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IPICYT

FONDO DE SUSTENTABILIDAD ENERGÉTICA

Primer Congreso Nacional de Bioturbosina

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Línea de Investigación: TRANSFORMACIÓN

Hidrogenación Electroquímica

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What is CIDETEQ?

cideteq

Center for Research and Technological Development in Electrochemistry

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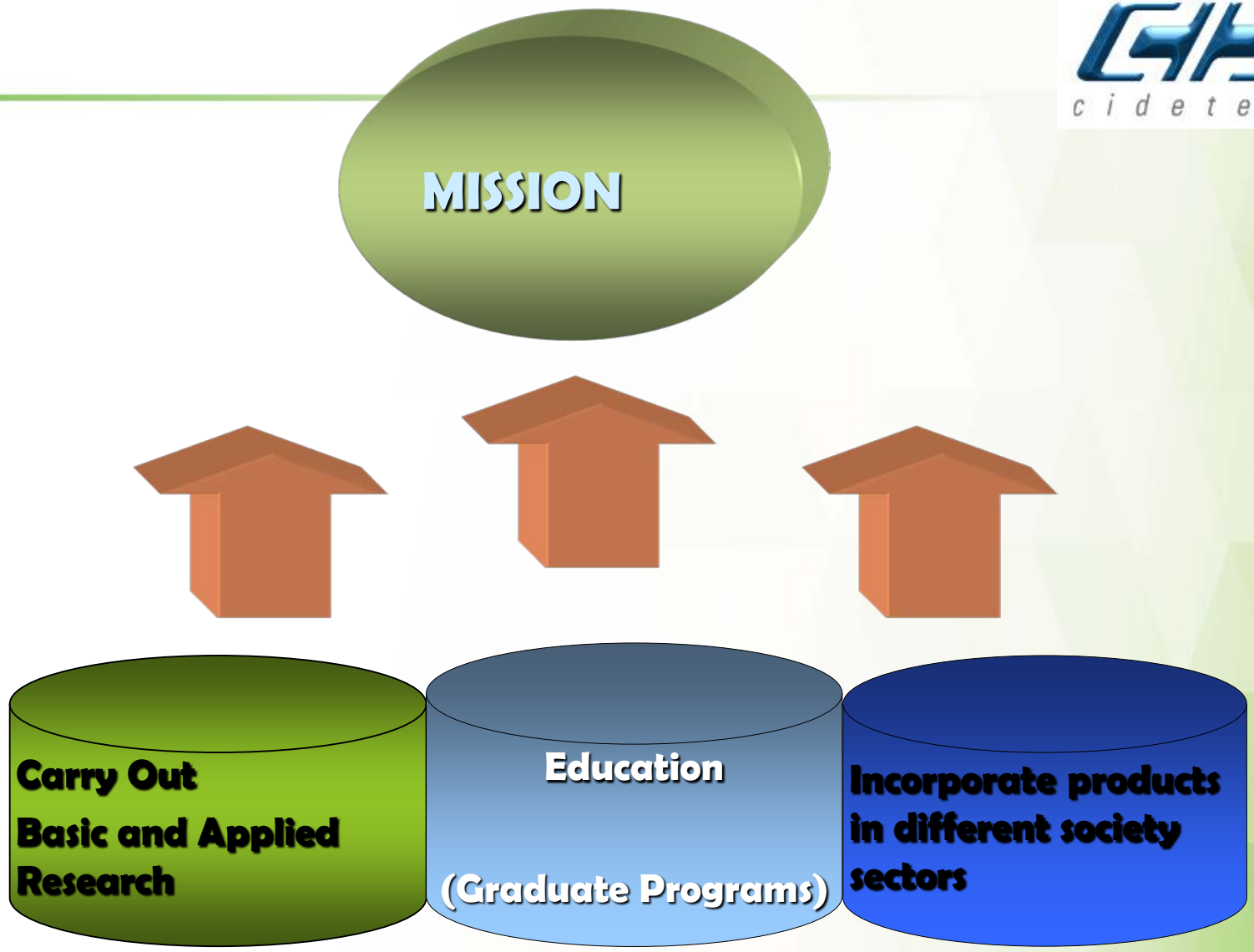
www.cideteq.mx



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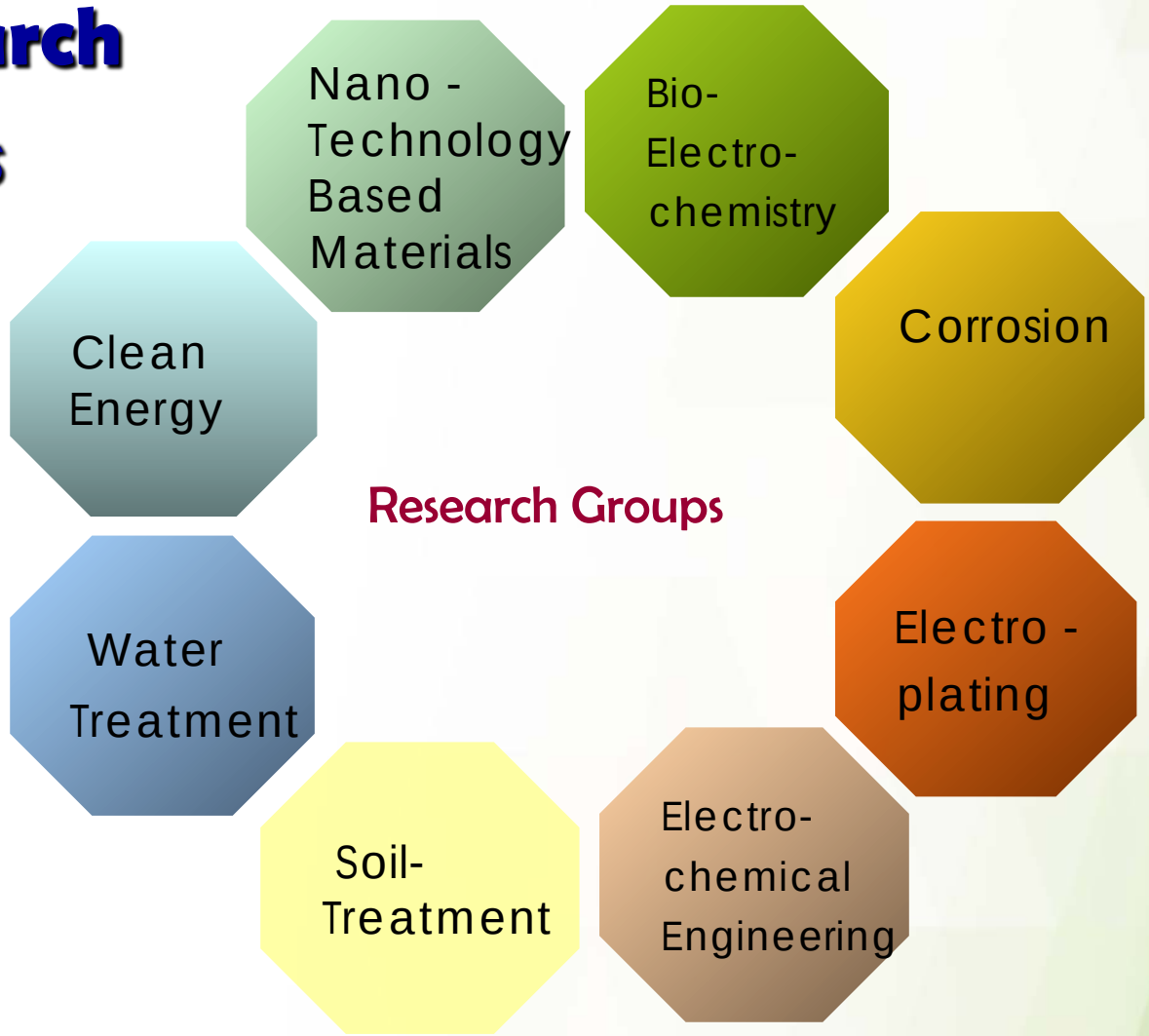
Developing Axles

