POLICY BRIEF 2020/01: Green Hydrogen – Fuelling human well-being in Africa and Europe

Johan van den Berg, AEEP Secretariat

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EXECUTIVE SUMMARY

Due to its unique potential to contribute to a climate friendly energy future, green hydrogen is likely to be a major commodity in the post-fossil fuel age. Africa and Europe have the opportunity to steer such development into alignment with the existing sustainability frameworks that already guide the partnership between the two continents. Concurrent with the publication of a research paper on green hydrogen commissioned by the Secretariat of Africa-EU Energy Partnership (AEEP), this policy brief concludes that optimal outcomes would be reached if the green hydrogen development trajectory between the continents is anchored in Agenda 2063 and Agenda 2030. Noting that African and European paths are likely to commence distinctly and join over time, the brief identifies a green hydrogen convergence roadmap and identifies roles and responsibilities for its custodians.

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Green Hydrogen – Why it matters

In driving the energy supply to the global economy towards sustainability and climate neutrality, the remarkable progress in renewable electricity has in the last decade led to justifiable optimism. Wind and solar PV have shown dramatic technological progress and also price decreases, to the extent that it is now entirely conceivable to have a modern economy based on an electricity generation that utilizes very high penetrations of variable renewable electricity. Such a system will include storage to cater for the variability in electricity generated from these energy sources.

From a global energy system perspective, making the electricity sector climate neutral would only address about a third of the greenhouse gas emissions that need to be eliminated.[1] The remainder of energy deployment occurs in industries like transport (shipping, aviation, road transport), manufacturing and heating. These needs are fed by non-electrical power sources,[2] traditionally the burning of fossil fuels (coal, oil, gas, petroleum). The solution advanced by experts is to electrify everything that can possibly be electrified and to install more renewable electricity generation to feed these additional segments of the economy. This is called "sector coupling". Electric vehicles are good examples, where the electricity from a wind turbine can allow personal transport without any harm to the environment.

There are however some sectors that cannot easily be electrified. These "hard-to-decarbonise" sectors include shipping, aviation, heavy land transport and heavy manufacturing (for instance where very high, direct heat is required).

Green hydrogen (abbreviated to "GH2" herein) can be made by combining renewable electricity and water to gain hydrogen and oxygen out of the chemical reaction (H2O » H2 + O). Hydrogen can be made in other, non-sustainable ways – the "green" refers to the climate neutrality of the electricity used to manufacture it.[3]

GH2 can act as an energy storage medium and thus is an enabler of an electricity system with a high penetration of very affordable but variable renewable energy plants (wind and/or solar PV).[4] Furthermore, GH2 can also be a technical solution to the challenge of the "hard-to-decarbonise" sectors. Ammonia is a derivative product of GH2 and can be used to make international shipping "renewable" and climate friendly. Renewable aviation fuel can also be manufactured from GH2. For direct heat applications, GH2 could be combusted on-site.

The value of GH2 thus lies in the fact that it potentially creates a way for modern economies to bring a far greater proportion of their energy sectors to climate neutrality and thus to sustainability. As a practical example, steel manufacture without GH2 may seem incompatible with long term climate stability.[5] With GH2 it can continue into the future, in harmony with the global climate. Given the very wide acceptance of the Paris Climate Agreement, it can be expected that fiscal incentives and national legislation across the globe, commencing with the OECD, will increasingly favour

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[1] See EPA at https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data, accessed on 24 August 2020

[2] In the case of transport, it is traditionally driven by combusting some petroleum product. Manufacturing often requires very high heat which is usually obtained by burning coal or gas, on-site.

[3] "Grey hydrogen" means hydrogen produced using fossil fuels. Blue Hydrogen means low-carbon hydrogen where the input energy is from nuclear or the majority of emissions produced by the grey hydrogen production process would be captured and stored. See http://www.certifhy.ca/Green%20and%20Blue%20H2.html, accessed 28 September 2020.

