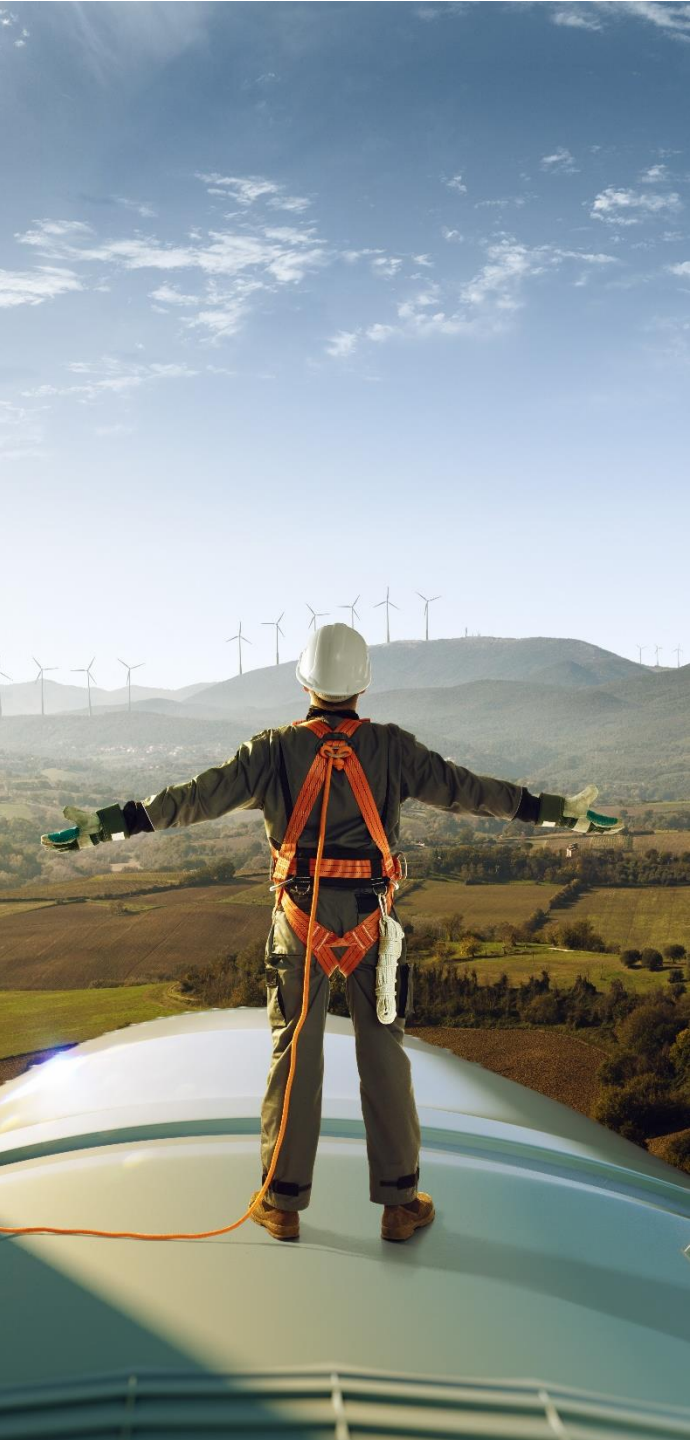

GLOBAL ENERGY SHOW
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ALBERTAH2

Hydrogen from Upstream Oil & Gas Facilities

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AlbertaH2

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AlbertaH2

- Who is AlbertaH2?
- The science
- Next steps

Who is AlbertaH2?

- Oil and gas specialists
- Extensive Process, Design and Operations experience
- Patent pending design is uniquely tailored for WCSB E&P facilities and conditions

AlbertaH2 Objectives

- Created H_2 production specifically to leverage
  - Existing infrastructure
  - Existing disposal practices
  - Oil and gas skillsets
  - A waste product

AlbertaH2 Features

- Electrolysis H_2 production
- Configuration presented is for natural brine (i.e. oilfield produced water)
- Designed to be retrofit into existing produced water systems

