BC Hydrogen Opportunity Assessment

Clean Energy BC

March 2, 2022

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Overview

- Attributes for Hydrogen Hub
- Green Hydrogen Demand
- Requirements to compete
- BC’s competitive advantage
- Appropriate policy focus

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Attributes required for hydrogen hub

- Supply demand/balancing point
  - Enabled by delivery & take away capacity
    - Pipelines & Ports
    - And ideally storage
- Many buyers and sellers
  - Ensuring liquidity
- Non-tangibles: BC's Hydrogen cluster

Source: BC Hydrogen Strategy

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Benefits of a market hub

- Liquidity reduces market risks
- Narrow bid/ask spreads
- Provides price transparency
- Net effect can be to spur investment

Source: Canaport LNG

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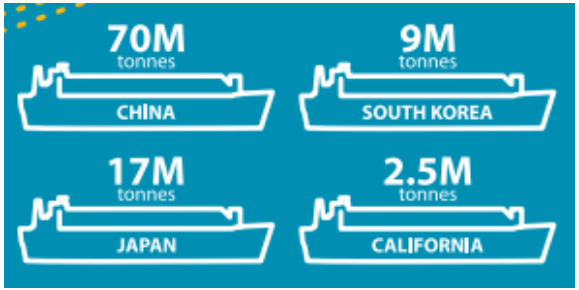
Significant hydrogen demand in Asia & California

- Canada's national hydrogen strategy: 30% of energy use by 2030
- 2020 study for California Energy Commission:
  - 2035 demand .3 MT/yr
  - 2040 demand 1.8 MT/yr
- Asia demand much larger
- Electrolysis used to supply this market, electricity requirements of > 4,000 TWh

BC Export Market Demand (2050)



Source: BC Hydrogen Strategy

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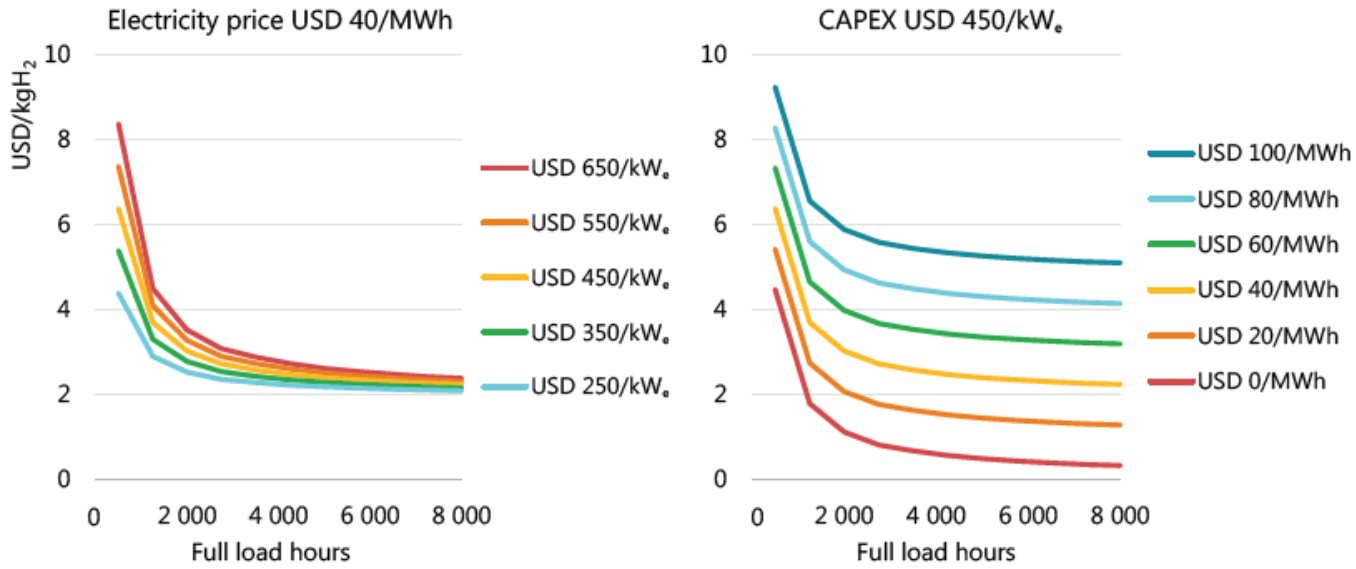
High utilization & low electricity costs = Competitive H2

Levelized cost of hydrogen by operating hour for:
different electrolyzer costs (left) and electricity costs (right)



Based on an electrolyzer efficiency of 69% (LHV) and a discount rate of 8%.

