

INSIGHTS

UNLOCKING THE POTENTIAL OF AFRICAN-EUROPEAN GREEN HYDROGEN TRADE

Three barriers that need to be addressed by policy to grow the African hydrogen industry and lower transition costs in Europe

CLIMATE, ENERGY & NATURAL RESOURCES | NOVEMBER 2024

The European Green Deal sets an ambitious 20-million-ton (MT) target for renewable (“green”) hydrogen consumption in the EU by 2030. To reduce costs, imports are important to reach this target, and several African countries are well-placed to meet this demand.

Unlocking this potential requires policies that address three main barriers: Credible EU demand, lowering trade costs by infrastructure investments, and lowering risks to investments in Africa.

With their proximity to Europe and abundant solar and wind energy, the green transition is an opportunity for Northern African countries to become a major hydrogen hub. For the EU, importing relatively cheap hydrogen from Africa reduces the cost of its hydrogen strategy and increases security of supply.

In this brief, we use Copenhagen Economics' global climate economic model, INTERSECT, to analyse costs of realising the EU hydrogen strategy and its derived trade effects based on region-specific cost structures.

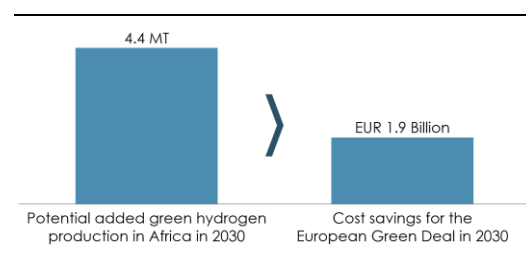
To illustrate just how large the potential for African-European hydrogen trade is, we simulate a scenario where policies successfully address the three big barriers: Demand credibility, trade costs, and investment risks.

We estimate that in this case African green hydrogen production can grow by over 500% from 1 MT to 5.4 MT in 2030. This will lower the cost of the European Green Deal by 1.9 billion euros in 2030 alone, see **Figure 1**, and

would make the African hydrogen industry the 6th largest net contributor to the EU budget.

Figure 1

Impact of unlocking the African hydrogen industry



Note: Additional green hydrogen production results from lowering trade costs and lowering risk to investments in Africa. Cost savings is the difference in cost between importing 10 MT to Europe with these barriers in place, and a scenario where the cost of capital is at a comparable level in Africa to Europe and infrastructure allows for cheaper pipeline transportation.

Source: Copenhagen Economics based on INTERSECT.

Hydrogen allows for decarbonisation across several hard-to-abate industries

With a projected revenue of 410 billion dollars in 2030, the growing interest in the global hydrogen market is not caused by its size alone (in comparison, the chemical industry is set to reach 4.7 trillion dollars).¹ Still, hydrogen produced from renewable power sources such as solar and wind - often referred to as green hydrogen - is set to play a key role in the path to net zero emissions, because it enables decarbonisation in other sectors.

Green hydrogen offers a carbon-neutral alternative to fossil fuels in hard-to-abate sectors, such as steel, chemicals or long-distance transportation. For this reason, a key initiative under the European Green Deal is the EU Hydrogen Strategy. This strategy sets ambitious 2030 targets for both production (10 million tonnes) and consumption (20 million tonnes) of green hydrogen in Europe.

Trade is an important part of hydrogen economics

BUT... there is one catch: Green hydrogen is expensive to produce. Currently, "grey" hydrogen (produced from natural gas) costs around 1.5 euros per kg, whereas its green counterpart may cost 2-4 times as much to produce.² Therefore, policymakers in Europe should implement the Hydrogen Strategy in a way that reduces unnecessary costs to taxpayers and consumers.

To reduce transition costs, green hydrogen should be produced where it is cheapest. There are three key cost drivers: having accessible areas with solar and wind abundance, transportation costs, and the risk premium to the cost of capital, see **Box 1**.

For Europe to reach its ambitious demand targets by 2030 in a cost-effective way, this implies utilising its preferred sites (such as the Iberian Peninsula and the North Sea) to the extent possible, and importing from other regions once additional EU production is more costly.

