REPORT

Integrated Africa Power

HDF'S GREEN HYDROGEN PLANS IN ZIMBABWE: *Assessing project potential and feasibility*

First author: Dr. Sandile Mtetwa-Omuthe,
Research & Project Associate, Integrated
Africa Power (IAP)

Second author: Chigozie Nweke-Eze
CEO, Integrated Africa Power (IAP)

12 September, 2023

Cited as:

Mtetwa-Omuthe, S. & Nweke-Eze, C. (2023) HDF's green hydrogen plans in Zimbabwe. Assessing project potential and feasibility. September.

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HDF’s green hydrogen plans

The French company Hydrogene de France (HDF) operates as an Independent Power Producer, specializing in green hydrogen in the forms of power-to-power (Renewstable®) and hydrogen-to-power (Hypower®) solutions. In a power-to-power model, a local renewable energy source, such as solar or wind, produces green hydrogen through electrolysis for subsequent storage. This stored green hydrogen is then used to generate electricity via a fuel cell. In the gas-to-power solution, green or low-carbon hydrogen sourced from gas transport networks or industries is employed for on-demand power generation (refer to Figure 1). Since 2012, HDF has developed an extensive portfolio of projects spanning the Caribbean, Asia, Europe, and South America, including a notable partnership with CEOG to establish the world's first high-power hydrogen power plant in French Guiana. HDF's ongoing projects and aspirations revolve around the installation of 200 MW each of power-to-power and hydrogen-to-power plants by 2025.[1] HDF has ventured into the African market, expanding beyond the four aforementioned regions, and commencing initial operations in Namibia in 2021. Africa's inaugural hydrogen power-to-power plant, located in Swakopmund, Namibia, is designed to produce 30 MW of electricity during the day and evening and 6 MW at night. The plant is also slated to manufacture 1,400 T of green hydrogen annually, boasting an energy storage capacity of 230 MWh. While the initial target for commencing construction of the Swakopmund plant was set for 2023, it is now reported to commence construction in 2024.[2]

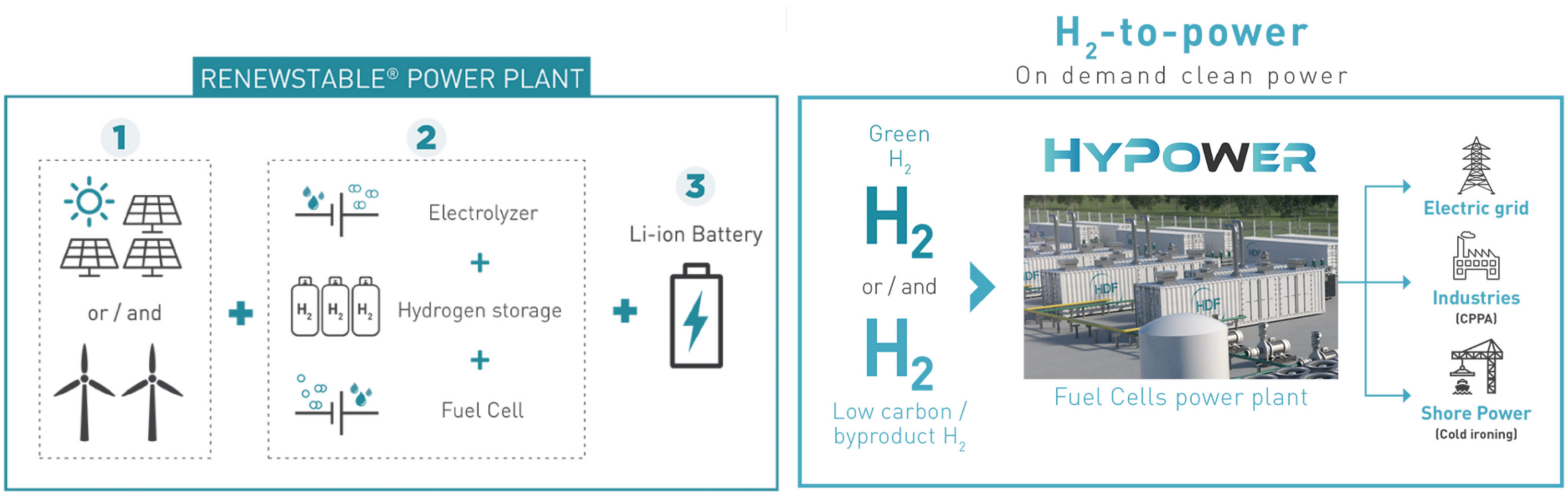

Figure 1: Schematic representation of power-to-power (left) and hydrogen-to-power (right) solutions. Image courtesy of HDF Energy

