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Canadian Low-Carbon Hydrogen Observatory.

November 2024

Foreword . Need to develop an observatory

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This executive summary presents the study to be published in November 2024 by Sia Partners, designed as an **annual reference document** following the development of the hydrogen sector in Canada.

The study will provide a detailed assessment of the infrastructure and resources required to establish a national hydrogen value chain. It estimates that implementing existing hydrogen projects could prevent 32 Mt of **CO_2 emissions**, improve Canada's trade balance by CAD$25.8 billion, and **call for 156 TWh of clean electricity per year**, with an estimated investment of **CAD$90 billion** .

As global decarbonization efforts accelerate, the **study will analyze how Canada is positioned in this global transition** by examining existing initiatives and providing clear estimates of the resources required to build a competitive hydrogen economy.

The Canadian Hydrogen Observatory will provide valuable insights into the **dynamics of collaboration, synergy and competition among provinces** at the forefront of hydrogen development. These provincial efforts will be explored in the context of global trends, to identify how regional initiatives can align with international movements.

Beyond its factual analysis, the Observatory serves as an **educational tool for public and private stakeholders, students, teachers and journalists**, by providing the knowledge and data needed to navigate and shape Canada's rapidly evolving hydrogen landscape.

Dr. Bruno G. Pollet

Professor
Deputy Director of the Hydrogen Research Institute (HRI) at UQTR

As in other regions of the world, to achieve carbon neutrality by 2050, Canada will have to focus primarily **on industries and sectors that are difficult to decarbonize**, called “no regrets sectors”, i.e. sectors that are “hard to decarbonize” or “hard to electrify ” such as iron, steel, fertilizers, etc.

Canada is blessed with vast land areas, abundant water, mineral resources, biomass, hydroelectricity, and natural gas and oil, creating an **enabling environment for building a robust hydrogen value chain**, from mineral extraction to the production, distribution, and use of low-carbon and renewable hydrogen. Hydrogen is therefore attracting significant attention in Canada as a **key player in the transition to a low-carbon economy**.

Canada is already well positioned as one of the world's top ten hydrogen producers and a leader in the production of hydrogen fuel cells.

Canada is also strategically creating and implementing these **“Hydrogen Hubs”** (as in Europe with the “Hydrogen Valleys”) to bring together several industrial and government-funded initiatives, to carry out small to large-scale industrial pilots and technology demonstrations across the entire hydrogen value chain. **Overall, hydrogen is seen as a critical part of Canada’s energy future**, with potential benefits for both the economy and the environment .

Executive Summary | H_2 Development in Canada *1/3*

A sector that is rapidly industrializing with very ambitious low-carbon hydrogen targets

01 Announced H_2 production capacity
5.4 Mt/year*

02 Total amount of H_2 consumed by planned projects
4.5 Mt/year*

03 Number of H_2 hubs in Canadian territory
6 H_2 hubs*

10 GHG emissions avoided by planned projects
32 $MtCO_2e$/year*

A Dynamism In Canada As Evidenced By The Volume Of Projects

The 2024 edition of the Canadian H_2 Observatory lists nearly **94 publicly announced projects**, representing the equivalent of **5.4 Mt of low-carbon H_2** of projected production capacity. Of these production projects, 19 are in operation, 14 are in FID/Construction, 43 are in concept stage and 6 are at an unknown level of development.

Applications Mostly Directed Towards Industry

More than **75% of the known applications concern the production of synthetic fuel**, mainly ammonia, for export - to Europe in the east, and Japan in the west. **The remaining 25% is divided between steel, petrochemicals, and – to a lesser extent – mobility**.

Projects Focused On Regions Close To The Coasts

Most hydrogen projects are located in British Columbia, Quebec, Ontario, Alberta, and the Atlantic provinces.The Observatory identifies 6 H_2 hubs** in which the majority of projects are concentrated, **in Vancouver, Quebec, Atlantic, Edmonton, Toronto, and Prince George**.

Strong Climate Benefits Linked To These Projects

Effective deployment of the projects would make it possible to avoid up to 32 $MtCO_{2eq}$/year, contributing to more than **13% of Canada's GHG reduction targets** of 260 Mt by 2030. It should be noted that the projects eliminating the most GHG are those based on electrolysis, powered by renewable electricity sources.

**** Based on publicly announced projects***
*** These hubs differ from those identified by NRCan through different methodological approaches*

Executive Summary | H_2 Development in Canada *2/3*

Establishing a clear industrial policy framework would allow the H_2 and manufacturing sectors to grow together.

09	10	07	07
Investment expenditure of planned projects	Impact on the Canadian trade balance	Electrolyzer capacity needs	Proportion of electrolyzers lacking an identified supplier
CAD$90 billion*	**CAD$25.8 billion***	**18.8 GW*** *(eq 2.9 MtH_2)*	**99%***

Massive Investments In The Sector

Cumulative project investments would reach more than **3% of Canadian GDP**. Of these CAPEX expenditures, nearly **95% are private investments**. The 5% of public origin comes **mainly from provincial funding,** but **large federal investments are planned** in the coming years.

Public Support And A Clear Framework Necessary

In a complicated economic context (inflation, interest rates, etc.), **securing robust business models is key** to initiating projects with CAPEX close to CAD billion. Clear federal and provincial support would provide **visibility and financially de-risk the sector**. Clean hydrogen tax credits (CIIHP) are expected in this regard.

Projects Positioning Canada As A Key Exporter

The completion of the projects would allow Canada to **become a major exporter** of its production and **know-how** in several sectors: steel, methanol and ammonia. In a context of global geopolitical tension, this would give Canada **strategic autonomy** in these critical industries.

High Manufacturing Needs

Of the 18.8 GW of electrolyzers needed to complete the projects, **only 1% have already been allocated to a technology supplier**. Developing a **long-term industrial policy** would support the establishment of manufacturers in Canada and thus avoid **technological dependency**.

***** Based on publicly announced projects***

Executive Summary | H_2 Development in Canada *3/3*

A resource planning effort is necessary to support the proper development of the hydrogen sector

05 Electricity needs of planned projects
156 TWh/year*

06 Water needs of planned projects
150 hm^3 /year*

08 Critical and strategic mineral needs
82 616 t*

Need For Access To Competitive Low-Carbon Electricity

If completed, the various mapped projects will require 157.7 TWh of low-carbon electricity, representing 31% of Canada's **current renewable and nuclear electricity production capacities, implying a significant effort to develop additional capacities.**

Planning To Be Anticipated For The Allocation Of Electrical Capacities

These low-carbon electricity needs are significant and require **planning and anticipation efforts** so as not to slow down the development of projects. The Atlantic provinces are jointly developing an ambitious wind energy strategy to support this need.

Water Uses To Be Monitored, Not Just For Electrolysis

Water needs, representing **less than 4% of** current total withdrawals for manufacturing industries **should not be a hindrance to the deployment of projects**. However, a comparative study on the location of water deposits and H_2 **production sites** should be carried out to avoid any risk.

Anticipating Future Needs For Critical Mineral Is Crucial

The **geographical concentration of refining and processing** of certain critical minerals for electrolyzers (platinoids for PEM, Zirconium and Nickel for ALK and Scandium for SOEC) requires particular attention to avoid shortages**/price instability.**

*** Based on publicy announced projects**

Table of contents.

Part 1.

Introduction

- Scope of the study
- Presentation of indicators
- Executive Summary
- Political context

Background and scope of work | Introduction to the Canadian H_2 Observatory

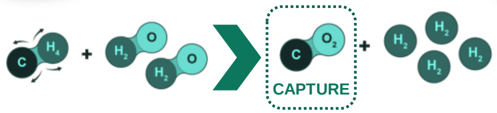
The Canadian Hydrogen Observatory studies the dynamics - provincial and federal - of the development of the hydrogen sector. With the aim of **neutrality and objectivity**, the analysis are based solely on **the projects announced by the players in the H_2 ecosystem.** Its purpose is not to make estimates/projections on the future of the sector in Canada but to provide a **state of play of its progress** and its economic and environmental impacts. **It is intended to be enriched but also updated annually**.

SCOPE | Low-carbon H_2 production processes considered*

Electrolysis

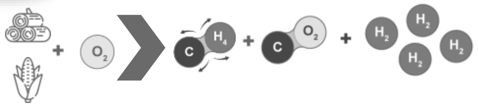
- Water electrolysis can be achieved through several technologies, among which the most common are PEM, ALK and SOEC electrolysis.

Reforming + CCUS



- Methane reforming can be accomplished through several technologies, including steam methane reforming (SMR) and autothermal reforming (ATR).

Biomass gasification



- The biomass gasification process involves heating the biomass to a very high temperature to extract the H_2.

SCOPE | Main applications of H_2 identified in Canada

Synthetic fuel

Production of synthetic fuels from H_2 (and often CO_2) : ammonia, methanol, diesel, etc.

Mobility

Use of H_2 in a fuel cell or directly in engines for heavy vehicles (or light – less frequent).

Steel

Production of low-carbon steel by direct reduction of iron using H_2.

Network injection

Mixing H_2 with natural gas for injection into the existing natural gas network

Petrochemicals

Mainly used in refineries (hydrocracking, hydrotreatment)

Other industrial applications

Grid service, stationary storage, cogeneration plant (heat, electricity), etc.

Scope of Work

- This study **comprehensively identifies and studies** all low-carbon H_2 projects that have been announced in Canada.
- This work studies **the dynamics of the sector**, **the resources to be mobilized to successfully carry out the projects** and **the associated externalities.**
- An **in-depth analysis of all public policies and support programs** aimed at accelerating the development of this sector was also carried out.

Objectives of The Study

- The objective of this study is to provide **an overview of the initiatives underway** around the low-carbon H_2 sector in Canada and to **provide a range of indicators** to study its **yearly evolution**.

Methane/RNG pyrolysis processes have also been studied but are in the minority in terms of volume of H_2 produced at the moment.

Background and scope of work | Presentation of the indicators

01. **Production capacity targeted by planned projects**

Lists the production targets for projects planned to date by province.

02. **Quantity of H_2 consumed by planned projects**

Lists the volume of H_2 consumed by usage projects planned to date by province.

03. **Number of H_2 hubs**

Mapping projects and their announced locations to identify potential concentrations.

04. **Share of actors with head offices outside of Canada**

Study of the players in the Canadian industry according to the location of their head offices.

05. **Electricity needs of planned projects**

Evaluates the territorial distribution of electricity needs in TWh/year for planned projects.

06. **Water needs of planned projects**

Evaluates the territorial distribution of water needs in hm^3/year for planned projects.

07. **Manufacturing needs of planned projects**

Evaluates the territorial distribution of the manufacturing needs for electrolyzers in GW for the planned projects.

08. **Critical mineral needs of planned projects**

Assesses the needs for each of the critical electrolyzer minerals for all planned projects.

09 **Capital expenditure of planned projects**

Lists investments announced to finance planned projects.

10 **CO_2 emissions avoided by planned projects**

CO_2 emissions assuming full achievement of announced production targets.

11 **Impact on the trade balance of planned projects**

Calculates the value in billions of dollars/year of exports of products synthesized by the planned projects.

General context | Role of H_2 in the energy transition

Industry accounts for **28% of global** GHG emissions **and transport is responsible for 23%**

Objective: 40% of Canada's GHG emissions by 2030 compared to 2005 (*2030 Emissions Reduction Plan)*

By 2024, at least 60 countries* will have published or will be involved in an **H_2 strategy/roadmap**

In the short term: A small number of heavy industries already using fossil hydrogen as a raw material are expected to switch to renewable or low-carbon hydrogen

- **Chemistry:** Ammonia (mainly for fertilizer production), methanol polymers, resins, etc.
- **Refining:** Hydrocracking, hydrotreatment (fuel desulfurization)
- **Iron & Steel**: Iron annealing
- **General industries:** Semiconductor, propellant fuel, glass production, fat hydrogenation, generator cooling

Obstacles to overcome in the current decade

- Making low-carbon H_2 competitive with its fossil equivalent
- Increasing demand and supply together
- Strengthening the policy framework for hydrogen

In the medium term: *"Hard-to-abate"* industrial processes whose GHGs are difficult to reduce will need new processes and could turn to hydrogen

- **High temp. process heat**: H_2 and synthetic methane/RNG could replace natural gas in burners where electricity cannot provide enough power (cement, glass, iron, cogeneration industry)
- **Steelmaking processes**: Hydrogen could be used as a reducing agent in the direct reduction of iron ore (H-DRI)
- **Synthetic fuels**: Combined with CO_2, hydrogen will make it possible to synthesize fuels and/or energy vectors with a low GHG footprint (e-kerosene, e-methanol, SAF, NH_3)
- **Heavy mobility**: When direct electrification is not a solution for reasons of autonomy, power, etc.

*Source: IEA, Global Hydrogen Review, 2024

Political context | Update on provincial strategies

Since the publication of the federal strategy in 2020, the potential for reducing provincial emissions using low-carbon H_2 has been well identified by local governments. **Six provinces have already defined and published** hydrogen **strategies**, highlighting its key role in the energy transition and establishing short- and medium-term actions and objectives to develop this sector - in line with territorial specificities. The Territories and Saskatchewan have not yet adopted a hydrogen strategy.

