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# Abstract

The African Hydrogen Partnership Association (AHP) will lay the foundation for establishing hydrogen economies and societies in sub-Saharan Africa. This document describes the African Green Hydrogen Deal and discusses background, vision, goals, strategies and basic organizational aspects.



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# Overview

Renewable hydrogen economies could address many of the economic and environmental challenges Africa faces.

Producing and consuming renewable hydrogen locally would avoid imports of fossil-based fuels and chemicals. This would reduce dependency on the US dollar and help improve trade balances. The savings from this and from reducing pollution (externalities), as well as socio-economic benefits, could fund new hydrogen programs.

Partnerships between industry, the financial sector, science institutions, the public sector and governments could make these hydrogen economies happen rapidly.

Hydrogen technology is ready for use and available now! New markets for it are growing rapidly and offer a great range of environmentally-friendly business opportunities.

Hydrogen technology can unlock the large amount of untapped renewable energy in Africa. Large scale storage and flexible transmission of renewable energy would achieve green electrification of sub-Saharan Africa. Using hydrogen as an energy carrier, large scale renewable energy farms as well as mini-grid solutions could become commercially viable.

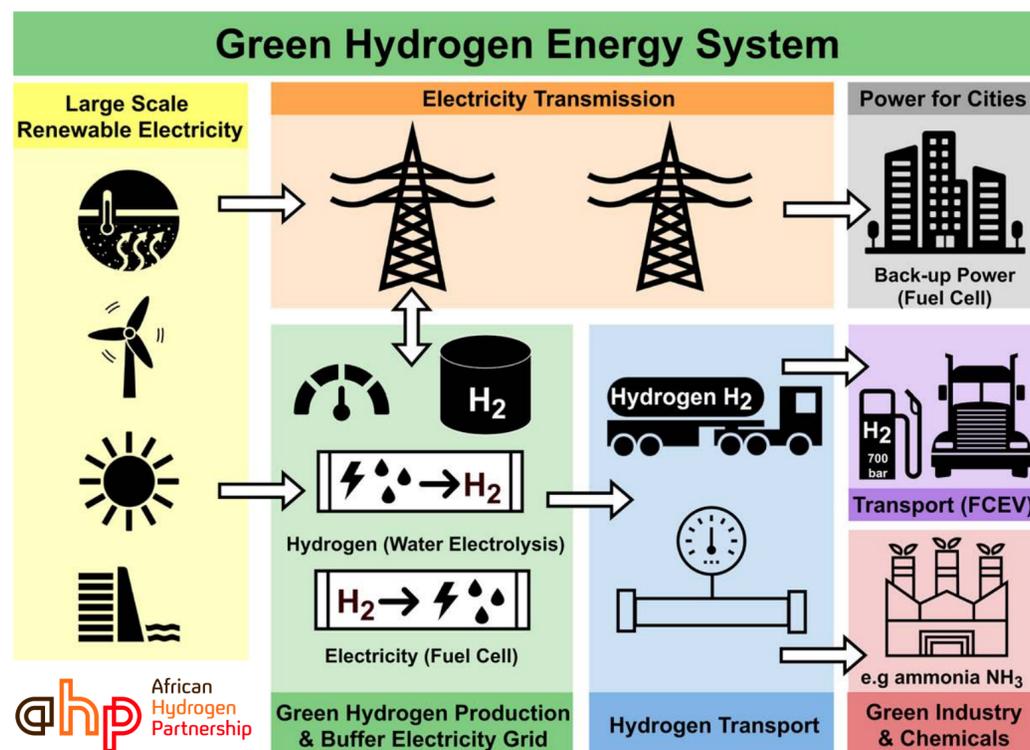
Hydrogen has a high energy density (compressed at 700 bar) so it is the only environmentally friendly alternative fuel for rail and automotive use. It could fuel vehicles carrying heavy loads and long-haul transport in trucks and buses. It could also power the millions of lightweight utility vehicles that sub-Saharan societies depend on.