In early 2023, HDF entered into an MOU with the Zimbabwean Electricity Transmission and Distribution Company (ZETDC) for the development of a power-to-power hydrogen plant in Zimbabwe. This plant, named 'MiddleSabi Renewstable,' will be located in the Chipinge district, a southeastern Zimbabwe region, specifically in the Chipangayi Renewable Energy Technology Park. The planned electricity generation capacity is 40 MW during the day and evening, with an additional 6 MW generated at night. The anticipated annual generation capacity is set at 178 GWh, intended to serve a minimum of 220,000 residents in the region. The agreement between ZETDC and HDF marks a significant milestone in solidifying HDF's commitment to investing in Zimbabwe. Construction of the MiddleSabi Renewstable plant is expected to commence in 2024/2025, following HDF Energy's achievement of financial closure on the project.[3]

But how does the MiddleSabi Renewstable Plant fit into Zimbabwe's energy sector? To understand this, let's first examine the current state of Zimbabwe's energy sector.

Zimbabwe's energy sector: the status quo

Zimbabwe's energy mix comprises non-renewable sources such as coal and oil and renewable sources including biofuels, hydropower, and solar. Renewables constitute 79% of the energy supply, while non-renewables account for 21% (refer to Figure 2). Focusing on electricity, the installed generation capacity in Zimbabwe stands at approximately 2500 MW. The renewable energy share (mainly hydropower) is 49%, whereas the non-renewable contribution (mainly coal) amounts to 51% (refer to Figure 2).[4,5] Whilst the installed generation capacity of 2500 MW can meet the peak power demand of 2200 MW (as of 2023), the country's actual power production is 1400 MW. The fluctuating water levels (due to climate change) affecting the hydropower Kariba Dam's generation capacity and the presence of an outdated thermal power station, namely the Hwange Thermal Power Station, pose a significant threat to the country's electricity access. Moreover, the economic challenges confronting the nation compound the issue of limited electricity access. Consequently, this predicament has led to frequent and unpredictable power outages that persist for over 12 hours daily in most parts of Zimbabwe.