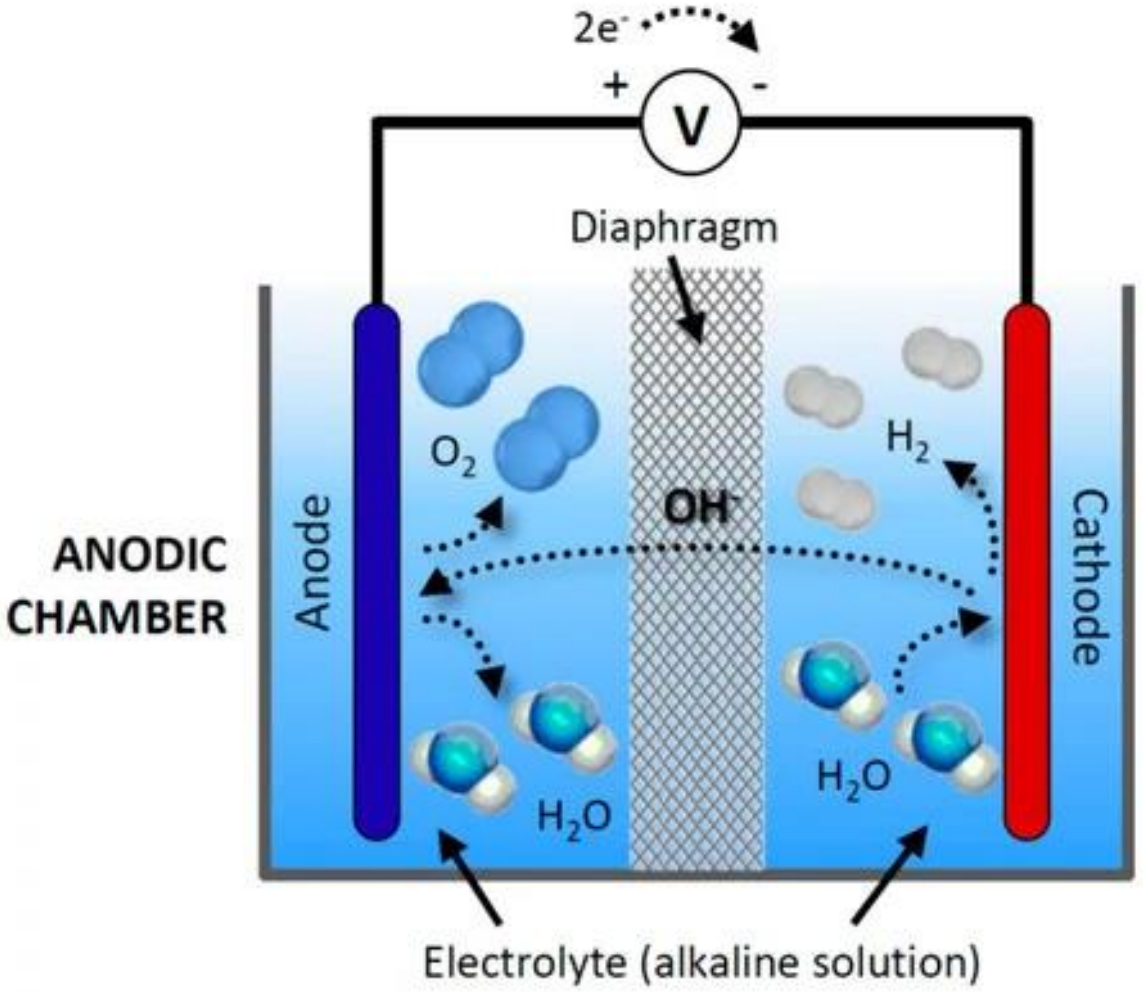
AlbertaH_2 Science

- Utilizes similar chemical injection to existing produced water system
- Utilizes a small fraction of produced water (110 kg H_2/m^3 of produced water)
- Fluid effluents are made compatible with liquids currently injected (i.e. corrosion inhibition, SRBs)

Alkaline Electrolysis

Oxidation

$2OH^- \longrightarrow H_20 + O_2 + 2e^-$



Reduction

$H_2O + 2e^- \longrightarrow H_2 + 2OH^-$ (-0.83 V)

$Na^+ + e^- \longrightarrow Na$ (-2.71 V)

AlbertaH2 Process

- Electrolyte is minimally treated produced water
- No membrane between electrodes
- Separates H_2 and O_2 production
- Eliminates limiting anode O_2 reaction

AlbertaH2 Process

- Increased H_2 production efficiency
- Simple equipment and operation
- Minimal gas cleaning
- Patent pending