Research Fields



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Clean Energy

Research Groups

Electro-chemical Engineering

PhD Francisco J Rodríguez
PhD Luis Gerardo Arriaga
PhD Abraham U Chávez

MC Federico Manriquez
Eng. Armando Contreras
MC Carlos Montoya S

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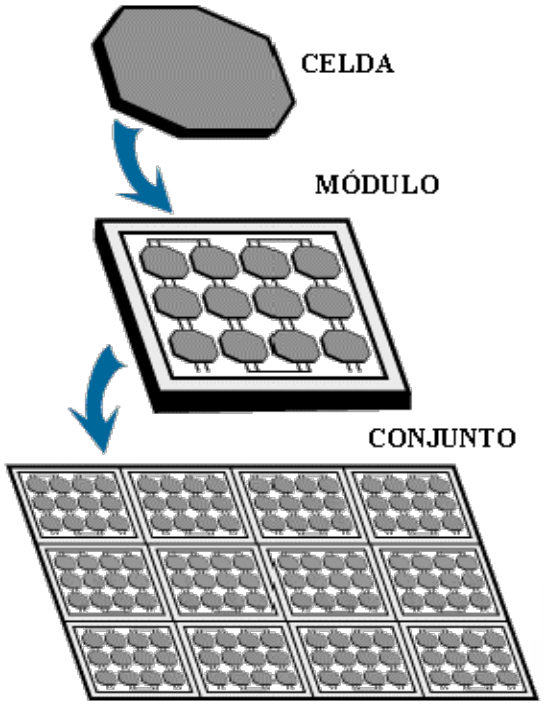
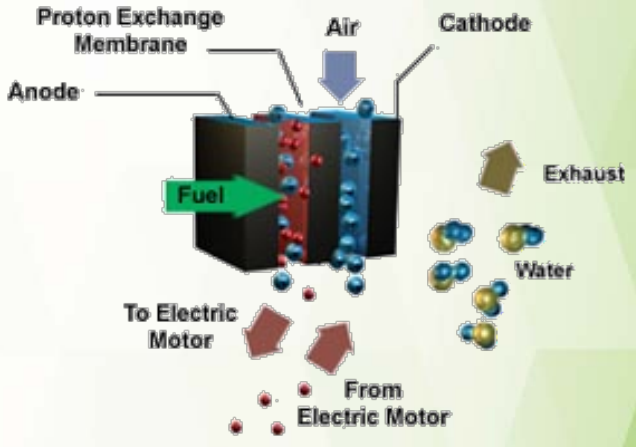
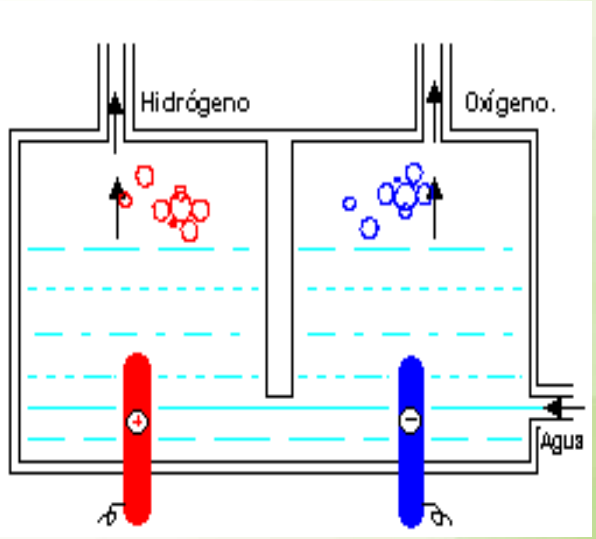
Alternative energies

PROJECT: Solar energy and fuel cells integration.