[4] There are other feasible storage solutions including pumped storage and batteries. The potentially greater uniqueness of GH2 is in transforming the hard-to-decarbonize sectors where sometimes there are no other technical solutions available that are potentially feasible

[5] See https://www.worldsteel.org/en/dam/jcr:f07b864c-908e-4229-9f92-669f1c3abf4c/fact_energy_2019.pdf and https://www.estep.eu/green-steel-for-europe/, both accessed 25 August 2020.

technologies that are climate compatible and/or penalise products with a heavy carbon footprint e.g. via carbon border tax adjustments.. As the most promising technology for decarbonizing hard-to-decarbonize sectors, green hydrogen is now receiving considerable attention and is likely to maintain this primacy - for at least as long as international climate resolve holds and/or until a better technology is found for the hard-to-decarbonize sectors.

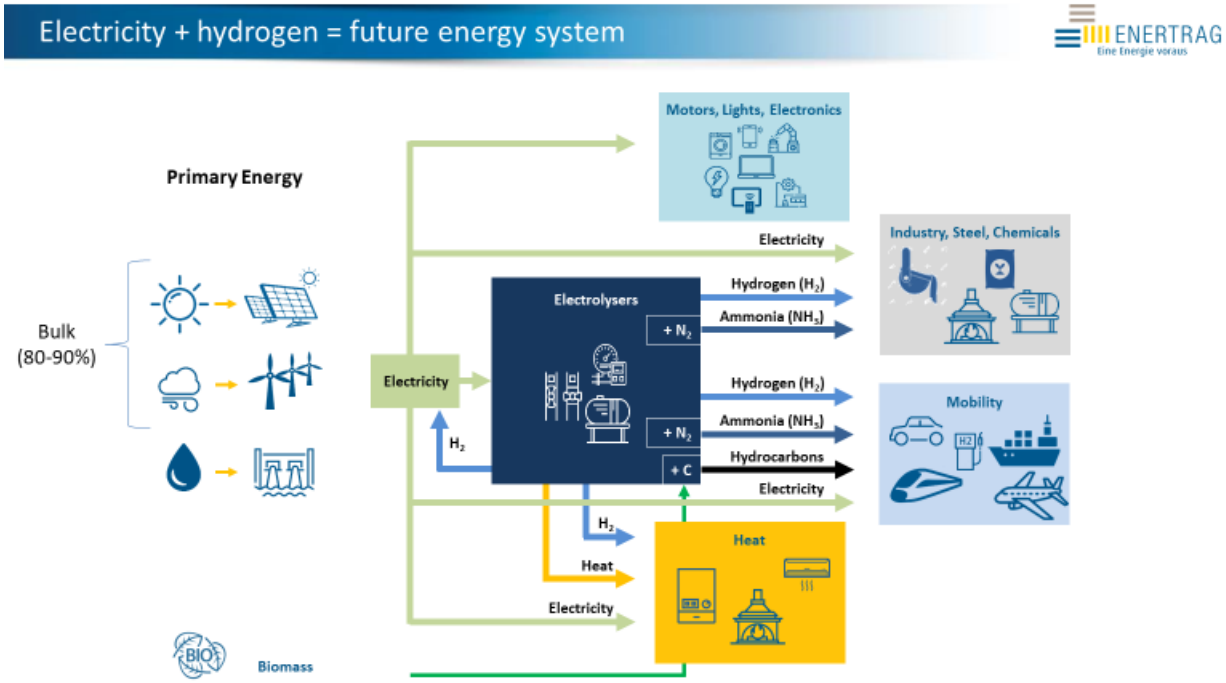

Diagram 1: A projection of the role of GH2 in a future energy system (Source: Dr Tobias Bischof-Niemz, Enertrag)

For these reasons GH2 has a high probability of becoming simultaneously a valuable commodity[6] and a key enabler of the post-fossil fuel era. *One estimate places 2050 global trade at € 630 billion per annum*.[7] GH2 prices are projected to drop quickly towards cost-competitiveness with non-renewable hydrogen.[8]

For Africa and Europe, GH2 has the potential to add another, synergetic component to their existing energy partnership, as appears below. The private sector-led plans in Europe for 2030 already imply GH2 Direct Foreign Investment in Africa of as much as USD 90 billion.[9] Most importantly,

[6] See European Commission "A hydrogen strategy for a climate neutral Europe" https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf p 3, accessed 18 August 2020

[7] See BNEF (2020) Hydrogen Economy Outlook as quoted ibid, footnote 9.

