The Potential of Solar-Hydrogen in Healthcare

Sun-Powered Futures ADB

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bpp TECH | CABLES | RENEWABLES

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AGENDA

1. Introduction
2. Hydrogen overview
3. The role of hydrogen for developing countries
4. Solar hydrogen for remote healthcare facilities: Papua New Guinea & Philippines
5. Focus: healthcare energy access & security

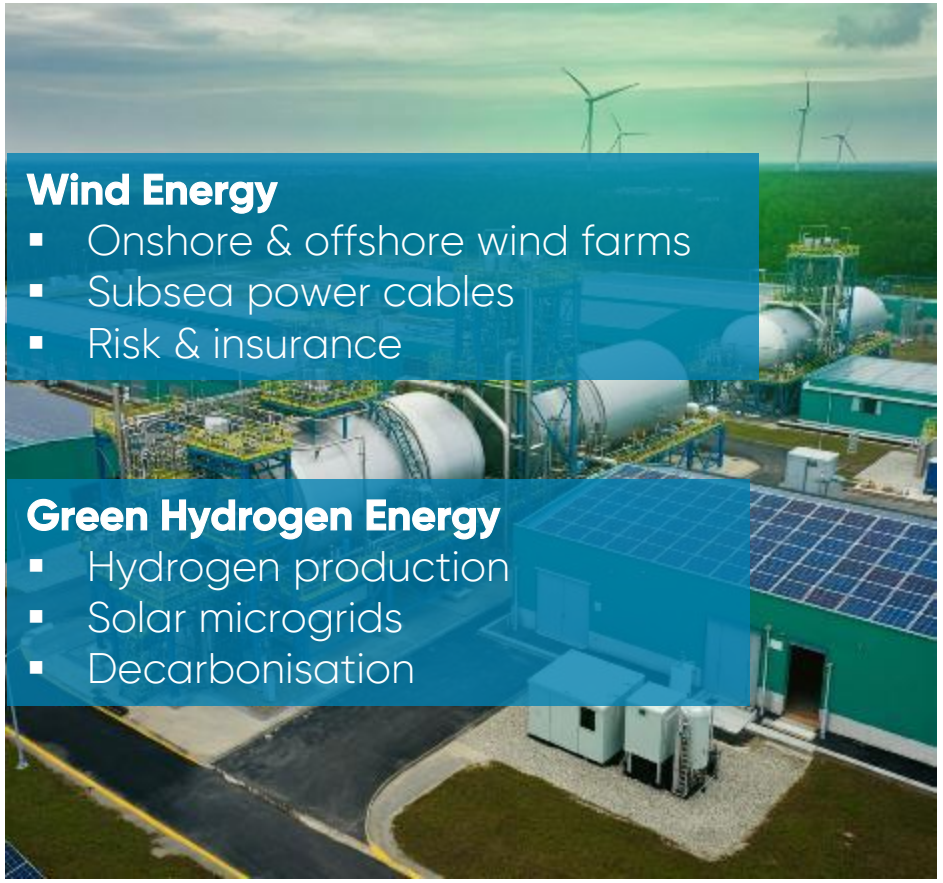
BPP RENEWABLES

Specialist Engineering Services. Est. 1989

BPP provides specialised engineering services to the subsea oil & gas, offshore renewables & insurance sectors. Working globally, BPP comprises BPP-Technical Services, BPP-Cables, and BPP-Renewables.

Key Services

- Risk Assessment
- Innovation Strategy
- Front End
- Product Development



Green H2 for Decentralised End-users

- Holistic Systems Design
- Financial Models
- Stakeholder Engagement
- Grid Connectivity Analysis
- Site Selection Studies

FUTURE VALUE GLOBAL

Regenerative Development

A systems approach to working with stakeholders across multiple sectors to solve wicked problems.

- ✦ Respectful collaborations built at the 'speed of trust'
- ✦ Deep community engagement
- ✦ Expertise in baseline assessments & gap analysis
- ✦ Co-design & ideation based on stakeholder needs
- ✦ In-country implementation
- ✦ Evidence-based measurement & evaluation