Federal Strategy

- In 2020, Canada released the "**Canadian Hydrogen Strategy**", which establishes a clear framework to promote the development of low-carbon H_2, while highlighting its crucial role in achieving **the goal of carbon neutrality by 2050**.
- It proposes detailed recommendations to achieve several major targets:

30% of the country's final energy from low-carbon H_2

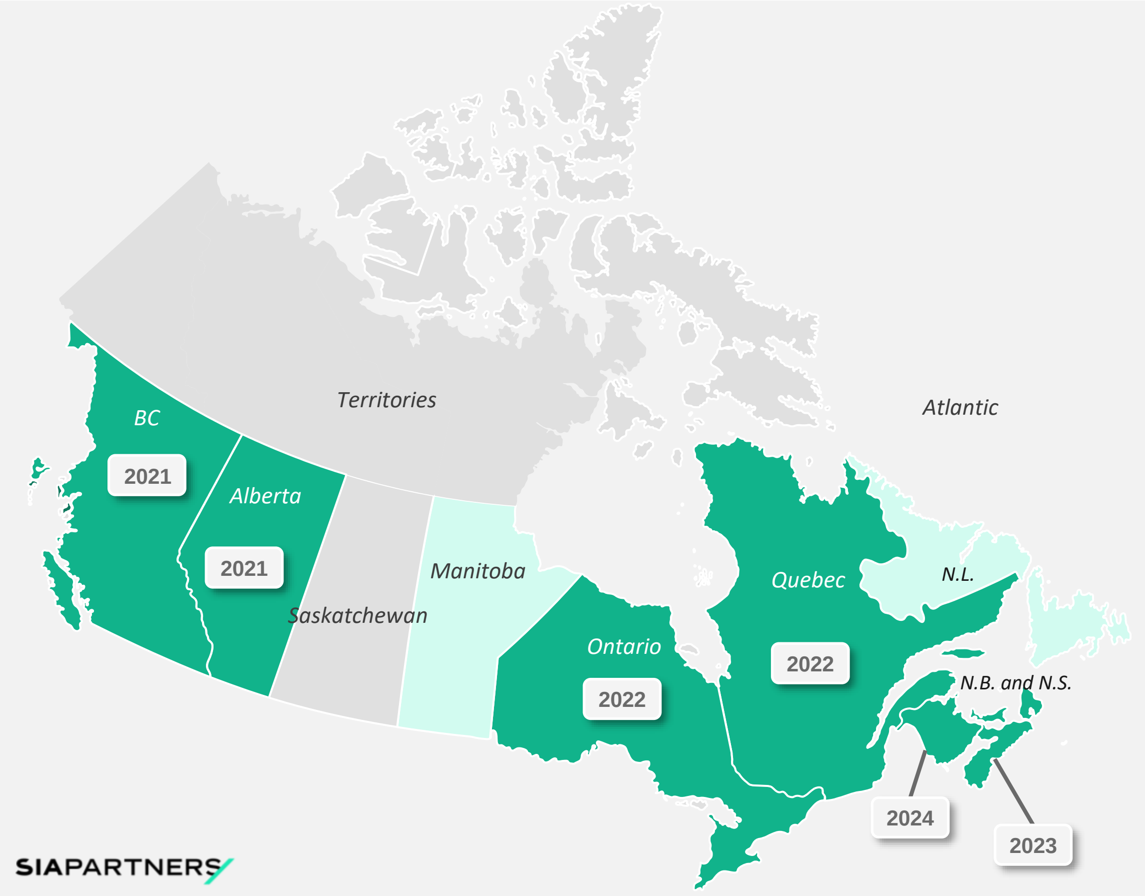
Creation of **350,000 jobs** in the H_2 sector

Reduction of GHG emissions by **190 $MtCO2_e$**

Legend

Status of provincial strategies

- Strategy published
- Strategy under construction
- No strategy
- XX: Strategy Publication Date



PROVINCIAL SPECIFICITIES

- **British Columbia:** Strategy focused on fuel cells and H_2 production from renewable energies
- **Alberta: Strategy focused on** H_2 production from natural gas with CCUS, and explores opportunities for H_2 from renewable energy.
- **Ontario:** Strategy focused on the production of H_2 from renewable energies and intended mainly for two applications: industrial sector and blending with natural gas. Objective of integrating H_2 into transportation, industry and energy production.
- **Quebec:** Strategy focused on the development of a local economy by focusing on H_2 from renewable energies, for the needs of Quebec and increasing its energy autonomy.
- **New Brunswick and Nova Scotia:** Strategy focused on the production of green H_2 powered by local wind potential.

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Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory

Regulatory Landscape | Canadian Hydrogen Incentives

The sector is supported at the federal level by Investment Tax Credits (ITCs). Presented originally in the 2022 fall federal budget, the Clean Hydrogen ITC (CHITC) was not passed into law until June 2024. The CHITC was passed at the same time as the Low-carbon manufacturing ITC, the CCUS ITC, and the Low-carbon electricity ITC. Together, **they would represent CAD$93 billion in federal subsidies** by 2034-35*.

TRANSVERSAL | ***Manufacturing***

Clean Technology Manufacturing Investment Tax Credit ◆
Up to 30% for new technology manufacturing machines

TRANSVERSAL | ***Innovation***

Strategic Innovation Fund – Net Zero Accelerator (SIF- NZA) ◆
Already subsidizing two H_2 projects ($315M), additional projects are in final negotiation

TRANSVERSAL | ***Decarbonization***

Canada Infrastructure Bank - (CIB) ◆
Invests in the biorefinery project in Varennes ($277 million), and in recharging infrastructure ($500 million)

HYDROGEN VALUE CHAIN

Supply

Electricity

Clean Electricity Investment Tax Credit ◆
Up to 30% for electricity production systems (wind, solar)

Methane

Methane Regulations ◆
Reducing methane emissions through emission standards and inspection practices – will reduce GHGs from H_2 produced by SMR

Production

Production of green hydrogen

Clean Fuel Fund ◆
$1.5 billion to increase domestic production of clean fuels

Investment tax credit for clean hydrogen ◆
15-40% of eligible costs depending on life cycle emissions and $17.7 billion to support the industry by 2035 **CHITC**

Transport, distribution and storage

Charging infrastructure

Support for the development of charging infrastructure ◆
More than $1 billion in funding for charging and refueling infrastructure
CIB **ZEVIP**

CCUS

Investment tax credit for carbon capture, utilization and storage ◆
37.5% to 60% on necessary equipment

Use

Mobility

Clean Fuels Regulations ◆
Reduce the carbon intensity of transport fuels by 15% (compared to 2016) by 2030

Support for the adoption of zero-emission buses ◆
$2.75 billion in ZETF funding to accelerate adoption of zero-emission buses **ZETF**

Support for the adoption of zero-emission medium and heavy-duty vehicles ◆
$625 million in funding to accelerate deployment of zero-emission medium- and heavy-duty vehicles **ZETP** **IMHDZEV**

Industry

Pricing Carbon Pollution ◆
Fossil fuel royalty and credit system for emission intensive industries

Legend

- **Name of Programs**
- ◆ Regulatory framework
- ◆ Support program
- ◆ Financial incentives

*Source: Reuters analysis, 2024

Part 2.

Dynamics of the sector

- H_2 production capacity
- Amount of H_2 consumed
- Implementation in the territory
- Headquarters of players

Dynamics of the sector | H_2 production capacity

● Based on the announced projects

There are 76 **low-carbon H_2 production projects** in Canada, at various stages of development, with a total production capacity of **5.4 Mt/year** (nearly 2 times Canada's annual production capacity from natural gas – 3 Mt/year*). Of these 76 projects, **19 are currently in operation**. **Electrolysis is the production method favored by low-carbon** H_2 projects with **55 projects announced**, 14 projects have planned to produce H_2 from reforming + CCUS, 3 have developed biomass gasification technologies and 6 favor other production methods.

Indicators

01 ● **H_2 announced production capacity**

5.4 Mt/year

Methodological notes

Estimation of the quantity of hydrogen produced by production method and by province based on **announced projects.** These values only reflect projects for which **volume has been announced and for which legitimacy has not been questioned.**

Legend

H_2 production capacity (Mt / year)

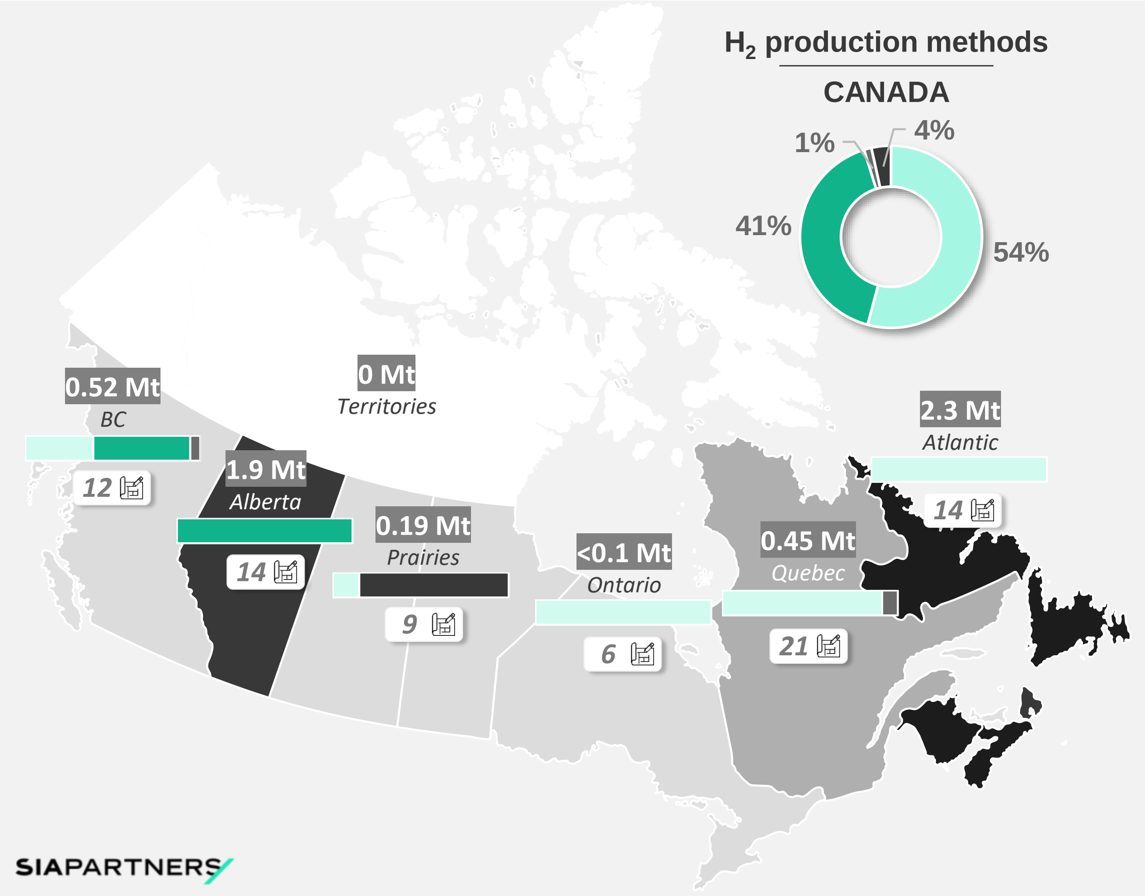
- 0
-] 0 ; 0, 3]
-] 0.3 ; 0.6]
-] 0, 6 ; 1]
-] 1; 1.5]
- > 1.5

XX Mt/year

XX – Number of announced projects

Share of different production methods

- Electrolysis
- Reforming + CCUS
- Biomass gasification
- Other



Provincial Specificities

- **Atlantic Provinces**: Largest producer of low-carbon H_2 in Canada. These provinces are taking advantage of their strong potential in renewable resources to develop ambitious hydrogen production projects. These are mainly electrolyzers connected to very large wind farms (~ GW).
- **Alberta**: A historically gas-producing province, it is the only province promoting reforming processes **associated with CCUS technology**, representing 38% of the country's low-carbon H_2 production.

ZOOM | Electrolyzer

- The electricity mixes of British Columbia and Quebec, **mainly composed of hydroelectricity**, are particularly decarbonized and cheap, **which favors the development of electrolysis projects in these provinces**. In BC, a major project for the production of H_2 by reforming + CCUS explains the distribution of production technology observed.

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Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory

**Canadian Hydrogen Strategy, 2020, NRCAN*

Dynamics of the sector | Quantity of H_2 consumed

● Based on the announced projects

There are currently **77 H_2 projects* in Canada that have announced at least some of their uses**. Of these 77 projects, **67 have specifically targeted their applications, representing a demand of 4.5 Mt/year of H_2 :** 26 aim to produce synthetic fuels, 22 use H_2 for mobility, 6 plan to inject it into the existing gas network, 4 to produce decarbonized steel, 2 to decarbonize petrochemical activities and 7 concern other industrial uses (network balancing, ethylene production, etc.).

Indicators

02. **Quantity of H_2 consumed by planned projects**

4.5 Mt/year

Methodological notes

Estimation of the quantity of hydrogen consumed by sector and by province **based on announced projects for 2030.**
These values only reflect projects for which **usage has been fully quantified and directed towards applications.**

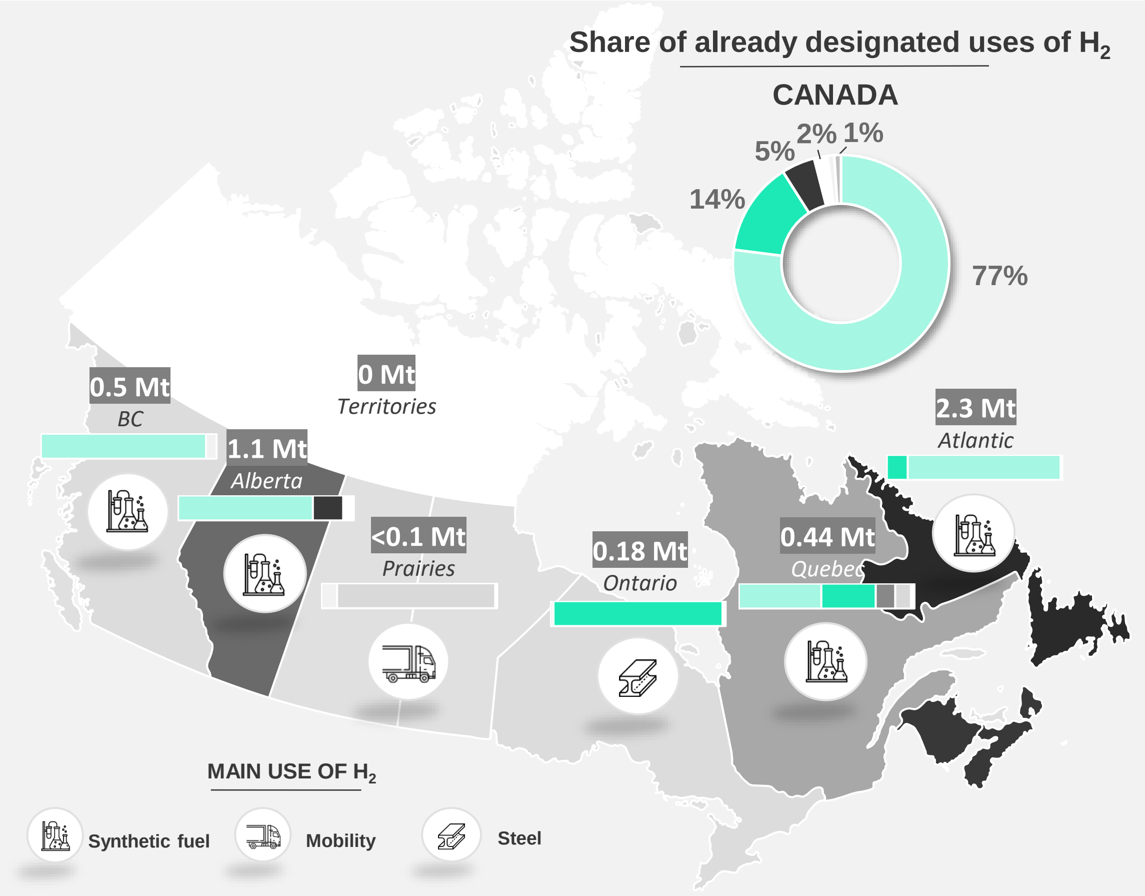
Legend

Amount of H_2 consumed (Mt / year)

- 0
-] 0 ; 0, 3]
-] 0.3 ; 0.6]
-] 0, 6 ; 1]
-] 1; 1.5]
- > 1.5
- XX Mt/year

Share of different applications of H_2 (%)

- Synthetic fuel
- Steel
- Petrochemicals
- Other industrial uses
- Mobility
- Network injection



Typology of Projects

- Although representing more than 1 in 4 projects, **mobility applications are associated with low volumes** (on average 3.5 ktH $_2$ /year)
- **Synthetic fuel and decarbonized steel production** projects correspond to volumes **30 times larger on average** (110 kt /year). These projects are mainly **intended for export** – to Asia in the West, and Europe in the East.

