The 5G impact on GDP, Energy Consumption, Greenhouse gas and People's Happiness

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Summary

1. 5G Impact on GDP

2. 5G Impact on Energy Consumption and carbon/greenhouse gas footprint

3. 5G Impact on Canadian Quality of Life

1. 5G Impact on GDP

5G IN CANADA: 5G and Related Technologies Could Deliver **16%**, or **$120 Billion**, of Canada's GDP Gr

GDP Impact Based on the **Input-Output analysis**

8 sectors involved in the Canadas GDP impact in our project report

- **Investment (Government and Private Sectors)**
- **Labour Market**
- **Manufacturing**
- **IoT (Autonomous Vehicles, etc.)**

- **Rural Area (Agriculture)**
- **Health Care (Remote Diagnosis)**
- **Entertainment Expense**
- **Retail (purchase of electronic products)**

1. 5G Impact on GDP

Investment in 5G

Canada **public sector spending weighed 21.7%** approximately for the total Canadian GDP in 2021.

An estimation says that **$28 billion investment** will spend specifically in 5G network infrastructure for carriers in Canada **from 2020 to 2026**.

Investment from public and private sectors on 5G network creates direct contributions on GDP increase

Contribution of 5G to Canadian Economy

$40B GDP

Incremental GDP Contribution from 5G

250K Jobs

Sustained Job Creation Due to 5G
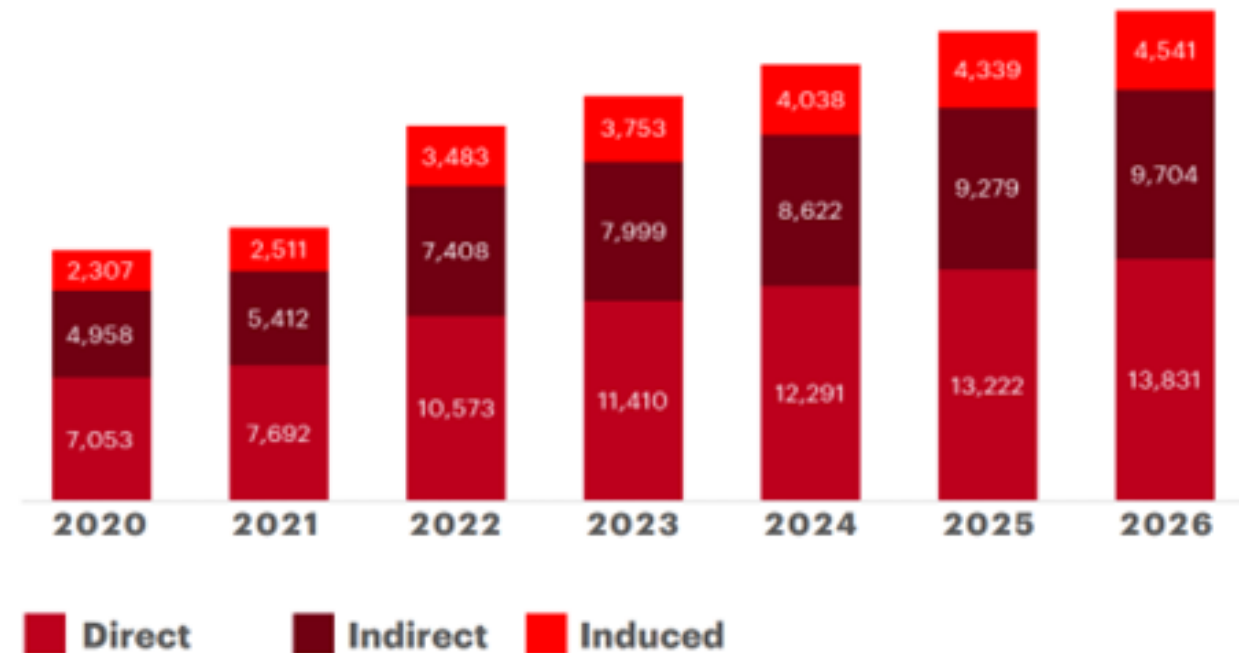
$26B Invested

Capital Investment by Carriers from 2020 to 2026

Labour Market

In Canada, the **education sector** accounts for approximately **6%** of total Canadian GDP.

a total of **154K** temporary, direct, indirect, and induced **jobs** will be created **between 2020 and 2026**.

	2020	2021	2022	2023	2024	2025	2026
Induced	2,307	2,511	3,483	3,753	4,038	4,339	4,541
Indirect	4,958	5,412	7,408	7,999	8,622	9,279	9,704
Direct	7,053	7,692	10,573	11,410	12,291	13,222	13,831