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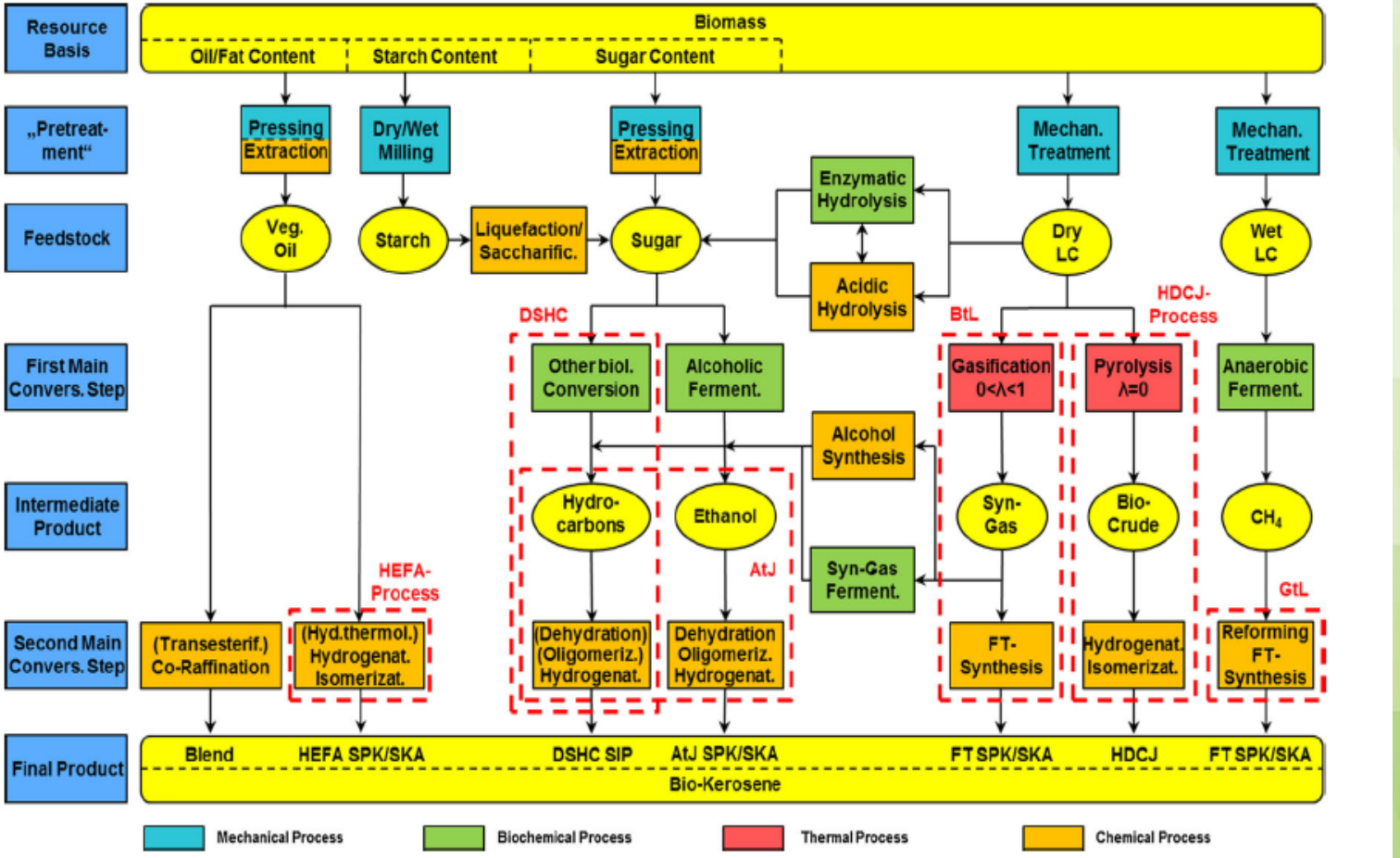
Hydrogen Requirements



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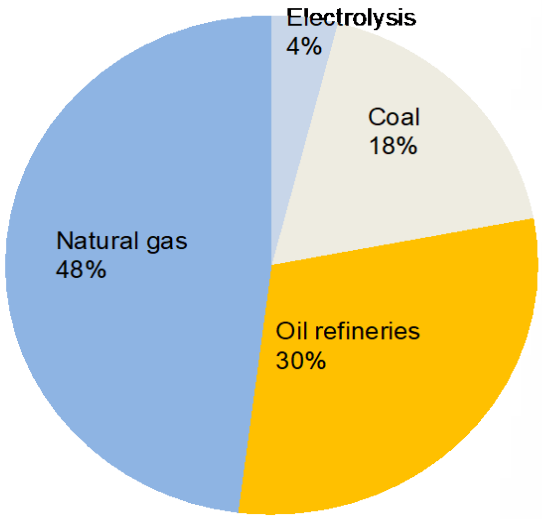
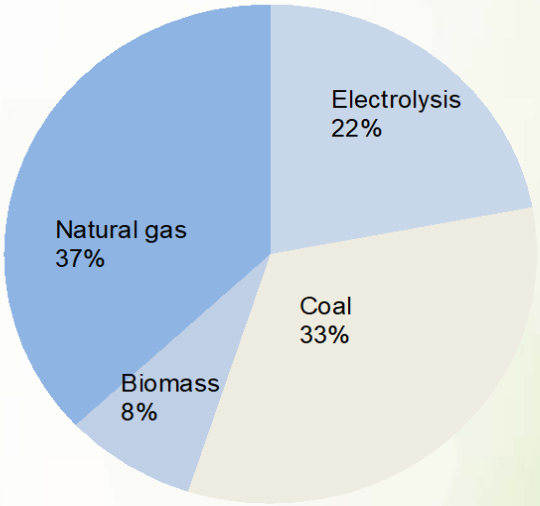
HYDROGEN SOURCES



Today



Prediction year 2050

Source:International Conference on Electrolysis. Copenhagen 2017

WATER ELECROLYSIS TECHNOLOGIES

Technology	Alkaline water electrolysis	SPE (Solid polymer electrolyte) electrolysis	SOEC (Solid oxide electrolysis cell)
Process	Aqueous electrolysis	"Reversed PEFC"	"Reversed SOFC"
Feed	80% KOH, 80ºC	Pure H_2O, 100ºC	Steam, 800-900ºC
Charge carriers	OH^-, K^+	H^+	O^{2-}
Industrial use	Well developed Large scale	High current densities Differential pressure Expensive catalysts	Not yet commercial Pilot scale

