AFSIA
Africa Solar Industry Association

GREEN HYDROGEN IN AFRICA
E-CONFERENCE

23-24 MARCH 2022

SUPPORTED BY

LONGi

GET.invest
Mobilising Renewable Energy Investments

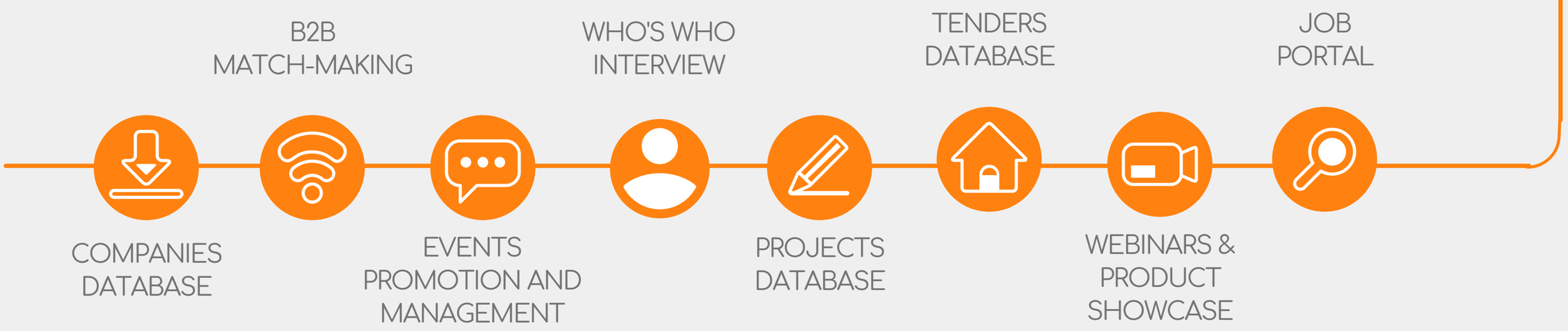
African Hydrogen Partnership

enea CONSULTING

MEMBER'S RESOURCES

AND BENEFITS

AFSIA SERVICES



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Africa Solar Industry Association

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AFSIA MEMBERS

FOUNDING

LONGi
HUAWEI
Bboxx
akuoenergy
AIIM
AFRICAN INFRASTRUCTURE INVESTMENT MANAGERS
enea CONSULTING
UL
Trinasolar
EVERSHEDS SUTHERLAND

PARTNER

nextracker
A Flex Company
ANTAI
Gridtech Infrastructure Company

STRATEGIC

AGSE Experience Life Living green with Renewables
ECREEE Towards Sustainable Energy
Stiftung Solarenergie Solar Energy Foundation
ACERD
ALER

CORPORATE MEMBERS

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Africa Rev
AMMP
AptechAfrica
DAYSTAR POWER
ENERGY SOLUTIONS
Disruptive Energy Services
Innovate the future of energy
Drop Access
for sustainable communities
Eastman
ENERGY. UNLIMITED.
EcoPhi
Renewables Engineering
Empower
Impact Investment
إنارة
ENARA
ENGIE
FINERGREEN
financer les énergies nouvelles
First Solar
gcsolar
GENIUS
WATTER
Globaltec
GOODWE
Goshop
greenyellow
SHIFT TO PROFITABLE ENERGY!
HENSEL
InfraCo
AFRICA
INSPIRED
EVOLUTION
JA SOLAR
JinKO Solar
JUBAILI BROS
SOLAR
mashriq
energy
meteo control
NAMENE
SOLAR
NRG Systems
OFGEN
energy simplified
SegenSolar
(Pty) Ltd
solar pipo
SPEG
Starsight Premier Energy Group
STUDER
SustainSolar
TALESUN
THENERGY
sustainable consulting
TUNUR
تونور
ZUHURA
SOLUTIONS
Transforming People & The Environment

THE TEAM

AFSIA
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INÈS

TEAM MANAGER
INDUSTRY NEWS

ALINE

MARKET
INTELLIGENCE

VESTINE

RESEARCH &
NEW PROGRAMS

JOSÉE

COMMUNITY
MANAGEMENT

LÉONCIE

EVENTS
MANAGEMENT

KERSY

ASSISTANT
NEW PROGRAMS

AFSIA 2022 ACTIVITY

HIGHLIGHTS

AFSIA Africa Solar Industry Association

PRIME

- 19 JAN — Launch Annual Outlook report 2022
- 4 FEB — Africa Solar Quiz - Leg 2
- **4-6 APR — Startup Energy Camp (Nairobi)**
- **17-19 May — SEforALL FORUM (Kigali)**
- **23 JUN — AFSIA Solar Awards (Brussels)**
- 8 JUL — AFSIA Solar Quiz – Leg 3
- **26-28 SEP — ARIS - Africa Renewables Investment Summit (Cape Town)**
- **TBC — Startup Energy Camp (TBD)**
- 4 NOV — AFSIA Solar Quiz – Leg 4

SHOWCASE

- Bboxx
- TDB — LONGi
- TDB — Eastman Global E-mobility
- TBD — Solar Employment in Africa report
- TDB — Eastman Global Solar storage

WEBINAR

- 23-24 MAR — GREEN H2 e-conference
- 12/19 APR — Jiinko
- 3-5 MAY — STORAGE e-conference
- TBD — Benefits of solar thermal for industries
- Africa Energy Startup: FINTECH
- 26 APR — Africa Energy Startup: CAMP WINNERS
- 28 JUN — Africa Energy Startup: PRODUCTIVE USE
- TBD — Digital solutions
- TBD — Africa Energy Startup: STORAGE & CHARGING
- TBD — Basics of PPA
- TBD — Africa Energy Startup: CAMP WINNERS
- TBD — Solar streetlighting

JAN · FEB · MAR · APR · MAY · JUN · JUL · AUG · SEP · OCT · NOV · DEC

EXTERNAL

- 17-19 JAN — World Future Energy Summit (Abu Dhabi)
- 16-18 FEB — Solar Power Africa (Cape Town)
- 22-23 FEB — Energy & Mining
- 1-3 MAR — Africa Energy Indaba (Cape Town)
- 7-9 MAR — Middle East Energy (Dubai)
- 7-9 JUN — ENLIT Africa (Cape Town)
- 21-24 JUN — Africa Energy Forum (Brussels)
- TBC — ALER Trade Mission Angola
- 22-24 AUG — The Solar Show Africa (Jo'burg)
- 18-20 OCT — 7th Global Off-Grid Solar Forum & Expo (Kigali)
- 18-21 OCT — African Energy Week (Cape Town)
- 7-18 NOV — COP 27 (Sharm El- Sheikh)
- TBC — ALER Trade Mission Mozambique

ONLINE EVENTS
PHYSICAL EVENTS

UPDATED 22 MARCH 2022

AFSIA
Africa Solar Industry Association

MEDIA & REACH

- 28,000 FOLLOWERS
- +1,000/MONTH
- 220,000 IMPRESSIONS/MONTH
- 100 UPDATES/MONTH
- ALSO “AFSIA EN FRANÇAIS” AND “AFSIA EM PORTUGÊS”

- 70,000 SOLAR PROFESSIONALS REACH
- +2,000/MONTH
- AVERAGE OPEN RATE: 24,9%
- AVERAGE CLICK RATE: 19,6%
- AVERAGE UNSUBSCRIBES: 0.1%

- 49 ARTICLES IN 2020
- 63 ARTICLES IN 2022
- PARTNERSHIPS WITH
  - AFRIK21
  - SUN-CONNECT
  - PV MAGAZINE
  - MINING AFRICA REVIEW

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AFSIA GREEN HYDROGEN

E-CONFERENCE 2022

Some of the best green H_2 experts from around the world

Dr. Innocent Uwuijaren

African Hydrogen Partnership

Dr. Thomas Hillig

THENERGY innovation²market

Dr. Chen Zhu

LONGi

Frank Mischler

PtX Hub Brussels

Eric Dabe

John Cockerill

Abdelaziz Yatribi

Scatec

Justin Wu

LONGi

Alexander Huppertz

GET.invest Mobilising Renewable Energy Investments

Ian Fraser

RTS™

Matt Cleary

enea CONSULTING

Fernando Szabados

EODev

Matthias Schlegel

FICHTNER

Jan-Georg Wagenfeld

Masdar

AFSIA
Africa Solar Industry Association

Day 1 – Wed 23

All times are in
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Dr. Innocent Uwuijaren

Chairman

- 20+ years experience in energy
- Previous worked with Global Energy, Eni, Total and Technip
- Technology expert, with special focus on disruptive engineering innovations to help the energy industry reduce inefficiencies
- Ph.D. in Subsea Engineering from University of Aberdeen

African Hydrogen Partnership

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African Hydrogen Partnership

The Importance of Hydrogen for Africa

AFSIA
Africa Solar Industry Association

Dr Innocent Uwuijaren - AHP Chairman

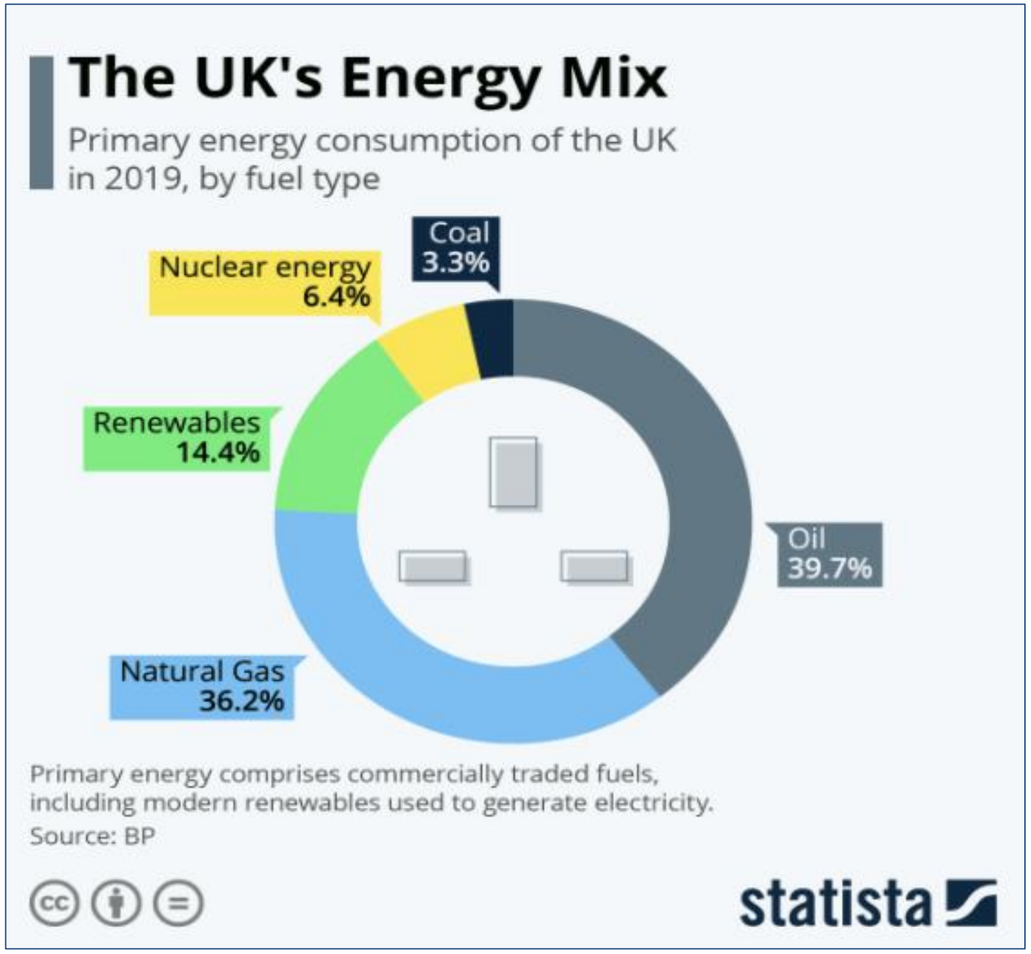
Hydrogen Demand - EU Commission

EU Commission - REPowerEU

"A Hydrogen Accelerator to develop infrastructure, storage facilities and ports, and replace demand for Russian gas with additional 10 million MT per year of imported renewable hydrogen from diverse sources and additional 5 million MT per year of domestic renewable Hydrogen." *(Factsheet, 8 March 2022)*[1)]

1) https://ec.europa.eu/commission/presscorner/detail/%20en/ip_22_1511

Hydrogen Demand – Europe Case Study



The EU's Energy Dependency

- **> 80% of primary energy consumption based on fossil fuels/nuclear energy**
- **Energy imports**
  - **> 50% of energy**
  - **> 90% of oil and petroleum**
  - **~ 90% of natural gas[1)]**

Decarbonizing All Sectors

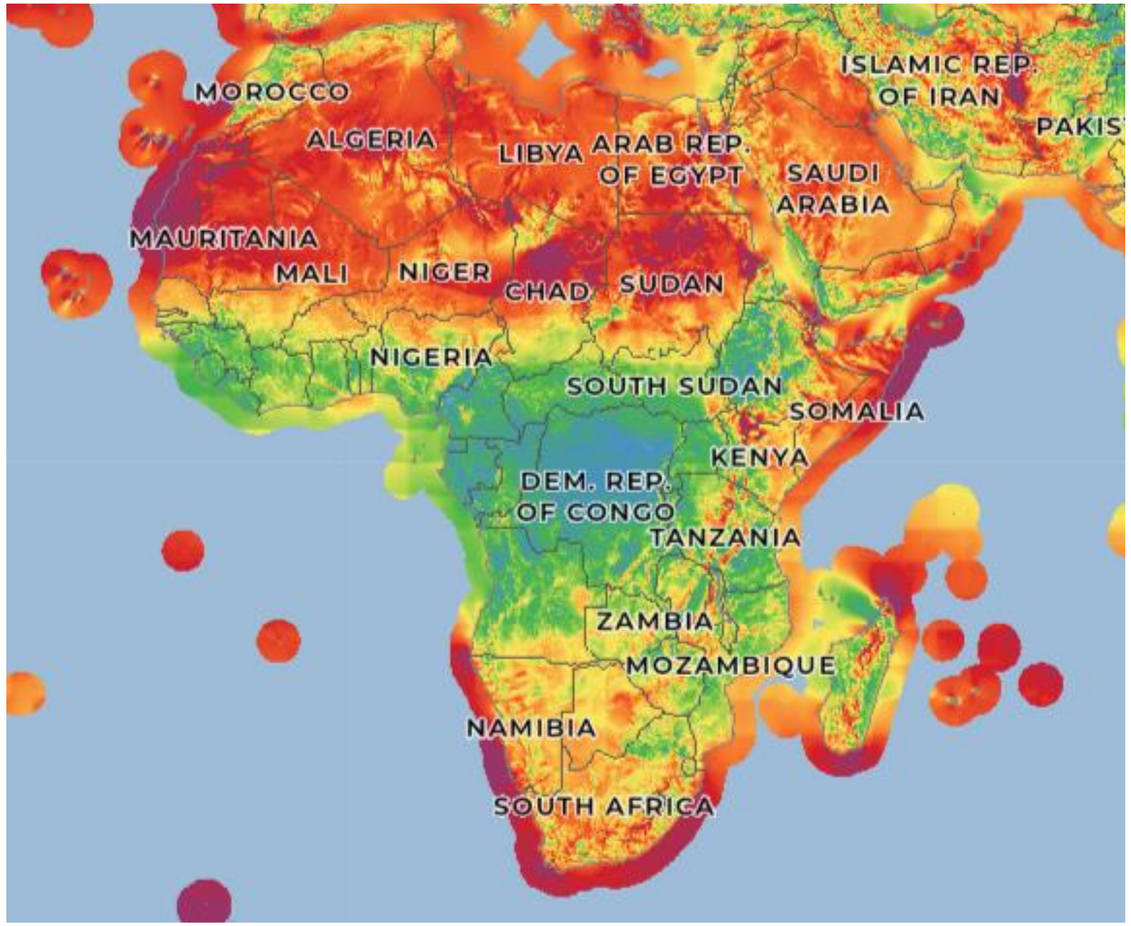
1. **Industry**
2. **Residential/Commercial**
3. **Transport**

