The Hydrogen Shift is Here

The Future of Power and Mobility

ADB – Clean Energy Forum

Presented by
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Hydrogenics in Brief

- Provider of clean solutions based on hydrogen
- Listed on NASDAQ (HYGS) and TSX (HYG)
- Sales offices, R&D & Production facilites:
  - Canada (HQ): Fuel Cells
  - Belgium: Water Electrolyzers & Systems Integration
  - Germany: Fuel Cell Systems and Integration
  - Joint Venture in South Korea
- Sales & Service offices: Asia
  - China, India, Indonesia and Malaysia
- Thousands of systems delievered worldwide
- Hundreds of Patents in core technology

Hydrogenics' Lines of Business

Onsite Generation
Water electrolyzers

Power systems
Fuel Cells (4 to … kW)

Industrial hydrogen

Hydrogen fueling

Backup power

Mobility power

Hydrogen Energy Storage / Power Systems
Load Control, Smart Grid and Community Energy Storage

Industry Leading Strategic Investors

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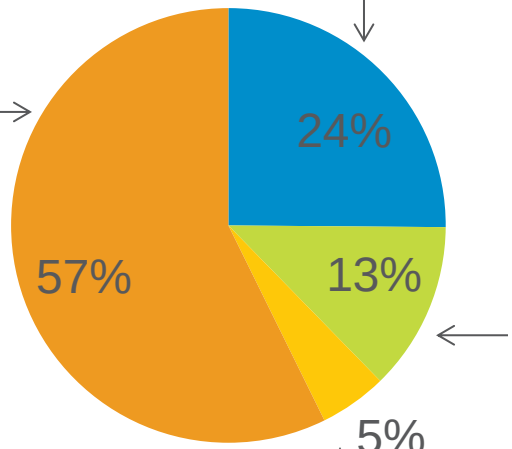
Hydrogenics has attracted investment from industry leaders across a number of applications which gives us greater stability

Shareholder Composition



COMMSCOPE®

- $5 billion USD company in the Telecom market
- Cooperation on back-up power systems

ENBRIDGE

- $11 billion USD company, largest gas supplier in North America and investor in RE projects
- Cooperation and investment in Power to Gas

GM

- $155 billion USD company, world 2nd largest Automotive company
- Some development on Fuel cells for vehicles

And its relevant to the world around us…

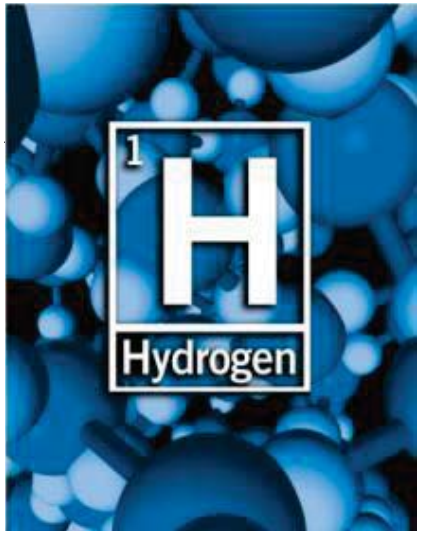
There is a "power shift" happening around the world.

- **From** fossil fuels **to** a blend of renewable, accessible alternatives
- **From** volatility **to** user-controlled supply management
- **From** excess waste and emissions **to** sustainable energy inventories and zero-emissions
- **From** thinking backward **to** rebuilding energy confidence in the future and energizing a way forward that is sustainable

Hydrogenics is helping accelerate a global "power shift" by engineering and building the technologies needed to make it happen.