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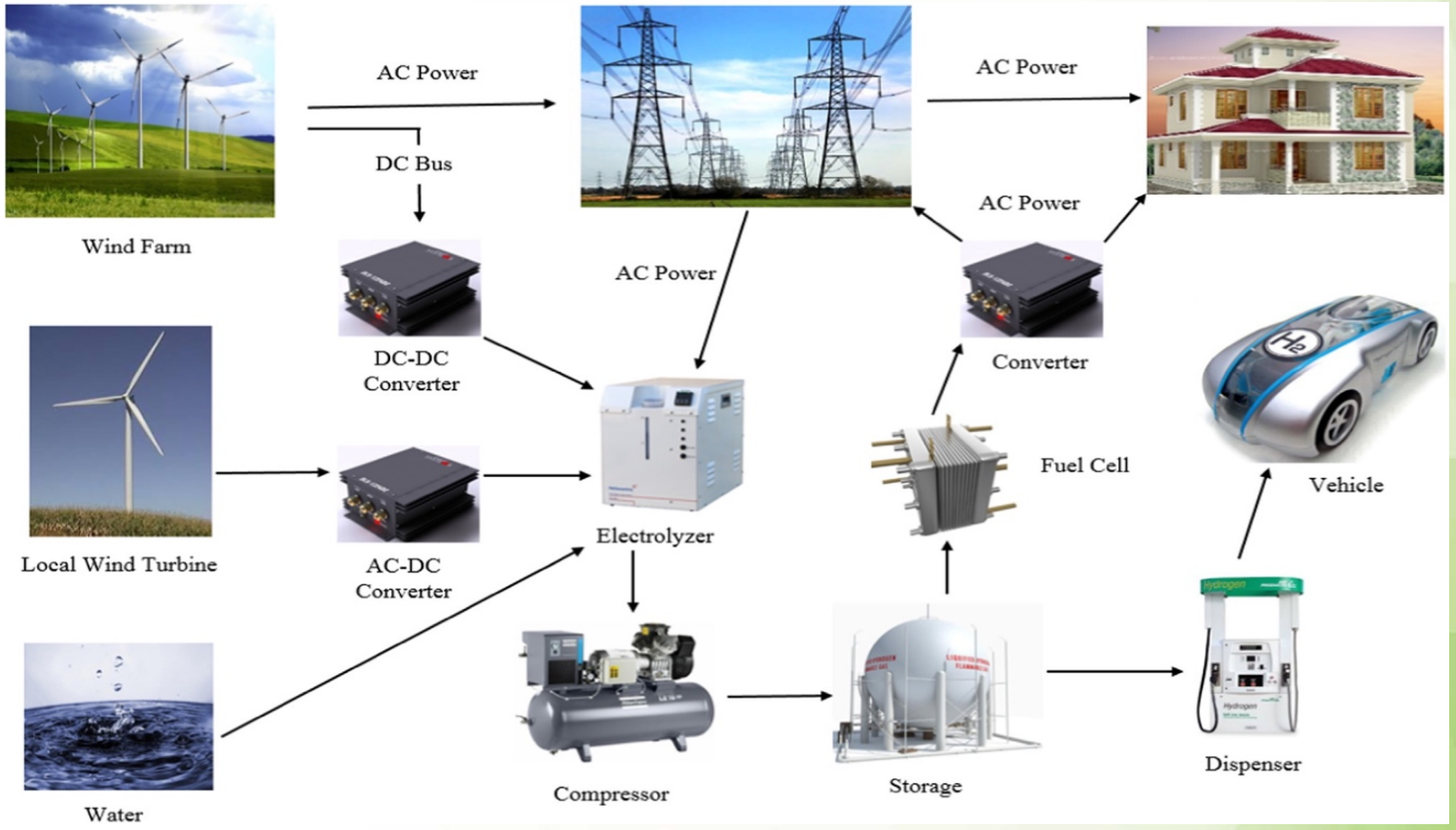
ENERGY SUPPLY FOR HYDROGEN PRODUCTION BY WATER ELECTROLYSIS AND FUEL CELL



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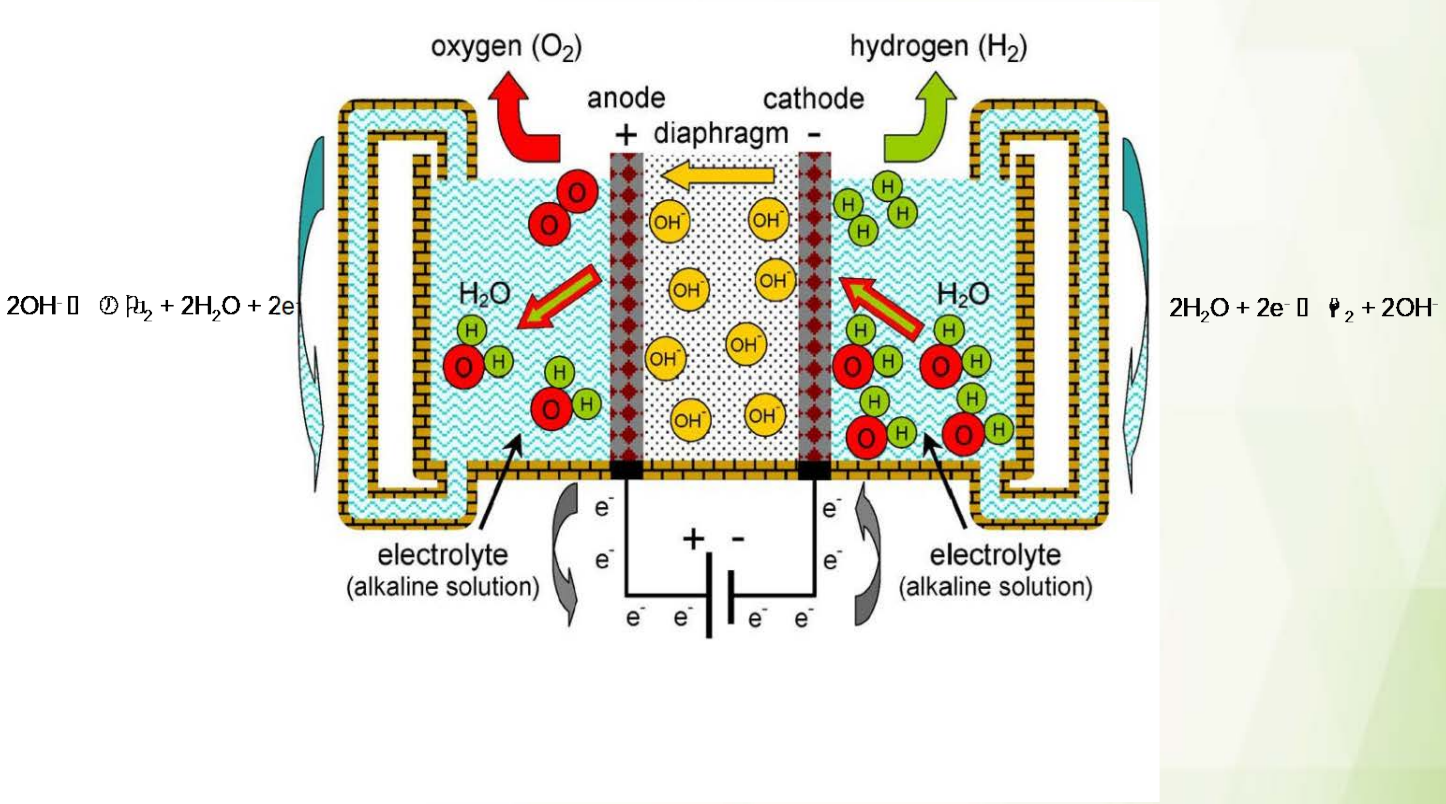
ALKALINE ELECTROLYSIS



