /100

-  **56.4**  **32.2**
-  **63.2**  **76.0**
-  **2.0**  **43.1**
-  **90.2**
-  **84.4**





INDICATORS:


GDP per Capita


Dealing with construction permits


Price of electricity


Energy security


Global cybersecurity


Mobile-broadband subscriptions


Domestic market size


Mean download speed

28. Ireland

Ireland boasts the fourth highest GDP per capita in addition to a skilled workforce, prime access to undersea cable routes and a cool climate. The country has a relatively small domestic market, high electricity prices and low scores for its approach to cybersecurity, but these are offset by Ireland's tax code, which incentivizes investment. Dublin has been chosen by Google, AWS, Microsoft, and Facebook as the location for their European headquarters. The region is also expected to see an additional €10 billion (EUR) of data center construction in the next few years. As all these new data centers increase demand for electricity, Ireland will need to expand access to renewable energy sources, in particular offshore wind.

Score:
56.08 /100

-  **95.1**  **46.2**
-  **59.4**  **41.8**
-  **34.1**  **41.6**
-  **80.6**
-  **71.9**

33. Thailand

Thailand is one of the largest economies in Southeast Asia, and despite its low ranking in GDP per capita, its economy is forecast to grow by 4% in 2021, following a contraction last year. The country has a relatively benign regulatory environment, based on its ability to support construction through Environmental Impact Assessments. Thailand ranks high on cybersecurity and has favorable electricity prices, making it an attractive investment destination for data center operators. This is underpinned by the new Thailand 4.0 initiative and stimulus plans, which seek to stimulate further development of the technology cluster within the country.

Score:
49.22 /100

-  **6.5**  **46.8**
-  **61.1**  **58.4**
-  **60.0**  **31.1**
-  **49.6**
-  **74.2**

42. Brazil

Despite a relatively low GDP per capita, the country's size means its economy is large in absolute terms and continues to have a high growth rate. Coupled with good levels of energy security, it is an interesting market for data center construction and on the radar for many investors. Recently, the government introduced the Regime of the National Broadband Program, which aims to incentivize improvements in broadband connectivity in the country and to build-out digital infrastructure.

Score:
38.69 /100

-  **8.6**  **36.3**
-  **0.0**  **73.6**
-  **44.9**  **6.1**
-  **74.7**
-  **32.4**

44. India

Although India's GDP per capita is low, thanks to a well-educated population of over 1.3 billion, the country had the second highest GDP growth in the world in 2019, at 6.1%. Despite poor scores across mobile broadband penetration, energy security, its approach to cybersecurity and the price of electricity, the country will continue to rise in importance in the global economy. Further growth in India's IT infrastructure and an increase in new internet companies will drive demand for new data centers.

Score:
37.76 /100

-  **0.0**  **4.3**
-  **64.4**  **88.3**
-  **27.8**  **13.2**
-  **26.4**
-  **59.5**

The Arcadis Data Center Construction Roadmap

At a macro level, data center operators travel through five steps on the road, from deciding to build a new data center to reaping the benefits of that investment. At each step, Arcadis offers services and solutions for clients that maximize the performance of their investment. We partner with clients throughout the entire journey and help them avoid the pitfalls of hidden costs, delays in acquiring permits or construction, and by designing and delivering sustainability and resilience features that will protect their investment over the longer-term.



STEP 1

Location

The first step is deciding where to place the proposed new data center. This is where companies need to understand countries' markets as well as regional differences within countries in terms of the availability and reliability of electricity, the status and availability of fiber optic networks, the regulatory and permitting regime, and many other factors. Ultimately, this includes the consideration of individual sites, where the data center can be constructed.

Savvy due diligence conducted at this stage is essential in terms of making informed decisions that can maximize return on investment across the entire journey.



STEP 2

Planning

Once a data center operator has decided where to place the new facility, they enter the planning phase. At this point they must decide how, and on what time schedule, they will design the new facility, secure all of the necessary permits and permissions, engage with a multitude of suppliers and service providers, have the facility built and outfitted and begin operating the data center. During this stage, companies will have to decide on the basic parameters of the new data center: roughly how large it should be, based on the desired use and other business objectives. It is important to note that this stage is also critical in terms of designing the long-term sustainability and resilience of the new data center. This is where companies can make decisions that can reduce the embodied carbon of the new building and outfit the asset with sustainability features that can greatly reduce the amount of embedded carbon as well as energy that will be used over the life of the facility.

It is critically important data center operators maintain highly competent due diligence efforts throughout this phase to help avoid unforeseen costs or delays in the ensuing steps. This is also the stage at which project, cost management and long-lead item procurement efforts work together in unison.



