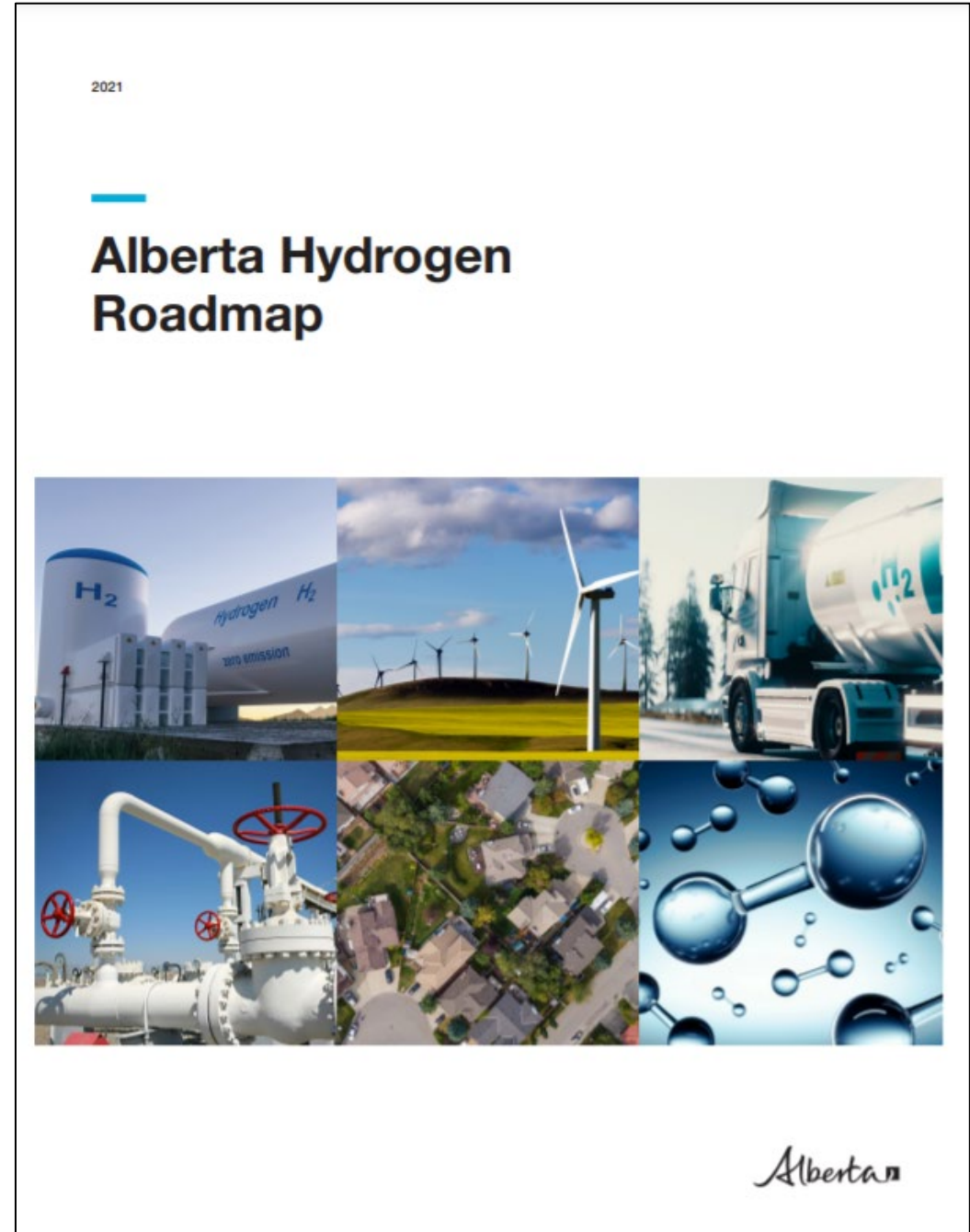


The Alberta Hydrogen Roadmap

What it might mean to the pipeline industry

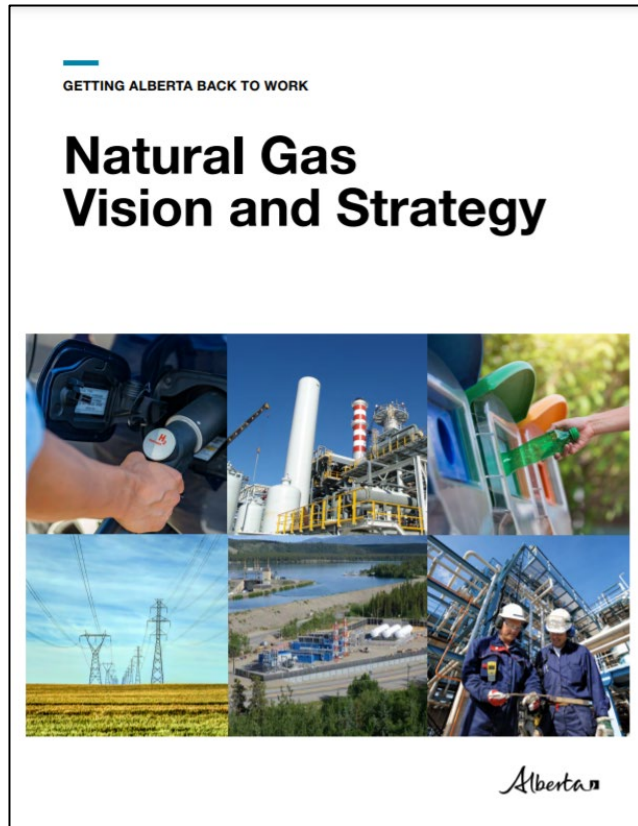
Brian Wagg
C-FER Technologies



Visions for Hydrogen