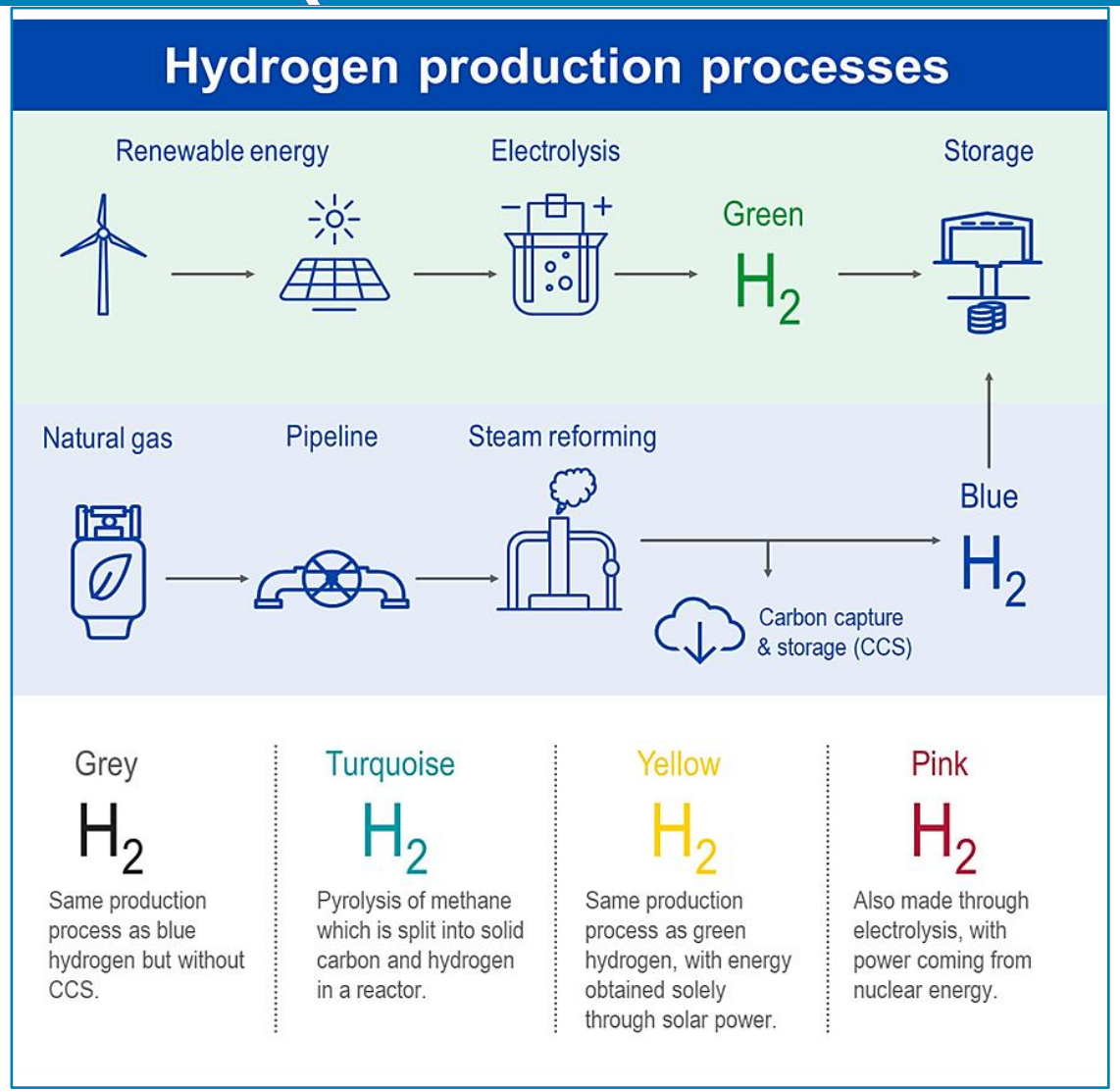
FutureValue is a vehicle for regenerative development to accelerate the world's transition to a **regenerative society**.

MEETING CRITICAL NEEDS

A GLOBAL APPROACH

FutureValue develops and invests in projects that meet critical areas of economic and social needs in global communities. This is what we call **regenerative development.**