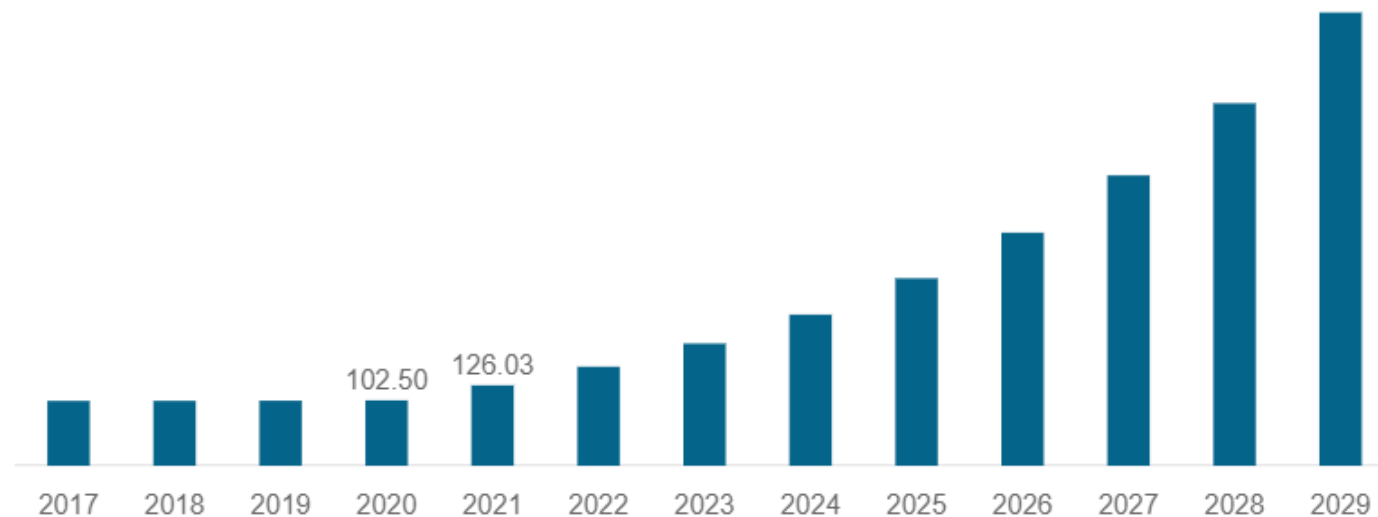■ Direct   ■ Indirect   ■ Induced

1. 5G Impact on GDP
Manufacturing and IoT

- The manufacturing industry accounts for more than **10%** of Canada's total GDP.

- The **manufacturing industry will benefit the most from 5G technology**. 5G networks offer manufacturing companies the ability to build s**mart factories** and **take advantage of technologies such as automation,** artificial **intelligence, etc.**

- Predicting **around $230 billion**)uplift to the nation's economy **over the next 10 years** as **IoT**

North America Internet of Things Market Size, 2018-2029 (USD Billion)

102.50   126.03

2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029

www.fortunebusinessinsights.com

Impact on Agriculture

▶ *7%, or $111.9B, of Canada's GDP coming from the agriculture and agri-food system*

Impact on Rural Area

▶ **By 2026 Govt of Canada wants to achieve 95% Broadband coverage**

Precision Agriculture

Use of sensors for soil, crop, livestock, smart irrigation, connected machinery to increase efficiency

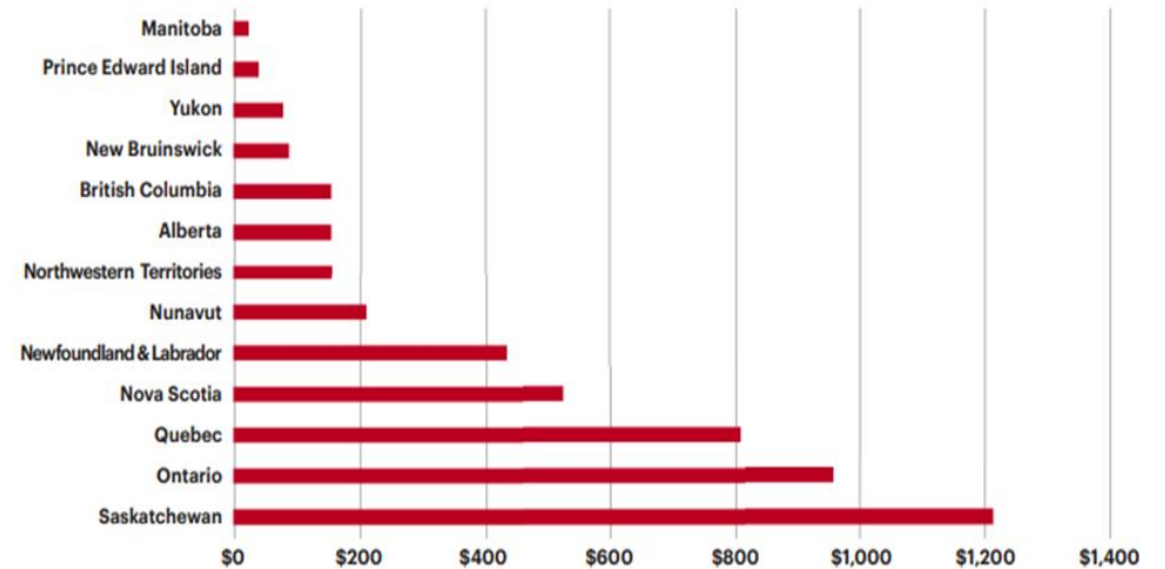**$270M** in annual savings from smart irrigation on blueberry farms

❖ *Using remote sensors can reduce the use of pesticides by 85% Reducing $360M CAD for the canola industry in Saskatchewan*

Expected GDP uplift from achieving government broadband penetration targets in every province/territory

1. 5G Impact on GDP

Impact on Healthcare

▶ On average, each person in Canada spends around $6,839 annually on medical care.

▶ In 2018, the Canadian government allocated more than $240 billion to healthcare.

