BCG

CENTRE FOR
Canada's Future

IN THE BALANCE

Future-proofing Canada's digital infrastructure to unlock benefits for all

DECEMBER 2019

BCG CENTRE FOR Canada's Future

This document was prepared by BCG's Centre for Canada's Future.

This report comes out of our ongoing work on infrastructure, which began with the CanInfra Ideas Contest in 2017. Through that work it became clear to us how critical digital infrastructure and world-leading connectivity are to Canada's digital future. Digital innovation has the potential to offer massive benefits for Canadian citizens, businesses and governments.

We have grown concerned that the policy dialogue in Canada may be trending towards an over-emphasis on short-term affordability goals, out of balance with the long-term imperatives of network quality and digital innovation. We prepared this report to dive deeper into the topic and examine Canada's current trajectory, the experience of other countries and the potential paths forward for Canada.

We hope our analysis proves useful for private and public sector decision makers as they navigate these challenging issues. This document represents the opinion of BCG and its Centre for Canada's Future and was 100% funded by BCG in Canada.

About BCG's Centre for Canada's Future: BCG established the Centre in 2017 to contribute to the national dialogue, and spark action on key economic issues. Its mission is to be a catalyst for moving Canada forward, leveraging BCG's capabilities in collaboration with leaders from across the private and public sectors.

THE FUTURE OF CANADA'S DIGITAL INFRASTRUCTURE IN THE BALANCE?

A calibrated approach is needed to balance affordability with the significant investment required to unlock the benefits of the digital revolution for citizens, businesses and governments.

Digital infrastructure is a foundational enabler for Canada's future, with the potential to drive ~$200B in annual GDP by 2040

It is key to unlocking business productivity (e.g., through Industry 4.0) and innovation and to generating social and economic benefits for Canada

Regulators are the catalyst for infrastructure development. They seek to foster investment and innovation, but need to balance the other key policy objectives of affordability, quality and availability

Canadian regulators have historically succeeded at incentivizing private investments, leading to strong infrastructure quality and availability

Affordability has been at the centre of a heated public debate, overshadowing the importance of investment on the cusp of 5G deployment

A singular focus on affordability risks driving disruptive policy interventions—cautionary tales from global peers underline the risk to investments and consumer outcomes

Some of the boldest policy interventions by foreign regulators delivered quick affordability wins but had the biggest long-term negative impacts on investment and quality

The risk of unintended consequences is high in the complex digital infrastructure eco-system. Nuances in policy parameters and existing environment can make it difficult to predict the outcome of bold regulatory interventions

Canada's policy makers must address the legitimate goal of consumer affordability without hampering Canada's competitiveness and its digital future—a sharp hit to industry revenue will flow through into a private investment gap that is unlikely to be filled by public funding

Win-win policy design principles can help move Canada forward:

- Unlocking the digital future's benefits is a bigger prize for Canada than low prices
- There is no 'perfect' regulatory regime: but carefully measured moves can reduce risk while allowing policy to adjust
- Regulators should 'do no harm' and move cautiously, applying win-win levers that tackle affordability

THE DIGITAL FUTURE

We often pay more attention to the digital services we use rather than the digital infrastructure they run on. Uber and Spotify are front of mind, not the 4G network that enables them.

Canada stands at the cusp of a new digital revolution. As key stakeholders in the future of the 5G digital economy, Canadians will enjoy the benefits of remote healthcare, autonomous vehicles and virtual reality experiences. Businesses will unlock massive productivity improvements from Industry 4.0. Canada's innovators will develop new solutions and sell them globally.

It's hard to size the benefits exactly. But if this revolution, enabled by digital infrastructure, causes a step change in economic growth like electricity or computers, the impact could be $200 billion or more per year by 2040. That's ~$4,500 per Canadian.

However, making that digital future a reality across Canada will take billions in investment in our wireless networks and wireline broadband systems. This investment won't happen automatically. It will require a steady policy environment and sustained incentives for private investment. We're concerned that headwinds to investment are looming and may throw Canada off course.

DIGITAL INFRASTRUCTURE IS FOUNDATIONAL TO CANADA'S DIGITAL ECONOMY AND ITS FUTURE COMPETITIVENESS, WITH SIGNIFICANT VALUE TO REALIZE OVER NEXT 20 YEARS

Digital infrastructure is a critical enabler for the future, with significant value to unlock for Canada

Personal digital revolution
- Unprecedented consumer innovation across urban & rural divide
- Social benefits through increased quality of life & safety

Industry 4.0
- Massive productivity unlock all across industry sectors (e.g., robotics, IoT, big data, AR)

Innovation ecosystems
- IP, profits, & jobs from globally competitive innovator firms
- Capabilities for future research

~$200B+

GDP per year by 2040 from accelerated digital economy for businesses and consumers

Significant opportunities as a result…

Lower costs for consumers (e.g., per month, per GB)

Expanded **national coverage** for businesses and consumers

Narrowing of the labour productivity gap for Canada

Enablement of **innovative digital businesses**

Improved network speed, latency, and device connectivity

… but several challenges looming on the horizon

Regulatory risk & uncertainty is of increased concern as it may impair ROIs

5G spectrum access slower, more expensive than some peers

Infrastructure investment ramp-up required to rollout next-gen tech (e.g., 5G, fibre)

Populist backlash against the telecom industry

Lack of shared vision among stakeholders (e.g., cities)

Source: Analysis of an Australian government report examining 19 studies to estimate productivity boosts from historical innovation events

A BALANCING ACT

There is no perfect regulatory regime. Countries need to adjust policy tradeoffs over time based on their current state, future needs and technology trends.

One of the key tradeoffs is between affordability—which is immediate, emotional and highly visible—and other factors such as quality, availability, investment, and innovation, factors that have significant long-term social and economic impacts, but are less visible, more gradual, and harder to measure.

When the policy balance skews too heavily toward short-term measures, other benefits suffer, but it can be years before the negative effects are noticeable, and by then it can be difficult to undo the damage.

Quality & availability

Canada's digital infrastructure is relatively strong compared to other advanced countries. It tends to perform well on speed, coverage, and other indicators, however, there is still room for improvement. This is no small accomplishment for a country that is larger and less densely populated than most.

Investment & innovation

Canadian providers have been investing significantly, driven by a stable regulatory environment. Investment per capita in wireless and wireline networks was almost two-thirds higher than the OECD average over 2005–2015. Since then, mobile investment per capita has continued to outpace leading economies such as Germany, France, Korea, and the UK, although it was lower than the US and Australia.

One result of this is that Canada saw more rapid deployment of 4G than many European countries. However, a gap appears to be emerging on today's 5G deployment.

Affordability & competition

As the recent election campaign showed, affordability is a hot topic in Canada. Pricing is a challenge to compare globally given differences in network quality, coverage, product bundling and other factors. Some studies have found Canada's prices to be high, while others find prices to be reasonable when adjusted for these factors. The subject is complicated by rapidly changing technology and pricing. Prices per unit may fall steadily year-to-year, but as customers use more data, monthly bills may not.

Policy makers also need to take the absolute burden into account. How should they weigh a reduction of, say, $10 per month in an individual's bill against a subsequent pullback in industry investment when considering interventions? The answer is not obvious.

THERE IS NO “PERFECT” REGULATORY REGIME:

Affordability is a legitimate policy objective to ensure that ‘good’ infrastructure is not only widely available but also economically accessible.

Regulators must constantly adjust tradeoffs across key policy objectives while considering current state, technology trends, and infrastructure needs.