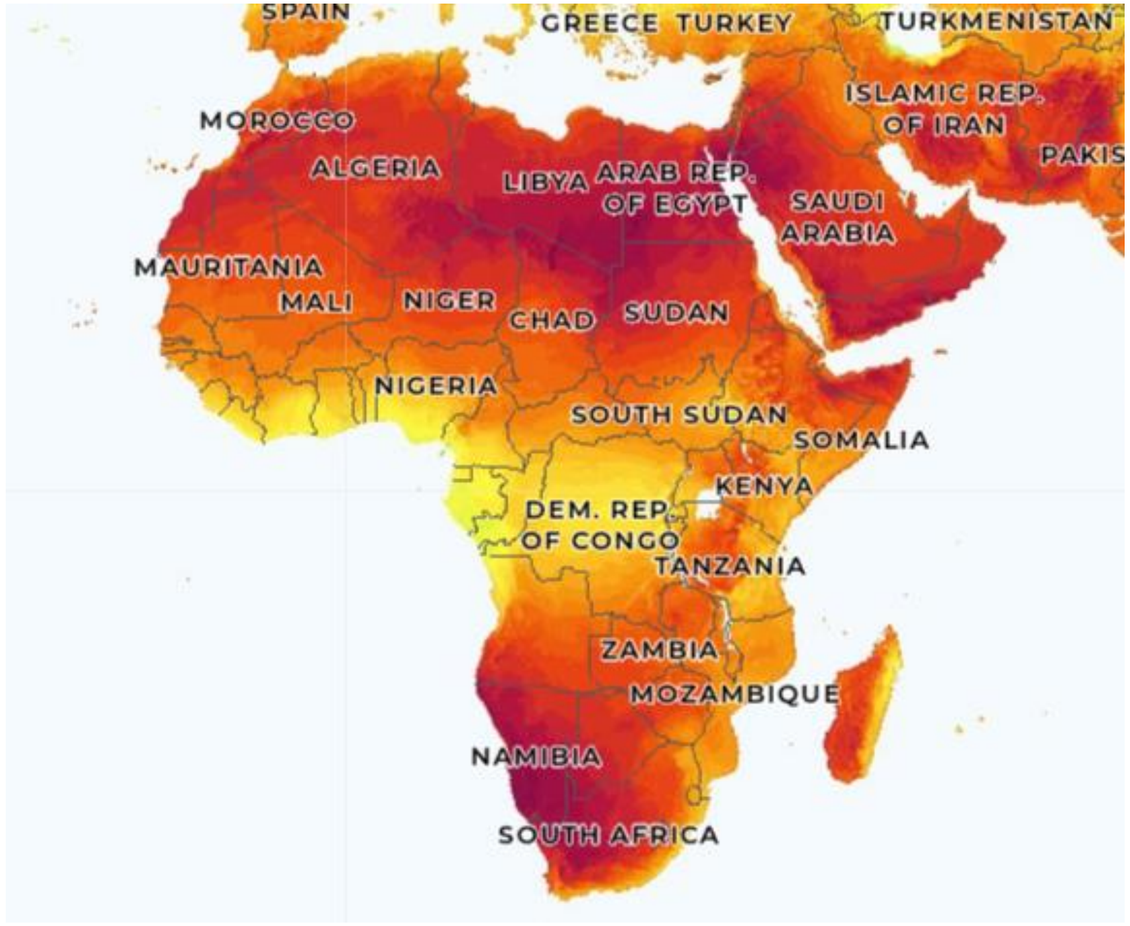
1) eurostat - https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_production_and_imports

Hydrogen Application – Versatile & Universal

Hydrogen Supply – Green H2 Potentials in Africa

Wind **Water** **Coastlines** **Solar**





Hydrogen Economies – Opportunities for Africa

Economic Benefits

- Low cost, price competitive carbon-free hydrogen
  - Green hydrogen
  - Natural hydrogen
- Markets
  - Domestic
    - Demand in Africa
    - Attracting energy intensive industries - FDI
  - Export
    - Within Africa countries
    - Internationally

Social & Environmental benefits

- Protecting the Climate
- Minimizing the impact on biodiversity and habitat
  - Green Hydrogen
    - Sun, Wind, Water, Space
  - Natural Hydrogen

Hydrogen Production in Africa – Successes & Challenges

Green H2 Success in Africa

- Egypt's Green Hydrogen Plant
- South Africa's Hydrogen Valley
- Mauritania's Project Nour
- Namibia's SCDI Green Hydrogen Project
- Morocco's HEVO Ammonia Project
- Green Fertilizer Plant in Kenya (in feasibility phase)

Challenges for Green H2 Production in Africa

- Technology access, cost & affordability
- Funds for economically & commercially feasible projects
- Energy Balance (grid / off-grid)
- Security and political stability
- Local capacity skills shortage
- Conflicting rules and regulations,
- Government policies and awareness

Maximizing Hydrogen opportunities in Africa

African Hydrogen Partnership
(Creating Alliance Globally)

African Hydrogen Partnership

- **The only continent wide H2 organisation solely dedicated to Green & Natural H2 business opportunities in Africa.**
- **Represents the whole African continent & all African countries.**
- **Organisations from all around the world can join the AHP**
- **Facilitates commercially & economically feasible projects in Africa**
- **Partners include industry organisations, academia, associations, etc.**
- **Administrative office located in Mauritius**

Project Initiatives & Collaborations (Green & Natural Hydrogen)

- **H2 Local Demand Projects**
  - **Hydrogen Production**
  - **Hydrogen derivatives**
    - **Green Ammonia**
    - **Green Urea**
    - **Green Fertilizer**
- **H2 export Projects**
  - **Collaborating with Europe on export infrastructures**
  - **H2 application in shipping industries**

THANK YOU

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Dr. Thomas Hillig
Founder & Managing Director
Germany

THENERGY
innovation²market

- 20+ years experience - 8 years as Founder and Managing Director of THEnergy
- Worked with Clean Horizon Consulting, Innotech Solar, Alstom
- Specialized in microgrids/mini-grids and off-grid renewable energy for industrial companies
- Awarded Top 3 Global Solar and Energy Influencer – Moderator of H2 group on LinkedIn
- Ph.D. in BWL / Marketing from Technische Universitat Berlin

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Frank Mischler

Head of PtX Hub Brussels (GIZ)

Belgium

PtX Hub
Brussels

- 25 years experience in Policy Advisory and Project Coordination
- Worked with GIZ (German Cooperation) and FAO (Food and Agriculture Organization)
- Facilitated the European Union’s climate diplomacy efforts with non-European G20 countries - Strategic Partnerships for the Implementation of the Paris Agreement
- Master’s degree from Institute for Environmental Management and Assessment (IEMA) from University of London

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Abdelaziz Yatribi

VP Business Development MENA and West Africa

Norway

Scatec

- 10 years experience in African solar industry - last 5 years with Scatec
- Previously worked with First Solar, NAREVA Holding
- Perfect tri-lingual – English, French, Arabic
- Master’s in management from London Business School

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Africa Solar Industry Association

Eric Dabe
Senior Sales Advisor
Belgium

John Cockerill

- 25 years experience in industrial sales and marketing
- Started in hydrogen in 2005 with NEL Hydrogen in Norway
- Perfect polyglot – English, French, Norwegian
- Master’s degree in industrial engineering from The Gramme Institute

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Panel

Commercial considerations of green H_2 in Africa

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Justin Wu
Senior Product Manager
China

LONGi

- 15+ years experience in the field of industrial Gas
- Currently responsible for technical services and product planning
- Previously has rich application experience in the field of Gas, especially in the field of chemical industry.
- Bachelor Degree in mechanical design and automation from Shanghai Ocean University

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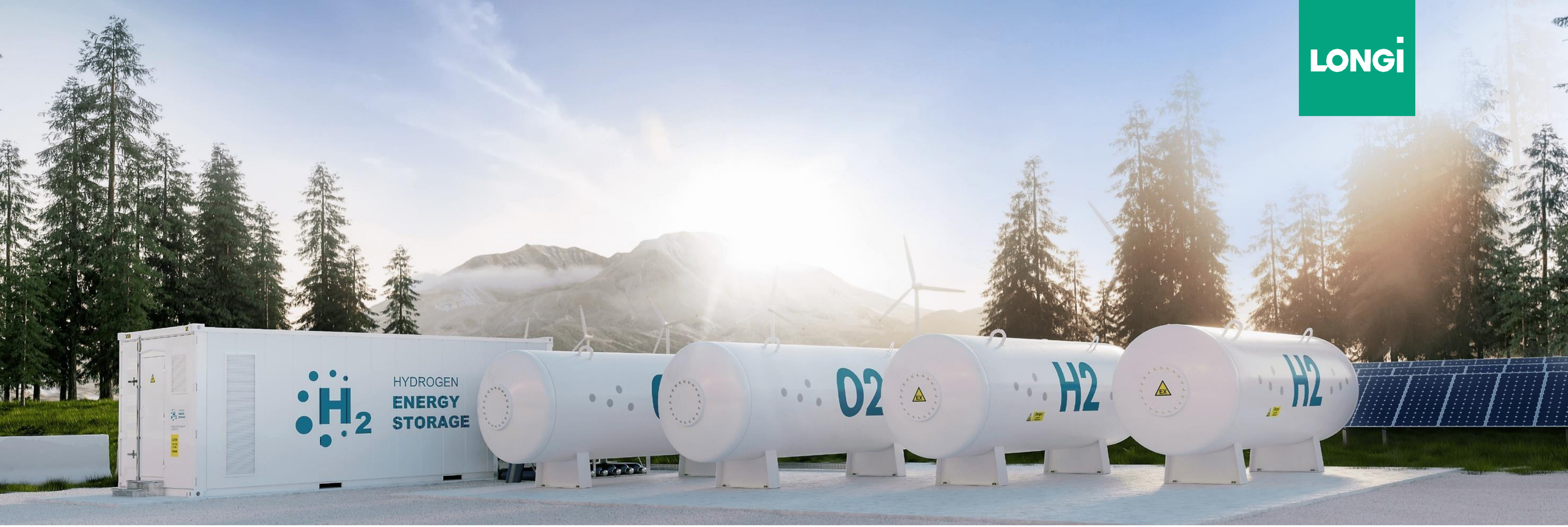
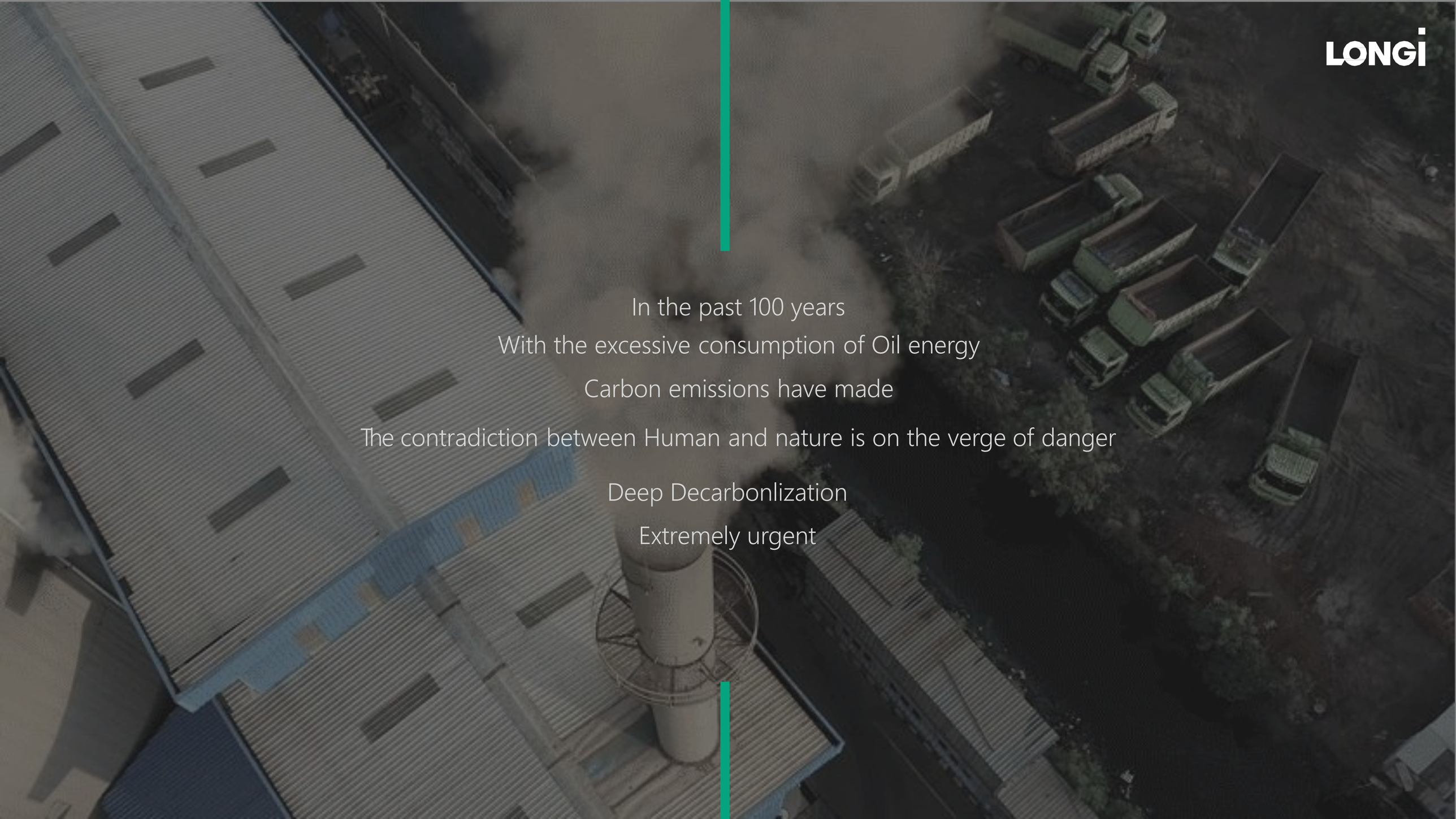


Renewable Energy+ Green Hydrogen Become Powerful Weapons for Carbon Neutrality

LONGi HYDROGEN



In the past 100 years

With the excessive consumption of Oil energy

Carbon emissions have made

The contradiction between Human and nature is on the verge of danger

Deep Decarbonlization

Extremely urgent

The most powerful weapon to accomplish carbon neutrality goals

In 2015，leaders from **over 170** countries and regions had signed **The Paris Agreement.**

and they proposed to limit the temperature rise within **2℃** and strive to be under **1.5℃** as the long term goals.

In 2020，China announced the commitments for peaking carbon emissions by **2030**

and reaching carbon neutrality by 2060 at the 75th UN General Assembly.

