

Hydrogen: Policy, Regulation and Prospects

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April 22, 2022



Hydrogen

MEDICINE HAT NEWS

APRIL 13TH, 2022

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Hydrogen coming fast and here to stay, city officials say

BY COLLIN GALLANT ON MARCH 18, 2022.

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A report into the potential for southeast Alberta to become a hydrogen production hub is due soon, but a council committee Tuesday was apprised of a high level overview of the rapidly advancing sector.

The utility and infrastructure division heard a presentation provided to a group of Alberta engineers and geophysicists

Report on regional potential for hydrogen hub is due soon.--NEWS FILE PHOTO

Energy / Columnists / Business

Varcoe: Hydrogen has the potential to be Alberta's next oilsands in importance

'This is an opportunity for Alberta to create generational wealth for the province. We have an opportunity to be a leader in clean, affordable energy,' said Associate Natural Gas Minister Dale Nally

Chris Varcoe • Calgary Herald
Nov 05, 2021 • November 5, 2021 • 4 minute read • 79 Comments

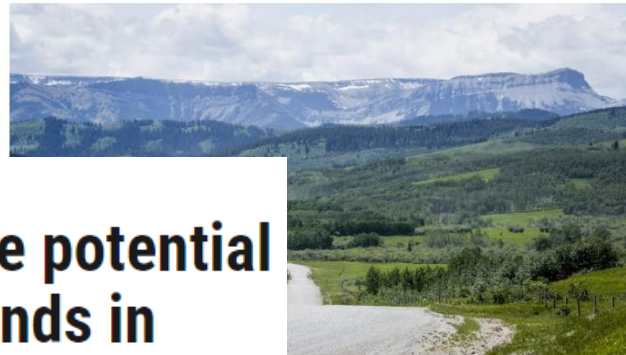
Calgary

'Which thing to build?': Montem Resources weighs coal mine versus hydrogen in Alberta

f t e r in

Montem is considering government's extension of a pause on coal development in some parts of the Rockies

Bob Weber - The Canadian Press - Posted: Apr 08, 2022 8:29 AM MT | Last Updated: April 8



B.C. Energy Minister Bruce Ralston tours Cellcentric's hydrogen fuel cell plant in Burnaby, August 2021. Cellcentric is a German-based partnership of Mercedes Benz and Volvo, developing zero-emission heavy trucks. (B.C. government photo)

B.C.'s hydrogen fuel project seeing big investor interest, Horgan says

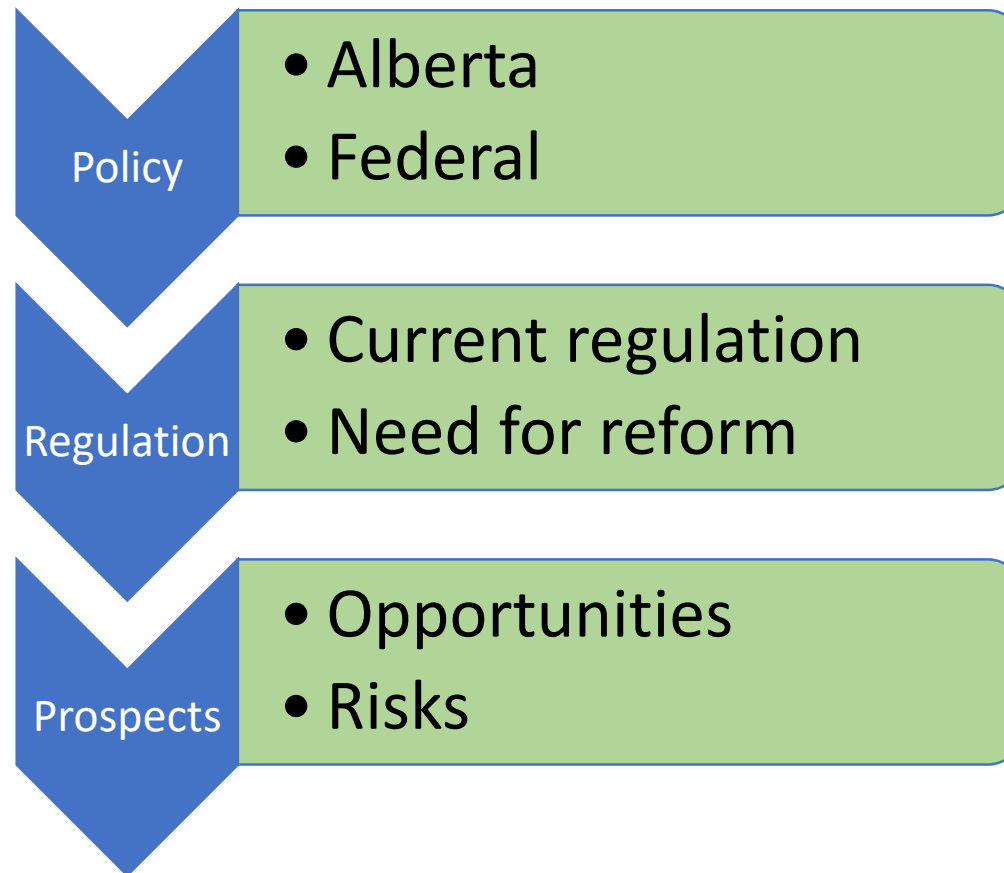
Dedicated permit office aims to streamline development