PROCEEDINGS OF THE IEEE | Vol. 100, No. 2, February 2012

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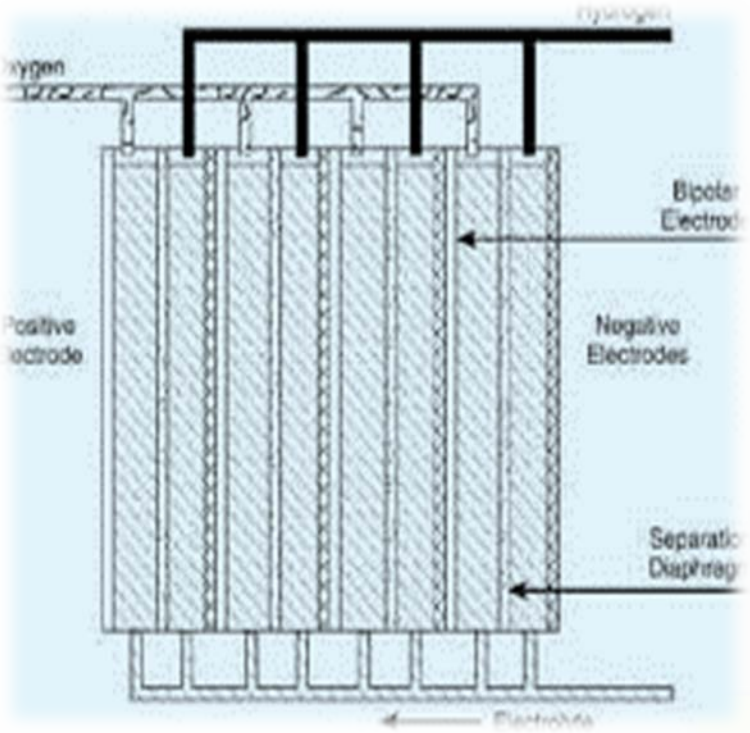
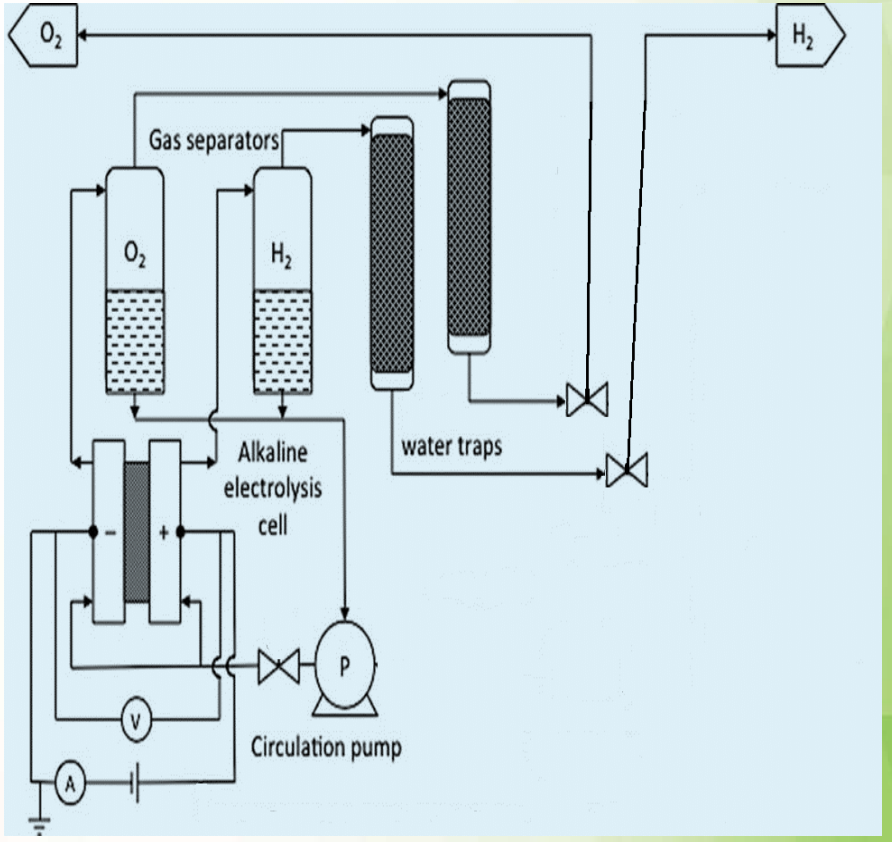
CELL ARRAY AND FLOW DIAGRAM





