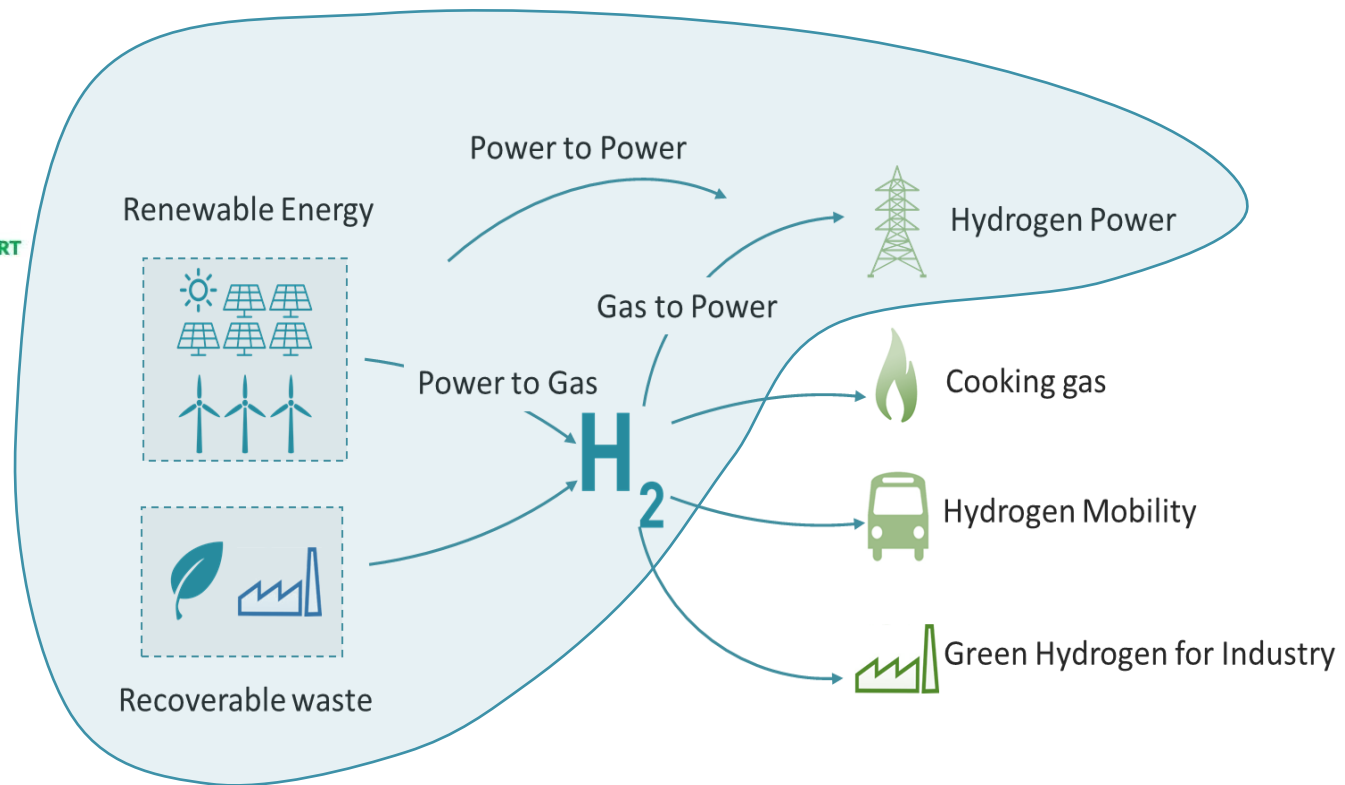
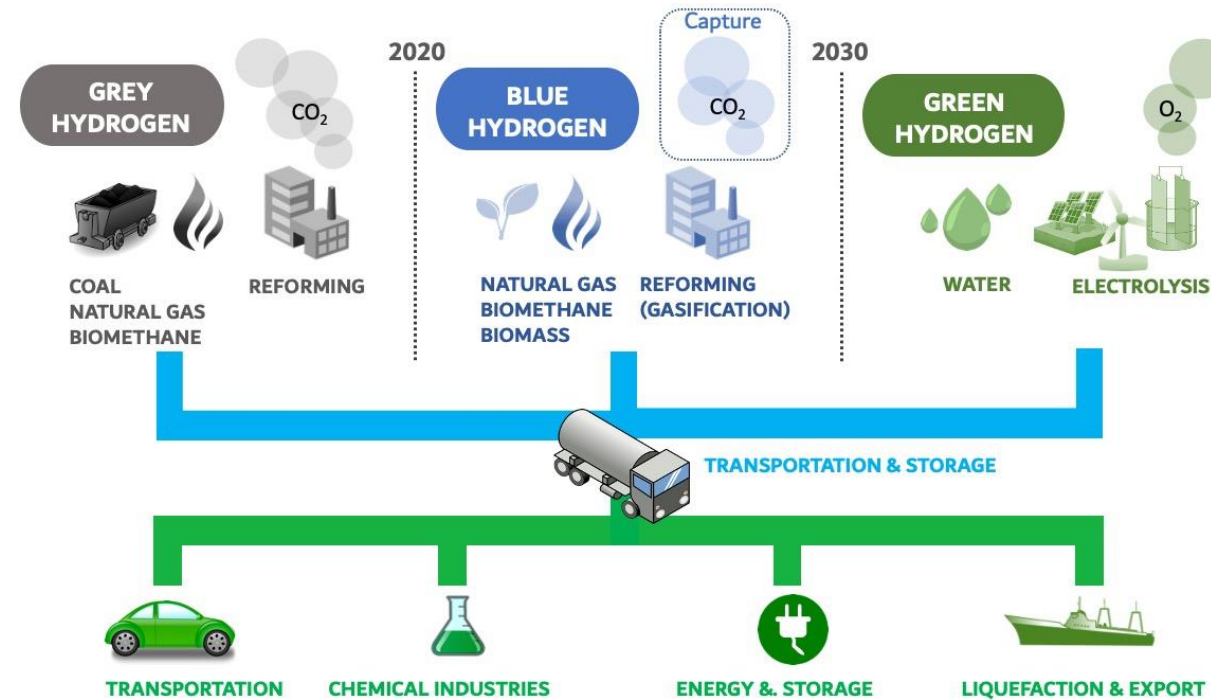