TOM FLETCHER / Mar. 31, 2022 10:50 a.m. / BUSINESS

Hydrogen



Hydrogen - Outline



Hydrogen: uses, benefits, challenges

Periodic Table of the Elements

1 IA																	18 VIIIA
1 H Hydrogen 1.008																	2 He Helium 4.002602
3 Li Lithium 6.94	4 Be Beryllium 9.012182											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
11 Na Sodium 22.98976928	12 Mg Magnesium 24.304											13 Al Aluminum 26.9815386	14 Si Silicon 28.0855	15 P Phosphorus 30.973761998	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955912	22 Ti Titanium 47.88	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938044	26 Fe Iron 55.845	27 Co Cobalt 58.933195	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.6305	33 As Arsenic 74.9216	34 Se Selenium 78.9718	35 Br Bromine 79.904	36 Kr Krypton 83.798
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.905848	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium 98	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.757	52 Te Tellurium 127.6	53 I Iodine 126.90447	54 Xe Xenon 131.29
55 Cs Cesium 132.90545196	56 Ba Barium 137.327	57-71 Lanthanoids	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.222	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium [209]	85 At Astatine [210]	86 Rn Radon [222]
87 Fr Francium [223]	88 Ra Radium [226]	89-103 Actinoids	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [277]	109 Mt Meitnerium [276]	110 Ds Darmstadtium [271]	111 Rg Roentgenium [272]	112 Cn Copernicium [285]	113 Nh Nihonium [284]	114 Fl Flerovium [289]	115 Mc Moscovium [288]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]
57 La Lanthanum 138.90547	58 Ce Cerium 140.12	59 Pr Praseodymium 140.90766	60 Nd Neodymium 144.242	61 Pm Promethium [145]	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50015	67 Ho Holmium 164.93033	68 Er Erbium 167.259	69 Tm Thulium 168.93048	70 Yb Ytterbium 173.0547	71 Lu Lutetium 174.967			
89 Ac Actinium [227]	90 Th Thorium 232.0377	91 Pa Protactinium [231]	92 U Uranium 238.02891	93 Np Neptunium [237]	94 Pu Plutonium [244]	95 Am Americium [243]	96 Cm Curium [247]	97 Bk Berkelium [247]	98 Cf Californium [251]	99 Es Einsteinium [252]	100 Fm Fermium [257]	101 Md Mendelevium [258]	102 No Nobelium [259]	103 Lr Lawrencium [260]			

- Most abundant element in the universe;
- In pure form, not widely accessible on earth.

Hydrogen: uses, benefits, challenges

- Isolate pure hydrogen through various processes
- Water is a good example
- H₂O can be separated

Hydrogen: uses, benefits, challenges

- Benefits

- “clean” when consumed
- Can be produced using renewable power

- Challenges

- Can be hard to effectively store
- Difficult to transport
- Costly

POLICY

Hydrogen - Policy

2021

Alberta Hydrogen Roadmap



Alberta

- 2021 – *Alberta Hydrogen Roadmap* published
 - Large natural gas reserves
 - Lots of CCUS
 - Renewable sector
 - Has the assets needed to make low-cost hydrogen