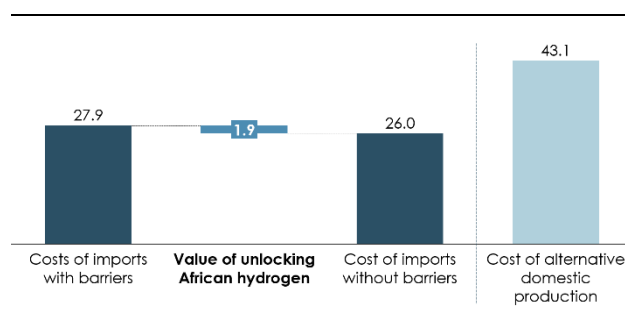
Other regions are not as restricted in the construction of cheap green hydrogen. Countries in North Africa are examples of such places, where the availability of high-value natural resources for cheap electricity generation, and close connections to Europe can ensure a larger supply of low-cost green hydrogen, see **Box 1**.

As shown in **Figure 2**, imports present the most cost-effective path to achieving the 20 MT consumption

target by 2030, assuming the domestic production target of 10 MT is met. In this scenario, additional production in EU-preferred sites would likely be unfeasible, resulting in a cost of 43 billion euros at non-preferred sites, compared to 28 billion euros when utilising imports. Unlocking the potential of the African hydrogen industry can reduce costs by an additional 2 billion euros. Note that this is only the cost in 2030. Reaching the full consumption target in 2030 will also require a credible demand in the previous years to build out the sector. In the next section, we will expand upon the main barriers to the African hydrogen industry and the needed tools to address them.

Figure 2

Cost of closing the gap between hydrogen production target and consumption target in 2030
EUR billion



Note: Cost of achieving the 10 MT of green hydrogen above the 10 MT production target to reach the 20 MT consumption target in 2030. The cost of imports without barriers is the cost when pipeline transportation from Africa is possible together with a lower cost of capital. The cost of alternative domestic production is the cost of producing the 10 MT in Europe at non-preferred sites. Note that this figure only includes the costs in 2030.

Source: Copenhagen Economics based on INTERSECT.

Exports can kickstart the African hydrogen industry with the right policy

The hydrogen industry in Africa is at an emerging stage, with growing interest in harnessing the continent's vast renewable energy resources. In the longer term, there is increasing recognition of hydrogen's potential to support Africa's energy transition, provide energy security, and drive economic growth, with further potential in derived products, such as e-fuels, for hard-to-abate sectors.³ In the short term, regional carbon prices will not be nearly high enough to incentivize a demand shift towards green hydrogen from the African economies themselves. Additionally, there is little inter-regional infrastructure in Africa to accommodate

¹ Markets and Markets (2024), *Hydrogen Market*

² European Commission (2020), *A hydrogen strategy for a climate neutral Europe*

³ White & Case (2023), *Green hydrogen in Africa, A continent of possibilities*

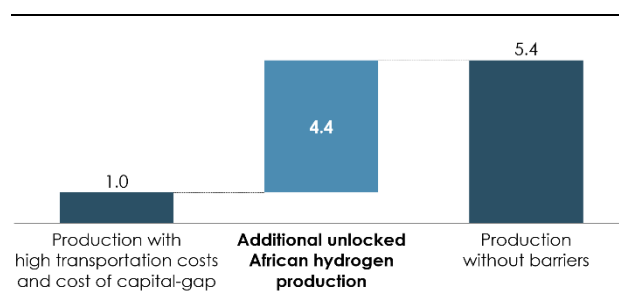
this offtake. Instead, any significant growth will have to come from exports.

The necessary policy mix has three components: First, EU demand must be credible. The Hydrogen Strategy provides the direction but challenges in implementation remain, for example, downstream green value chains remain complex and undeveloped. The EU should ensure that national schemes will be timely, sufficient and credible to incentivize demand, for example by supporting standards towards RFNBO certification. **Without any credible EU demand, we find that there will be no significant green hydrogen production by 2030 in Africa.** Second, African-European transportation costs have to be minimised by significant and long-term infrastructure investments. Steps have already been taken here by constructing new pipelines or repurposing existing gas pipelines, e.g. the planned South Central Corridor that will transform existing gas pipelines connecting Germany to Tunisia.⁴ Finally, the cost of capital-gap between Africa and the developed markets needs to be shortened if not eliminated. This can be achieved partly through institutional reforms in the target countries and partly by the use of so-called blended finance. To reduce its transition costs, the EU should consider ramping up its loans and investments into renewable energy and electrolyser capacity – e.g. by extending the mandate of the European Investment Bank.

