

31. Windenergietage

Hyphen – Namibia's first Gigawatt-scale green ammonia project

Potsdam

9. November 2023



H₂

ENERTRAG makes the energy transition happen



Green Electrons



30 years experience as 100% RE
Independent Power Producer

> **1 000 employees** in 9 countries

2 GW wind & solar implemented

2 TWh/a electricity production
from **1 GW** of own assets

> **15 GW** wind and solar PV **under
development** globally

Green Power Plants



1 GW green „Verbundkraftwerk“
in operation (Wind, solar PV,
battery, heat storage, electrolysis)

> **1 000 km** own collector grid and
collector substations (to **380 kV**)

System services (e.g. primary
control reserve; black start
capability in planning)

> **6 GW** in remote control

Green Molecules



Wind-hydrogen plant in MW-scale
in operation since 2011

250 t/a Wind/PV-hydrogen for
6 fuel-cell trains from/to **Berlin**

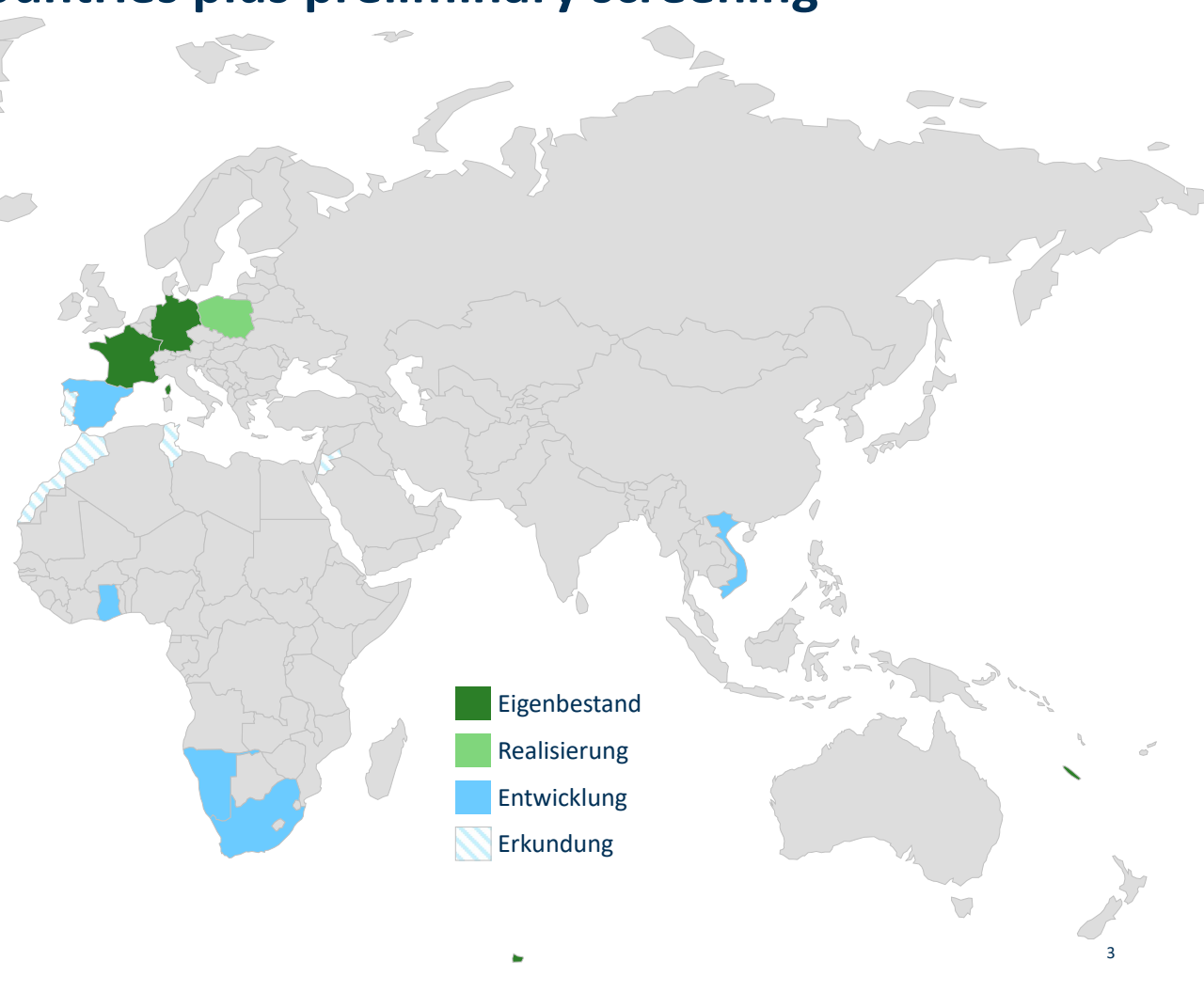
240 MW electrolysis in H2-IPCEIs

eKerosin from green H2 with
CEMEX in DE & Sasol/Linde in ZA

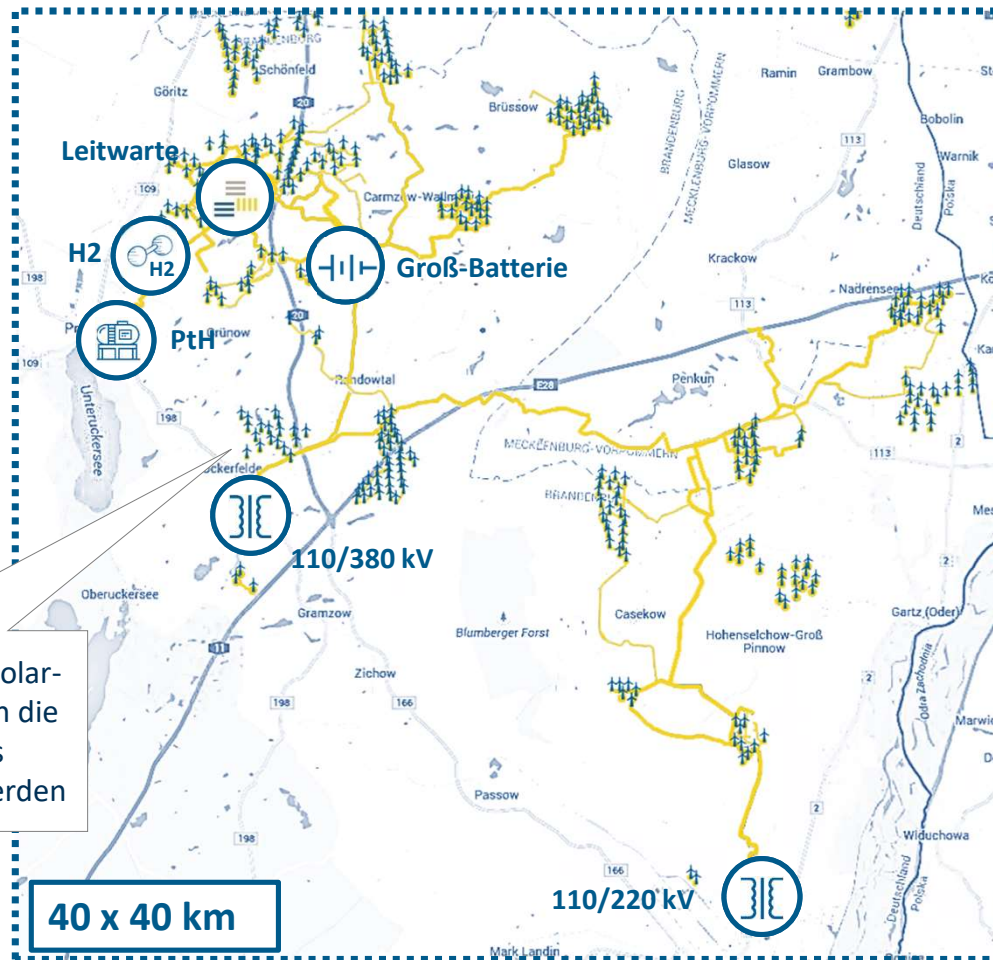
Green ammonia in NAM (2 Mt/a)

ENERTRAG Worldwide: 9 active countries plus preliminary screening

Country	Offices
Germany	9
France	3
Poland	1
Spain	1
Ghana	1
Namibia	1 (Hyphen)
South Africa	3
Uruguay	1
Vietnam	2



In Betrieb: ENERTRAGs Verbundkraftwerk Uckermark mit Arealnetz



Sowohl eigene Wind- und Solar- Erzeugungsanlagen als auch die von Dritten können ans Arealnetz angeschlossen werden

40 x 40 km

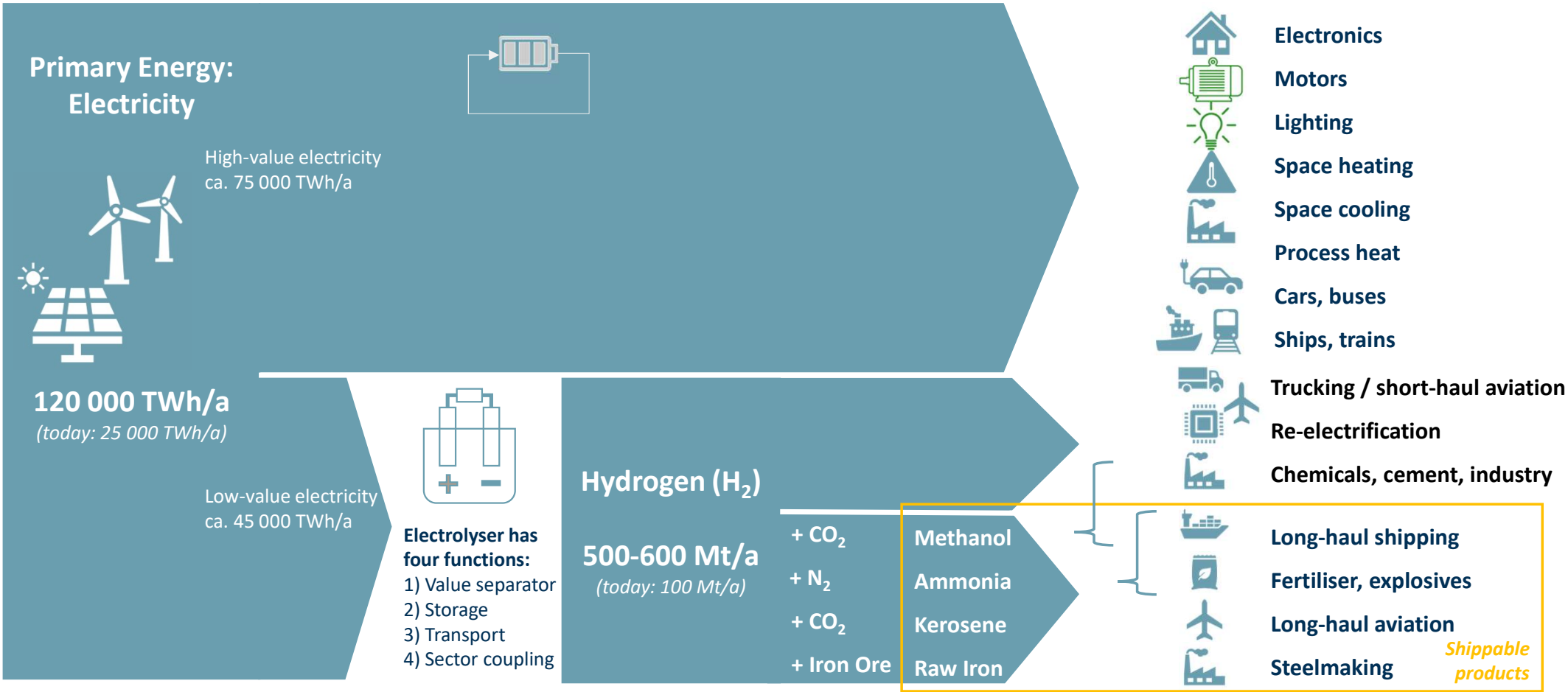
- 800 MW Wind, 100 MW Solar
- 21 MW Biogas
- 22 MW / 34 MWh Batterie
- 0,6 MW Wasserstoff-Elektrolyse
- > 600 km MV/HV-Erdkabel
- 1,000 m³ Windwärmespeicher







