WATER *for* ALBERTA'S HYDROGEN ECONOMY

Hydrogen development requires sustainably balancing the competing water demands of the Water Nexus: food, people, and energy.

Water in Alberta is a finite resource.

The amount of water available for use varies regionally, seasonally, and year over year.

Hydrogen production requires water.

Different hydrogen production technologies have different water demands.

Hydrogen developers in Alberta must consider water availability early in planning.

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DEMAND FOR HYDROGEN

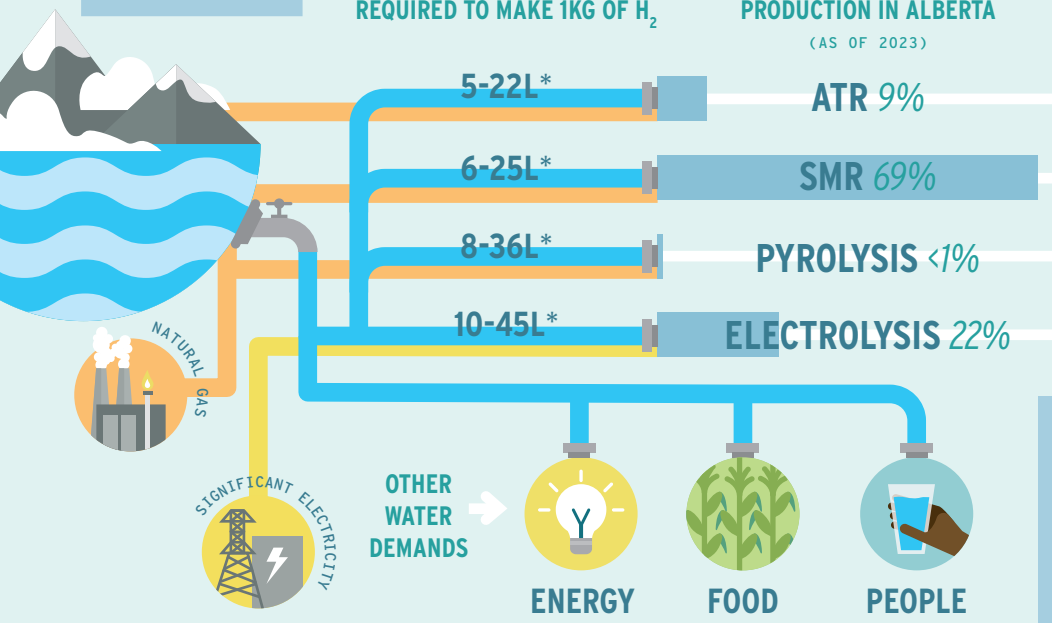
Hydrogen production is increasingly being explored in Alberta to support the Net-Zero by 2050 goal. Hydrogen production consumes water and therefore competes with other demands for a finite amount of available water as part of the water, energy, food nexus. Here, "available water" refers to that which can be withdrawn for new uses under Alberta's Water Act and other regulations, accounting for environmental needs and water that is already allocated.

Numerous new hydrogen production facilities have been proposed in Alberta with a range of different technologies.

Autothermal Reforming (ATR) | Steam Methane Reforming (SMR) | ELECTROLYSIS | PYROLYSIS

Each have different efficiencies and water consumption rates.

*The theoretical minimum water demands are lower but are difficult to achieve in practice.



DID YOU KNOW?

- 1KG OF H_2 STORES AN EQUIVALENT AMOUNT OF ENERGY TO ABOUT 4L OF GASOLINE[1].
- AS OF 2023, THERE ARE OVER 20 MILLION TONNES/YR OF NEW H_2 PRODUCTION PROPOSED IN ALBERTA. IF CONSTRUCTED, THIS COULD CONSUME AS MUCH WATER AS 2 - 8.5 MILLION PEOPLE EACH YEAR.

WATER SUPPLY FOR HYDROGEN

In Alberta, the Water Act ensures enough water remains in all rivers for the environment, for industrial uses, for municipal use, and for us to drink. Water availability in Alberta is regionally variable. While 80% of the surface water is in the north, 80% of the population is in the south[2]. Transferring water between the seven major basins is rarely permitted under The Water Act and would be costly.

River flow is also seasonally variable, depending on snow melt from the mountains and rainfall events (**Figure 1**). Large industries operating year-round, like hydrogen, often require water storage to avoid water shortages in the fall and winter. If they run out of water, they can't operate. In the longer term, climate change is likely to impact river flows across Alberta.

Groundwater is less commonly used for large water demands. Aquifer diversions are limited, and it is expensive to drill wells and install and operate equipment.