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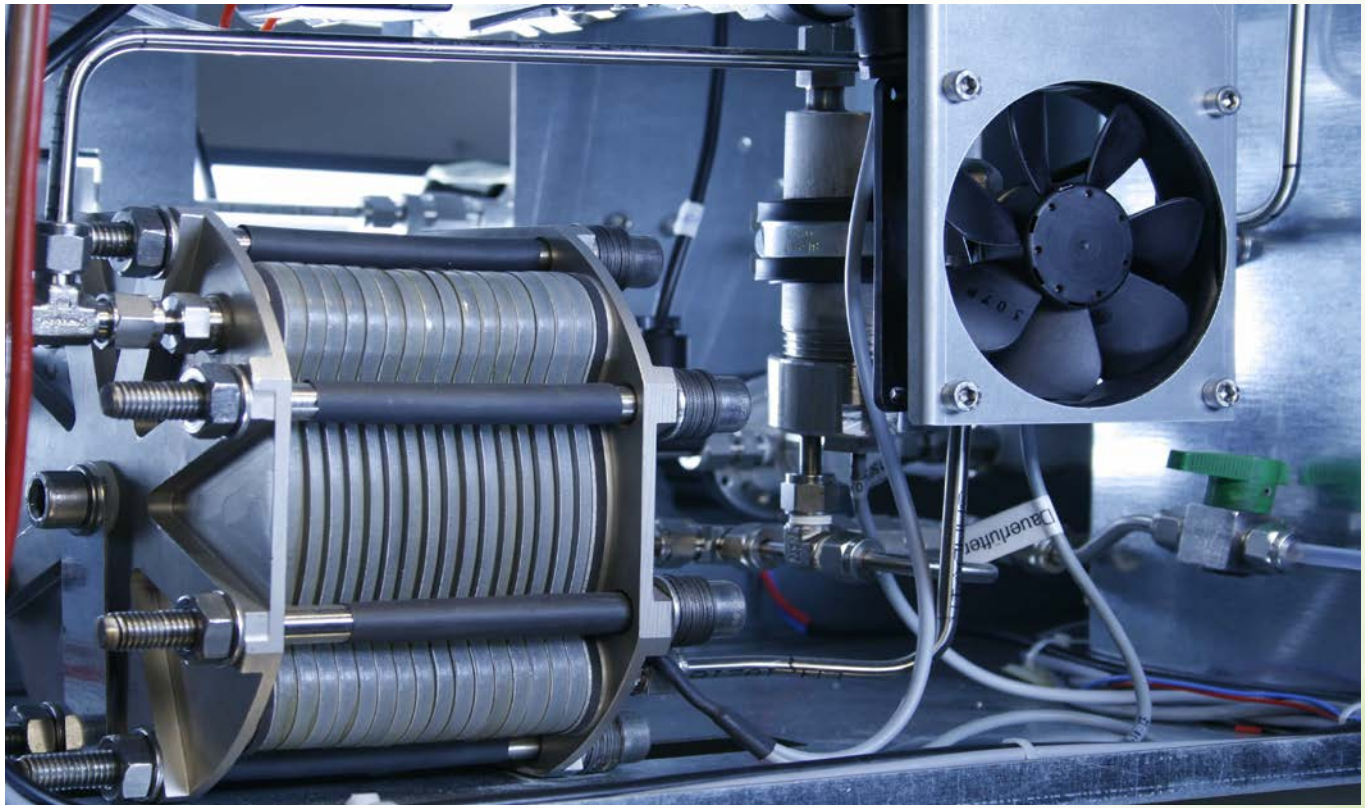
ALKALYNE ELECTROLYSER



PRODUCTION CAPACITY 600- 1000 Nm3/hr
4.4 kWh/Nm3 H

Anode: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$
Cathode: $4H_2O + 4e^- \rightarrow 2H_2 + 4OH^-$
Electrolyte: 25% KOH 80ºC

By courtesy of StatoilHydro

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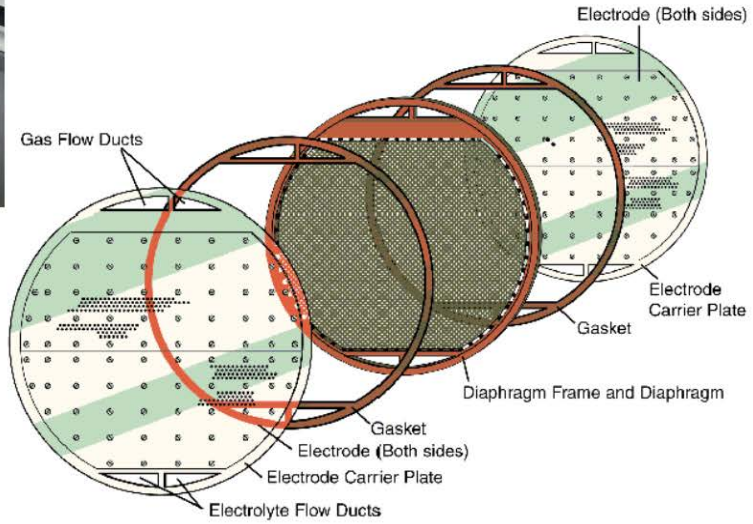

Bipolar technology
Electrodes of coated mild steel

By courtesy of StatoilHydro

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Conclusion Mitsui

- Japan.Mitsui (2017)
- Global Strategic Studies Institute

- In a short term, electrolysis is the most promising technology with low-Price electricity at high availability.

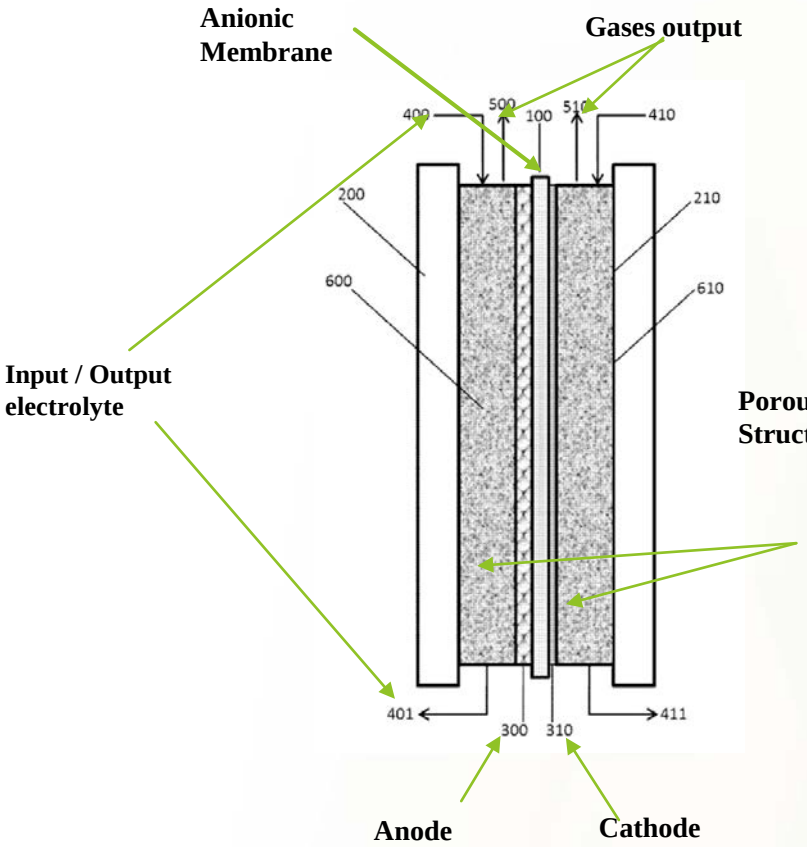
International Conference on Electrolysis Copenhagen 2017