ZOOM | Synthetic fuels

- **Strategic location** (access to the Pacific and Atlantic Oceans), **the wide availability of land** and the presence of **very significant wind/solar potential have pushed several players to develop ambitious** H_2 production projects for export, **mainly in the form of ammonia.**
- Some projects also plan local uses, notably in the form of **ammonium nitrate** for the mining sector.

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*This number differs from the number of production projects because some usage projects do not have associated production, and vice versa.

Dynamics of the sector | Implementation in the territory

● Based on the announced projects

In Canada, 6 H_2 **Hubs** appear to be emerging based on the announced projects: **Prince George, Vancouver, Edmonton, Toronto, Quebec and the Atlantic**. These hubs have several things in common: a **high density of production projects** , **well-targeted end uses** and **infrastructure projects** to support the development of a regional ecosystem. *NB: These hubs differ from the 8 identified by Natural Resources Canada (NRCan) because of the methodological approach which focuses on current and planned projects, rather than on broader criteria used by NRCan .*

Indicators

03. **Number of Hydrogen Hubs**

6 H_2 Hubs

Methodological notes

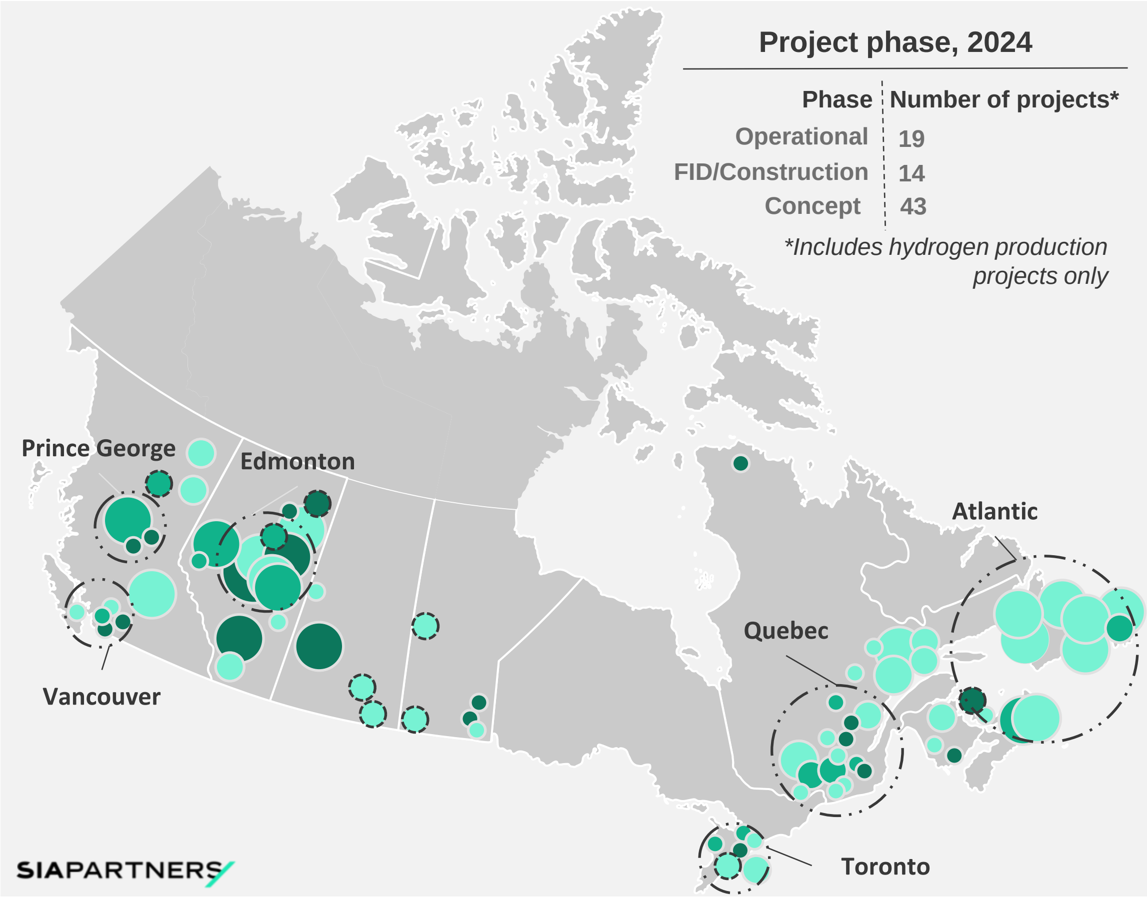
Distribution of projects across the territory and number of associated hubs obtained by aggregating **production capacity data and** project development phases.
This analysis only reflects projects for which **the location is known.**

Legend

H_2 production projects capacity (kt/year)
-] 0 ; 10]
-] 10 ; 50]
-] 50 ; 100]
-] 100 ; 500]
- > 500
- Capacity unknown

Project phase
- Operational
- FID/Construction
- Concept

Identified Hubs
- Name of the Hub



Project phase, 2024

Phase	Number of projects*
Operational	19
FID/Construction	14
Concept	43

**Includes hydrogen production projects only*

The 6 Hydrogen Hubs

- **Prince George.** Has a particularly advantageous location (in the center of BC) and developed transport infrastructures: air, rail network and close to the main highways in the region.
- **Vancouver.** Benefits from strategic access to the Asia-Pacific market. Historic birthplace of H_2 in Canada. Proximity to the SFU Hydrogen Hub in Burnaby ($10M invested).
- **Edmonton.** Primarily focused on reforming with CCUS, Edmonton has experience in H_2 production and the world's largest CO_2 pipeline.
- **Toronto** is well located to serve as a distribution point to the United States and has major airports, ports and highways that support good logistics for hydrogen.
- **Quebec.** It is characterized by structuring projects, on a large scale, and for local needs only.
- **Atlantic.** Has many ports and focuses on an export strategy to Europe in the form of low-carbon ammonia.

Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory

Industry dynamics | Headquarters of the players

Based on the announced projects

Of the 163 stakeholders involved in the benchmarked projects, **31% of them have their head offices located outside of Canada**. Foreign stakeholders mainly position themselves **as technological reinforcements, expert support or as buyers of part of the production** for export projects. The 3 most represented regions are **Europe** – which benefit from valuable feedback from the sector, **the United States** – bordering Canada, and **Japan** – involved in Western Canadian export projects.

Indicators

04. **Share of actors with head offices outside of Canada**

31%

Methodological notes

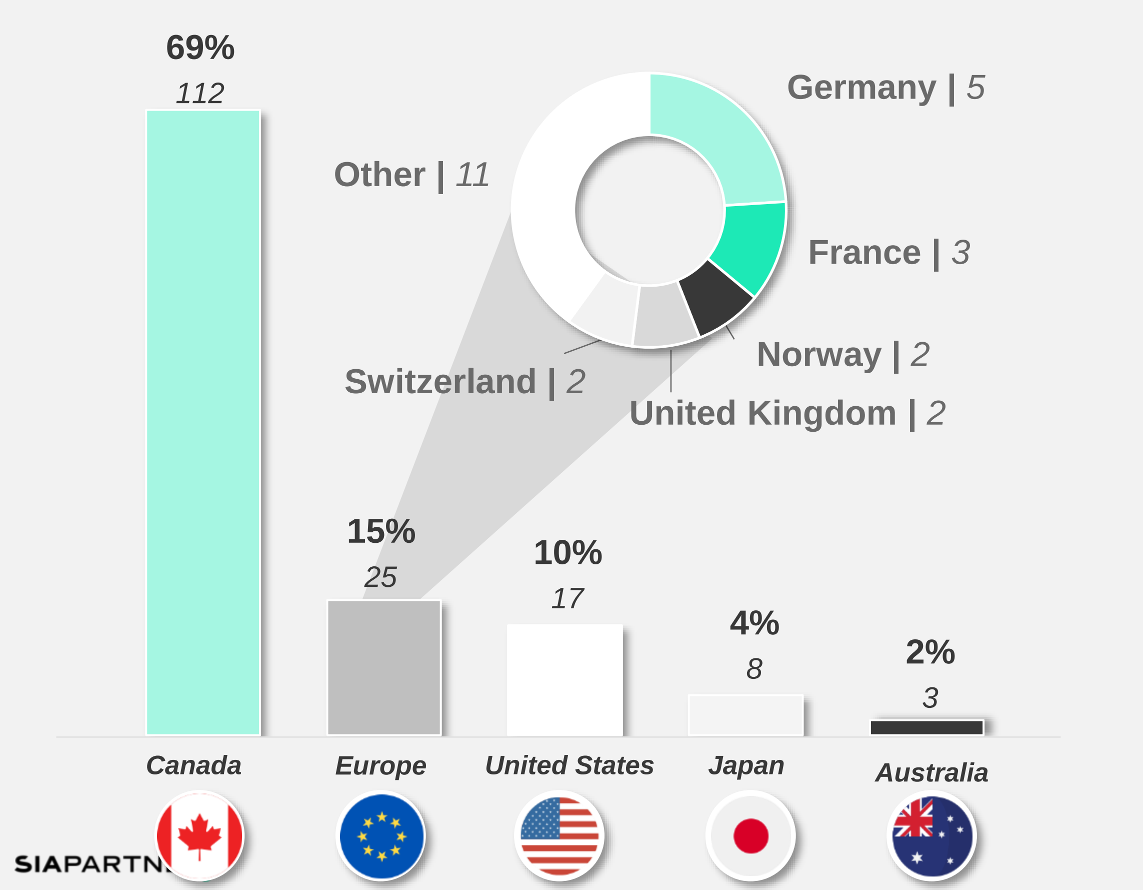
The headquarters of subsidiaries are considered **similar to the parent companies.**

In the case of regional branches (Ex: Mistubishi Canada), **the head office of the parent company was also considered.**

Each actor is only counted once in the analysis, without regard to the number of projects they are carrying out.

Most present actors

	Head office	Number of projects
HTEC	Canada	10
Suncor	Canada	4
Air Product	US	4
Shell	United Kingdom	3
Cummins	US	3



European Nationality

The companies that are expanding to Canada are:

- **Industrial multinationals** that are starting their decarbonization thanks to low-carbon H_2 *Ex: ArcelorMittal , Shell, Yara etc.*
- **Project leaders** who are taking advantage of the favorable context in Canada: *TES, Hy2gen, etc.*
- Specific **technology providers:** *Enapter, Topsoe etc.*
- **Companies with specific expertise**: H_2 pipeline - *Ontras, Elering, etc.*

American Nationality

- Technology **champions**: Cummins, Nikola, Plug Power etc.
- **Historical industrial gas players** with a strong investment capacity/experience with H_2: Esso , *Imperial Oil* , *Air Product, etc.*

Japanese Nationality

Players participate mainly as **investors in ammonia projects** in Alberta **for export to Japan.**

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Part 3.

Resources to be mobilized

- Electricity needs
- Water needs
- Manufacturing needs
- Critical mineral needs

Resources to be mobilized | Electricity Needs

Based on the announced projects

The **energy sources available** in each province influence the preferred hydrogen production method. The electricity mixes of Quebec, Ontario and British Columbia rely heavily on hydroelectricity, making hydrogen production through **electrolysis** suitable. In contrast, Alberta, with its abundant natural gas resources, favours **reforming** coupled with CCUS technologies. Across Canada, electrolysis requires the largest share of the country's electricity needs, **representing 31% of the 500 TWh of low-carbon electricity** produced in Canada annually.

Indicators

05.