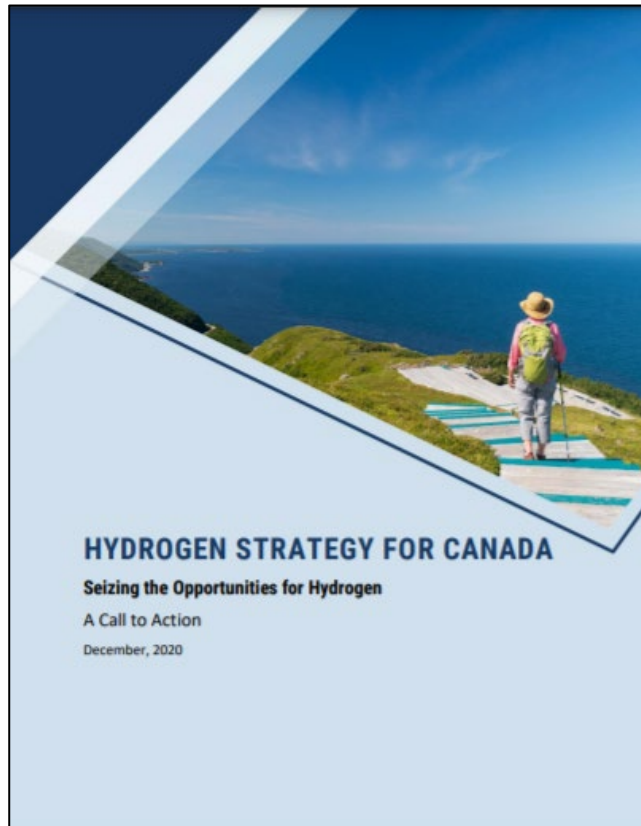
Oct 2020



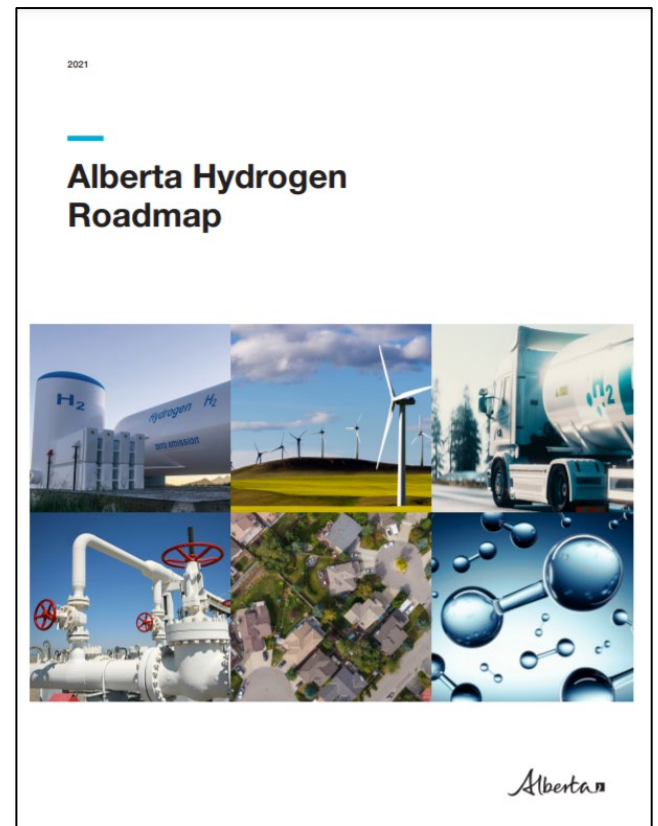
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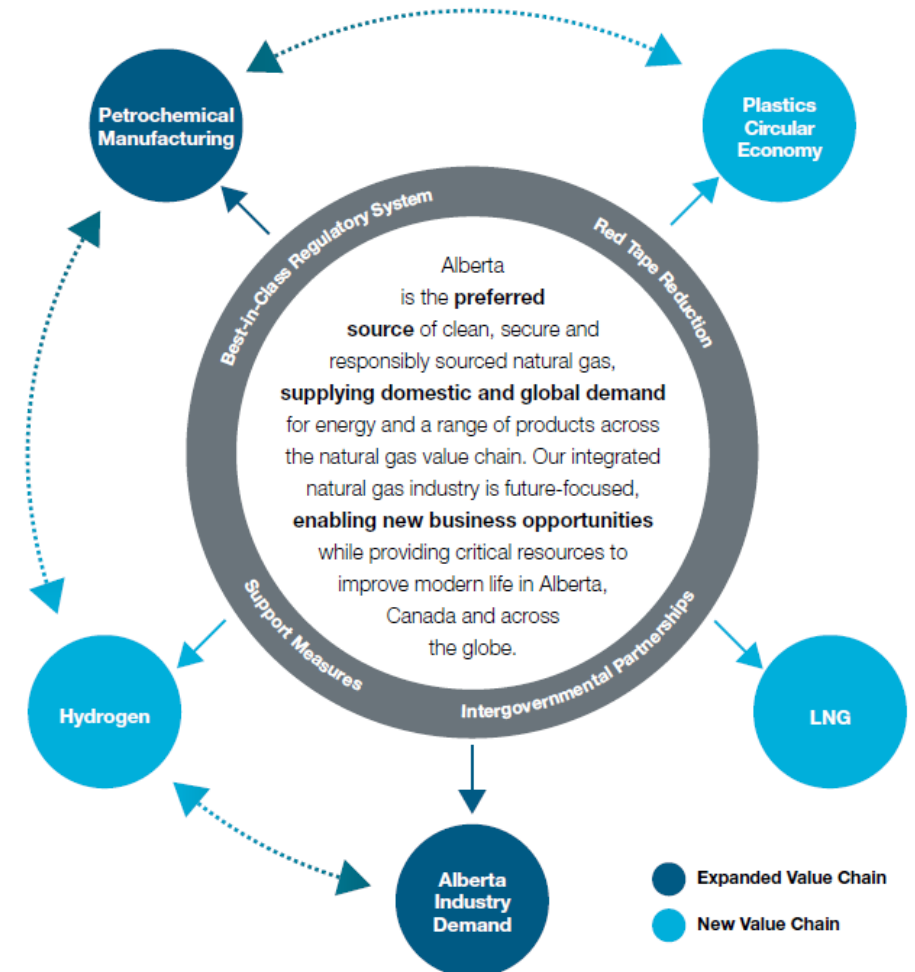
Nov 2021