— ENERTRAG-eigenes 20-, 30- und 110-kV-Arealnetz (per Erdkabel)

Sun + Wind + Hydrogen = Global Energy System in 20xx

Potential global energy system in the end state



Easily shippable products alone require 300 Mt/a of green hydrogen

Green Ammonia	$H_2 + N_2 = NH_3$	Fertilizer		Global demand: 170 million t/a → H₂ demand: 30 million t/a
Green Methanol	$H_2 + CO_2 = \text{Methanol}$	Shipping Fuel		Global demand: 500 million t/a → H₂ demand: 90 million t/a
Sustainable Aviation Fuel	$H_2 + CO_2 = \text{Kerosene}$	Aviation Fuel		Global demand: 400 million t/a → H₂ demand: 80 million t/a <i>(assumption: 50% PtL and 50% bio-based)</i>
Green Steel	$H_2 + Fe_2O_3 = Fe + H_2O$	Green Steel		Global demand: 2 000 million tons/a → H₂ demand: 100 million t/a

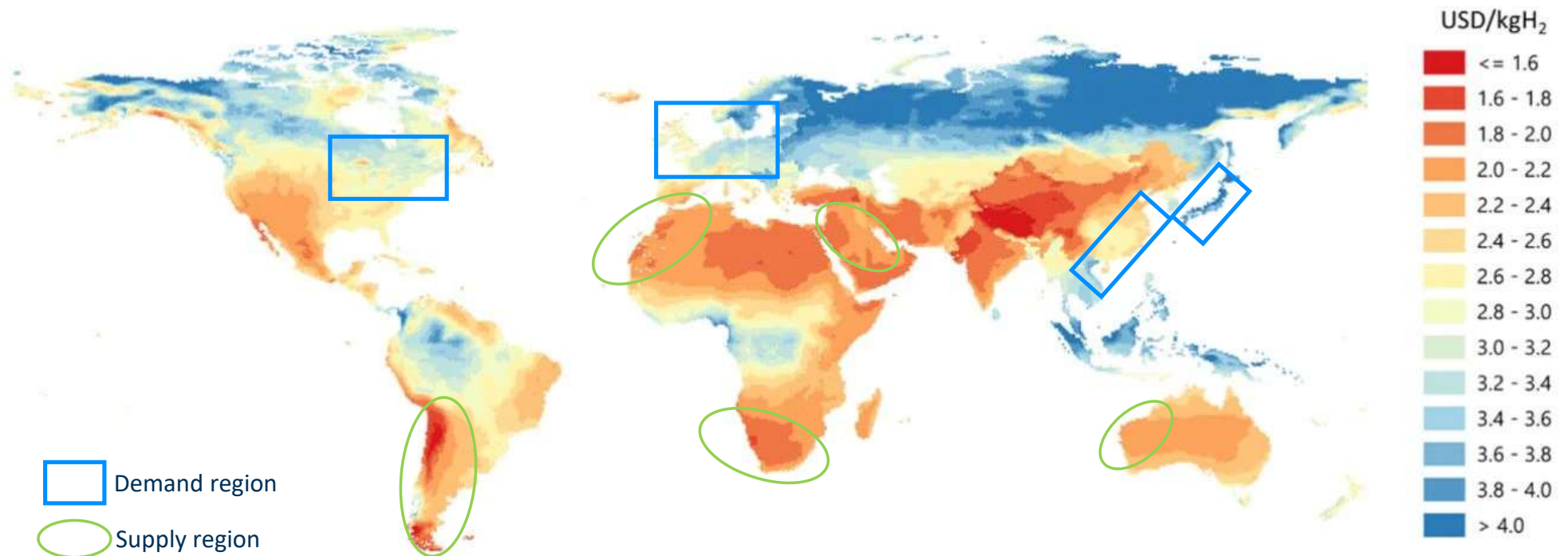
Focus of Hyphen project in Namibia

Focus of HyShiFT project in South Africa

Today's demand for grey hydrogen globally: 100 million t/a

Hubs to provide access to low-cost hydrogen-derivatives supply

Hydrogen costs from hybrid solar PV and onshore wind systems in the long term



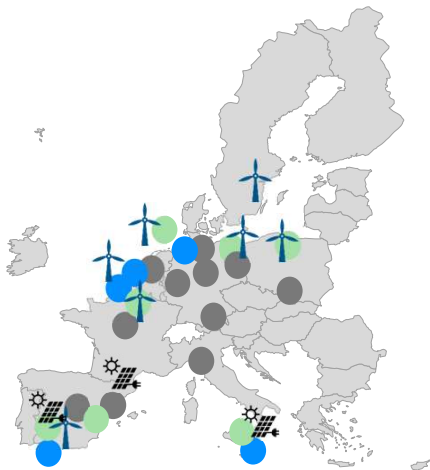
Source: IEA

Natural import and natural export hubs for green-hydrogen derivatives should work together to establish mutually beneficial energy-trade partnerships