[8] This will occur through economies of scale and technological innovation. At present GH2 is competitive with non-sustainable production methods of hydrogen only in exceptional circumstances. The cost range for "grey" hydrogen is presently USD 1,50 – 2,50/kg, while GH2 is in the range USD 2,50 – 7,00.8 This gap is projected to close.8 Projections show GH2 prices at USD 1,00 – 1,20 by 2024, if powered by wind or solar PV.8 In this sense it is likely to inhabit a very large market segment that is presently not in existence as yet – as opposed to merely displacing conventional hydrogen from the market it occupies now.

[9] Elaborated below

collaboration on GH2 between Africa and Europe has the potential to lead to very significant societal and socio-economic benefits on the two continents.

Green Hydrogen – Where are we on the continents and especially between Europe and Africa?

On both continents, the policy frameworks are in place to anchor a GH2 development path that is aimed at ensuring broad human and societal well-being. Most prominently this is done through the common framework of Agenda 2030 and the Sustainable Development Goals, also international conventions like the United Nations Framework Convention on Climate Change, the Kyoto Protocol and the Paris Climate Agreement. SDG7 calls for universal access to sustainable energy by 2030. The Sustainable Development Goals are explicitly inter-related, meaning that human welfare and development are inseparable from technological interventions on energy.

In 2020, the European Green Deal has emphatically set Europe on a path of expedited sustainability. Hydrogen is seen as very important in this journey, as evidenced by the very recent publication by the European Commission of the European Hydrogen Strategy. The title alone - "A Hydrogen Strategy for a Climate-neutral Europe"[10] - clearly places hydrogen centrally to long-term climate and sustainability plans. The impetus at European level reflects intent also at Member State level. For instance, Germany has a National Hydrogen Strategy with well elaborated aims and ambitions.[11] France has likewise elaborated a strong role for hydrogen.[12] A European Clean Hydrogen Alliance[13] was recently launched and already has dozens of prominent members.[14] The European Green Deal sees an important role for Africa in its external dimension while the Hydrogen Strategy includes an express desire to collaborate with Africa. The status in Europe is thus that the train has left the station and that planned collaboration with Africa (including imports) is on it.

On the African side, there is additional policy support for a broadly beneficial green hydrogen development path in *Agenda 2063 – The Africa we want.* This is the long-term developmental blueprint of the African Union. It sets out Africa´s vision of its desired future as an "integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the international arena".[15] The document, like the SDGs, underlines the importance of environmental sustainability and climate resilience to the achievement of a prosperous future.

The strong, values-based guiding framework is appropriate given the immense potential Africa has for the cost-effective production of GH2 and derivative products. The reason for this is that the major input cost to GH2 is renewable electricity and that Africa is abundantly blessed with wind and solar PV endowments and available land. The potential has led to the establishment of the African Hydrogen Alliance, which held its inaugural conference in Addis Ababa in February 2020 and where

[10] See https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf, accessed 25 August 2020
[11] https://www.cleanenergywire.org/factsheets/germanys-national-hydrogen-strategy, accessed 28 September 2020.
[12] The French government has launched a €7bn ($8.2bn) national hydrogen strategy that includes a target to build up a capacity to produce H2 from non-fossil sources via 6.5GW of electrolysis by 2030 – see https://www.rechargenews.com/transition/frances-7bn-hydrogen-strategy-could-feature-role-for-nuclear/2-1-872014
[13] See https://ec.europa.eu/growth/ndustry/policy/european-clean-hydrogen-alliance_en, accessed 25 August 2020
[14] See https://ec.europa.eu/docsroom/documents/42749, accessed 25 August 2020
[15] https://www.un.org/en/africa/osaa/pdf/au/agenda2063-presentation.pdf p 17, accessed 18 August 2020

strong conviction was expressed that GH2 can be very competitively produced in Africa.[16] The conference occurred in consultation with the African Union Commission.

There are very significant markets for derivative GH2 products that could open up quite soon. Ammonia for use as a zero-carbon fuel in shipping and as a key ingredient in the production of zero-carbon agricultural fertilizer is estimated to have potential global demand values of € 50 billion and € 250 billion per annum, respectively, should international regulations enforce climate neutrality. Capturing a modest market share could be transformative for African countries. The global market for sustainable aviation fuel could be even larger. The status of GH2 in Africa is thus that pan-continental acknowledgement exists that the commodity holds considerable promise. The effort to unlock benefits at a broad scale for societal and developmental benefit already has a custodian and promoter in the abovementioned Alliance and the sympathetic AUC is being kept abreast of developments. It should be noted that while GH2 is not widely seen as a direct or immediate contributor to energy access in Africa, it can lead to many benefits on job creation, trade, tax revenues and Direct Foreign Investment that could indirectly benefit SDG7 in Africa.