HYDROGEN PRODUCTION PROCESS



Global H2 Production

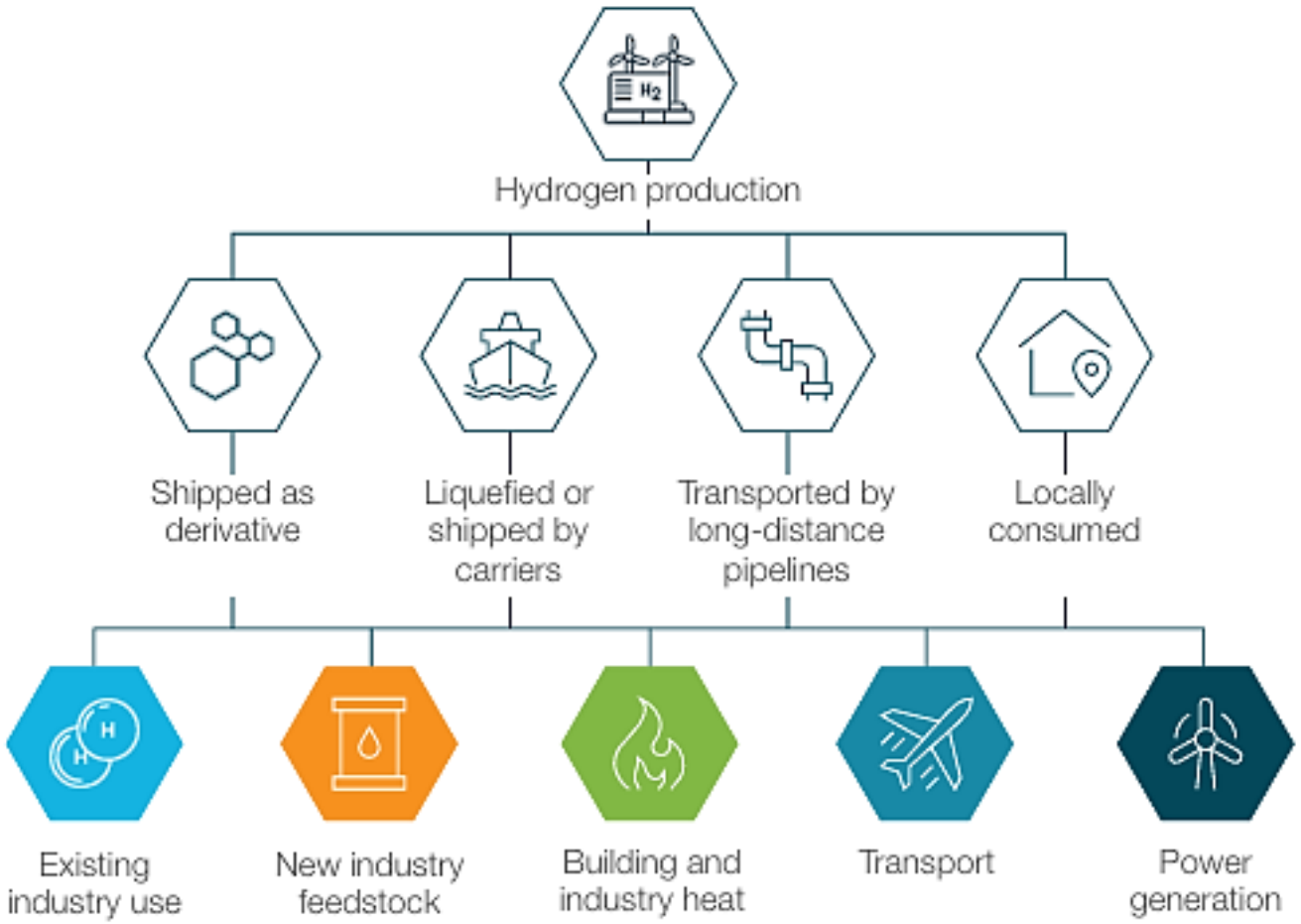
Source of Feedstock	% of Global H2 Produced
Natural Gas	47%
Coal	27%
Oil	22%
Water	4%