Illustrative figure

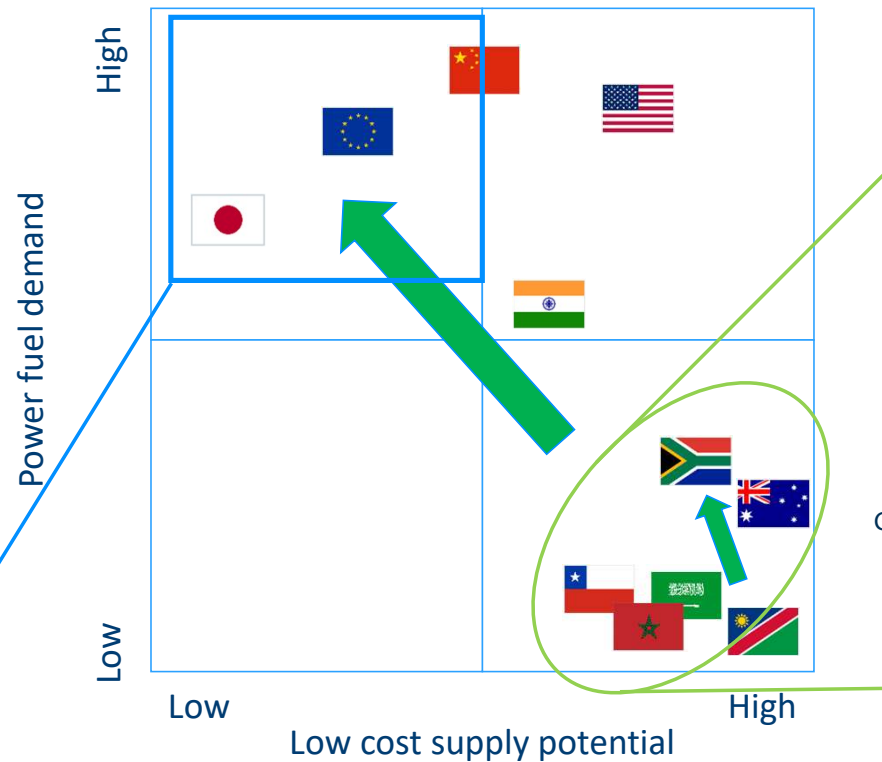


Import hubs

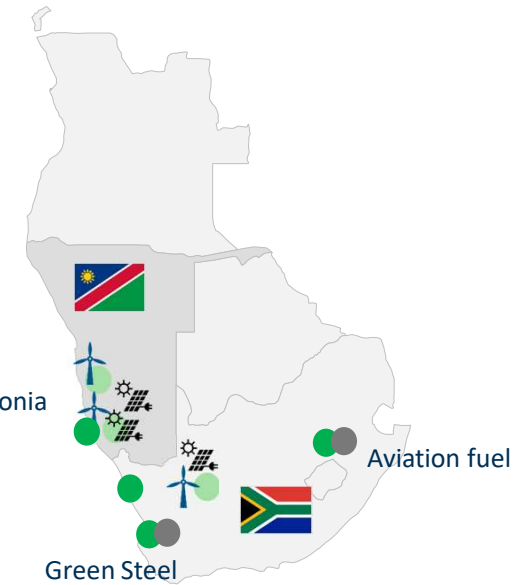


- Import hub
- Major off-taker
- Major production area

Source: ENERTRAG

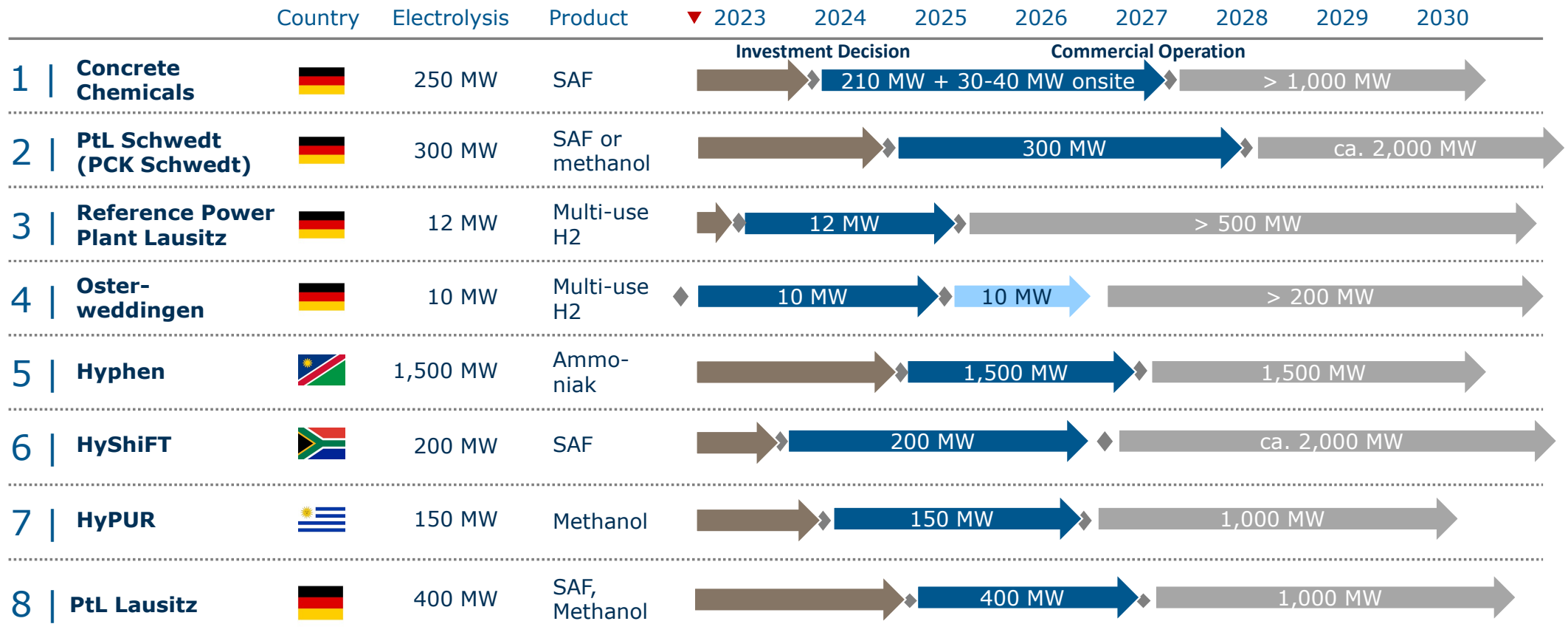


Export hubs



- Export hub
- Major off-taker
- Major production area

ENERTRAG-H2-Pipeline Großprojekte: GW-Skala in Deutschland & international



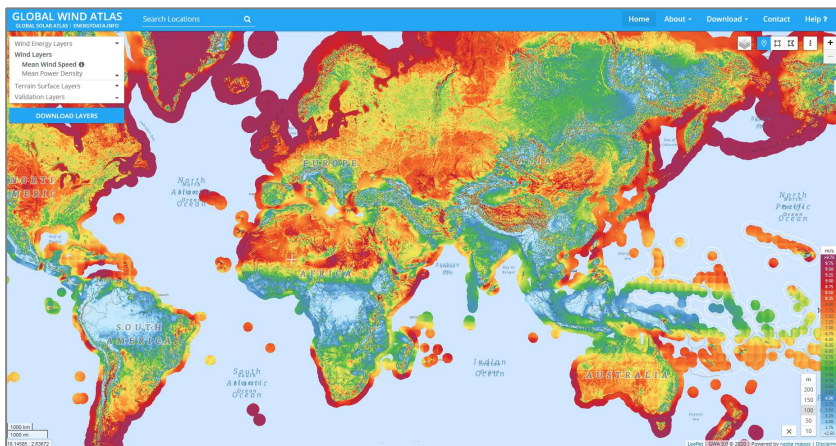
SAF = Sustainable Aviation Fuel, here: PtL Kerosene / e-Kerosene



Un-depletable African resources: wind, sun, land, coastline, biomass

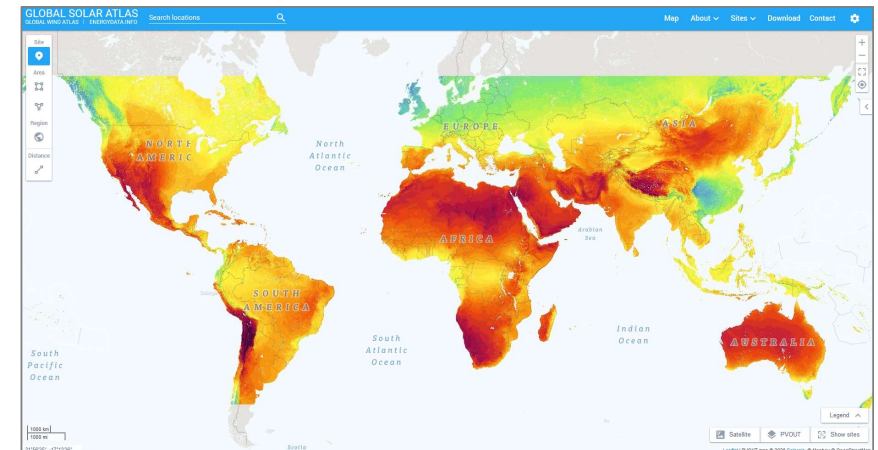
WIND

Extremely good wind resources in the North and South



SOLAR

Extremely good solar resources all over

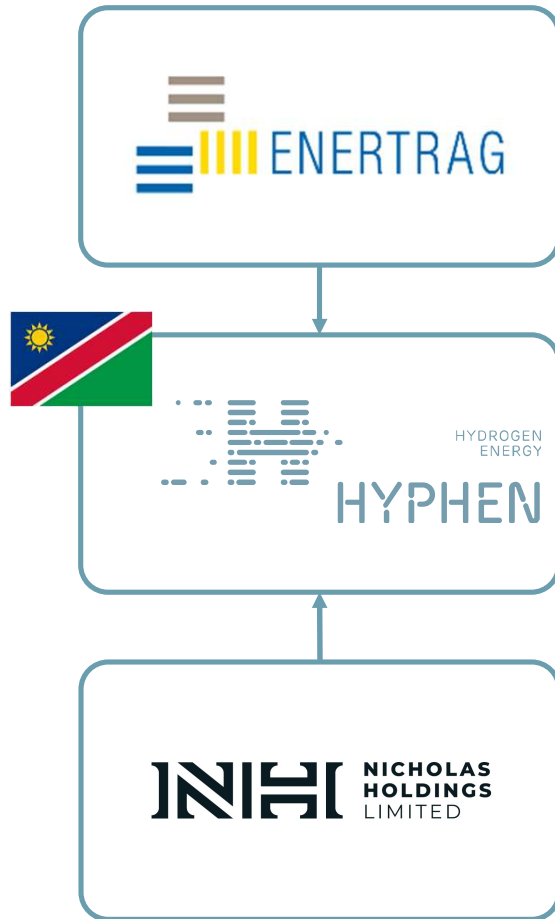


Wind, solar, available land resources, coastline and biomass are all competitive advantages for Africa over many other regions globally to produce very competitively priced green hydrogen and derivatives

With a focus on easily tradable, hydrogen-rich products (ammonia, aviation fuel), a large export potential exists



Hyphen signed concession agreement with Namibian government in May 2023



“Hyphen”: joint venture German ENERTRAG and Nicholas Holdings

- ENERTRAG: One of largest renewables players in Germany (> 900 employees, 1 GW assets) with global footprint, operational green-hydrogen facility since 2011, 10 GW development pipeline
- Nicholas Holdings: > 30-year track record as infrastructure investor in sub-Saharan Africa, majority shareholder of largest private train operator in Africa (Traxtion)

Hyphen is preferred bidder in competitive tender by Namibian government in, awarded at COP27 in 2021

- Tender scope: Development, implementation and operation of first GW-scale green hydrogen plant on government land in Namibia
- Six international consortia participated
- Evaluation done with help from NREL (USA) and by experts sponsored by the EU Commission

Tuesday, 23 May 2023: Namibian cabinet approved signature of Feasibility & Implementation Agreement

Friday, 26 May 2023: Signature of Feasibility and Implementation Agreement between the Government of the Republic of Namibia and Hyphen



Der Weg zum Abschluss der FIA-Vereinbarung

Der Prozess, den Hyphen bis zur Ernennung zum bevorzugten Bieter für die Entwicklung des Projekts durchlaufen hat, ist in der Publikation **“Traction – Namibia’s Green Hydrogen Overview”** ausführlich dokumentiert.