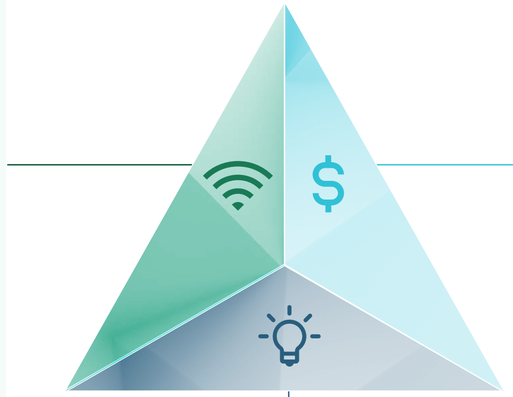
Quality & availability

Facilitate the deployment and timely availability of services across the country, including rural areas

Policy levers

- Supporting rural coverage to bridge the digital divide
- Setting deployment obligations for new tech
- Acting as the source of truth for key metrics

Long-term, gradual, hard-to-measure but with huge social and economic impact



Investment & innovation

Foster innovation and evolution of networks through supporting investments and rapid deployment of required infrastructure

Policy levers

- Optimizing spectrum management policies
- Co-investing in infrastructure with the private sector
- Adopting tax policies that support further investment
- Streamlining local laws and processes for infrastructure rollout

Affordability & competition

Benefit consumers and businesses from greater choice and affordability through sustained competition

Policy levers

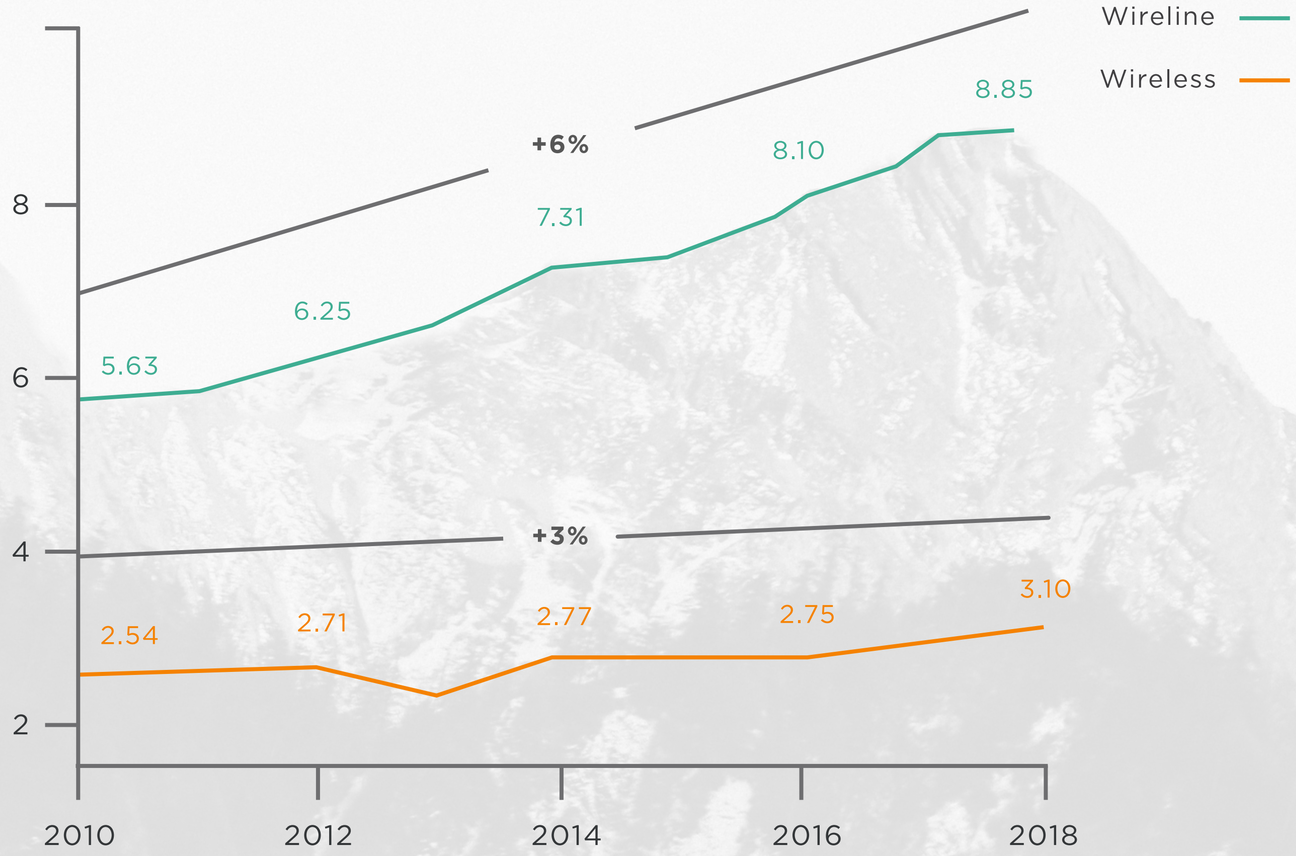
- Providing subsidies for lower income segments
- Regulating competition and market entry
- Defining wholesale frameworks
- Setting rules for foreign competition

Highly visible, immediate and emotional wallet issue

A STABLE REGULATORY ENVIRONMENT HAS HISTORICALLY CONTRIBUTED TO HIGHER PRIVATE INVESTMENT IN CANADA'S DIGITAL INFRASTRUCTURE RELATIVE TO GLOBAL PEERS

Canadian telcos have increased investments over the last decade…

CapEx by major Canadian telcos (CAD $B)



…with Canada outpacing global peers on infrastructure investment

Telecom investment per capita[1]

$255 vs. $156 OECD average

Funds re-invested[1] **per $1 of revenue…**

23¢ vs. 15¢ OECD average

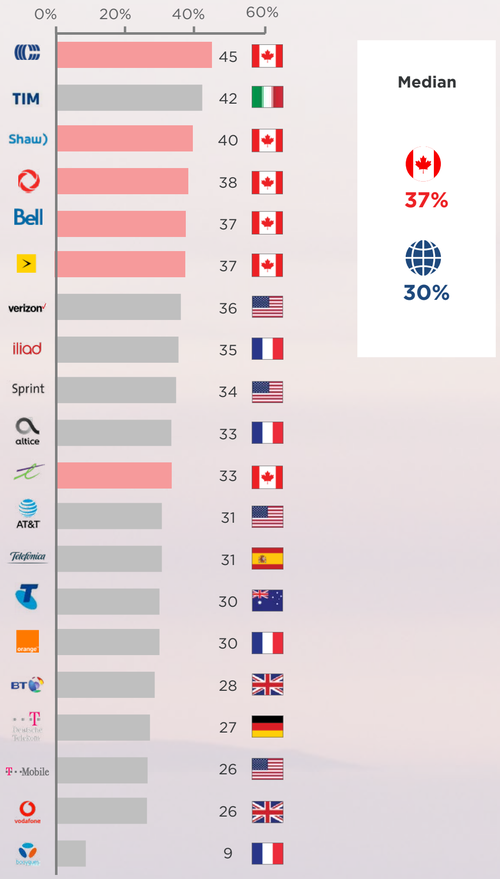
Canada ranked **1st** in G7 on both investment metrics

1. Average of 2005 to 2015 figures in USD. Source: OECD; World Bank; CRTC; Company reports; BCG analysis

RETURN ON CAPITAL FOR CANADIAN TELCOS IS IN LINE WITH GLOBAL PEERS AS THEIR HIGHER MARGINS ARE BALANCED WITH HIGHER CAPITAL INVESTMENTS

Canadian telcos have higher EBITDA margins than many global peers…

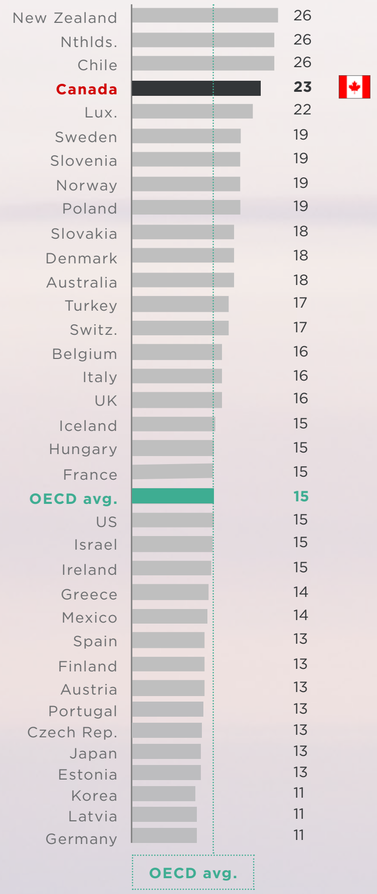
Avg. EBITDA (% of Revenue)
(Fiscal Year 2016–2018)



Median
37%
30%

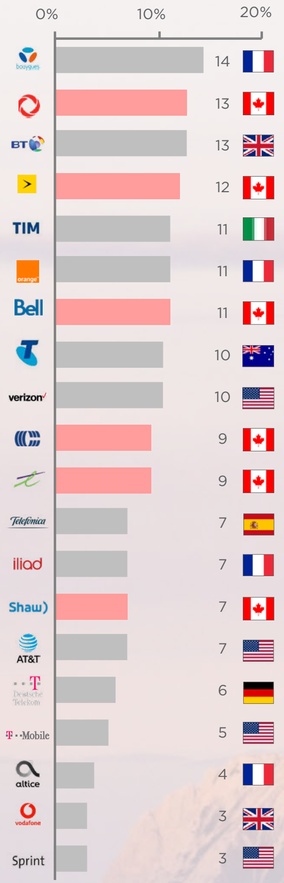
…but also make higher capital investments than other countries…

CapEx intensity
(% avg. 2005–15)[1]



…which is reflected in the returns they are able to generate

Average ROCE[2]
(Fiscal Year 2016–2018)