96% from fossil fuels

Source: IRENA 2021

HYDROGEN INDUSTRIAL APPLICATIONS

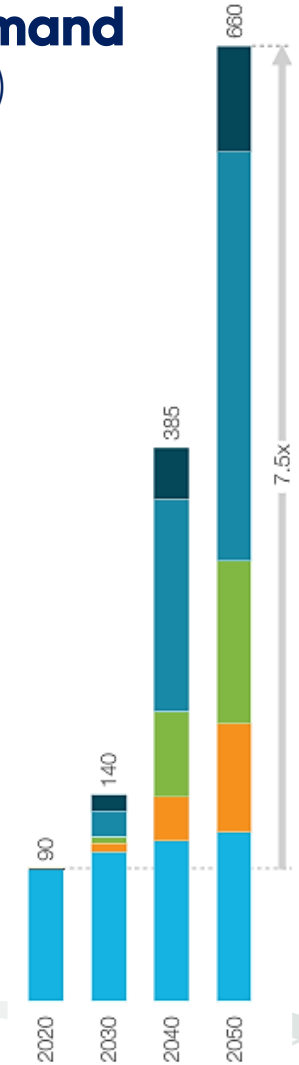
Hydrogen Supply Chain



Source: Hydrogen Council 2021

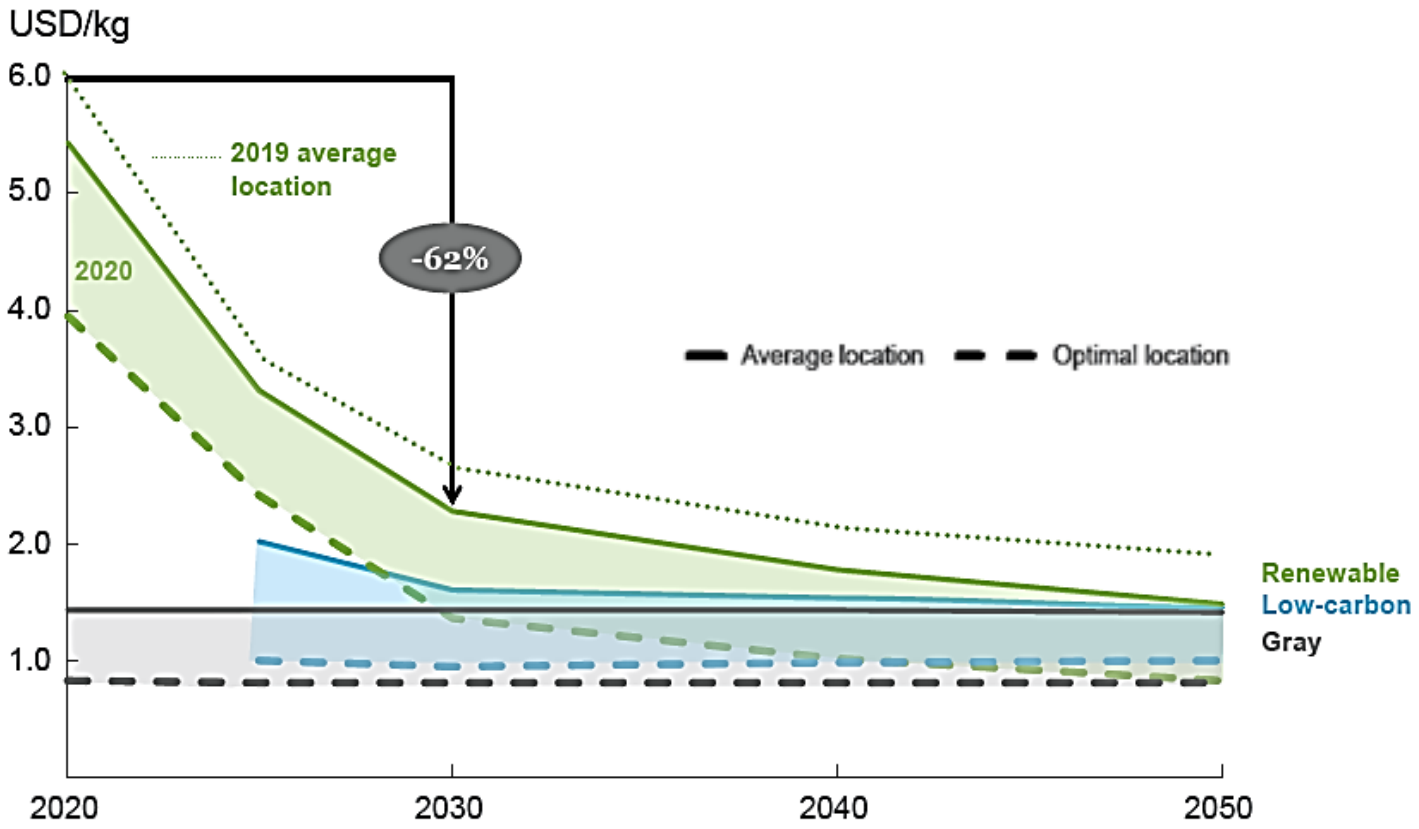
Hydrogen Demand

(millions of tons)