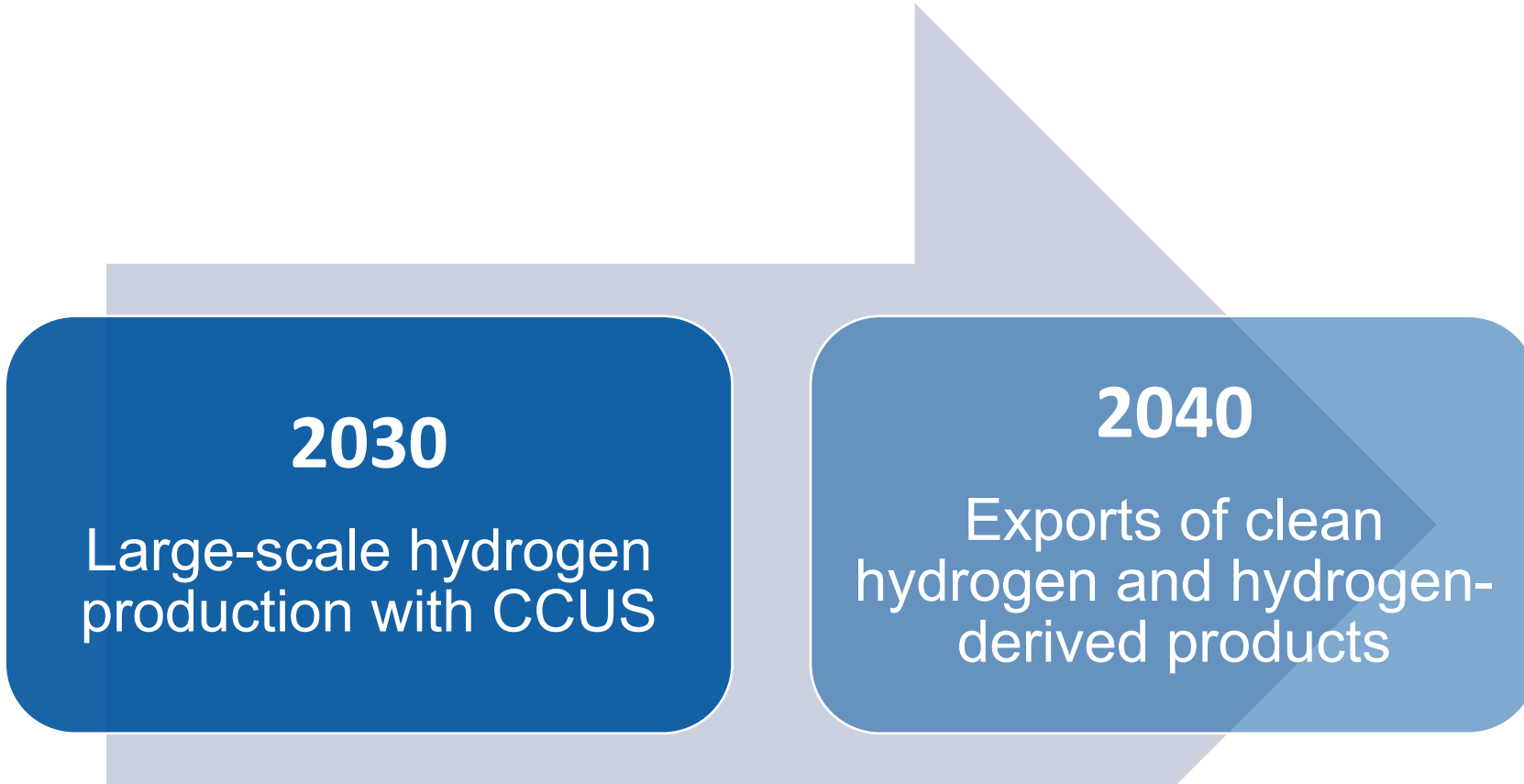
- Remove barriers to enable investment
- Accelerate natural gas deployment into new markets:
 - Petrochemicals
 - Plastics
 - LNG
 - Hydrogen
- Improve value chain from research to industrial implementation
- Deploy new technologies
- Build government, indigenous and industry alliances so local companies can compete internationally