Median
10%
7%

1. OECD definition of telecom infrastructure investment includes expenditure associated with acquiring the ownership of property and plant, but excludes expenditures on R&D and spectrum; Telecom investment & revenue data unavailable for certain years in the following countries: Sweden (2005), Israel (2005-08), Latvia (2005-11)
2. Return on capital employed (ROCE) has been calculated as NOPAT divided by capital employed; Source: Capital IQ; OECD; United Nations; BCG analysis

PRIVATE INVESTMENT HAS DRIVEN STRONG QUALITY AND AVAILABILITY IN MOBILE AND WIRELINE NETWORKS IN CANADA RELATIVE TO OTHER PEER COUNTRIES

Canadians have experienced top-quartile rankings in **mobile network** speed and availability…

Speed

3RD fastest mobile download speed globally[1]

10TH fastest mobile upload speed globally[1]

12TH fastest mobile download speed globally for rural Canada, if it were country

Availability

88% 4G availability[2]

Canada ranked ahead of:

Coverage

99% of Canadians were covered by LTE networks as of 2017

…and strong penetration of higher speed **fixed broadband**

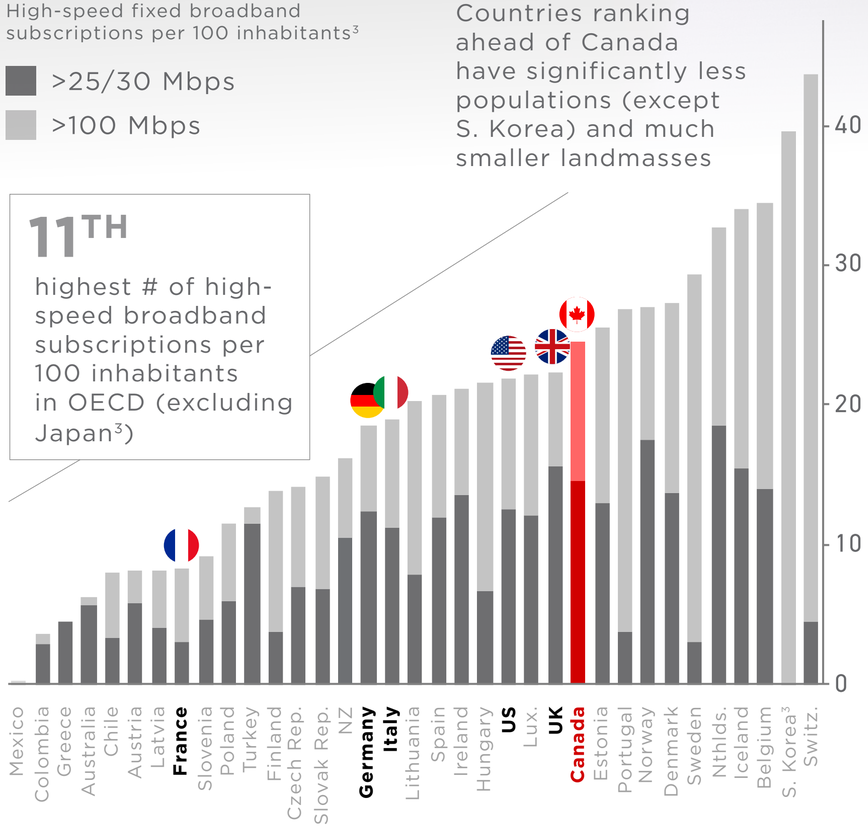
High-speed fixed broadband subscriptions per 100 inhabitants[3]

>25/30 Mbps

>100 Mbps

Countries ranking ahead of Canada have significantly less populations (except S. Korea) and much smaller landmasses

11TH highest # of high-speed broadband subscriptions per 100 inhabitants in OECD (excluding Japan[3])

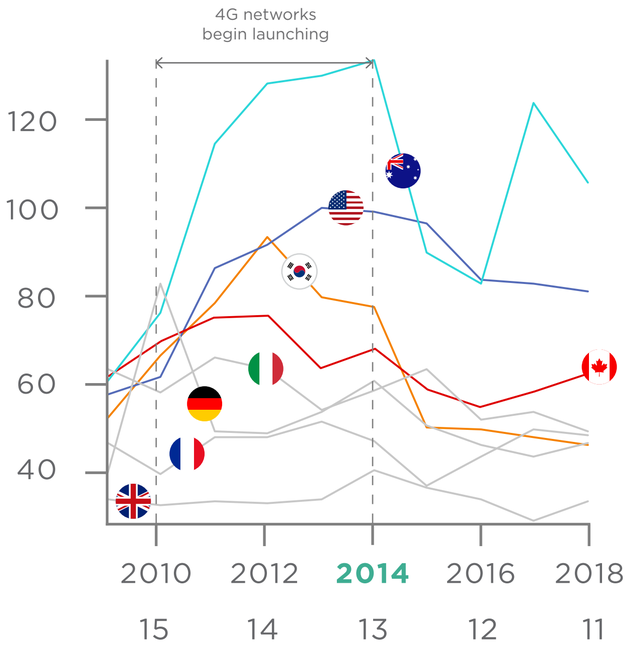


1. Measured as average speeds across an operator's 3G & 4G networks
2. Measured as time users with 4G device have a 4G connection
3. Breakdown of speed tiers unavailable for S. Korea with ~96% of subscriptions >50Mbps in 2016; Japan excluded from ranking given data unavailability from OECD

Note: Speed and Availability metrics (May 2019), fixed broadband (Dec 2018)
Source: OECD; World Bank; 2018 Canada Speedtest Market Snapshot; OpenSignal; CRTC; BCG analysis

CANADA WAS AT THE FOREFRONT OF 4G DEPLOYMENT AS A RESULT OF HIGHER INVESTMENT, BUT IS ALREADY LAGGING ON 5G ROLLOUT

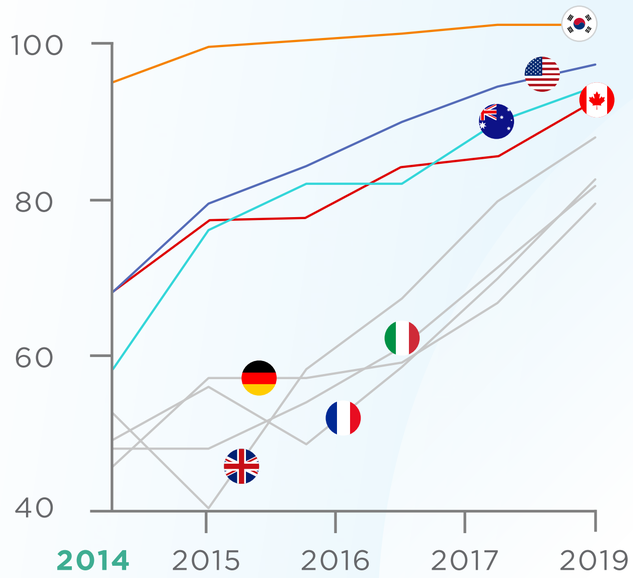
Mobile CapEx per capita ($US)



Canada CapEx intensity (%)

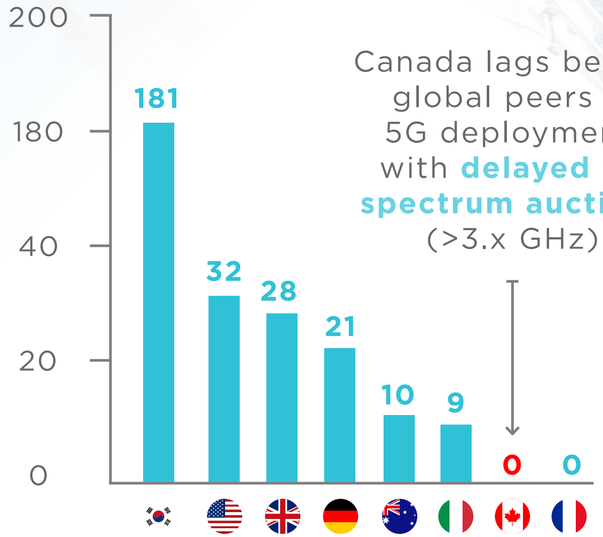
>

4G availability[1] (%)



5G networks available[2] (#)

(for commercial use)



Canada lags behind global peers in 5G deployment, with **delayed 5G spectrum auctions** (>3.x GHz)

$4B additional CapEx over the next five years is likely required for 5G (radio) buildout in Canada, excluding backhaul, core networks, and spectrum[3]

1. Availability is measured as proportion of time users with a 4G device have a 4G connection
2. Data from Nov 2019; a network deployment is defined as a carrier's 5G network in a city with 5G devices available for commercial use
3. Directional estimate on cost of Radio Access Network rollout

Source: CRTC, Telegeography, Opensignal, Speedtest Ookla 5G Map, UN, OECD, Company reports, BCG analysis

AFFORDABILITY HAS BEEN AT THE CENTRE OF A HEATED PUBLIC DEBATE FOR YEARS

A consensus on the affordability question has been elusive due to the inherent complexity of the topic…

- Affordability—regardless of analytical comparisons—is a highly visible and emotional wallet issue for consumers
- Canada has unique geographic and population distribution attributes that complicate global comparisons
- There are many ways to measure affordability, resulting in different points of views on the debate
- Telecom services are highly dynamic and fast evolving products, making like-to-like value assessment difficult

NUANCES OF THE DEBATE HAVE DRIVEN OPPOSING VIEWS ON AFFORDABILITY

Perspective — **Canada's prices should be cheaper**

Argument — Prices paid by Canadian consumers are high relative to other G7 countries and Australia

Approach — "Baskets" of service usage tiers are defined, priced, and compared to baskets in other countries, without accounting for any other factors (e.g., demand, quality, etc.)