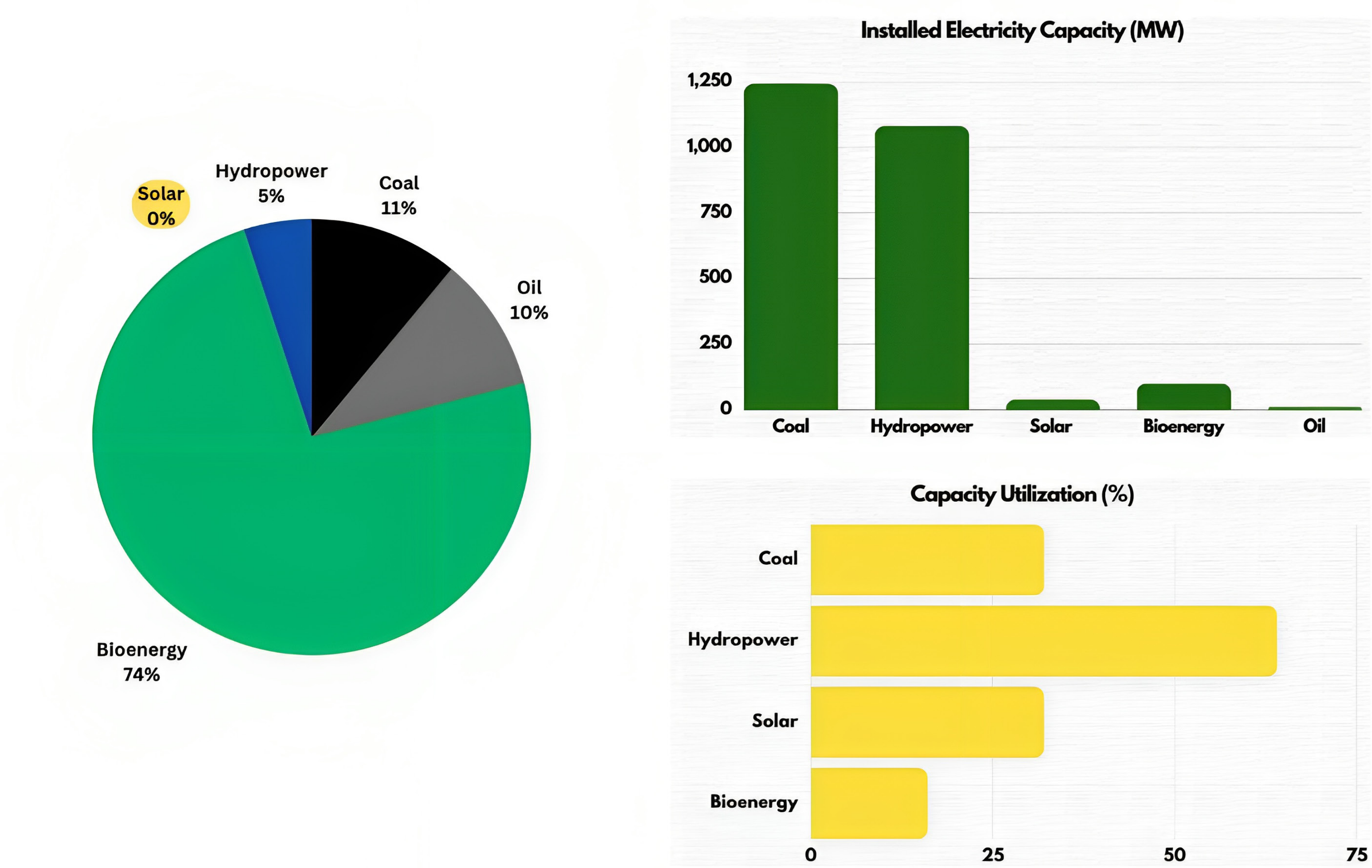

Figure 2: Zimbabwe's energy mix (left) and installed electricity capacity versus capacity utilization (right). Data courtesy of IRENA (2023)

While the current scenario might depict a nation grappling with energy turmoil, an alternate perspective exists. This challenging landscape presents extensive opportunities for the pursuit of highly ambitious and innovative approaches to adopting clean energy and better electricity access. A notable example lies in Zimbabwe's potential for solar power generation. Given a solar potential of up to 20 MJ/m2/day, which theoretically translates to an annual output of 10,000 GWh,[6] Zimbabwe's current reported solar electricity production is a mere 54 GWh (refer to Figure 3). Therefore, the substantial potential for widespread solar adoption in Zimbabwe's national grid supply remains significantly underutilized. While numerous planned projects by both domestic and foreign independent power producers are set to increase the installed solar capacity from <40 MW to 1100 MW by 2025,[7] a pragmatic assessment suggests that achieving this target is highly implausible. This can be pointed to a lack of funding for domestic power producers and concerns over the country's economic stability combined with unfavourable policies and regulations for foreign investment.