As displayed in **Figure 3**, we find that a policy mix with the latter two components can lift the production of renewable hydrogen by **4.4 MT in Africa** given a credible EU demand from around 1 MT to 5.4 MT in 2030 – almost all of which is exported to the EU.

Figure 3

Renewable hydrogen production in
Africa
MT hydrogen



Note: Production with high transportation costs and a cost of capital-gap is a scenario where no policy mix addresses the infrastructure needs to lower the transportation costs and to lower the cost of capital. In all scenarios, we assume that there is a credible demand from the EU.

Source: Copenhagen Economics based on INTERSECT.

INTERSECT

INTERSECT is our global climate economic model, co-developed with Bain & Company, used to analyse and forecast in detail how different climate scenarios affect businesses and regions.

INTERSECT is a Computable General Equilibrium (CGE) model rooted in economic theory and extended to account for carbon emissions and allow for technology choice in a large range of sectors. Our model adds to the existing body of climate-augmented economic models, and as a commercial model, INTERSECT is continuously updated to account for the most recent knowledge. We calibrate INTERSECT against various carbon emission scenarios and have built specialized industry modules to accurately reflect technological evolution in hard-to-abate sectors.

For more information feel free to reach out or visit [our webpage](http://www.copenhageneconomics.com) (www.copenhageneconomics.com).

⁴ Euractiv (2023), Rome, Berlin plan massive hydrogen pipeline to Africa

Box 1 Hydrogen economics

There are three drivers of the price of green hydrogen:

- Capital costs, in particular investments in electrolyzers
- Operating expenditure, in particular, electricity costs to run the electrolyzers
- Transportation from the production site to the consumer

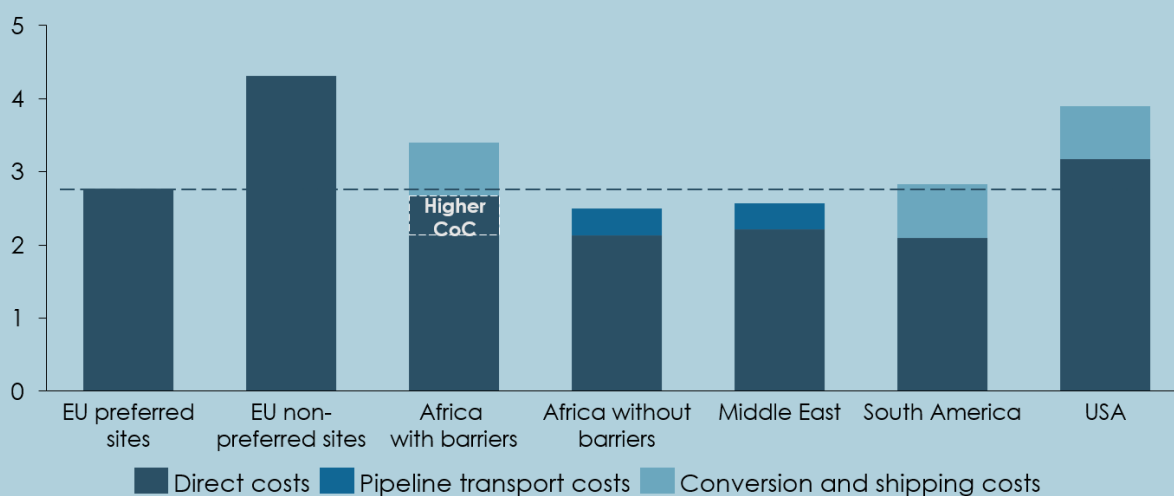
Capital costs vary significantly across regions based on the investment risk of the projects. Costs are thus higher in countries in Africa compared to Europe where there is lower country- and project risk and more government support. **Electricity costs** depend on the availability of high-value renewable energy resources and often the possibility of behind-the-meter production to avoid grid costs. **Transportation costs** depend on the distance and the state of the hydrogen. Closer distances allow for cheaper pipeline transportation, either by new pipelines or repurposed ones, transporting the hydrogen directly. Shipping requires conversion of hydrogen to a derivative product such as ammonia and possibly a re-conversion (so-called cracking) near the use point.