> "Average Canadian monthly rate… is well above the average for the group of surveyed foreign jurisdictions
>
> **Wall Communications Inc.**

VERSUS

Perspective — **Canada's prices are fair**

Argument — Prices paid by Canadian consumer are reasonable once you consider value for money and factors such as geographic size, Canada's economics, weather conditions etc.

Approach — Statistical regression analysis to compare plans in Canada with global peers using multiple factors (not only plan characteristics and pricing)

> "Prices for communications services in Canada are cheaper than the prices foreign providers would charge for the same plans
>
> **NERA Economic Consulting**

IN REALITY, THE PRODUCT BOUGHT BY CONSUMERS IS CONTINUOUSLY IMPROVING, DRIVEN BY DEMAND, TECH ADVANCEMENTS, AND INFRASTRUCTURE INVESTMENTS

The same "product" is actually improving…

Global Mobile Wireless Speeds[1] (2018–19)

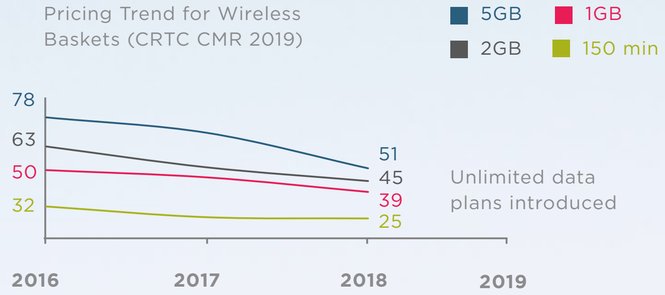
9th → 3rd

Average Fixed Broadband Speed (2017–18)

19th → 15th

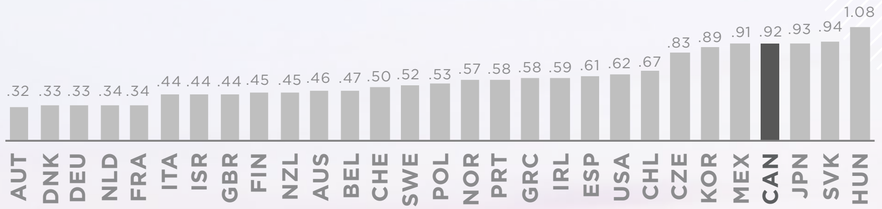
…and average prices for the same product have continued to fall

Pricing Trend for Wireless Baskets (CRTC CMR 2019)



However, room for improvement on spend as portion of income compared to peers, while consumption levels are going up

Estimate for 2018 mobile Average Revenue Per User (ARPU) as portion of average monthly wage (%)



> "While average monthly price for mobile wireless service has dropped, Canadians' appetite for the latest devices, more data and faster broadband speeds are contributing to a general increase in their communication bills
>
> **CRTC**

1. Selected peer countries include all OECD except Iceland, Slovenia, Latvia, Lithuania, Luxembourg, Turkey, & Estonia
Source: CRTC and public submissions; ISED; OECD; Speedtest; Cable.co.uk; OVUM; BCG analysis

AFFORDABILITY IS A HOT BUTTON TOPIC BROADLY ACROSS CANADA, WHICH HAS BEEN COVERED CLOSELY BY THE MEDIA, CATALYZING A POLICY RESPONSE

Mobile bills have been at the centre of a debate around affordability, fueling populist proposals

> Why Canadian cell phone bills are among the most expensive on the planet
>
> NATIONAL POST

> Sick of cell phone contracts? The B.C. government wants to hear from you
>
> CBC

> Tired of high cell phone and internet bills? This election is full of promise(s)
>
> Global NEWS

30%

...trust in telecom companies, ahead of pharma & social media companies but behind hospitals, food retailers, airlines and banks
PROOF CanTrust Index

90%

...of Canadians surveyed were frustrated that their internet fees are higher than in other countries
Survey by Distributel (Broadband attacker)

Political promises

> More affordable cell phone bills
>
> Lower cellular fees and better coverage
>
> We need to disrupt the telecom monopoly

...with a wide range of policy interventions discussed or in the making for both wireline & wireless

Wireless

- Increasing competition from MVNO entry
- New allocation rules for Spectrum auction
- Lower monthly prices (CRTC intervention?)

Wireline

- Significantly lower wholesale Internet rates (final rates ruled by CRTC on Aug 15th ~40% lower vs. interim rates)
- Disaggregated rates offering access to FTTH and opportunities to selectively invest in infrastructure

Source: Media; party platforms; BCG analysis

Note: CRTC's wireless review is underway, with focus on retail market competition, MVNO access, and barriers to infrastructure deployment

GLOBAL LEARNINGS

We looked at over a dozen case studies of countries intervening to improve affordability for wireless and/or wireline customers

Each country's context is unique: different starting points, objectives, and industry and regulatory structures

However, three broad themes emerged from our case studies

1

Short-term affordability gains often translate into long-term losses

2

Actions are quick, but corrections can take years

3

'The devil is in the details'—many nuances in policy parameters can drive different impacts

GLOBAL LEARNINGS REVEAL COMPLEXITY OF BALANCING AFFORDABILITY, COMPETITION, AND CONSUMER OUTCOMES THROUGH POLICY TOOLS

1 SHORT-TERM AFFORDABILITY GAINS OFTEN TRANSLATE INTO LONG-TERM LOSSES

Regulators can achieve short-term affordability wins (e.g., by fostering services-based over facilities-based competition), but often at the detriment of infrastructure investment levels and thus consumer outcomes in the medium to long-term

Illustrative examples

2009

- MVNOs were mandated in 2009 as a measure to reduce consumer prices
- Rules on spectrum cost recovery and timing limits incentivized MVNOs to quickly maximize market share
- Intense competition for market share drove plan prices down by 60–80% within 2 years
- Lower revenues for incumbents led to declining private CapEx levels for next 7 years (9% annualized)
- Ten years later, Israel lags most OECD countries in telecom infrastructure & network quality

2 ACTIONS ARE QUICK, BUT CORRECTIONS CAN TAKE YEARS

Intricate moving parts and long investment and regulatory cycles mean that negative and unintended ramifications can take years to reverse

Illustrative examples

2001

- Regulatory wireline wholesale changes allowed new entrant with low-price offer, reducing industry revenues
- Falling revenues and slowdown in copper build contributed to a CapEx drop that took 16 years to recover
- Government driven actions, such as the 2016 large scale fibre investment efforts, helped push CapEx back to peak levels; resellers with opportunities to use networks contingent on contribution to deployment costs

3 THE DEVIL IS IN THE DETAILS

Nuances in policy parameters and existing environment play a key role in determining future impact of regulatory interventions—similar measures can have different results

Illustrative examples

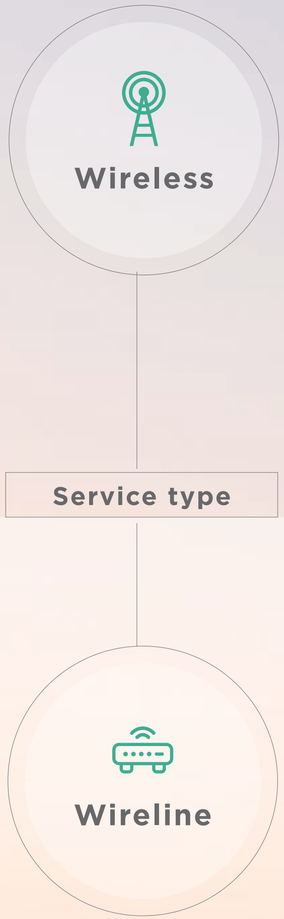
2006

- Regulators allowed MVNOs to compete with MNOs to drive lower prices for consumers, drastically reducing wholesale rates (11x lower in 6 years), and easing the portability process for consumers
- Growth in MVNOs' market share accelerated—reaching 17% in 9 years—and competition intensified as MVNOs engaged in price wars that led to aggressive decline in revenue/subscriber (-8% annualized)
- Private CapEx per capita levels declined at 3% per year, with impact on consumer outcomes; Spain ranked 21st globally in 4G speed (download speeds were half of Korea's)

