

October 2024



The Underpinnings of Our Virtual World

Investing in Digital Infrastructure

Our digital world has a physical foundation.

It's easy to forget there are physical assets underpinning our increasingly virtual existence. Digital infrastructure including data centers, cellular towers, and fiber-optic cable support many of the activities we associate with modern life. These physical assets enable person-to-person connectivity and on-demand commerce and entertainment. They support innovation in fields ranging from transportation to healthcare. They will be essential in a future where artificial intelligence and connected devices play a greater role.

Given how critical these assets are, the digital infrastructure space is expected to see massive investment in the coming years. Spending is likely to reach into the trillions of dollars. The International Monetary Fund

estimates it will cost around US\$418 billion just to connect all of the world's currently unconnected people.

And there could be a cost for economies that don't spend enough on digital infrastructure. In one-quarter of European Union member countries, more than half the companies say a lack of digital infrastructure is an obstacle to making long-term investments, according to the European Investment Bank.

These factors help explain why institutional investors are directing capital towards digital infrastructure. In this report, we will look at two subsectors of digital infrastructure—data centers and cellular infrastructure. But first, here's a look at why demand for these assets is soaring.

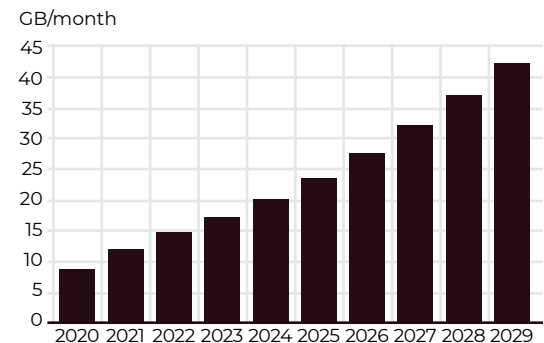


Powerful forces are driving the growth of digital infrastructure.

1 We're using more mobile devices for more purposes.

In developed countries, we're using our phones in ways we hadn't thought possible 20 years ago. Meanwhile, people in many emerging markets skipped the desktop computer phase entirely and went straight to accessing the Internet via their smartphones. Ericsson says worldwide mobile broadband subscriptions totaled almost 7.5 billion in 2023, up from 2 billion a decade earlier. The telecom giant predicts data traffic per smartphone will soar between now and the end of the decade.

Global mobile data traffic per smartphone is projected to jump ~5x this decade



Source: Ericsson

2 Businesses are embracing digitalization and the cloud.

The COVID-19 pandemic accelerated a trend among businesses to leverage data and digital technologies to improve productivity, and to scale and innovate. It also accelerated the adoption of cloud computing, in which businesses choose from a vast array of computing services offered by third parties over the Internet. For businesses, a key advantage of moving to the cloud is being able to access state-of-the-art computing services without having to maintain and build that infrastructure themselves.

US\$679 billion

Expected worldwide end-user spending on public cloud services in 2024, up 20.4% from 2023

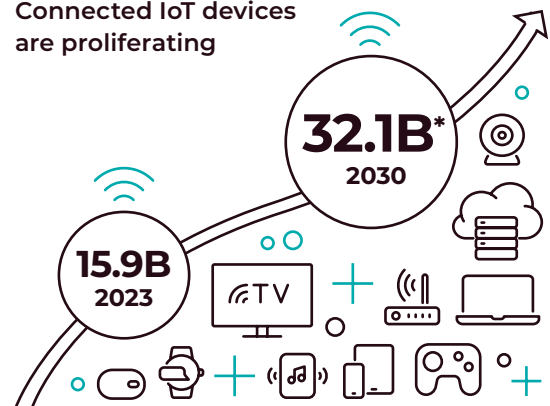
Source: Gartner



3 We're at the dawn of a new era of interconnected devices.

Fifth-generation, or 5G, telecommunications networks are being deployed around the world. Compared with previous wireless standards, 5G provides faster speeds, improved capacity and extremely low latency (the delay between when information is sent and received). These attributes will help deliver unprecedented communications between people, mobile devices and other objects, and support use cases like self-driving cars. This deeply interconnected world—the Internet of Things—will also drive demand for edge computing, where data is analyzed closer to IoT devices to further reduce latency.