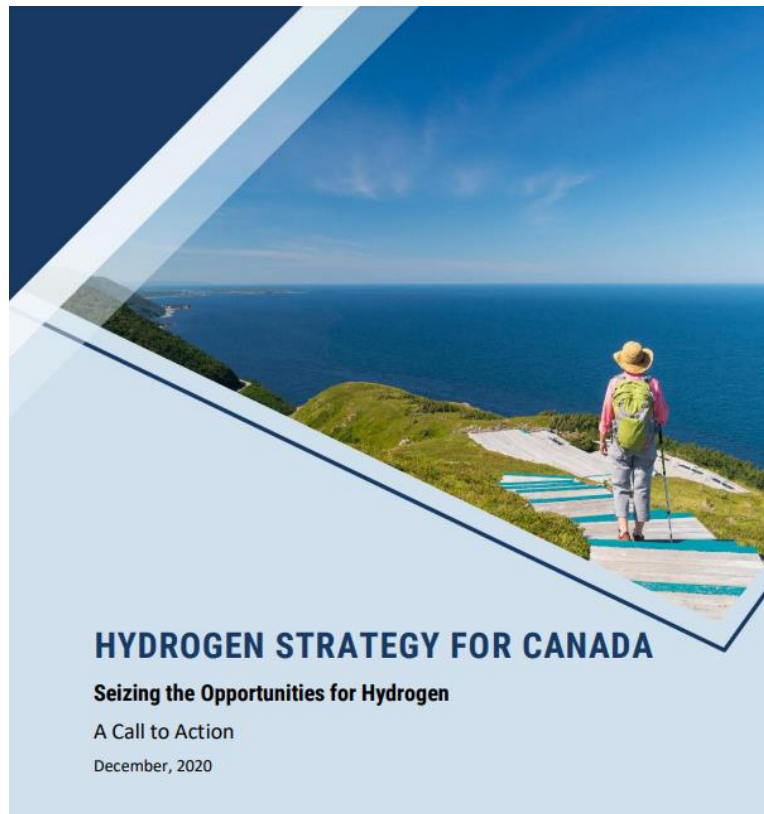
Hydrogen - Policy

- Roadmap's five key considerations for hydrogen:
 1. **Clean Hydrogen in Alberta** – focuses on assessing the logistical questions associated with hydrogen, such as production, storage, and distribution.
 2. **Carbon Capture Utilization and Storage** – looks at the interplay between natural gas hydrogen production and the need for CCUS in order to achieve realizable emissions reductions.
 3. **Technology and Innovation** – considers the gaps in current technology that need to be addressed to make large scale hydrogen a reality.
 4. **Alberta's Hydrogen Markets** – discusses the various markets for hydrogen with an emphasis on domestic (i.e., in Alberta) uses and consideration of potential export markets.
 5. **Alberta's Hydrogen Future** – considers scenarios for how hydrogen development may unfold over the coming years, and what actions are needed today to give rise to each scenario.

Hydrogen - Policy

- Natural Gas Steam Methane Reforming (“**SMR**”) is identified as the dominant production method in Alberta. SMR is an industrial thermochemical process that combines hydrocarbons and steam into hydrogen and CO₂
- Autothermal Reforming (“**ATR**”). This process uses natural gas, steam, and oxygen in the reforming process. The resulting CO₂ is pure, making carbon capture more efficient. The Roadmap anticipates ATR will become the dominant method of hydrogen production in Alberta in the near term

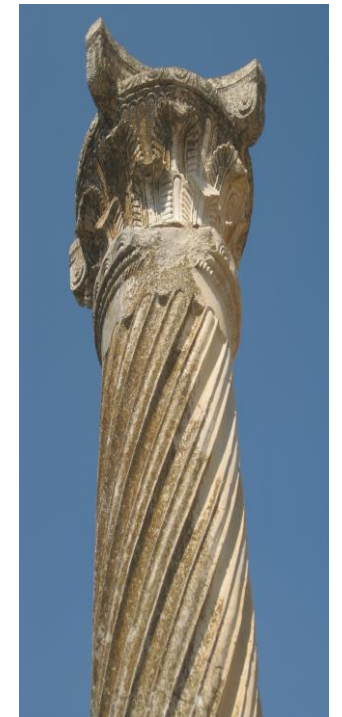
Hydrogen - Policy



- 2020 - *Hydrogen Strategy for Canada – Seizing the Opportunities for Hydrogen*

Hydrogen - Policy

- *Strategic Partnerships –*
- *De-Risking of Investments –*
- *Innovation –*
- *Codes and Standards –*
- *Enabling Policies and Regulation –*
- *Awareness –*
- *Regional Blueprints –*
- *International Markets -*