2010

- MVNO access was regulated in an effort to reduce communications expenses; MNOs were required to actively negotiate with MVNOs to set wholesale rates using "retail minus" methodology
- MVNOs gradually gained market share, reaching 12% after 8 years and broadening options for consumers; higher competition contributed to moderate price decreases, as revenue/subscriber declined by 2% annually
- Private CapEx levels also decreased; however, Korea's wireless network quality remained world class due to strong public funding & structurally favourable infrastructure economics

CASE STUDY DEEP-DIVE: Policy interventions and relevant outcomes



		Trigger	Case studies across the world
	2004	Government allowed MVNOs to enter market on a "retail minus 30%" wholesale structure	MVNOs were not able to offer competitive prices, and thus, had a negligible market participation during first 4 years post MVNO market entry. On top of the strict wholesale rate, MVNOs were not allowed to keep their customers if they chose to switch host networks.
	2008	Government modified regulation, giving more power to MVNOs	New regulations allowed MVNOs to gain traction and create pricing pressures on MNOs, contributing to a 10% annual decline in avg revenue per subscriber. Regulatory changes included: (1) MVNOs were now allowed to keep their customers and switch networks, and (2) MNOs were incentivized (through lower spectrum prices) to welcome MVNOs at attractive margins
	2012	Low-price player entered market disrupting competition	Low-price MNO entered France in 2012 with an offering 30% cheaper than competitors, sending industry revenues per subscribers down at 8% per year until 2018. Decreased profitability impacted CapEx levels and long term consumer outcomes.
	2006	Regulator pushed for MVNOs as a way to reduce prices	Regulator pushed for MVNOs by strongly reducing wholesale rates (11x lower in 6 yrs). Effort was aimed at increasing competition and decreasing prices. MVNOs' growth through low-price offerings (price war) led to a steady decline in industry revenues per subscriber (7% annualized over 6 years), directly impacting investments and consumer outcomes.
	2009	Gov't incentivized aggressive MVNO entry through spectrum policy	In 2009 MVNOs were mandated to reduce consumer prices; 2 yrs later typical plan prices declined by 60–80%. By 2018, annual industry CapEx spend was ~35% lower than 2009, contributing to Israel lagging most OECD countries in telecom infrastructure and network quality.
	2010	Gov't incentivized MNO/MVNO cooperation to reduce prices	Gov't implemented regulations to incentivize MVNO access with the goal of reducing household communication expenses. Gov't established wholesale rates at 31%–44% discount on retail prices. Proliferation of ~30 MVNOs led to more consumer options and limited pricing gains (2% annual decrease in revenue/subscriber).
	2014	Regulator fostered MVNO participation as a post-merger remedy	Regulators fostered MVNO participation with the intent to protect prices post large merger by allowing MVNOs to buy fixed network capacity from largest player. This led one MVNO to capture 14% market share in 5 yrs, creating price pressures on operators, thus decreasing ARPUs by 3% per year.
	2001	Regulator lowered wholesale prices to incentivize competition	Regulator set lower charges for access to Deustche Telecom's DSL network, allowing new players to enter with lower-price offerings. Lower prices directly impacted investment levels, as new resellers were not investing in their own infrastructure.
	2001	Gov't modified wireline regulation to allow resellers in market	Regulatory wholesale changes allowed Free to enter broadband market with low-price offer. Keeping network investments in mind, French regulators first introduced tiered wholesale rate structure incentivizing new players to build their own networks and then agreed in '16 on a scheme to foster large-scale fibre investments, conditioned on reseller's contribution to deployment costs.
	2006	Regulator forced large incumbent to separate is wireline network	Regulator forced BT to separate its wireline network to provide access to rivals. New structure fostered service-based competition over facilities-based, contributing to a rapid decrease in investment levels (60% decrease over 8 years). Current broadband network quality is poor, with average UK speeds at 61 mbps in 2019 (41st globally), versus 116 mbps in Canada (11th globally).
	2009	Gov't launched & managed a national broadband network as a monopoly	NBN Co, a government-owned corporation, was launched in '09 to design, build and operate Australia's wholesale BB access network as a monopoly. NBN's goal was to provide a wholesale open-access network to retail service providers and deliver internet connectivity at 100Mbps to 90% of Australian households via FTTP. NBN resulted in delays, cost over-runs, and lagging broadband penetration & speeds.
	2013	Gov't established regulations to provide access to resellers in effort to increase comp	Government established broadband regulations aimed at fostering competition through increased network access to resellers while incentivizing infrastructure investment by existing operators through aid schemes and selectively applying wholesale mandates on region-by-region, and speed basis. Spain's fixed network investments have grown at 2% per year since 2013. Broadband speeds rank 15th globally.

Source: Global case studies, BCG analysis

WHAT DOES IT MEAN FOR CANADA?

Digital infrastructure business system is complex

The starting point for policy change is understanding the complexity of today's digital infrastructure business system. Even the simplified version shown in this section highlights the complex interlinkages of core fibre and wireless networks with telecom players, customers, startups, investors, governments and others.

Affordability moves that drastically impact telecom industry revenue will limit private investment in the network, and reduce and delay the digital infrastructure benefits.

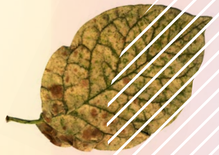
Private investment is $10B+ per year

Private investment in digital infrastructure in Canada is well over $10B per year, an order of magnitude greater than public investment in digital infrastructure programs. It is challenging to predict how the industry would respond to a major revenue hit. But capital market expectations and the experience of other countries that took similar moves suggest a sharp drop in capital expenditure would follow.

On page 20, we show a scenario where a 25% drop in wireless prices and low mandated wireline wholesale rates could lead to a $2B+ annual CapEx gap. A gap of this magnitude is unlikely to be filled by Canada's governments, and would have significant effects on the speed and geographic coverage of 5G and fibre networks. Global examples show that even if the government supplies some additional public funding, that effort is unlikely to be as efficient in building infrastructure as private investors.

Stakeholder impacts: some short-term gain and long-term pain

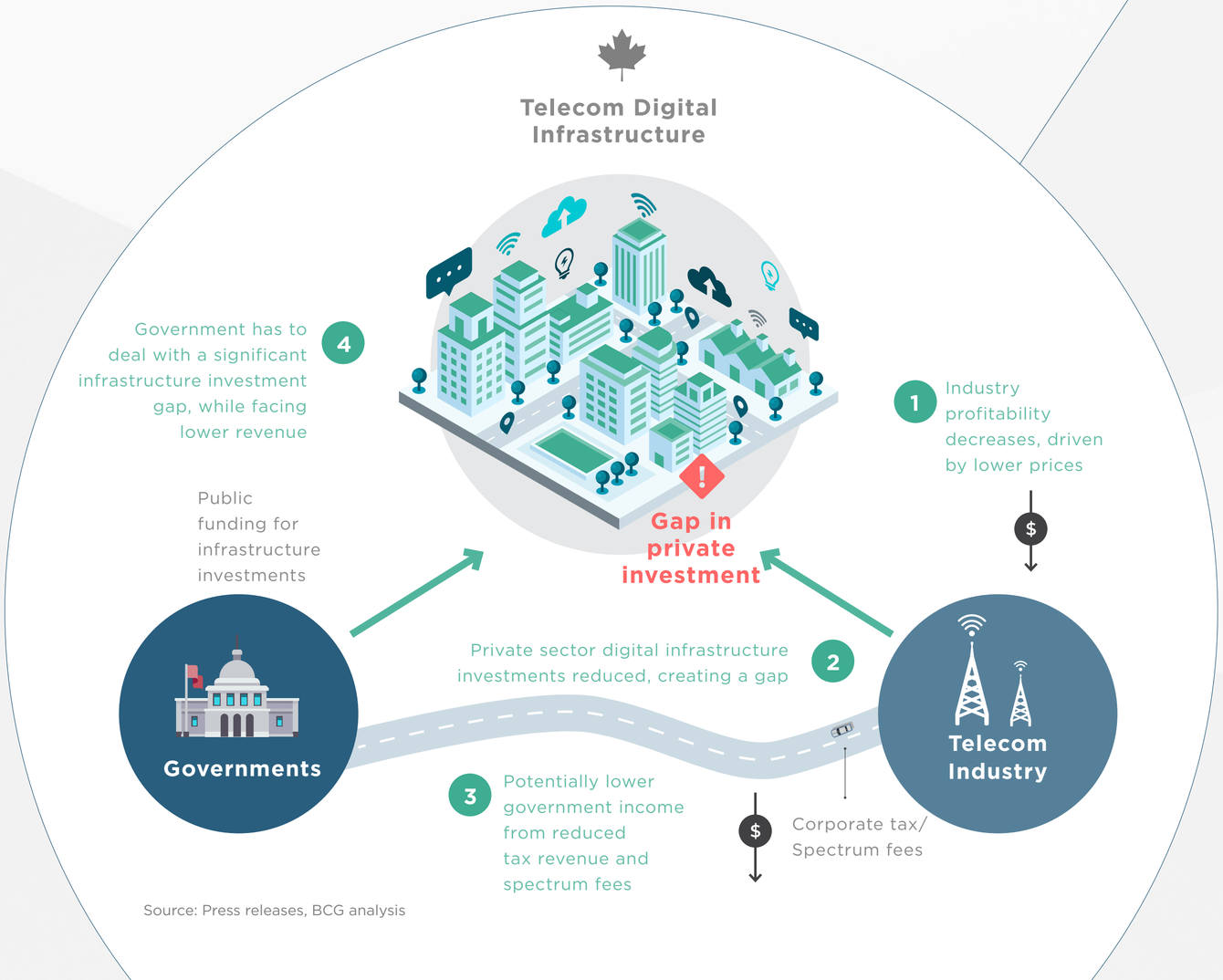
An aggressive affordability agenda would have wide-ranging impacts, some obvious and others less so. The obvious ones include some immediate benefits to the wallets of Canadian consumers and businesses. However, we were struck by the size and pervasiveness of downstream trade-offs. Citizens may end up with slower and less-certain access to world-class connectivity, especially in digital-divide areas where business cases will become even less attractive. Slow adoption of Industry 4.0 would harm business competitiveness. And governments would be affected by slower long-term economic growth, increased demands on infrastructure budgets and counterproductive impacts on their innovation policies.