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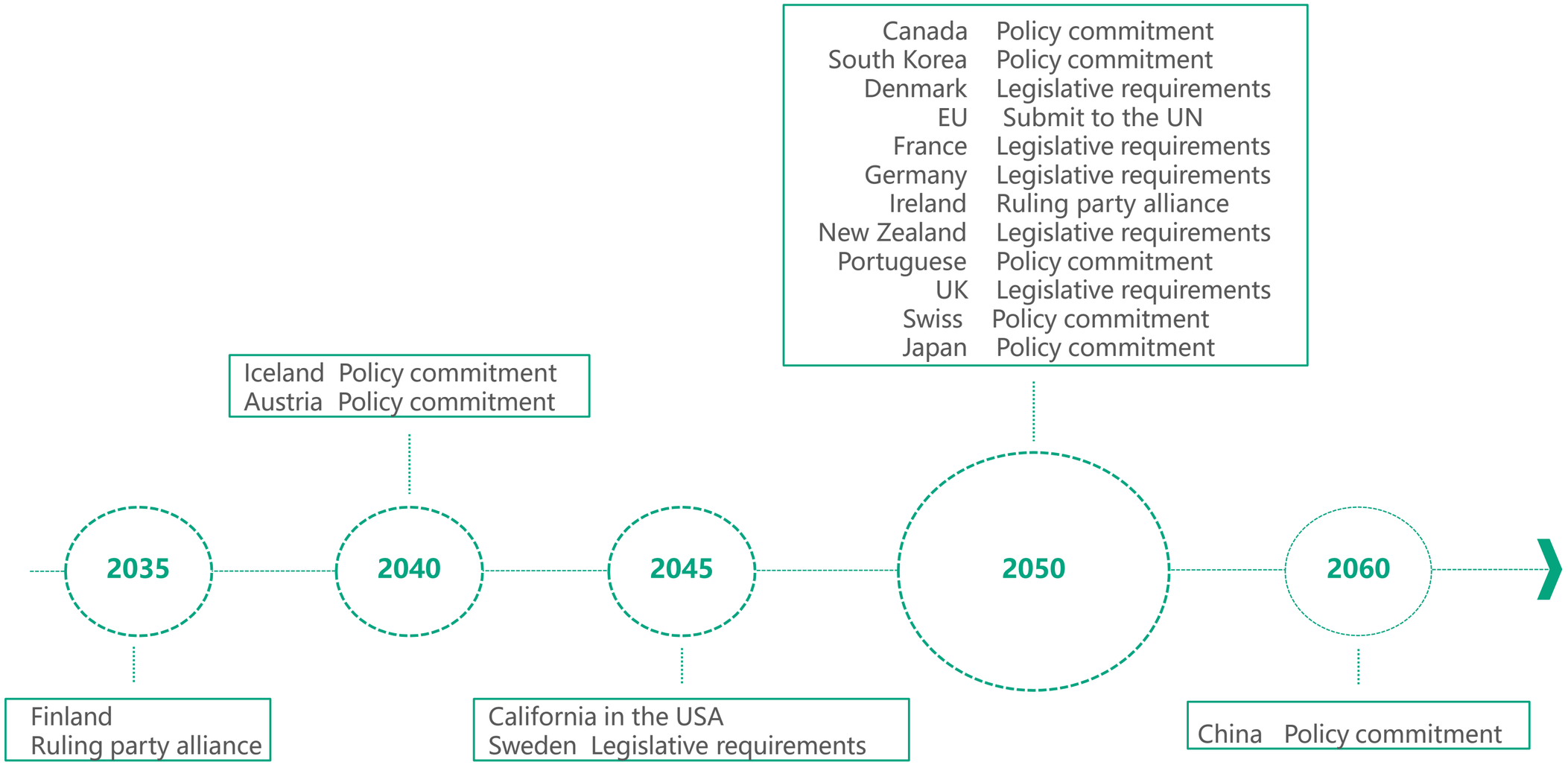
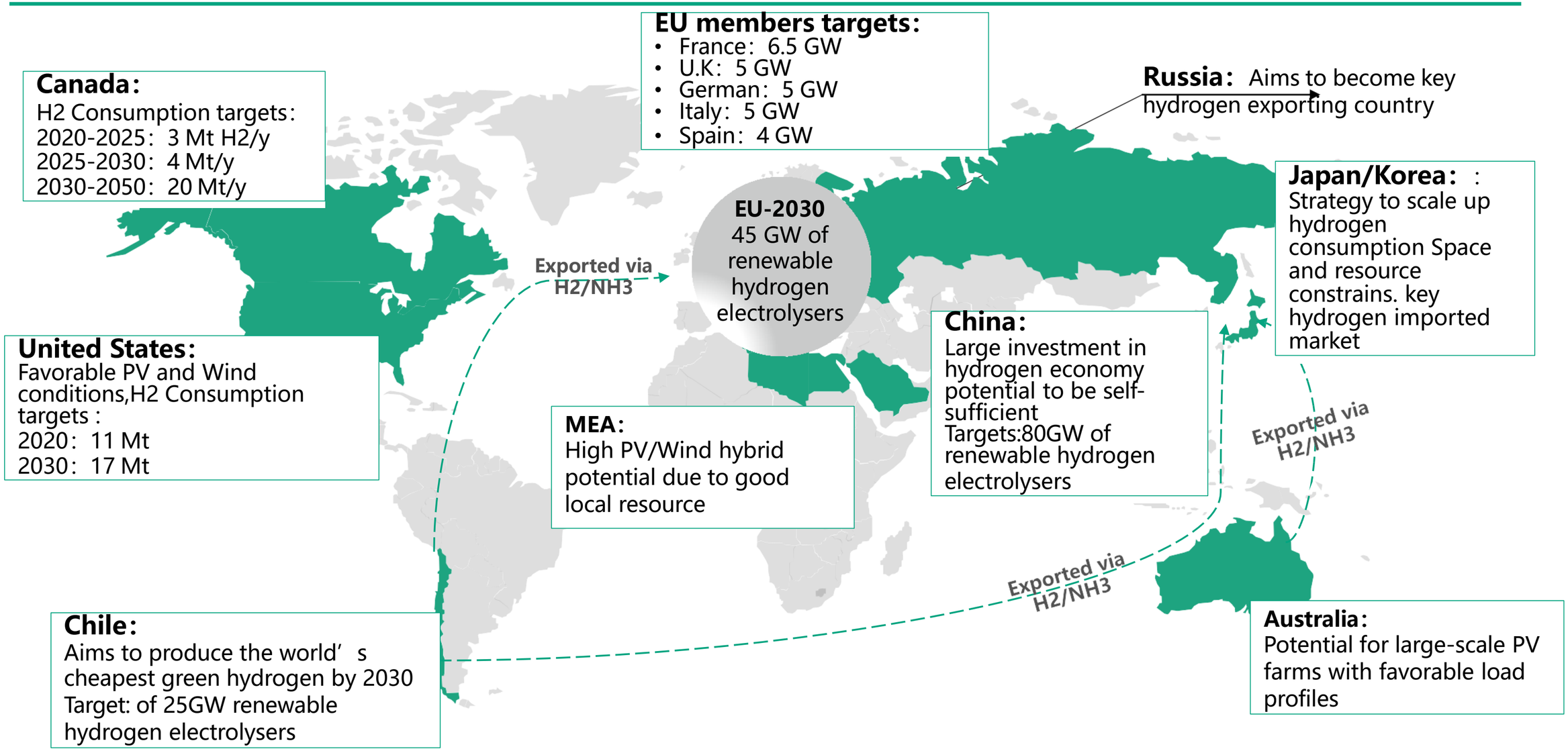
Carbon Neutrality Schedules of Major Countries

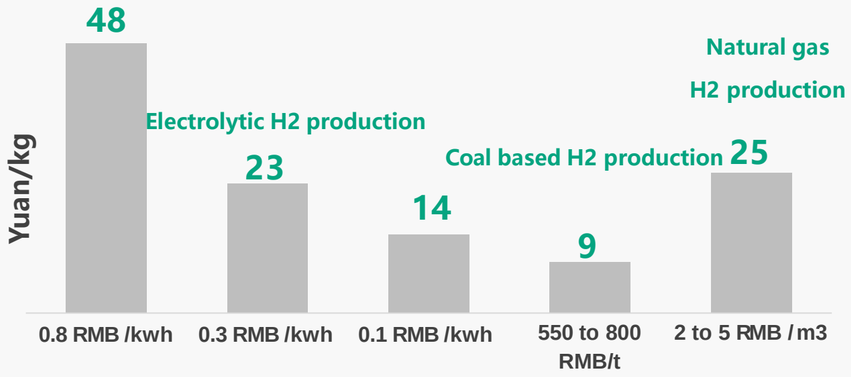


Global Scope of Hydrogen Strategy

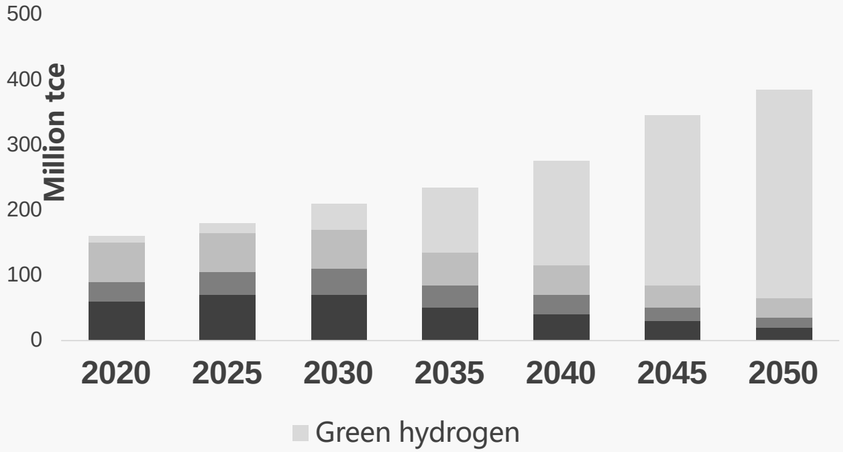


Hydrogen energy will gain an indispensable secondary clean energy

Economic efficiency of different H2 technologies



Forecast of Green H2 Ratios



Under Goal of "Carbon Neutrality " by 2060

- >130 million ton — Hydrogen demands
- 20% — Ratio in ultimate energy Consumptions
- 1.5 billion t/ Year — CO_2 Emission reduction

China Hydrogen Alliance
China Hydrogen Energy, Fuel and Cell Industrial White Paper 2020 and the research reports

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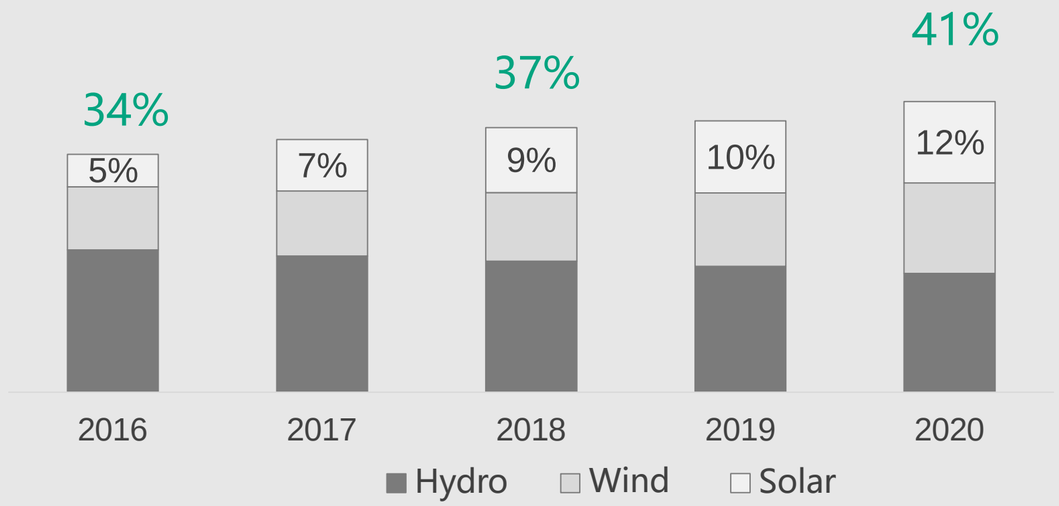
Why Did LONGi Entered Hydrogen Energy Field?

National CO2 emission

Without Solutions if not introduce "Hydrogen Energy " Enter in-depth decarbonization process

Power market is rapidly transiting to renewable energy

Installation ratio of renewable based power in China



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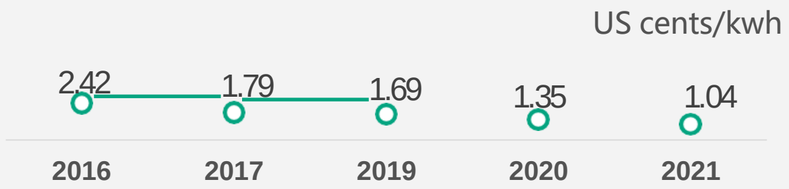
Lower LCOE，Lower LCOH

Solar Power

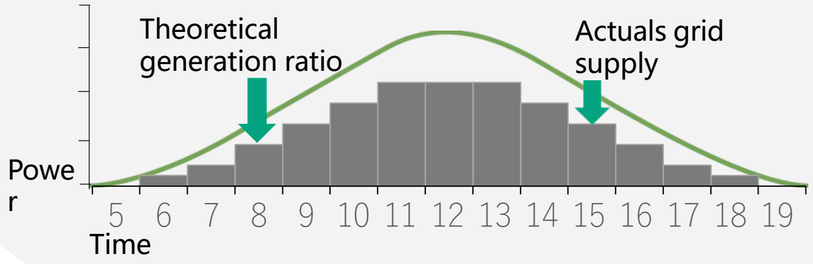
Rapid LCOE reductions by PV power generation

Lowest solar bid prices in Middle East



Intermittent and discontinuity difficulties contributed by renewable energy hard to overcome

Intermittent feature of solar power generation

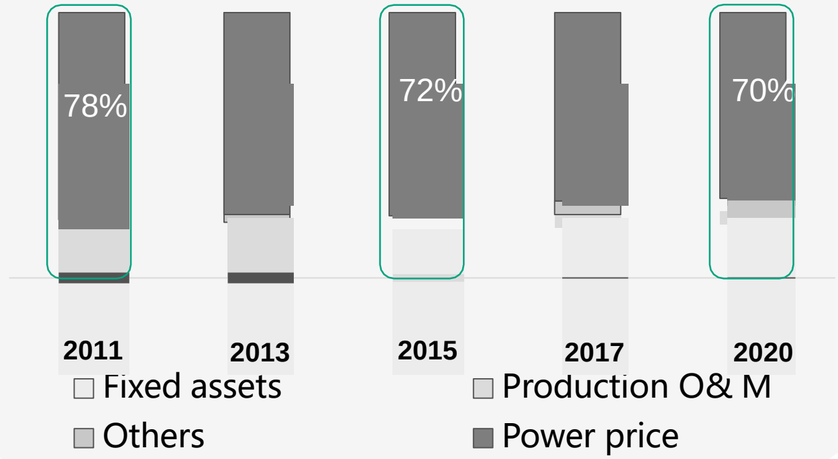


Hydrogen Energy

High cost power lead to high H2 production cost

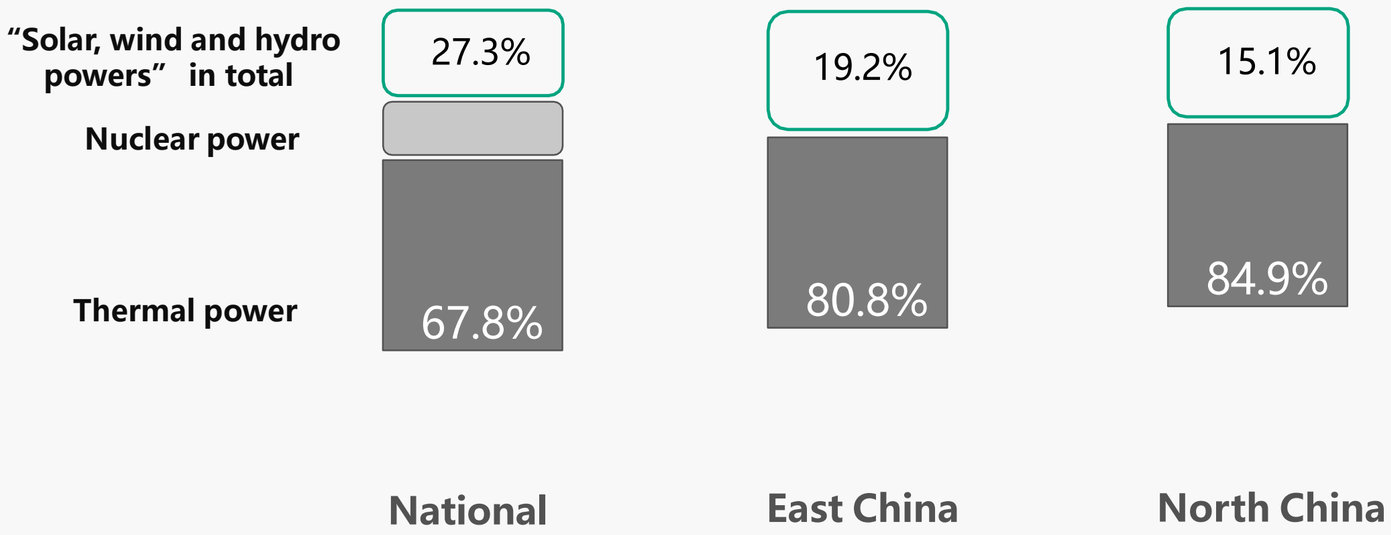
Grey hydrogen and non-renewable energy hydrolysis cannot facilitate carbon reduction goals

Cost structure of traditional electrolytic H2 production



Power structure of China

Power structural ratio in China and partial provinces



- Renewable sourced power shares 27.3% in various powers in China
- Renewable sourced power shares 19.2% in various powers in East China
- Renewable sourced power shares 15.1% in various powers in North China

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100% green power generations is the ultimate solution for zero CO_2

Coal based H2 production

13.5~19.4

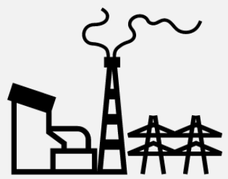
kgCO_2/ kgH_2

H2 production by Natural gas

6.5~10.8

kgCO2/ kgH_2

H2 production with grid power



42.5

kgCO2/ kgH2

(National average)

100% intermittent green energy electrolytic H2 production

0.0

kgCO2/ kgH2

Transfer CO2 emissions to power generation side

Truly materialize "green hydrogen" generatio

LONGi HYDROGEN

LONGi “Green Power + Green Hydrogen” Strategy

LONGi Hydrogen Vision: Committed to be world leading company for hydrogen energy equipment

2000
LONGi was established

2005
Achieve annual production capacity of 30 tons of silicon ingots

2012
Listed at Shanghai Stock Exchange

2014
Shipment of mono-crystalline cells and modules topped the world

2018
LONGi proposed “Solar for Solar” development model

Set out in hydrogen industry and carried out strategic researches

2020
LONGi joined the Climate Group’s initiatives of RE100, EV100 and EP100 and proposed the "Zero-carbon Solar Products"initiative

“LONGi became the PV solution supplier for the China Pavilion at the Expo 2020 Dubai

2000~2005

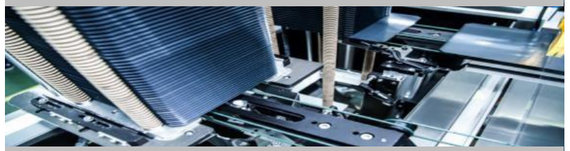
Accumulate technology during the early years as a start-up company

2002

Poly silicon materials

Carbon-silicon separation technology

2006~2013



Focus on mono-crystalline products and technical revolution

2006

Determined to choose PV as core of business, focusing on mono-crystalline technical route from a strategic perspective.