BARRIERS TO HYDROGEN ADOPTION

Hydrogen Production cost USD/kg

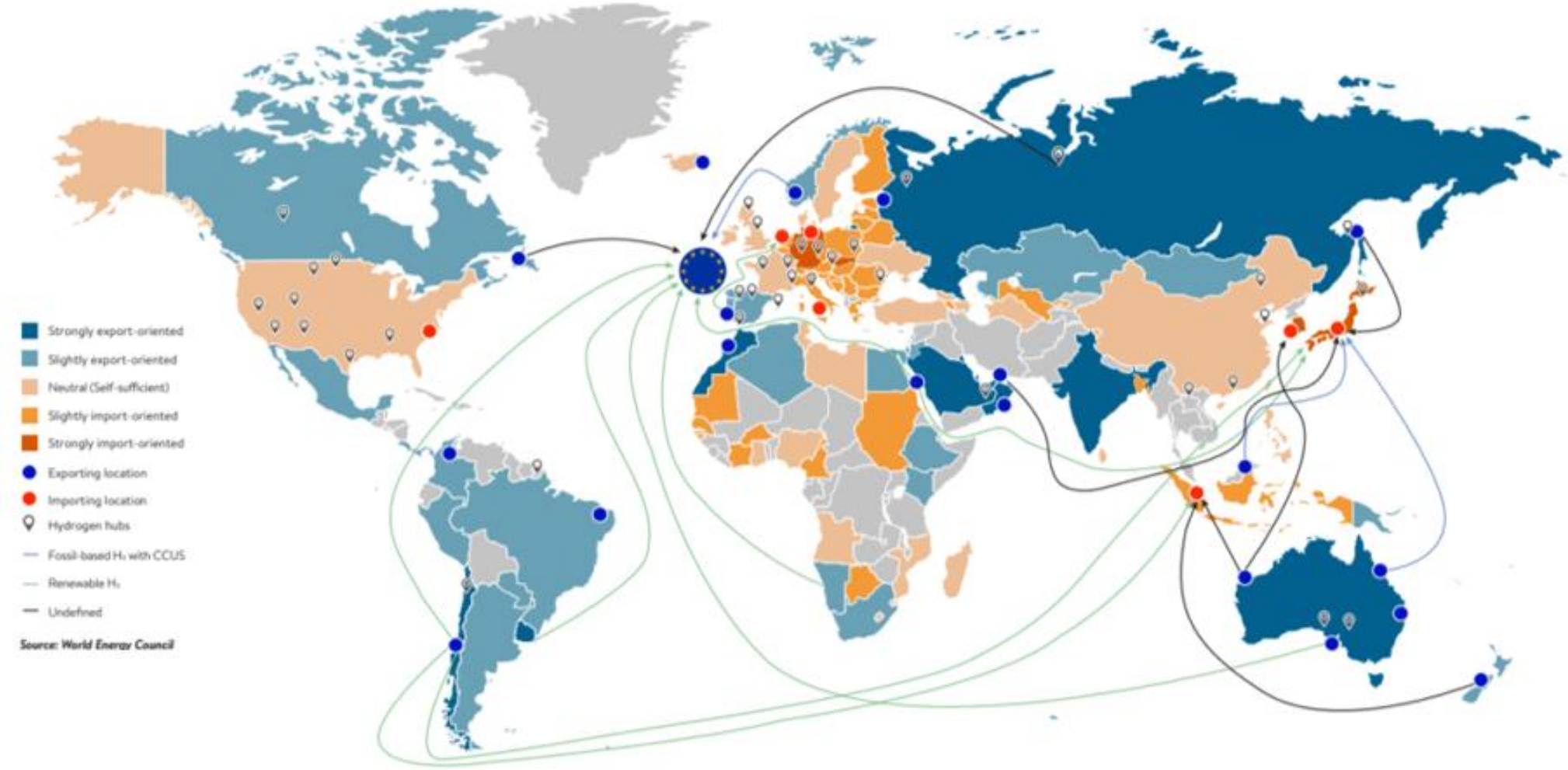


Source: Hydrogen Council 2021

ADOPTION CHALLENGES

- Cost Competitiveness
- Operational Efficiency
- Infrastructure Availability
- Financial Incentives
- Clear Policy Frameworks
- Technological Expertise & Skills Development
- Supportive Business Environment

THE GLOBAL ROLE OF HYDROGEN: INTERNATIONAL MARKETS



Source: Hydrogen Council - Global Hydrogen Flows 2022

OPPORTUNITIES IN DEVELOPING COUNTRIES

1. **Renewable energy generation & electrolysis**
   Green hydrogen production and demand (both domestic and international) will stimulate infrastructure development and wider renewable energy adoption, including for critical infrastructure like healthcare.

2. **Decarbonisation of domestic industries**
   Many industries such as chemical, iron and steel, cement, aviation, maritime and heavy cargo transport industries, can benefit from reengineering their operations by using green hydrogen.

3. **Clean energy transition roadmaps, including hydrogen**
   Regulatory frameworks and transparency create long-term stability, thereby mitigating risks for businesses and investors; developing countries need significant support to develop hydrogen roadmaps.

4. **Attracting FDI in energy-intensive industries & critical infrastructure**
   The cost-competitiveness of clean energy will attract Foreign Direct Investment in the renewables transition for energy-intensive industries using hydrogen, as well as sector-specific critical infrastructure.

5. **Skilled employment creation**
   Skills development across various sectors and industries along the hydrogen value chain will increase clean energy adoption and investment attractiveness.

CENTRALISED GREEN HYDROGEN APPLICATIONS

Multi-MW Green Hydrogen Microgrid

Source: Hydrogen De France (HDF) Baseload Power – French Guiana

System features

- 55 MW of solar photovoltaic
- 130 MWh energy storage capacity
- 16 MW alkaline electrolysers
- 3 MW of fuel cells
- 600 H2 tonnes/ year
- 10,000 Households