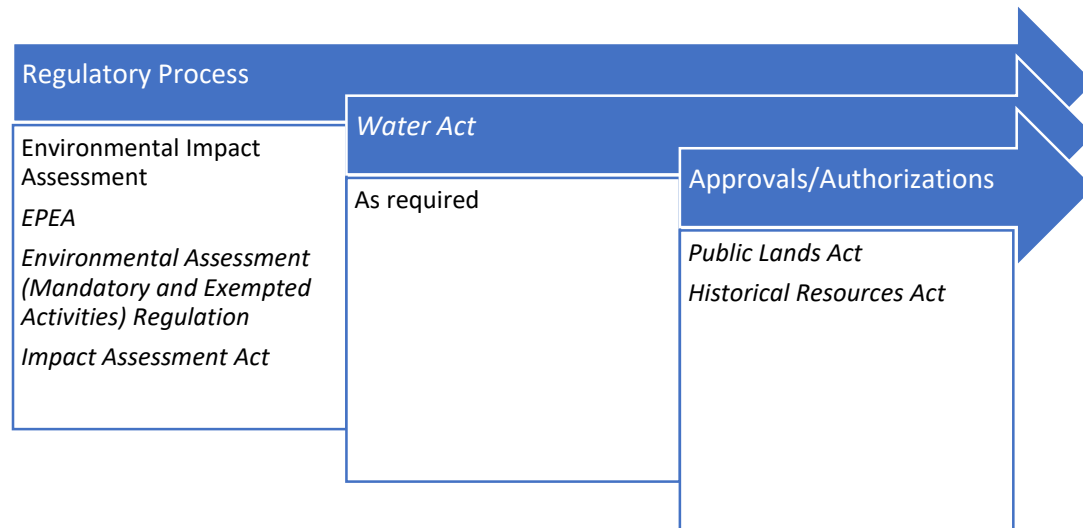
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Regulatory Framework

Hydrogen – Regulatory Framework

- No express legislative framework (i.e., no *Hydrogen Act*)
- Covered off by existing legislative schemes in place
- Type of production is key factor in determining regulatory process that is engaged
- Therefore, hydrogen production follows the process seen in many other types of development

Hydrogen – Regulatory Framework



- Should a project fall more closely in line with oil and gas production methods and distribution, then the legislative requirements associated with the oil and gas industry, such as the *Pipeline Act* and *Oil and Gas Conservation Act*, can be expected to have application.
- In this context, the primary regulator would be the Alberta Energy Regulator (“**AER**”)
- In a power generation context, or in a utility context such as blending with natural gas, application to the Alberta Utilities Commission (“**AUC**”) would be expected.





Prospects



Hydrogen - Prospects

- **Is hydrogen a “silver bullet”:**
 - Alberta’s stance on emissions associated with production
 - CCUS issues
 - Legislative Reform
 - Blending of hydrogen with natural gas

Hydrogen - Prospects

Color	GREY HYDROGEN	BLUE HYDROGEN	TURQUOISE HYDROGEN*	GREEN HYDROGEN
Process	SMR or gasification	SMR or gasification with carbon capture (85-95%)	Pyrolysis	Electrolysis
Source	Methane or coal 	Methane or coal 	Methane 	Renewable electricity 

Note: SMR = steam methane reforming.

* Turquoise hydrogen is an emerging decarbonisation option.

“[w]e are agnostic to the colour of hydrogen, as long as it’s clean hydrogen... it will be industry that decides the colour of the hydrogen”

Associate Minister of Natural Gas Dale Nally

<https://www.weforum.org/agenda/2021/07/clean-energy-green-hydrogen/>

Hydrogen - Prospects

Ambiguous

- “Science based” emissions standards to be developed???
- Consideration of entire emissions profile associated with a given hydrogen energy stream???

Defensive

“An **emerging narrative against natural gas-based hydrogen production** can disrupt Alberta’s efforts to build a clean hydrogen economy. As Canadian and global carbon intensity benchmarks and Guarantee of Origin schemes are proposed and developed, Alberta needs to **actively inform their development with data grounded in robust analysis and science**”.
(emphasis added)

Hydrogen - Prospects

CCUS Risks

Edmonton

**Opinion | Carbon capture
Alberta learned its lessons**

f t e r in

Politicians tend to use CCS as a distraction, says Graham Thomson

Graham Thomson · for CBC News · Posted: Nov 29, 2019 7:00 AM MT | Last Updated: Nov 29, 2019 7:00 AM MT



Steve MacDonald of Emissions Reduction Alberta spoke about the feasibility study into carbon capture and storage at the Scotford Refinery.

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CLIMATE CHANGE, POLITICS

Pipe Dream

The failure of Alberta's carbon-capture experiment

BY GRAHAM THOMSON · JULY 1, 2015

AAA

Sometime later this year, a consortium of oil companies in Alberta will flip the switch on a first-of-its-kind climate change project in Canada. If it works, the Quest project will capture and bury one million tonnes of carbon dioxide (CO₂) emissions every year from Shell Canada's Scotford upgrader in Fort Saskatchewan. That's one million tonnes a year for the next 25 years—roughly equivalent to pumping the weight of four Great Pyramids of Giza underground, or, as Shell likes to say, the equivalent of taking 175,000 greenhouse-gas-spewing cars off the road every year.