STEP 3

Permitting

Every jurisdiction in the world has its own unique regulatory regime, which dictates myriad aspects of the design, construction, and operation of any type of building, including data centers. During the permitting phase, data center operators settle on the detailed design of the proposed, new facility. Based on that design, companies then have to secure all of the necessary permits and other permissions needed to actually build the data center and switch it on.

Sustainable and resilient design of the building(s) can significantly enhance the value of the asset(s) and greatly reduce negative impacts on the environment and the communities near a site. Good design, project management and cost management expertise can help companies better navigate their way through this phase.



STEP 4

Construction and delivery

The construction and delivery of the new facilities is undoubtedly the most critical step of this process. Deficiencies in due diligence or the earlier stages of project and cost management, all too often, become evident during the build. Add to that the fact that construction cost overruns and delays in delivery are not just frequent, in some places, they are the norm. Whether it's 1 or 2% more expensive than planned or 10 to 20%, every unexpected cost or delay in this stage decreases return on investment in the facility. In other words, the difference between a successful project to build a new data center and a really successful one, is how well the operator can pull off the build and get things up and running as quickly and smoothly as possible, through clarity, strong management, and cooperation throughout the supply chain.

This is where data center operators can reap the full benefits of skillful project and cost management services.



STEP 5

Operations

After the facilities have been built, the networking and storage equipment is installed, it's connected to the fiber optic network, and the new data center is brought online. Operators will need to ensure energy supply and maintain back-up generators as a last resort. They will also run and service the cooling systems and arrange for the upkeep and maintenance of the building.

Sustainability and resilience features (designed into the plan earlier on and delivered during the build phase) can generate tremendous savings over the long-term. They allow data center operators to reduce or supplement energy consumption from the grid or harden the building against shocks like storms and flooding.

Smart analytics solutions can help operators optimize their maintenance schedules to prevent breakdowns and diminished asset performance from delays in discovering faulty equipment or infrastructure.

Rank	Market	GDP per capita	SUPPLY				DEMAND		
			Dealing with construction permits	Price of electricity	Energy security	Global cyber-security	Mobile-broadband subscriptions per 100 pop	Domestic market size	Mean download speed
1	United States	75.2	67.5	47.3	87.3	99.0	70.7	98.8	58.4
2	Singapore	77.5	86.5	100.0	65.1	93.7	72.7	45.9	100.0
3	Japan	46.1	75.0	11.2	76.2	90.3	100.0	80.7	76.9
4	Sweden	65.1	62.7	76.1	98.7	76.9	58.3	48.0	100.0
5	Norway	98.6	69.0	77.6	89.1	92.6	43.6	43.6	68.8
6	Denmark	73.5	85.8	8.8	100.0	84.9	67.0	39.1	88.8
7	UAE	50.7	91.1	73.7	61.2	76.3	100.0	51.4	15.0
8	Finland	59.6	57.7	62.0	93.3	85.7	79.5	37.7	51.8
9	France	48.8	53.8	60.5	92.2	97.5	38.5	72.1	53.9
10	Switzerland	100.0	47.8	60.5	99.0	72.7	42.7	46.9	69.6
11	Taiwan	29.4	84.6	69.8	72.4	55.9	43.7	63.1	100.0
12	Hong Kong	57.8	100.0	48.3	68.7	80.3	67.4	46.3	55.6
13	UK	50.7	68.3	40.5	92.2	100.0	41.8	72.5	38.8
14	Australia	68.5	78.8	27.3	76.0	92.2	65.4	60.2	27.6
15	China	9.6	61.1	64.4	54.3	80.3	40.9	100.0	55.6
16	Korea	36.3	78.1	71.2	70.8	88.9	52.4	66.2	32.9
17	Luxembourg	100.0	76.9	67.8	81.7	91.4	40.0	14.1	74.8
18	Canada	54.7	50.7	66.8	91.7	92.6	29.1	65.4	50.7
19	Netherlands	63.1	42.1	56.6	79.1	91.2	38.1	54.5	72.1
20	Poland	16.6	58.9	60.0	63.0	77.9	89.1	58.0	42.6
21	New Zealand	49.4	83.2	68.3	86.6	72.9	53.0	33.6	58.1
22	Malaysia	11.6	89.2	68.3	69.5	92.7	54.4	54.9	41.6
23	Estonia	26.3	73.8	76.6	75.7	95.0	73.3	12.5	55.9
24	Austria	61.2	55.8	77.1	93.3	80.0	36.2	45.5	33.1
25	Russia	11.5	64.9	87.3	71.8	81.9	35.8	75.6	24.9

