BRITISH COLUMBIA

cleanBC

our nature. our power. **our future.**

# Green Hydrogen: Keystone of the Energy Transition

AQPER Symposium 2020: The Power of Renewable Energy
February 4-6, 2020

Hôtel Château Laurier Québec
Québec

# My Presentation

- CleanBC
- Opportunities & Challenges
- BC's Electricity Profile
- 15% Renewable Gas
- BC Hydrogen Roadmap
- Discussion Points


HYUNDAI
HYDROGEN
HTEC
Shell V-Power
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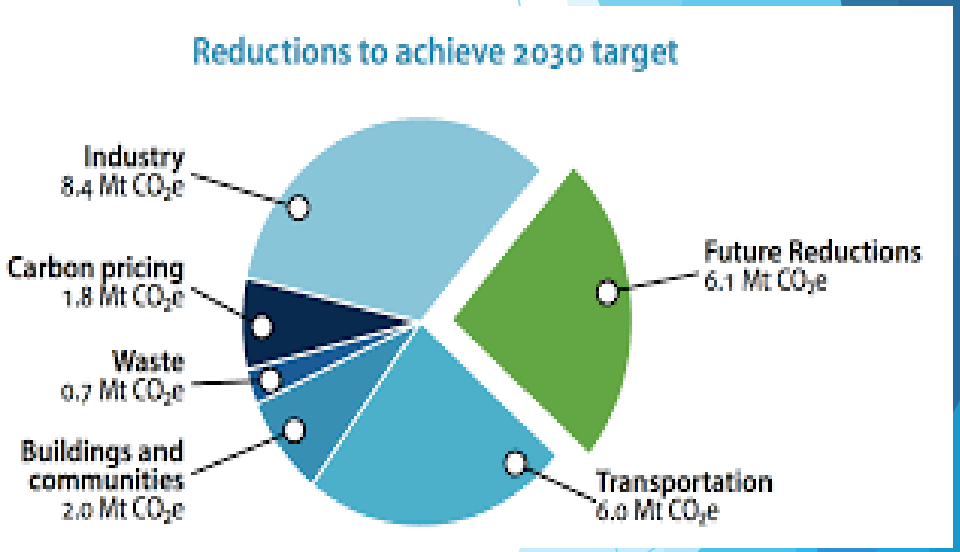
# CleanBC Highlights

- CleanBC focus is biofuels, electrification & energy efficiency
- Cleaner Transportation
  - Zev Standard, incentives, clean fuels
- Improve Where We Live and Work
  - building code & energy efficiency standards
  - Incentives
  - 15% renewable gas
  - support for communities to fuel switch
- Cleaner Industry
  - Clean Industry Fund
  - upstream methane reduction & electrification
- Reduce Emissions from Waste
- Carbon Pricing

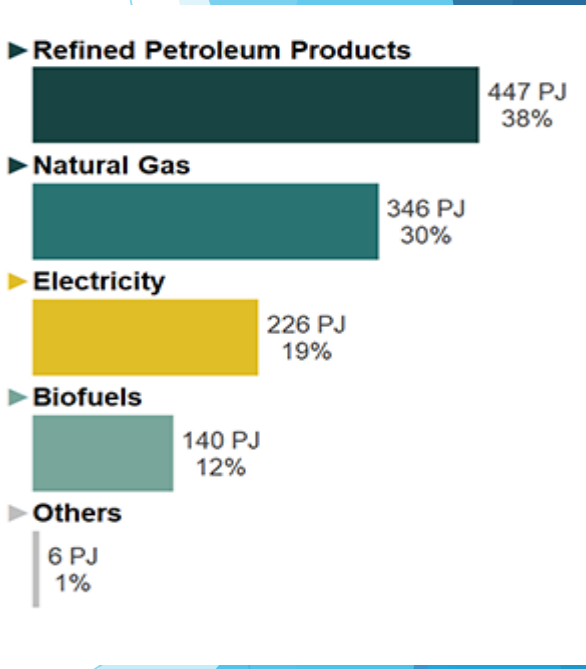
# CleanBC

- Legislated GHG reduction targets:
  - 40% by 2030, 60% by 2040, 80% by 2050
- 18.9 Mt GHG = 75% of the way to 2030.  6.1 Mt remaining
- Minimum 15% Renewable Gas by 2030
- Renew the BC Bioenergy Strategy
  - Build out the bioenergy and biofuels cluster
  - Create Centre of Excellence for Biofuels
- 95% organic waste diversion for agricultural, industrial, and municipal waste
  - systems in place to capture 75% of landfill gas
- Develop a BC Hydrogen Roadmap