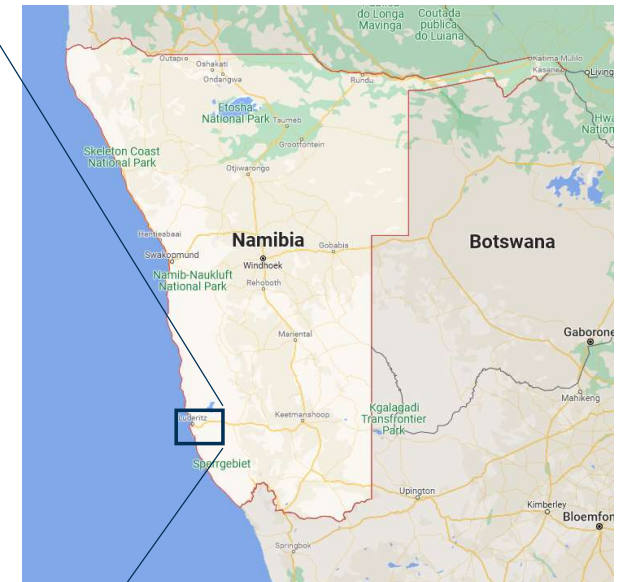
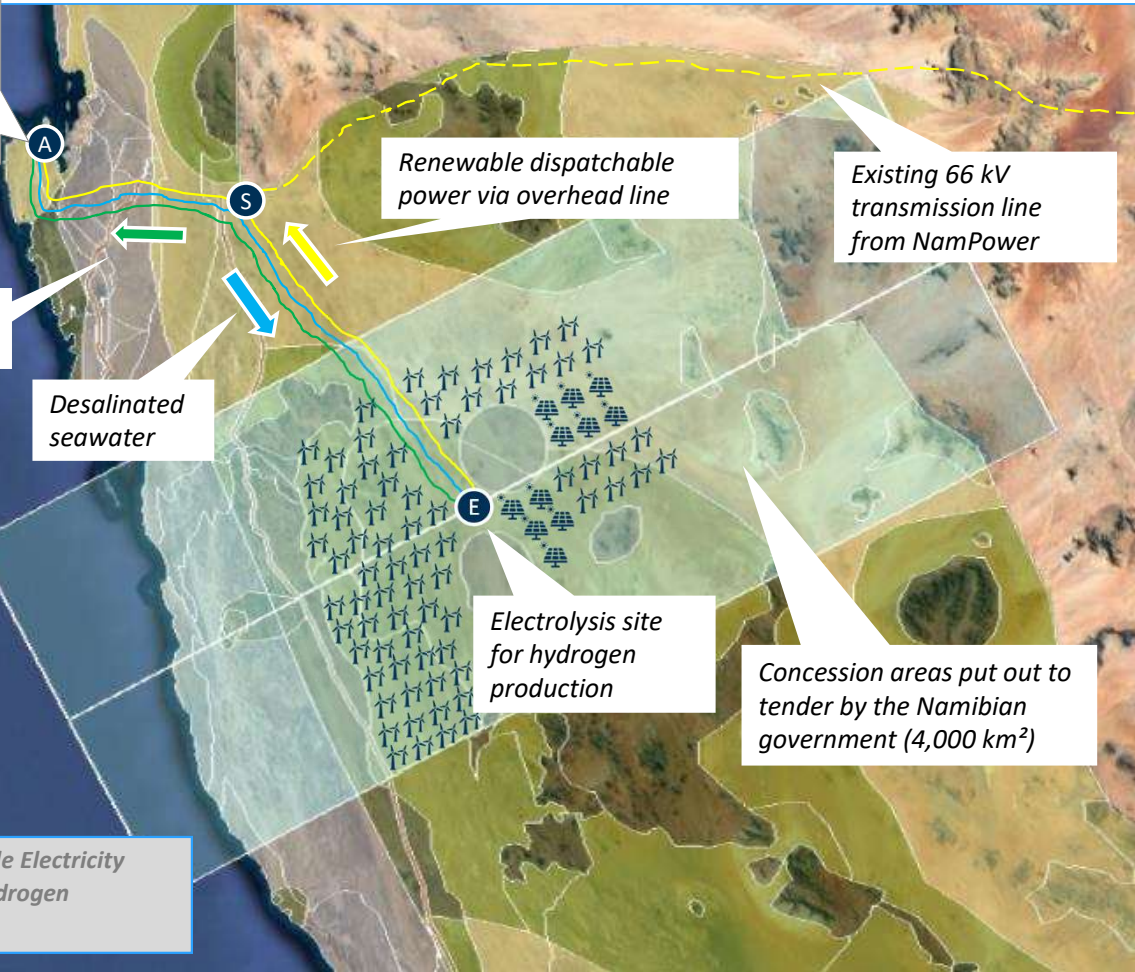
2027 Ziel ist es, bis Ende 2027 jährlich eine Million Tonnen grünen Ammoniak zu produzieren.

2029 Bis Ende 2029 solle jährlich zwei Millionen Tonnen grünen Ammoniak produziert werden.

Hyphen in Namibia: Project area and connection to Lüderitz port



Lüderitz port area:
ammonia plant, air
separation, desalination
and multi-buoy port
terminal