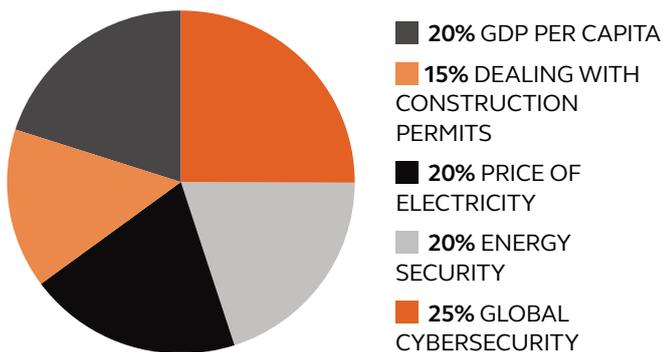
Rank	Market	GDP per capita	Dealing with construction permits	SUPPLY			DEMAND		
				Price of electricity	Energy security	Global cyber-security	Mobile-broadband subscriptions per 100 pop	Domestic market size	Mean download speed
26	Germany	56.4	63.2	2.0	90.2	84.4	32.2	76.0	43.1
27	Saudi Arabia	26.4	63.5	90.7	54.3	90.5	50.8	65.6	6.9
28	Ireland	95.1	59.4	34.1	80.6	71.9	46.2	41.8	41.6
29	Lithuania	21.2	79.3	80.5	81.7	95.6	44.2	23.6	54.3
30	Spain	35.1	45.4	0.0	82.4	93.3	42.9	64.8	64.3
31	Italy	40.2	39.4	44.9	85.0	82.1	40.3	68.6	29.4
32	Belgium	56.3	56.7	45.4	79.3	77.7	28.4	47.5	63.6
33	Thailand	6.5	61.1	60.0	49.6	74.2	46.8	58.4	31.1
34	Turkey	9.1	52.6	83.4	53.2	85.1	27.5	68.0	6.9
35	Indonesia	2.3	35.8	74.6	53.7	70.4	35.7	73.2	9.5
36	Iceland	88.1	47.4	67.3	78.6	8.0	59.9	0.0	38.4
37	Portugal	26.5	51.2	18.5	79.6	67.0	27.2	40.8	39.5
38	Czech Republic	26.1	10.3	59.5	83.7	30.9	36.3	41.4	40.5
39	Vietnam	0.7	65.9	65.9	48.6	65.1	26.0	50.8	10.2
40	Egypt	0.7	46.4	79.5	35.7	83.0	14.7	60.9	0.1
41	Mexico	9.5	40.6	43.9	61.0	42.4	24.8	69.9	8.3
42	Brazil	8.6	0.0	44.9	74.7	32.4	36.3	73.6	6.1
43	Chile	17.2	57.7	77.1	66.4	12.0	38.5	46.5	4.4
44	India	0.0	64.4	27.8	26.4	59.5	4.3	88.3	13.2
45	Uruguay	18.9	13.5	45.4	80.1	52.3	51.5	21.9	14.2
46	South Africa	5.4	39.4	48.3	41.6	46.8	28.6	54.3	12.8
47	Tunisia	1.8	61.3	89.3	49.9	24.6	28.7	31.1	5.7
48	Argentina	12.0	10.8	74.1	71.3	0.0	31.6	56.1	2.4
49	Philippines	1.4	43.5	38.5	37.0	45.0	23.8	55.7	8.4
50	Nigeria	0.0	52.2	72.2	0.0	46.4	0.0	59.4	0.0

Methodology

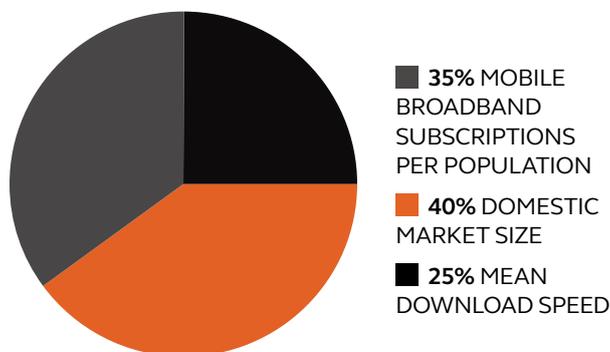
The index ranks 50 of the world's key established and emerging markets based on their performance across eight criteria: GDP per capita, dealing with construction permits, price of electricity, energy security, cybersecurity, domestic market size, the number of mobile broadband subscriptions and mean download speed. The final index value is a sum of weighted scores which have been collated from publicly available sources. Scores for each of the eight metrics are normalized on a scale of 0 to 100 using World Bank methodology. This ensures that the very large differences in scale and performance highlighted by our data are reflected in the overall assessment. All markets are ranked on a scale of 0 to 100 in a way that ensures that distance between two markets in the underlying data is scaled proportionally and remains consistent across all 50 markets.

Using the above-mentioned criteria, we have created one ranking for the supply criteria and one for the demand criteria and then combined those with equal weighting (50/50).

Within the supply side, we have used the following weighting:



Within the demand side, we have used the following weighting:



Criteria description and source of data

GDP per capita

Indicator used to analyze the prosperity of a country and its economic growth. It is a useful unit to make cross-country comparisons of average living standards and economic wellbeing.