▶ The total spending on health makes up about 11.3% of Canada's GDP

▶ Improved treatment in the ambulance could result in a 20% reduction in the average length of hospital stay the healthcare system could save $140 million

Connected Ambulance

Enhanced, interactive communication between awaiting Emergency team and remote paramedics

Potential to improve health outcomes for **7,303** stroke patients in ON

1. 5G Impact on GDP

Impact on Entertainment/Gaming/Education/Retail

▶ Improved live event experiences with AR and multiple view angles

▶ B.C. immersive technology companies generated $2.3B in annual revenues which is 35% of all AR/VR revenue activity in Canada

▶ 5G will revolutionize classrooms with AR/VR technologies

▶ Retail sector GDP accounts for approximately 5% of total GDP

Immersive Entertainment

Leveraging HD video, Augmented and/or Virtual Reality to provide immersive fan experiences

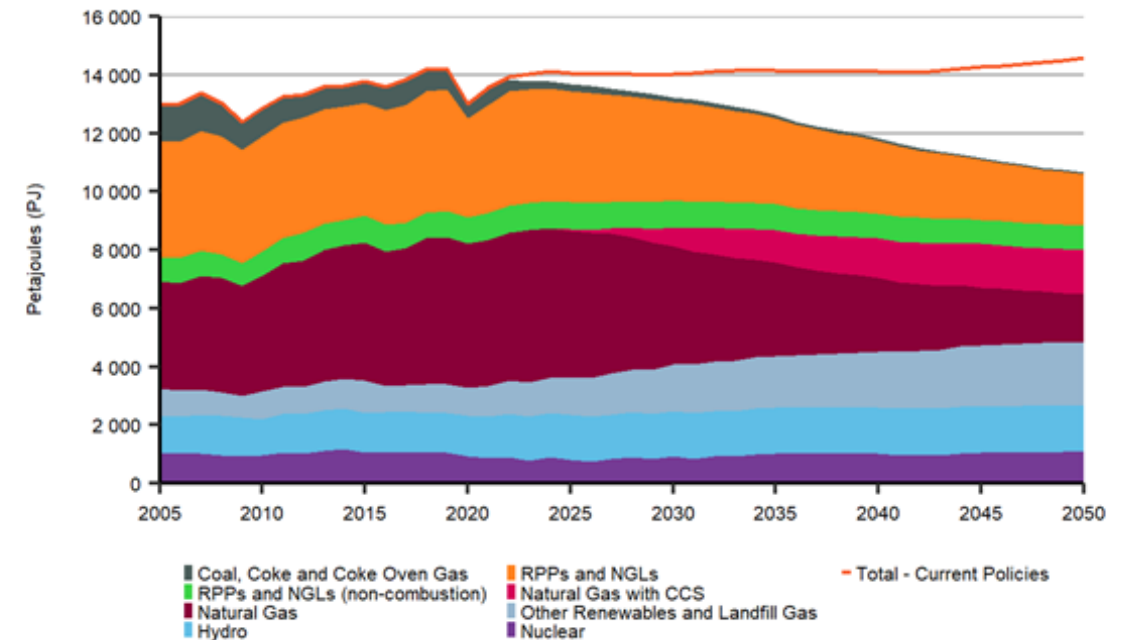**$17M** of incremental revenue for a VR *Hockey Night in Canada* experience

2. 5G Impact on Energy Consumption and carbon/green house gas footprint

▶ The Canadian's plan contains retrofitting buildings and delivering more energy-efficient transit options

▶ 5G wireless technology is central to reaching Canada's carbon emission reduction commitments.

Legend:
- Coal, Coke and Coke Oven Gas
- RPPs and NGLs (non-combustion)
- Natural Gas
- Hydro
- RPPs and NGLs
- Natural Gas with CCS
- Other Renewables and Landfill Gas
- Nuclear
- Total – Current Policies

Y-axis: Petajoules (PJ)
X-axis: 2005, 2010, 2015, 2020, 2025, 2030, 2035, 2040, 2045, 2050

2. 5G Impact on Energy Consumption and carbon/green house gas footprint

▶ **Think about:**

❑ in quick maintenance/repair time (less operating time)

❑ increased confidence in public transport (less cars and emission)

❑ Smart cities, adjusted buildings (HVAC, lighting)

❑ smart transportation to optimize vehicle traffic patterns and diminish congestion