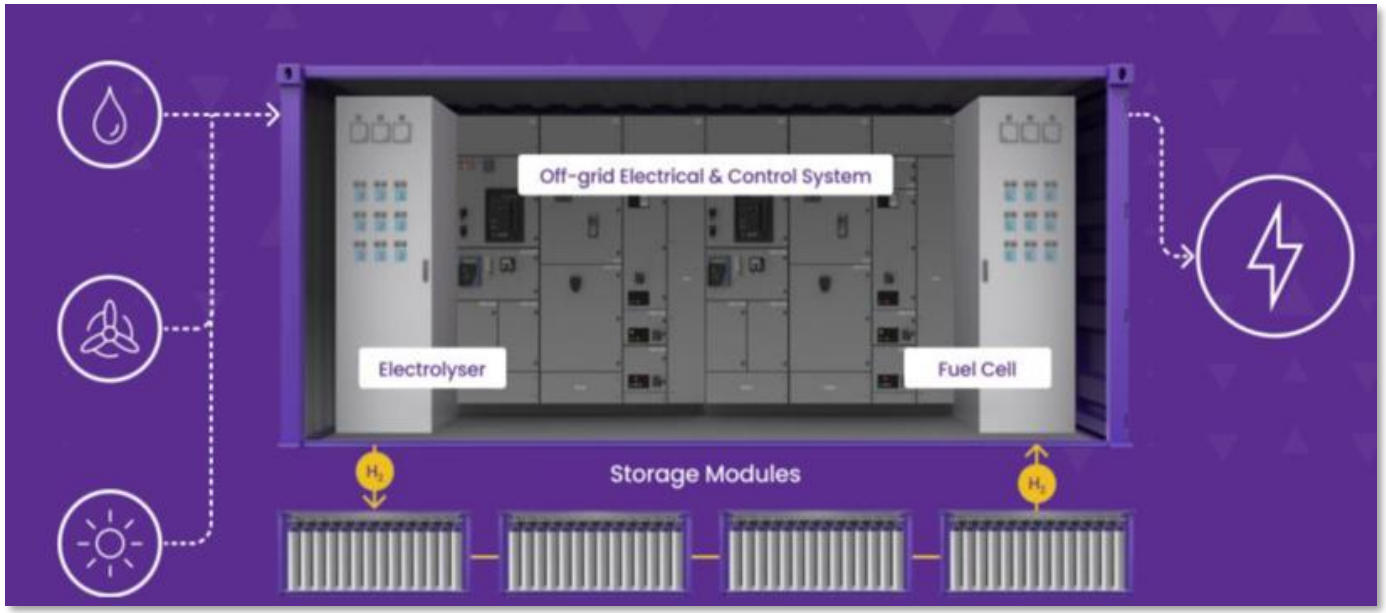
Benefits

- Alternative power production system
- Overcomes challenges of constrained grid connection
- Flexibility to meet local demand
- Large scale hydrogen production

DECENTRALISED GREEN HYDROGEN APPLICATIONS

Small Scale Green Hydrogen Power System

20’ ISO Container
610 x 244 x 289 cm (LxWxH)



Source: Endua

System features

- Charge power up to 200kW
- PEM electrolyser (3.5 kg H2/ hr)
- 19 kg of H2 per tank @100bar
- Up to 100kW PEM fuel cell

Benefits

- Off-grid power demand
- Flexibility to meet local demand
- Rapidly deployable and modular
- Commercially ready and safe
- Cost-effective long-term energy storage
- Energy storage and power deliver in a single system

RENEWABLE ENERGY ACCESS DRIVERS IN HEALTHCARE FACILITIES

Drivers	Electricity prices	Grid access & reliability	Energy consumption	Dependence on fossil fuel	Oxygen availability	Climate targets
Details	• Indo-Pacific countries have some of the highest electricity tariffs globally • Rural areas often face even higher costs due to reliance on diesel-generated electricity	• Frequent power outages with **SAIDI of ~1,000 minutes annually** • **5-10% of Philippines** cannot be connected to the national grid • **83% of PNG** remains without electricity access	• A rural HCF consumes **20–30 kWh per day**, while large hospitals require **~1,000 kWh per day** for essential operations • Rural HCFs may have access to electricity for only 4-12 hrs per day • In PNG, **40% of HCFs** have no power	• **~60%** of the Philippines' electricity generation relies on imported coal and diesel • Rural HCFs areas face logistical challenges and high diesel costs to maintain energy security • Dependence on fossil fuels makes climate mitigation difficult	• Many rural HCFs have difficulty obtaining a **reliable oxygen supply** in cylinder form because of logistical and cost factors • The **cost of oxygen** is high due to the **high energy costs** of the processes to make it	• The **Philippines** aims to cut greenhouse gas emissions by **75% by 2030** under its NDC • **PNG** is aiming for **70%** electrification by **2030** • Initiatives like solar microgrids and hybrid systems for HCFs align with these goals
Impact on HCF	• High operational expenses for backup power systems limit budgets for healthcare delivery • Diesel generators further inflate costs due to fuel logistics in remote locations (LCOE can be at least 2x higher than RE system)	• Hospitals face disruptions in critical services such as vaccine refrigeration and surgeries • Only around a third of hospitals have access to a reliable backup generator	• Operational challenges arise due to energy shortages, especially in peak demand times • RE can lower energy costs and ensure uninterrupted operations; solar + storage has demonstrated lower LCOE for off-grid uses	• Higher costs for electricity in remote hospitals and clinics (landed cost of fuel is 1.5-2x) • High local demand of diesel, which can lead to reduced fuel availability in an extreme natural event	• Vulnerable groups face severe impacts, including rising maternal deaths in both countries • Deaths among hospitalised newborns and children fell by 25% when oxygen was provided	• Solar power is a critical part of both countries' NDC targets with RE systems and stand-alone home systems to electrify underserved communities

Source: Energy Catalyst Acceleration Programme 2025, FutureValue & BPP-Tech

SOLAR-HYDROGEN FOR REMOTE HEALTHCARE FACILITIES

PROJECT OPPORTUNITY

Solar-hydrogen microgrid for remote Healthcare Facilities (HCFs) to address energy challenges

Key Challenges for HCFs

Energy access and security are major issues for critical infrastructure development in remote and/or rural regions.

This especially impacts healthcare facilities which rely on unsustainable, unreliable and costly power sources.

ENERGY RELIABILITY

FOSSIL FUEL RELIANCE

CLIMATE RESILIENCE

PROJECT GOALS

- **Healthcare Enhancement**
  Ensure continuous, reliable power to support life-saving hospital operations.
- **Environmental Sustainability**
  Reduce carbon emissions by shifting away from fossil fuels.
- **Community Impact**
  Improve energy access for the broader community, fostering local economic growth and resilience.
- **Business Case**
  The potential of hydrogen microgrids allows developing regions to bypass outdated and fossil fuel reliant energy systems, providing more sustainable growth.