SHIFT **POWER | ENERGIZE** YOUR WORLD

Availability of Hydrogen:
Most Common Element in the Universe



- Natural Gas Reforming : main format today
- By-product hydrogen
  - : Hydrogen created as a by-product of chlor-alkali production, at carbon monoxide plants & other chemical production
  - : Excess gas in Oil and Gas industry
- Gasification of biomass
  - : Converts organic waste to a hydrogen-rich gas stream (Ex. Palm waste)
- **Electrolysis from water and power such as renewable energy sources**
  - : **Large-scale energy storage using hydrogen produced during off-peak times**
- Steam-reformation of biogas
  - : Renewable bio-gas reformed and purified to hydrogen

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Where is the Shift Today

Tokyo 2020 Olympic Village to be hydrogen-powered: report

- Manufacturing processes like Food, Glass and Steel, on-site production of H2 or Power Plants require Hydrogen

- Major manufacturers like Toyota, Honda, Ford, GM, Mercedes Benz and Hyundai are launching major Fuel Cells Cars Fleets in 2015-16
  - Germany has committed to more H2 stations than Gas stations on the Auto-bahn by 2021

- Korea has over 150 MW of Fuel Cell power stations
  - Hydrogenics has a new JV planning hundreds of MW over the new few years

- Japan is developing its vision of a Hydrogen economy, 2020 Olympics will be primarily powered by Hydrogen

- Hydrogen fuel cells is being used on over 5000 Telecom sites and in data centres as back up power globally
  - Indonesia has close to 1000 Telecom sites using Fuel Cells

- Thousands of Forklifts with Major companies like BMW, Walmart, etc…

Hydrogen has the best potential for Energy Storage

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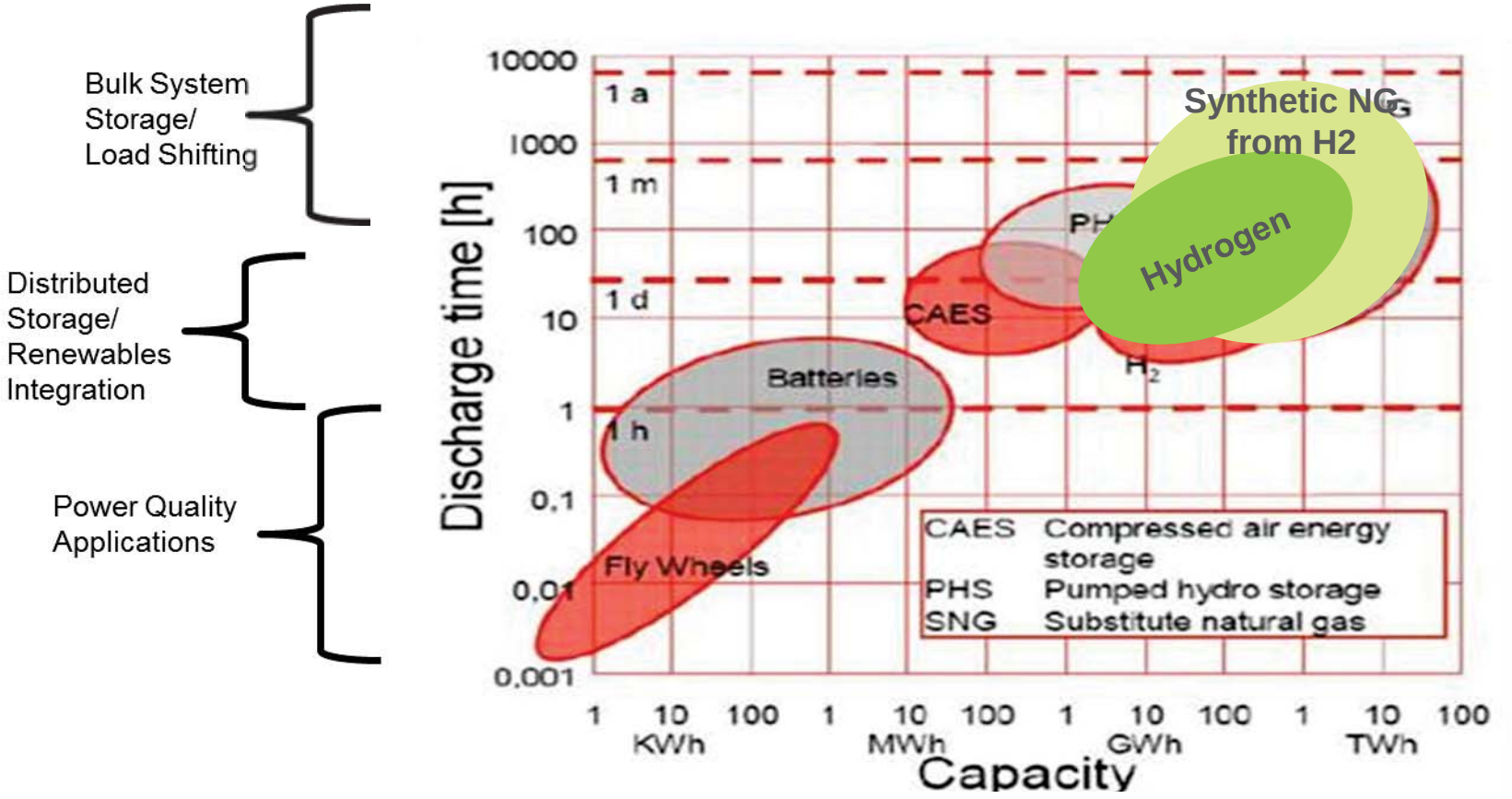
Among alternative energy storage technologies hydrogen provides large capacity with longer duration capabilities