Presenter : Dwight DaCosta
Business Developer

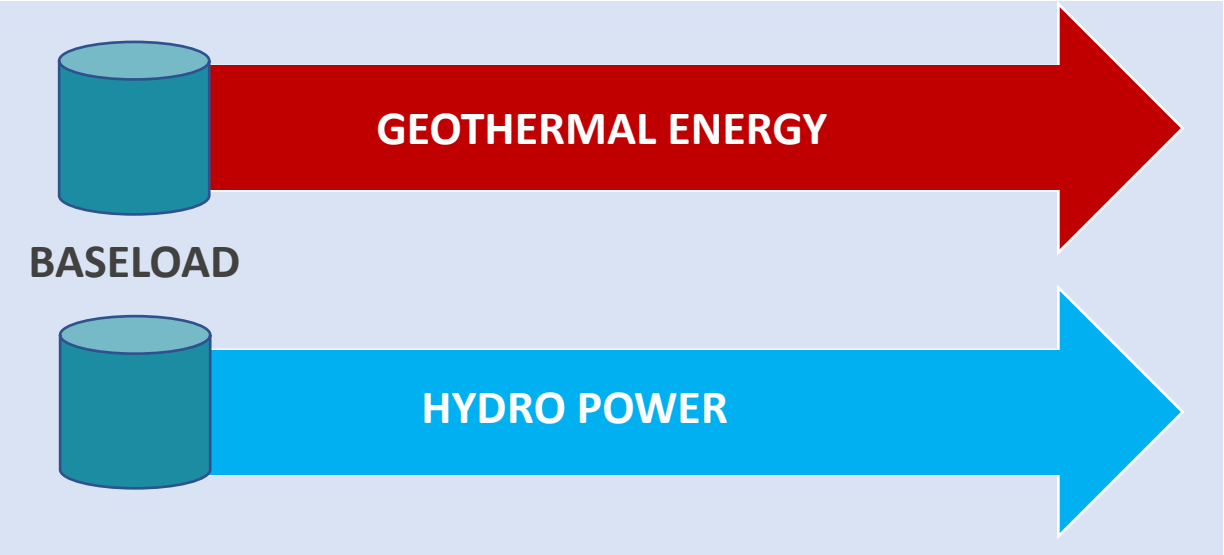


GAME-CHANGING H₂ POWER

WHAT IS "GREEN HYDROGEN POWER"



RENEWABLE ENERGY RESOURCES IN THE CARIBBEAN

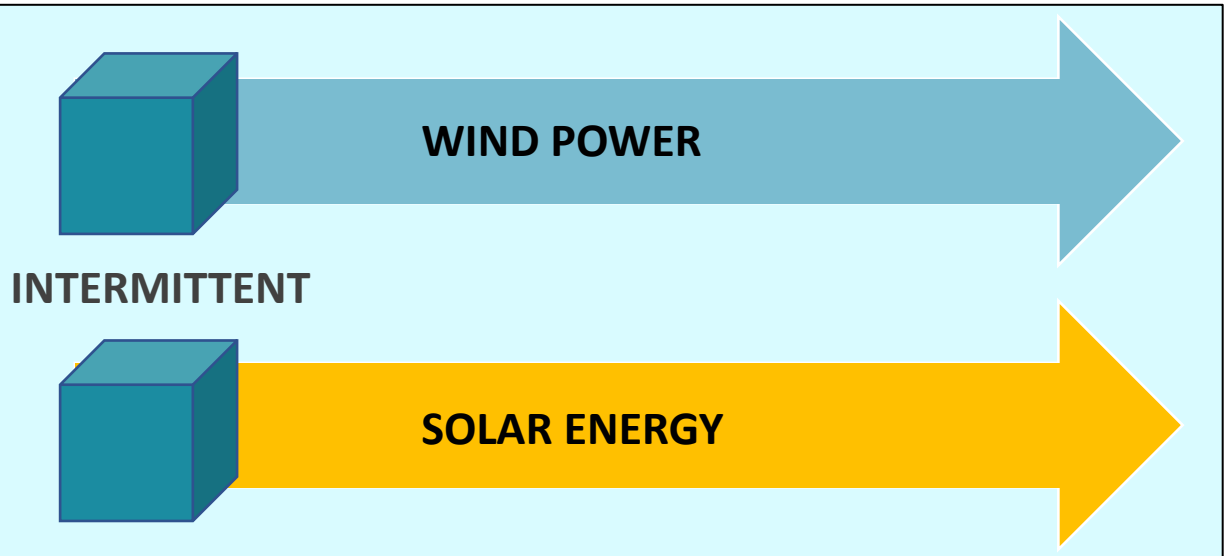


GEOTHERMAL RESSOURCES

- Highly cost intensive
- Resource existing only in a few islands

HYDRO RESSOURCES

- Highly cost intensive
- Scarce in the Caribbean



WIND SPEED

- 8,4- 8,9 m/s
- Abundant but highly site specific to implement

SOLAR IRRADIATION

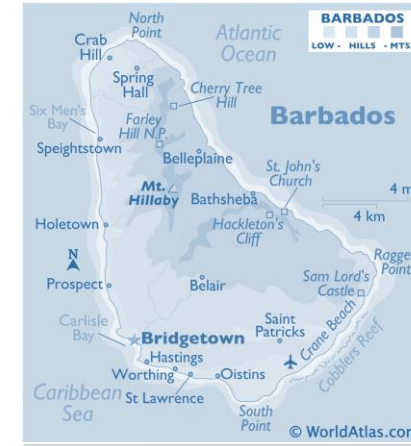
- 2100 kWh/m²/ year
 Excellent irradiation
- Abundant on most eastern Caribbean islands