Electricity needs of planned projects

156 TWh/year

Methodological notes

Estimation of the quantity of electricity required by means of production and by province **based on planned projects.**
These values are based on projects for which **hydrogen production capacity is known.**

Legend

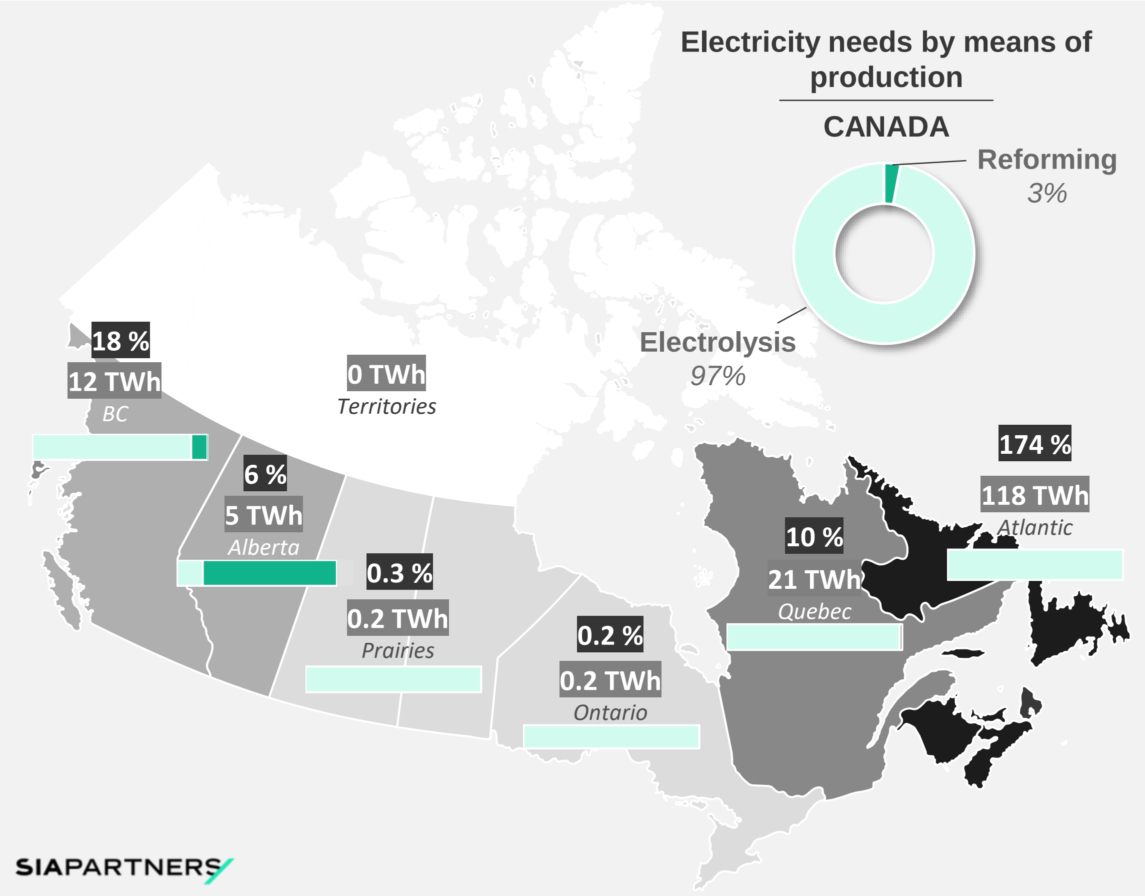
Provincial electricity needs (TWh/year)

- 0
-] 0 ; 5]
-] 5 ; 20]
-] 2 0 ; 60]
-] 6 0 ; 80]
- > 80
- XX TWh/year

XX % — Electricity needs/capacity ratio

Share of needs by production methods (%)

- Electrolysis
- Reforming + CCUS
- Biomass gasification
- Other



Electricity Challenges

The massive electrification of the economy is congesting existing electricity grids, **slowing the development of industrial projects** and encouraging provinces to **prioritize projects** and/or **develop additional renewable capacities.**

The Quebec government has adopted 4 criteria to select the projects that will receive the electrical blocks: technical capacity, social acceptability, capacity to decarbonize and economic benefits.

Nova Scotia plans to supply 5 GW of offshore wind power by 2030 to support (among other things) the low-carbon H_2 sector.

The use of **intermittent electricity sources**, such as wind or solar, also raises issues for the production of H_2 by electrolysis.

- *Some electrolyzer technologies (e.g., low-pressure alkaline electrolyzers) do not handle load variations well, sometimes requiring the installation of buffer batteries to ensure technical feasibility.*

Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory

Resources to be mobilized | Water Needs

Based on the announced projects

Canada has abundant water resources, however there is heterogeneity between the locations where water is abstracted and the areas where the resource is located: **60% of fresh water flows to the Arctic,** while 85% of the population lives within 300km of the US border. Historically, the regions around Calgary, Edmonton and Toronto have shown higher signs of **water stress with 20 to 40% of river water withdrawn for various uses**. The production of H_2 in these areas will therefore have to be accompanied by particular care to avoid exacerbating the local water stress.

Indicators

06. **Water needs of planned projects**

150 hm³/year

Methodological notes

Estimation of the quantity of water withdrawn by means of production and by province **based on planned projects.**

These values reflect the quantities of water **withdrawn** from projects for which **capacity and production technology are known**.

Legend

Provincial water needs (hm³/year)

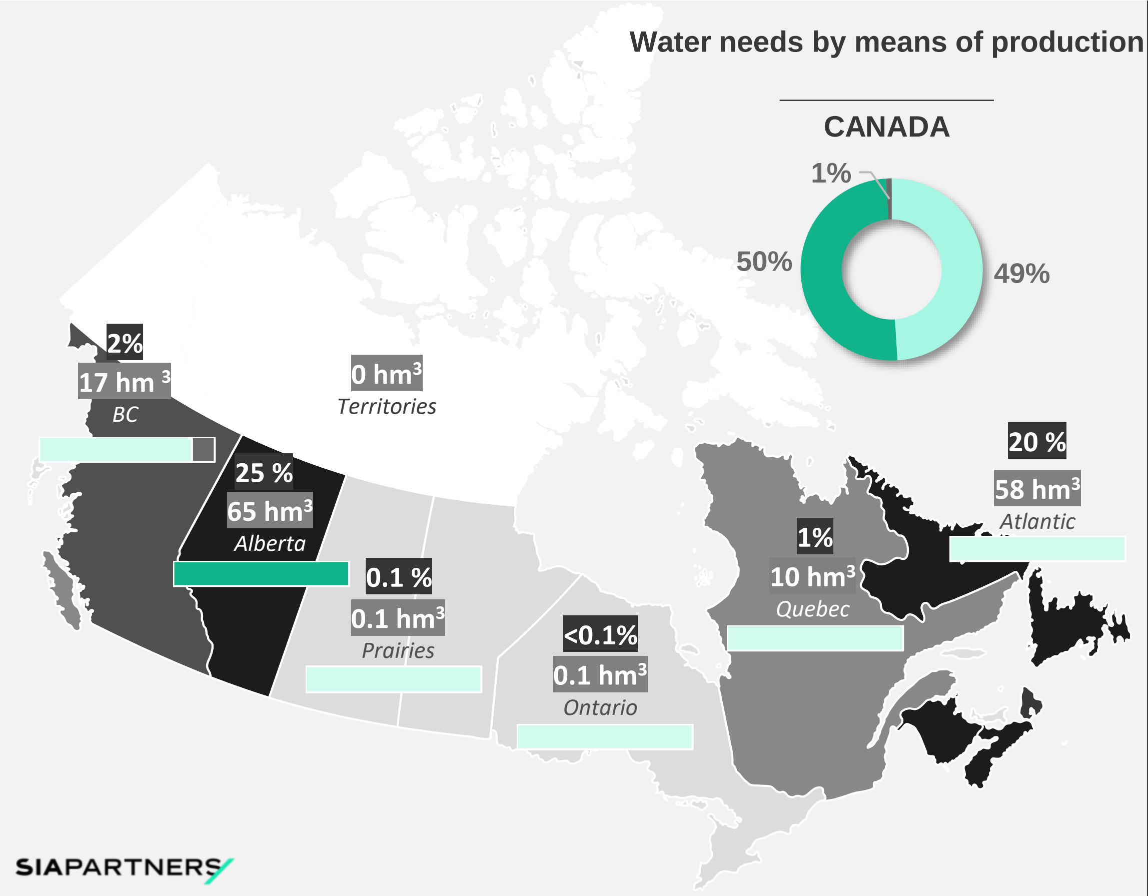
- 0
-] 0 ; 5]
-] 5 ; 10]
-] 10 ; 15]
-] 15 ; 20]
- > 20

XX hm3/year

XX% Ratio of water withdrawal for H_2 to current withdrawal for manufacturing industries

Share of water by production methods

- Electrolysis
- Reforming + CCUS
- Biomass gasification



Provincial Specificities

- **Alberta:** The main province using reforming, accounting for **40% of total water withdrawals for the hydrogen sector in Canada.** The technology can require up to **2 times more water per kg of H_2 produced,** compared to other processes.
- **Atlantic Provinces:** Have abundant water resources, necessary for their ambitious electrolysis production objectives.

ZOOM | Water challenges

- Producing H_2 by electrolysis requires **a high level of water purity. The water must therefore be demineralized,** and the discharge of demineralized water can disrupt surrounding ecosystems.
- Carbon capture processes **require on average 20% more water.** Some technologies (reforming + CCUS) then require up to 50L of water per kg of H_2 product.

Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory
IRENA (2023), Water for hydrogen production

Resources to be mobilized | Manufacturing Needs *(electrolyzers)*

● Based on the announced projects

Electrolyzers are a key technology for low-carbon hydrogen production. According to the IEA, the completion of all current projects could increase the global installed capacity of electrolyzers to **170-365 GW by 2030.** In Canada, **18.8 GW of electrolyzers** are needed to support the projects identified - **the vast majority of projects have not yet specified their technology** (PEM, ALK, etc.). It should also be noted that **99% of this demand does not have an announced technology supplier**, which leaves **significant room for the establishment of manufacturers in Canada**.

Indicators

07. **Manufacturing needs of planned projects**

18.8 GW

Methodological notes

Only projects with **known production capacity** were considered.

Some projects only share their information in tons of H_2 produced annually, **conversion calculations** were used to estimate the size of the electrolyzer.

Legend

Provincial manufacturing needs (MW/year)

0

] 0 ; 50]

] 5 0 ; 10 0]

] 100 ; 500]

] 500 ; 1000]

> 1000

XX MW/year

Share of capacities provided by suppliers

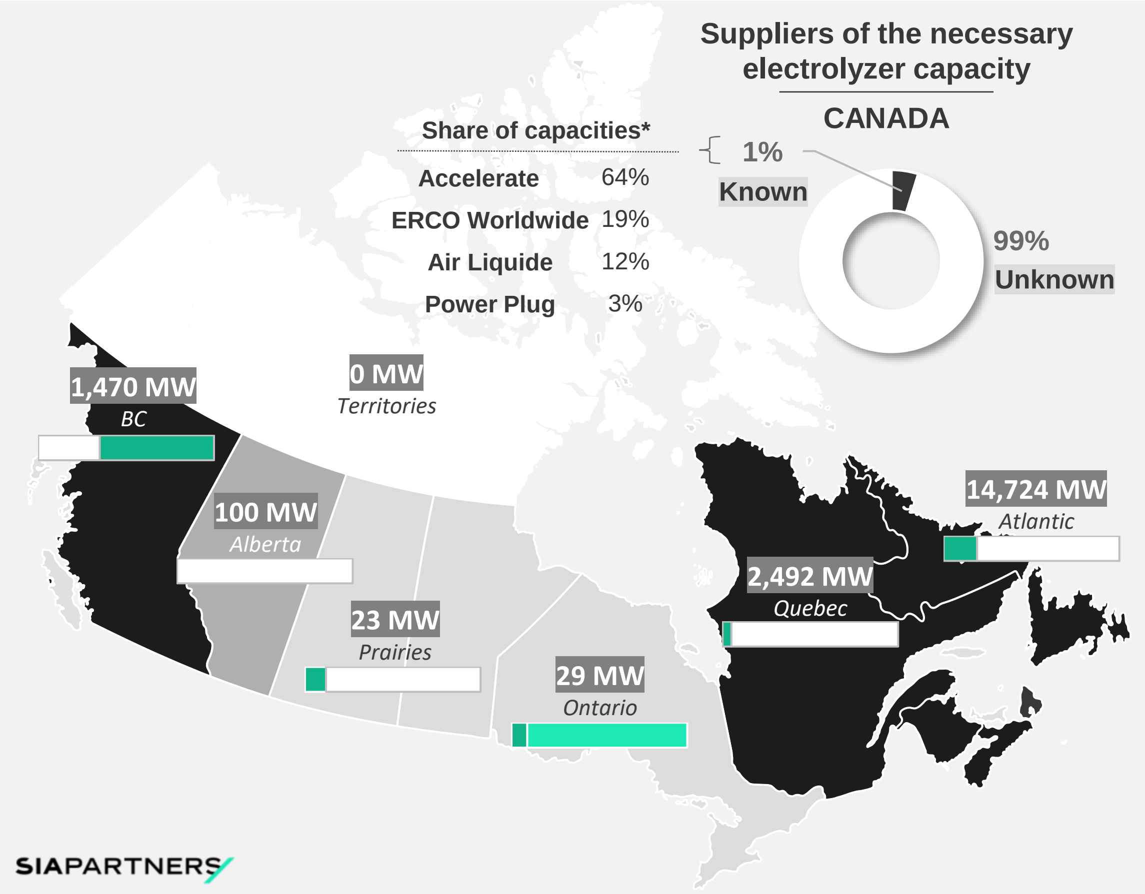
Share of different electrolysis technologies

PEM

SOEC

ALK

Unknown



Provincial Specificities

- The **majority of demand for manufacturing capacity is located in the Atlantic** (78%), followed by Quebec (12%) and British Columbia (8%) due not only to the significant capacity of the projects identified, but also to the complementarity of these regions with electrolysis technology (abundant decarbonized electricity)

ZOOM | Manufacturing needs

- Of the 1% of capacities already allocated to a technology, **a dominance of PEM technology is observed.**
- **The vast majority of projects have not made public their technology supplier** – which is most often announced during the final phases of the projects – refelcting the still low maturity of these projects but opening up a **very interesting opportunity for manufacturers.**

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Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory

**Manufacturers responsible for shares of 1% or less are not represented.*

Resources to be mobilized | Critical mineral Needs

● Based on the announced projects

The growing demand for electrolyzers is driving a significant increase in demand for nickel, platinum, zirconium and iridium, among other minerals. These **minerals are essential in the manufacturing of key components** such as membranes, electrodes, catalysts, etc. Due to the geographical concentration of reserves, production, refining and processing of some of these minerals, manufacturers **anticipate major geopolitical and economic challenges** in scaling up their production chains.