- Conclusion
- The hydrogen production by water electrolysis is a pathway for sustainability energy for the future.
- Urgent task: Efficiency on the process and minimize use of grid energy.
- Tech Challenges:
- * To reduce bubble effect
- * Improvement the electrode surface
- *Corrosion Resistance
- * Efficiency on Catalytic Reactions

STATE OF THE ART FOR ALKALINE ELECTROLYSIS.

	Name	CLAVE	ASSIGNEE
Design	High pressure electrolyser	US 8623195 B2 / 2014	Casale Chemicals S.A
	Electrolysis cell of alkali solutions	US 2016/0369412 A1	Industrie de Nora Milán, IT
	Electrolyser module	US 2010/0012503 A1	Next Hydrogen Corporation.
	Electrolyser stack divided into sub-stacks	WO 2016/034183 A1	GREENHYDROGEN.DK
Electrodes	High performance cathodes for water electrolysers	US 2014/0246330 A1	Casale Chemicals
	Cathode Electrode for hydrogen generation	EP 2361234 (2013)	Industrie de Nora S.P.A. (100.0%) Via Bistolfi 35 20134 Milano, IT
	Cathode coating by catalitic metal for hydrogen production	MX2015006588A	Industrie de Nora S.P.A. Via Bistolfi 35 20134 Milano, IT
	Diaphragm-electrode assembly for use in alkaline water electrolysers	US 2016/0289850 A1	De Nora Tech Inc., Concord, OH (US)
Zero-Gap	Electrolytic cell separator assembly	US 6187155 B1	Stuart Energy Systems Inc., Ontario (CA)

DESIGN AND BUBBLE EFFECT



Picture: Surface of reaction

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DSA ELECTRODE (CATALITIC EFFICIENCY AND CORROSION RESISTANCE

De Nora Cathode Technology evolution

2013
Nickel Metal Cathode, Molibdenum Oxide coated

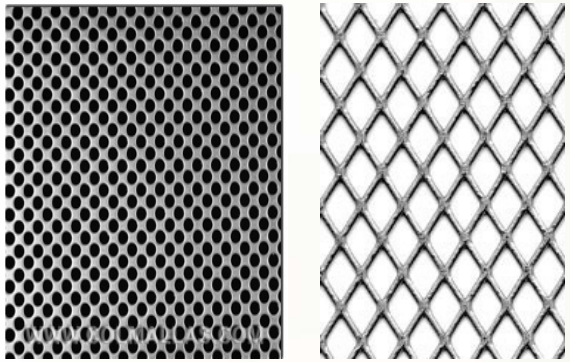
→

2015
Nickel Metal Cathode, Ruthenium Coating

→

2016
Titanium Metal Cathode Ruthenium Oxide Coating

*Mesh Metal Electrode



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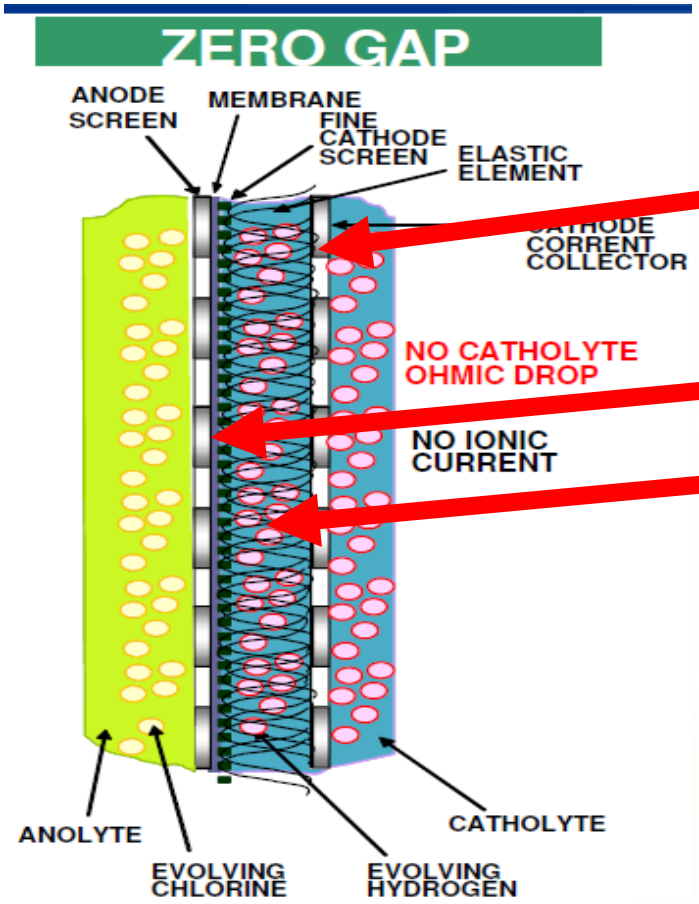
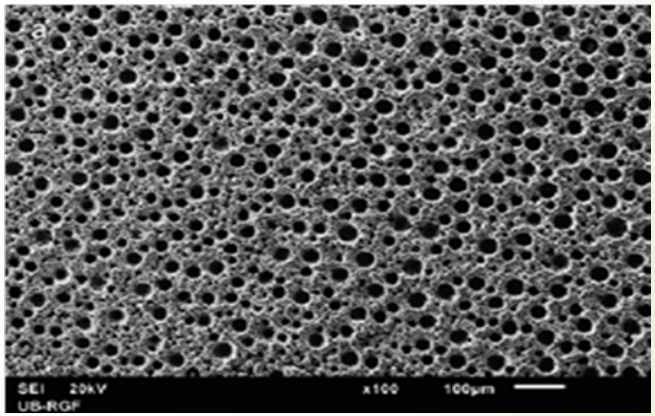
ZERO-GAP (BUBBLE EFFECT AND LOW OHMIC DROP)



- Cathode Wall collects the current .
- Cathode / Membrane interaction.
- Metal Foam.