Connected IoT devices are proliferating

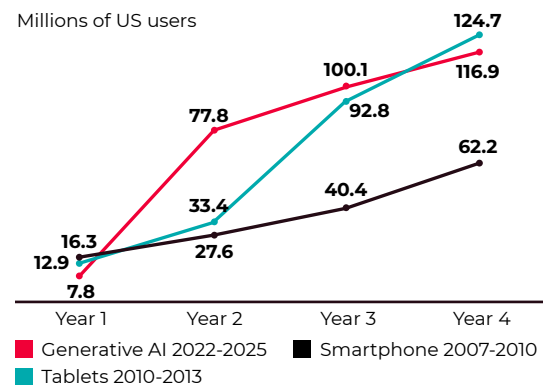


Source: Transforma Insights | *estimate

4 Artificial intelligence is moving into the mainstream.

Businesses have used artificial intelligence applications like data analytics for a while. But the recent rise of AI's wildly popular subset, Generative AI, is putting the technology into the hands of more workers and more consumers. Just how widespread the use of AI will become remains to be seen, but it's clear the technology will be transformational. Increased adoption will drive demand for massive computing power and ultra-fast network responsiveness.

Generative AI has a steeper initial adoption curve than other recent technologies



Source: eMarketer



Digital infrastructure is attracting billions in capital.

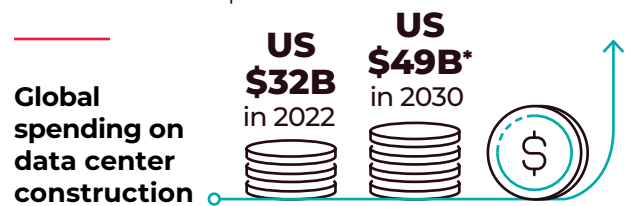
Strong tailwinds are driving significant investment in cellular towers and data centers. The forecast of continued strong demand is only part of the appeal. Cellular tower and data center owners typically enter multi-year, escalating contracts with their clients. That makes these assets attractive for long-term investors, such as pension funds, who seek steady, inflation-protected returns.

US\$34.8 billion

**Digital infrastructure M&A
in the Asia-Pacific region in 2023**

Source: White & Case

The criticality of these assets is another factor. Indeed, the wireless networks of which cell towers are the backbone are sometimes called the fourth utility (after electricity, water and gas) because of their importance in our daily lives. That helps shield these assets somewhat from the impact of economic downturns. The same can be said of data centers. In a data center industry survey by consultancy Turner & Townsend, 79% of respondents called their sector “recession-proof.”



Source: White & Case | *estimate



A cellular tower is the vertical real estate that houses antennas and other electronic communications equipment owned by mobile network operators.

Three decades ago, many wireless operators owned their towers, since building and operating an extensive wireless network conferred a competitive advantage. As coverage became more distributed among all players, that advantage faded. With pressing requirements to invest elsewhere in their networks, many U.S. carriers opted to sell their tower assets and lease them back. That gave rise to an independent “towerco” model in the U.S. that has since spread to many other global markets.

Growth in the towerco sector comes from building new towers for carriers expanding their networks. It also comes from increased co-location, in which the antennas and equipment of more than one mobile network operator are installed on the same tower. Co-location enables cell tower companies to generate more revenue from each tower. That helps keep their costs down and has the added benefit of being more sustainable and reducing the visual impact of new towers. Co-location has broader benefits too, lowering the overall cost of expanding wireless networks to underserved or rural areas.



A data center is a warehouse-like building that houses computing equipment—servers, storage systems, routers, etc.—supporting a range of business applications. Some businesses operate their own data centers; others lease computing equipment operated by a third-party operator. Still others opt for co-location, in which a data center operator hosts the infrastructure (power, cooling and so on) in a physical space in which clients run their own computing equipment. Important customers of data centers are the so-called hyperscalers—the well-known cloud providers that provide computing power and data storage on a global scale.

The model for how best to deliver critical computing power to businesses has evolved over decades, from the mainframe computers of decades ago to companies building their own data rooms after the advent of smaller, cheaper servers. The limitations of the on-premises model (including operating costs and scalability) spurred the growth of the data center industry.

Growth in the data center sector continues as more companies move their critical IT applications to the cloud and as AI supercharges demand for computing power and data storage.

Amid strong demand, digital infrastructure owners face some headwinds.