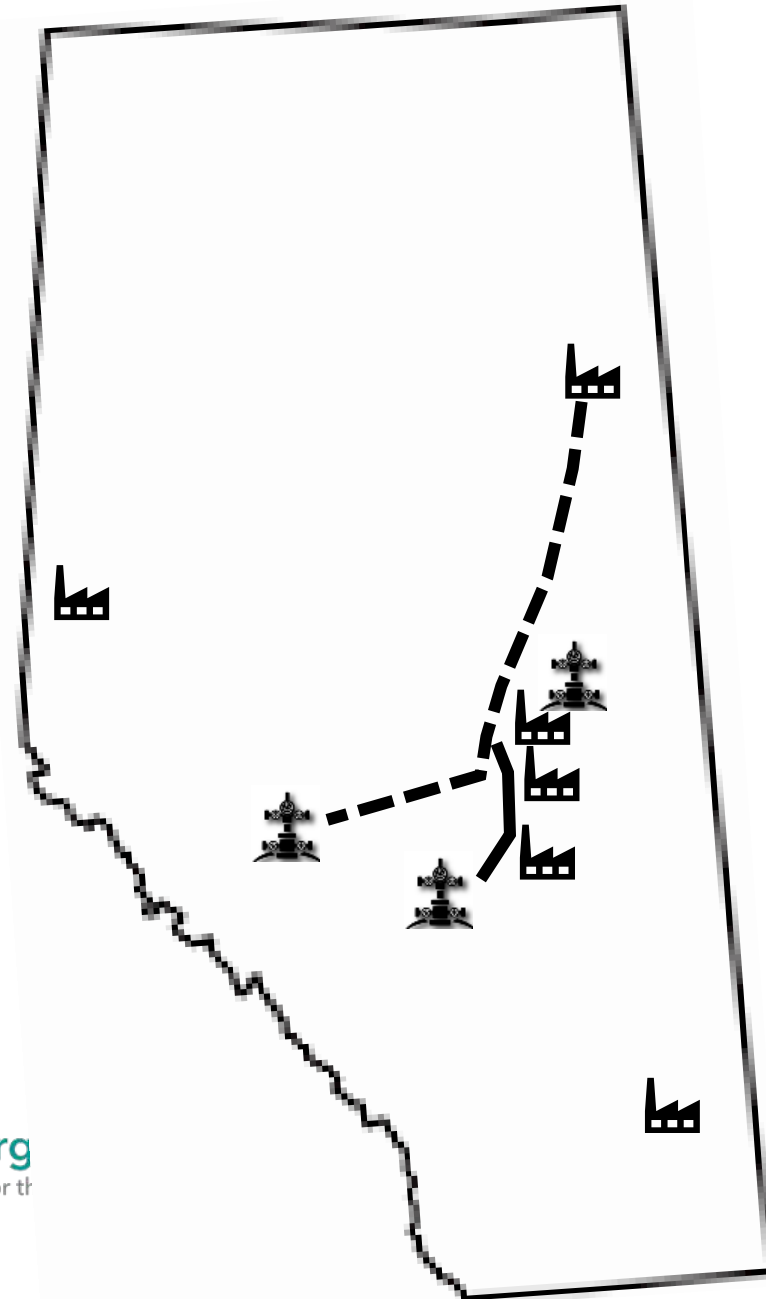
Natural Gas Vision & Strategy

Alberta



Hydrogen – Key Growth Area





2020-2021

- Map hydrogen system
- Build alliances
- Identify gaps and barriers
- Align with Canadian hydrogen strategy



2021-2023

- Develop Hydrogen Road Map
- Align western provinces
- Reduce red tape
- Advance pilots & demonstrations
- Explore provincial/federal funding partnerships



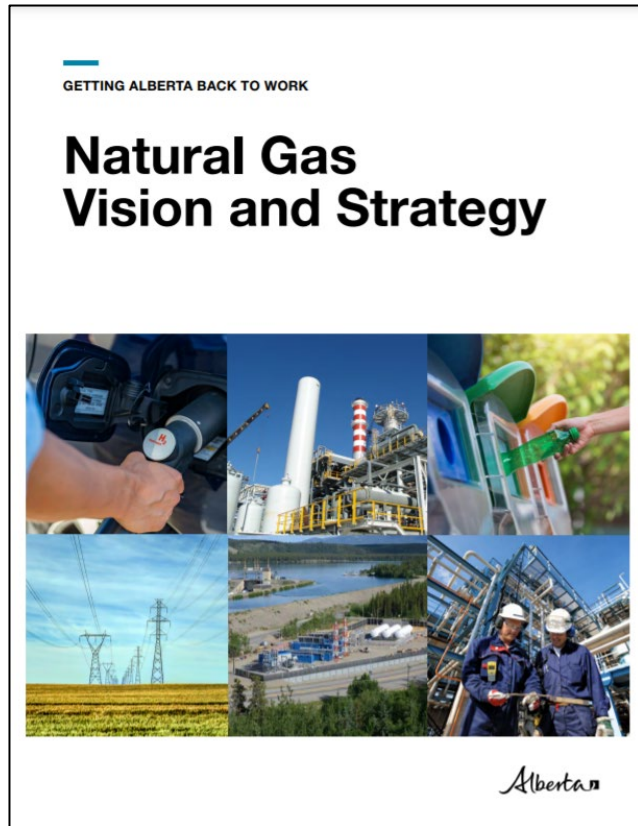
2023 & beyond

- Accelerate commercialization, infrastructure & end use
- Ensure Canada-wide network
- Secure world-scale export

