

Challenges and opportunities to produce Green Hydrogen in Africa

November 2021

A global rush to undertake investment opportunities in the African region is likely to ensue. We will take a dive into some of its structural enablers to understand its potential.

The African region, just like Latin America, is strategically placed to become a production hub for both Green hydrogen and Low Carbon Hydrogen. The main advantages include resource and land availability, intercontinental pipeline infrastructure, and a potential hydrogen export market.

In this Insight we will analyze four structural enablers: Renewable Energy Potential and Low Grid Emissions, Industrial Hydrogen Production and Strategic Infrastructure, Regulatory Framework and Fossil Resources.

Renewable Energy Potential and Low Grid Emissions

The use of renewable energy resources for electricity production in Africa is not a nascent phenomenon. Countries within the region have mainly relied on hydroelectric power, with coal and use of natural gas only being present in a few countries in North Africa and South Africa. Nations like Kenya have an impressive 93% renewable energy generation with geothermal power contributing over 45% of total power demand, resulting in low grid emission factors of 0.04 tnCO₂/MWh in 2020. Namibia, a country with 91% renewable energy generation spread across Hydropower (70.8%), Solar (19.1%) and Wind (1%) also has low emission factors in the range of 0.058 tnCO₂/MWh (2019 figure, source Irena).

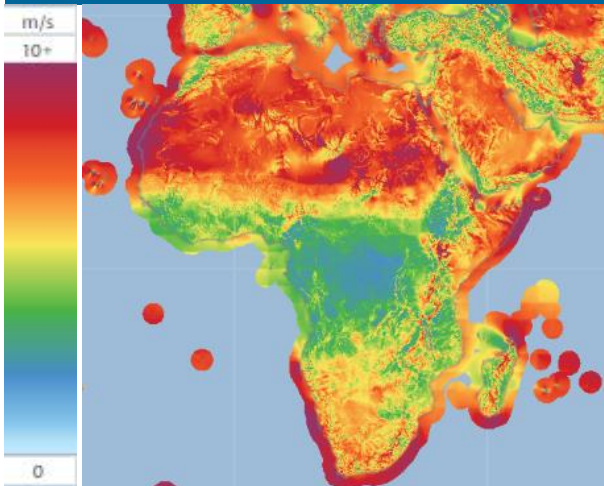
Morocco and South Africa on the other hand, have significantly high emission factors of 0.75 tnCO₂/MWh (2019) and 0.94 tnCO₂/MWh (2020) respectively. This is attributed to high shares of conventional power generation in these countries. Over 80% of Morocco's power demand was met by non-renewable sources ranging from Coal, Natural Gas and Oil in 2019. For South Africa, 90% of power demand in 2020 was met by coal-fired power plants.^{1,2}

In general, Green House Gas (GHG) Emissions in the region have remained significantly low at 480 Mt CO₂ while the transport and industrial sectors contributed 355 Mt CO₂ and 155 Mt CO₂ in 2018, compared to the average of the world's emissions.³

Further, the uptake of Intermittent RES power projects has been on the rise in Africa which has abundant wind and solar resources. This implies that there exists capacity to produce Green Hydrogen and Low Carbon hydrogen with existing composition of the electrical grid served by a dynamic energy matrix dominated by RES, leading to efficient hydrogen production unaffected by intermittency.

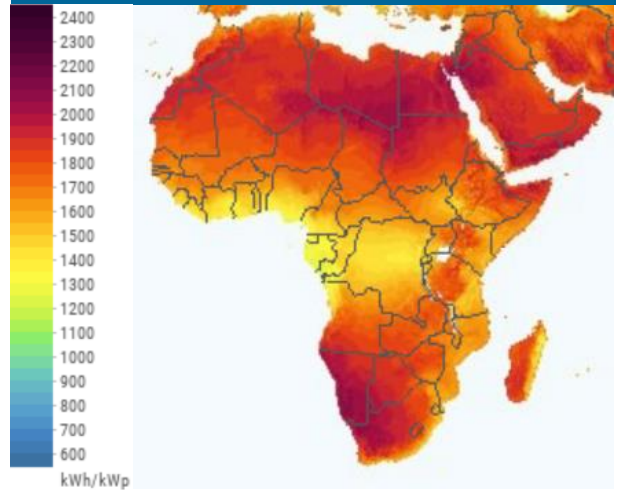
1. https://www.irena.org/IRENADocuments/Statistical_Profiles/Africa/Morocco_Africa_RE_SP.pdf
2. <https://www.eskom.co.za/wp-content/uploads/2021/08/2021IntegratedReport.pdf>.
3. [Africa_Energy_Outlook_2019\(1\).pdfh](#)