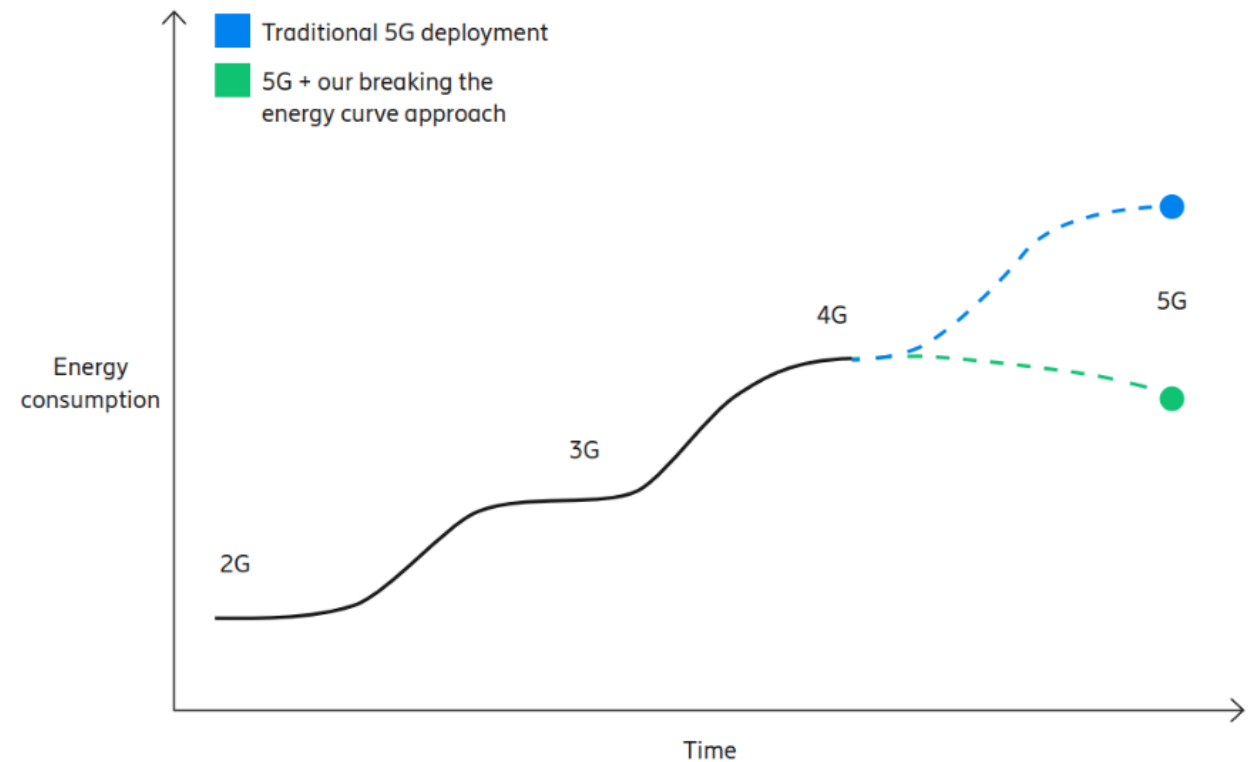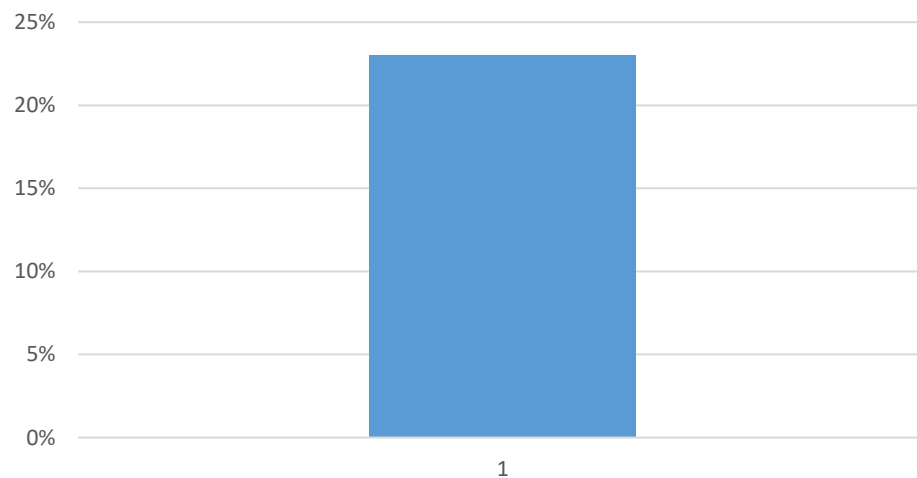❑ Extended reality (XR) technologies that delivery the remote work
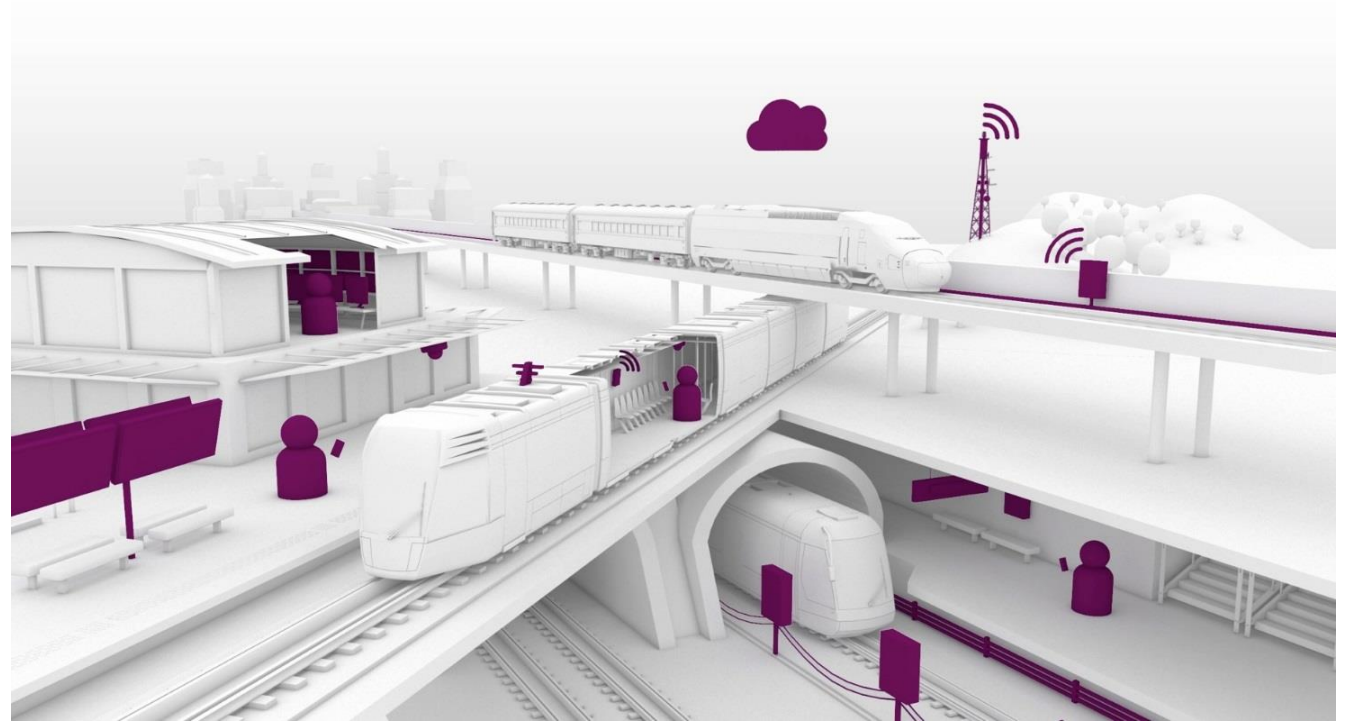
2. 5G Impact on Energy Consumption and carbon/green house gas footprint