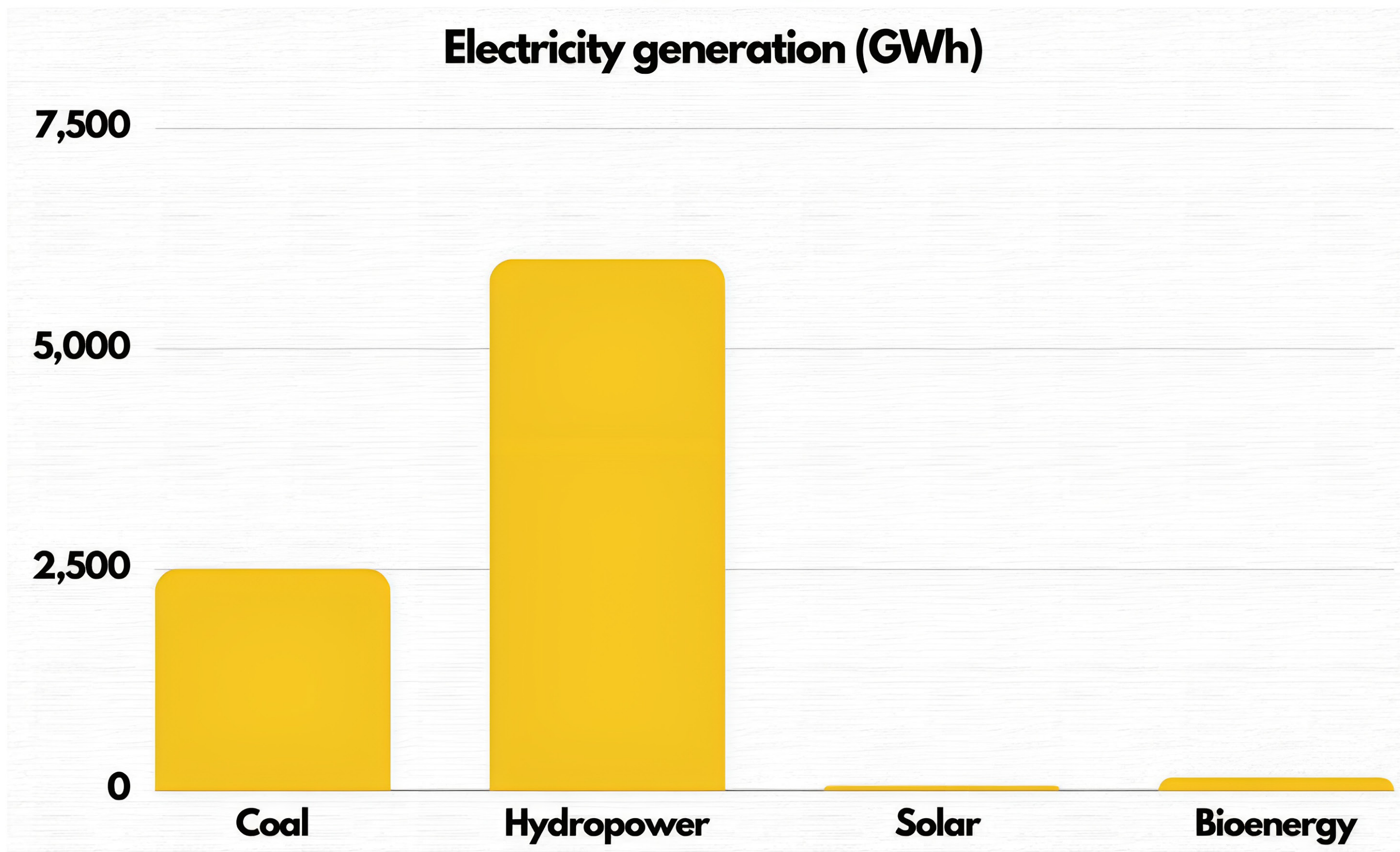

Figure 3: Zimbabwe's annual electricity generation. Data courtesy of IRENA (2023)

Besides large-scale solar adoption, there has been progressively popular adoption of residential solar installations among individuals fortunate enough to afford home solar kits. This trend is being driven by households aiming to overcome the extended periods of power outages experienced daily. The solar kits typically range from 3-5 kVA in capacity with good quality products priced between USD 1000 to 4000. With soaring electricity tariffs in Zimbabwe becoming burdensome, especially considering the economic turmoil and prevalent hyperinflation, residents are struggling to cope with the steep and exponential increases in electricity prices. Therefore, all factors considered, solar power emerges as an affordable long-term alternative. Although comprehensive data and statistics concerning residential solar energy usage in Zimbabwe are lacking, reports indicate that as of 2019, at least 100,000 households were equipped with solar kits.[8] This figure, when compared against the total number of households in Zimbabwe, translates to a barely 3% adoption rate of residential solar energy. This low rate can primarily be attributed to the high capital costs of solar kits, especially within a country where a significant portion of the population falls under the category of low-income earners. As a result, the adoption and efficient utilization of both residential and large-scale solar energy face several challenges. The vse challenges include the high initial cost of home solar kits, the widespread distribution of substandard home solar kits that lack durability, the inherent intermittency and non-storable nature of solar power, as well as a history of proven failures in initiating and expanding large-scale solar projects.