PLAYING OUT THE PREVIOUS GLOBAL LEARNINGS IN THE CANADIAN CONTEXT, AFFORDABILITY-FOCUSED INTERVENTIONS COULD LOWER PRICES BUT ALSO CREATE A GAP IN PRIVATE INVESTMENT

Capital markets will steer incumbents to respond to revenue and margin pressures…

Illustrative scenario



Source: Press releases, BCG analysis

…with effects already emerging after CRTC's reduction of mandated wireline wholesale rates

Entrants/resellers were fast to **lower prices for their Internet customers**, crediting the regulatory move

But…

Bell **scaled back** their **rural broadband coverage** target by 200k households after originally increasing it due to the federal Accelerated Investment Incentive program in 2018

Other industry players such as Sasktel, Rogers, Cogeco, and Eastlink have also stated their intent to **review future investment** plans, especially in remote and rural regions which typically provide lower financial returns

Videotron **pulled its best offer of '1 gigabit internet' from the retail market** after the same mandated wholesale changes

Furthermore…

Profitability pressures will likely drive incumbents to **accelerate cost cutting measures** (e.g., digitalization, automation, and outsourcing)

THE MATERIAL REDUCTION EXPECTED IN CAPEX SPEND BY INCUMBENTS WILL CREATE A GAP THAT IS DIFFICULT TO FILL BY PUBLIC FUNDING, RIGHT AT THE CUSP OF 5G DEPLOYMENT

Cumulative private investment gap of **~$15B** possible[1] over next 5 years…

…which is **4x** bigger than projected public funding across all levels of government

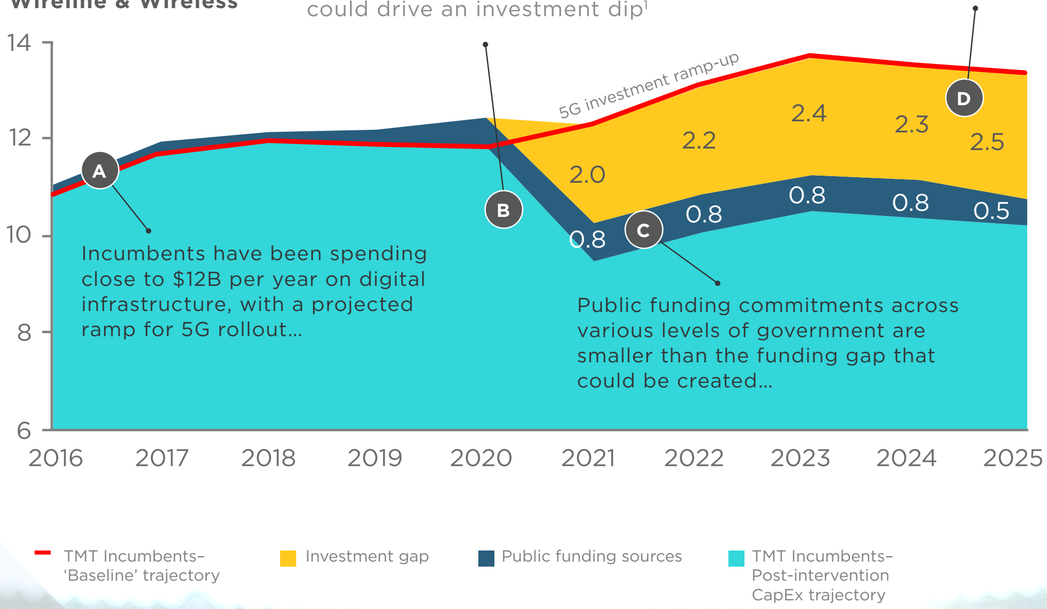
…at a point in time when **significant 5G investment** is needed

…plus industry facing **several billion** in future spectrum costs

Potential impact on CapEx investment in the networks

…but aggressive changes to economic incentives (e.g., wireline wholesale rates, substantial wireless price decreases) could drive an investment dip[1]

…resulting in a significant investment gap that will hamper 5G deployment

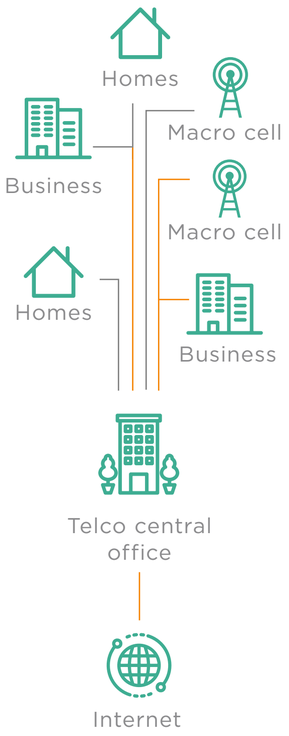


1. Assumes a scenario where the lower mandated wholesale wireline rates by the CRTC are in effect and the wireless revenue for the industry drops by 25% at constant CapEx intensity
Note: Figures above include Bell, Rogers, Telus, Cogeco, Vidéotron, SaskTel, Shaw and Eastlink (wireline only)
Source: Company reports; broker reports; BCG analysis

5G DEPLOYMENT WILL BE HAMPERED BY CAPEX REDUCTIONS FOR EITHER WIRELINE OR WIRELESS GIVEN THE CONVERGENCE OF FIBRE AND MOBILE TECHNOLOGIES

5G deployment in Canada relies on both **dense fibre and significantly more small cells**, powering interconnectivity through high speed, low latency mobility technology

Pre-5G network grid



$Billions

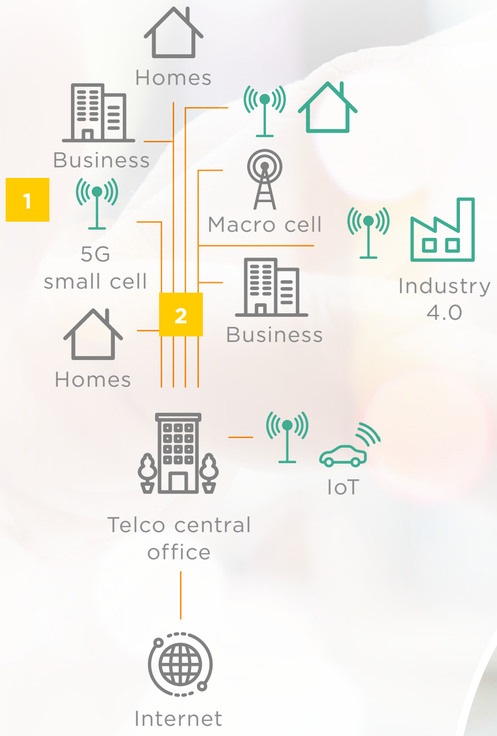
in additional CapEx over the next five years for 5G buildout