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Shifting the Energy Mix

Using Excess Renewables or Grid Power to Create Hydrogen

- A typical grid has about 30-35% excess power generated due to seasonal or spikes in the grid
  - This can be used to create Hydrogen

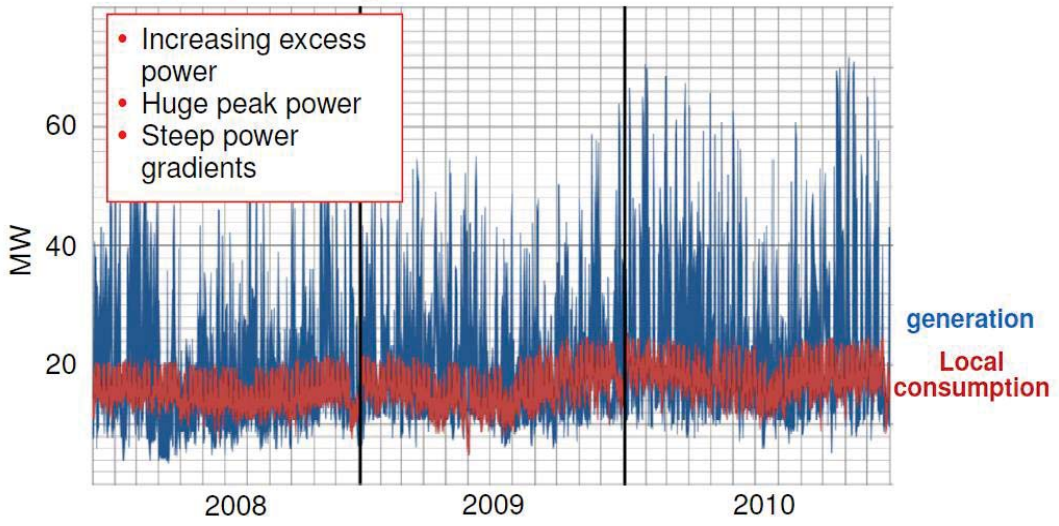
- Renewables often do not generate power when needed, up to 50% wastage for instance on many wind farms

- Creating Hydrogen is far easier than hydrocarbons, it is available almost everywhere ex. water

- Transporting H2 is getting better and better

- Utilities are looking to become more efficient and cost effective

Supply of renewable power in the region of Falkenhagen, 20 KV grid



Solution: Storage of excess wind power instead of curtailment.