Visions for Hydrogen



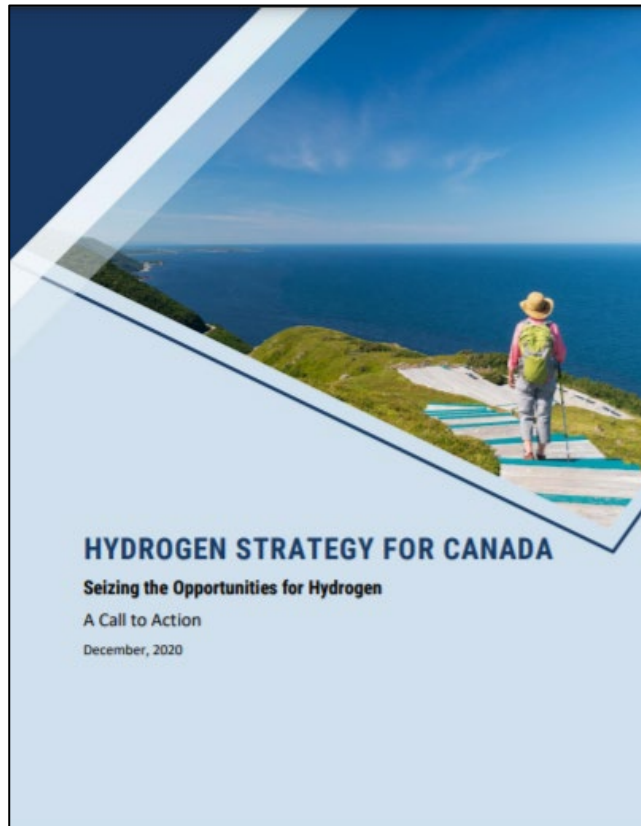
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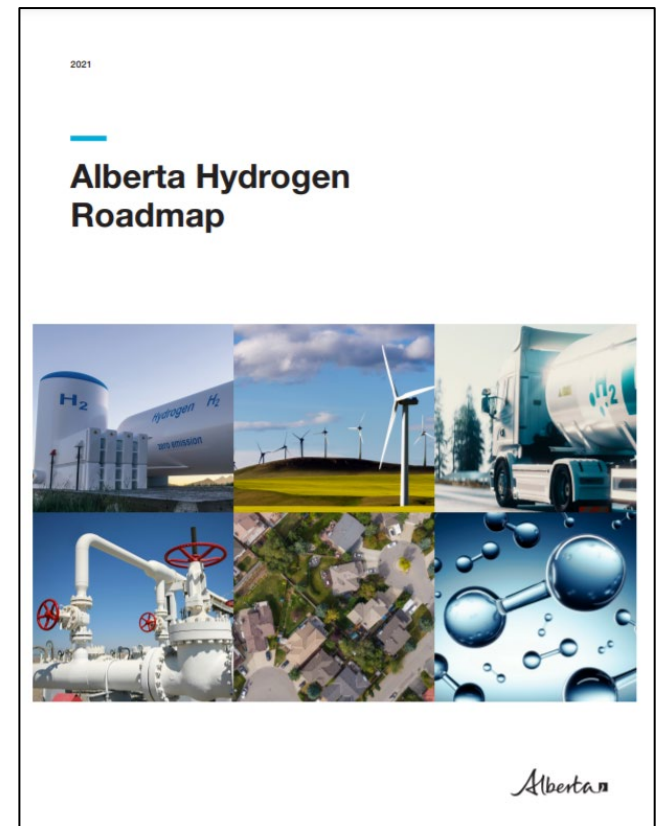
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- Growth and jobs
- Transform O&G industry
- Energy resilience
- Cleaner air
- Decarbonization

- Sources
 - Electrolysis
 - Hydrocarbons
 - Biomass
 - Industrial by-product

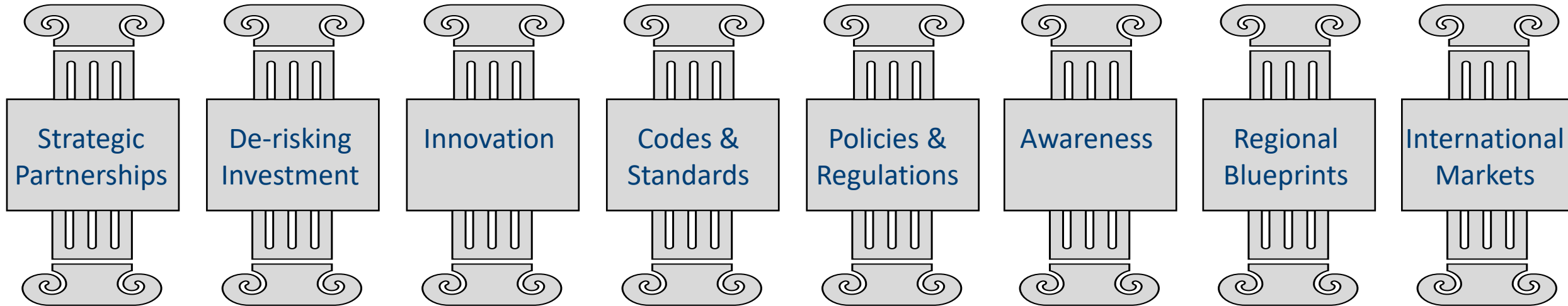


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 H₂ Opportunity		
	2030	2050
 % of Delivered Energy	6%	30%
 Hydrogen Demand	4 Mt-H ₂	20 Mt-H ₂
 GHG Emissions Abated	up to 45 Mt-CO ₂ e	up to 190 Mt-CO ₂ e