Based on these factors, the expected regions to be in a position to deliver the green hydrogen that Europe needs are South America, the US, the Middle East, and Africa.⁵ In **Figure 4** we show our forecasted costs of hydrogen in 2030 for Europe and the likely import regions.

Figure 4

Cost of hydrogen in Europe in 2030

EUR / kg hydrogen



Note: Assumed fixed shipping cost of 0.5 USD / tonnes, conversion cost of 0.3 USD / tonnes, and pipeline transportation cost from Africa and the Middle East to Europe of 0.4 USD / tonnes.

Source: Copenhagen Economics based on INTERSECT. Transport and conversion costs are based on IEA, Global Hydrogen Review 2023.

⁵ Morocco, Mauritania, and Egypt are countries, which with proximity to Europe can integrate into a European hydrogen pipeline network and export hydrogen directly. Other countries, such as, South Africa,

Kenya, and Namibia are more posed to export derivatives such as green ammonia by sea transport.

Box 1 (cont.)

Production costs in Europe depend on the availability of so-called preferred Smart Integrated Renewable Energy Systems (SIRES) such as offshore wind in the North Sea or solar PV on the Iberian Peninsula (the Iberian Peninsula is expected to have lower production costs for renewable hydrogen but is located farther from the current main demand areas in Belgium, the Netherlands, and Germany⁶). However, natural resources from these preferred sites are likely insufficient to reach the full consumption target of 20 MT, especially given the time horizon. Producing large amounts of hydrogen outside of these sites is associated with higher costs. As such, it will be more cost-efficient to utilise imports together with internal production

A report published by The Hydrogen Council⁷ finds that the cost of capital in developing markets can be between 4-12 percentage points higher than in developed markets. Working with a baseline of 10 percentage points higher, the cost of capital corresponds to an approximate 25% increase in direct costs (cf. **Figure 4**).

The lower cost in South America, the Middle East, and Africa is often driven by higher load factors in solar PV, with some countries in these regions, such as Morocco and Mauritania, having the possibility to combine this with efficient wind power. Northern African and Middle Eastern countries are, with their proximity to Europe, in a position allowing pipeline transportation at a lower cost than shipping, whereas imports from South America and the USA necessitate conversion to derivative products for transport and possible re-conversion to hydrogen.

⁶ CIP Fonden (2023), Roadmap for the future, [Available here](#).

⁷ The Hydrogen Council (2024), The Africa Hydrogen Opportunity

Hard facts. Clear stories.

**Signe Rølmer Vejgaard, Partner**

Signe takes the lead on our climate, energy, and natural resources service. With over 10 years of consulting experience with CE, she advises clients on the implications of regulation and climate policy, as well as how to devise a commercial strategy towards a low-carbon future.

Email: sir@copenhageneconomics.com

**Anders Kronborg, Senior Economist**

Anders advises both private and public clients on green transition strategies, mining, energy economics, and policy. He uses a scenario-based approach to work with companies and investors to analyse potential transition risks.

Email: afk@copenhageneconomics.com

**Nicolaj Lade Lausten**

Nicolaj is involved with the policy business unit, engaging in various key policy areas such as climate, energy, the financial sector, and healthcare and life sciences.

Email: nll@copenhageneconomics.com

About Copenhagen Economics

At Copenhagen Economics we believe sound economic analysis equips decision makers with the Hard Facts and Clear Stories to make better choices for the benefit of society. An expert-driven consulting company, clients choose us because of our economic insights, our specialised sector knowledge, our ability to build trustful relations, and our collaborative culture, where we take care to build teams that best meet the needs of the client.

You can read more about the services we operate [here](#).