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Source: IEA 2019

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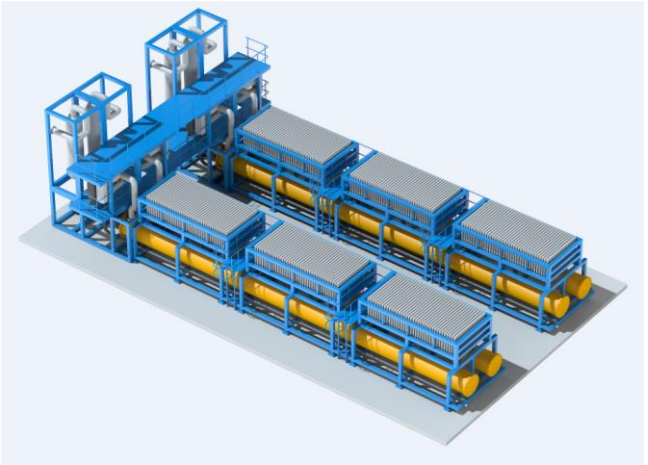
Low cost electricity required to compete green H2

- Electrolysis only commercially viable pathway
- CapEx about 20% of cost of green hydrogen
- Electricity dominant cost driver

Chlor-alkali Electrolyzer



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BC’s competitive advantage: Renewable energy mix

- BC electricity sector almost fully decarbonized
- With a flexible hydroelectric fleet
  - Able to store surplus renewable production
  - Supporting steady supply of renewable energy
  - Enhancing production efficiencies
    - Capital utilization & conversion efficiency

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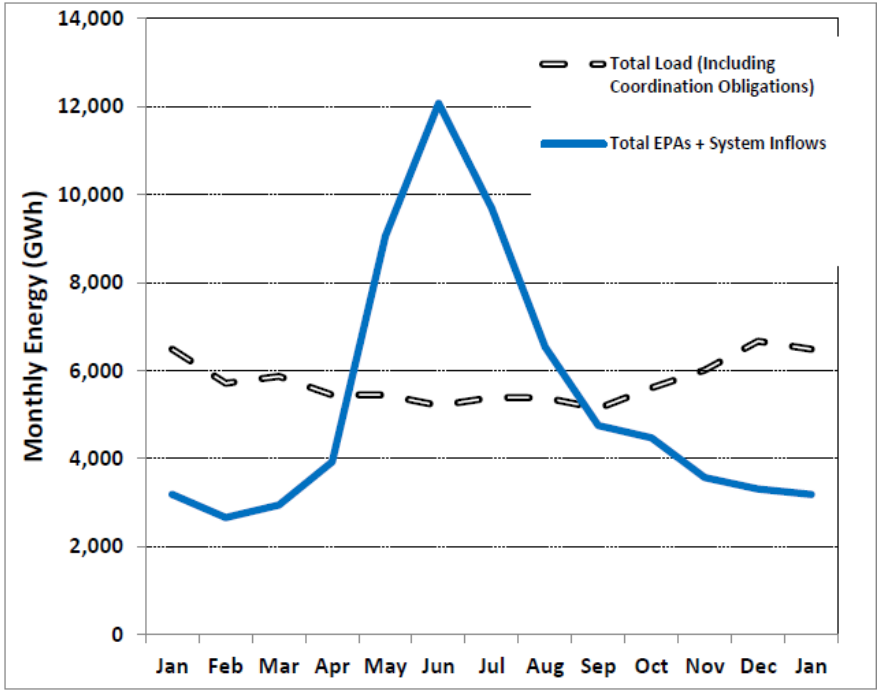
Competitive advantage: Renewable energy surpluses

- Low value of energy during freshet strengthens position
  - Site C development results in energy surpluses until about 2030
- Large volume of untapped renewable energy potential
  - Competitively priced onshore wind
  - Longer-term offshore wind