Strategic Pillars



- Natural Sciences and Engineering Research Council (NSERC)
- Natural Resources Canada (NRCan – CANMET)
- National Research Council (NRC)
- Sustainable Development Technology Canada (SDTC)
- Prairies Economic Development Canada (PairiesCan)

Storage & Distribution Challenges



Challenges



Canada is lagging other countries in developing standards for hydrogen in NG pipelines



Storage and transmission can be best optimized when regions collaborate across provincial boundaries



Hydrogen transportation costs can be significant if key infrastructure is lacking



Technical limitations exist for bulk storage and transport on rail and ship



Liquefaction is energy intensive and presents safety challenges, but is required for large scale distribution



Lack of technical data on feasibility of leveraging and modifying Canada's pipeline infrastructure to support large-scale hydrogen distribution



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Storage & Distribution - Recommendations

✓ Findings

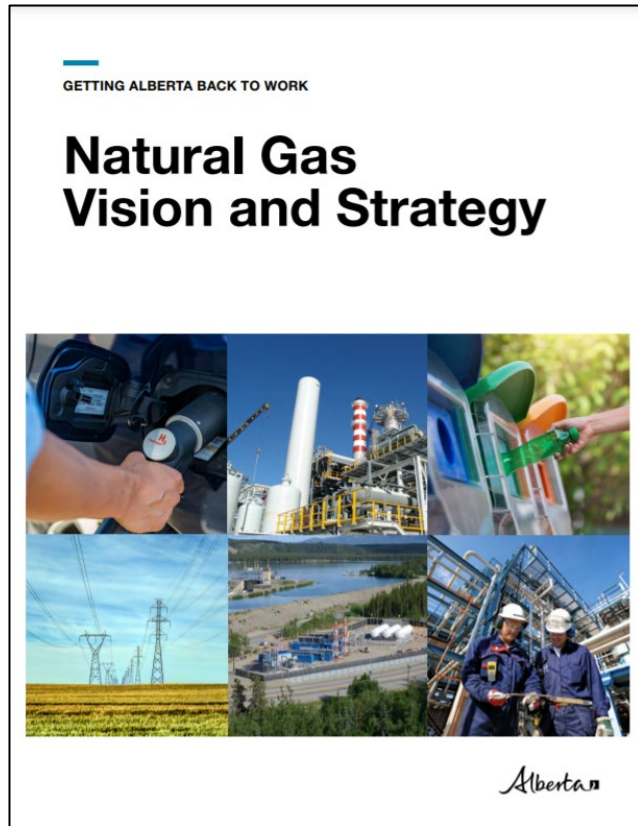
- *Fast-track regulatory approvals for high pressure gaseous distribution in Canada (450 bar)*
- *Accelerate updating Canadian codes & standards related to pipeline blending*
- *Begin scaling up natural gas injection and power-to-gas demonstrations in different regions including investment support, policy/regulatory incentives and support for R&D and innovation*
- *Scale H₂ transport and distribution networks starting with refuelling station networks in urban areas and in industrial clusters*
- *Invest in strategic liquefaction assets in Western Canada to complement Eastern Canadian assets*