Indicators

08. **Critical mineral needs*****

82,616 t

Methodological notes

An estimate of the quantity of minerals needed in 1 MW of electrolyzers made it possible to quantify the critical mineral needs for each of the identified projects of **known capacity and technology.

2 scenarios have been evaluated by making assumptions about the choice of electrolyzer technology (TRL≥7) for projects **with known capacity and unknown technology** :

- Scenario 1 – 50% ALK 50% PEM
- Scenario 2 – 40% ALK 40% PEM 20% SOEC

Legend

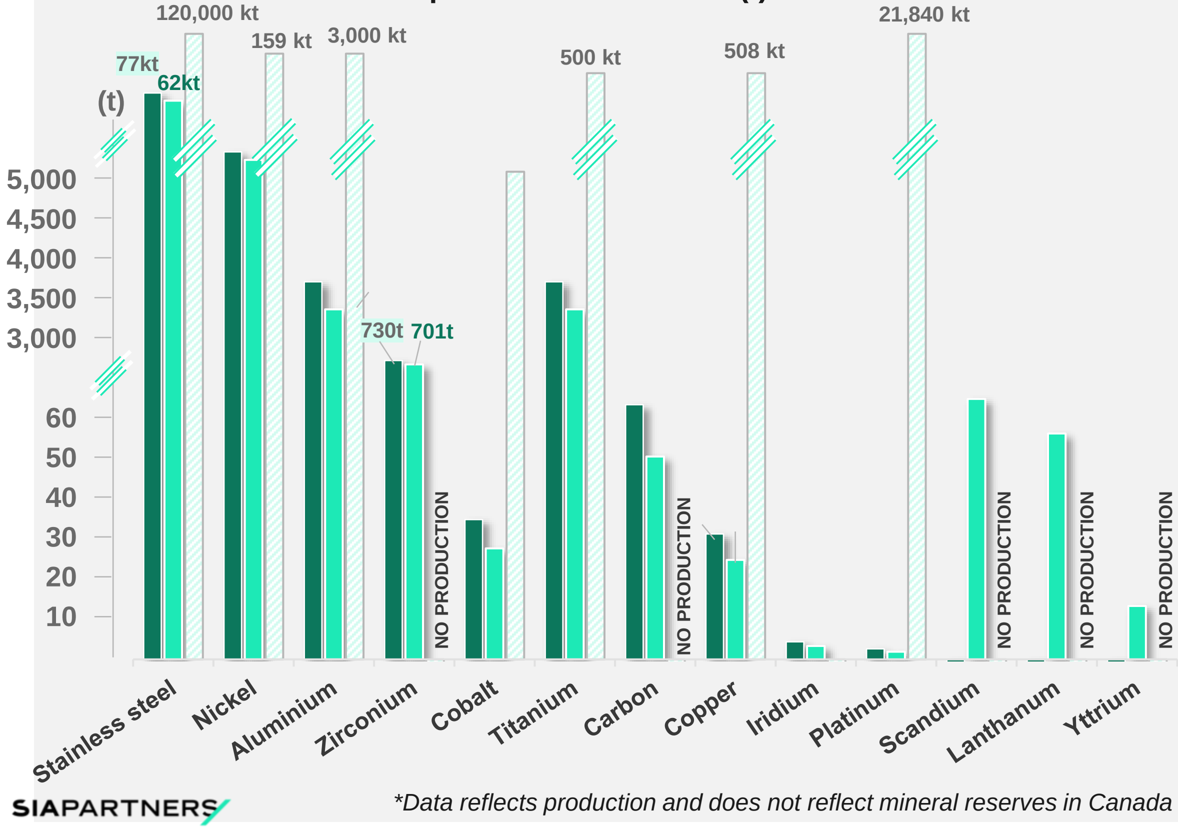
Distribution of needs by scenario

SCENARIO 1 | 50% ALK, 50% PEM

SCENARIO 2 | 40% ALK , 40% PEM, 20% SOEC

ANNUAL PRODUCTION IN CANADA IN 2023**

Quantity of critical minerals required by scenario and production in Canada (t) *



*Data reflects production and does not reflect mineral reserves in Canada

A Major Challenge

- In recent years, **inreasing pressure** over energy transition minerals has led manufacturers and public authorities to identify in detail the criticality of their supply chain. **Some manufacturers do not publish their production ambitions** so as not to artificially increase prices.
- However, there are solutions to reduce the associated risks: **developing technologies** that use fewer minerals (AEM), **substituting and/or reducing** the concentration of the most critical minerals.

ZOOM | Canada

- Canada is one of the world's leading mineral producers and **has a strategy for critical and strategic minerals** as of 2022. Of the 13 minerals identified in this study, **Canada has developed production chains for 7 of them** .

***Source: Eikeng E., Makhsoos , A. and Pollet, BG, (2024), Critical and strategic raw minerals for electrolyzers , fuel cells , metal hydrides and hydrogen separation technologies*

****Source: US Geological Survey (2024) Mineral Commodity Summaries*

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Part 4 .

Positive externalities

- Capital expenditure
- GHG emissions avoided
- Impact on the trade balance

Positive impacts | Investment expenditure

● Based on the announced projects

In total, public and private investments announced in Canada for H_2 projects reach approximately **$90 billion, representing 3% of the national GDP**. Of this amount, nearly $ **5.1 billion comes from public funds**. The **federal government** has committed to $ **1.8 billion,** while the various **provincial governments** are contributing to **$3.3 billion**. Major federal programs: *CIIHP, CII CCUS, CII Clean Technology Manufacturing, etc.*, **representing $93 billion end to end**, should support the financing of the sector by 2035.

Indicators

09. **Investment expenditure of planned projects**

CAD$90 billion

Methodological notes

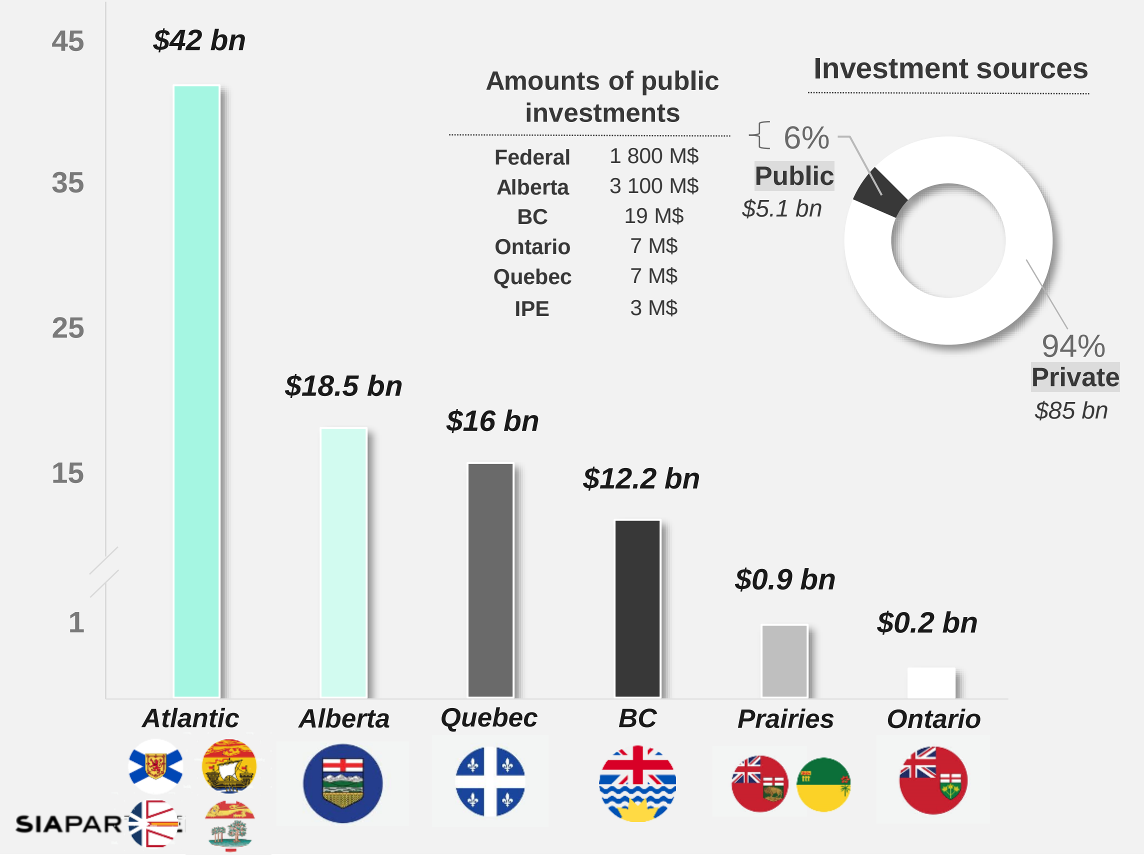
Estimated investment expenditure based on planned projects. These amounts **do not include investments made by manufacturers.**

These values only reflect **projects for which investment amounts have been publicly announced.**

Main federal programs involved in the projects

	Amount invested (M$)
INFRASTRUCTURE BANK OF CANADA	614
CII FOR CCUS AND CII FOR CLEAN HYDROGEN	400
STRATEGIC FUND FOR INNOVATION	349
EXPORT AND DEVELOPMENT CANADA	298

Total announced investments by province *(CAD$ billion)*



Amounts of public investments

Federal	1 800 M$
Alberta	3 100 M$
BC	19 M$
Ontario	7 M$
Quebec	7 M$
IPE	3 M$

Provincial Specificities

- **Atlantic provinces: representing 45% of Canadian** H_2 production , but no provincial investments have yet been announced. Public funds come mainly from federal agencies, notably Export Development Canada, given the region's export objectives. Currently, over 80% of investments in the Atlantic are destined for Newfoundland and Labrador.
- **Alberta:** Accounts for over 93% of announced provincial public funding for hydrogen in Canada, with $2.3 billion through Alberta Petrochemicals Incentive Program and 745 million via the Alberta Carbon Capture Incentive Program.

Federal Investment

- The Canadian strategy progress report, published in May 2023, specifies that a majority of the federal investment will be made through the Clean Hydrogen Tax Credit (CHTC), amounting to $17.7 billion by 2035.

Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory

Positive impacts | Avoided GHG emissions

Based on the announced projects

The production of low-carbon H_2 supports the objectives set by the *Emissions Reduction Plan for 2030* (-40% by 2030 below 2005 levels). **This plan aims to reduce annual CO_2 emissions by 260 Mt between 2005 and 2030.** Based on the projects announced, and with the methodologies for calculating the GHG intensity of H_2 production developed by the Government of Canada, the **H_2 sector could contribute to more than 12% of this objective*** . However, it should be noted that a large part of the low-carbon H_2 produced will serve foreign markets, **thus not directly contributing to the decarbonization of Canada.**

Indicators

10.

GHG emissions avoided by planned projects

32 $MtCO_2e/year$

Methodological notes**

Quantification based only on projects for which **production sources are known and for which uses are already indicated.**

GHG avoided = GHG substituted – GHG emitted

Substituted GHGs are calculated as the emissions associated with the use replaced by H_2. The **GHGs emitted correspond to the GHG intensity of** H_2 production (techno, elec mix, etc.)

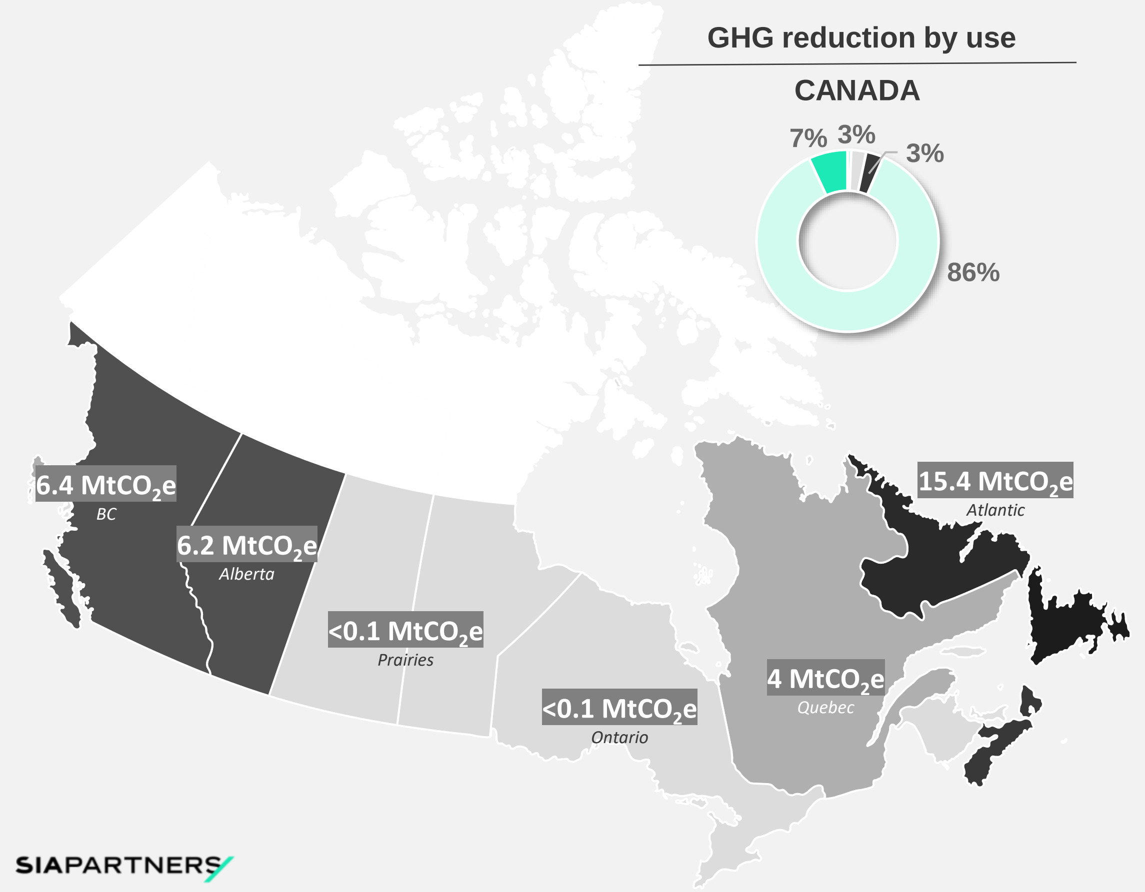
Legend

GHG emissions avoided by province ($MtCO_2e$ /year)

-] 0 ; 1]
-] 1 ; 5]
-] 5 ; 10]
- > 10
- XX $MtCO_2e/year$

Share of different uses of H_2 contributing to the reduction of GHGs (%)

- Synthetic fuel
- Steel
- Petrochemicals
- Mobility



Ghg Analysis

- Some identified projects plan to use H_2 to produce synthetic fuels that will be exported to Asia or Europe. Although the final use of the energy is relocated outside Canada, **the avoided GHG emissions were considered in this quantification** .
- The quantification of GHGs **only concerns announced projects for which use and production are known and quantified.**

Limits Of The Estimate

- GHG quantification does **not take into account the transport, distribution and storage of H_2** between the place of production and the place of use.
- The analysis also does not take into consideration **the manufacturing/end-of-life phases of equipment** linked to new uses.