**Average wind speed:
> 10 m/s (like offshore)**

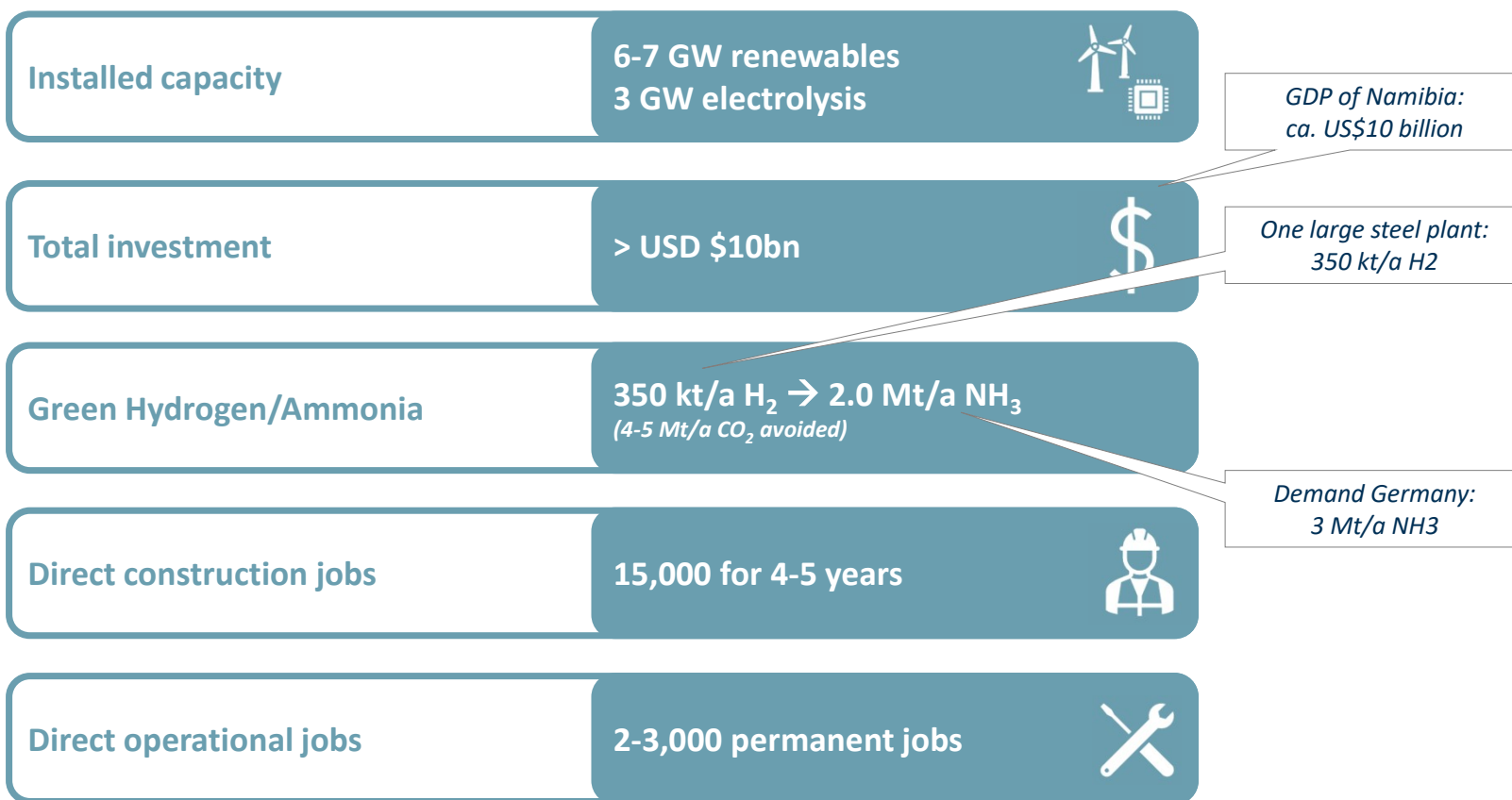
**Solar: 2 600 – 2 800 full-
load hours p.a. (only
1 000 in Germany)**

Link to Hyphen video: <https://hyphenafrika.com>

HYPHEN

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Hyphen will bring investment to the tune of the Namibian annual GDP





Medien-Echo von Ende Mai zur Vertrags-Unterzeichnung in Namibia


KLIMANEUTRALITÄT

Namibia startet milliardenschweres Wasserstoff-Projekt mit deutscher Beteiligung

Das afrikanische Land will eine gigantische Wasserstoff-Produktion aufbauen. Maßgeblich beteiligt ist das deutsche Energieunternehmen Enertrag.

Klaus Stratmann

24.05.2023 - 20:50 Uhr • Kommentieren • 6 x geteilt



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Geingob: Green hydrogen can transform Namibia

2023-05-29 Malhapa Ndjaveru



← Tweet

Ursula von der Leyen  @vonderleyen

Today's agreement is a major step for the production of green hydrogen in Namibia.

Proud that [#GlobalGateway](#) allows the EU and Namibia to invest in a shared future.

Together we will fight climate change, make Namibia energy-independent and create jobs and prosperity.

Dr Hage G. Geingob  @hagegeingob · 1h

The Agreement between the Government of the Republic of Namibia and Hyphen, signifies an exciting chapter for Namibia's growth trajectory. We wish to thank all of our development partners and including @EU_Commission, for the unwavering support that Namibia has enjoyed so far!



4:50 PM · May 24, 2023 · 17.6K Views

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Status quo: Sasol's Secunda site produces synthetic fuels (including kerosene for aviation) from coal and emits 57 million tons of CO₂ per annum



Sasol's Secunda site today converts large quantities of coal into fuels (incl. certified aviation fuel), chemicals – and CO₂

It is one of the largest CO₂ point sources globally: 57 Mt/a

The site is located in the middle of South Africa's coal region, next to 40 GW of Eskom coal-fired power plants

The site employs approximately 20,000 people and is a significant economic factor for the region