# BC's Energy: Opportunities & Challenges

- 68% of end-use energy in BC is fossil fuel (30% natural gas / 38% petroleum)
  - Significant opportunity for decarbonization via clean gas
- BC has substantial natural gas reserves
- Over 98% of B.C.'s electricity is clean and/or renewable
  - Projected surplus into mid-2030s
- Electricity and natural gas are relatively inexpensive in BC
- Impacts on utility ratepayers is a key government consideration
- Technical and cost barriers relating to clean gas
- GGRR allows up to 5% RNG @ $30/GJ




BRITISH COLUMBIA
Peace Canyon
G.M. Shrum
Kennedy
Skeena
Glenannan
Telkwa
Williston
McLeese
Mica
ALBERTA
Chapmans
Revelstoke
Kelly Lake
Nicola
Creekside
Cheekye
Ashton Creek
Selkirk
Burrard
Dunsmuir
Cranbrook
Seven Mile
Meridian
Ingledow
American Creek
Kootenay Canal
U.S.A.

# BC Electricity System

## BC Hydro

- 12,100 MW Capacity / 98% Clean
- 30 hydro plants / 79,000 Km of transmission & distribution

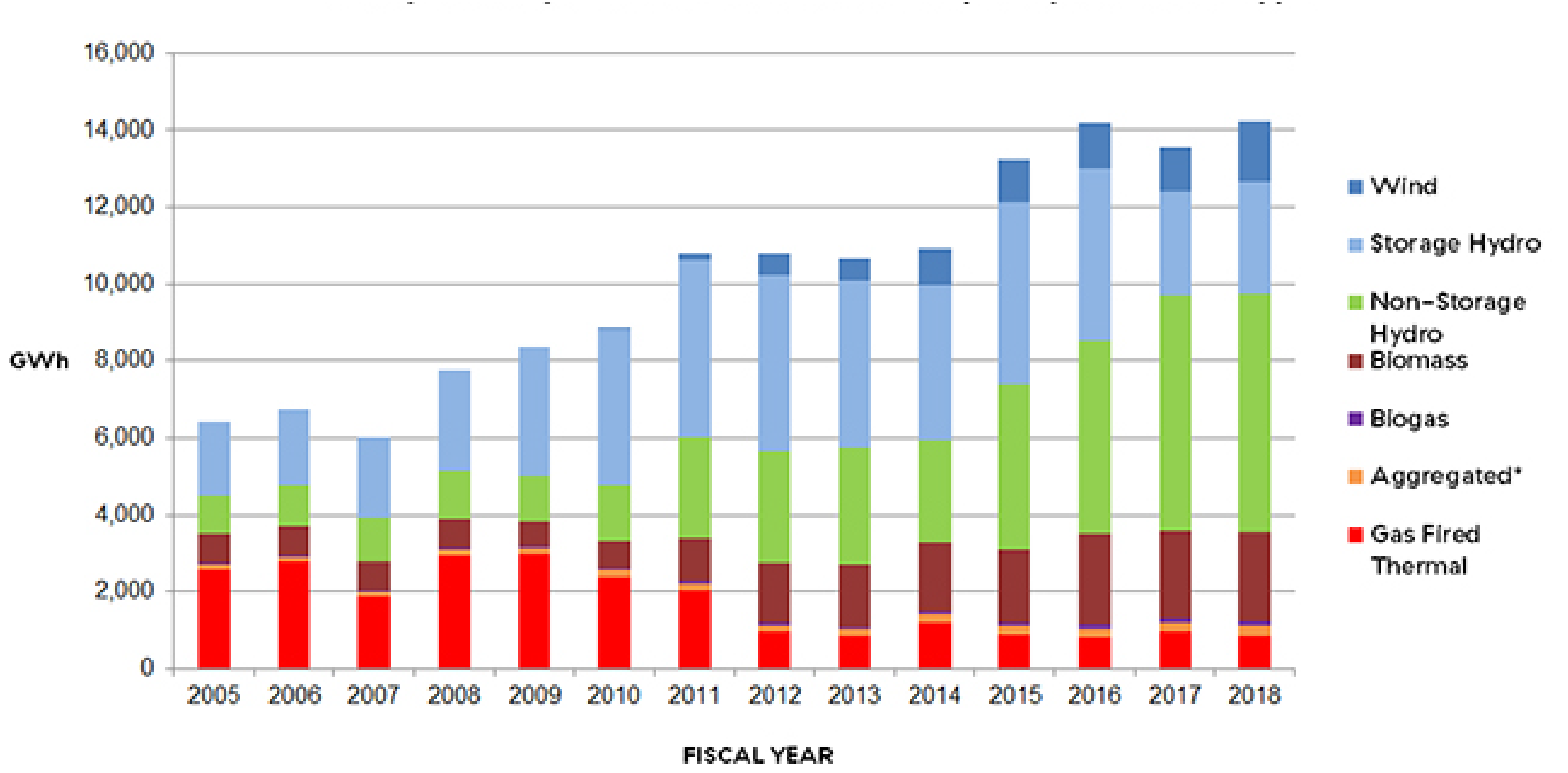