RENEWABLE ENERGY TARGETS

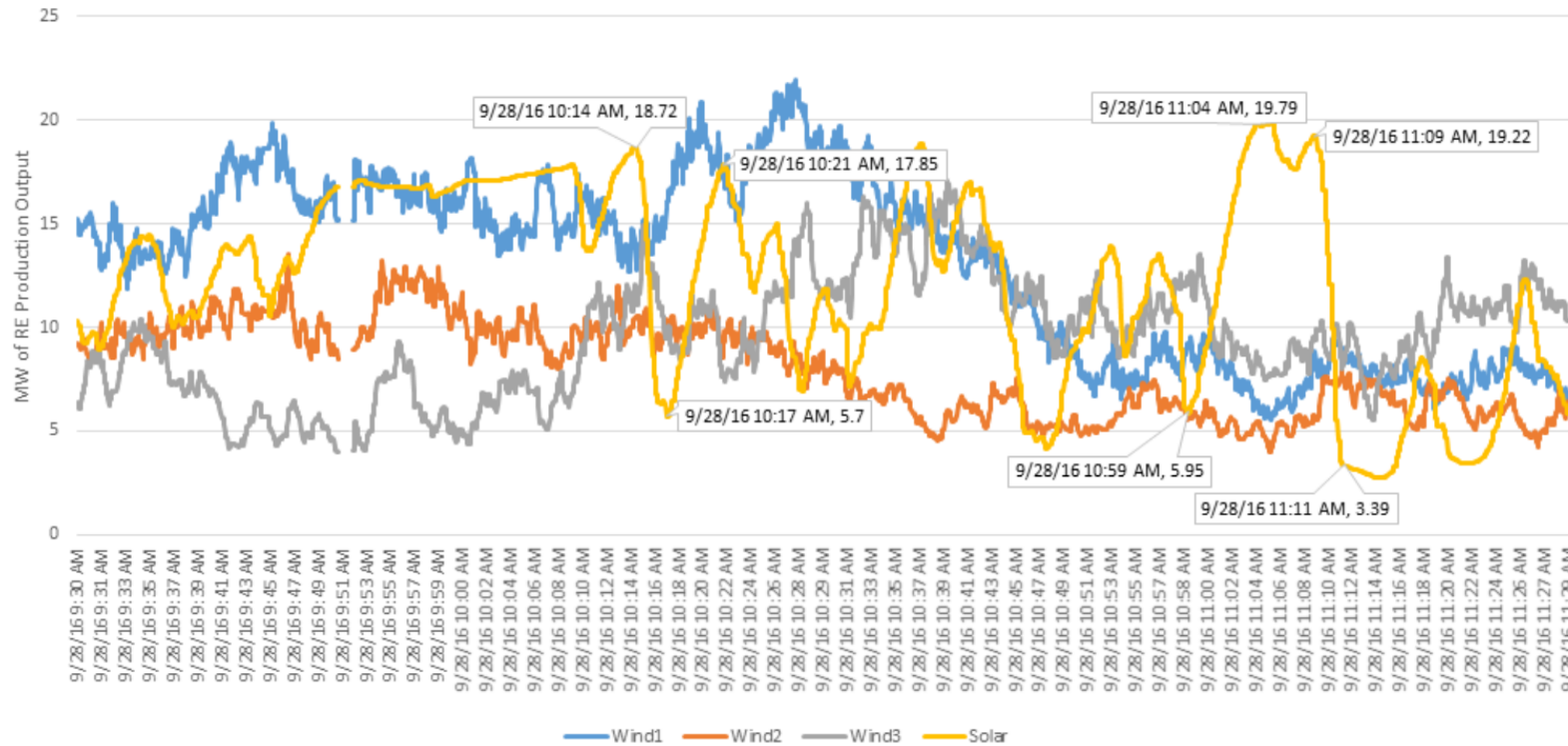
Caribbean countries have set high renewable penetration targets

Country	Installed Generation (MW)	Demand (MW)	Energy (GWh/yr)	% RE Penetration Target 2030	Required Wind Capacity at 35% CF (MW)	Required solar Capacity at 20% CF (MW)
Barbados	249	150	1000	100%	326	571
Jamaica	1021	692	4425	50%	722	1263
St. Lucia	88	62	409	50%	67	117