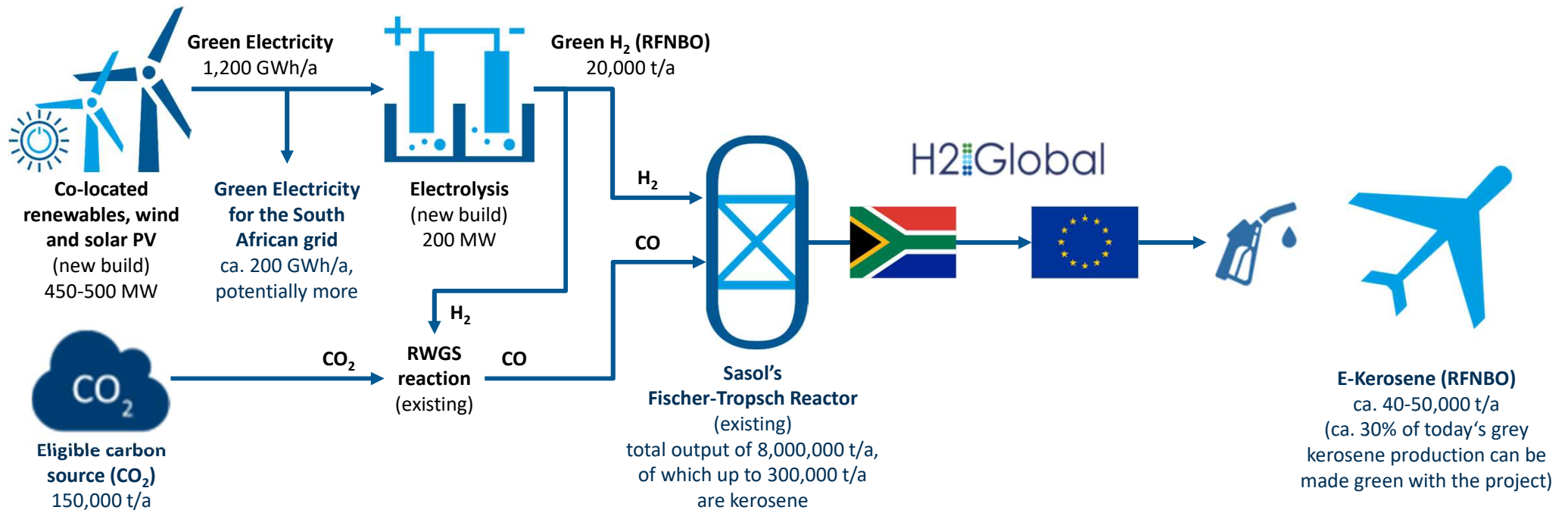
Fischer-Tropsch reactor in Secunda is the largest one in the world that produces certified synthetic aviation fuel today

The entire site can be converted fully from coal input to green hydrogen input, but that can only be done gradually





Project HyShiFT: Industrial-scale E-Kerosene production to kick-start the industry





Advanced status & leveraging of existing Secunda assets allows COD in 2026/27

Wind and solar development completed

- Land secured for 300 MW solar PV and 200 MW wind nearby Sasol Secunda
- Wind measurement completed (above-average wind speeds in the area)
- Environmental permitting processes completed for 2 out of 3 individual renewables projects, third environmental authorization expected soon

Work on electrolyser integration into Secunda started

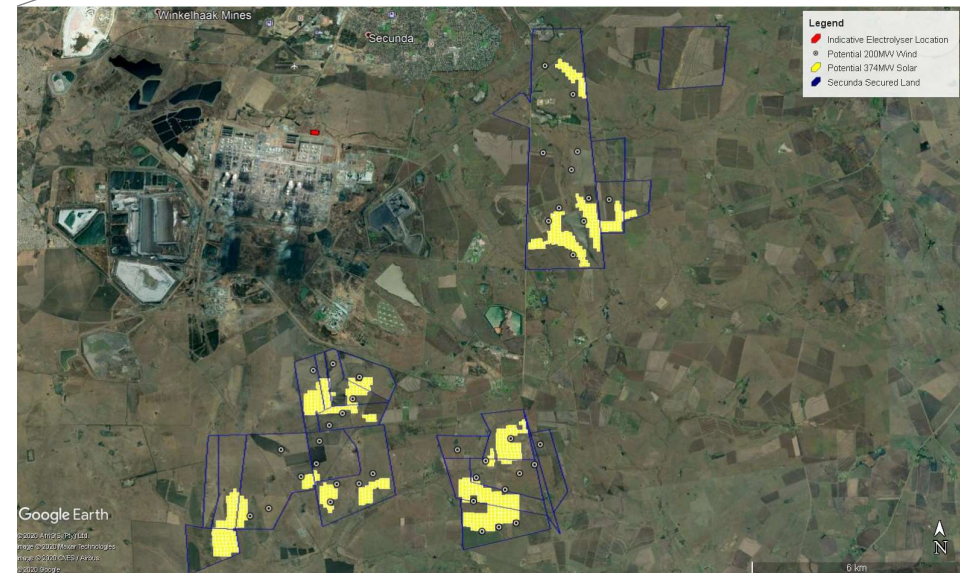
- Technical integration studies ongoing

Total investment: almost €1 billion

Ca. 2,500 full-time jobs during 2 years of construction,

Ca. 200 permanent jobs for operations of solar, wind, grid, electrolysers

Commercial operation possible as early as 2026/27



Opportunity for new energy trade partnerships in green hydrogen between Europe and Africa



What does Germany / Europe want?

- Rapid decarbonisation of industry and Quick and lasting independence of Russian energy imports
- But not enough own resources for green hydrogen → diversify energy supply base and partner with countries that share the same values

Many African countries have the resources to produce large quantities of low-cost green-hydrogen derivatives

These new export opportunities can achieve long-term sustainable growth, because

- they are un-depletable (unlike oil/gas/minerals),
- cover a large part of the value chain (oil = wind/sun; refined and oil-based products = green ammonia) and
- every large green-hydrogen project automatically brings large co-benefits (surplus electricity is a design feature, desalinated water can be over-dimensioned at low cost, hydrogen at marginal pricing, ammonia for import substitution of fertiliser)

Main objective must be to increase bankability of the projects as much as possible, measurable in the amount of non-recourse project-finance

Support desirable for the mutually beneficial creation of new energy trade partnerships in following dimensions

- Offtake & price certainty for market ramp-up (e.g. H2Global or similar insurance-like long-term instruments on volume/price)
- Certification: Clarity around green hydrogen or green-hydrogen-rich products definition (certification) and participation of supplier countries
- Industry build: Capacity building in supplier countries to build/grow renewables and chemicals industries (up- & downstream)

Gemeinsam.
Eine Energie voraus.



Dr. Tobias Bischof-Niemz

Bereichsleiter

ENERTRAG SE

tobias.bischof-niemz@enertrag.com