Figure 1: Wind Availability in Africa



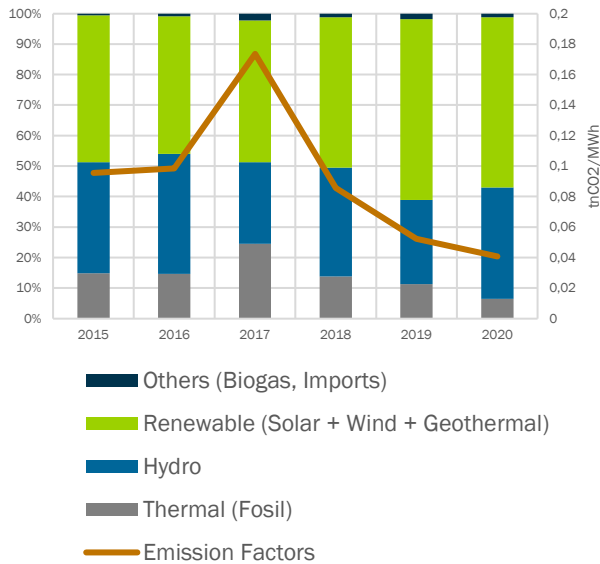
Source: Global Wind Atlas, World Bank 2020

Figure 2: Solar Energy Availability in Africa



Source: Global Solar Atlas, World Bank 2020

Kenya Grid Emission Factors



Source: Prepared by the autor.

Industrial Hydrogen Production and Strategic Infrastructure

Hydrogen production for Industrial use in Africa is not a recent phenomena, with countries like Nigeria, Egypt, Algeria and South Africa involved in Large Scale Hydrogen production for Ammonia production and Oil refining by use of natural gas and coal (SA). The adoption of RES for these processes can be a good pilot for adoption and development of Green and Low Carbon Hydrogen to be used as an energy carrier.

Further, the existence of an intercontinental Natural Gas Pipeline between Africa and Europe from Libya and Algeria to Italy and Spain, gives the continent a significant leverage in the low carbon hydrogen export market to the European Union.

Given the global commitments to decarbonization targets, Africa which accounts for less than 4% of overall global emissions will be crucial in developing strategic partnerships with countries in the European Union and Asia where local production capacity of Hydrogen is not sufficient to meet the demand necessary for achieving their decarbonization goals.

Regulatory Framework

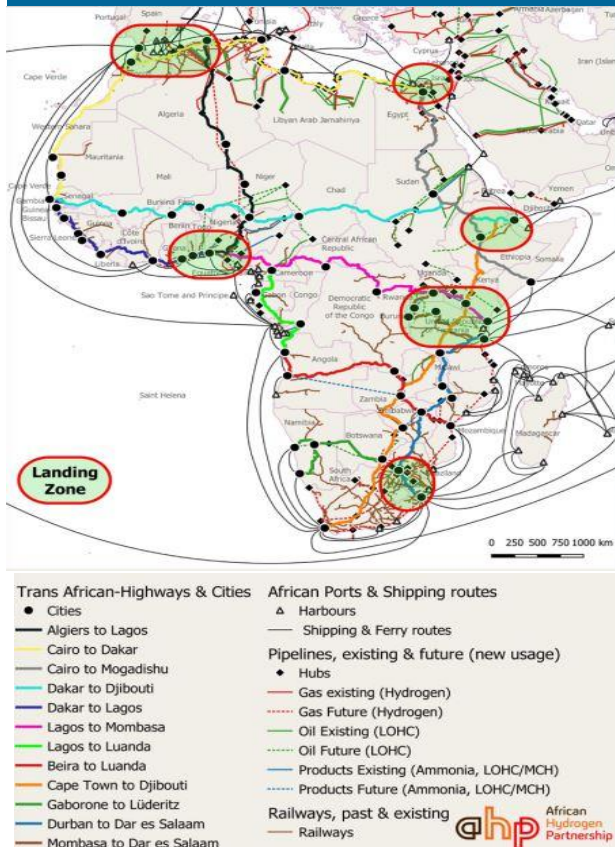
The availability of national and regional hydrogen strategies and road maps with clear and determined objectives is paramount to the development and uptake of hydrogen as an energy vector. The development of National Hydrogen development road maps in Africa are still in early stages of adoption, with Morocco, Namibia and South Africa making significant progress.

The Morocco's government developed a pilot hydrogen framework dubbed as the "Green Hydrogen Cluster" aimed to enhance collective participation by the global private sector to increase uptake of green hydrogen adoption and use. A Memorandum of Understanding (MoU) for Hydrogen export with Germany is already in place.