TECHNICAL LIMITATIONS OF ISOLATED GRIDS

Significant Ramps Over 2 Hours September 28, 2016 9:30AM - 11:30AM



CARIBBEAN ISLANDS HAVE OFTEN ONLY A WEAK GRID INFRASTRUCTURE OR NO INFRASTRUCTURE AT ALL

HIGH PENETRATION OF RENEWABLES ENERGY WILL LIKELY AFFECTS THE STABILITY OF THE GRID DUE TO THEIR INTERMITTENCY

SOURCE: JPS RE Intermittency Challenges

CARIBBEAN CONTEXT : ALL ABOUT STORAGE

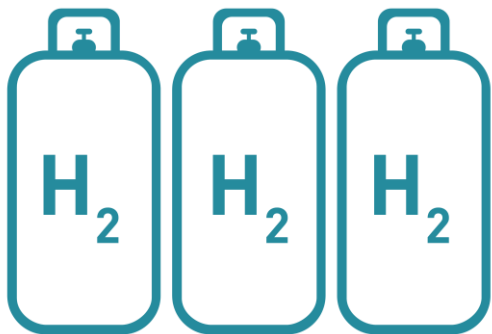


4HR TO 6HR AT PEAK

BEST FOR FREQUENCY CONTROL

BATTERIES ARE CURRENTLY MOST COMPETITIVE BUT MOST SUITABLE FOR SHORT DURATION GRID STABILITY SUPPORT

RENEWABLE ENERGY PENETRATION ABOVE 10 % USING INTERMITTENT SOURCES REQUIRE FLEXIBLE STORAGE RESSOURCES



OVER DAYS

BEST FOR GENERATION SHIFTING

IDEAL FOR LONG TERM STORAGE AND WORK IN PERFECT SUPPORT FOR ENERGY SHIFTING

HDF ENERGY, A GLOBAL PURE PLAYER IN HYDROGEN

H2 INFRASTRUCTURE



Development, operation & ownership of large-scale hydrogen infrastructure



Electricity production



Green hydrogen production

MULTI-MW FUEL CELL TECHNOLOGY



Design and mass production of high-power fuel cells



Power supply

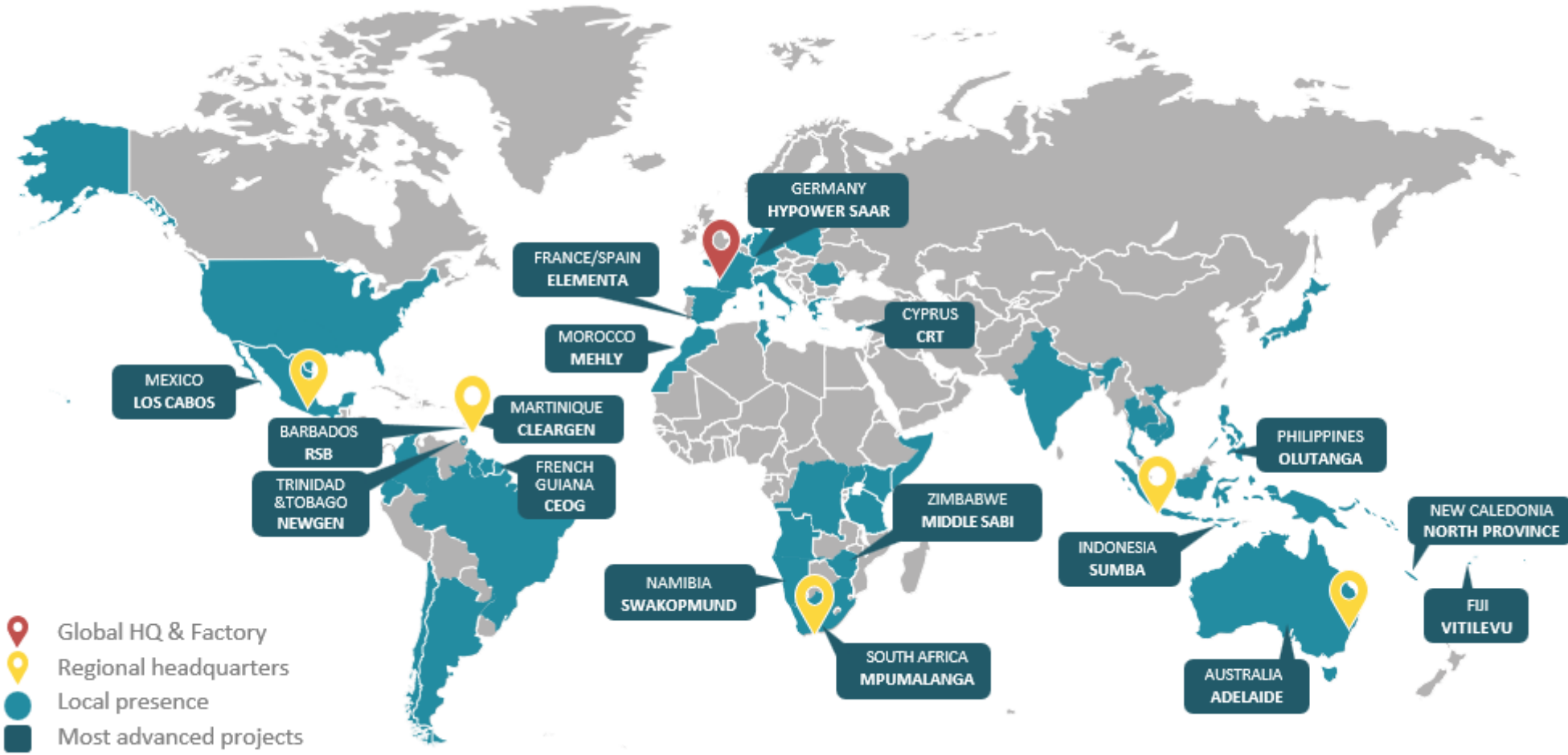


Marine



Rail

GLOBAL LEADER IN HYDROGEN INFRASTRUCTURE WITH STRONG LOCAL PRESENCE



Present in **30+ countries, 5 continents**