In terms of development *between* the continents, African voices are clearly looking towards export already. The EC´s hydrogen strategy envisions imports from Africa:

> *For example Africa, due its abundant renewables potential and in particular North Africa due its geographic proximity, is a potential supplier of cost-competitive renewable hydrogen to the EU, requiring that the deployment of renewable power generation in these countries strongly accelerates*[17]

In the EC´s Hydrogen Strategy, the EU private sector is said to be planning by 2030 40 GW of electrolysers outside Europe for import. If half should be in Africa, the order of magnitude of variable renewable energy installed to make this possible would be roughly 60 GW – very closer to the installed capacity of the Southern African Power Pool which is responsible for serving approximately 350 million people with electricity. The electricity component alone would represent Foreign Direct Investment of roughly USD 90 billion (calculated at USD 1,400/kW installed).[18] The German strategy likewise foresees imports from partner countries.[19] On an Africa-wide basis such added installed capacity would approximate a 40% increase on what exists today.[20]

The status between the continents is thus that exports from Africa to Europe are widely foreseen in the medium and long term, with African use cases for GH2 also expected to be growing over time. This leads to the challenge of steering such development as seems very likely to take place in a manner that will optimize human well-being and societal benefit.

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[16] The minutes of the preparatory meeting state: "In many regions of the African Continent, renewable electricity could be produced for less than USD 20/MWh…one kg of green hydrogen could be produced for USD 0.9 or less". See https://899bf48d-9609-4296-ac4c-db03c22bc639.filesusr.com/ugd/6a6d83_50be2773c500400180da49fe38e12013.pdf, p 2, accessed 25 August 2020. A comparison of these prices with those in footnote 6 above demonstrates the potential.

[17] EU hydrogen strategy ibid, p 20

[18] IRENA Renewable Power generation costs in 2018: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/May/IRENA_Renewable-Power-Generations-Costs-in-2018.pdf

[19] See https://www.bmbf.de/files/bmwi_Nationale%20Wasserstoffstrategie_Eng_s01.pdf, printed page 5 – 6, accessed on 29 September 2020.

[20] See https://www.irena.org/documentdownloads/publications/prospects_for_the_african_powersector.pdf p 1, accessed 29 September 2020.

Green Hydrogen – The Foundation of a Values-Based Partnership between Africa and Europe

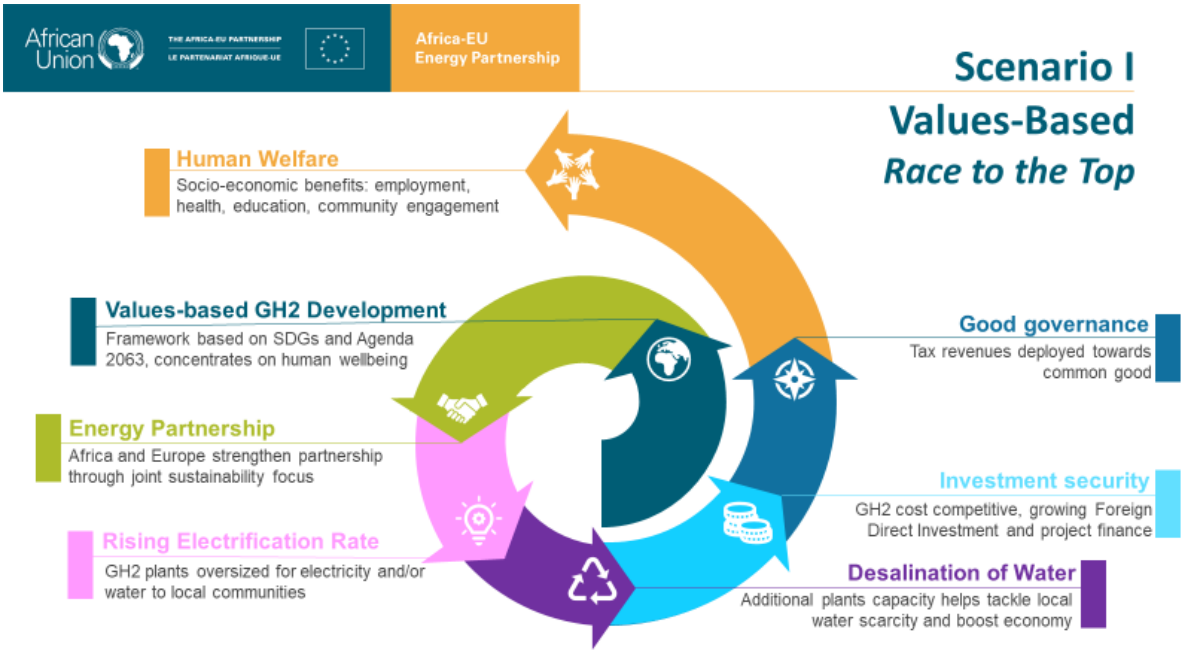
Rich endowments of high value commodities have in the past been observed to have adverse effects on economic growth, good governance and development outcomes. The so-called "resource curse" postulates to an inverse relationship between national resource endowments and these desired outcomes. This has often occurred with fossil fuel endowments.[21]