There's a secondary application of renewable hydrogen after the power and transport sectors. It serves the chemical industry (such as for making fertilizer), the steel industry (used as a reduction agent) and as a reliable fuel for high temperature industrial processes.

Sub-Saharan Africa is an ideal environment for developing the first hydrogen economies from scratch. That's because the flexibility of hydrogen is highly valued by African authorities. They understand that it is the most versatile energy carrier and could be the crucial missing link in their transition to green energy.

## Vision

The African Hydrogen Partnership Association (AHP) will lay the foundation for establishing hydrogen economies and societies in sub-Saharan Africa.



# Goal - African Green Hydrogen Deal

African nations will gain many economic and environmental benefits from the African Green Hydrogen Deal. The Deal will allow rapid development of the new hydrogen technology with all its socio-economic benefits (described in full in the 'Benefits' section). In return, African national and local governments will enact rules and regulations that allow economically and commercially feasible hydrogen projects to get started and develop quickly.

This green hydrogen technology revolution is uniquely achievable in Sub-Saharan Africa because:

1. The region is not locked into old energy technologies (unlike Europe and other areas), so large scale depreciations and exit risks aren't an issue
2. African governments have the power and flexibility to kickstart such a development in a very short time
3. National hydrogen energy plans can be developed from scratch in the region - they're not constrained by existing political and economic interests, as in other parts of the world
4. African governments are already proactively and decisively supporting environmental policies (e.g. Ethiopia's green policies)
5. There are unlimited natural resources for producing low cost green electricity and hydrogen
6. A rapidly growing, young population demands innovative green energy concepts in these growing economies.

The goals of the African Green Hydrogen Deal:

## 1. Relieve

Alleviate the financial exploitation caused by

- US\$ dependency
- external damage created by foreign companies (e.g. air, water, landscape pollution)
- unfair international wealth distribution

## 2. Raise

Elevate national African economies by creating a high value industry and jobs, making them leading forces in the rapidly developing new hydrogen technology market