Figure 4: Zimbabwe's first purpose-built grid tied solar PV station with 2.5 MW installed capacity. Image courtesy of NRE Zimbabwe

Potential contributions of MiddleSabi Renewstable green hydrogen plant

In line with Zimbabwe's Vision 2030, which serves as the foundation for transforming the country into a 'Prosperous Upper Middle-Income Nation' by 2030, there is a strong focus on driving rapid industrialization for economic growth. An essential component of this endeavour involves ensuring energy access and security while simultaneously decarbonizing the energy supply, aligning with the United Nations Sustainable Development Goals. Consequently, the significance of a renewable, low-to-zero carbon, storable, reliable, and high-energy-density form of energy cannot be emphasized enough. This is precisely where green hydrogen steps in. Green hydrogen, derived from electrolysis, where water is split into its constituents, H2 and O2, by passing an electric current through it, has gained prominence. The electric current is facilitated by renewable energy sources such as solar or wind power. Given that the energy needed for electrolysis is generated from carbon-free water through renewable means, the production of green hydrogen stands as an emission-free process. Also, reversibly, water is the only by-product when hydrogen is combusted in a fuel cell to produce electricity (refer to Figure 4). This inherent quality positions green hydrogen as an ideal candidate for sustainable and clean energy production.

Furthermore, the efficiency in storing green hydrogen adds to its appeal, making it a superb option for energy storage. Its capacity to store substantial amounts of energy for extended durations renders it invaluable for managing intermittent renewable energy sources like solar and wind power. Consequently, green hydrogen plays a pivotal role in bridging the supply-demand gap within the power grid, thus ensuring a consistent power supply. In addition, the versatility of green hydrogen makes it an even more ideal component of a robust energy mix. It finds application in various sectors, including electricity generation, heating, industrial processes, transportation, and more. Given the reasons that endorse the merits of green hydrogen, HDF Energy's proposed establishment of a green hydrogen power plant in Zimbabwe, if executed accurately, holds the potential to signify a positive stride toward fulfilling energy demands and achieving supply decarbonization.

