

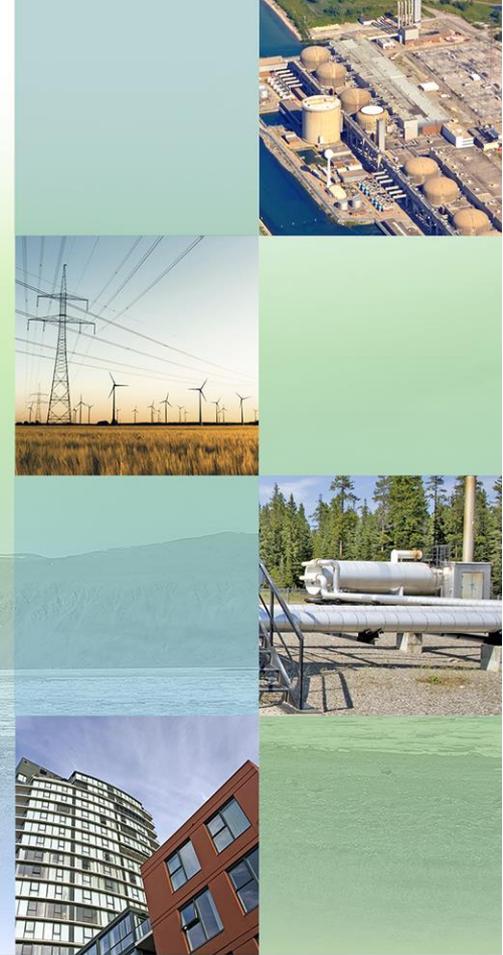


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Hydrogen in Canada

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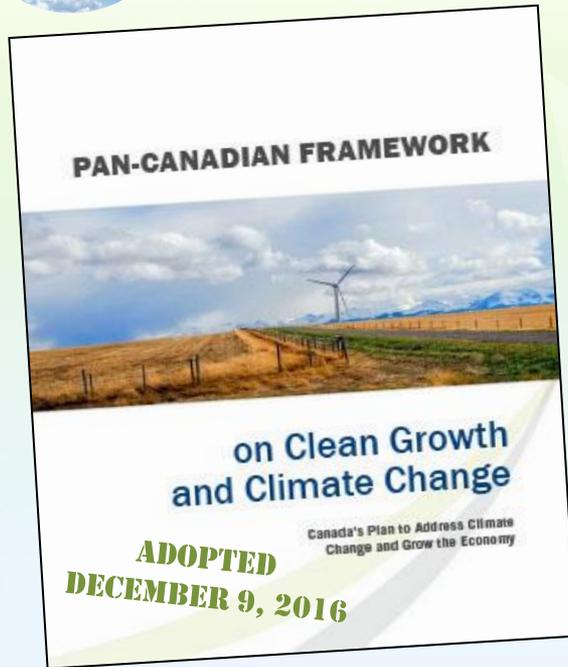
Outline

- Canadian Climate Change and Environmental Context
- Supporting Policies and Federal Actions
- Canadian Hydrogen Sector
- International efforts





Pan-Canadian Framework – 4 Pillars



Pricing carbon pollution



Complementary mitigation actions across all sectors



Adaptation and climate resilience



Clean technology, innovation & jobs

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Pillar 2: Mitigation Actions

CANADA STRIVES TO HAVE **90%** OF ELECTRICITY FROM NON-EMITTING SOURCES BY 2030.

Government



- Green procurement
- Greening Government Operations (-40% by 2030)

International



- \$2.65B in international climate finance by 2020
- Climate and trade policy, gender action, **Powering Past Coal Alliance** for coal phase-out
- **Talanoa Dialogue**

Electricity



- Phase-out coal, increase renewables
- Transmission lines, smart grids
- Reduce diesel use in remote communities

Building(s)



- "Net-zero energy ready" model building
- High standards for heating equipment

Transport



- Canada-wide Zero-Emission Vehicle Strategy
- Emission standards for new light-duty and heavy-duty vehicles