Source: World Bank

Ease of obtaining construction permits

The procedures, time, and costs to build, including obtaining necessary licenses and permits, completing required notifications and inspections, and obtaining utility connections.

Source: World Bank

Price of electricity

The average price of electricity for warehouse use in each country is measured in US cents per kilowatt-hour.

Source: World Bank

Energy security

The energy trilemma score scores countries on their ability to provide sustainable energy through three dimensions: energy security, energy equity (accessibility and affordability), environmental sustainability.

Source: World Energy Council

Cybersecurity

Measures the commitment of countries to cybersecurity at a global level.

Source: The International Telecommunication Union

Domestic market size

Sum of gross domestic product plus value of imports of goods and services, minus value of exports of goods and services.

Source: The World Economic Forum Global Competitive Index

Mobile-broadband subscriptions

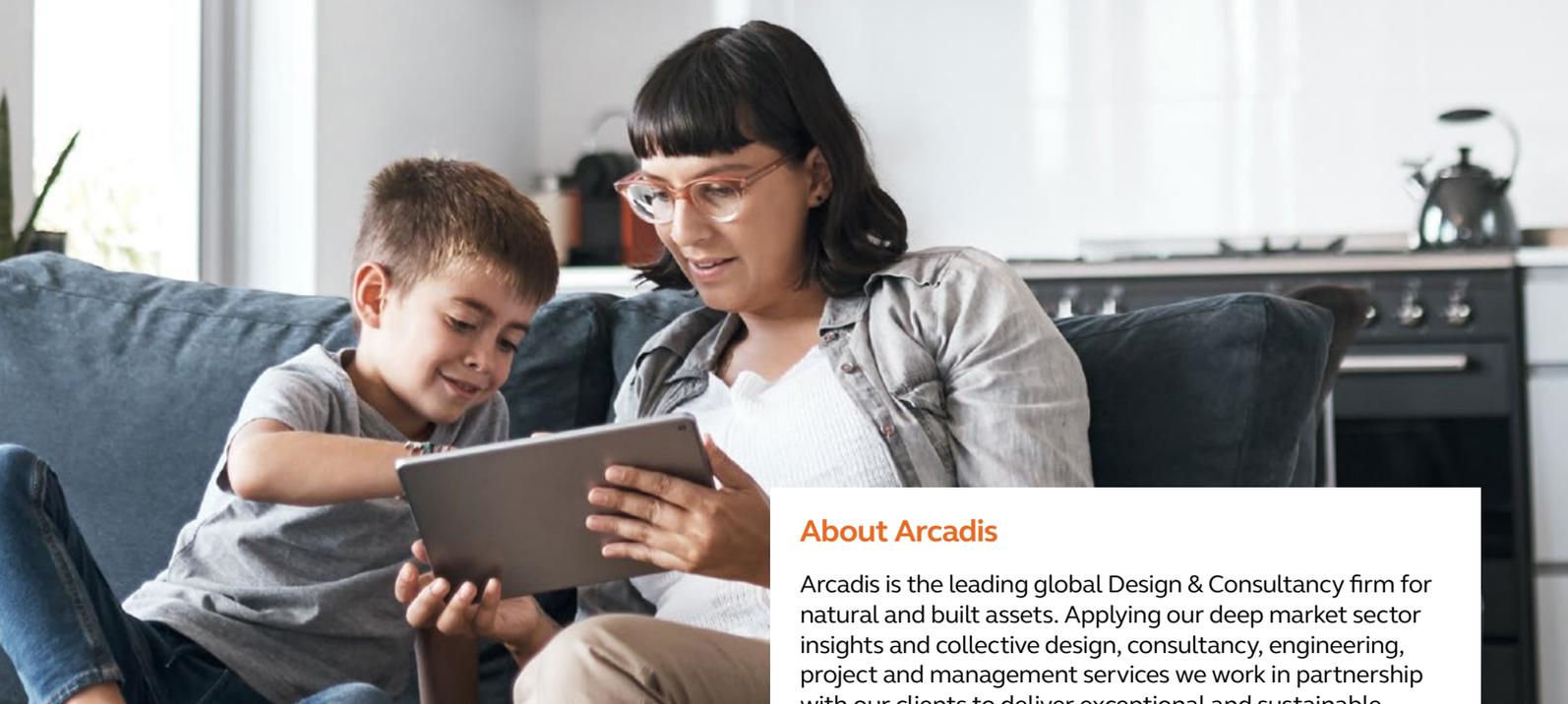
Number of active mobile-broadband subscriptions per 100 population in leading online markets.

Source: The World Economic Forum Global Competitiveness Report

Mean download speed

Mean download speed is based on the download speed of at least 50% of customers at peak time.

Source: cable.co.uk



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.

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