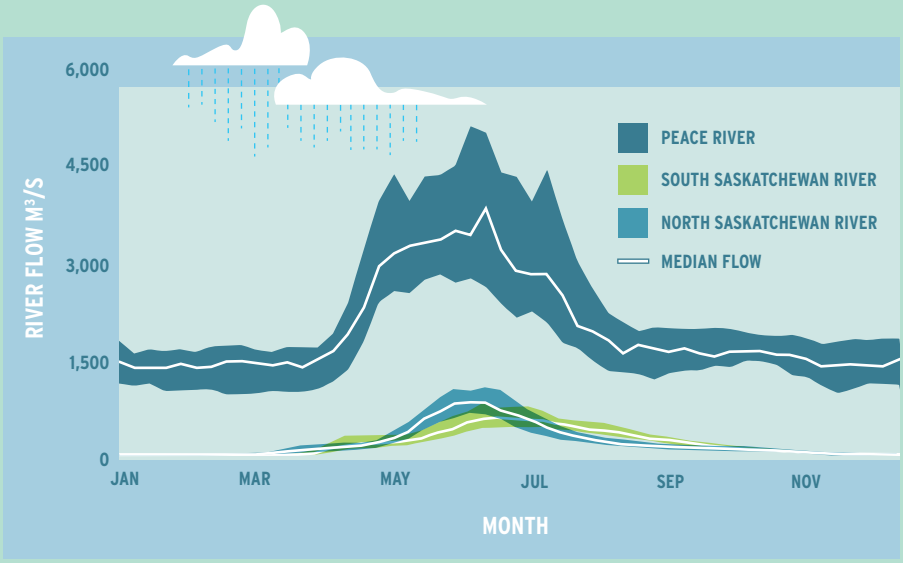


Figure 1: Visualization of river flows in different regions of the province, which vary seasonally and annually. The Peace River is in northern Alberta, while the South Saskatchewan River is in the south.

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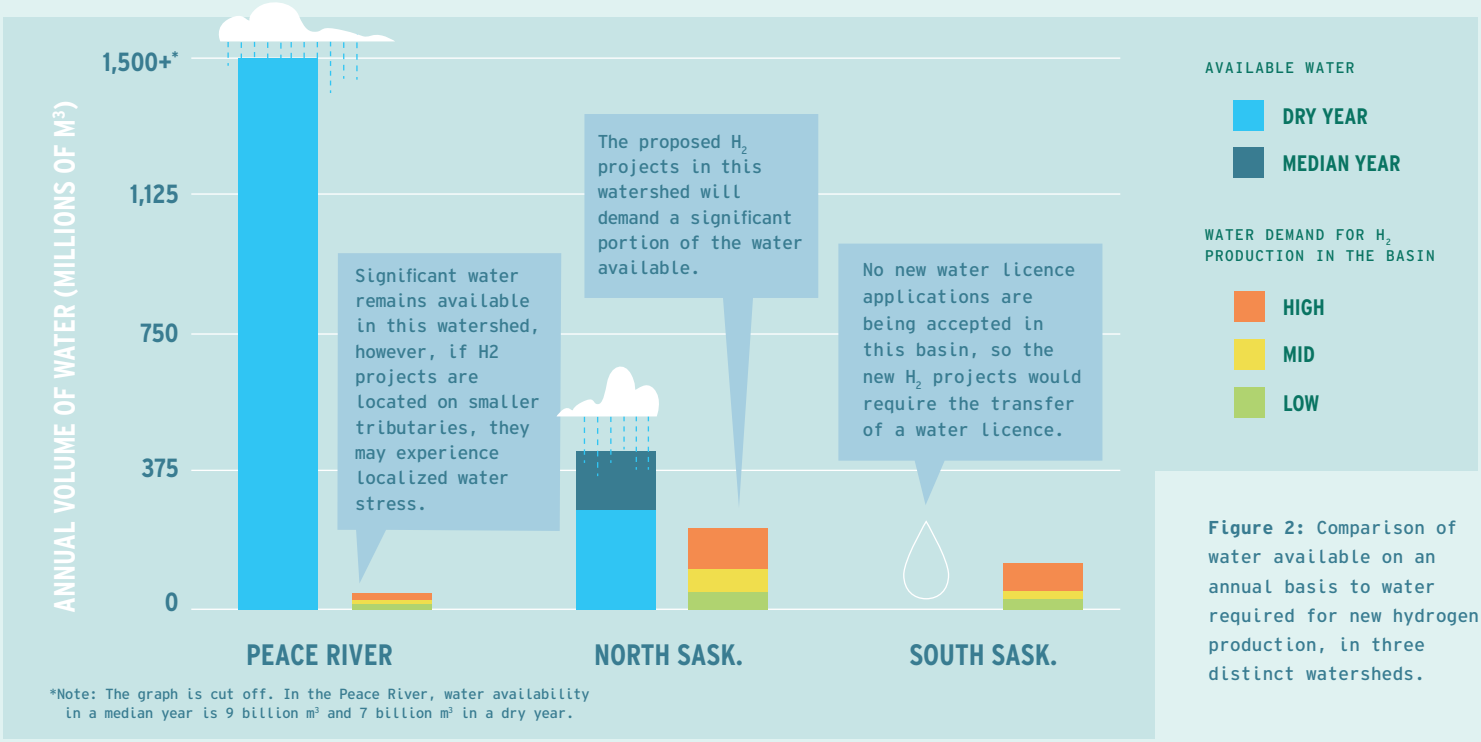
COMPARING WATER SUPPLY TO DEMAND