Potential Additional System Benefits

Oxygen Production
High-purity medical oxygen may be generated alongside hydrogen, supporting healthcare needs.

Water Production
Clean water is a by-product of the hydrogen production process, benefiting the hospital.

SOLAR-HYDROGEN FOR REMOTE HEALTHCARE FACILITIES

SOLAR-HYDROGEN FEASIBILITY STUDIES

Feasibility finalisation date: 31 March 2025

Project Objectives

Design and assess the techno-economic feasibility of solar-hydrogen systems for standalone offgrid (Papua New Guinea) and microgrid (Philippines) solutions for clean electricity, fresh water & oxygen supply to remote healthcare facilities.

Project Co-funder

UK Research and Innovation

Kikori Hospital, Kikori Station, Kikori District, Gulf Province, Papua New Guinea

Garcia Memorial Provincial Hospital, Talibon, Central Visayas, Philippines

SOLAR-HYDROGEN FOR REMOTE HEALTHCARE FACILITIES

APPROACH

Identifying constraints & potential solutions

How will this project benefit all stakeholders?

RENEWABLE ENERGY
1. Utilise renewable sources
2. Reduce carbon footprint & mitigate climate impacts
3. Decentralised & close to consumption

ENERGY EQUITY
1. Energy affordability
2. Energy resilience
3. Energy self-sufficiency
4. Energy access, gender equality & inclusion

SYSTEM RESILIENCE
1. Withstand & recover from disruption
2. Continuity of energy supply
3. Maintain essential services
4. Support critical infrastructure

Health Needs & Site Assessment

↓

System Design & Simulation

↓

Techno-Economic Analysis & Business Model

↓

Policy Assessment & Deployment

Satellite view of Kikori Hospital, Gulf Province, PNG with simulated solar array

SOLAR-HYDROGEN FOR REMOTE HEALTHCARE FACILITIES

HEALTH NEEDS & SITE ASSESSMENT – KEY FINDINGS

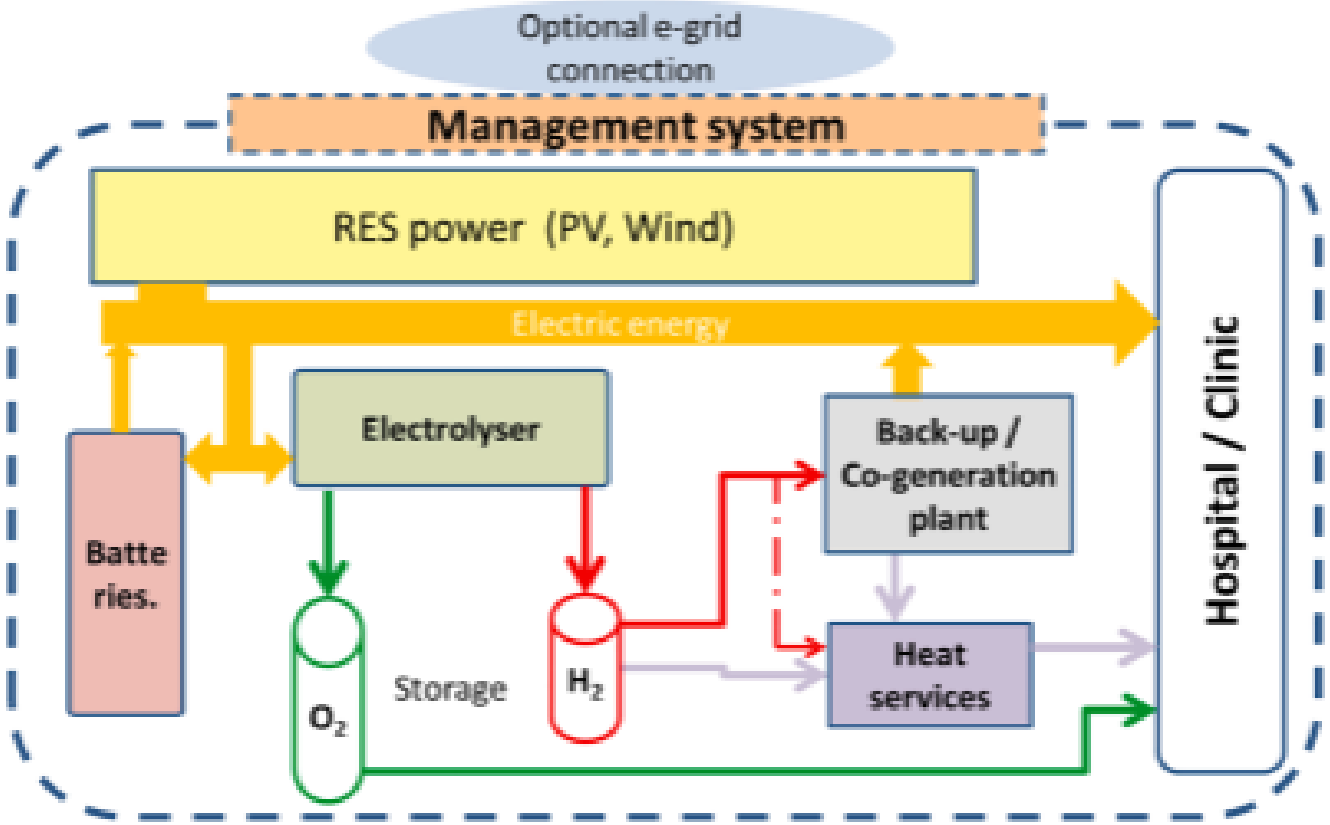
Parameters	Kikori Hospital - PNG	Garcia Memorial Provincial Hospital - PH
Daily Energy Demand (kWh)	236	934
Power Peak Load (kW)	27	174
Current Power System	76.8kW Solar with 77kWh battery system + 70.4kW diesel engine	Grid connected system with back-up 160kW diesel engine
Oxygen demand & supply	Four oxygen concentrators, subjected to continuous faults, lack of supply	300-400 tanks/month (108,960 kg/year); £30,960 – £41,280 annual cost
Main challenges identified	Underpowered c.f. energy demand Power blackouts Diesel cost, supply & genset reliability Lack of policy framework	Central Visayas grid is 86% fossil fuel Constrained grid with rolling brownouts Climate vulnerable infrastructure Lack of policy framework
Solution requirements	Energy access Energy security (reliable 24/7 power) Fossil fuel displacement	Energy transition Energy security (reliable 24/7 power) Climate resilience