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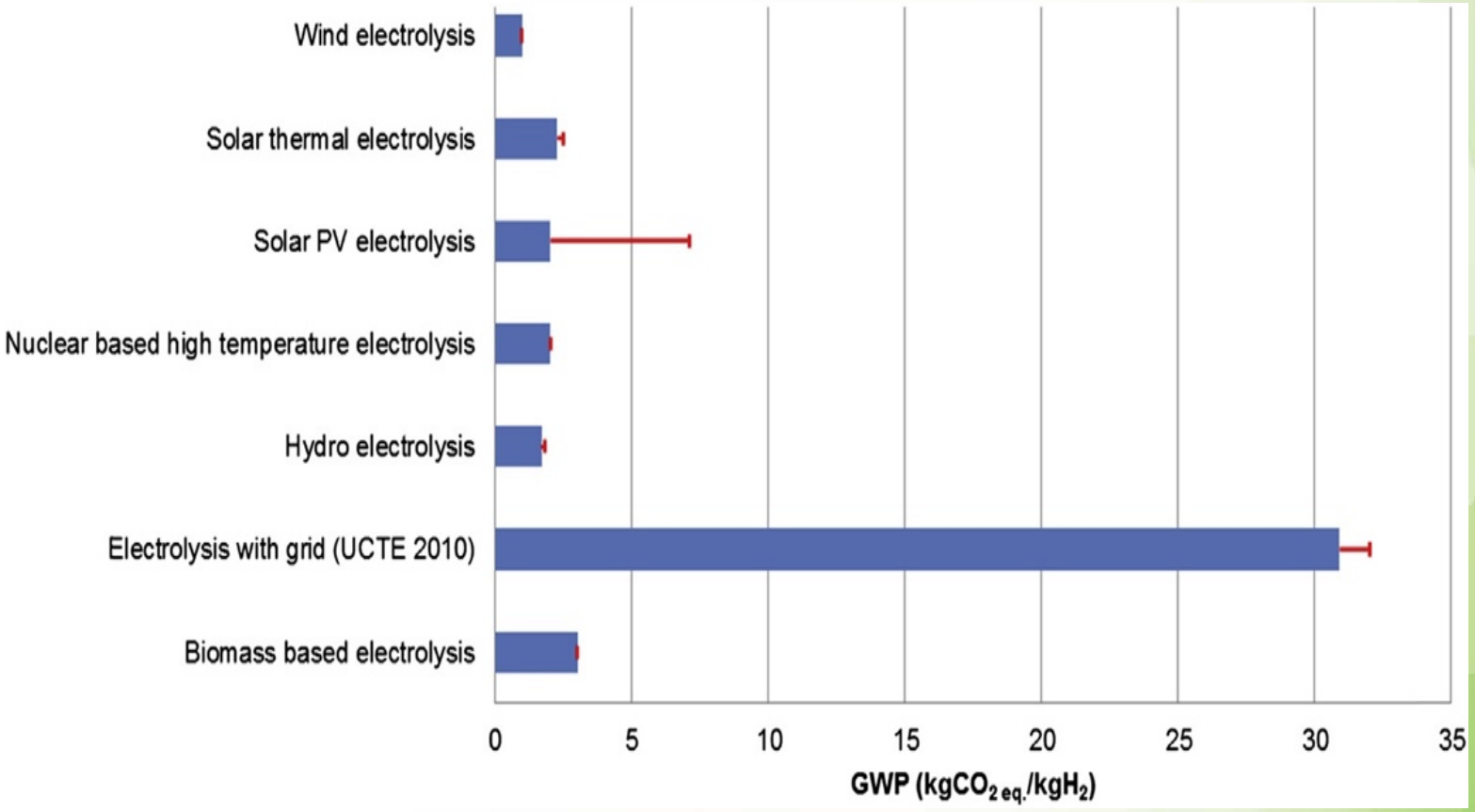
GLOBAL WARM POTENTIAL / KG DE H2



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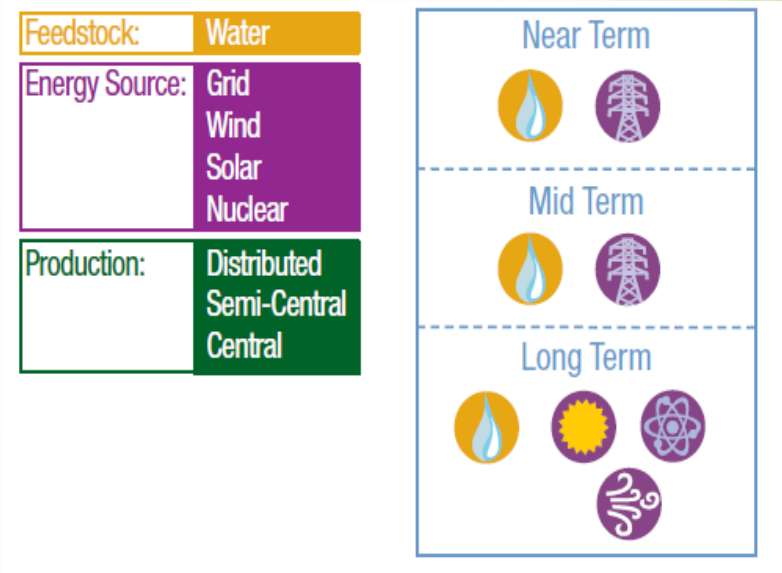
WIND TURBINES

High sustainability potential

Using wind power or waste heat from nuclear reactors would generate hydrogen without emitting greenhouse gases.



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THANKS!!!