Carbon dioxide emission drop (2025)	48-54 million (metric) tons
Passenger vehicles off the street	10.5 million

Canada's current emission saving targets by 2025

2. 5G Impact on Energy Consumption and carbon/green house gas footprint

1. **Formulate the network (core, transport, Radio access and infra)**

2. **Trigger energy-saving software**

3. **Build 5G with accuracy and Run site infrastructure intelligently (autonomous systems, AI)**

Environmental metering · Precision climate control · Remote-controlled rectifiers · Smart locking system · Smart connected batteries · Smart distribution: DC up conversion/AC inverter · Smart controller for asset management and secure access to ENM · Energy metering · Smart space management · Interface for sensors and surveillance equipment

2. 5G Impact on Energy Consumption and carbon/green house gas footprint

- **Spectral efficiency versus the number of BS antennas**

- **The goal is to repeat the experiment and visualize how the number of antennas affects the energy, using Matlab**
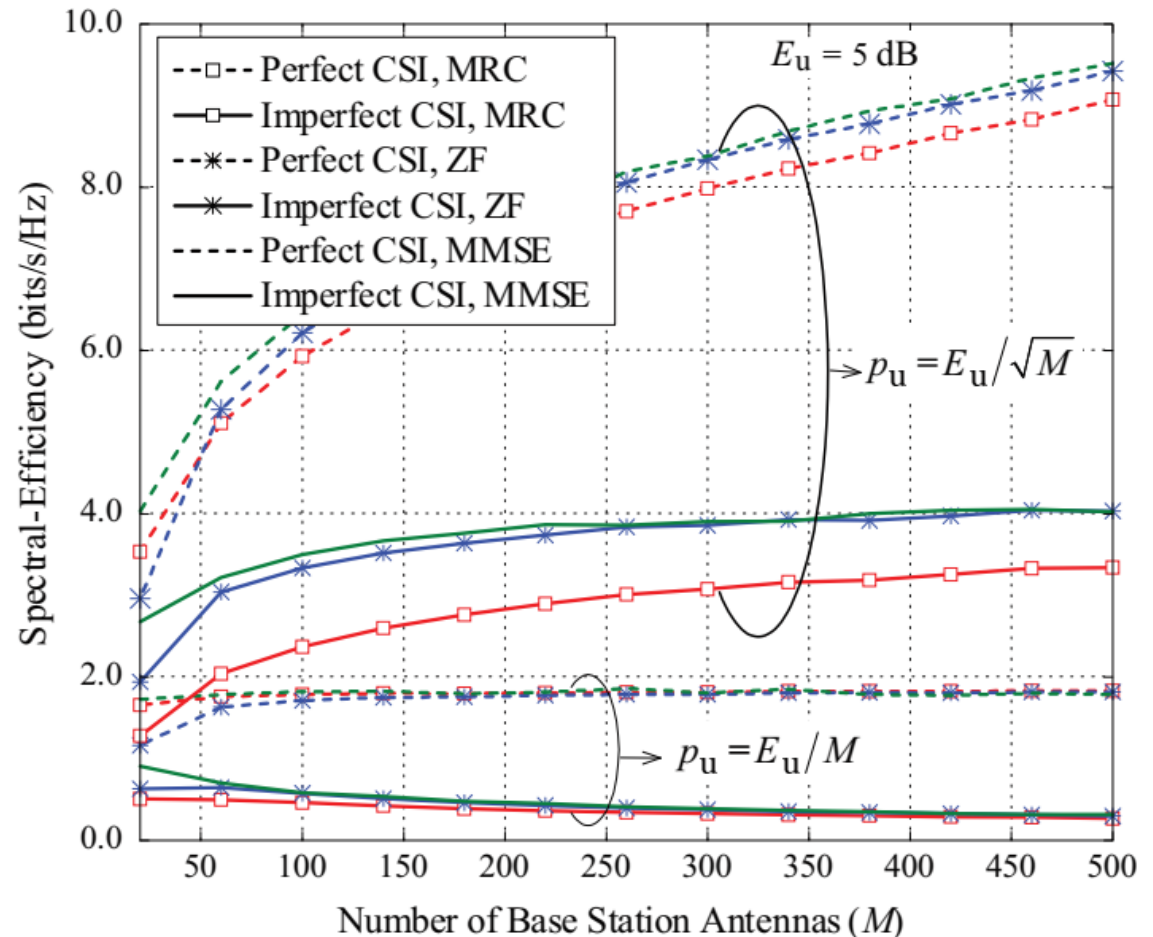
3. 5G Impact on Canadian Quality of Life