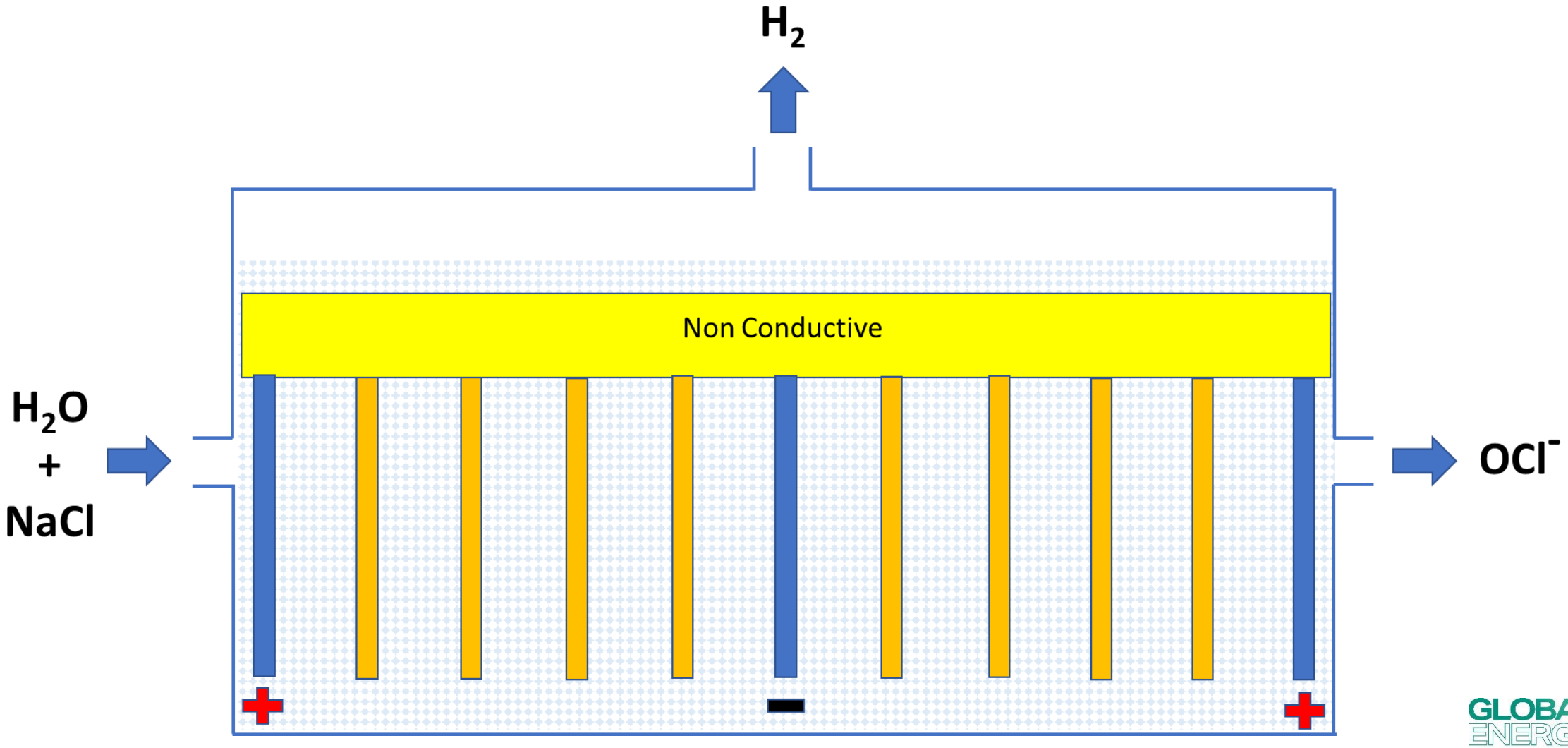
AlbertaH_2 Conditions

- Produced Water Electrolyte
  - H_2O, NaCl, Ca^{2+}, CO_3^{2-}, SO_4^{2-}…
- NaCl: 3,000 – 30,000 ppm
- Voltage controlled (1< DC <6)

AlbertaH2 Features

- Unpartitioned electrolytic cell
  - Includes driving electrodes and one or more pairs of bi-polar electrodes
- Hydrogen production achieved in a “two-step” process
- Catalyst bed used to reduce hypochlorite (OCl^-)to enable normal disposal well injection

AlbertaH2 – Electrolytic Cell



Chemistry

$2H_2O_{(aq)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$ (-1.0 V) ✓

$Na^+_{(aq)} + e^- \rightarrow Na_{(aq)}$ (-2.71V)