e·on

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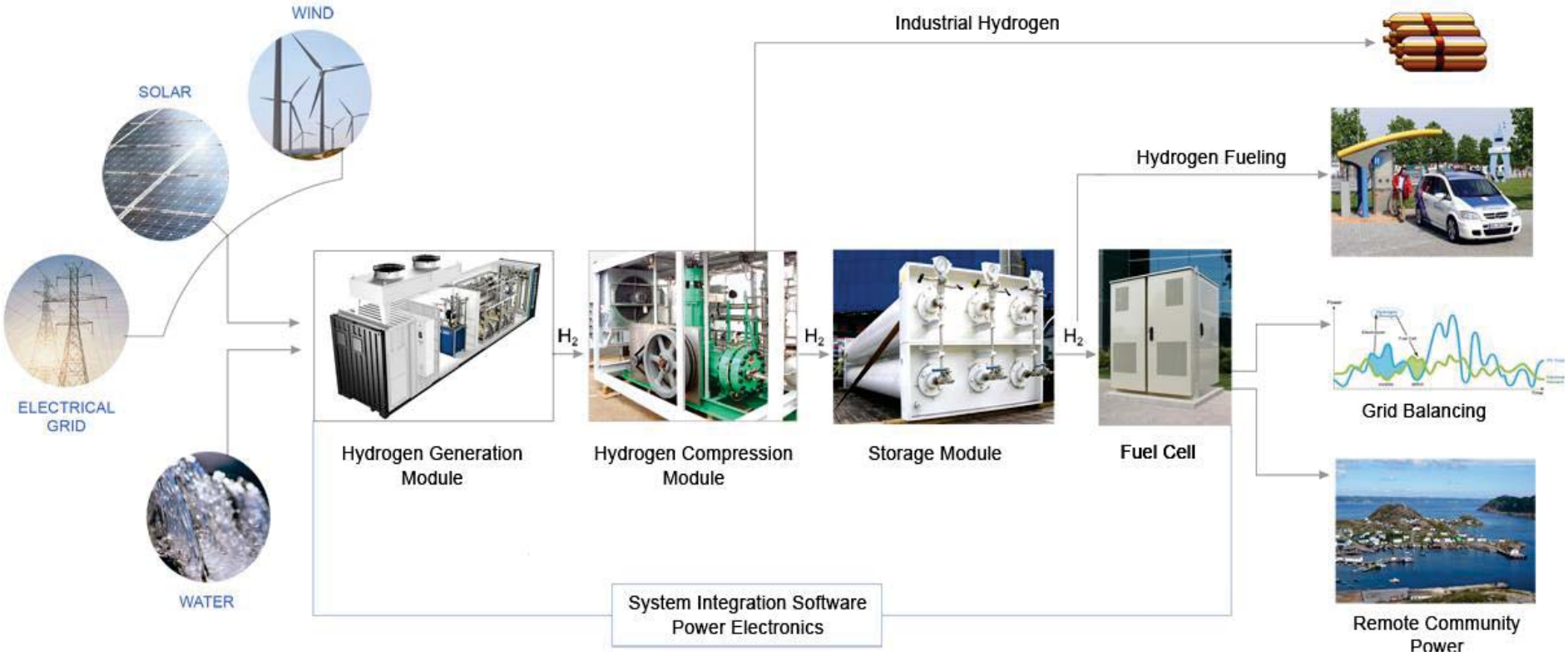
Hydrogen Energy Storage System



OPPORTUNITY

- Hydrogen can be produced and stored economically for instantaneous electricity production
- Fuel cells can be used as electricity generators and over time replace conventional combustion power plants and diesel generators

BENEFITS

- Match intermittent renewable energy supply with demand
- Enable renewable energy to be used for baseload power eliminating high cost and carbon emitting power plants
- Enable load profiling including grid optimization and peak shaving opportunities

The Shift is Already Here – Power-To-Gas in Germany

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E.ON inaugurated 2MW Power-to-Gas commercial operations in Falkenhagen, Germany in August 2013

Usage of Hydrogen:

Fuel Cell Module is used in Many Applications













Large Power Systems for Grid Tie or Back Up

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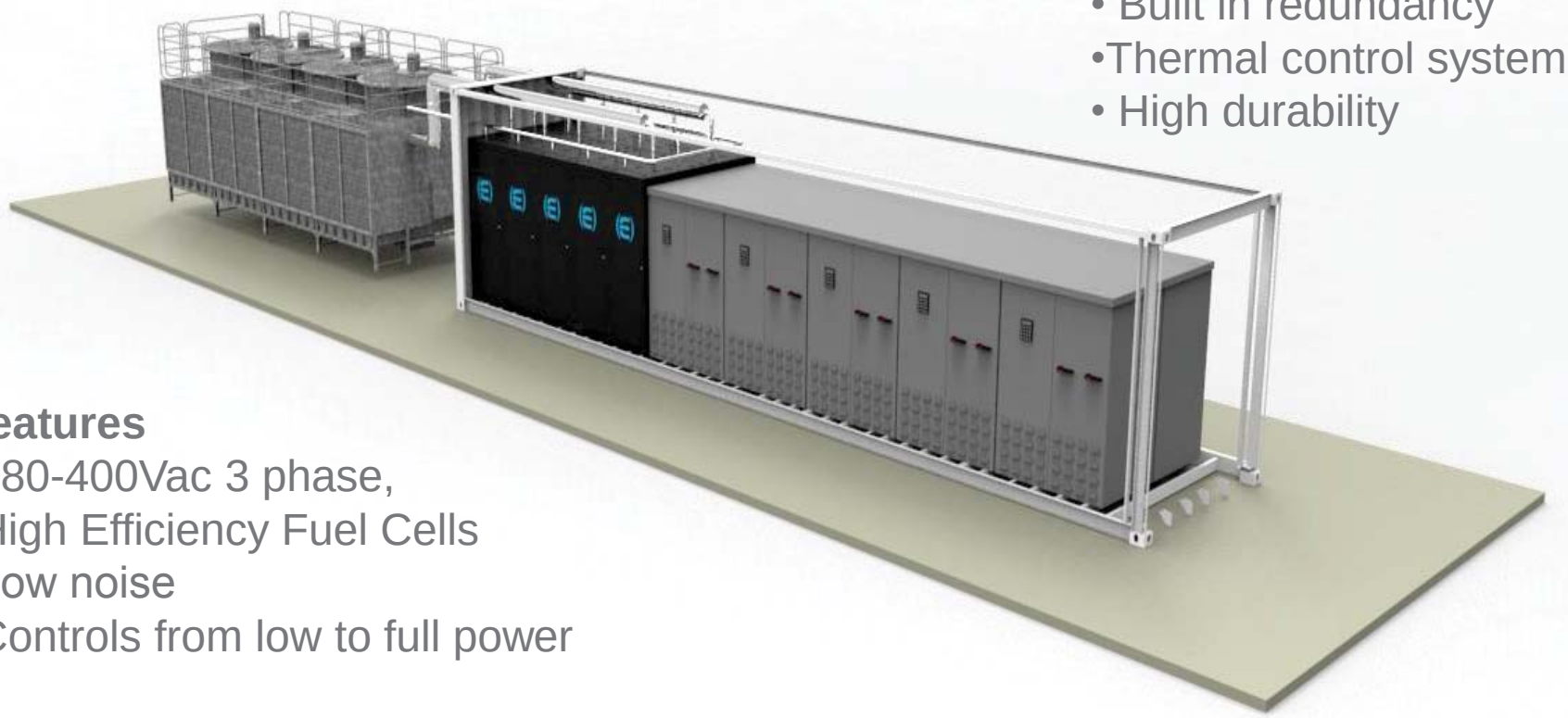
1MW Fuel Cell Plant

Using the building block of our next generation Fuel Cell Power Modules, greater density and performance is achieved on a utility scale.