Even with powerful tailwinds driving demand for digital infrastructure, the sector faces some challenges. A big one is simply fulfilling current demand, let alone preparing for a surge in future demand.

Here are other challenges that companies operating in the sector, and their investors, are working to address:

»» **Attracting talent:** Digital transformation has opened skills gaps across sectors, and the digital infrastructure sector is no exception. A 2023 survey by the Uptime Institute found that 58% of data center operators were having difficulty filling open positions, and almost as many reported difficulties in retaining staff. Attracting professionals with transferable skills into the sector is one solution. Upskilling and diversifying workforces are others.


»» **Improving sustainability:** As passive infrastructure, cell towers have a relatively low emissions profile. Data centers consume significant amounts of electricity to run servers, networking equipment, cooling equipment and more—underscoring why data center capacity is expressed in megawatts. With efficiency

improvements and other innovations, the data center sector has managed to limit the growth in its energy usage amid exponential growth in demand for its services, the International Energy Agency says.

»» **Climate-proofing assets:** Many forms of physical infrastructure are vulnerable to extreme weather; digital infrastructure is no exception. Violent storms can cause damage to cell towers and heat waves can test data centers' cooling abilities. Owners are working to make their assets more resilient in the face of climate change, so that we can expect to rely on this critical infrastructure in emergency situations.

»» **Addressing siting concerns:** Most of us expect immediate access to the benefits of our digital world, from streaming to being able to work remotely. Nonetheless, digital infrastructure proponents can face questions about how the assets required to support these activities will affect local communities. Thoughtful engagement with stakeholders is critical, to ensure projects meet the infrastructure's objectives and have the social license to operate.



An aerial photograph of a cellular tower standing in a vast, green rural landscape. The sun is setting behind the tower, creating a bright glow and long shadows across the fields. The sky is filled with soft, golden clouds. The tower has multiple antennas and equipment mounted on its lattice structure.

Investing in digital infrastructure: Four case studies

A significant expansion of digital infrastructure will be critical if individuals, businesses, cities, and countries are to take full advantage of the economic and social opportunities arising from digital innovation. Project proponents are racing to meet growing demand while also being careful to consider the sustainability and resilience of these critical assets. Additionally, they're working to show they can balance insatiable demand for ever-faster

connectivity and computing power and community concerns about the local impact of digital infrastructure.

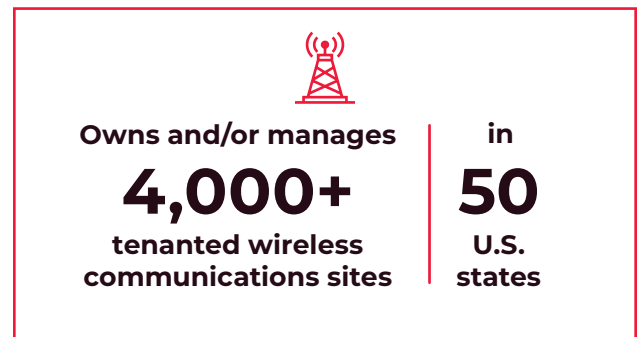
At Ontario Teachers', we've made investments in companies that operate cellular tower and data center assets from Dallas to Mumbai. Here's a look at four of our portfolio companies in the space and how they're seizing on current market opportunities.

Diamond Communications: Partnering with property owners to extend connectivity

The U.S. wireless industry helped give rise to a powerful on-demand economy in the U.S. and turned mobile communications into an essential aspect of Americans' lives. The sector's criticality is set to continue as the rollout of 5G mobile networks progresses.