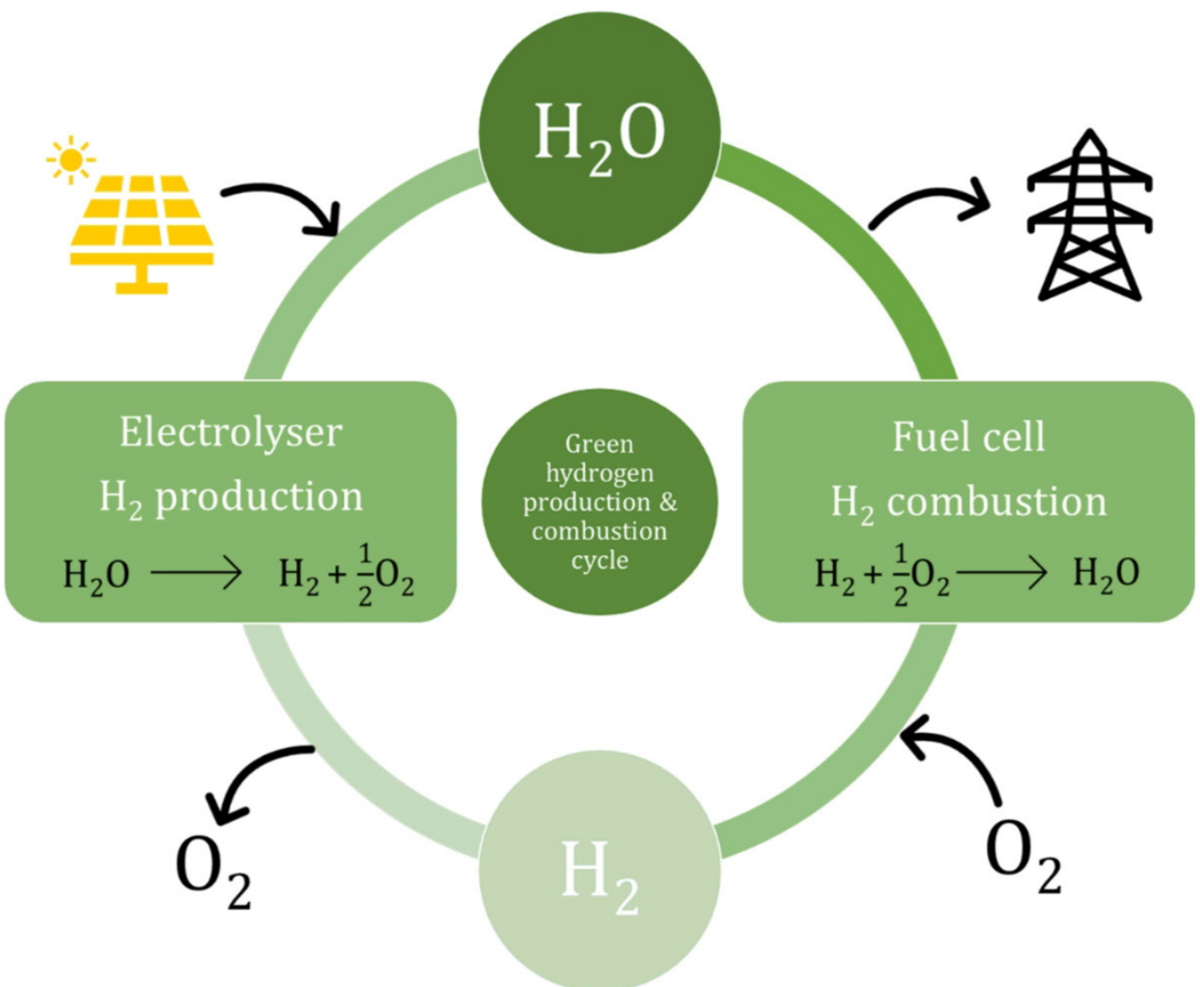

Figure 5: Schematic representation of the green hydrogen production and combustion cycle to generate electricity

Taking a more quantitative perspective on the benefits, the MiddleSabi Renewstable Project is anticipated to contribute 46 MW to the grid. Theoretically, this would satisfy 6.25% of Zimbabwe's current 800 MW electricity deficit. This analysis is conservative, as it considers Zimbabwe's existing electricity mix, excluding other power generation projects in the pipeline. More significantly, the green hydrogen power plant is to be located in an underdeveloped region of Zimbabwe that primarily serves rural communities. Given that only 32% of rural households in the country had access to electricity as of 2023,[9] the planned power generation of 178 GWh by MiddleSabi Renewstable, intended to serve at least 220,000 residents, represents a significant addition. This aligns well with Zimbabwe's Vision 2030 goals of achieving 75% electricity access in rural communities by 2030.[10] There are several additional benefits offered by the planned green hydrogen plant, as outlined by HDF Energy,[3] which includes:

1. Increasing the GDP per capita of the Chipinge District through economic benefits derived from electrification.
2. Diversifying the skillset of the labour force in Zimbabwe through training on the emerging technology and market of green hydrogen.
3. Creating direct and indirect employment for the region.
4. Addressing gender imbalance in the energy sector by actively promoting female participation in the project.

Overall, this project is expected to make numerous contributions, with a focus on driving environmental, economic, and social impacts.

Conclusion

Green hydrogen presents an advanced and forward-looking method for harnessing and utilizing clean energy in Zimbabwe, aligning seamlessly with the country's overarching net-zero agenda for 2050. While the advantages of the MiddleSabi Renewstable Project are unquestionable, a critical issue to address pertains to the project's feasibility and the potential risks that could jeopardize its success.