€ 5 billion projects under development



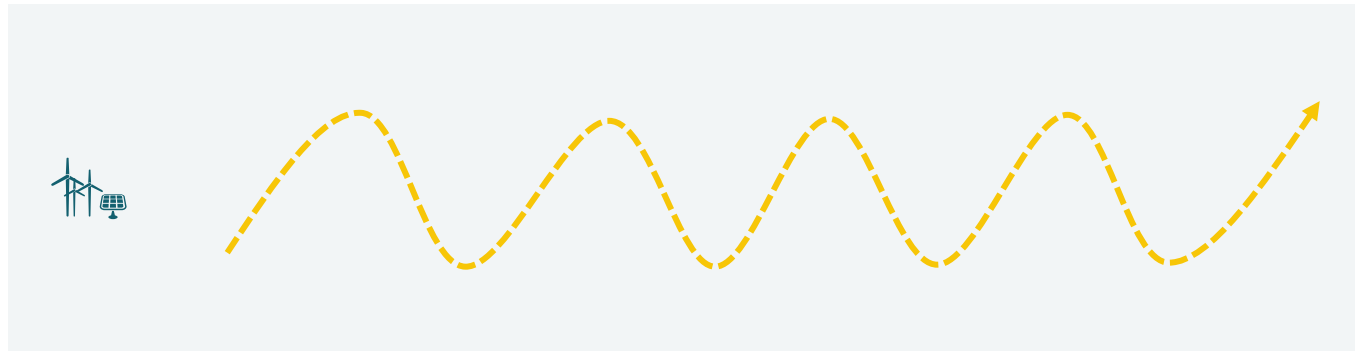
30+ different nationalities among staff

HDF PROVIDES THE MISSING BRICK IN THE RENEWABLE ENERGY VALUE CHAIN

INTERMITTENT RENEWABLE ELECTRICITY PUTTING PRESSURE ON THE GRID AND CAPPING THE GROWTH OF RENEWABLE ENERGIES



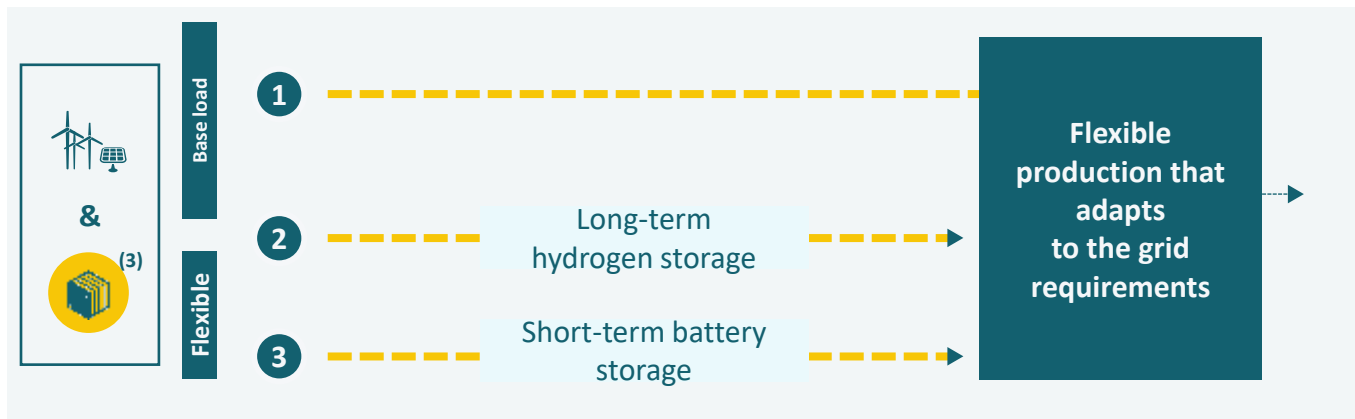
Traditional renewable IPP ⁽¹⁾



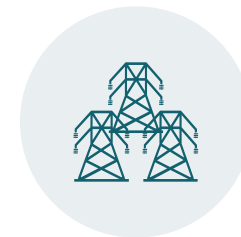
NON-INTERMITTENT AND COMPETITIVE RENEWABLE ELECTRICITY



Through project SPV



HDF ENERGY ENABLES THE MASSIVE ROLL-OUT OF RENEWABLE ENERGIES BY PROVIDING STABILITY TO THE GRID






Grid operators

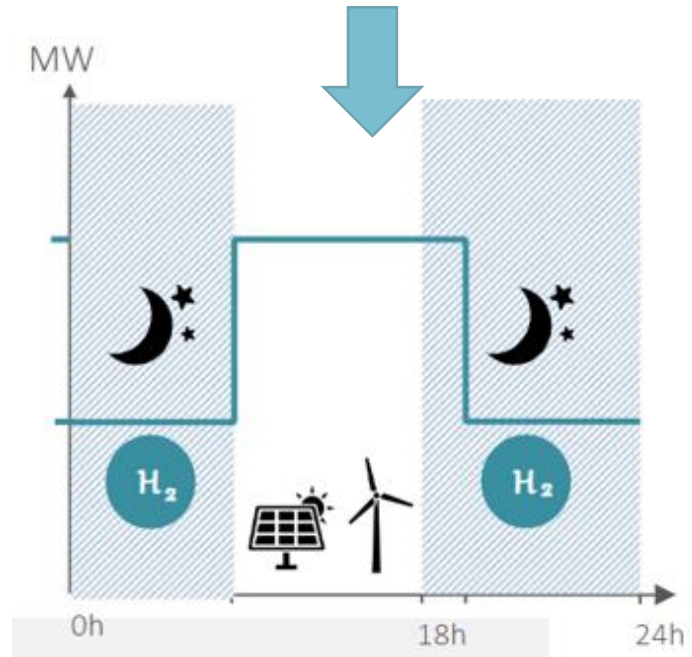
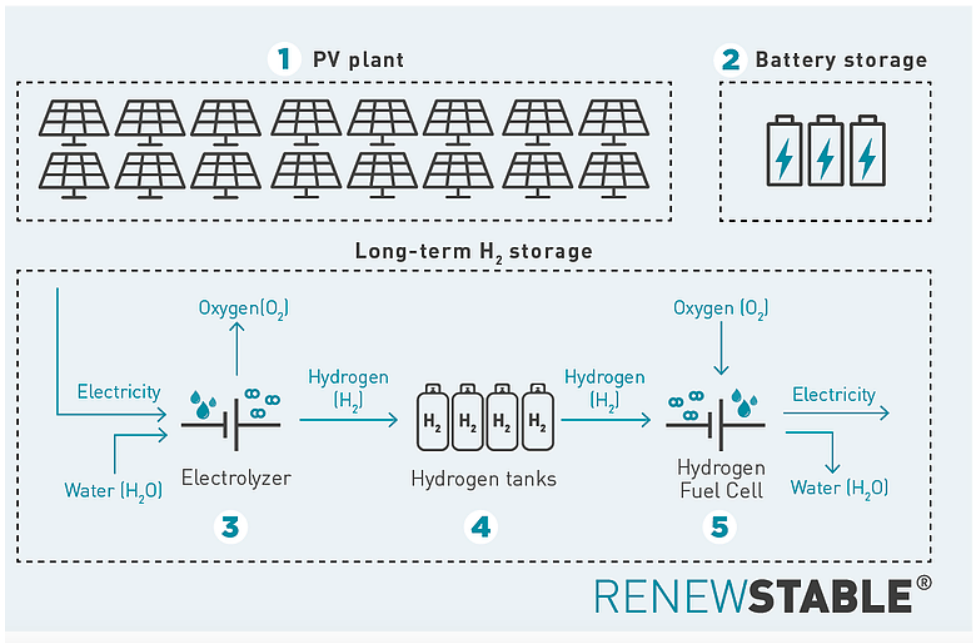
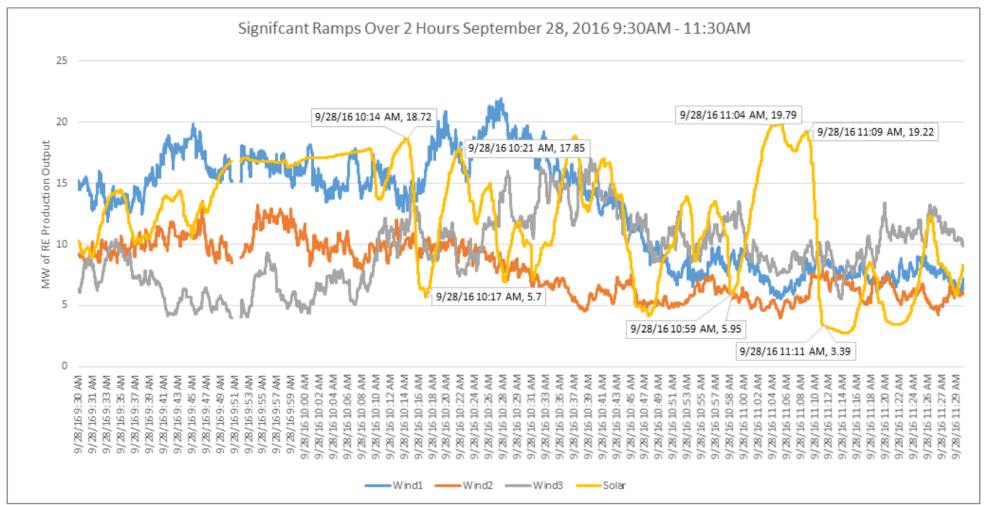


Customers

(1) IPP : Independent power producer
 (2) PPA : Power Purchase Agreement
 (3) Multi-MV fuel cell that produces electricity from Hydrogen

HDF RENEWSTABLE[®] POWER PLANT

- 
1 The Solar Power Plant generates the carbon-free primary source of electricity for the Renewable Power Plant when the sun is shining.
 - 
2 The Battery Storage provides the end of the day peak power and, in combination with the hydrogen storage, ensures the stability of the electricity service.
- The long-term hydrogen storage system:**
- 