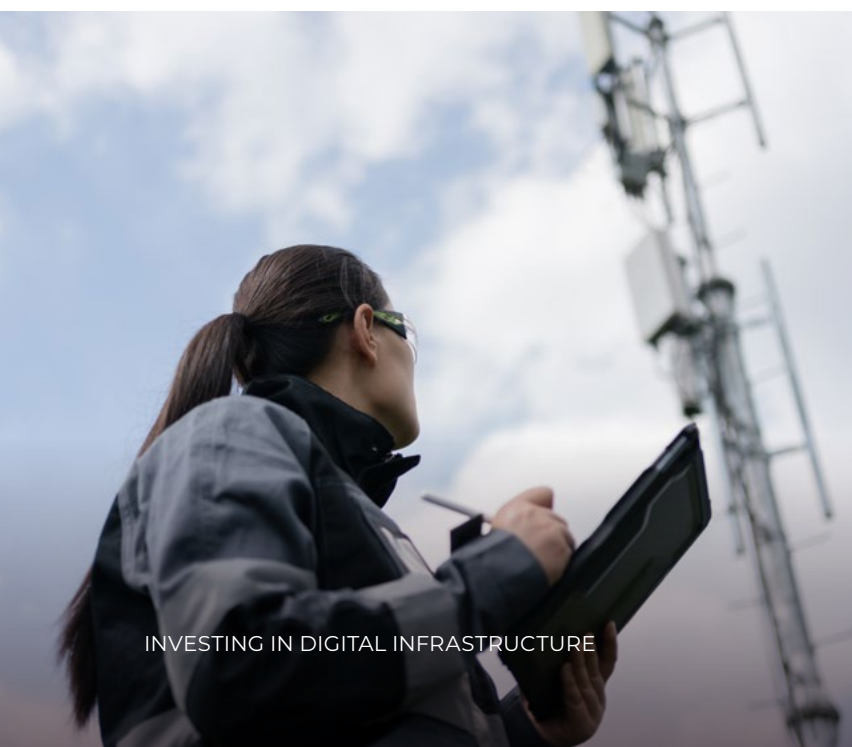
That growth is driving optimism at Diamond Communications. The Delray Beach, Florida-based company, founded in 2006, is the second-largest privately held wireless infrastructure company in the U.S. Diamond offers new tower development for wireless carriers and government entities, wireless co-location on its existing and managed properties, indoor wireless systems, fiber-network development, and high-speed broadband and WIFI networks for property owners.

Diamond has expanded through organic growth, infrastructure development and acquisitions and now owns and/or manages more than 4,000 tenanted wireless communications sites—towers and rooftop installations—in all 50 U.S. states. In addition, Diamond manages more than 400,000



untenanted properties for third-party companies, including major electric utilities and operators of outdoor media and toll road assets. Diamond has also helped municipalities, golf courses, and master planned community developers provide connectivity solutions for their residents, customers and employees with support from the wireless carriers as tenants on new or existing infrastructure.

Overall, Diamond is well positioned to benefit from the continued growth of wireless communications.



Ontario Teachers' invested in Diamond in 2023, attracted by the opportunity to partner with Diamond founder and CEO Ed Farscht, an industry veteran. Farscht says the industry's long-term outlook is strong, not least as the growth of AI creates more mobile connectivity use cases.

Improving connectivity in Grand Teton National Park

Diamond has extensive experience in working to meet regulatory and environmental standards and engaging with multiple stakeholders. An eight-year project to install new wireless infrastructure in Grand Teton National Park illustrates Diamond's approach. The company focused on protecting park species during construction, and minimized visual impacts by deploying stealth communications towers that blend into the natural surroundings. The result: improved safety and connectivity in this popular U.S. national park, benefiting visitors and employees alike.

“

As the volume of data going through the network grows and the number of connected devices in the U.S.

proliferates, you'll need more towers, and more tenants on existing infrastructure.

That's what's driving growth in the sector. ”

Ed Farscht, CEO,
Diamond Communications

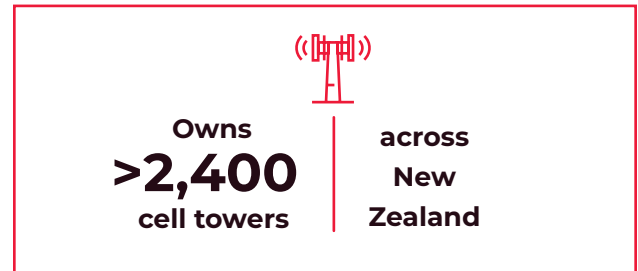
Connexa: Pioneering the independent towerco model in a new market

The independent towerco model came only recently to Australia and New Zealand. In a two-year period starting in January 2021, mobile network operators in the region seized on strong investor interest, their own capital needs and favourable commercial factors to largely divest their cell towers.

Connexa was at the center of how that trend played out in New Zealand. The company was created in July 2022 when Ontario Teachers purchased a majority stake in the passive mobile telecom tower assets of New Zealand's largest telecom company, Spark New Zealand. Within months, Connexa had acquired the tower assets of another local mobile network operator, giving it more than 2,400 towers or roughly two-thirds of the towers in New Zealand.