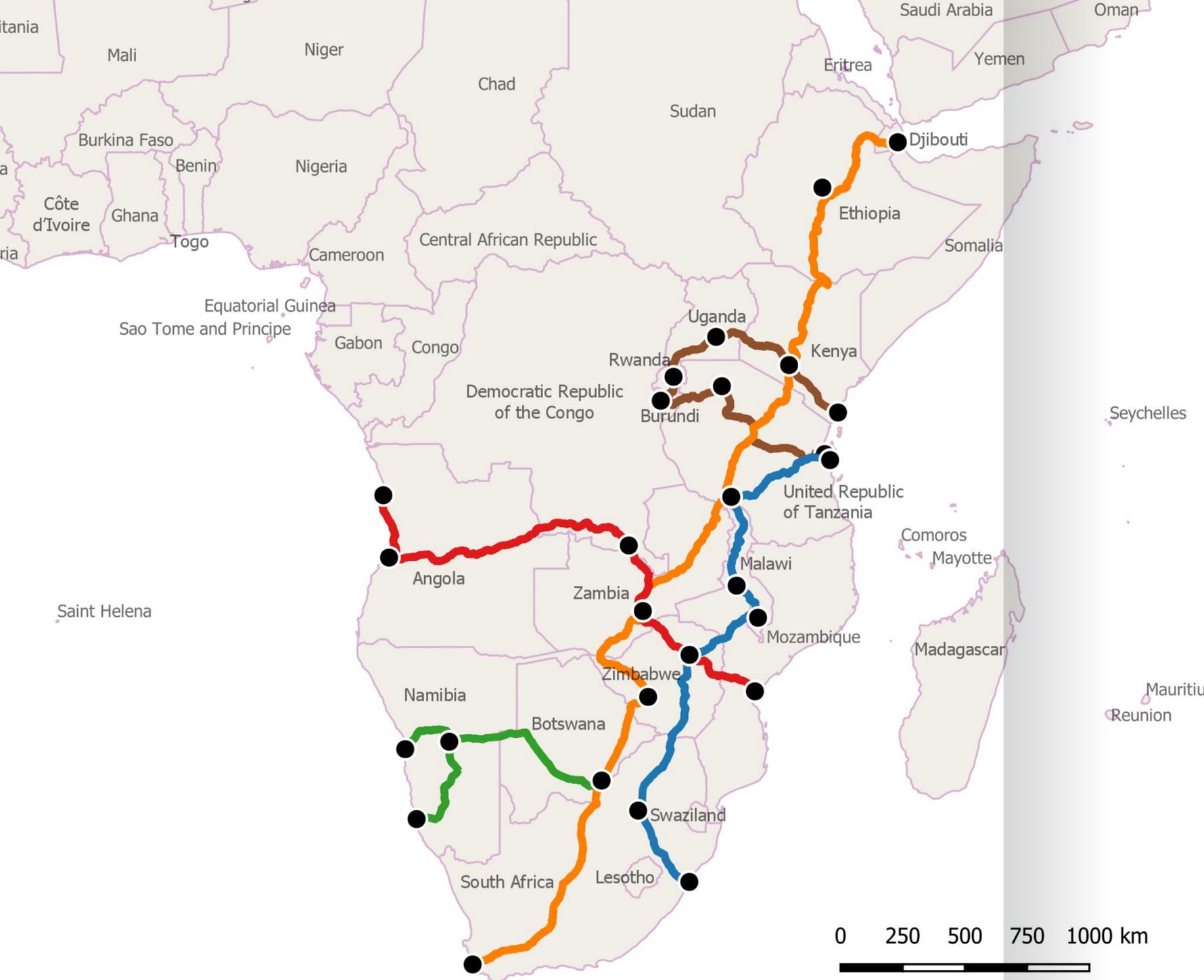
## 3. Revolutionize

Make African nations initiators and leaders of the next industrial revolution in Green Hydrogen - simultaneously revolutionizing the economy, society and environment

AHP will:

1. initiate and support economically and commercially feasible programs that combine large scale Power-to-Gas/Hydrogen (P2G) and Hydrogen (H2) Fuel Cell (FC) applications
2. form strategic alliances, consortiums and syndicates with the strongest partners from business, industry, finance, governments, research and science
3. connect with supranational organizations to implement hydrogen strategies.





# Strategies: Hydrogen Routes

The first hydrogen economies will begin with construction of large scale P2G renewable energy facilities or hubs along important trans-African highways. They'll also be built in ports, where hydrogen stations will provide fuel for long haul heavy goods vehicles (HGVs), buses and trains powered by hydrogen fuel cells.

Hydrogen routes will connect major mining centers that use heavy duty hydrogen vehicles (such as forklifts, tugs and bulldozers.) They will connect harbors, trade centers, metropolitan areas overland and connect near-shore islands with hydrogen-powered ferries. In metropolitan areas where there's severe air pollution, lightweight and convertible hydrogen fuel cell business vehicles could provide sufficient reliable energy to run a small business during the day and to supply electricity to the owner's home at night. These vehicles will make clean transport and power available and affordable for everyone.

P2G stations and hydrogen automotive applications are complementary business solutions, systems and products. In the hydrogen economy, the consumer transports green energy from large scale, independent renewable energy production facilities and from local mini-grids to wherever they need to consume the energy.

This is a new, revolutionary concept for Africa and would remove its current dependency on the electricity grid for energy.

With its large trans-African highway network, Africa offers great business opportunities for the new and rapidly growing hydrogen technology sector.