## FortisBC

- 225 MW Capacity
- 4 hydro plants

## Independent Power Producers

- 5,257 MW Capacity
- 123 EPAs

## 17,582 MW Total Capacity


16,000
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GWh
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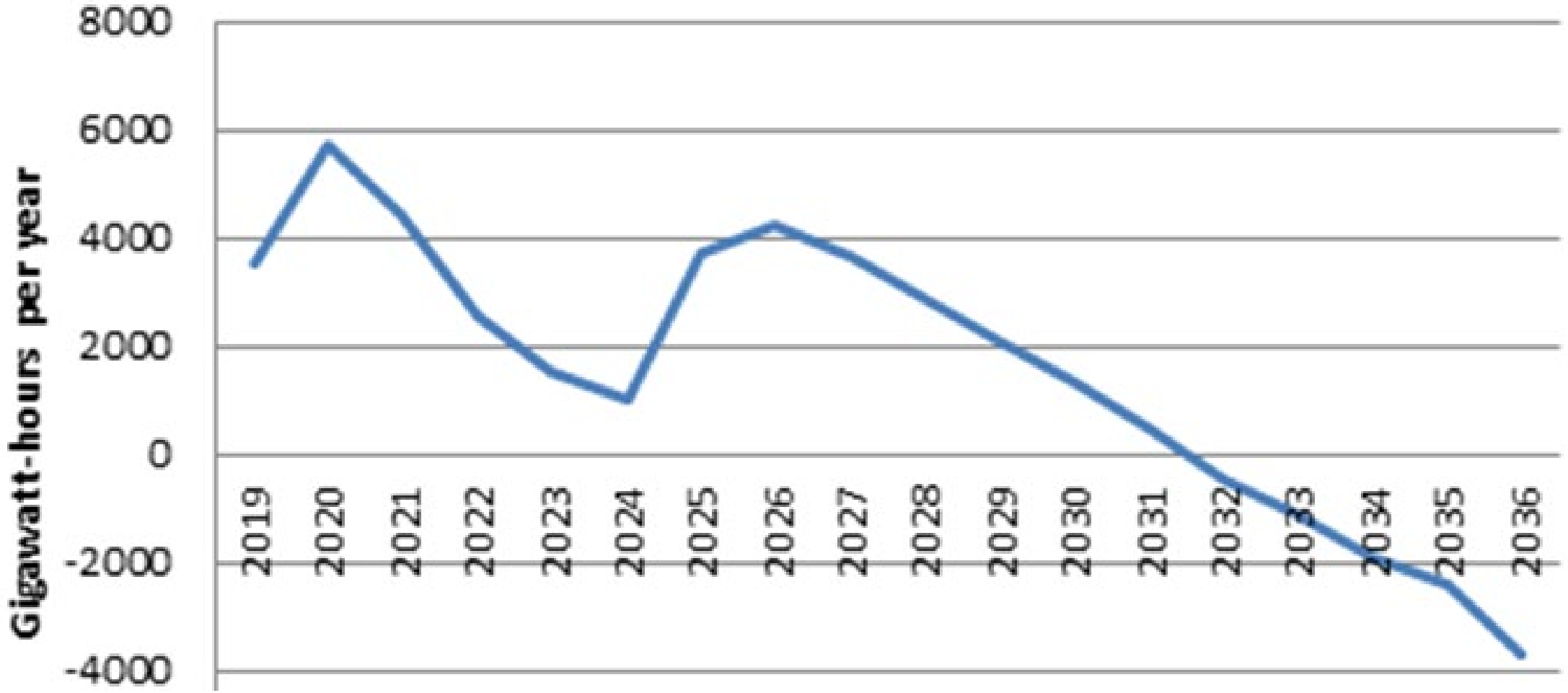
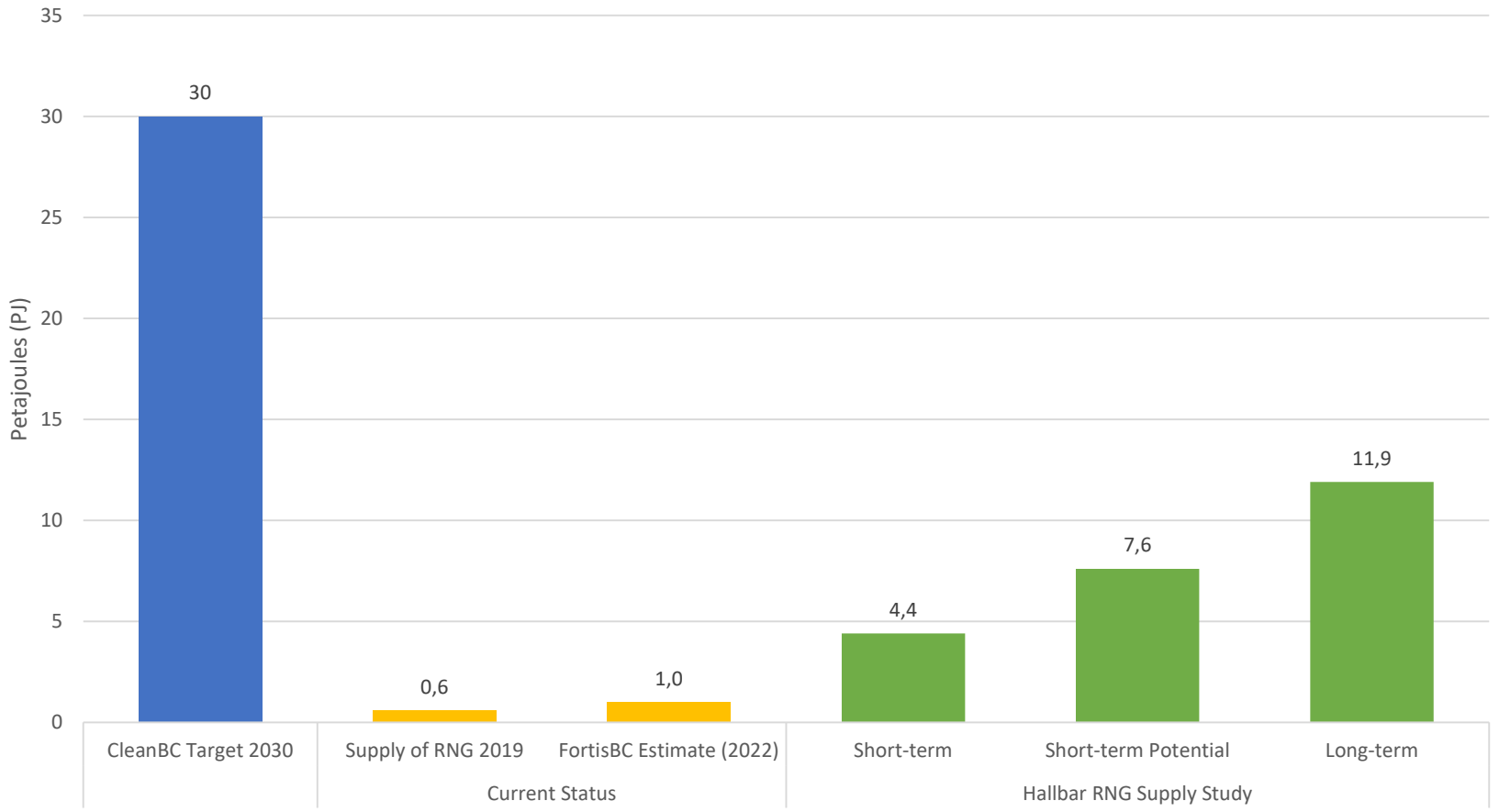
2018
FISCAL YEAR
Wind
Storage Hydro
Non-Storage Hydro
Biomass
Biogas
Aggregated*
Gas Fired Thermal
Source: BC Hydro
*Energy Recovery, Muncipal Solid Waste, and Solar