2013

Production and sales of mono-crystalline silicon wafer ranked No.1 in the world

2014~2020

Lead the PV industry for upgrade and evolution

2016

Invest and deploy production capacity in Yunnan, China and Kuching

2019

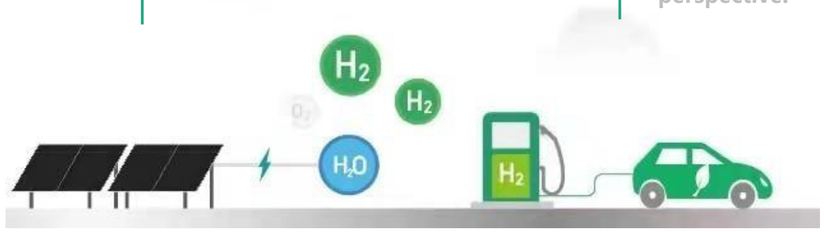
LONGi’s global market share of mono-crystalline products reached to 72% in 2019 from 20% in 2014

2021~ Now

Solar technology to boost energy transition

2021

LONGi officially entered hydrogen energy field Provide solutions of “Green hydrogen”



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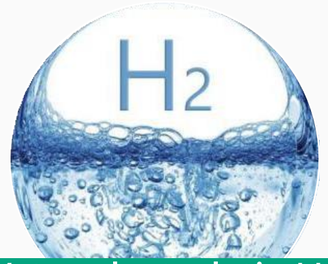
Vision of a green hydrogen production in application

The current and ideal green hydrogen production is to " produce H_2 with solar facilities featured intermittent, and store H_2 in scale" (100% renewable energy based H_2 production)

Solar power



Water electrolytic H2 production

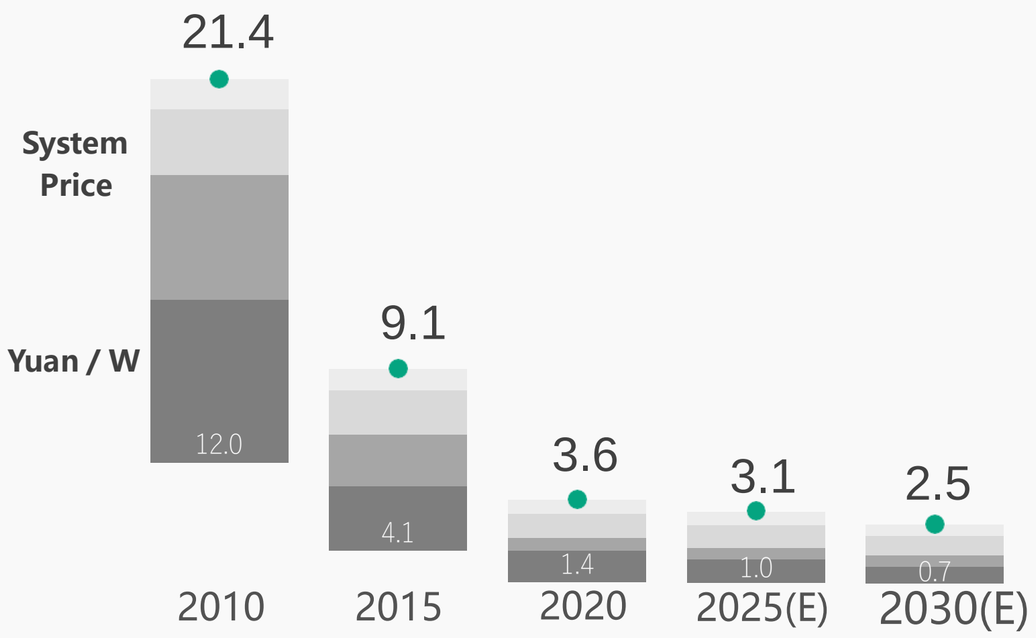
Petrochemical plants

Scaled hydrogen storage

Significant cost reduction of solar power

Rapid cost reductions of solar power

- **Cost reduction ratio witnessed a 80% cut in past decade, more rooms available**



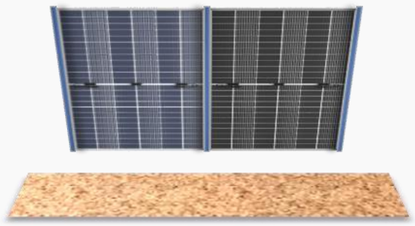
Power generation improvement route in life cycle

- **Improve system power yields by: improve cell conversion rate + module bifacial rate + advanced supports etc.**

N-type Cells

Conversion rate: 25.21%

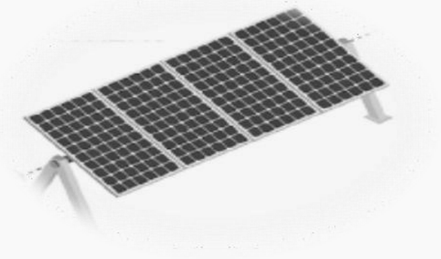
Bifacial modules



Bifacial ratio: ~70%

Power generation gain of backsheet: 12%

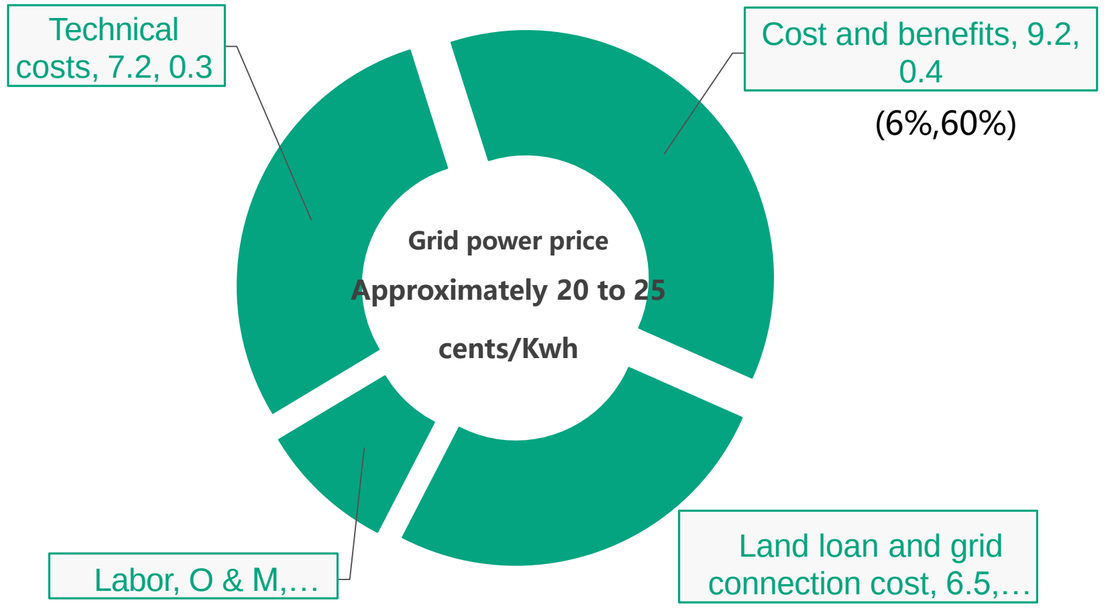
Tracing supports



System power generation gain: >8%

Non-technical costs account for a large proportion of LCOE

Technical costs of solar power generations maintains at an extremely low level



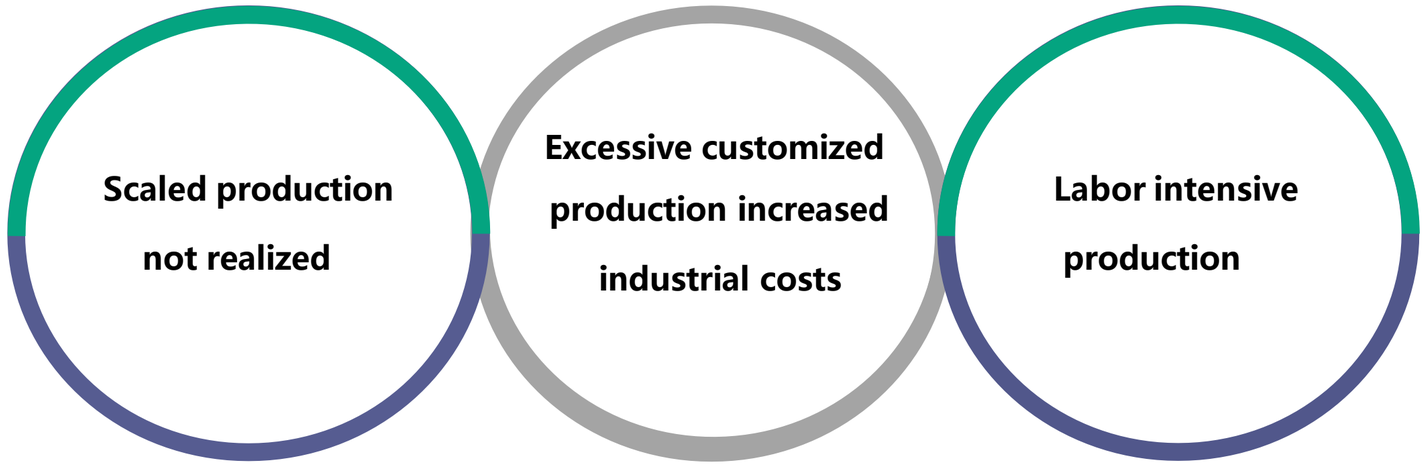
- Take Large scale power station as example

MOU：rmb/kwh

- In areas with good solar radiation resources, Solar LCOE has reached 15-20 cents/kwh
- Technical cost of solar power generations close to 7.0 cents/kwh
- The controllable and reduced non-technical costs able to supply cheaper power to H2 production with hydrolysis process

LONGi HYDROGEN

Industrial pain points of electrolytic hydrogen equipment



Paths of cost reductions:

Path 1

Scaled production
Automation production

Path 2

Industrial standardization

Path 3

Technology advancements
Efficiency and consumption Efforts

Path 4

Digital and smart not realized

LONGi HYDROGEN

LONGi officially entered hydrogen energy field

Milestones

2018

Carried out strategic researches on hydrogen energy industrial chain,
and developed hydrogen production equipment by electrolysis process jointly with science and research
units at home and aboard

2021

March 31
Registered in Xi' an Hi-tech Industrial Zone
Hydrogen equipment plant loscates in Wuxi, Jiangsu Province

2021

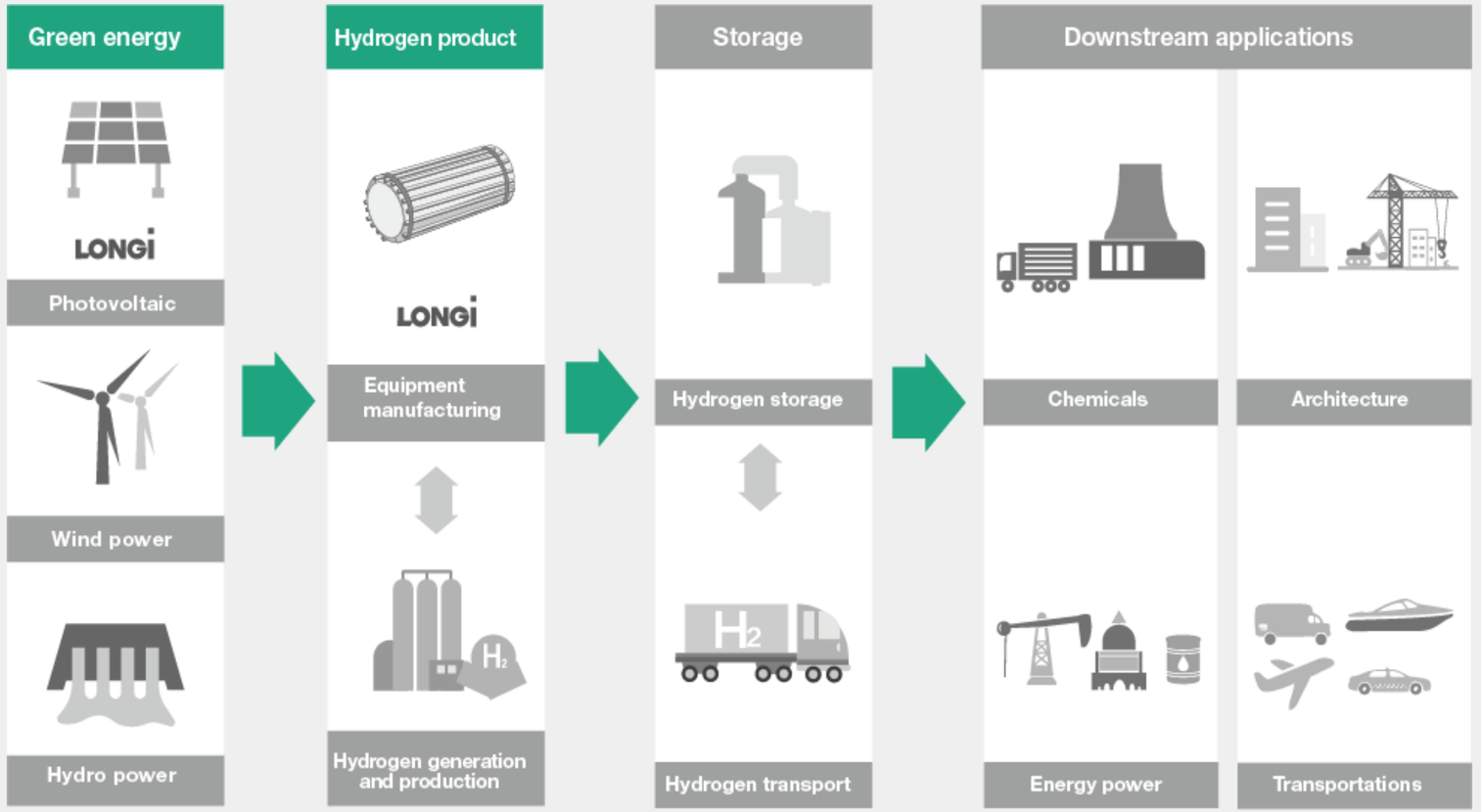
Realize mass production in Q4 with capacity of **500MW**

2022

Forecast: reach **1.5GW** in year end

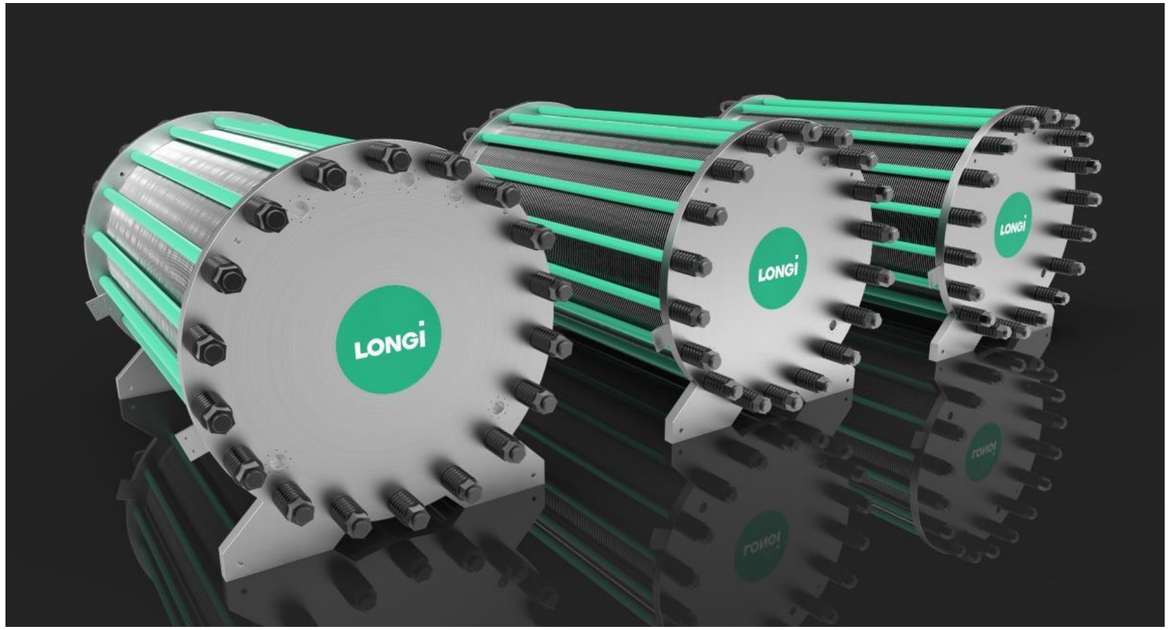
2025

Scheduled capacity from **5 to 10GW**



LONGi HYDROGEN

LONGi Hydrogen ALK Equipment



- Standardized production, compact structure, precision, unanimous product quality
- cancel asbestos wire net to prevent alkaline contaminations to environment
- Multiple designs to the alkaline skids

Higher performance	Modularized	Smart supports	Safe and stable	Loading
Accessible	**More applicable**	**3 tier managements**	**One bottom operation**	**Scope**
1000Nm3/h	**Large scaled H2 production**	**DCS supervision, PLC equipment management, interlocked alarming and automatic controls**	**With interlocked functions for wrong operations, 200 thousand safe operation duration**	**30%-110%**

LONGi HYDROGEN

LONGi Hydrogen ALK Equipment

Modularized LGS/LGPU
Gas Separation Unit/ Gas Purification Unit

Widely applied in different industries such as petrochemical, chemical, power, steel, metallurgical, transportation and other manufacturing industries.