Connexa has set out to demonstrate the benefits of having an independent towerco business in the country, including improved efficiencies, faster deployment, and fewer unnecessary tower builds. It built its team in the immediate aftermath of the pandemic, when access to talent in locked-down New Zealand was especially challenging, in part by attracting local professionals from outside the telecom sector.

CEO Rob Berrill says Connexa is poised to grow because of its strong build-to-suit pipeline and the co-location opportunities in New Zealand.



As part of its founding transactions, the two New Zealand mobile network operators that Connexa acquired towers from became its clients and committed to order a significant number of additional tower sites over the next decade. That gave the new company visibility into how many towers it can build.

Berrill says it will also benefit from advancing co-location in New Zealand. Having a single tower support multiple tenants is beneficial from an economic perspective and results in less visual interference. But it hasn't been the norm in New Zealand. Connexa aims to change that, by encouraging co-location in the market. That includes training its workforce to think co-location first, and educating anchor tenants and additional tower tenants on how the model works.

“

We're benefiting from our clients' commitment to roughly 50% growth in site density over the next decade. By having that level of forward commitment from the mobile network operators, we're able to unlock supply-chain efficiencies, adopt more modular and standardized deployment methods, and build sites in a more efficient way than what's historically been the case. ”

Rob Berrill, CEO, Connexa

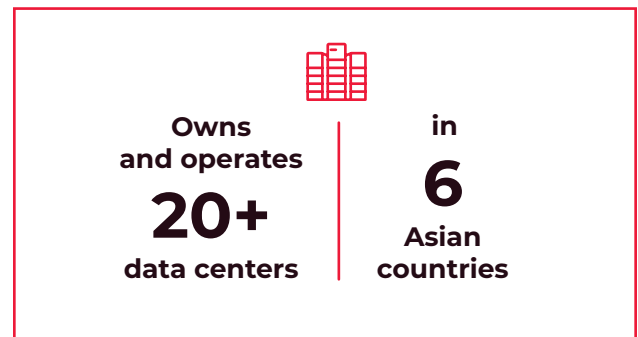


Princeton Digital Group: Offering global hyperscalers deep local expertise in Asia

In 2017, global telecom veteran Rangu Salgame identified a gap in the data center market: the need for a pan-Asian platform that could seamlessly serve hyperscalers with international standards and have the local expertise to deliver and help its clients expand in the region. That led Salgame and a partner to co-found Princeton Digital Group.

The company grew rapidly, building a portfolio of 1 gigawatt in less than seven years, both by acquiring existing data centers and building its own. Ontario Teachers' invested in PDG in late 2020, attracted by its diversified portfolio and strong position in a growing Asian sector. The company now owns 21 data centers in six Asian countries: China, India, Japan, Indonesia, Malaysia and its home base of Singapore.

PDG serves some of the world's biggest cloud companies, and Salgame says execution is critical to the tech giants that are its clients. The company has put a strong focus on hiring, training and retaining the professionals needed to build and run data centers: people with expertise in land acquisition, securing power and more.



Salgame says AI is altering the data center landscape, not least because of the scale and amount of power it will require. Anticipating the change, PDG has for the past two years focused on building AI-ready data center campuses to accommodate the expected surge in demand. Three notable projects are in Mumbai, Tokyo and Johor, Malaysia, which is right across a narrow strait from Singapore. Together, the three campuses will have capacity of more than 400 megawatts.



Sourcing enough power for current and future demand—in a sustainable manner—is a challenge for the whole data center sector. Salgame says PDG has set a target of getting all its power from renewable sources by 2030. To get there, it has procured renewable power sourced from biomass in Indonesia and is buying solar power for its data centers in India. It also prioritizes sustainable design and construction for new projects, which includes locating data centers near renewable energy supply, incorporating sustainable building materials, adopting new cooling technologies, and implementing water conservation practices.

Integrating green design principles in Tokyo

The US\$1 billion, 96-megawatt Saitama data center campus near Tokyo is PDG's flagship campus in Japan. The project underscores PDG's view that Japan is a high-priority market for global hyperscalers, and it comes as the country is at the cusp of large-scale digital transformation. The new campus also reflects PDG's focus on the sustainability of its operations. The project includes features like a state-of-the-art air-cooled chiller system and storm water reuse.