Hydrogen production facilities are proposed across Alberta. **Figure 2** compares water that is available for new uses to the anticipated water demands of proposed new hydrogen production for three notable watersheds. For comparison, a city of 1.7 million people would consume about 100,000,000 m³ of water annually.



*Note: The graph is cut off. In the Peace River, water availability in a median year is 9 billion m³ and 7 billion m³ in a dry year.

Figure 2: Comparison of water available on an annual basis to water required for new hydrogen production, in three distinct watersheds.

The figures above show that new hydrogen production is expected to require new water licences. In some cases, industrial facilities transitioning to hydrogen production can utilize existing water licences with an amendment to their purpose, resulting in a minimal impact to consumptive water use. The Water Act also allows for the transfer of existing water licences between users under specific circumstances. Transferring existing licenses to support new hydrogen production may also result in a net-zero impact to water use.

Water consumption for hydrogen production is comparable to diesel and gasoline production, on the basis of water consumption per net energy unit[3,4]. Replacing diesel and gasoline with hydrogen may therefore result in a net-zero impact to water use, but this must be determined on a location and facility specific basis; not all current diesel and gasoline water uses are in the same locations as proposed future uses for hydrogen. **Figure 3** compares the locations of proposed hydrogen production facilities to water availability across Alberta.

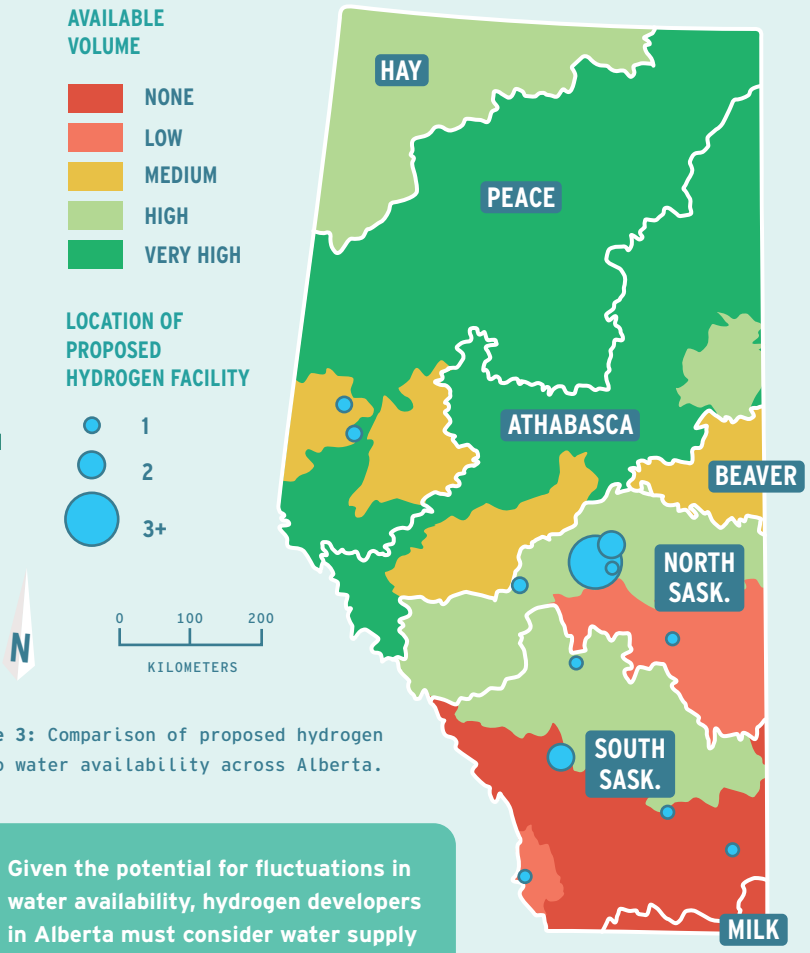


Figure 3: Comparison of proposed hydrogen facilities to water availability across Alberta.

Given the potential for fluctuations in water availability, hydrogen developers in Alberta must consider water supply early in planning and site selection.

REFERENCES

[1] www.natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/energy-from-hydrogen-the-basics/23025

[2] www.albertawater.com/interesting-facts/

[3] www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html

[4] www.osti.gov/biblio/1392949

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