Industry



- **Clean Fuel Standard**
- Methane regulations
- Hydrofluorocarbon regulations

Forestry, agriculture, waste



- Renewable fuels and bioproducts
- New Agricultural Policy
- Enhanced sequestration

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Our Clean Energy Vision

Generation Energy: Over 380,000 people across the country helped to define Canada's energy future. Four themes emerged:

- **Smarter Energy Use:** economy-wide energy efficiency improvements
- **Clean Power:** using less carbon-intensive sources of electricity
- **Greater Use of Low Carbon Fuels:** supporting fuel switching, supply and demand side actions
- **Cleaner Oil & Gas:** reducing emissions per unit of fuel produced, improving oil and gas cost competitiveness, and expanding value-added oil and gas products and services

Energy Vision: Builds on GenEn, operationalizing actions which must be taken across the themes and adds a 5th theme:

- **Strengthening Market Access:** leveraging Canada's clean energy advantage and international actions to market Canada as a supplier of choice, and improve foreign investment.

Clean Electric Future: Stemming from the Energy Vision

- Federal and Provincial Ministers agreed to promote economically-balanced clean growth, through the development an **electrification strategy for the economy**, including generation, infrastructure, market growth and collaboration

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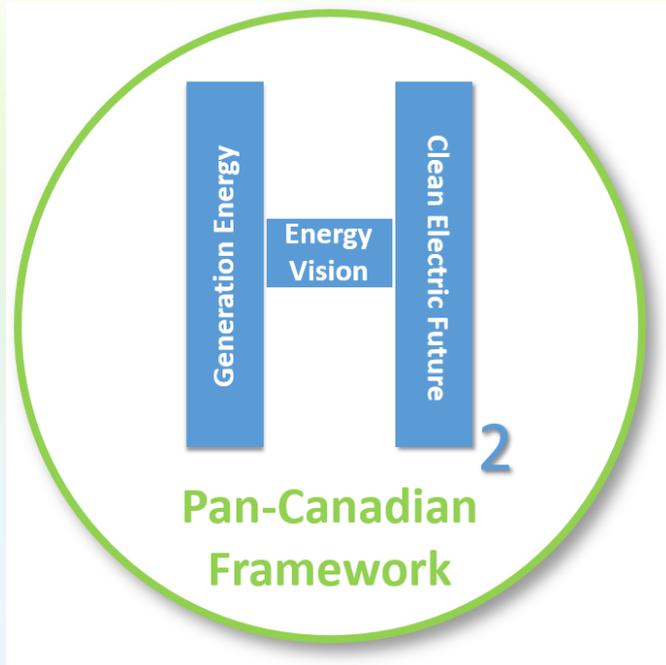


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Building the Business Case for Hydrogen...



Other enabling factors

- 80% non-emitting electrical grid, and it's getting cleaner
- Complementary sub-national climate policies
- Vast natural resources, including access to precious metals
- Well established hydrogen clean technology industry develops pool of highly qualified professionals

Supporting Programs

Targets for Zero Emission Vehicles: 10% personal vehicle sales by 2025, 30% by 2030 and **100% by 2040**

Investing in Infrastructure: \$182.5M over 6 years to

- Develop a national fast-charging network for EVs, Natural gas refuelling along freight corridors and **Hydrogen refuelling stations in metropolitan centres**
- Demonstration of next generation charging technologies, and development and alignment of binational codes and standards.

Budget 2019:

- \$435M/ 5yrs to deploy new ZEV recharging and refuelling stations, Federal purchase incentives

R, D&D:

- Over \$17B in investments for clean technology and innovation

Off-Diesel:

- Supporting the transition of remote communities from diesel based energy systems

Provinces:

- Federal support directly to Provinces to transition to a low carbon economy
- ZEV sales mandates investing in infrastructure and vehicle purchase incentives.

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Canada's Hydrogen Sector

Strong export market demand, with export sales making up 80% of revenues in 2017

- Including China (40%), the U.S. (9%), and Germany (8%).

Well established: Approximately 60% of industry has been involved in hydrogen and fuel cell activities for over a decade.