“

If I lose sleep, it's on talent.

The execution of these projects is critical to our business success. Our customers are signing long-term contracts with us and relying on us to support mission-critical applications. For those customers, delivery delays and service downtimes aren't options. ”

Rangu Salgame,
Chairman, CEO and co-founder,
Princeton Digital Group

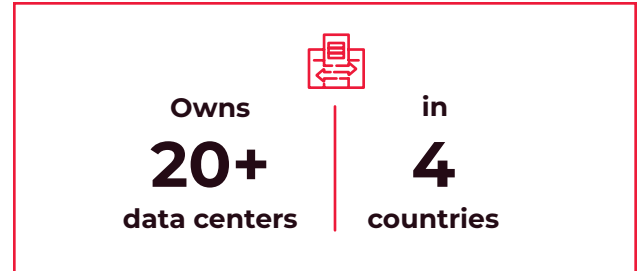


Compass Datacenters: Leveraging offsite construction to help clients expand rapidly

Data centers are sometimes referred to as the central nervous system of the modern economy, and it's clear they will be critical for the foreseeable future. That's why "built to last" is a strategic anchor for Dallas-based Compass Datacenters. Telecom and data industry veteran Chris Crosby founded the company in 2011 with a focus on large, purpose-built data center campuses.

Compass manufactures most of its data center components offsite, an innovative approach that prioritizes efficiency and sustainability. Designing and configuring new data centers from a standard kit-of-parts helps Compass better control the quality and pace of construction while also providing the flexibility its clients need. The result: Compass is able to deliver new data centers quickly into a rapidly growing market, and its clients can scale more easily as their needs change.

Offsite manufacturing enables Compass to significantly reduce construction waste and improve worker safety. It has also given the company an advantage in building a diverse workforce in an industry where attracting talent can be a challenge. Crosby says Compass has been able to attract more women than would have been the case if it relied on traditional construction. In mid-2024, all of its construction managers in the U.S. were women.



The built-to-last philosophy also helps Compass with sustainability decisions. For instance, the company uses both AI and a special carbon-sequestering technology to produce concrete on-site, reducing emissions. It employs only water-free cooling. It has invested in long-lasting low-carbon roofing materials for all its centers and uses hydrotreated vegetable oil instead of diesel fuel to power its generators.

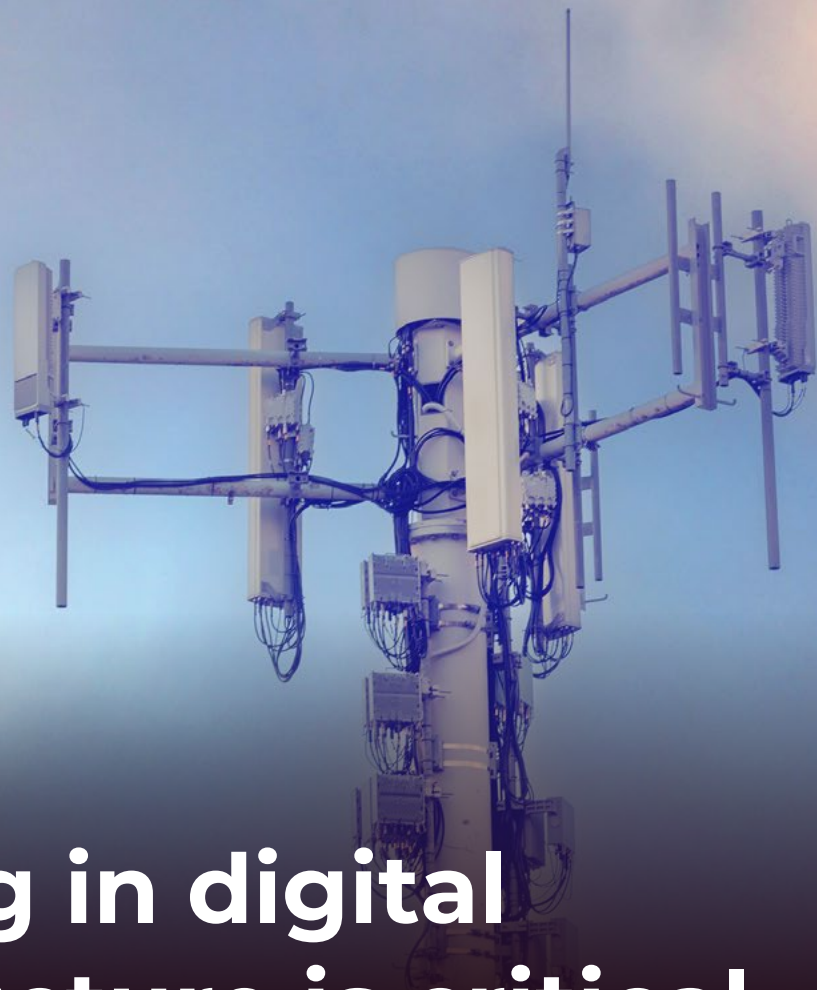
Since it built its first data center in the southern U.S., Compass has grown to more than 20 data center campuses in four countries. Ontario Teachers' first invested in Compass in 2016, attracted to the company's innovative design approach and speed-to-market as well as its focus on single-tenant mega-campuses.