Steps to take:

- *Carbon Capture & Storage: Summary Report of the Regulatory Framework Assessment*, released in 2013
- availability and quantity of pore space for CCUS
- monitoring and liability

Hydrogen - Prospects



“Adoption of clean hydrogen in Alberta has the potential to reduce GHG emissions. Modelling conducted for the Hydrogen Roadmap shows that under a 2030 scenario where hydrogen is widely integrated into Alberta’s energy systems at a large scale, the province could reduce GHG emissions by 14 million tonnes per year. **This represents a reduction of five per cent of Alberta’s 2019 emissions**”. (emphasis added)

Alberta Hydrogen Roadmap: Executive Summary Ministry of Energy, at pg. 9

Hydrogen - Prospects

- **Legislative Reform**

- Alberta does not presently have a dedicated regulatory framework for hydrogen and has instead relied upon an “amalgam of existing environmental and oil and gas statutes and regulations that do not always apply perfectly”

Brendan Downey et al, “Pathways to Net-Zero: Opportunities for Canada in a Changing Energy Sector”, 2021 59-2 Alberta Law Review 225, 2021

- Minor amendments needed, not whole scale new legislation

- *Gas Utilities Act*

(e) “gas” means all natural gas both before and after it has been subjected to any treatment or process by absorption, purification, scrubbing or otherwise, and includes all fluid hydrocarbons not defined by clause:

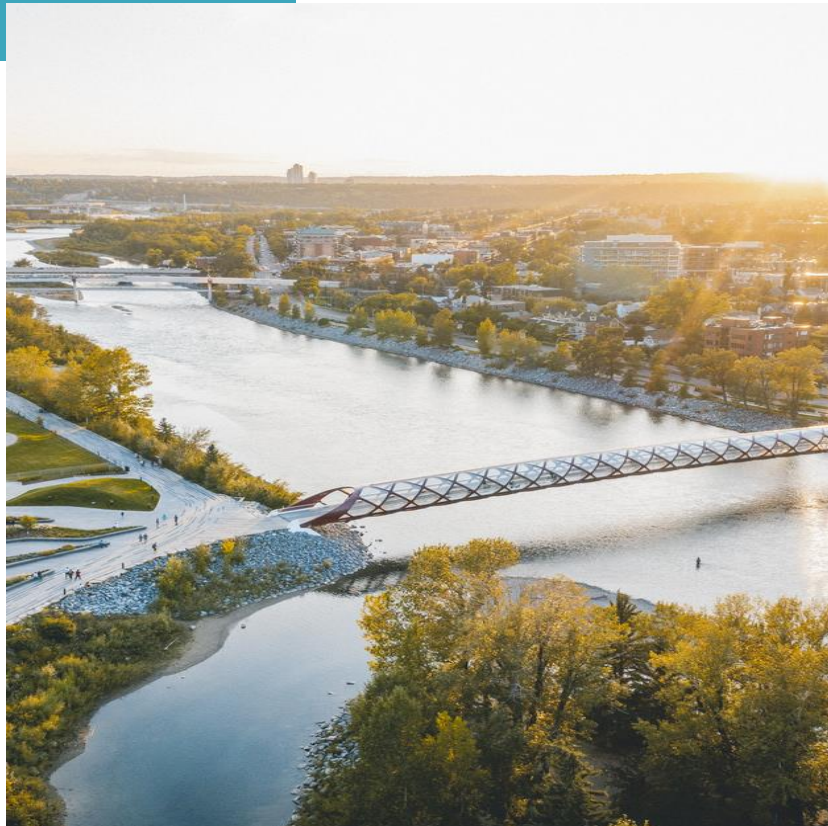
(i) as oil.

Hydrogen - Prospects



- Blending of hydrogen with natural gas:
 - immediate effect of reducing greenhouse-gas (i.e., the hydrogen aspect of such a blend does not emit GHG)
 - Enbridge Gas Inc., City of Markham Hydrogen
 - ATCO Fort Saskatchewan Hydrogen Blending Project
 - *AUC Proceeding 27256 – Hydrogen Inquiry*
 - *B.C. Greenhouse Gas Reduction Regulation*

Hydrogen – Closing



- Hydrogen development has inherent limitations
- Limitations may be temporary, and capable of resolution through advances in technology and other means
- Governmental policies, across Canada, are aligned on the role of hydrogen as a significant tool in achieving decarbonization but differ on some of the more technical aspects of advancing same
- As hydrogen development is scaled-up and new production methods brought online, further consideration of the ability of existing regulatory and legislative regimes to adapt to hydrogen will be need.

Questions

MCLENNAN ROSS