The Government of Namibia is in the process of developing a National Hydrogen Strategy. Additionally, it recently awarded a tender to Hyphen Hydrogen Energy for the development and operation of a large-scale green hydrogen project in Tsau Khaeb National Park and may release a second request for proposal (RFP) early next year for the development of another large-scale green-hydrogen complex. The anticipated production capacity of the Tsau Khaeb National Park is 300,000 Tn/year (as a reference this figure is similar to the annual H₂ consumed as feedstock for the industry in countries like Argentina and Chile). Namibia's green hydrogen production would be powered by 5GW of wind and solar and a 3GW electrolyser capacity. This is anticipated to make the country a global leader in Green Hydrogen Production.

In South Africa, the Government has embarked on plans to make the country a Green Hydrogen exporter and earmarked the Boegoebaai SEZ region for production.

Figure 3: Hydrogen Markets and Landing Zones



Source: African Hydrogen Partnership

Further, several firms including Hydrogen South Africa (HySA) and Anglo-American are leading Hydrogen development exploits with Hydrogen powered mini-grids and pilot Hydrogen powered fuel cell trucks in mines respectively.

Regionally, efforts are collectively being made to make the continent a Hydrogen production hub. The African Hydrogen Partnership (AHP), which maps potential landing zones/ bridgeheads for initial development of green hydrogen in Africa is in place. The specific markets identified include Kenya, Djibouti, Egypt Ethiopia, Ghana, Morocco, Nigeria, Tanzania and South Africa (Figure 3).

Further, the development of an African Hydrogen Atlas, that aims to map hydrogen production potential in 31 countries in West Africa and South Africa is an indicator of progress on roadmap development in the region.

Fossil Resources

There exists natural gas resources and coal that have been in use for production conventional gray hydrogen to use in industrial processes through Steam Methane reformation in North Africa and coal gasification in South Africa for many years.

Almost half of Africa's 55 countries have known gas reserves having Nigeria as the largest natural gas producer and Mozambique with potential to serve as the second-largest LNG producer after the completion of various projects. The South African government's intention to expand the LNG industry is reflected in the country's Integrated Resource Plan (IRP). Botswana could be a standalone gas system depending on successful development of its coalbed methane (CBM) resources. Namibia could be a standalone system depending on successful development of the Kudu field or through small-scale LNG imports.

This implies that blue hydrogen production (through Steam Methane Reformation with Carbon Capture and sequestration) in the region would also be a great possibility that should be analyzed.

INVESTMENT OPPORTUNITIES IN AFRICA

The global energy transition and the challenge to move towards a NZE energy matrix in the near future could bring many opportunities to the region.

Table 1: Opportunities in Africa

Renewable Energy Potential and Grid Emissions	Low grid emissions with abundant Renewable Energy sources across the continent
Industrial Hydrogen Production and Infrastructure	Egypt, Algeria, Nigeria and South Africa engaged in Hydrogen production for industrial use. Existing LNG infrastructure between N.A and Europe
Regulatory Frameworks	Regional Development Frameworks, National Hydrogen Strategies for Namibia and S.A on development; For Morocco, "Green Hydrogen Cluster"
Fossil Fuels – Blue Hydrogen	South Africa, Egypt, Morocco, Algeria, Mozambique and Tanzania have Natural Gas and Coal (S.A)

Source: Prepared by the author

While the continent has made significant progress towards becoming a green hydrogen production hub, several challenges persist:

Country-specific National hydrogen strategies remain minimal (Only 3 of the 54 Countries have made advancements) this is attributed to lack of regulatory frameworks necessary to implement Hydrogen production for domestic use and the export market.

There are some initiatives at an early stage but the uncertainty of the H2 market, requires a strategic analysis to foster the development of RE energy.

The economics of hydrogen demand in the region is still uncertain at best and therefore initiatives like more bilateral agreements with Europe and other economies are crucial for hydrogen development.

Significant Investment in Hydrogen production infrastructure, from electrolyzers to strategic pipelines are required. The existing Natural Gas Pipelines are predominantly present in Northern Africa, implying new pipeline development for the rest of the continent in addition to RE and electrolyzers' development costs will be necessary.

More information:

info@grupome.com

www.me-consultores.com

Insight developed by:

Erick Amkoa
Semi-Senior Consultant
eamkoa@grupome.com

Francisco Baqueriza
Junior Analyst
fbiqueriza@grupome.com

Laura Souilla
Partner & Managing Director
lsouilla@grupome.com