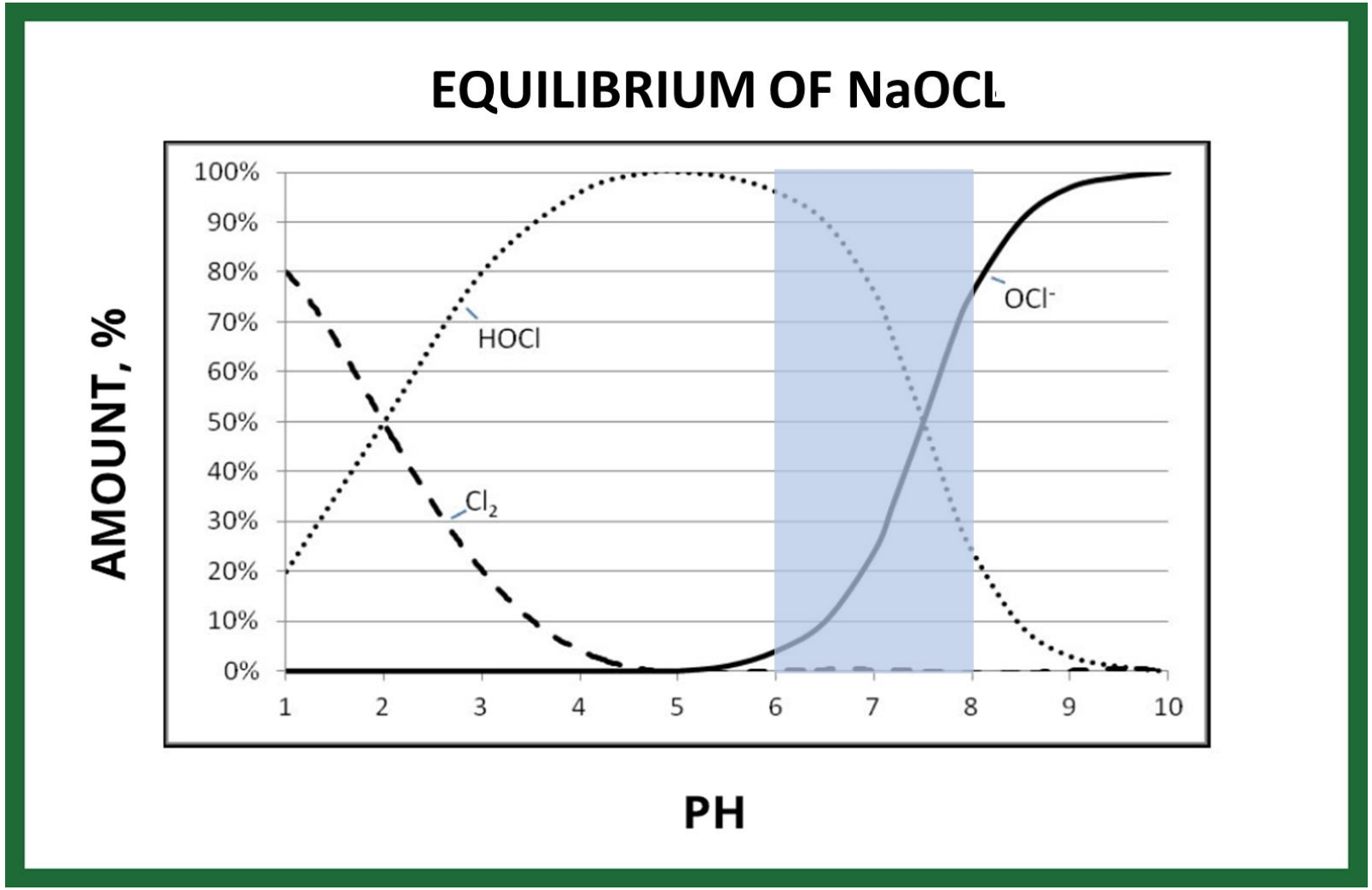
$2H_2O_{(aq)} \rightarrow O_{2(aq)} + 4H^+ + 4e^-$ (-1.42 V)