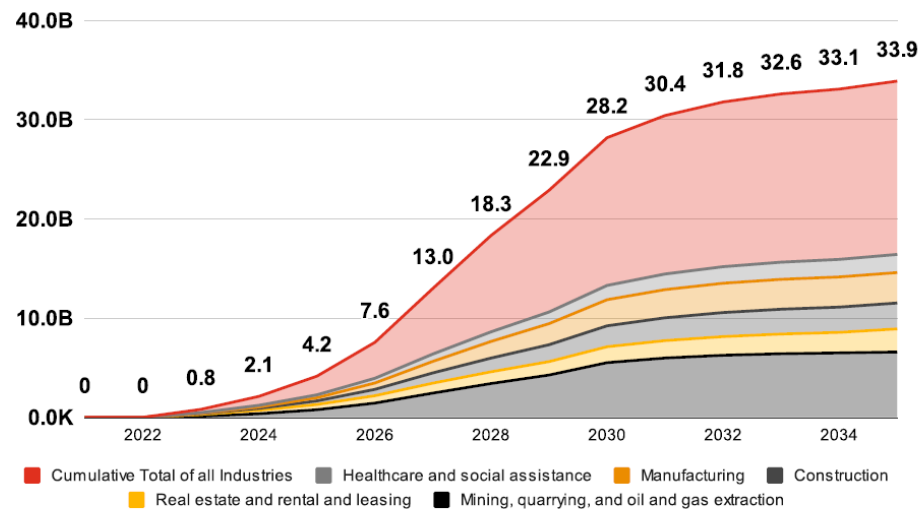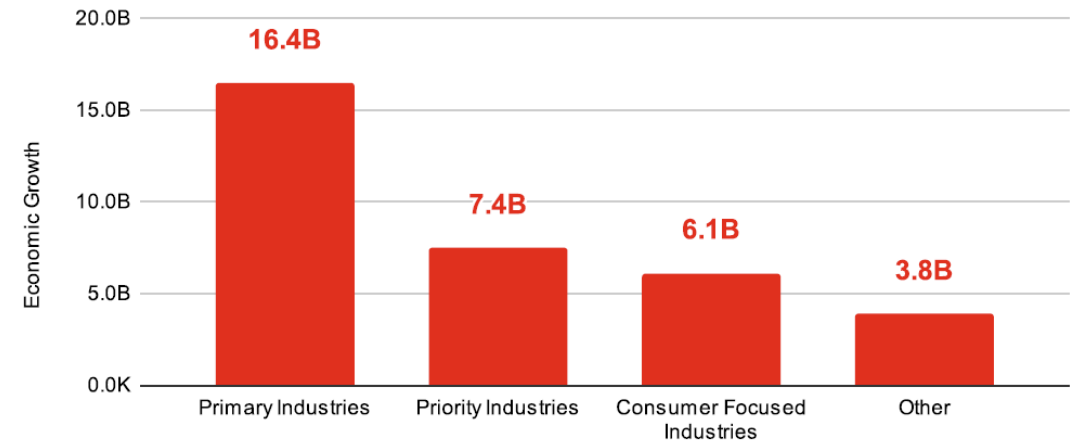**Exhibit 4 – Annual impact of 5G on the Canadian economy and for select industries ($CAD, Billions)[43]**

Exhibit 5 – Annual impact of 5G on Western Canada's economy ($CAD, Billions)
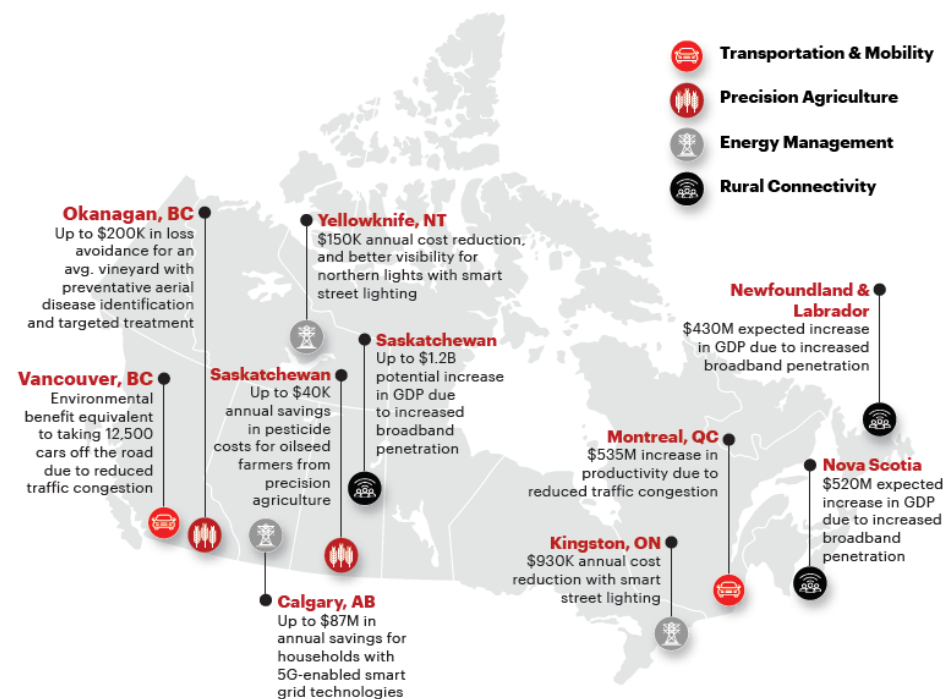
Western Canada's primary industries by GDP

	Real estate and rental and leasing	Mining, quarrying and oil & gas extraction	Healthcare	Construction	Manufacturing
Now	• Smart Homes • IoT sensors for Smart Buildings	• Self Driving Vehicles for Material Handling • Asset Inspection Drones • Virtual Reality in Oilfields and Mines	• Connected Ambulances (direct communication with hospital Emergency Room) • Community Epidemic Control	• IoT sensors for Smart Buildings • Augmented Reality for Planning	• Digital Twin computerized models for asset optimization • VR in Manufacturing Processes • Wearables for operators to improve safety • Autonomous Material Handling

Adoption timeframe

Summary of the estimated benefits of select 5G-enabled use cases

- **Transportation & Mobility**
- **Precision Agriculture**
- **Energy Management**
- **Rural Connectivity**

Okanagan, BC Up to $200K in loss avoidance for an avg. vineyard with preventative aerial disease identification and targeted treatment