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**This data has been cross-checked with the reduction targets defined in some provincial strategies and is found to be comparable.*
***The methodological approach is based on the Guide to Quantifying Greenhouse Gas Emissions (MELCCFP) and the quantiGES method (ADEME).*

Positive impacts | Impact on the trade balance

Based on the announced projects

In 2022, all Canadian exports **represented CAD$ 940 billion*.** The development of H_2 projects and - by extension - associated decarbonized molecules/products, could contribute to an increase of nearly **3% in the entire Canadian trade balance.** In a context of rising global protectionism, the development and export of critical industrial sectors (ammonia, methanol and steel) contribute to strengthening **Canada's strategic autonomy and industrial sovereignty.**

Indicators

11 **Impact on the trade balance of planned projects**

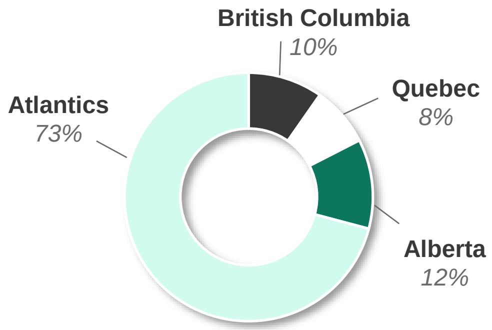
CAD$ 25.8 billion

Methodological notes

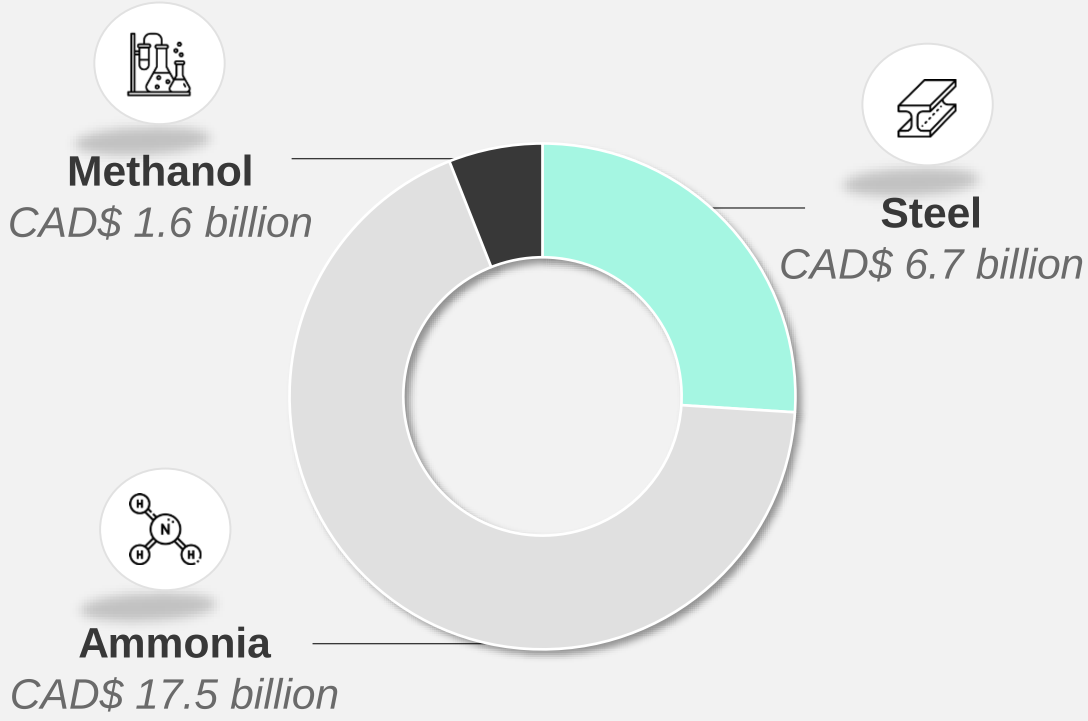
The impact on the trade balance of planned projects is **assessed in exported CAD based on observed market prices**.

Due to the low-carbon nature of the molecules/products considered, the prices observed may be slightly higher than those of carbon molecules/products.

Distribution *of exports by province (in $)*



Impact on trade balance by product



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Prices Noted

DECARBONIZED STEEL

- Price observed: **$920/t**

Source: Global efficiency, Green steel economics, 2024

AMMONIA

- Price observed: **$1,335/t**

Source: S&P Global, Mounthly average price, September 2024

SYNTHETIC METHANOL

- Price observed: **$1,900/t**

Source: IRENA, Innovation Outlook: Renewable methanol , 2021

Limits Of The Estimate

- These assessments are very sensitive to the observed prices of raw materials. The latter depend both on the study periods (post Covid, etc.) and on geography.

**Source: Canada's state of trade , Office of the chief economist , 2023*

Part 5 .

Provincial vision

- Alberta
- Atlantic
- British Columbia
- Ontario
- Prairies
- Quebec

Provincial Vision | How to navigate this section

Water
Low-carbon electricity
Natural gas
Biomass

Raw materials required for hydrogen production

Grants
Favorable regulatory landscape
Industry Association
Provincial H_2 Strategy

Support mechanisms

Synthetic fuels
Mobility
Steel
Petrochemicals

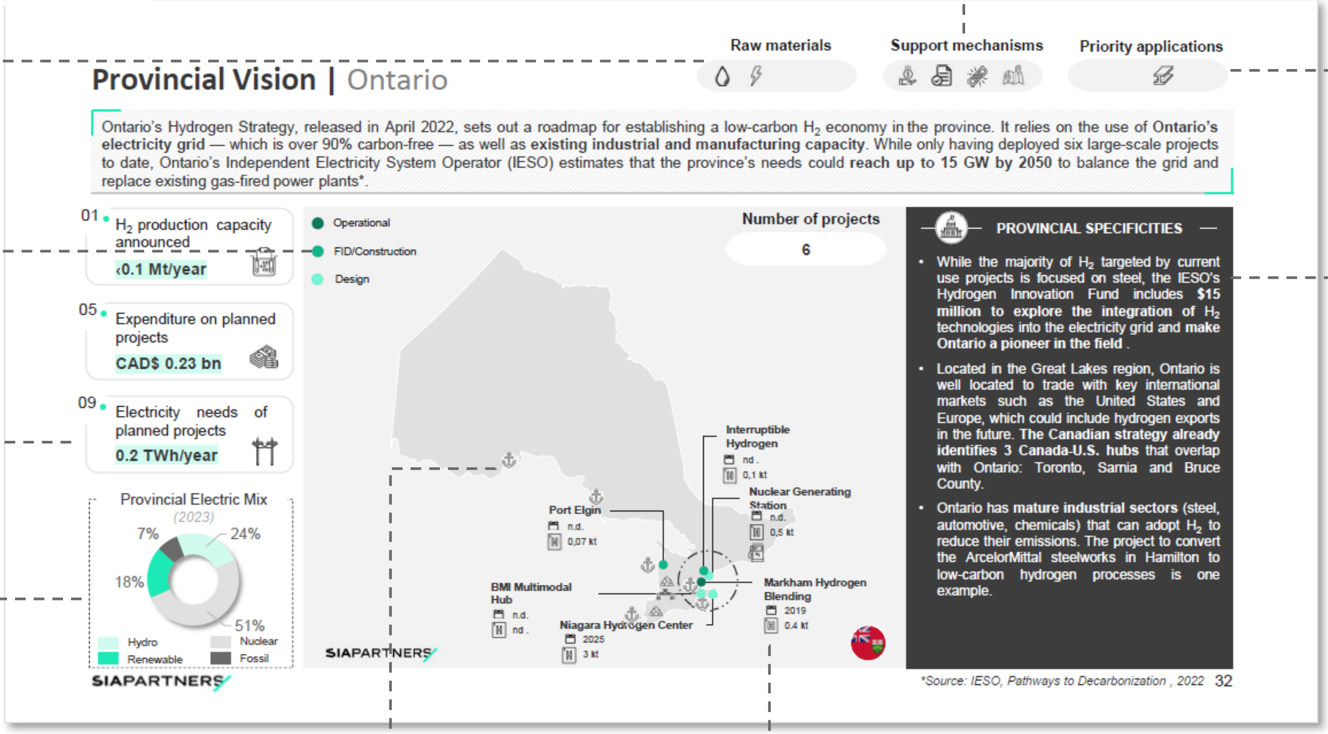
Priority applications

Project phase

- Operational
- FID/Construction
- Design

Provincial indicators

Provincial Electric Mix



Description of the specific features of the province

Project details

- Actual or planned commissioning
- Production ambition in kt/year
- Creation of a wind farm
- Creation of a solar park
- Hydrogen station

Provincial infrastructure

Presence of port infrastructure
Presence of salt cavities
Presence of pipeline
H_2 Hubs
H_2 Stations

Provincial Vision | Alberta

Raw materials | **Support mechanisms** | **Priority applications**

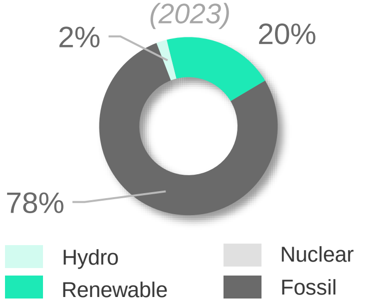
In its H_2 Roadmap released in 2021, Alberta aims to become a leader in the H_2 sector. The province is focusing on **H_2 production using natural gas reforming combined with CCUS technologies** to leverage its abundant natural gas reserves to produce H_2. With 14 announced production projects representing **1.9 Mt/year, Alberta is the second most ambitious region behind the Atlantic.** The Roadmap also aims to integrate H_2 into many domestic applications, for example by blending H_2 with natural gas for residential heating.

01 • H_2 announced production capacity
1.9 Mt/year

05 • Expenditure on planned projects
CAD$ 18.5 bn

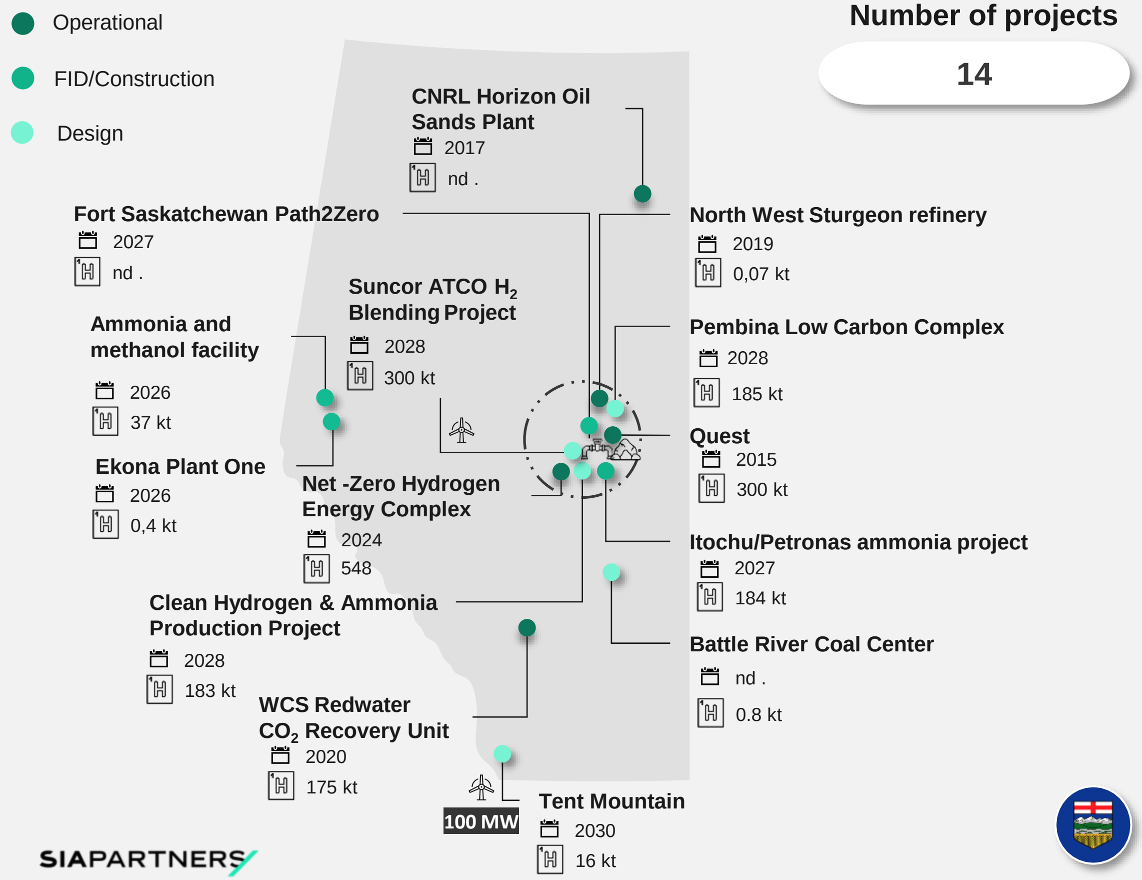
09 • Electricity needs of planned projects
5 TWh/year

Provincial Electric Mix (2023)



Number of projects

14



Provincial Specificities

- The Edmonton Hydrogen Hub **was the first to be established in Canada in 2021.** It brings together projects for the production, transportation and use of low-carbon H_2.
- Alberta plans to establish hydrogen export corridors through British Columbia to reach global markets.
- As part of its strategy, the costs of production of hydrogen from SMR or ATR with CCUS were estimated at below **CAD$2/kg in 2020 in Alberta,** a below average global cost for these processes.
- The Alberta Petrochemicals Incentive Program (APIP) supports the growth of **facilities that use natural gas** in their production processes. Projects for the production of H_2 from natural gas with CCUS are eligible for funding.