When assessing feasibility, various factors come into play, including the project's potential for execution and its bankability. Commercializing green hydrogen inherently involves a high level of risk and substantial capital investment. To attract investments, several aspects must be substantiated. This holds significance as HDF Energy has not yet reached financial closure for MiddleSabi Renewstable. While the public may not have access to intricate details regarding the bankability of the HDF-Zimbabwe partnership, several key criteria warrant consideration. These criteria encompass the maturity of the technology, market demand, the presence of a robust supply chain for required resources, the reliability of all project stakeholders, the ability to demonstrate project cash flows, adherence to environmental and social regulations, and the availability of government incentives that can mitigate the project's economic burden, such as tax incentives or subsidies. A key concern centres around the supply chain dynamics, particularly the availability of electrolysers. Presently, project timelines for green hydrogen power plants in the EU are being extended due to delays in electrolyser manufacturing. Therefore, it is of interest to understand how HDF Energy proposes to navigate such uncertainties. Additionally, the absence of a green hydrogen strategy by Zimbabwe also raises concerns since the regulatory and policy frameworks for supporting and implementing green hydrogen projects are currently undefined.

The assessment of project execution potential extends beyond bankability to examine the project developer's capability to successfully implement the project. This involves evaluating the developer's history in undertaking similar projects and the quality of the project team. With over a decade of experience in the green hydrogen industry, an extensive portfolio of pipeline Renewstable plants across the Caribbean, South America, and Namibia, coupled with their track record of achieving bankability for projects in Cyprus, Mexico, French Guiana, and Namibia, HDF Energy, at first glance, appears well-positioned for successful project execution.

Lastly, a commonly cited risk associated with green hydrogen production and utilization is the project's sustainability, which hinges on water availability. Solar power, necessary for electrolysis, is abundant and expected to remain so; however, the issue of water scarcity could emerge. Considering the impact of climate change-induced drought, which has evidently affected water levels at the Kariba Dam, one might argue that a long-term water deficiency at the project site is plausible. This presents a sustainability risk that cannot be overlooked.

Future scope

The proposed HDF Energy plant aims to provide capacity to fill approximately 6% of the current electricity deficit faced by Zimbabwe. While this is commendable, it falls short of meeting the full need. Construction is anticipated to begin only in 2025, pending successful financial closure, and additional years will be required to officially commence operations. Hence, it's clear that there is significant time pressure on this project to contribute to Vision 2030. As a result, it becomes crucial for the nation to intensify its efforts in creating a more diverse clean energy mix capable of effectively addressing the power needs of industry, households, and commerce. If the country has demonstrated its ability to attract private investments for establishing a green hydrogen power plant, it logically follows that other green energy initiatives can similarly be financed.

According to the nation's recent National Renewable Energy Policy Document (NREP 2019), energy sources like solar, biofuels, mini-hydropower and geothermal have been identified for expansion, research, and large-scale implementation. However, as of 2023, the installed capacities of these energy sources remain low in the case of solar (refer to Figure 2) and bioenergy (100 MW of a potential 1000 MW) and virtually non-existent in the case of geothermal (0 MW of a potential 50 MW) and mini hydropower expansion (0 MW of a potential 150 MW).

The potential of MiddleSabi Renewstable and green hydrogen, in general, in Zimbabwe, offers a ray of hope. Moving forward, the country needs to establish a roadmap that clearly outlines actions, milestones, and timelines, thereby ensuring that all involved parties fulfil their obligations and contribute to shaping better project delivery. Hydrogen's versatility can promote its use not only in electricity generation but also in other industries, such as fertilizer production. As time can only determine the project's feasibility and execution, it represents a positive stride towards promoting a balanced and strategic energy mix. This, in turn, can ensure widespread access to energy while enhancing security for various needs, including electricity, cooking, heating, cooling, and potentially even transportation.

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First author: Dr. Sandile Mtetwa-Omuthe, Research & Project Associate, Integrated Africa Power (IAP)

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CEO, Integrated Africa Power (IAP)

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