World Leading: The sector is recognized for its expertise and leading technologies, with products and services contributing significantly to global deployment:

- Hydrogen fuel cell commuter trains operating in Germany
- North America's first utility-scale power-to-gas energy storage facility in Ontario, Canada, and
- Thousands of FCEVs and fueling stations around the world.



Hydrogen Production

Hydrogen mainly produced via the steam reformation of natural gas

- An estimated **3 million tonnes** produced annually for industrial use, ranking in the top 10 of global hydrogen producers.

Hydrogen production from renewable energy at industrial scale will commence with **Air Liquide's** 20MW electrolyser, scheduled to commence in 2020.

A recent **Hydrogenics-Enbridge joint venture** resulted in the first-of-its-kind, 2.5MW power-to-gas facility in North America.

- The Ontario facility will take surplus renewable power from the electricity grid to create hydrogen for storage, direct use (e.g., backup power, transportation, industrial use), or to be combined with carbon dioxide to produce synthetic natural gas.



Well Established Globally

Canada's expertise includes: RD&D, advanced fuel cells, electrolysers, fueling systems, and engineering, testing, systems integration, as well as hydrogen production, transport, and storage.

Ballard Power Systems is continuing its strong growth in fuel cell products and services, and hydrogen powertrain design and implementation, with an increasing focus in heavy duty transportation

- The company is working jointly with multiple global industry players across Europe, U.S., and Asia, building on increasing momentum in the sector.

Hydrogenics' focus in on renewable hydrogen generation and hydrogen power systems

- The company has a growing global demand for its products, and a number of international partnerships in North America, Europe and Asia.



Growing Domestically

The multitude of supporting policies and programs are starting to have an effect. Market activity in Canada has significantly increased over the past two years:

- Toyota's plan to bring 50 FCEVs to Quebec, other vehicle manufacturers have deployment plans as well
- New public hydrogen stations opening (3 opened to date, 12 total planned)
- Ontario's transit agency (Metrolinx) assessing the feasibility of hydrogen-powered trains for regional service
- Canada's first power-to-gas project coming online in Ontario
- Air Liquide's announcement of its plans to produce world's largest hydrogen from renewable power facility in Becancour, Quebec, and
- Alberta's heavy Class 8 hydrogen hybrid truck project.



...and we keep growing

Hydrogen Energy Technology Corporation (HTEC) provides hydrogen infrastructure and technology solutions. Partnered with Shell to design and build the first retail hydrogen station in Canada.

Kraus Global, a global supplier of retail fuel pumps for compressed gas, including natural gas and hydrogen

Greenlight Innovation, a global supplier of fuel cell and testing equipment, announced that its partner, Austrian **AVL Powertrain Engineering**, was opening a fuel cell R&D center in Vancouver in May 2018.

Harnois Energy is a leading station owner and petroleum products supplier, signed a letter of intent to partner with HTEC on hydrogen fueling activities.

Xebec Adsorption is supplying purification equipment orders within Canada, Italy, Japan, and Taiwan.



Collaboration on Codes and Standards

Through the **Regulatory Cooperation Council**, we have been working with the U.S. Department of Energy over the years, on the development and alignment of codes and standards for alternative fueled vehicles and refuelling infrastructure:

- Enabled the establishment of Binational Code oversight committees and technical committees
- Held two Canada/US workshops on Hydrogen Codes and Standards held. Findings and recommendations include:
 - Need for a North American Codes & Standards Roadmap
 - Improve Technical Coordination Between Industry, Government, and SDOs
 - Track technology development and trends.
- Supporting the Center for Hydrogen Safety



Hosting the World



F-Cell Conference in Vancouver (May 22-23, 2019):

- Supported by AVL. Two days of policy and technical discussions,
- Canada's domestic Hydrogen Pathways Report will be released,

Clean Energy Ministerial (CEM) in Vancouver (May 27-29, 2019):

- Canada, in collaboration with Japan, the US, EC, and Netherlands will launch the **New Hydrogen Initiative** to accelerate the commercial scale deployment of hydrogen and fuel cell technologies across all sectors of the economy
- Initial focus will be
 - Industry
 - Transit
 - Communities
- 20 countries to be founding members



Thank You

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