# BC Hydro Load Resource Balance



# RNG Supply & Demand



# Under Consideration: Clean Portfolio Standard for Natural Gas

- 15% by volume ≈ 2.06Mt GHG ≈ 30PJ
- RNG supply constraints, cost, need to protect ratepayers
- Outcome-based approach to GHG reduction by gas utilities
- Reductions could be achieved through a combination of GHG emission reductions from:
  - clean gas blending
  - the utility's distribution/ operations
  - demand side management
- Examples: RNG/ Syngas, electrification, energy efficiency, hydrogen injection

# B.C. Hydrogen Roadmap

- Hydrogen in B.C. Study was completed in June 2019
  - Hydrogen can play a large role in decarbonizing B.C.'s energy systems
  - By 2050, $H_2$ can abate 31% of provincial GHGs (15.6 Mt CO2e/year reductions)
  - Other key recommendations:
    - Specify a carbon intensity for hydrogen
    - Set a lower electricity rate for grid electrolysis
    - Support $H_2$ blending into natural gas distribution network
    - Fuel cells for transportation and stationary power
    - Feedstock for synthetic fuel production
- B.C. Hydrogen Roadmap Spring 2020
- BC Hydro Phase 2 Review
  - A broad, transformational review looking at the integration of new technologies and electricity market trends

# Enabling Measures for Green Hydrogen Production

- BC Hydro
  - Allow renewable hydrogen plants to buy electricity directly from renewable electricity plants
  - Provide an interruptible non-firm shaping service with no demand charge
  - Provide a wheeling rate based on actual costs rather than fixed postage rate
- Gas Regulation
  - Expand the definition of Renewable Natural Gas to include hydrogen
- Water Use
  - US DOE range for electrolysis 13.2-18.6 L/kg-$H_2$
  - *Water Sustainability Act*
- Regulatory Toolbox

# B.C. Hydrogen Export Study

- ITM Power, Chiyoda Corporation, Mitsui & Co
- Techno-economic feasibility study for centralized hydrogen production in BC for export to Japan
  - Chiyoda LOHC technology and ITM Power electrolysers
- Findings:
  - Site location is critical
  - BC Hydro industrial electricity rate of $64/MWh is too high for Japan landing price of $2/Kg
  - CAPEX requires significant reduction through government assistance
  - Export to California and deployment in BC are viable due to the LCFS

# Discussion Points

- Direct electrification of the B.C. energy system cannot get us all the way
- Hard to decarbonize sectors are expensive to address (displacing fossil fuels)
- Utility Role in $H_2$
- Capital intensive investments required
- Utility ratepayers are extremely sensitive to higher bills
- Finding public dollars for new technologies or costly low-carbon projects is challenging
- RNG supply will likely remain constrained
- Establishing new economic growth sectors is complex
  - E.g., creating an active biomass market with buyers and sellers
- SMR with carbon capture is challenging

# Thank You !

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