“

The fact of the matter is the places that have data centers are going to be the economies that thrive. ”

Chris Crosby, founder and CEO, Compass Datacenters





Investing in digital infrastructure is critical.

Because they require significant capital and planning and are operated under multi-year contracts, digital infrastructure assets like cell towers and data centers are well suited to Ontario Teachers' long-term, active investment approach. With demand for digital infrastructure expected to outstrip supply in the coming years, investing in these assets will help us pay pensions and deliver retirement security for our members.

What's more, we believe that, when built and operated with sustainability and resilience in mind, these assets will help unlock economic growth and innovation across countries, with broad benefits to businesses and people.

“

Digital infrastructure presents an attractive investment opportunity, one with a stable and contracted cash flow profile that helps insulate investors from downside risk and also offers significant growth potential. To stand out in a market attracting substantial new capital, we align with companies that have the talent and expertise to capitalize on digital transformation and exponential data growth to create long-term value. ”

Daniel Rossetti, Managing Director, Infrastructure & Natural Resources, Ontario Teachers'

Contact us

Head Office

Toronto

160 Front Street West, Suite 3200
Toronto, Ontario, M5J 0G4
+1-416-228-5900
communications@otpp.com

www.otpp.com
otpp.com/linkedin

International Offices

New York

Ontario Teachers' Pension Plan (USA), LLC
277 Park Ave, 47th Floor
New York, NY 10172
+1-212-888-5799

San Francisco

Ontario Teachers' Pension Plan (USA), LLC
633 Battery Street, Suite 110
San Francisco, CA 94111

Dallas

Ontario Teachers' Pension Plan (USA), LLC
The Texas Capital Bank Building
2000 McKinney Avenue, Suite 1220
Dallas, Texas, 75201

London

Ontario Teachers' Pension Plan (Europe) Limited
10 Portman Square
London, W1H 6AZ
+44-20-7659-4450
contact_london@otpp.com

Ontario Teachers' Pension Plan (Europe) RE Limited
Met Building, 11th Floor
22 Percy Street
London W1T 2BU

Hong Kong

Ontario Teachers' Pension Plan (Asia) Limited
 (20). 制定^{キヨ}離^リ麻^マ欄^{ラン} 綽^{シャク}繩^{ジュウ} 願^{ガン}櫛^シ三^{さん}轂^{コク}椅^キ丙^{ヘイ}峴^{ケン}
 Suites 2801, 2805-2810, Alexandra House
 18 Chater Road, Central
 +852-2230-4500
 inquiry_asia@otpp.com

Singapore

Ontario Teachers' Pension Plan (SEA) Private
Limited
182 Cecil Street
#36-01 Frasers Tower
Singapore 069547
inquiry_asia@otpp.com

Mumbai

**Ontario Teachers' Pension Plan (India) Private
Limited**
6 and 7, 4 North Avenue
Maker Maxity, Bandra Kurla Complex, Bandra (E)
Mumbai 400051
+91-022-6813-3470
inquiry_india@otpp.com

São Paulo

Ontario Teachers' Pension Plan (Brazil) Consultoria
Ltda
Rua Prof. Atílio Innocenti, 165
Vila Nova Conceição
São Paulo, SP 04538-000

This report was published in October 2024 and is only current as of that date. It continues to be made available only for historical information and reference purposes.