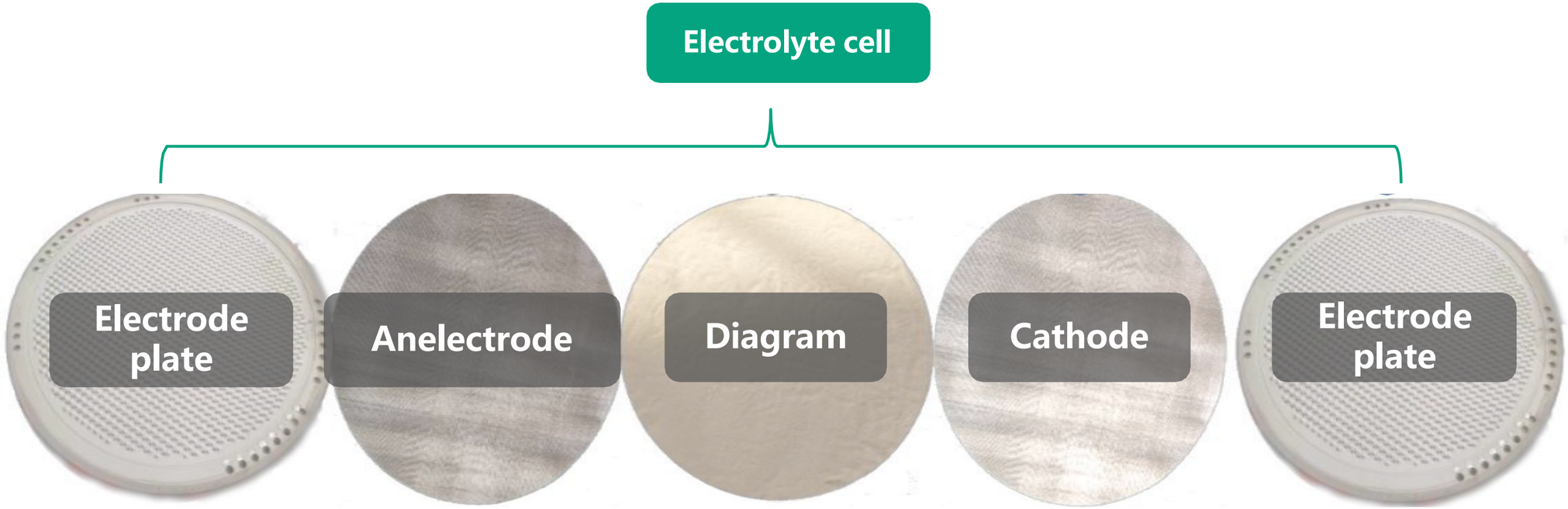
The standardized, modeled and adaptable solutions able to match different scenarios and maximize LCOH for customers.

LONGi HYDROGEN

LONGi Hydrogen R&D

LEADING TECHNOLOGY

Innovative process were designed for electrodes and diaphragm to core parts of electrolyzer, the current density is able to reach: **5,500A/m²**, and capacity in mass production can reach: **3,500-4,000A/m²**



LONGi HYDROGEN

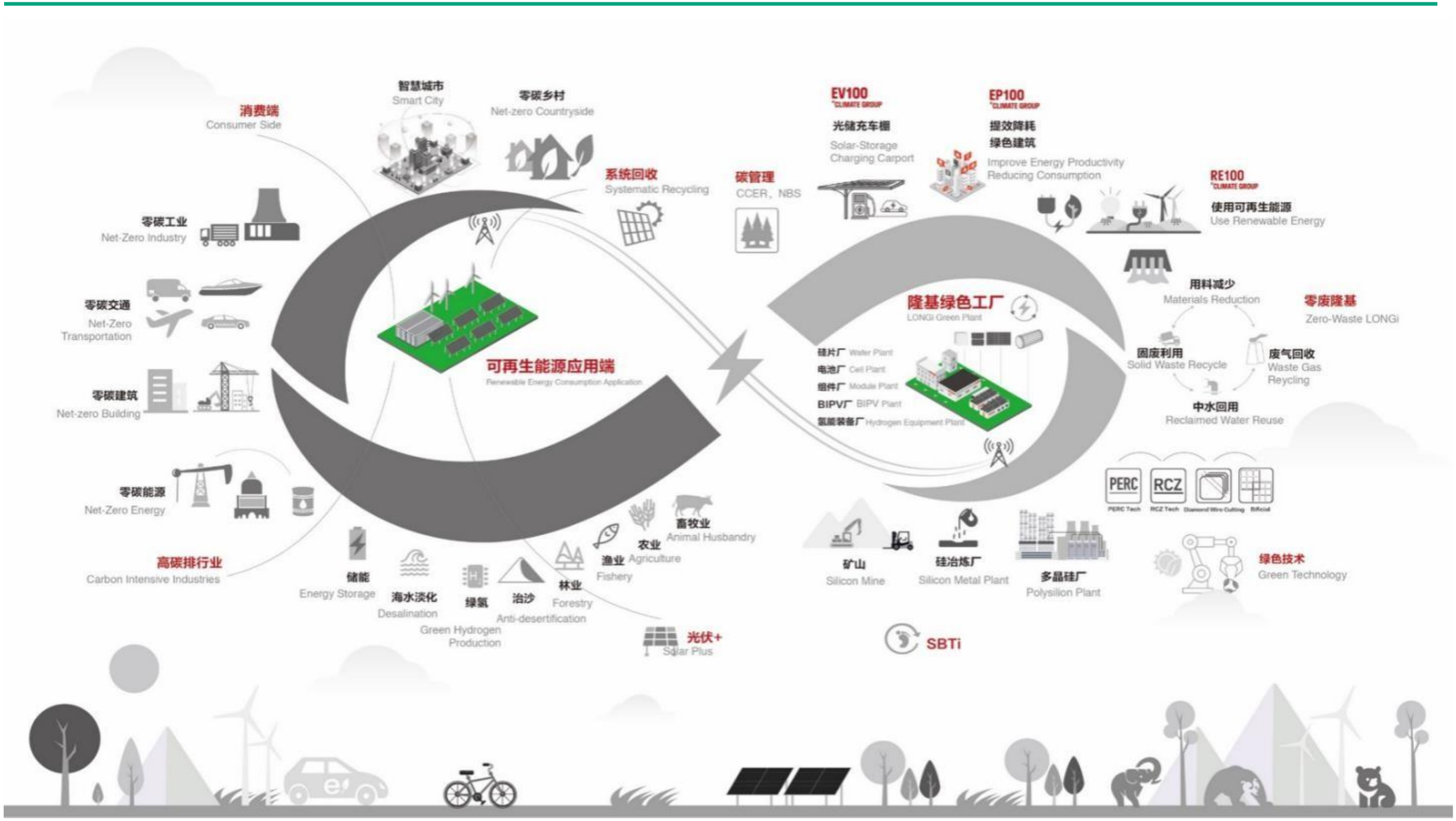
LONGi & SINOPEC

On April 13, 2021, **LONGi and SINOPEC** signed a frame agreement for strategic cooperation in PV and hydrogen energy areas.

On Nov 2021, SINOPEC lands **World's Largest Photovoltaic Green Hydrogen Production Project** in China.

- Total investment of 470.77 million USD;
- PV plant installed capacity of 300MW ;
- Annual capacity of green hydrogen 20,000 tons;
- Hydrogen storage capacity of 210,000 Nm^3;
- Transmission pipelines with a capacity of 28,000 Nm^3/h.

LONGi sustainable ecosystem



THANKS

AFSIA
Africa Solar Industry Association

Day 1 – Wed 23

All times are in
Central African Time – CAT

2:00 – 2:30	Keynote Speech Dr. Innocent Uwuijaren African Hydrogen Partnership
2:30 – 3:30	Panel Commercial considerations of green H_2 in Africa Dr. Thomas Hillig - THEnergy Frank Mischler – PtX Hub Eric Dabe – John Cockerill Abdelaziz Yatribi - Scatec
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LONGi
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ahp African Hydrogen Partnership
enea CONSULTING

Ian Fraser

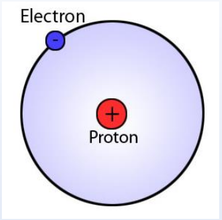
CEO

South Africa

- 50+ years experience in a wide variety of engineering & business activities
- Founded RTS Africa Engineering 32 years ago
- Specialized in the application of imported specialized engineering technologies; including hydrogen generation
- Sub Saharan Africa sales / service agents for NEL Hydrogen since 1996

AFSIA
Africa Solar Industry Association

African Hydrogen Partnership



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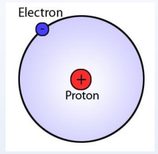
RTS Africa Engineering (Pty) Ltd
RTS Africa Technologies (Pty) Ltd

AFRICA.
A GREEN FUTURE
WITH HYDROGEN ENERGY

Presented By
Ian N Fraser
RTS Africa Engineering (Pty) Ltd

African Hydrogen Partnership



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AFRICA GOING GREEN

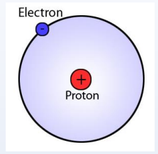
At present – Africa is a net importer of energy.

Energy is imported in the form of fossil fuels of various kinds - at enormous cost and damage to the environment.

WHY???

Africa has the resources to become a NET EXPORTER of energy

African Hydrogen Partnership



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AFRICA GOING GREEN

AFRICA HAS VAST OPEN AREAS WITH STRONG SOLAR RADIATION AND ALSO WIND ENERGY

African Hydrogen Partnership

Electron

Proton

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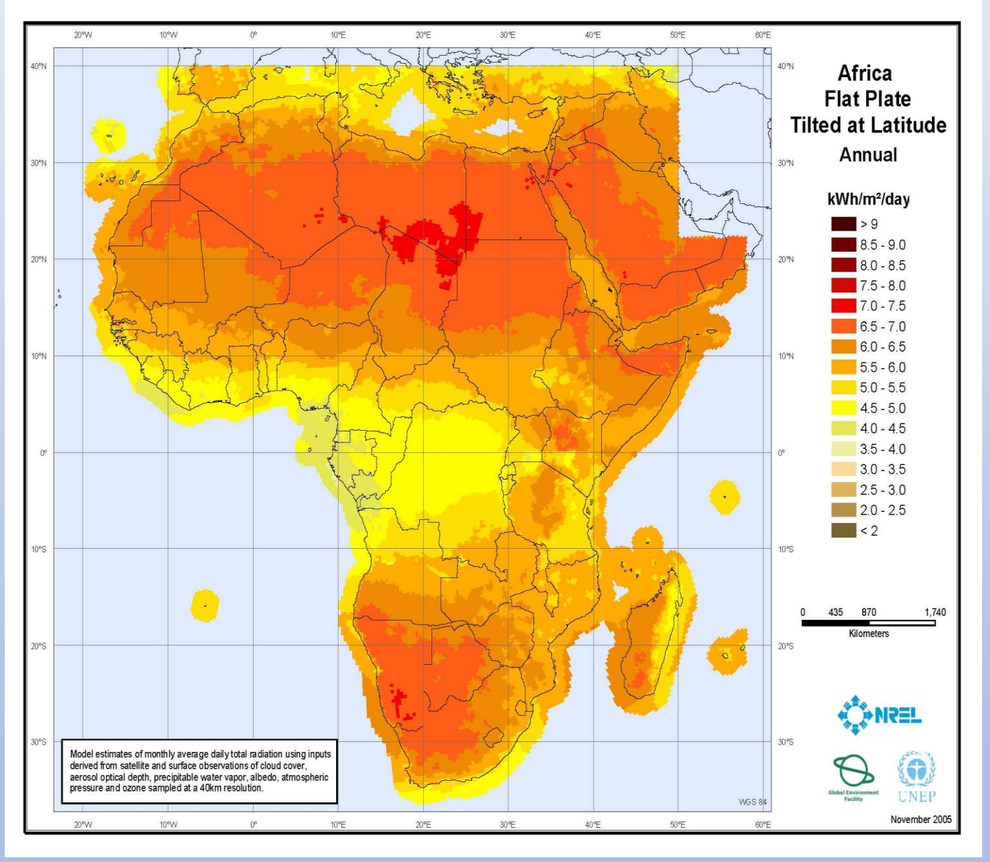
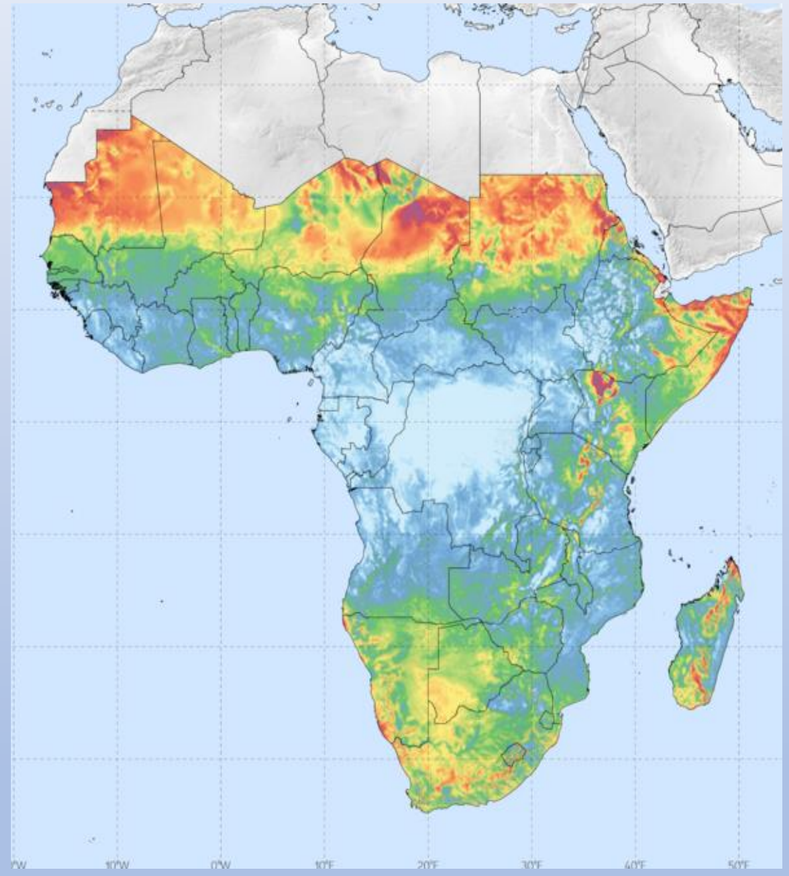
AFRICA GOING GREEN

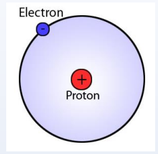




SOLAR AND WIND ENERGY DISTRUBUTION IN AFRICA

- The areas in yellow, orange and red – all deliver > 5kW/m³.
- The darker orange areas deliver >7kW/m³.