Ensuring that broad societal and developmental benefits flow from Africa's GH2-related endowments require a careful custodianship of the development path. In this respect, two scenarios can be painted:

- **Scenario 1: Value-based – gradual race to the top**

  In scenario 1, called *Values-based wellbeing*, the multilateral basis of the climate-orientated rules that create a market for GH2 is fully recognized and embedded in all aspects of bicontinental collaboration on the subject. The SDGs as a holistic and inter-related set of goals ultimately aimed at long term human wellbeing are used to create a framework between Africa and Europe that is intended to ensure that GH2 development is fully sustainable. Decent job creation, community engagement, social license to operate, and local socio-economic benefits from GH2 projects all form part of the evaluation and execution structure. In countries with low electrification rates, a minimum percentage of renewable energy generation capacity that is added for the purpose of producing GH2 for export is ring-fenced to either go into the national grid or to supply a local community that does not have access to the national grid. For this reason, GH2 developers oversize the renewable energy plants. As export builds and African countries earn valuable hard currency to further build their economies, electrification rates simultaneously improve. In countries with water scarcity, the oversized plants are used to desalinate water which likewise boost the economy and human wellbeing. African countries with significant GH2 export earnings investigate sovereign wealth funds that ringfence proceeds for broad societal well-being, like Norway has done. Those with existing manufacturing of steel, vehicles and the like green their production processes to take advantage of the increasing desirability of such products. Given the anchoring of the GH2 initiative in broad sustainability norms, the close relationship between Africa and Europe is further strengthened. Other international and sub-international actors find themselves excluded from African GH2 exports unless they agree to likewise pursue broader sustainability. The high governance standards improve the investment climate and countries are increasingly able to attract Direct Foreign Investment and utilize project finance in their energy sectors. There is a gradual race to the top.