Provincial Vision | Atlantic

Raw materials | **Support mechanisms** | **Priority applications**

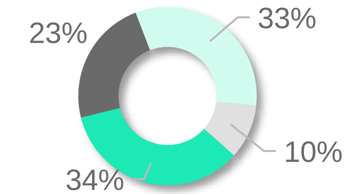
Nova Scotia published its hydrogen strategy in 2023, followed by New Brunswick and Newfoundland and Labrador in 2024. With the largest announced production volume in Canada, the Atlantic provinces are benefiting from considerable investments, with over **CAD$42 billion that will benefit local economies**. Their **vision, focused mainly on exporting** their hydrogen production, is supported by the **presence of robust port infrastructures and their advantageous geographical location,** opening up North Atlantic prospects.

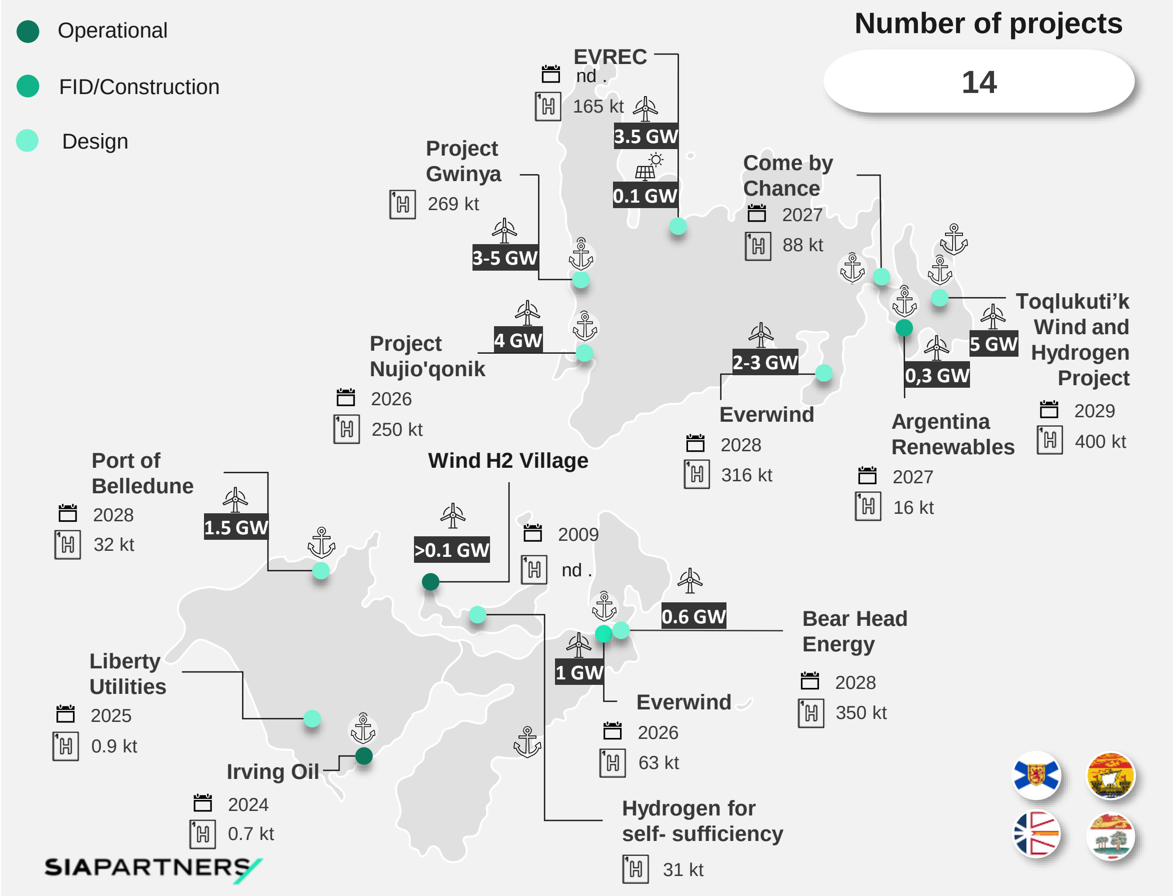
01 • H_2 announced production capacity
2.3 Mt/year

05 • Expenditure on planned projects
CAD$ 42 bn

09 • Electricity needs of planned projects
118 TWh/year

Provincial Electric Mix
(2023)





Provincial Specificities

- To support the planned H_2 projects, electricity and water needs will have to increase by **132% and nearly 20% respectively** in the region. This production effort will be particularly pronounced in Newfoundland and Labrador where these needs will increase by **170% and 85% respectively.**
- To meet their needs for renewable electricity, the provinces of NL have signed a **memorandum of understanding with the federal government** to accelerate the development of **offshore wind energy projects.** More than 20GW of wind energy is under construction in the region to support hydrogen production, with more than **17GW planned for Newfoundland and Labrador.**
- To promote the development of the sector, **memorandums of understanding have been signed** by the Government of Newfoundland and Labrador with the Port of Rotterdam and the City of Hamburg. The Port of Belledune has also signed memorandums of understanding with Rotterdam, Hamburg and Wilhelmshaven.

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Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory

Provincial Vision | British Columbia

Raw materials | **Support mechanisms** | **Priority applications**

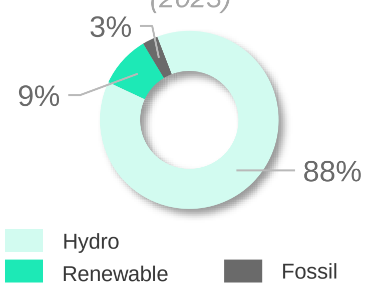
The cradle of H_2 development in Canada, with industrialists established for over 45 years (Ballard), British Columbia is the first province to have published its H_2 strategy in 2021. The strategy focuses on **the production of H_2 from electrolysis and reforming processes combined with CCUS** to optimize the use of the province's natural resources: hydroelectricity and natural gas. BC is focusing on H_2 as a vector for decarbonizing current uses, but also as an **economic opportunity with 3,750 jobs expected by 2050 to build and operate** H_2 production plants .

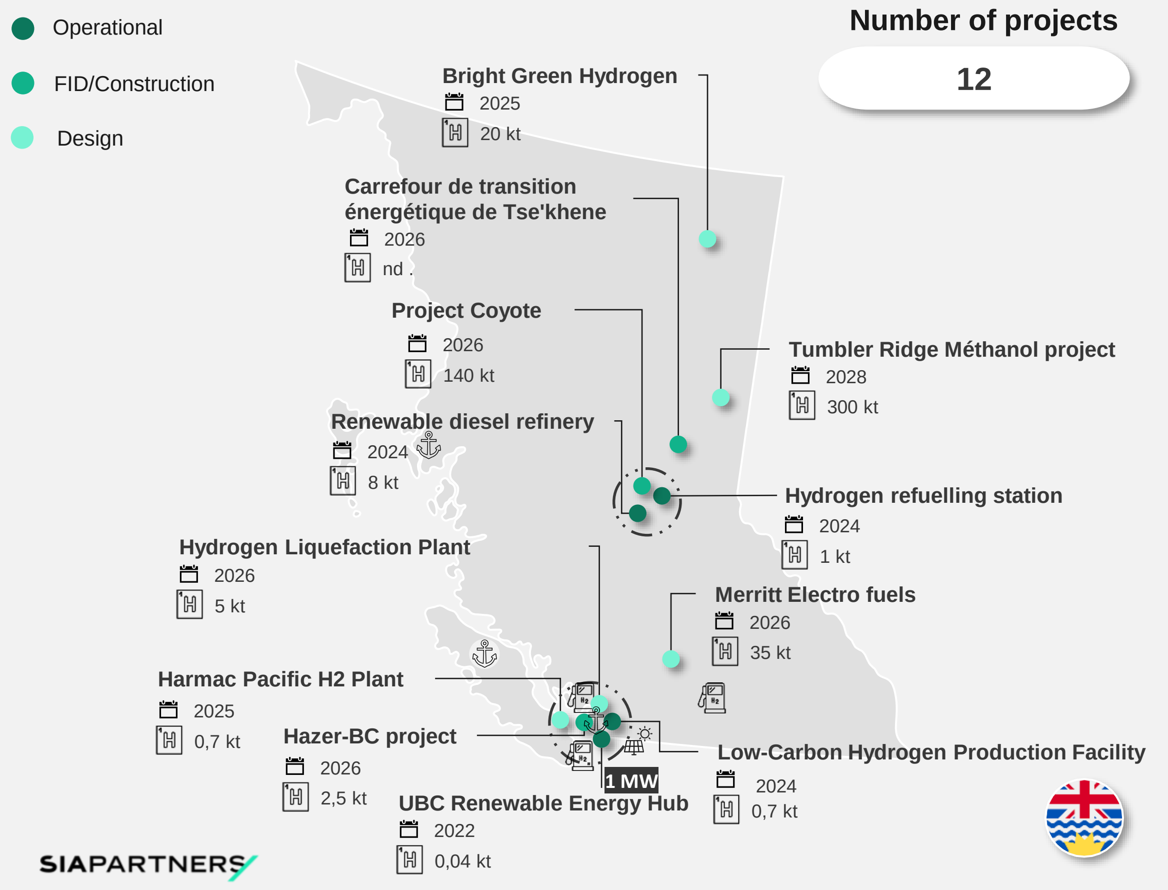
01 • H_2 announced production capacity
0.52 Mt/year

05 • Expenditure on planned projects
CAD$ 12.2 bn

09 • Electricity needs of planned projects
12 TWh/year

Provincial Electric Mix
(2023)





Provincial Specificities

- British Columbia has **2 mature hydrogen hubs** : Prince George and Vancouver, which concentrate a large part of the demand/production. A third hub close to Vancouver is also in development (SFU Clean H_2 Hub).
- British Columbia is the only Canadian province to be developing a **biomass gasification project associated with large-scale CCUS technology** (Bright Green Hydrogen project).
- As part of the **Indigenous Clean Energy Opportunities** partnership, the province is working with the First Nations Energy and Mining Council to identify opportunities for Indigenous groups to participate in the hydrogen sector.
- **The province has launched the BC Hydrogen Office** to facilitate the approval process for H_2 projects. This office works with federal and local governments to attract investment and streamline permitting procedures.

Source: Sia Partners (2024), Analysis for the Canadian Hydrogen Observatory

Provincial Vision | Ontario

Raw materials | **Support mechanisms** | **Priority applications**

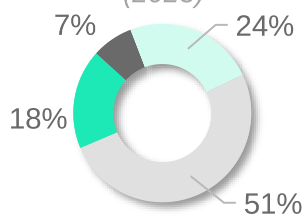
Ontario's Hydrogen Strategy, released in April 2022, sets out a roadmap for establishing a low-carbon H_2 economy in the province. It relies on the use of **Ontario's electricity grid** — which is over 90% carbon-free — as well as **existing industrial and manufacturing capacity**. While only having deployed six large-scale projects to date, Ontario's Independent Electricity System Operator (IESO) estimates that the province's needs could **reach up to 15 GW by 2050** to balance the grid and replace existing gas-fired power plants*.

01 • H_2 announced production capacity
‹0.1 Mt/year

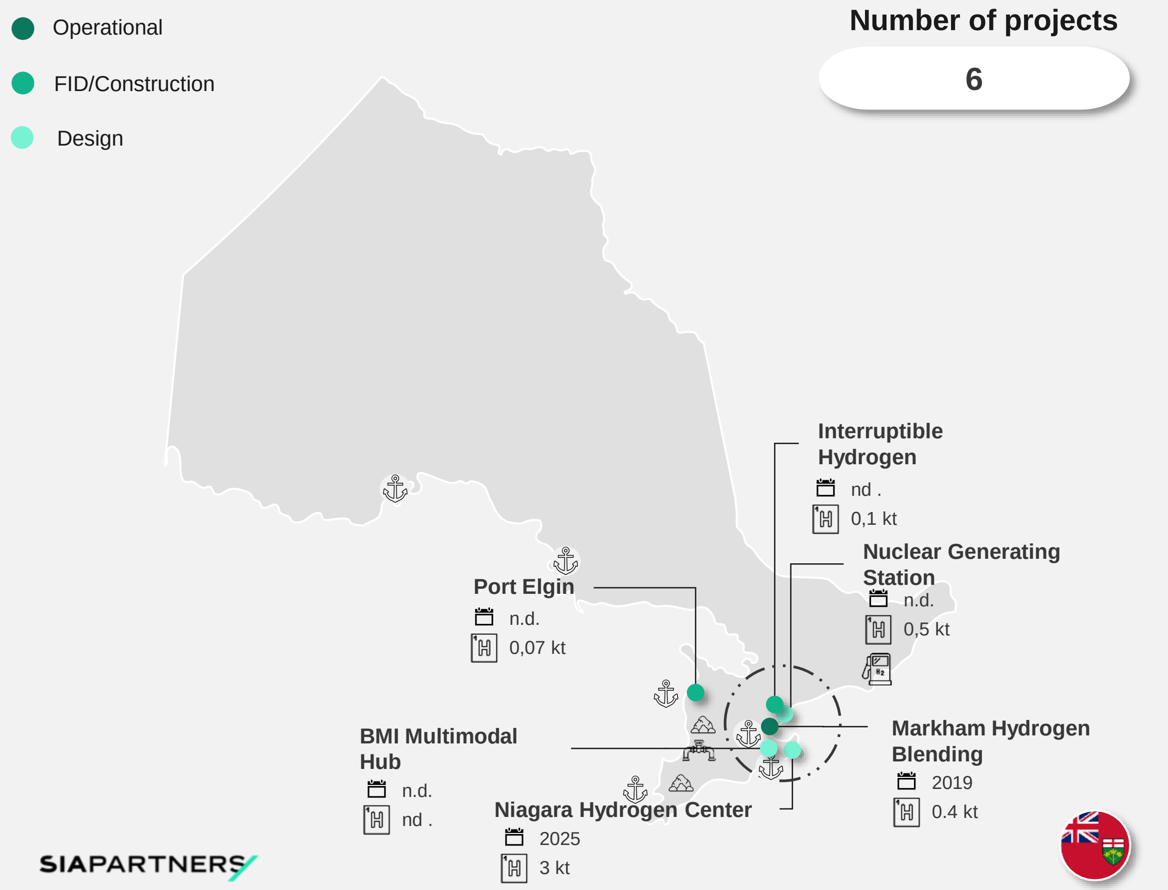
05 • Expenditure on planned projects
CAD$ 0.23 bn