3 converts electricity from the photovoltaic park into hydrogen using an electrolyzer system during the day, turning water and oxygen into hydrogen.
 - 4** stores the gaseous hydrogen produced in horizontal metallic tanks and then,
 - 5** produces electricity from the stored hydrogen using Hydrogen Fuel Cells during the night.



OUR FLAGSHIP SOLUTION: RENEWSTABLE[®], NON-INTERMITTENT SUPPLY OF RENEWABLE ENERGY

MULTI-MW POWER PLANT LEVERAGING HYDROGEN POWER FOR GRID STABILITY: PRODUCTION OF CARBON-FREE ELECTRICITY, DAY AND NIGHT

As an Independent Power Producer, HDF provides a standard offer with modular services adaptable to the network needs

1 Solar park

Carbon-free power production by the PV park when the sun is shining

2 Batteries

Short-term energy storage using batteries

3 Electrolyser

$H_2O + E^- \Rightarrow O_2 + H_2$

5 Fuel Cells manufactured by HDF

$O_2 + H_2 \Rightarrow H_2O + E^-$

4 Hydrogen Storage

Long-term H_2 based mass energy storage

KEY BENEFITS

INCREASE RENEWABLES PENETRATION

- Maximize carbon-free generation
- Reach the optimum energy mix

SUSTAIN GRID STABILITY

- Preserve the grid from intermittency
- Build grid resilience thanks to island mode operation

BUILD ENERGY INDEPENDENCE

- Locally produce electricity that is consumed locally
- Reduce dependence on fossil fuel imports