The global recommended standard for HCFs is 72-96 hours of power backup

SOLAR-HYDROGEN FOR REMOTE HEALTHCARE FACILITIES

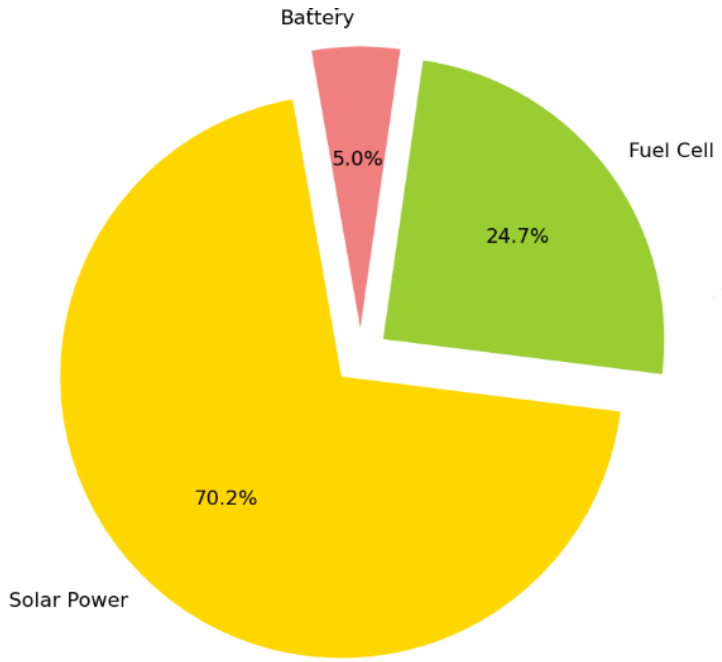
SYSTEM DESIGN – SIMULATION & ANALYSIS

Schematic layout of a green hydrogen system



Simulated results for the PNG case study

A simulation of a solar outage occurring for 24 hours per month has demonstrated that a combination of solar, battery and hydrogen power can meet the hospital energy demand



WHERE TO NEXT?

CONTINUOUS ENGAGEMENT

Image: FutureValue, BPP-Tech project team & the British High Commissioner to PNG, Anne Marco

SIGNIFICANT OPPORTUNITY

Opportunity to address the need of HCFs in developing economies

- Climate finance initiatives
- New technology
- Innovative deployment in HCFs
- Socio-economic impact

NEXT STEPS

Finalise preferred funding and operational model to enable green hydrogen adoption:

1. Finalise business model
2. Confirm supply chain partnerships
3. Secure project financing
4. Ensure regulatory compliance
5. Deploy pilot system

FOCUS: HEALTHCARE ENERGY ACCESS & SECURITY

1. **Acceleration support**
   Specialised program and kick-starter support to speed up testing and commercialisation of green hydrogen for remote healthcare facilities (HCFs), helping bring down costs.

2. **Create demand**
   Advanced market commitments and subsidies for HCFs to gain energy access and security will create a demand signal, attract private sector investment, and boost market development.

3. **Market entry & scaling**
   Market entry strategies, cross-border knowledge sharing, value chain development and enhancement, and sector-specific commitments are critical for business confidence in green hydrogen.

4. **Hydrogen policy & operationalizing roadmaps**
   Hydrogen roadmaps need to be developed and operationalized; institutions like ADB can support energy policy development and appropriate regulatory frameworks to encourage testing and adoption of green hydrogen in developing economies.

CONTACT DETAILS

For further information on green hydrogen & sector applications, please contact:

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