Future convergence

1. Small cells will connect to fibre, powering 5G mobility
2. Dense fibre will support backhaul portion of 5G network
3. IoT solutions will rely on speed & mobility of 5G
4. 5G will enable Industry 4.0 (e.g., factory robotics)

Fibre — Copper/Coaxial cable

5G network grid



Wireline policy changes that **reduce the economics of fibre** and negatively impact its buildout will also **hamper the deployment of 5G**

Source: Ciena; Deloitte 'Deep Fibre' reports; The Globe and Mail

THE STAKES ARE HIGHER THAN MONTHLY BILLS AND PRIVATE INVESTMENT LEVELS, WITH LONG TERM IMPACTS DIMINISHING THE POTENTIAL OF CANADA'S DIGITAL FUTURE

Short term wins and losses for stakeholders

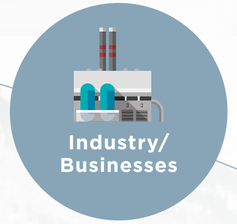
- **Consumers** will see a decrease in their monthly bills for telecom
- **Incumbents** will see their profit pools shrink and mitigate by reducing investment
- **MVNOs and wireline resellers** will benefit from material share gain opportunities
- **Policy makers** may reap short-term political benefits from greater affordability

...but long term downside to the economy

Full benefits from the personal digital revolution will be delayed (remote health, autonomous vehicles, AR/VR experiences, AI services)

More concentrated advancements in cities, widening the digital divide

Intervention from government to fill the funding gap implies increase in taxes or redirection of other investments in the economy



Slower, less extensive 5G rollout limiting productivity gains offered by "Industry 4.0" opportunities (industrial IoT, robotics...)

SMEs suffering another digital divide as they struggle to match private networks rolled out by big corporations

Slower productivity growth and weaker competitiveness versus countries with leading digital infrastructure

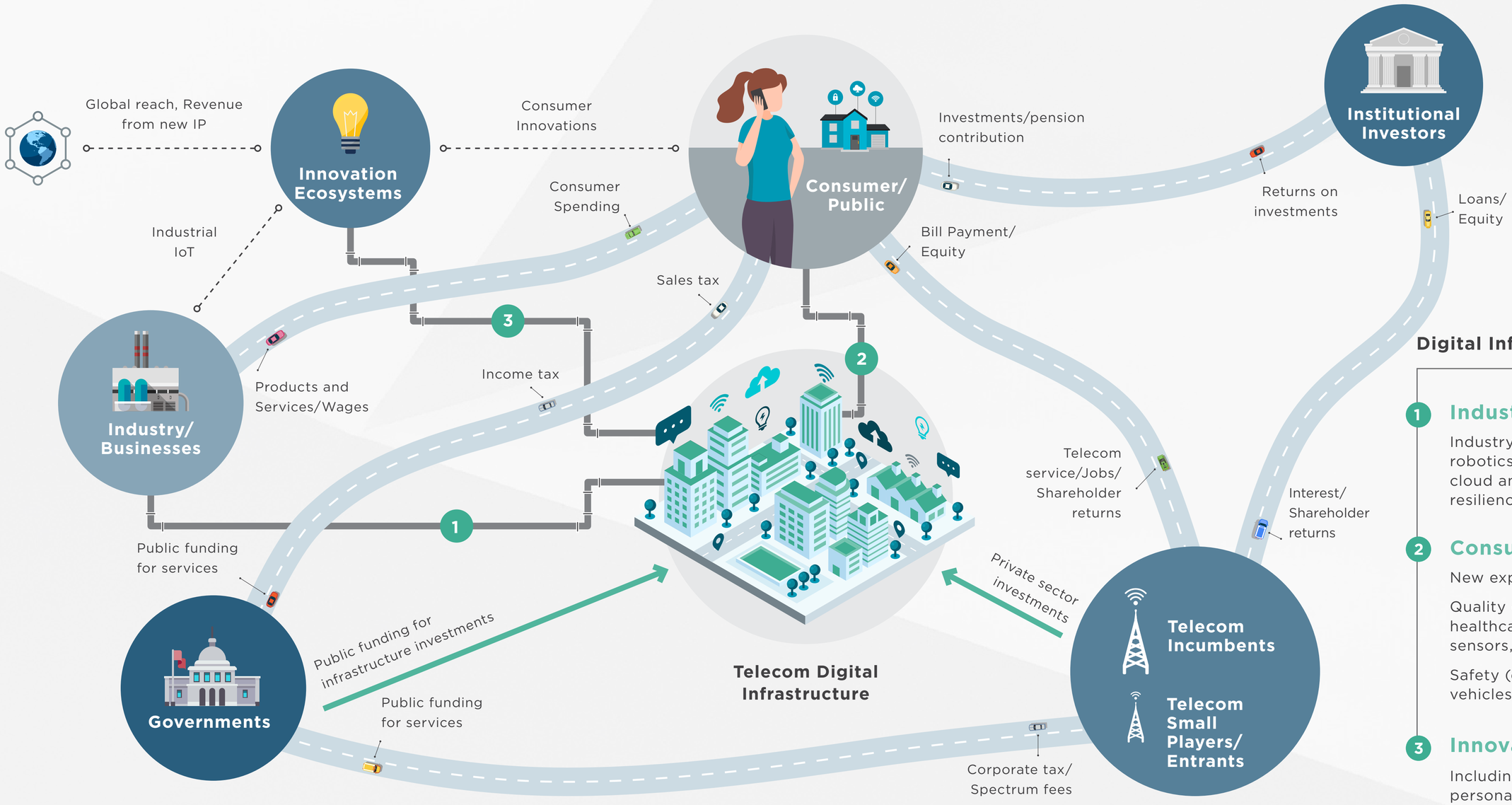
IP and innovation slowing as start-ups and scale-ups have limited capabilities to experiment with future innovations

Lower attractiveness for talent pools and reduced government revenue streams to fund innovations

Slower and less extensive digital infrastructure rollout could generate an opportunity cost of $50–100B[1] to Canada's digital economy by 2040

1. Opportunity cost estimate based on the potential impacts to GDP from 5 and 10 year delays in 5G deployment, resulting in lost boosts to economic growth from new technologies
Source: Statistics Canada; Finance Canada; Australia Productivity Commission; Telegraph; Macrotrends; Company reports; BCG analysis

COMPLEX INTERLINKAGES: POLICY CHANGES SHOULD CONSIDER ALL STAKEHOLDERS AND THE FLOW-THROUGH OF INCENTIVES ACROSS THE ECONOMY



Digital Infrastructure Benefits

1 Industry

Industry 4.0 including robotics and automation, AI, cloud and big data, IoT, cyber resilience, 3D printing

2 Consumer

New experiences (e.g., AR/VR)

Quality of life (e.g., remote healthcare, environmental sensors, AI services)

Safety (e.g., autonomous vehicles, robotics for seniors)

3 Innovation Ecosystems

Including Industry 4.0 and personal digital revolution startup/scaleups

THE FUTURE OF CANADA'S DIGITAL INFRASTRUCTURE IN THE BALANCE

It is easy to get tangled in the details of digital infrastructure policy. Indeed, as we have noted, the details can be extremely important in deciding whether a policy move is a success or triggers painful unintended consequences in such a complex business eco-system.

However, rather than focusing on specific levers, we would like to conclude by sharing the meta-learnings from the global case studies and our work in Canada. You might call these learnings 'design principles' for refreshing the regulation of digital infrastructure in Canada.

The first step is to clarify the objectives of our digital infrastructure. In our view, this should be enabling our digital economy to maximize its long-term growth while continuing to push affordability and breaking down the digital divide.

After that, it is critical to remember that the benefits of digital infrastructure are not just that it is cheap. They also include the productivity unlocks of Industry 4.0, the personal benefits of digital innovations such as remote healthcare and autonomous vehicles, and the jobs and profits Canadian digital innovators will spark.

We also stress the importance of caution in such a complex business environment with long-term investment horizons. Careful, incremental moves enacted with a 'do no harm' mindset are crucial.

Finally, it is important to remember that there are policy moves that can break the affordability-investment trade-off. For example, measures that can make it cheaper and faster to deploy local fibre and radio infrastructure can yield lower prices and better networks.

Canada's current digital infrastructure is a strength. We hope this document contributes to sustaining and improving it, for the long-term benefit of citizens, businesses and governments.