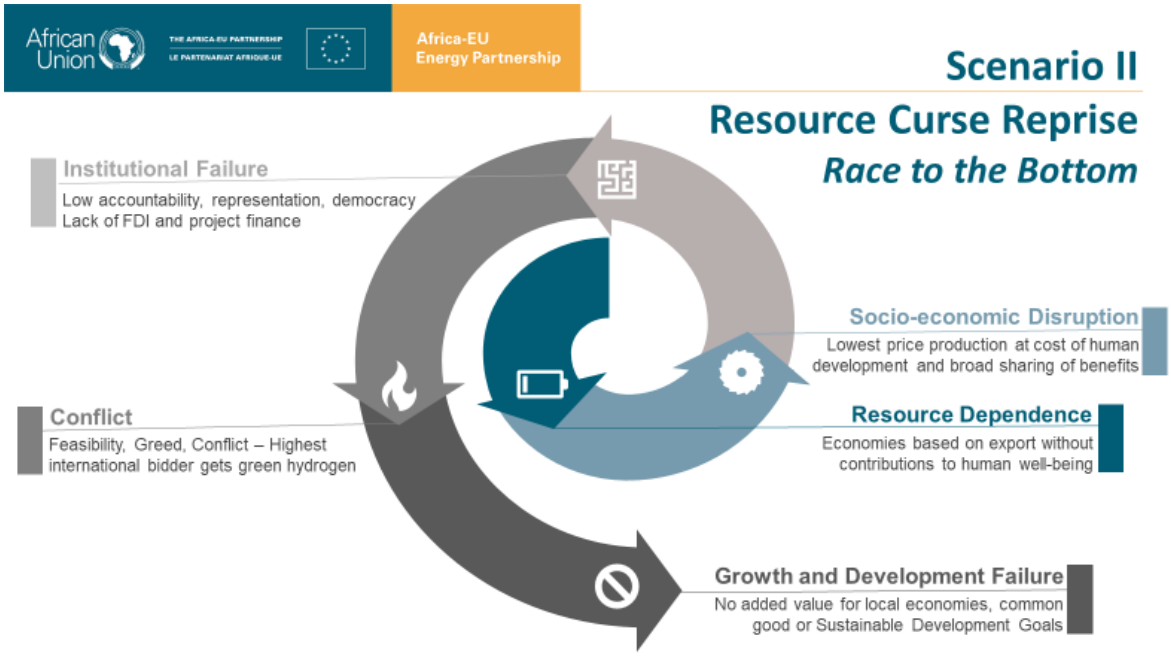
[21] In economic terms, the observed dynamic called "Dutch disease" sees raising resource exports significantly strengthening the currency, making other export products less competitive on the world market and hence leads to a decline of other economic sectors (de-industrialization). At the same time the vulnerability of the economy to external price shocks increases. Politically, such resource discoveries can lead to corruption in an effort to secure the resource and/or the proceeds for a political elite as opposed to the broad population.



Scenario 2: Value-based - gradual race to the top (own illustration)

- **Scenario 2: Resource curse reprise – race to the bottom**

  In scenario 2, called *Resource Curse – reprise*, GH2 acquires a high value and market prominence because of a multilateral focus on climate change, but multi-lateralism and sustainability break down in the execution as each national and sub-national actor largely tries to optimize its narrow self-interest in adapting to a new set of rules. National and corporate actors all search for the lowest cost GH2 merely to comply with decarbonization rules. They competitively engage with potential exporters in Africa to secure supply. Price is the only determinant of who gets the supply and it becomes extremely difficult to secure long term relationships or to secure steady and predictable GH2 supply. There is no requirement for broad public benefit from GH2 investment and potentially a narrow, politically connected class of people benefit without any tangible contribution to SDG7 in Africa, nor to any of the other SDGs. Indeed, the resource curse causes the countries with the greatest endowments of renewable energy to have worse governance and human development outcomes than those less endowed. The flagging governance standards poison the investment climate, countries are increasingly unable to attract Direct Foreign Investment and cannot easily utilize project finance in their energy sectors. There is a gradual race to the bottom, as price outweighs everything else.



Scenario 3: Resource curse reprise - race to the bottom (own illustration)

Continental convergence on Green Hydrogen – The Road Ahead

GH2 is likely to be a major commodity in the sunset years of the fossil fuel age, and beyond. The opportunity exists for Africa and Europe to collaborate for the medium and long term to ensure that human well-being benefits from this new pursuit. The answer to this challenge is to embed GH2 development within the SDGs and Agenda 2063, in order to ensure that such development takes place within qualitative values frameworks that advance all aspects of human development, simultaneously. Such embedding would strengthen the partnership between Africa and Europe, given the deep commitment these continents have to these values vis-à-vis some other international actors that are likely to be active in the commodity trading future.

The AUC and the EC are ideal partners to pursue such a development path. Interested Member States on the two continents can be engaged to further increase impetus. Most immediately, it is proposed that the EC, the AUC and interested Member States on both sides ensure that the the 6th AU-EU Summit as rescheduled will make reference to a Bicontinental Green Hydrogen Roadmap that is values based and anchored in the abovementioned frameworks. Further, that the AUC and EC are mandated by the Summit to consultatively develop a values-based design and monitoring framework for the bicontinental roll-out of GH2.

GH2 is a significant and immediate opportunity presenting itself to Africa and Europe, allowing energy and climate agendas to be aligned for the long term and to mutual benefit. Anchoring the opportunity in existing sustainability frameworks will allow these benefits to be broadly shared for enhanced human well-being.