Benefits

- Scalable plant Layout
- Built in redundancy
- Thermal control system
- High durability



Features

- 380-400Vac 3 phase,
- High Efficiency Fuel Cells
- Low noise
- Controls from low to full power

Production of Hydrogen :
HySTAT™ Process Part (BOP)

Specifications			
Cell stacks	1	2	4
Capacity	10 or 15 (Nm3/h)	20 or 30 (Nm3/h)	60 (Nm3/h)
Pressure	10 or 25 barg	10 barg	10 barg
Op. range	40 – 100%	40-100% (20 -100%)	40-100% (10 – 100%)

World Leader with over 50+ Hydrogen Fueling Stations Worldwide

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Hychico (Patagonia, Argentina): 2007

Early Project of Wind to H2



Customer: Hychico (Capex)

OBJECTIVE OF THE PROJECT

- Maximize wind utilization.
- Produce H_2 and O_2 from wind to
  - sell the O_2 to an industrial gas company
  - use the H_2 with natural gas to produce electricity going to the grid.

OUR SOLUTION

- 2 x HySTAT-60/10 outdoor solution to produce 60Nm³/H H_2 and 30Nm³/H O_2.
- 1 ICE for natural gas and hydrogen.

Off Grid Building in Brisbane: 2013

Excess Solar Energy – Create Hydrogen – Fuel Cells in the Evening

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(2) HyPM™-R30 FC Racks

Controller

DC-DC's

Fuel Cells

6 x 10 kW = 60kW

Cooling

HySTAT®-30 Electrolyzer

Brisbane, Australia

Sir Samuel Griffith Center

OBJECTIVES

- Off-grid and energy independent. Building.
- Australia's first zero-emission building.
- Solar cells installed on the roof and solar film on the windows. 85% of the generated solar power used during the day and 15% used to produce H_2 feeding a fuel cell to generate electricity in times when the sun is not out.

SOLUTION:

- HyPM® 30 electrolyser to produce 30Nm^3/h of hydrogen.
- Six 10KW HyPM™ fuel cells, fully integrated in two 30kW HyPM™ FC Racks

Shifting Power Efficiently in Asia

- How excess Hydrogen can be used to generate power in the Oil and Gas industry (MW power systems for the Grid)
  - Korea MW installations ongoing
- Using excess Grid power or from Wind, Hydro, Solar and other renewable as the most effective form of Energy Storage (Power to Gas)
  - Hydrogen has the greatest energy density of any storage technology, far greater than batteries
- Hydrogen is used in Power Plants and many production processes like Food production (ex. Palm Oil)
- Specific examples of usage of Fuel Cells in SE Asia for small scale power
  - Telecoms Site, Small communities
- Combined renewables using Solar-Hydro-Wind-Electrolysers (to create H2) and Fuel Cells for Remote communities or power requirements

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The Future is Now for Hydrogen

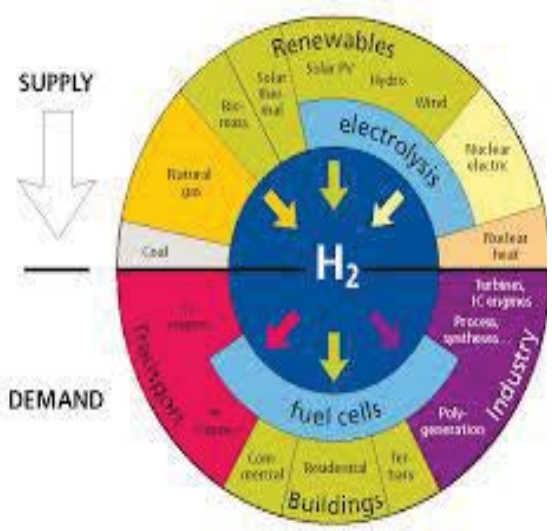
- We have mastered the technology and brought it down to form factors that fit existing systems
  - Hydrogenics has been producing H2 since 1948 and fuel cells since 1997

- There are many new ways to obtain Hydrogen in greener methods and easier to access

- Many business cases can compete with existing technologies:
  - Back up power for Telecoms using fuel cells

- Large companies such as auto companies are investing billions into the technology to reduce costs in fuel cells developing the Hydrogen Economy

- We work well in conjunction with other renewables, excess power and solve some of their energy storage issues



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Zero Emission
Power
Hydrogen
Generation
Utility Energy
Storage
Hydrogen
Fueling
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