Yellowknife, NT $150K annual cost reduction, and better visibility for northern lights with smart street lighting

Newfoundland & Labrador $430M expected increase in GDP due to increased broadband penetration

Vancouver, BC Environmental benefit equivalent to taking 12,500 cars off the road due to reduced traffic congestion

Saskatchewan Up to $40K annual savings in pesticide costs for oilseed farmers from precision agriculture

Saskatchewan Up to $1.2B potential increase in GDP due to increased broadband penetration

Montreal, QC $535M increase in productivity due to reduced traffic congestion

Nova Scotia $520M expected increase in GDP due to increased broadband penetration

Kingston, ON $930K annual cost reduction with smart street lighting

Calgary, AB Up to $87M in annual savings for households with 5G-enabled smart grid technologies

Exhibit 10 – 5G use cases and applications by <u>consumer focused</u> industries[56]

Consumer focused Industries

Adoption timeframe		Public Administration	Retail Trade	Consumer Services	Utilities	Arts, entertainment and recreation
	Now	• Intelligent Traffic Management • Body-Worn Cameras for improved safety • Intelligent Parking management	• In-Store Contextualized Marketing • Omni-Channel Operations provides an integrated shopping experience • Customer Traffic Flow Monitoring • Cashierless Checkout / Shopping	• Cloud Gaming • Connected Cars • High Quality Video Streaming • Fixed Wireless Access for improved connectivity • Remote Health Consultations • Wearable Devices	• Smart Grids • Residential smart meters	• Immersive media applications (ultrahigh-definition, AR,VR) • Home entertainment subscription for cars
	Near-term (1-3 years)	• Transport Proximity Management for vehicle capacity planning • Environmental monitoring	• Endless Aisle AR lets shoppers scan entire inventories quickly • Smart shelves • Contactless Shopping	• Augmented Reality • Virtual Reality • Massive media car infotainment	• Augmented Reality Remote Maintenance • Digital Twin computerized models for asset optimization • Condition Based Maintenance (CBM) • IoT sensor environmental monitoring • Drone-led Critical Infrastructure Inspections	• Improved live event experiences with AR and multiple view angles • Live virtual "in-stadium" experiences
	Long-term (3+ years)	• Remote Search & Rescue • Assisted Perception & Visual Communication for Public Safety • Automated Public Transport	• Magic Mirror AR lets shoppers try on clothing and accessories virtually in store • Dynamic Pricing • Consumer 3D calls/holograms	• Self-driving System for Cars • Urban Air Mobility (UAM)	• Private 5G Network with dedicated bandwidth for Utilities	• Connected haptic suits for improved virtual interactions • 3D holographic displays