RECALL OUR OVERARCHING OBJECTIVE:

Maximizing GDP for Canada in the long-term by accelerating future growth and prosperity in an increasingly global and digital economy

- Fast-tracking personal digital revolution
- Fostering Industry 4.0
- Boosting an innovation eco-system

…This objective must be achieved while balancing multiple, sometimes conflicting constraints

Affordability & Competition

Making telecom services more affordable for consumers…

Pressing issues: Improving affordability of telecom services for all Canadians, especially those most in need

Quality & Availability

…in a way that ensures high quality and broad accessibility…

Pressing issues: Bridging the digital divide and ensuring Canadians get access to world-class, next-generation products & services

Investment & Innovation

…while fostering investment & enabling widespread innovation

Pressing issues: Leveraging existing and new digital infrastructure to unlock the digital future and narrow Canada's productivity gap

A **carefully calibrated** multi-stakeholder **approach** needed to balance affordability and the massive, sustained investment required to **unlock the benefits of the digital revolution** for citizens, businesses and governments

KEY PRESSING ISSUE: IMPROVING AFFORDABILITY OF TELECOM SERVICES FOR ALL CANADIANS, ESPECIALLY THOSE MOST IN NEED

How can policy makers drive more affordable services for consumers across Canada?

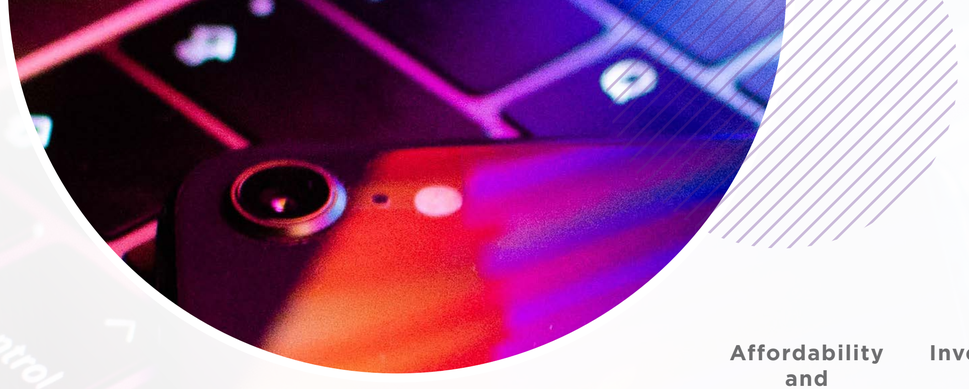
$

Affordability & Competition

	Example policy levers	Affordability and Competition	Investment and Innovation	Quality and Availability
		Short & long term impacts	Long term impacts	
Indirectly, by driving **market forces** to lower prices through **increased competition**	Measured boost of competition, e.g., by evolving wholesale wireline regulations & defining a cautious MVNO entry framework Wireline: e.g., setting rates (incl. disaggregated) that don't disincent incumbent fibre build Wireless: e.g., usage-based rate framework with feasible economics for MNOs & MVNOs, tiered tech access, requiring MVNOs to contribute to host infrastructure development, cap on capacity sold by MNOs under mandated rates, sunset clauses, well defined eligibility for initial entry			
	Aggressive market intervention to intensify competition and enable new entrants, significantly driving down prices and industry revenues Wireline: e.g., extremely low mandated rates that harm the economics of infrastructure deployment Wireless: e.g., low barriers to entry/capital reqs., capacity-based or very low usage-based rates that could trigger price wars, no obligations to invest in infrastructure leading to free riding			
	Revisit foreign ownership restrictions to ease access to capital, promote competition, and enhance pressure to perform on industry players			
Directly, through **policy interventions** in pricing levels	Targeted: Improving affordability for low income segments of the population by expanding targeted low cost programs for broadband and mobile; e.g., basic packages at low price points		•	•
	Broad: Applying price caps on specific wireless services (CRTC has the regulatory power under the Telecommunications Act to regulate prices of services, but the CRTC has forborne from doing so since the early 1990s)			

Positive impact Negative impact

KEY PRESSING ISSUE: BRIDGING THE DIGITAL DIVIDE AND ENSURING CANADIANS GET ACCESS TO WORLD-CLASS, NEXT-GENERATION PRODUCTS & SERVICES



How to make wider-reaching deployment of high quality technology faster and more economical/ cheaper?

Quality & Availability

	Example policy levers	Affordability and Competition	Investment and Innovation	Quality and Availability
		Short & long term impacts	Long term impacts	
Removing barriers for fast infrastructure **deployment** thus, reducing delays	Streamline local regulations / permitting processes to facilitate faster construction & deployment of high density networks required for 5G	•		
	Improve spectrum auction policies to accelerate release and encourage more investment by network operators (vs. maximizing spectrum revenue)			
Improving the economics of infrastructure & tech deployment	Consider organizational changes to reduce fragmentation in funding and investment decision processes e.g., set up a government-led coordinating body that oversees digital infrastructure funding sources (ISED, CIB, etc.) to determine optimal funding mix, assess projects, and make investment decisions	•		
	Utilize innovative funding programs and partnerships to increase attractiveness of infrastructure projects in urban and 'digital divide' areas e.g., foster supercluster-type partnerships across investors, telcos and government, catalyzing diverse models of financing through a combination of grants, low-cost loans, equity, etc.	•		
	Foster greater sharing of infrastructure to optimize capital spend, accelerating next-gen rollouts and widening its geographic reach e.g., encourage network sharing agreements, encourage 'neutral host' structures in marginal spaces, consider Tower Co. structures			

Positive impact Negative impact

KEY PRESSING ISSUE:
LEVERAGING EXISTING AND NEW DIGITAL INFRASTRUCTURE TO UNLOCK THE DIGITAL FUTURE AND NARROW CANADA'S PRODUCTIVITY GAP

How to leverage digital infrastructure to foster innovation ecosystems and close Canada's productivity gap?

Investment & Innovation

Example policy levers	Affordability and Competition	Investment and Innovation	Quality and Availability
	Short & long term impacts	Long term impacts	
Encouraging collaborative **experimentation & usage** of digital **infrastructure by** Canadian **innovators**			
Enable and support world-class testing/innovation hubs to facilitate experimentation in new 5G/IoT technologies e.g., ENCQOR 5G— 'Evolution of Networked Services through a Corridor in Québec and Ontario for Research and Innovation', CENGN (Centre of Excellence in Next-Gen Networks), Rogers/UBC partnering to build 5G hub			
Boost digital innovation by offering companies targeted tax incentives in specific geographies e.g., provide accelerated capital cost allowance (CCA) for digital infrastructure investments in 'digital divide' geographies			
Allow access to more spectrum, including at local levels, by private and public entities to encourage experimentation e.g., creative and dynamic use of spectrum such as Citizens Broadband Radio Service in the US, licensing private use of spectrum by enterprises			
Boosting commercial **viability** and **growth of** Canadian **innovation** using digital infrastructure			
Prioritize access to and earmark gov't procurement budget for growing Canadian tech companies focused on industry 4.0 apps, IoT, and/or 5G			
Enhance targeted government investment funds that focus on 5G/IoT startups e.g., focusing part of the Strategic Innovation Fund (or similar provincial programs) on scaling up companies working on next generation connectivity			

Positive impact Negative impact

CONCLUDING THOUGHTS…

The global case studies and our experience in Canada suggest some higher-level policy design principles that are critical as Canada moves forward

1

The prize is not just low prices

Unlocking benefits of the digital future is a bigger prize for Canada in the long run

2

There is no ‘perfect’ regulatory regime for this complex business system

Measured, small moves vs. big ones give room to calibrate and adjust for tradeoffs

3

Therefore, ‘do no harm’ and move cautiously

Very long investment cycle means that bad policy choices can take years to undo

4

Looking ahead, it is critical to prioritize win-win levers in policy making

Still tackle affordability with fewer long-term risks to digital economy

Canada has done very well on digital infrastructure as demonstrated by its strong network quality and availability—now is not the time to launch regulation that would hamper the required private investments right on the cusp of the 5G era

More **open dialogue** and collaboration between the public and private spheres needed to realize the benefits of Canada’s digital future

ABOUT BCG'S CENTRE FOR CANADA'S FUTURE

BCG established the Centre for Canada's Future in 2017 to contribute to the national dialogue, and spark action on key economic issues. The Centre's mission is to be a catalyst for moving Canada forward, leveraging BCG's capabilities in collaboration with Canadian leaders from across the private and public sectors

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Director, BCG Centre for Canada's Future

More on this topic from BCG

Click here to find out more about the role that digital innovation enabled by digital infrastructure can play in **Winning the '20s**, a series of BCG publications on how businesses can thrive in our rapidly changing global competitive environment.

You can also **click here** to read BCG's latest insights in telecommunications.

BCG is partnering with **GSMA** to study the linkages between future growth in the connectivity industry and the broader societal impact across the globe.

Acknowledgments

Thank you for the significant contributions from Diego Sanchez, Josh Beattie, Antoine Pidoux, Matthew Su, Ilana Hosios, Anguel Dimov, and other BCG staff.

We would also like to thank BCG's global experts, the Marketing team, Ian Kleinman and the Design team, and the thought partners from the public and private sectors we interviewed for this study.

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