African Hydrogen Partnership



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AFRICA GOING GREEN

How can these initiatives be co-ordinated?

African Hydrogen Partnership

THE INAUGURAL MEETING WAS HELD IN ADDIS ABABA IN FEBRUARY 2020.

Attended by over 40 delegates representing private, public and administrative bodies from Africa, Europe and Asia

African Hydrogen Partnership

Electron

Proton

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AFRICA GOING GREEN

How can these initiatives be co-ordinated?

It was resolved that the AHP would become the primary driver for the uptake of Green Hydrogen Energy for the African continent.

African Hydrogen Partnership

Electron

Proton

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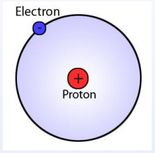
Studies by the AHP have demonstrated that Africa can produce sufficient Green Hydrogen to satisfy all energy demands in Africa plus a significant additional volume for export.

African Hydrogen Partnership



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How practical is this in practice?

Morocco is already exporting Green Hydrogen to Europe through a pipeline.

The Port of Rotterdam has a major Hydrogen terminal geared for the importation of Green Hydrogen into Europe.

Japan has indicated that she will buy all the Green Hydrogen that Africa can supply.

African Hydrogen Partnership

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AFRICA GOING GREEN

CONVERSION OF TWO ORE HAULERS TO HYDROGEN POWER

- Electric vehicles powered by hydrogen fuel cells offer many benefits to the transport sector

- These include: Refuelling times comparable to internal combustion engine vehicles, long ranges, plus space and weight efficiency.

- Anglo American is leading initiatives to promote the adoption of fuel cell electric vehicles (FCEVs) for commercial use, facilitating the creation of consortia to promote the development of hydrogen freight corridors in a various parts of the world, including the UK, South Africa and China.

ANGLO AMERICAN

ENGIE

nel

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African Hydrogen Partnership

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Anglo American Green Hydrogen Project

CONVERSION OF TWO ORE HAULERS TO HYDROGEN POWER

- POWER SUPPLY : SOLAR WITH GRID BACK UP
- HYDROGEN GENERATION BY 2 X NEL HYDROGEN ALKALINE ELECTROLYSERS
- CAPACITY - 2 X 350Nm³/hr. – (700Nm³/hr.)

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African Hydrogen Partnership

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AFRICA GOING GREEN

CONVERSION OF TWO ORE HAULERS TO HYDROGEN POWER

SCOPE OF PROJECT

Extract from an interview by Engineering News with Nel Hydrogen Electrolyser Senior Vice President Business Development David Bow

"The long-term target is to convert the entire fleet of haul trucks at Mogalakwena to hydrogen and to also introduce de-carbonised hydrogen mobility at other Anglo American mines".

"It's important to understand that just one of these trucks, when diesel powered, consumes over 900 000 litres of diesel fuel a year, which equates to enormous amounts of carbon emission".

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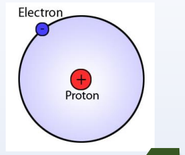
African Hydrogen Partnership



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AFRICA GOING GREEN

CONVERSION OF TWO ORE HAULERS TO HYDROGEN POWER

SCOPE OF PROJECT

Extract from an interview by Engineering News with Nel Hydrogen Electrolyser Senior Vice President Business Development David Bow.

"If you look at the total installed base of 28 000 mining trucks around the world, the emission from those trucks is equivalent to the entire emissions from a country such as New Zealand or Finland.

If you de-carbonise those 28 000 trucks that are in the hands of open pit mining companies around the world, you are roughly removing an impact of 150-million cars off the roads," said Bow.

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AFRICA GOING GREEN

CONVERSION OF TWO ORE HAULERS TO HYDROGEN POWER

- **The feasibility study identifies three hubs – Johannesburg, extending to Rustenburg and Pretoria; Durban, encompassing the city itself and Richards Bay; and Limpopo province centred around Anglo American's Mogalakwena PGMs mine.**

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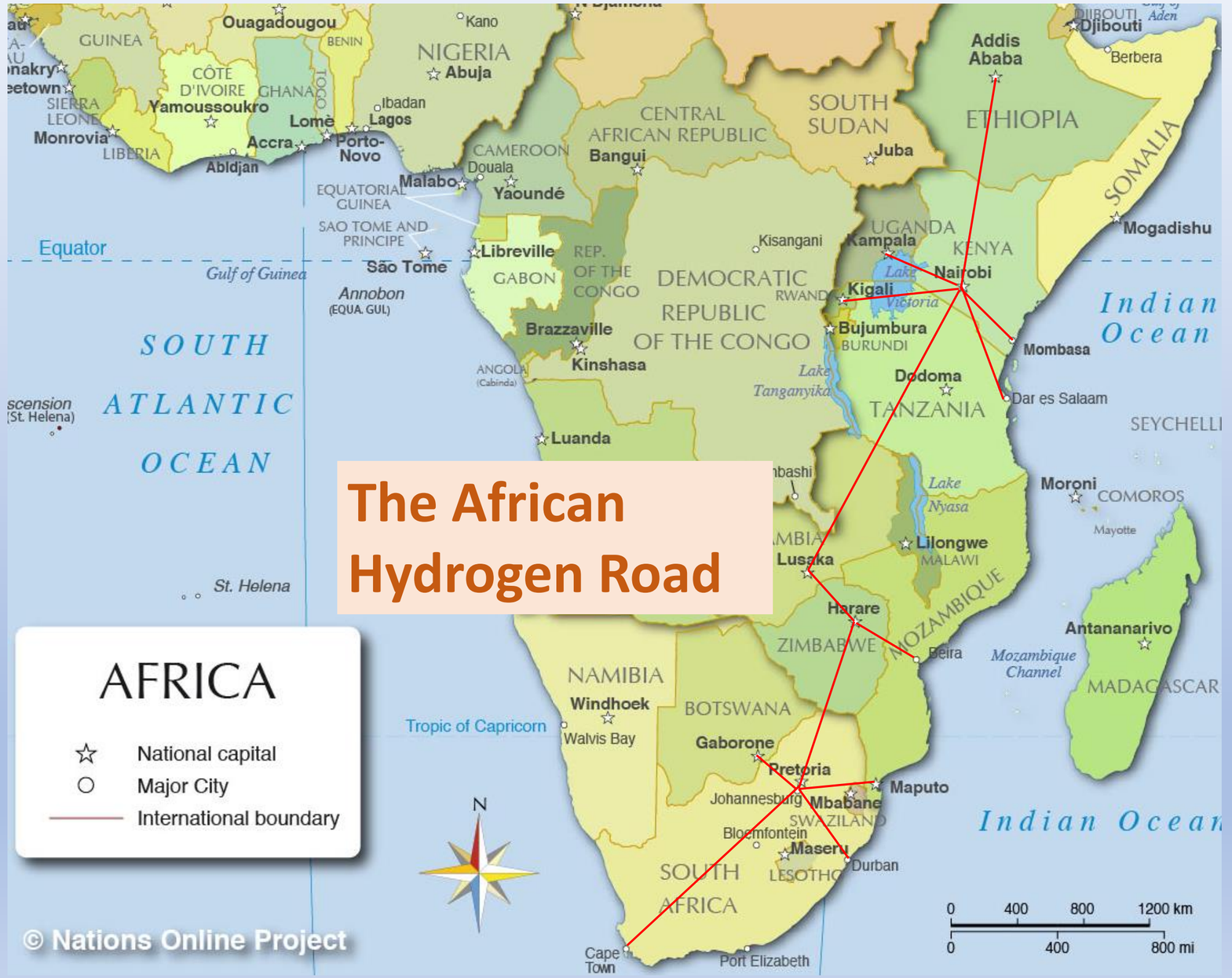
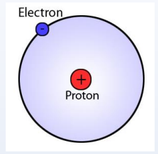
The AHP forsees the establishment of a ‘Hydrogen Road’ from Southern to East Africa.



African Hydrogen Partnership



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BUT WHAT ABOUT?

The Elephant in the Room?!!!

Hydrogen is Dangerous!!!!

Hiroshima & Nagasaki!

Hindenburg Airship

African Hydrogen Partnership

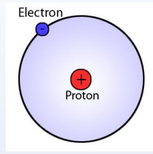

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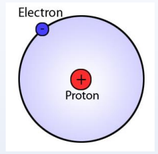
Image of Tests Carried out by Norsk Hydro Electrolysers (NEL Hydrogen)

Photo from a video comparing an intentional hydrogen tank release and a small gasoline fuel line leak. After 60 seconds, the hydrogen flame has begun to subside, while the gasoline fire is intensifying. After 100 seconds, all of the hydrogen was gone and car's interior was undamaged (the maximum temperature inside the back window was 67°F). The gasoline car continued to burn for several minutes and was completely destroyed.

African Hydrogen Partnership



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If we proposed adopting the present system of storing fossil fuels in vehicles:-

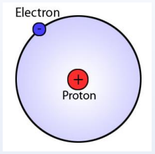
In a light metal – or plastic? Tank?

With an explosive mixture of petrol/Diesel fumes and air?

Under the back seat or boot of your car?

Would you approve this arrangement?

African Hydrogen Partnership



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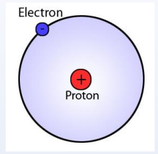
Hydrogen offers far less risk than liquid fuels.

- It is stored in the vehicle in a high pressure vessel.
- It is difficult to rupture this vessel.
- If it does leak – hydrogen has such low density that it disperses rapidly into the atmosphere.
- **The One Cardinal Rule:-**
- All hydrogen installations must provide ventilation so that any free hydrogen can disperse easily and harmlessly into the atmosphere.

African Hydrogen Partnership



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AFRICA GOING GREEN

THANK YOU FOR YOUR ATTENTION

‘An African Future with Green Hydrogen Energy’

QUESTIONS?

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ahp African Hydrogen Partnership
enea CONSULTING

Fernando Szabados

Business Developer

Paris

EODev

- 10 years experience as Electrical Engineer
- Worked with Peak Scientific – specialized in hydrogen, nitrogen, and zero air generators
- Strong international experience (Latin America, Europe, Africa) and polyglot French, Spanish, Portuguese, English
- MBA from La Sorbonne Business School

AFSIA

Africa Solar Industry Association

Time to shift

www.eo.dev

Accelerate the energy transition

The Energy Observer Group

From an odyssey around the world to the development and industrialization of cutting edge hydrogen technologies

Energy Observer

The first hydrogen-powered, zero-emission vessel to be self-sufficient in energy, advocating and serving as a laboratory for ecological transition

Energy Observer Foundation

Bringing skills together, raising awarness of hydrogen's potential and promoting the UN 17 Sustainable Development Goals

Energy Observer Productions

Producing multimedia audiovisual content to inform and inspire all audiences

30 people

Energy Observer Developments (EODev)

Designing, industrializing and commercializing sustainable, reliable and affordable hydrogen-based energy solutions

60 people

EODev

About EODev

Created in 2019

60 passionate people

25 M€ raised

4 patents

Production capacity of 600 units

3 sites in France

Our shareholders

ACCOR

Energy Observer

Groupe Monnoyeur

thélem assurances

TOYOTA

AMFIL

Our industrial partners

TOYOTA	Industrial fuel cell supplier
EVE SYSTEM	Development of custom EPMS & batteries
Eneria	Assembly and maintenance of EODev products

EODev

GEH2®: the hydrogen power generator

In case of grid failure or simply when you go off-grid, the GEH2 electro-hydrogen generator brings you the power you need quietly, without CO2 emissions or fine particles.

Reliable

Running exclusively on hydrogen, the GEH2 is equipped with the latest generation of fuel cell from our partner Toyota, giving it an exceptional reliability and a record life span.

Efficient

The combined use of a fuel cell and a battery allow for an optimized efficiency and an unmatched responsiveness. The overall electrical efficiency of the GEH2 exceeds 45% regardless of the load when a diesel genset barely reaches 30% at its best.

Easy to use

Easily handled by crane or forklift, the GEH2 offers a user friendly touch interface and a remote control option. Connect it to a hydrogen bundle, turn it on, power your application. It is that simple.

Scalable

GEH2 units can be parallelized to meet your power requirement. It can also be connected to diesel or gas generators for peak shaving purposes and even to the grid.

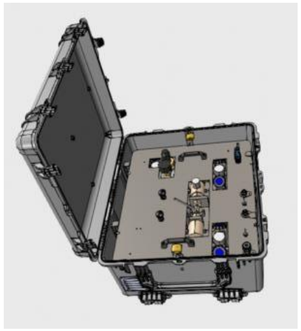
EODev

How it works

External hydrogen storage

H_2

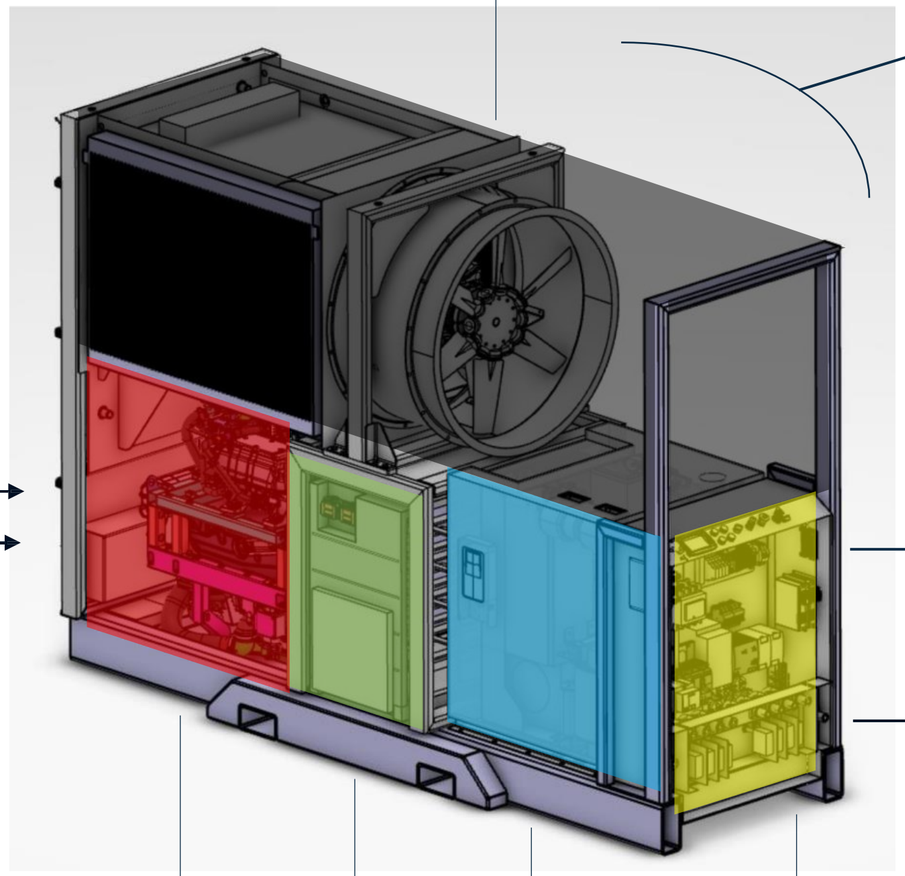
Double hydrogen adduction pressure management box



O_2

Oxygen from the air

Cooling system



Fuel cell

Battery

DC/AC power conversion

Human machine interface & power oulets

Cloud data acquisition and monitoring

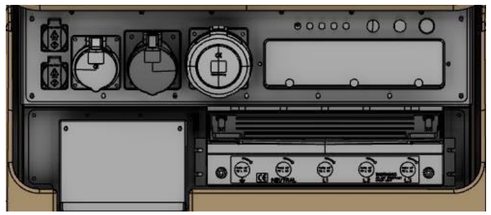
125A

63A

32A

16A

Fuse box



Powerlocks box

H_2O & heat

The transformation of hydrogen and oxygen into electricity creates water and heat