ENSURE COST STABILITY

- Benefit from a stable and competitive set price for 20+ years

BOOST THE LOCAL HYDROGEN ECONOMY

- Create local jobs and skills

OTHER INFRASTRUCTURE MODELS

LOW-CARBON HYDROGEN PRODUCTION

HYDROGEN FROM CLEAN POWER SOURCES TO DECARBONIZE THE INDUSTRIES



2 Electrolyser
 $H_2O + E^- \Rightarrow O_2 + H_2$

1 Clean electricity
 from PV or wind renewable source

3 Low-carbon H₂
 to be used by industrial off-takers
 (steel, ammonia, petrochemistry)

- Used as feedstock for industrial activities
- Drastically reduce CO₂ emissions

IN DEVELOPMENT PHASE

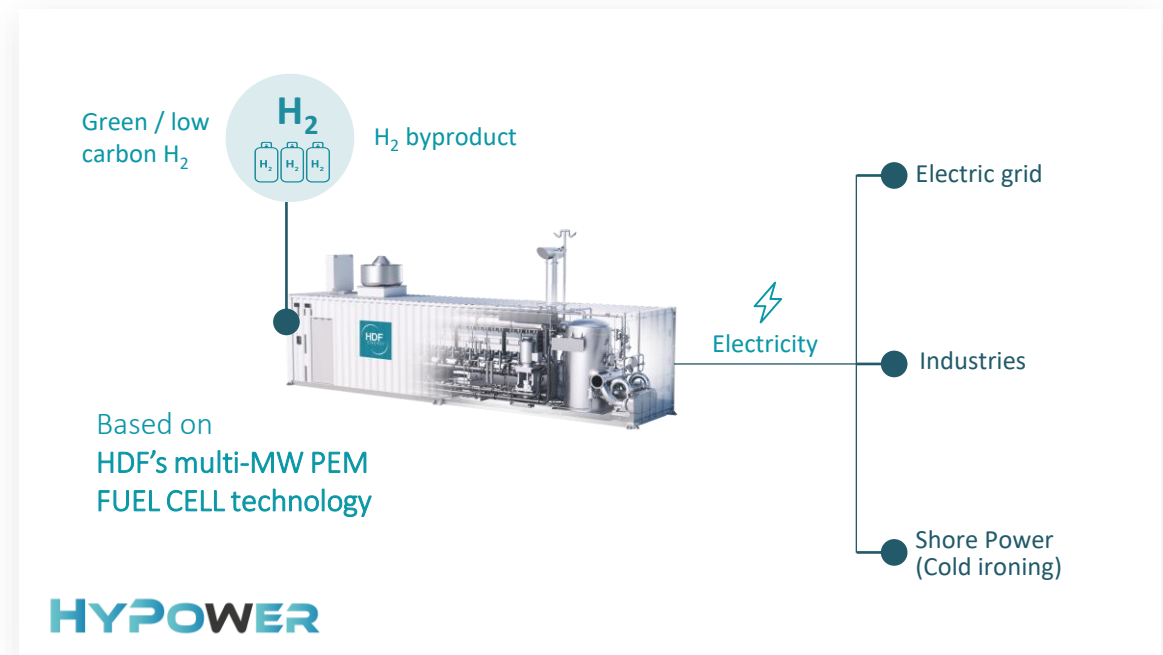
NewGen, Trinidad and Tobago.

The world's largest clean hydrogen production facility



HYDROGEN TO POWER INFRASTRUCTURE

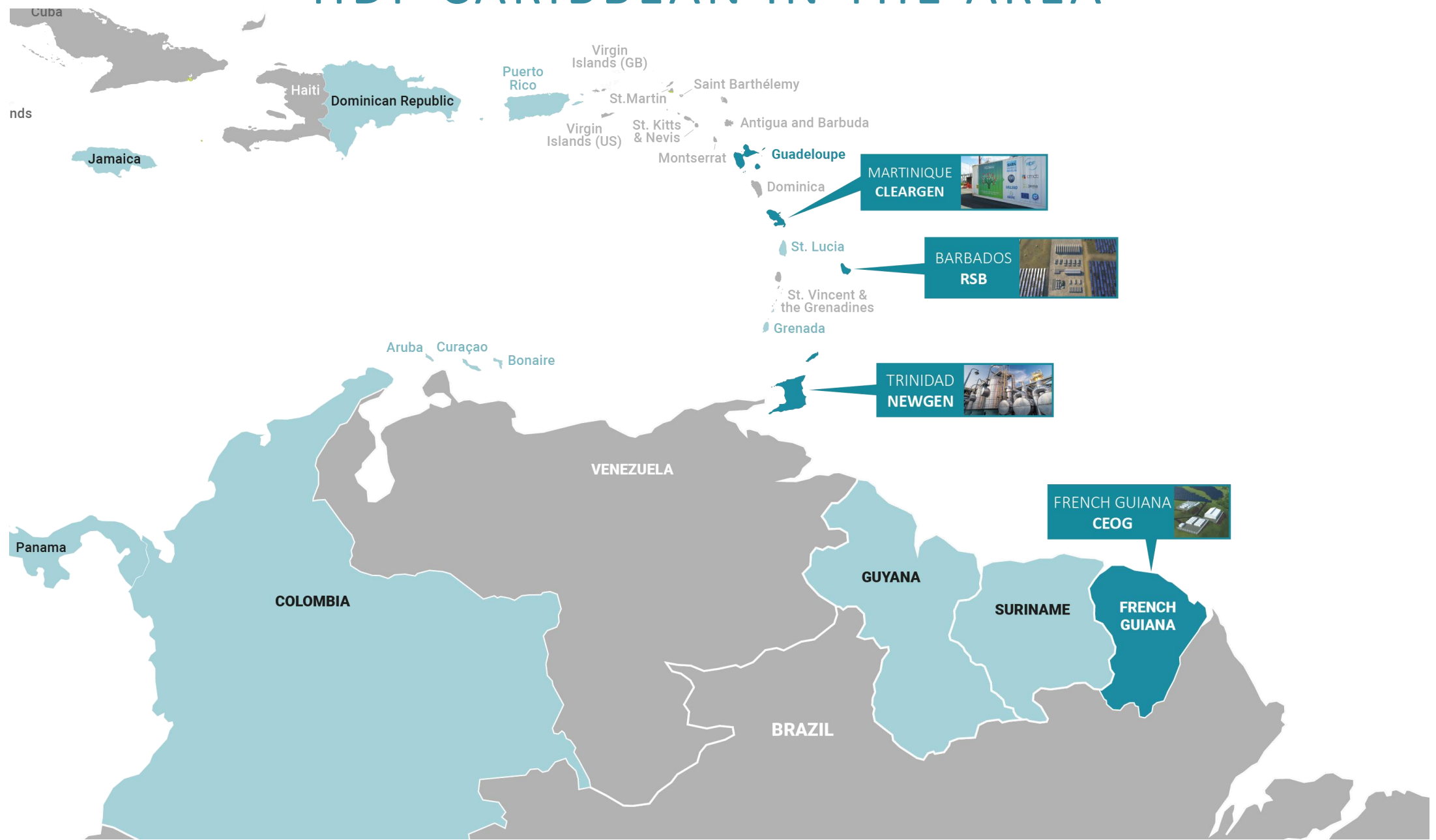
ON-DEMAND 24/7 PRODUCTION OF LOW-CARBON POWER