09 • Electricity needs of planned projects
0.2 TWh/year

Provincial Electric Mix
(2023)



Hydro | Nuclear
Renewable | Fossil



Provincial Specificities

- While the majority of H_2 targeted by current use projects is focused on steel, the IESO's Hydrogen Innovation Fund includes **$15 million to explore the integration of** H_2 technologies into the electricity grid and **make Ontario a pioneer in the field** .
- Located in the Great Lakes region, Ontario is well located to trade with key international markets such as the United States and Europe, which could include hydrogen exports in the future. **The Canadian strategy already identifies 3 Canada-U.S. hubs** that overlap with Ontario: Toronto, Sarnia and Bruce County.
- Ontario has **mature industrial sectors** (steel, automotive, chemicals) that can adopt H_2 to reduce their emissions. The project to convert the ArcelorMittal steelworks in Hamilton to low-carbon hydrogen processes is one example.

Provincial Vision | Prairies

Raw materials | **Support mechanisms** | **Priority applications**

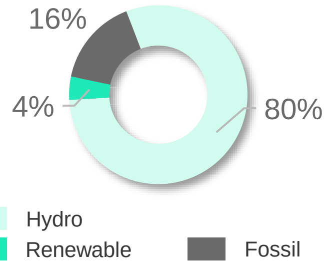
Manitoba **is currently developing its own hydrogen economic development strategy**, 20 years after initial preliminary assessments, which were conducted in 2003. Saskatchewan, meanwhile, **does not have an H_2 strategy** but released its **CCUS priorities** in September 2021, where key actions were highlighted to **advance private sector investment** in CCUS - recognizing that increasing the potential availability of CCUS hubs and facilities will encourage **the development of low-carbon hydrogen production**.

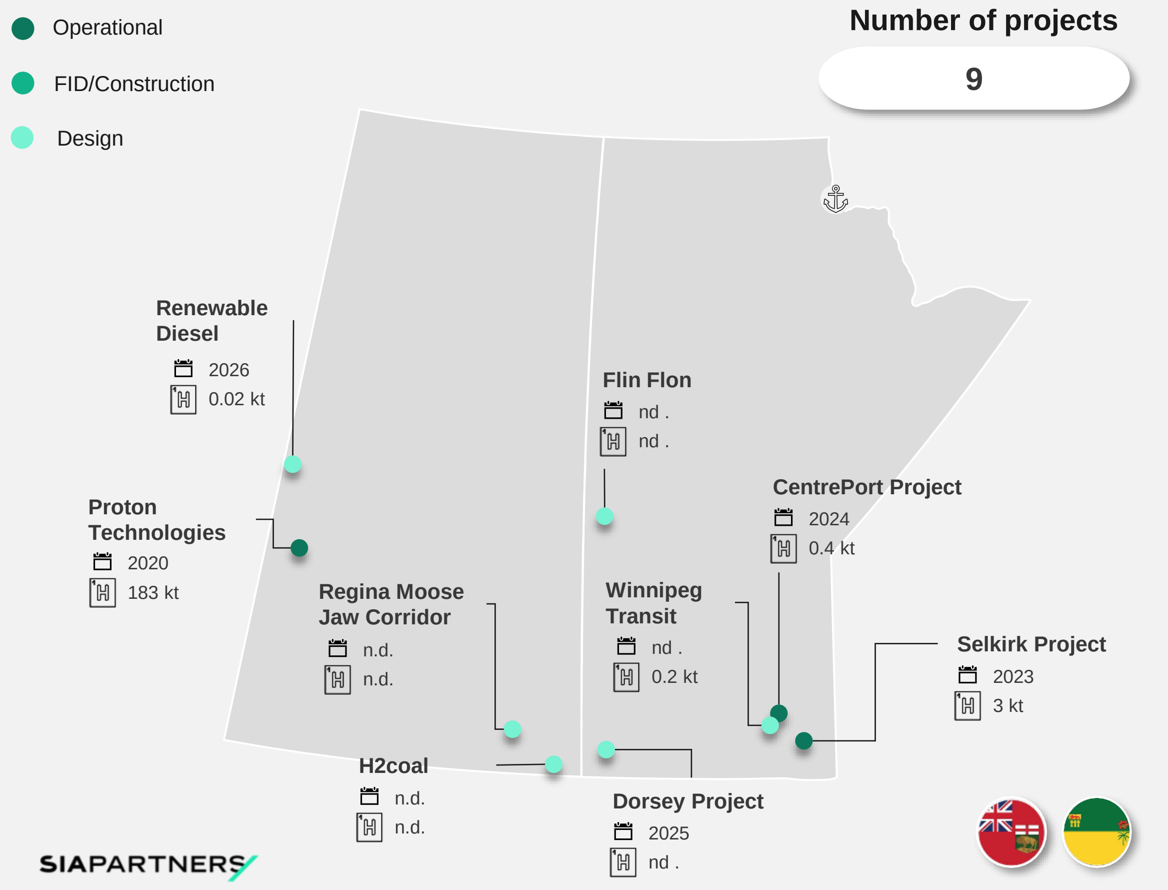
01 • H_2 announced production capacity
0.19 Mt/year

05 • Expenditure on planned projects
CAD$ 0.96 bn

09 • Electricity needs of planned projects
0.2 TWh/year

Provincial Electric Mix
(2023)





Provincial Specificities

- The Prairies provinces are strategically located to become an **H_2 transportation corridor with routes to canadian and american markets.**
- **Agriculture, which is highly developed in these two regions,** would also provide significant biomass deposits for the production of H_2 or ammonia.
- In both provinces**, natural hydrogen is also being looked at closely**. Recently, Max Power Mining identified the largest natural hydrogen deposit in Canada in Saskatchewan.
- A strategic project for the region, led by Proton Technologies **aims to extract hydrogen from depleted oil wells**. By injecting O_2 into the reservoir, the technology causes a partial underground combustion that releases hydrogen. This **process uses existing oil infrastructure**, reducing the costs and environmental impact of H_2**.**

Provincial Vision | Quebec

Raw materials | **Support mechanisms** | **Priority applications**

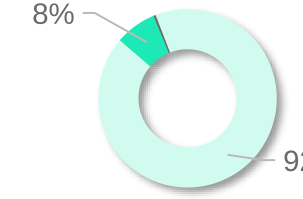
In its H_2 and Bioenergy Strategy published in 2022, Quebec affirms its ambition to develop **regional energy ecosystems** to support the decarbonization of industries and meet **local needs**. This strategy also establishes an order of merit in H_2 applications with priority given to **green chemistry**, **green steel** and **long-distance maritime/air/road transport.** Quebec is the province **with the most production projects** (21 projects identified) but the capacities produced remain limited **due to the provincial desire not to export H_2.**

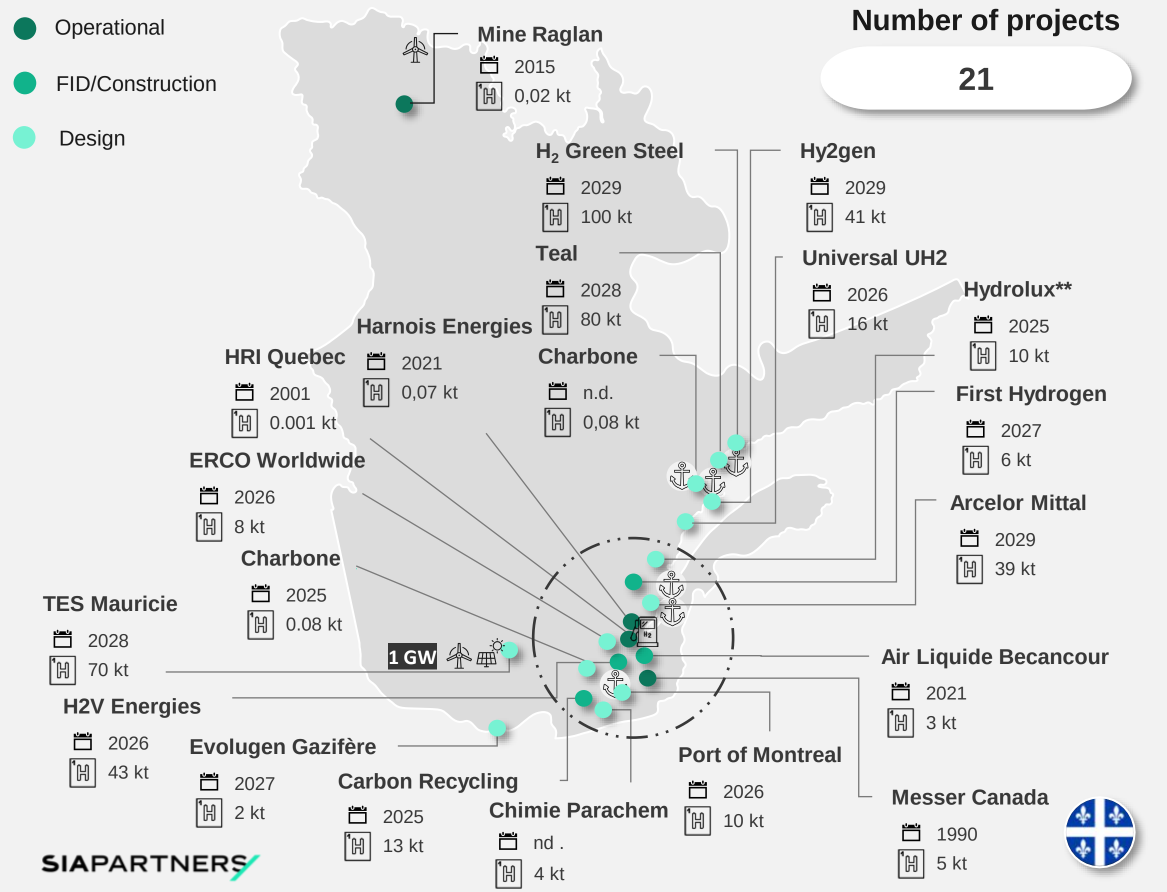
01 • H_2 announced production capacity
0.45 Mt/year

05 • Expenditure on planned projects
CAD$ 16 bn

09 • Electricity needs of planned projects
21 TWh/year

Provincial Electric Mix
(2023)





Provincial Specificities

- Historically, the high abundance of low-carbon, **low-cost hydroelectricity has attracted several** H_2 project developers to Quebec. These **projects are now facing challenges in allocating the energy blocks needed to support the significant electricity needs of** H_2 production.
- In this context, draft laws (PL 69 in particular) aim to give **producers more flexibility** to deploy additional renewable capacities (wind and solar) off the grid.
- The priority applications are the "no regrets" sectors, namely **green chemistry and green steel**. A recent study by Propulsion Québec* also identifies an opportunity in **heavy and long-distance transport**.
- Quebec has **several attractions** for the development of H_2: the presence of **critical and strategic minerals**, the abundance **of decarbonized energy and fresh water, a dynamic R&D** ecosystem, etc.

Potential for adoption of green hydrogen in heavy and long-distance transport in Quebec, 2023

***Project with multiple locations*

Glossary | Abbreviations

ALK Alkaline
ATR Autothermal reforming
BC British Columbia
Bn billions
CAD Canadians Dollars
CAPEX Capital expenditure
CO_2 Carbon dioxide
CCUS Carbon capture, usage and storage
FID Final investment decision
GDP Gross Domestic Product
GHG Greenhouse gases
GW Gigawatt
H_2 Hydrogen
H_2O Water
Hm Hectometer
IPE Prince Edward Island
Kg Kilogram
Km Kilometer
Kt Kilotons
L Liters
M Millions
Mt Megatons
$MtCO_2e$ Megatons of CO_2 equivalent
MW Megawatt
NB New Brunswick
n.d. Not determined
NG Natural gas
NL Newfoundland and Labrador
NS Nova Scotia
O_2 Oxygen
PEM Proton Exchange Membrane
QC Quebec
R&D Research and Development
SMR Steam Methane Reforming
SOEC Solid Oxide Electrolyzer
T Tons
TWh Terawatt hour
USA United States of America

Glossary | Terminologies and acronyms

CIB Canada Infrastructure Bank
Hubs Concentration of green hydrogen production projects
ITC Investment tax credit
CHITC Clean Hydrogen Investment Tax Credit
E-fuels Synthetic fuels produced from renewable energy sources
ZETF Zero Emission Transport Fund
Hubs Centralized infrastructure dedicated to the production, storage, distribution and use of hydrogen as an energy source
IVMHDZEV Incentives for medium and heavy duty zero emission vehicles
Atlantic Newfoundland, Labrador, Nova Scotia, New Brunswick, Prince Edward Island
ZETP Zero Emission Trucking Program
ZEVIP Zero Emission Vehicle Infrastructure Program
Prairies Manitoba and Saskatchewan
CFR Clean Fuels Regulation
NRCan Natural Resources Canada
SFU Simon Fraser University

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