Visions for Hydrogen



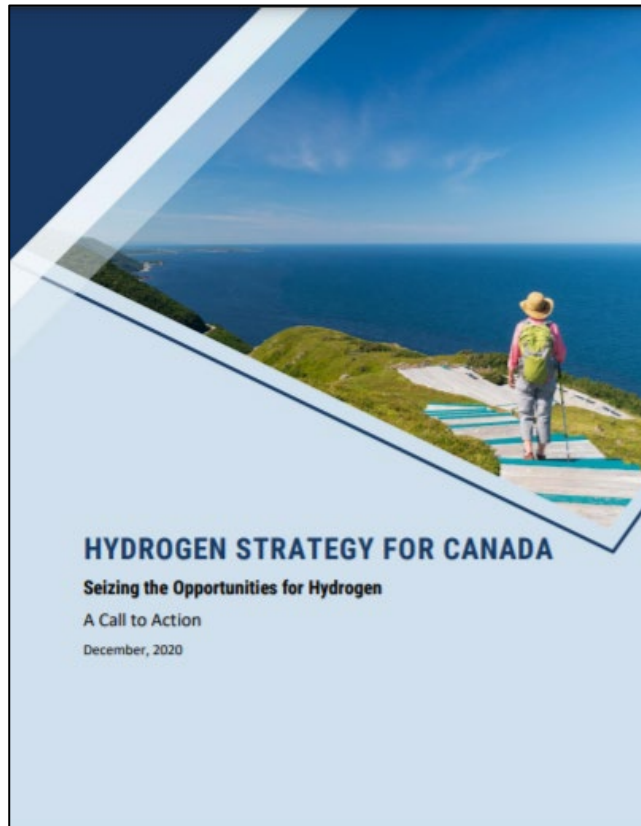
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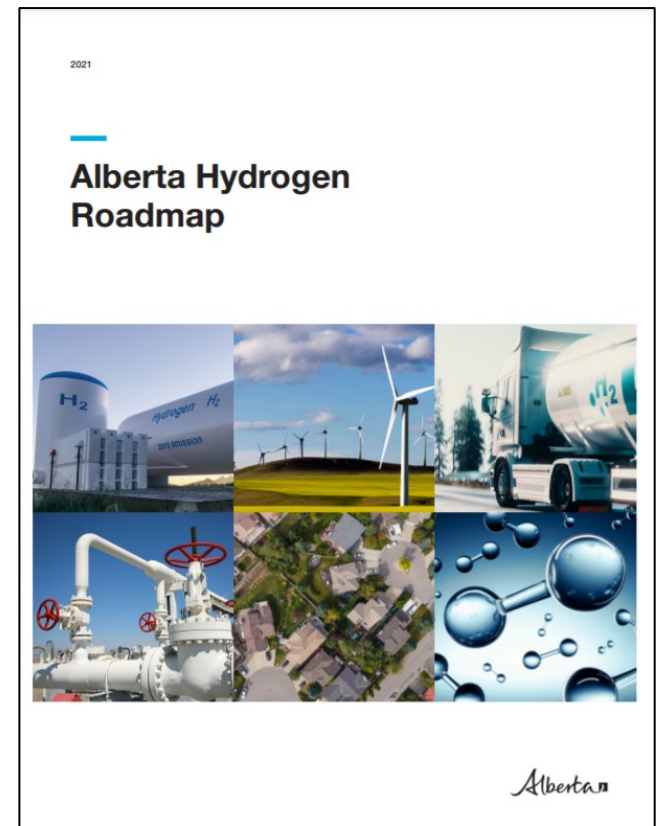
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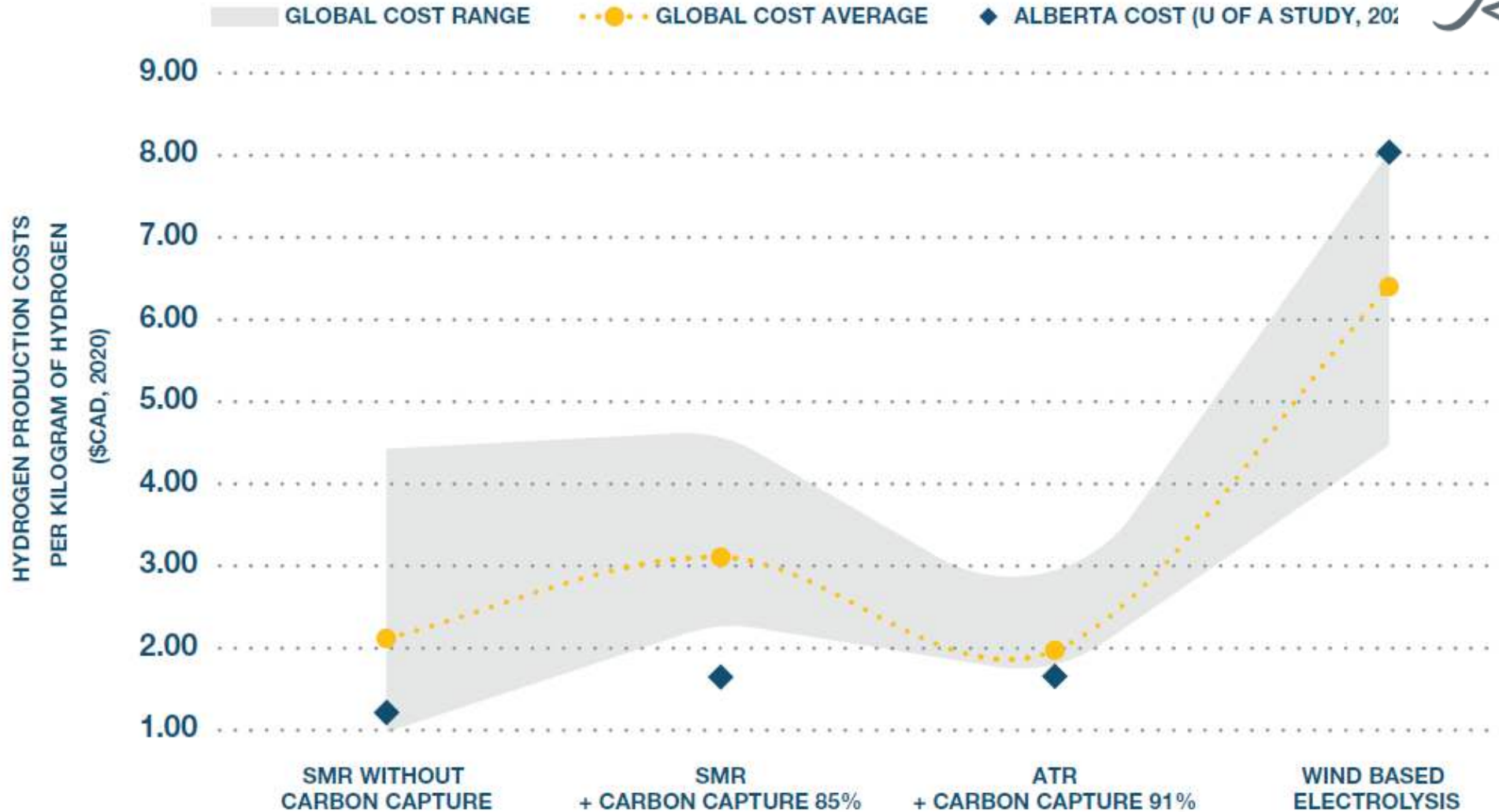