These are five feasible hydrogen routes along existing trans-African highways and business centers:

1. Beira - Harare - Lusaka - Lubumbashi - Lobito - Luanda
2. Cape Town - Gaborone - Bulawayo - Lusaka - Mbeya - Nairobi - Addis Ababa - Djibouti
3. Gaborone - Windhoek - Walvis Bay - Lüderitz
4. Durban - Johannesburg - Harare - Lilongwe - Blantyre - Mbeya - Dar es Salaam
5. Mombasa - Kampala - Kigali - Bujumbura - Mwanza - Bagamoyo - Dar es Salaam

This is not an exhaustive or final list: other routes could also be constructed. But significantly, these five hydrogen routes connect 15 capitals (metropolitan regions) as well as several significant mining regions and 11 major harbors.



## African Hydrogen Routes

- █ 1. Beira - Harare - Lusaka - Lubumbashi - Lobito - Luanda
- █ 2. Cape Town - Gaborone - Bulawayo - Lusaka - Mbeya - Nairobi - Addis Ababa - Djibouti
- █ 3. Gaborone - Windhoek - Walvis Bay - Lüderitz
- █ 4. Durban - Johannesburg - Harare - Lilongwe - Blantyre - Mbeya - Dar es Salaam
- █ 5. Mombasa - Kampala - Kigali - Bujumbura - Mwanza - Bagamoyo - Dar es Salaam

# Benefits

## Economic and Social:

1. Reduced dependency on US dollar
  - a. Stronger national currencies and financial budgets
  - b. Reduced risks associated with international US dollar denominated loans
  - c. Fairer international wealth distribution
2. Electrification of rural and urban regions
3. Creation of state-of-the-art, cutting edge business sectors and jobs
4. Reduced costs associated with externalities
5. Much lower investment and exit risks compared to large scale fossil fuel and nuclear power plants and large grids, due to diversification and new energy supply concepts
6. Ideal technical solutions for the large size and region-specific needs of Africa (long haul, heavy duty, heavy load and lightweight utility vehicles)
7. Economic growth and socio-economic benefits
8. Increase in tax revenues

## Environmental:

1. Reduced carbon dioxide emissions
2. Cleaner air, soil and water. No toxic substances or pollution from hydrogen fuel. No costly externalities.
3. Less deforestation (e.g. clean cooking)
4. Mitigate the risks of terror and exploitation that can be associated with climate displacement (climate change related migration)
5. Cutting edge technology is scalable to meet the challenge of rapid population growth

# Organisation

The African Hydrogen Partnership Association will function as an umbrella organization for national hydrogen associations. These will be established as legally independent branches, with AHP holding the majority of votes. This will create efficiencies across national borders, delivering accountability and transparency. It will provide full visibility of operations and decision-making, mitigating the risk of bribery and corruption.

**The AHP together with the national branches will form these functional groups:**

1. Renewable energy
2. P2G hydrogen generation
3. Storage, transportation and refueling
4. Land, air and water transport
5. Stationary applications
6. Capital markets
7. Science and regulation



# Timeline: Establishing the Association

The AHP could be set up in a year or less, as long as we can establish close collaboration with founding members in an interim organization. The full Association should start activities from late 2019 or early 2020.

The interim organization, staffed by business managers and government officials, will manage the process of establishing the Association.

# Founders

Mr. Huegemann laid the foundations of the African Hydrogen Partnership Association with the African Hydrogen Power initiative. This will give way to African Hydrogen Partnership once the interim organization has been established. He holds a Masters degree in Finance and Quantitative Analysis from the University of Otago in New Zealand. Mr. Huegemann works as Manager of Derivatives Technology for one of largest global fund management companies.

Mr. Oldenbroek lives and works in Africa. Mr. Oldenbroek graduated from Delft University of Technology as a Mechanical Engineer, specializing in energy technology. He worked as a project and sales engineer before returning to the University of Technology. His PhD studies researched integrated transport and energy systems based on renewable hydrogen, specializing in microgrids with vehicle-to-grid and hydrogen fuel cell electric vehicles. This study sparked his passion for the unlimited potential of renewables, including battery and hydrogen fuel cell technology. Living in Africa, he has a clear understanding of the large potential of the African continent.



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