IN OPERATION

CLEARGEN, Martinique

HDF CARIBBEAN IN THE AREA



CLEARGEN - MARTINIQUE



THE FIRST WORLDWIDE INSTALLATION OF A HIGH-POWERED FUEL CELL
PRODUCING ELECTRICITY FROM EXCESS HYDROGEN



The **Cleargen Demo** produces electricity from by-product hydrogen in SARA's refinery (Martinique, French West Indies). It is a first of a kind project and one of the biggest operating MW fuel cells.



HYDROGEN
FUEL CELL
1 MW



HIGH POWER
FUEL CELL
1ST



GENERATION
7 GWh / YEAR



PPA
15 YEARS

COLLABORATIVE PROJECT



FINANCED BY



OUR FLAGSHIP RENEWSTABLE® PROJECT



THE WORLD'S FIRST MULTI-MEGAWATT HYDROGEN POWER PLANT PRODUCING CLEAN ELECTRICITY 24/7



FRENCH GUIANA



STATUS: UNDER CONSTRUCTION



**SOLAR PV
55 MWp**



**STORAGE
CAPACITY
128 MWh**



**POWER
GENERATION
50 GWh/YEAR
Day: 10MW
Night: 3MW**



**HYDROGEN
PRODUCTION
600 TONS
H₂/YEAR**



**POWER SUPPLY
FOR 50 000
INHABITANTS**



**POWER PURCHASE
AGREEMENT
25 YEARS**

OFFTAKER



EQUITY INVESTORS



LENDERS



EPC



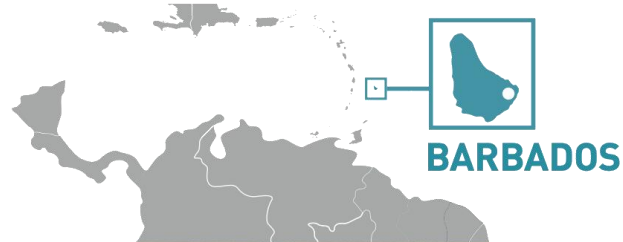
TOTAL INVESTMENT

170 M€

RENEWSTABLE® DEVELOPED BY HDF ENERGY



FIRST MULTI-MEGAWATT HYDROGEN
POWER PLANT IN THE CARIBBEAN
PRODUCING CLEAN ELECTRICITY 24/7



STATUS: UNDER DEVELOPMENT

 SOLAR PV 50 MWp	 STORAGE CAPACITY 120 MWh	 POWER GENERATION 60 GWh/YEAR Day: 13MW Night: 3MW
 HYDROGEN PRODUCTION 600 TONS H ₂ /YEAR	 POWER SUPPLY FOR 50 000 INHABITANTS	

EQUITY INVESTER 	TECHNICAL ASSISTANCE 	TOTAL INVESTMENT 150 M€
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TRINIDAD & TOBAGO: NEWGEN

Development Stage (Financial Closing Q2-25)

Project Rationale

- Trinidad & Tobago is the largest industrial base in the Caribbean, it is one of the main exporter of ammonia
- All hydrogen feedstock currently derived from steam methane reforming of natural gas
- Newgen will utilize renewable power from a new solar facility and energy efficient power from combined cycle power plant to produce clean hydrogen
- 20 years Tolling Agreement with the national gas operator NGC



Production
Low carbon hydrogen
For ammonia production



CO2 reduction
200 000 T/CO2



Project CAPEX
200MUSD



Offtaker



<https://newgenenergy.com/>



OUR GIGA FACTORY IN FRANCE: THE WORLD'S FIRST MASS PRODUCTION PLANT FOR MULTI-MW PEM FUEL CELLS



Production capacity
1 GW by 2030



Employees
+500 by 2030



Location
Bordeaux, France



Factory size
7 000 m²
(phase 1)



Operational
In 2024



Environmental certification

GAME-CHANGING H₂ POWER



WWW.HDF-ENERGY.COM