EODev

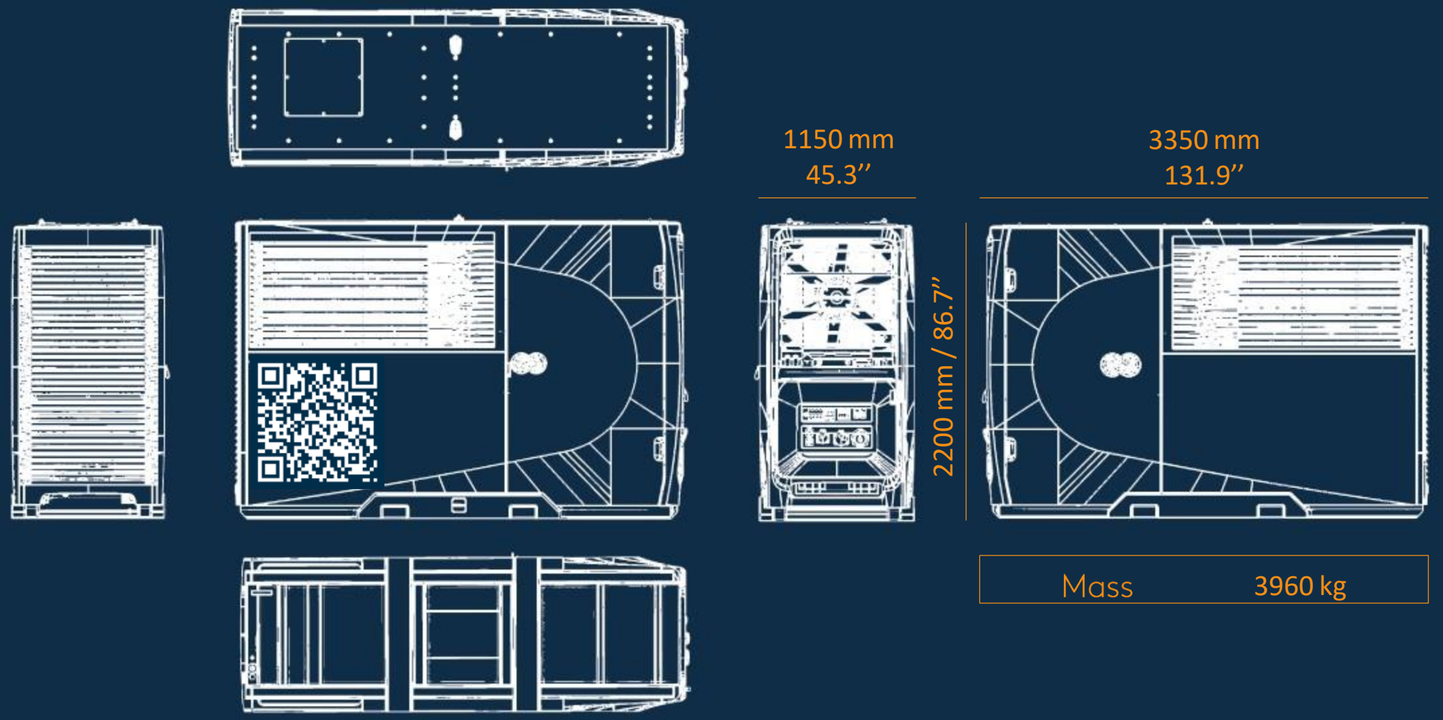
Project in Nigeria

- Replacement of Diesel gensets
- Zero-emission solution
- Requirement of around 1MW/day
- Industry sector
- Usage of 20h/day
- Prime Power
- H2 Daily requirement of around 2,5 tons

The GEH2 by the numbers

Performances	
Power output – ESP ISO rating	110 kVA
Power output – PRP ISO rating	100 kVA
Voltage output	230V / 400V 480V (Q4 2022)
Frequency output	50 – 60 Hz
Operating temperature	-15°C to 40°C
Protection index	IP 43

Main components	
Fuel cell brand	Toyota
Fuel cell type	PEM
Battery brand	EVE System
Battery type	LiFePO4
Battery capacity	44 kWh



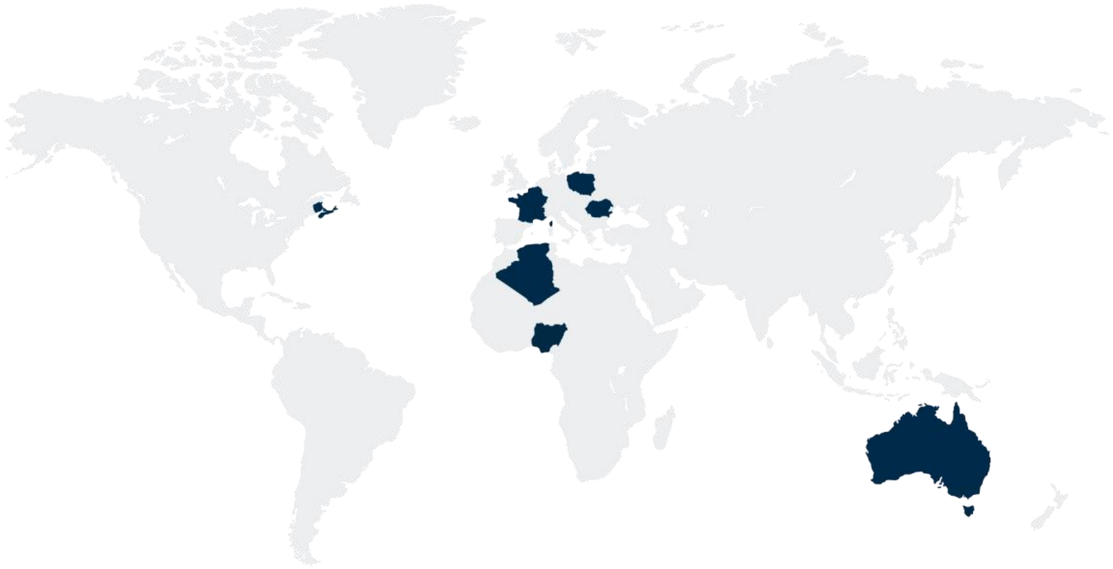
Environmental performances	
GHG emissions (CO_2)	0
Polluants emissions (NOx, PM)	0
Noise level at 1m 50Hz	XXX db TBC
Noise level at 7m 50Hz	XXX db TBC
Volume of filtered air	XXX cbm TBC

Rank 1 suppliers origin

EODev

A network of dealers worldwide

GEH2®



France, Belgium, Luxembourg, Poland, Romania, Moldavia, Algeria
Eneria - www.eneria.fr

Australia
Blue Diamond - www.bluedm.com.au

Atlantic Canada (New Brunswick, Nova Scotia, Prince Edward Island)
Aspin Kemp & Associates - www.aka-group.com

Nigeria
Buserve LTD - www.buserveltd.com

EODev

REXH2®

France, Belgium, Luxembourg, Poland, Romania, Moldavia, Algeria
Eneria - www.eneria.fr

United States, Canada
Aspin Kemp & Associates - www.aka-group.com

Hydrogen specifications & packaging

Packaging type	Rack 200/300 bars	Rack 500 bars	Tube trailer 200/300 bars	Container 500 BARS
Hydrogen capacity	13/19kg	32kg	250/350kg	Up to 1'000kg
GEH2 running time at 80% load	4h30/6h30	10h30	80/110h	Over 300h

Hydrogen quality required

Characteristics		ISO14687 Grade D
Hydrogen fuel index		> 99.97%
Impurities	Total hydrocarbons (C_1 basis)	< 2 ppm
	Water (H_2O)	< 5 ppm
	Oxygen (O_2)	< 5 ppm
	He	< 300 ppm
	N_2, Ar	< 100 ppm
	Carbon dioxide (CO_2)	< 2 ppm
	Carbon monoxide (CO)	< 0.2 ppm
	Total sulfur coumpounds	< 0.004 ppm
	Formaldehyde	< 0.01 ppm
	Formic acid	< 0.2 ppm
	Ammonia	< 0.1 ppm
	Total halogenated compounds	< 0.05 ppm

EODev

Powering the fan zone of a major public event

From lighting to giant screens and foodtrucks, sports and cultural events are particularly energy-intensive with many temporary needs scattered over large areas where the grid is not sized accordingly.

The Automobile Club de l'Ouest (ACO), a pioneer in hydrogen car racing and organizer of the 24h of Le Mans, entrusted EODev to replace a 50 kVA Pramac diesel genset with a GEH2 to power the main fan zone of the event.

161 kg of CO2 where saved and the visitors benefited from a better air quality and a quiet power generation.

Stéphane Darracq, ACO Managing Director

« We are looking for innovation partners: it is therefore natural that we turned to EODev to invest in hydrogen technology for off grid power. »

EODev

Zero emission roadworks in the center of Paris

The construction sector has always been a major energy consumer, but the trend is accelerating with the increasing electrification of construction sites and the development of electric building machinery.

The European leader in rental equipment, LOXAM, has deployed a zero-emission worksite in the heart of Paris for its client Vinci. From the living area to the recharge of an electric excavator, everything was powered by an EODev GEH2.

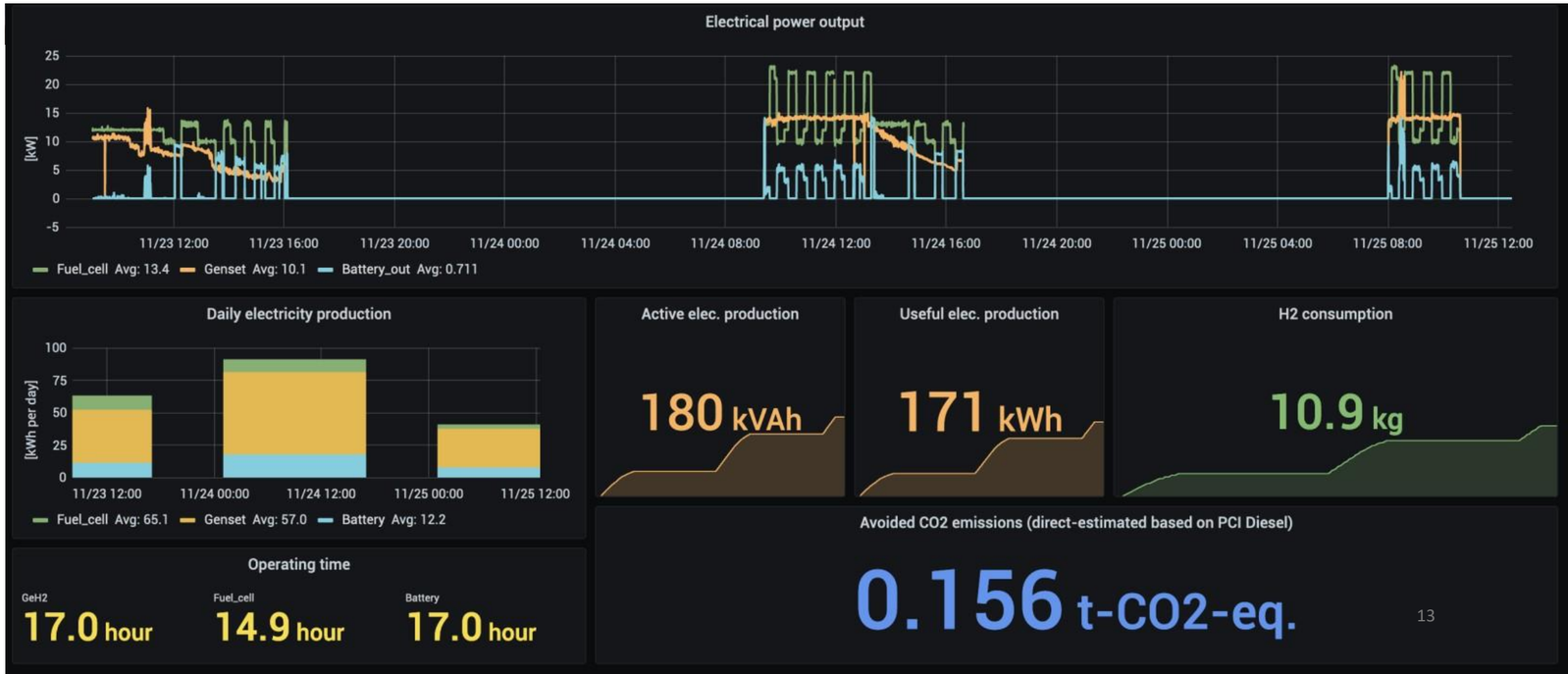
156 kg of CO2 where saved over 3 days and the neighborhood experienced the silence of the generator.

Cédric Conrad, Loxam CSR Manager

« The solution we are proposing today can be very well adapted to all types of uses where the reduction of environmental pollution is absolutely key.»

LOXAM

EODev



Hydrogen bivouacking in the desert

Between the sand and the heat, the desert is probably one of the most hostile off-grid areas.

A GEH2 from EODev was recently used in replacement of a 50 kVA Caterpillar to power the bivouac of a sports event in the middle of the desert, proving its high reliability and ability to operate in the harshest conditions.

1.23 MWh where produced and 1.24 tons of CO2 saved over 2 weeks, thus allowing to respect this preserved environment.

EODev

Loxam Power
Rental company

Enedis
Electrical network

Toyota Motor Europe
EV charging

Time to shift

www.eo.dev

AFSIA
Africa Solar Industry Association

Day 2 – Thu 24

All times are in
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2:00 – 2:30	Partner Showcase Global business cases for green H_2 Matt Cleary – Enea Consulting
2:30 – 3:30	Panel Latest green H_2 technologies and applications Dr. Innocent Uwuijaren - AHP Dr. Chen Zhu – LONGi Hydrogen Jan-Georg Wagenfeld – Masdar Matthias Schlegel - Fichtner
3:30 – 4:00	Country Deep-Dive Perspectives for green H_2 in Algeria Dr. Mouloud Bakli – Clean Power Engineering
4:00 – 4:20	Partner Showcase European Union supports African green H_2 Alexander Huppertz – GET.invest

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ahp African Hydrogen Partnership
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Matthew Cleary

Manager

France

- 8 years experience, specialized in energy consulting
- Previously worked with Oliver Wyman in the Global Energy Practice
- Specializes in hydrogen, energy finance, hard-to-abate sectors (aviation, shipping, steel), impact measurement
- Master's Degree in Advanced Global Studies – International Energy from Science Po

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Africa Solar Industry Association

Hydrogen market discussion: perspectives & learnings from Europe

24 March 2022

enea CONSULTING

Enea is an international strategy / financial advisory boutique advancing energy and climate solutions

Diversification & decarbonisation strategy

Strategic due-diligence & financial advisory

Modelling & data science for asset management and impact

80+ EXPERTS — In-house specialists with complementary backgrounds

15 YEARS — Dedicated to energy transition, climate and impact

6 OFFICES — Paris, London, Singapore, Hong Kong, Melbourne, Sydney

360 DEGREES — Supporting large and small organisations across the value chains

Energy production and resources
- Renewable & distributed power
- Bioenergies, waste & resources
- Biogas & hydrogen

Infrastructure
- Storage, microgrids & smart networks
- Power, gas, heating, cooling networks
- Energy access & off-grid systems

Energy usage and GHG emissions
- CCUS & Nature Based Solutions
- Energy efficiency & industrial ecology
- Low carbon transport

Sustainable finance and impact
- Impact & ESG frameworks and metrics
- Green & sustainable investment thesis
- Sustainable finance instruments & products

Enea has been engaged in energy access pro-bono work since its beginnings. Today, that commitment has taken shape as the “Energy Access Booster”, a program offering support to entrepreneurs in the field of energy access in Africa and Asia – https://energyaccessbooster.com

We act as a catalyst of energy transition and decarbonisation

Diversify and decarbonise **Energy companies**

Decarbonise **commercial and industrial activities**

Foster the deployment of capital to **sustainable assets**

Develop climate and energy policies for **governments**

Accelerate the growth of **emerging leaders**

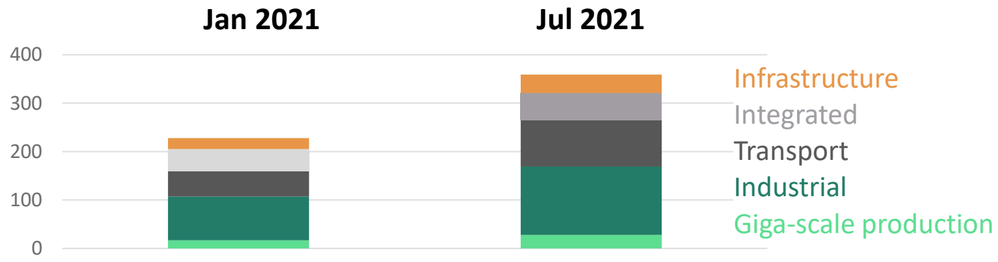
+100 start-ups

*Enea has been working on **HYDROGEN** since 2007, helping actors across the value chain address key strategic and operational issues*