Automated vehicle & Smart Home

Smart Hospital & Smart mining

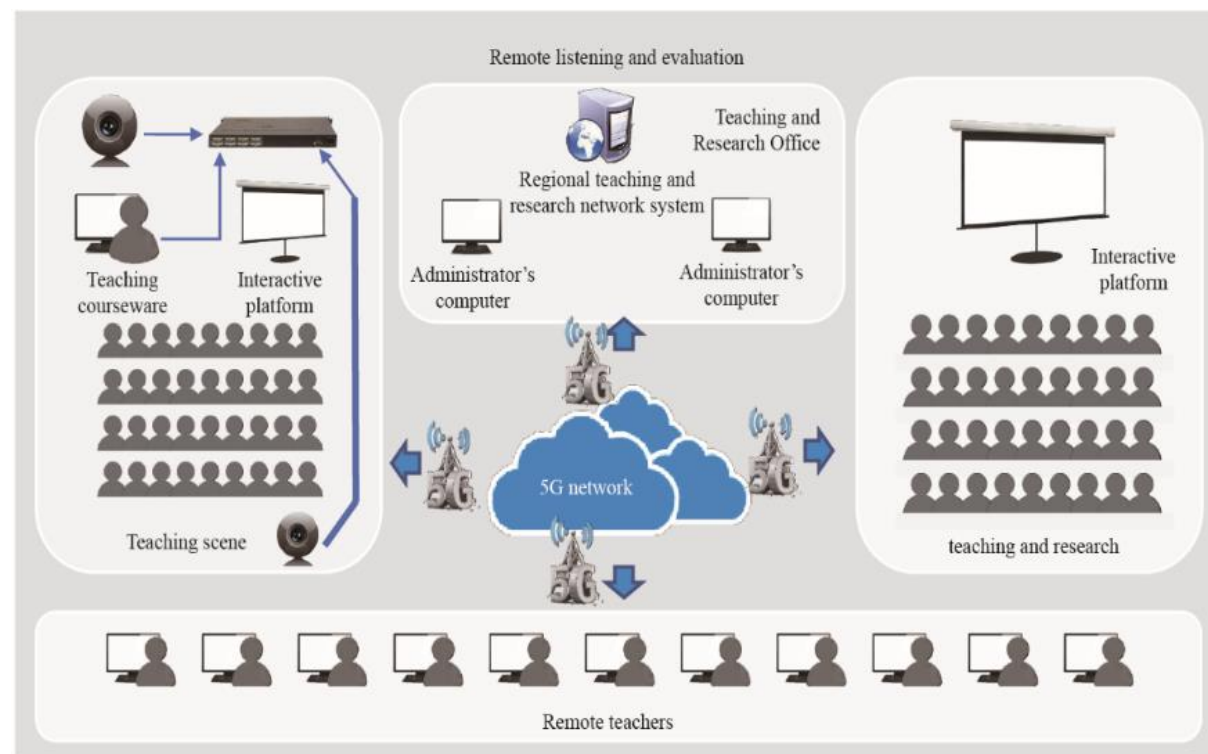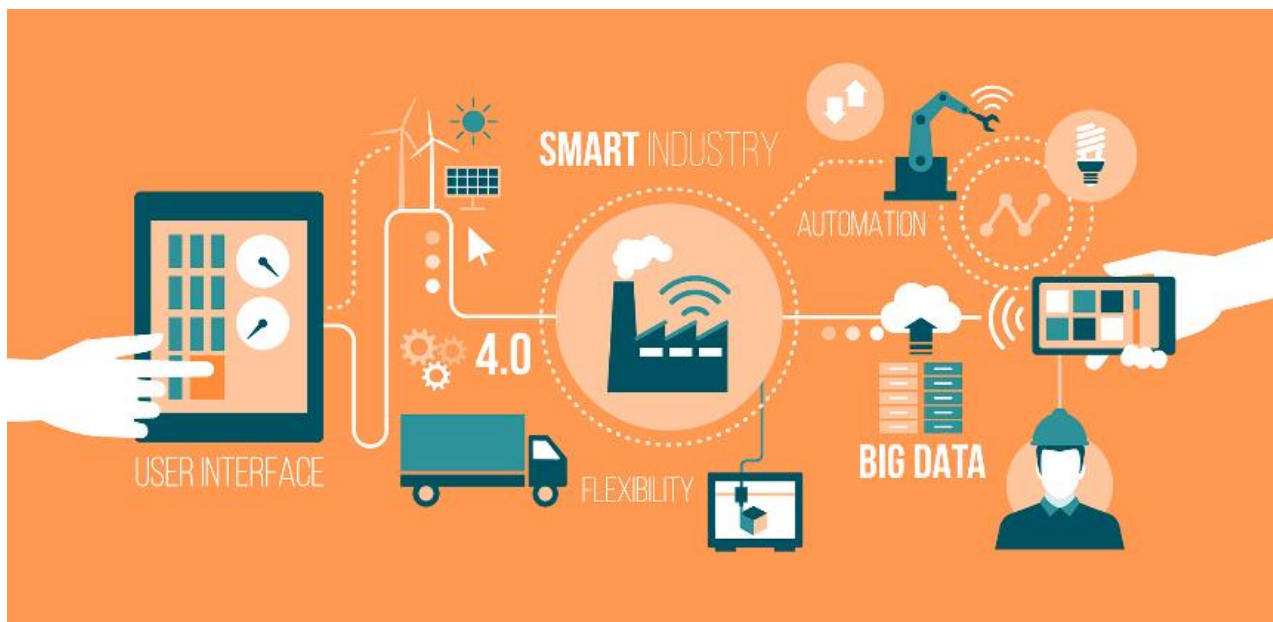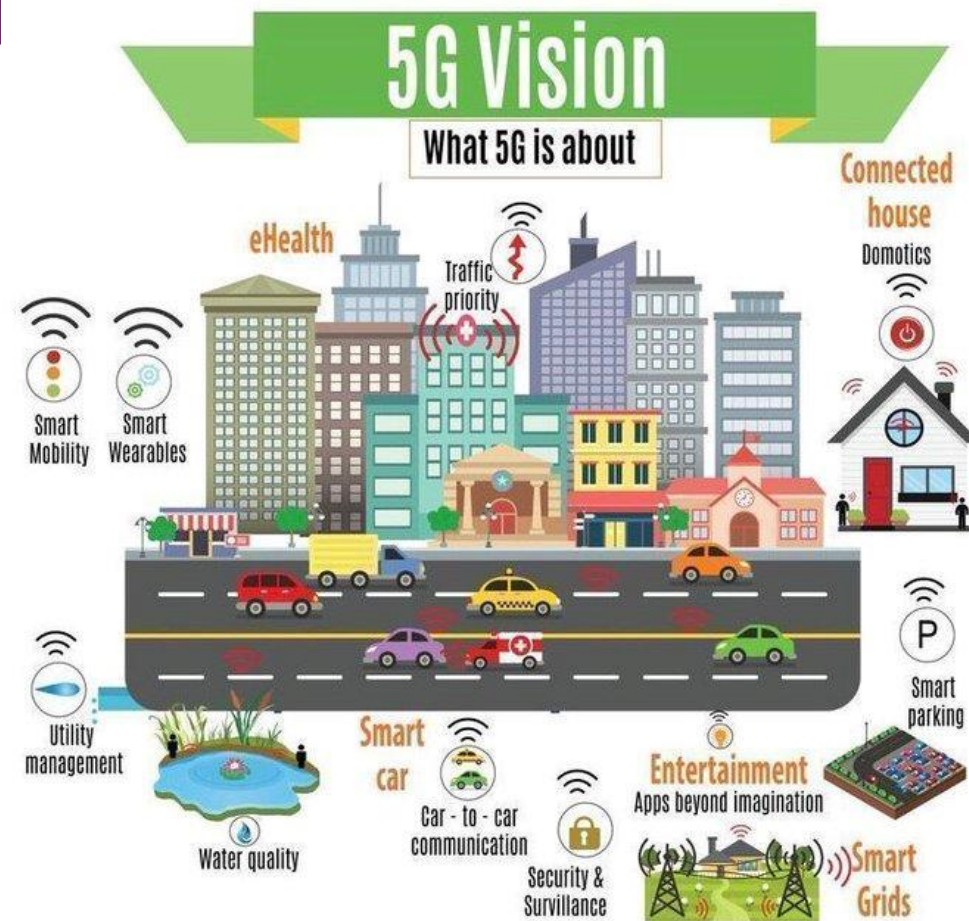# Smart Industry 4.0 & Smart School

smart Transportation system & Smart City

Thank you