Monthly Energy Production vs. Demand



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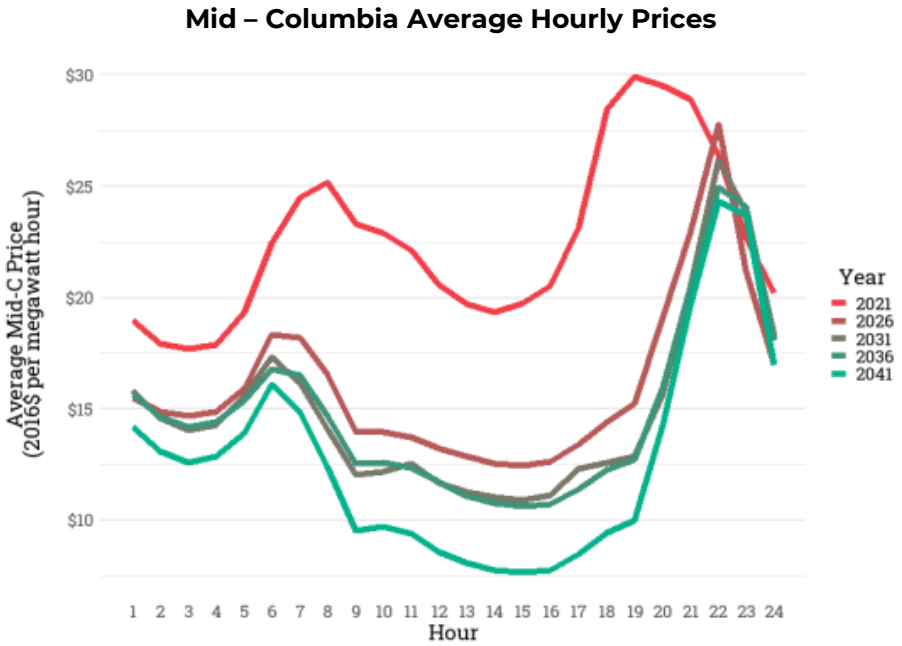
BC can compete with low cost solar in Desert SW

- Solar from Desert Southwest offers low costs
- High volume of solar, integration of electricity markets allows BC to access these low prices
  - Diminishing the Desert SW competitive advantage



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BC can compete with low cost solar in Desert SW

- Low capacity factors offered by solar limit its attractiveness
  - Long duration energy storage needed
- Increasingly difficult to site large scale solar
  - Proposed legislation to limit large solar
- Water availability for electrolysis a constraint?
- US funding clean hydrogen hubs: $8 billion authorized

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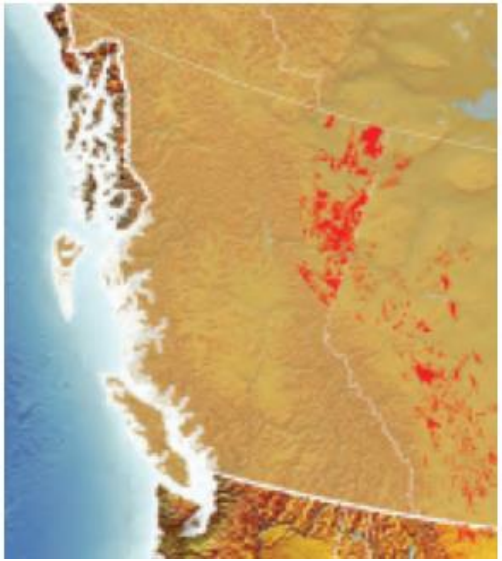
BC has significant geological storage capability

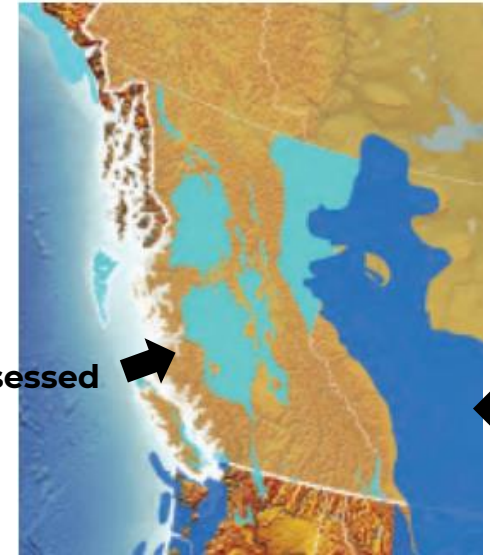
Natural Gas Fields in BC



(2,000 MT CO2e)

About 50% could be available for hydrogen storage

Saline Aquifers



(1,000+ MT CO2e)

Source: Zen and the Art of Clean Energy Solutions

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Policy focus: Supply or Demand Development?

- Technology is portable
  - $ required large
- Demand is permanent
  - Low carbon fuel standard: first step
  - Hydrogen RNG standard?
  - Develop infrastructure

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Summary

- BC has many of the attributes of hydrogen hub
  - Available infrastructure: Ports & Pipelines
    - Ready access to major market: California
  - Availability of low cost electricity
  - Intellectual Capital
- Policy focus
  - Demand development permanent

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