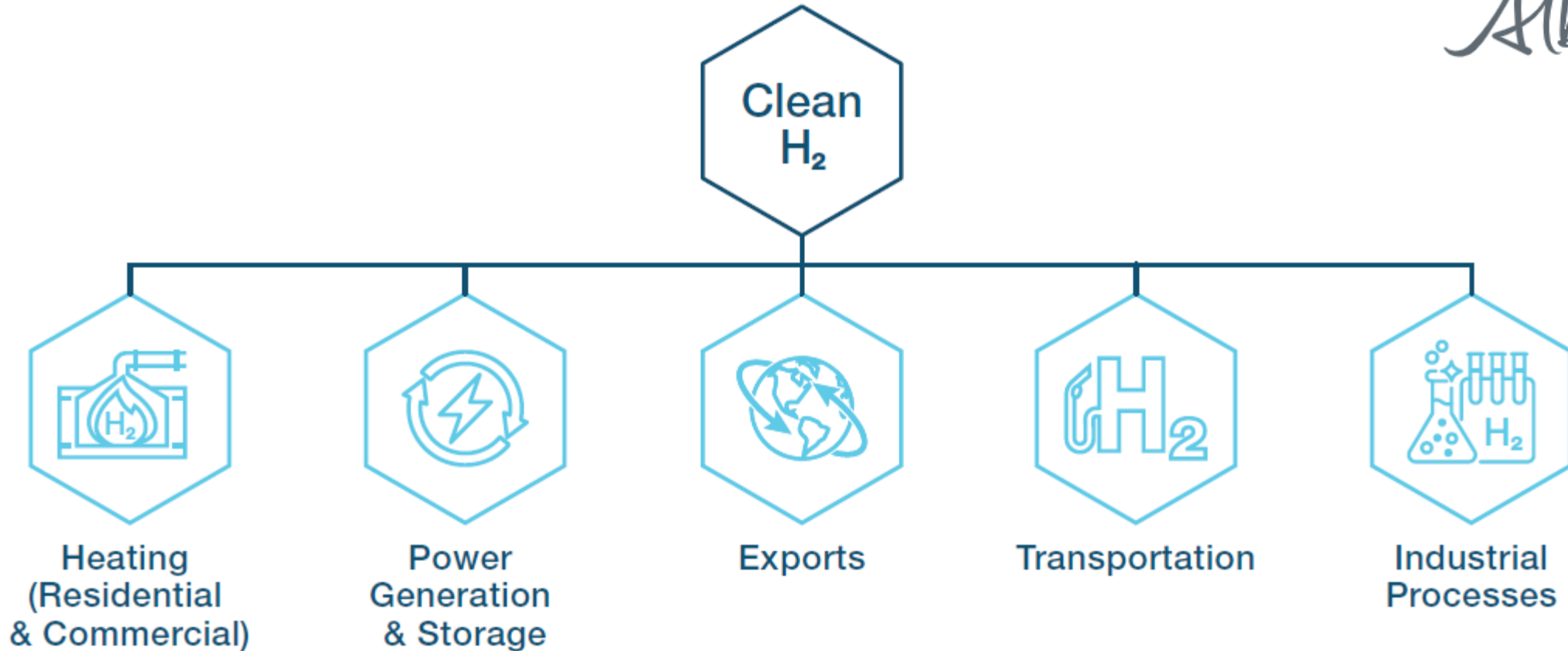
Ambition for 2030

Clean hydrogen is integrated at scale into Alberta's domestic energy system for use in transportation, heat, power generation, and renewable energy storage, as well as industrial use. Alberta has established itself as the global supplier-of-choice in clean hydrogen exports.



Production Cost Advantage

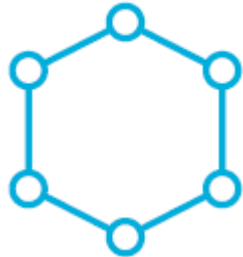






Centralized

- Large-scale production and storage in central location
- Supports large industrial use and export



Decentralized

- Small-scale hydrogen production adjacent to end use
- Minimizes or eliminates transportation

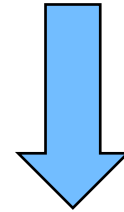


Semi-Central

- Medium-scale hydrogen production close to end-use
- Industrial clusters share infrastructure



Steam
Methane
Reforming
Reaction



Water
Shift
Reaction



7-9 t CO₂ created for each 1 t H₂



Ambition for 2030

Clean hydrogen is integrated at scale into Alberta's domestic energy system for use in transportation, heat, power generation, and renewable energy storage, as well as industrial use. Alberta has established itself as the global supplier-of-choice in clean hydrogen exports.

Plan For Action



1. Build new market demand
2. Enable CCUS
3. De-risk investment
4. Activate technology and innovation
5. Ensure regulatory efficiency, codes and standards to drive safety
6. Lead the way and build alliances
7. Pursue hydrogen exports

Planning, Promotion & Coordination



Southeast Alberta
Hydrogen Task Force

Applied
Research

Natural
Resources
Canada



Funding



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