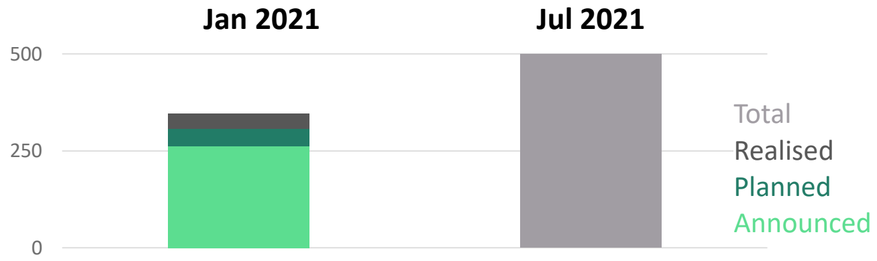
We are currently seeing unprecedented “hype” around hydrogen – but major questions remain

>130 new large-scale H2 projects and >$150bn investment to 2030 announced in 2021

Number of large-scale projects announced as of:



Total investment announced ($bn) as of:



However, the sector faces major challenges which must be resolved in the coming years, including:

Ultra-low share of clean hydrogen and future role of “low-carbon” hydrogen (from nuclear / CCUS)

Share of H2 from low-carbon sources in 2020 (%)

Share price volatility as proxy for investor uncertainty around how future market will develop

Share price growth (%) across	PLUG POWER	McPhy	ITM POWER	ceres
2020…	*+962%*	*+854%*	*+578%*	*+408%*
…and 2021	*-18%*	*-42%*	*-24%*	*-30%*

Massively scaling up availability of cheap renewable power to support H2 production growth

Power demand for H2 production in 2050 (TWh)[1]

1: In IEA “Net Zero Emissions” scenario
Sources: Hydrogen Council, IEA, Reuters, Enea analysis

We identify three lessons for the development of H2 in Africa based on our recent experiences in the market

1 **Focus on the right sources of demand**

Need to be realistic about the use cases where hydrogen is genuinely the best option – rather than viewing it as a miracle solution for every scenario

2 **Build up cost-competitive supply**

Focus should be on “delivered” rather than just “produced” cost of hydrogen; need to consider carefully the role that low-carbon hydrogen can play in helping to scale markets

3 **Put in place appropriate policy**

Governments and public bodies are setting out their ambitions on hydrogen – but need to go further in helping to establish the rules / standards which will enable markets to develop

Hydrogen **demand**: H2 production is energy-intensive; usage should focus on applications where H2 has a clear advantage vs alternatives

Illustrative classification of clean H2 use cases

Short term
(Ready ~now)

Decarbonise existing uses

H2 already used today with no obvious alternative

Medium term
(Next ~5-10 years)

Other industrial contexts

Some mobility or power uses

H2 not used today but alternatives (eg. power, biofuels) not appropriate / scalable and H2 tech is ~within reach

Long term
(~10+ years)

Large-scale “Power-to-X”

H2 not used today, alternatives not appropriate / scalable, but major scaling of H2 tech needed

Deprioritise
(Major issues)

Light mobility

Residential heating (pure H2)

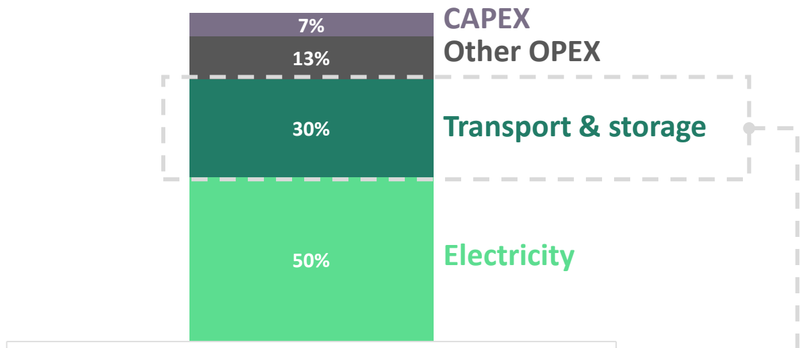
Short-term power balancing

…

Alternatives (eg. power) offer greater efficiency – save H2 for more challenging use cases

Hydrogen **supply**: H2 transport / storage form a key part of the cost stack; CCUS-based H2 may play a crucial role in some contexts

Production is not the only cost item which counts – although it is important (illustrative cost stack)

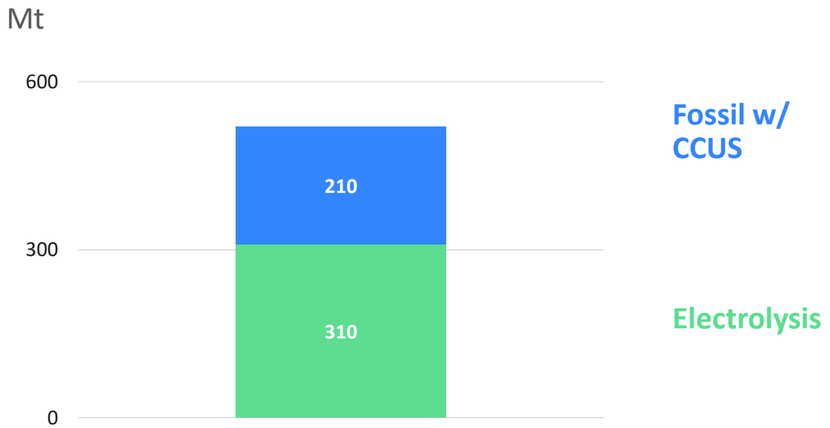


Electrolyser @ 8,000 h/yr

Transport & storage cost drivers:

- **Centralised vs decentralised** H2 production / distance from end use
- **Transportation** mode (trucks, pipelines, maritime) and carrier (gaseous or liquid H2, ammonia, liquid organic H2 carriers, …)
- **Storage** technology (gaseous vs liquid storage, compression level, …)

And a word on low-carbon "blue" H2…



H2 supply in IEA NZE scenario, 2050

Potential roles for CCUS-based H2?

- **Short term:** decarbonise existing fossil H2 production; scale up production to support early market development
- **Long term:** continued role in regions with abundant natural gas supply / carbon storage potential (eg. Middle East); limit renewable power demand from electrolysis (up to 20% of total power consumption by 2050)

Source: IEA, Enea analysis

Hydrogen **policy**: Governments are acting to define their H2 strategies – but should do more to help establish effective markets

Many countries have set out ambitious hydrogen strategies and investment schemes (selected examples)

40 GW capacity by 2030, **€1.3 billion** funding (FCHJU)

10 GW green hydrogen capacity by 2030, **multi-billion investment** programme to support tech development

€7 billion budget towards 2030

Clean hydrogen could deliver ~**30%** of end-use energy by 2050 according to hydrogen strategy report

$40bn hydrogen strategy announced by June 2022; production capacity of **1.4GW by 2030**

Targets local market of **4 TWh** and an export market of **10 TWh by 2030**

But a lack of detailed policy measures is limiting further development (IRENA / WEF example enabling measures)

Supply & demand	• Hydrogen clusters • Public procurement • Additionality rules	• H2 trading market • Industry fuel shift & green product quotas
Markets & finance	• Power prices • Electrolyser cost • Fiscal incentives	• Carbon CfDs • Grey H2 ETS credits • Infra capacity payments
Standards	• Overarching reg. framework • TSO governance • Interoperability	• Tech. / safety standards across value chain • Carbon intensity
Technology	• Production targets (electrolysers / key components)	• R&D coordination • Workforce strategy • Supply chain bottlenecks

Source: National strategies, IRENA / WEF

We help our clients to address the key strategic and operational questions they face on hydrogen

Hydrogen project developer

Strategy definition across key European markets

Review of potential green H2 demand use cases across several European markets; assessment / prioritization of options and roadmap development

Identification and assessment of potential sources of demand

Detailing of prioritized options and go-to-market approach

Infrastructure investment fund

Future of aviation (H2 / SAF) and market scan

Aviation decarbonisation pathways (technologies, costs, regulation, market forecasts); scan and review of investment opportunities (140 names)

Identification of potential future applications for key alternative fuels

Market scan of >140 actors across aviation ecosystem and filtering / shortlisting

Logistics solutions provider

Development support for green H2 production project

Site identification and assessment; pre-feasibility study (opportunity sizing, mapping / engagement of potential clients) and investment committee paper

Mapping of potential demand sources close to production site

Modelling of renewable power generation and H2 production

Paris
Melbourne
Hong Kong
Singapore
Sydney

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Dr. Innocent Uwuijaren

Chairman

African Hydrogen Partnership

- 20+ years experience in energy
- Previous worked with Global Energy, Eni, Total and Technip
- Technology expert, with special focus on disruptive engineering innovations to help the energy industry reduce inefficiencies
- Ph.D. in Subsea Engineering from University of Aberdeen

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Dr. Chen Zhu

CTO & Head of R&D

China

LONGi

- Career dedicated to R&D
- Prior to LONGi Hydrogen, R&D Director for LONGi Module Design Center, Rene Sol Product Center and Assistant R&D Director at Hanwa Q-Cells Cell Research Center
- Senior Engineer of Electronic Information Engineering, Industry Professor in Southeast University
- Ph.D. in Condensed Matter Physics from the Nanjing University

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Jan-Georg Wagenfeld

Energy Consultant & Hydrogen Expert

United Arab Emirates

Masdar

- 8 years experience in energy R&D
- Member of Masdar Clean Energy Technology Team on Energy Storage, Hydrogen Transition and Sustainable Fuels
- Previously worked as CSP expert with the German CSP company Frenell, specializing in thermal energy storage
- MSc. in Mechanical Engineering from the Karlsruhe Institute of Technology

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Matthias Schlegel
Head of Hydrogen Division
Germany

FICHTNER

- 15 years experience in energy technology, management and finances with Fichtner
- Managed major hydrogen projects for the German Aerospace Center and planning Power-to-X plants for private and public stakeholders
- Author of “Hydrogen - A Handbook for Investors and Project Developers”
- Degree in Engineering and Technology Management from the University of Stuttgart

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Latest green H_2 technologies and applications

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Alexander Huppertz

Head of Mobilization

Bonn

- 10 years experience in investment mobilization for renewable energy projects
- Project Manager and Energy Advisor for GIZ
- Since 2021 he is also coordinating the Hydrogen Window under GET.invest
- Masters of Arts in International Relations and Development Politics from University Duisburg-Essen

GET.invest
Mobilising Renewable Energy Investments

AFSIA
Africa Solar Industry Association

ALEXANDER HUPPERTZ
Head of Mobilisation

GET.invest
Mobilising Renewable Energy Investments

GET.invest

Introduction & how we can support hydrogen projects in accessing finance

GET.invest is supported by

german cooperation
DEUTSCHE ZUSAMMENARBEIT

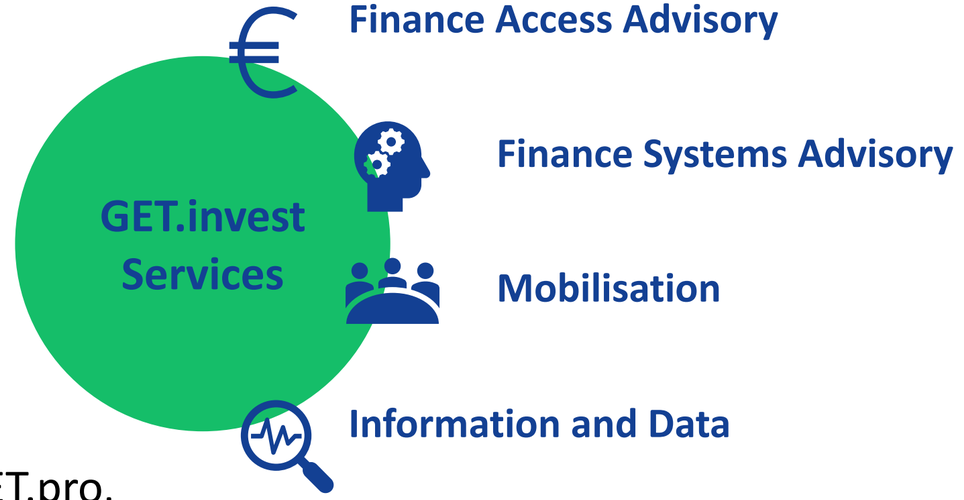
Sweden
Sverige

Ministry of Foreign Affairs of the Netherlands

AUSTRIAN DEVELOPMENT COOPERATION

GET.invest in a Nutshell

- **European** programme **mobilising investment** in renewable energy**, building a pipeline** of investment-ready projects
- **Supports all relevant delivery models**, incl. on- and off-grid electricity, clean cooking, productive use
- **Broad partner network** incl. many financiers as well as industry associations and others
- **Active in Sub-Sahara Africa**, the **Caribbean** & the **Pacific**
- Implemented by **GIZ**, hosted on the multi-donor platform GET.pro, and supported by the **European Union, Germany, Sweden, the Netherlands, and Austria**.



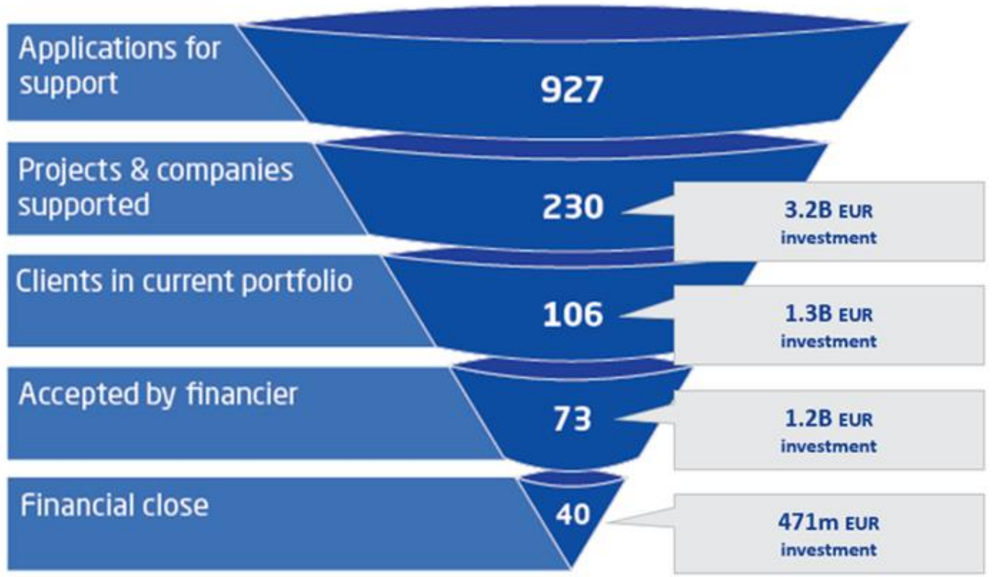
Highlight: Finance Access Advisory I – *Finance Catalyst*

GET.invest
Mobilising Renewable Energy Investments

A **leading, open, scalable, and flexible** TA facility providing **on-demand** advisory to **get projects and businesses ready for finance** and **link them with financiers → more pipeline, faster progress**

- Simple application process, “level playing field” access
- 25+ expert advisors that coach and support towards investment-readiness
- Support covers improving business case, financial structuring, finding the right finance, negotiations
- Builds pipeline for financiers, accelerates investment

  → Open to support also hydrogen projects!



“Funnel” from *intake* to *outtake*.
GET.invest and predecessor program (2016-12/2021)

Highlight: Finance Access Advisory II – *Finance Readiness Support*

GET.invest
Mobilising Renewable Energy Investments

A **new modality for providing TA** to specifically **locally owned and managed companies → inclusion, last mile impacts, domestic value chain and new investees**

- Financier X: “local companies can’t raise a dime”
- Locally owned and managed companies usually less investible, but closer to the ground and “last mile”
- Consultations and experience: need deeper and longer support, more business development
- GET.invest has piloted new TA modality with leading advisory firms in one framework
- Goal: feed into specialized (early stage) financiers, build “winners” for future larger transactions
- Initial cohort: 15 advisees, work has started!

Service Providers

CATALYST OFF GRID ADVISORS
KPMG
GFA CONSULTING GROUP
GreenMax Capital Advisors
INENSUS
ENERGY4IMPACT POWERED BY MERCY CORPS
Open Capital
PERSISTENT

How we can support hydrogen projects

Context

- Hydrogen market early stage, going into piloting, but expected to grow
- Financing and access-to-finance challenges similar to other markets
- GET.invest requested by donors, and also keen, to expand added value to hydrogen projects

Our offer

- Proven set and scope of support
- Finance Catalyst open for applications from hydrogen-related investment projects
- Leveraging expertise of partners, incl. GIZ PtX hub, Solar Power Europe
- Two hydrogen projects already being advised

Applications for TA/advisory support can be submitted at:

www.get-invest.eu/finance-catalyst/access

Thank You for Your Attention!

ALEXANDER HUPPERTZ
Head of Mobilisation

E-mail: Alexander.huppertz@get-invest.eu

www.get-invest.eu @GET_invest @GET.invest

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