$2Cl^-_{(aq)} \rightarrow Cl_{2(aq)} + 2e^-$ (- 1.36V) ✓

$2OH^-_{(aq)} + Cl_{2(aq)} \rightarrow 2OCl^-_{(aq)} + H_{2(g)}$ ←

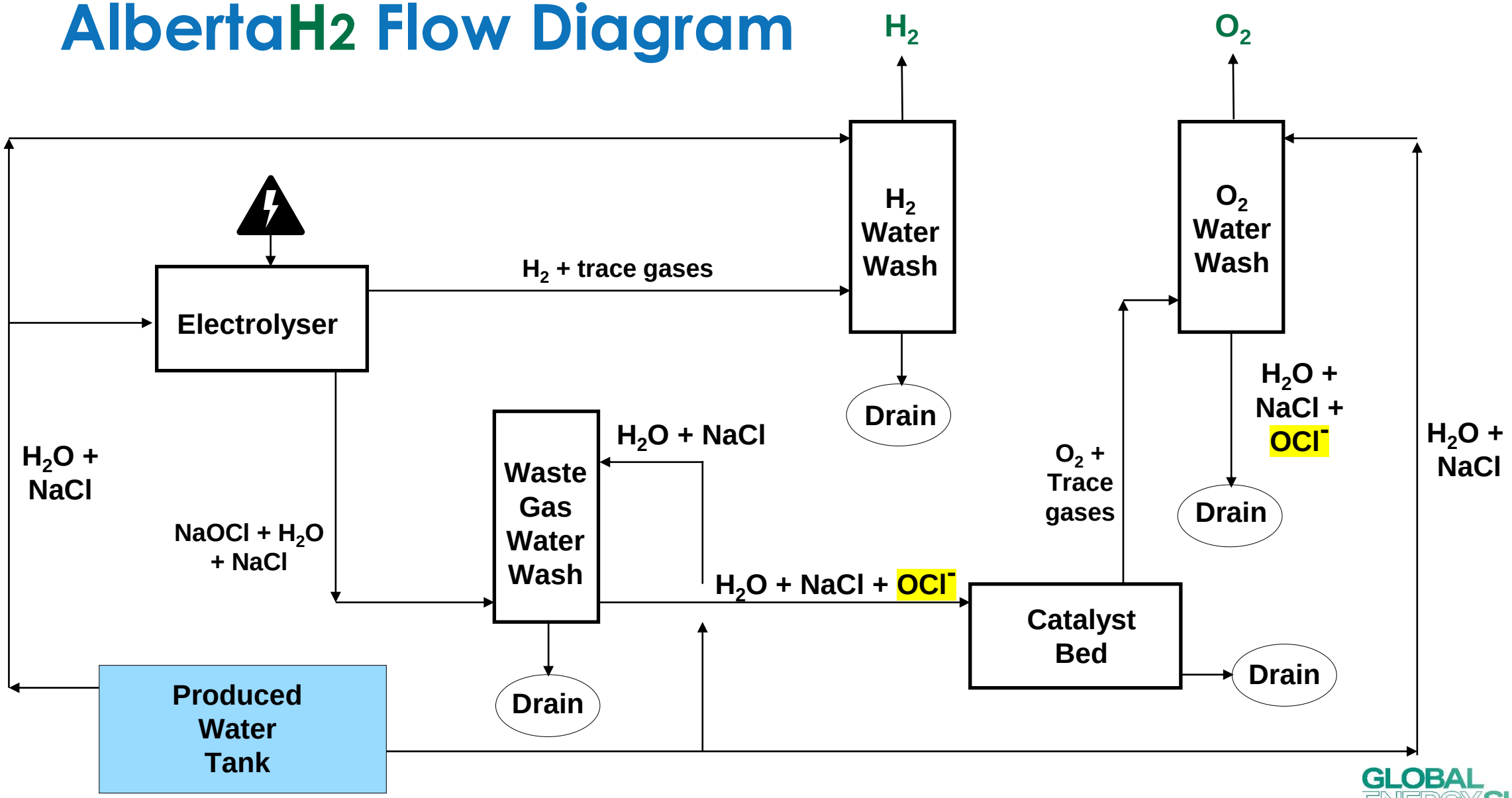
→ At pH>7, favoured due to higher OH^- ions concentration

AlbertaH2 – Operating Range



AlbertaH2 operating range

AlbertaH2 Flow Diagram



Next Steps

- ❑ Finalize design for test skid
- ❑ Fabricate test skid
- ❑ Test and optimize
- ❑ Field flow with industry partner

Summary

- H2 Production utilizing oil and gas infrastructure
- Designed by oil and gas expertise with extensive H2 knowledge
- Simplified process – cost reduction
- Optimize and Commercialize

Additional Benefits

- Utilize existing infrastructure (i.e. decommissioned leases)
  - Extend life of lease that would otherwise require decommissioning and reclamation

- H_2 produced locally for use at site, truck transport and/or slipstream into natural gas pipeline

Thank you!