7 • 1 • 2025

GREEN ENERGY OR GREEN COLONIALISM? THE CASE OF GREEN HYDROGEN IN NAMIBIA

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Diritto, Istituzioni, Società

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doi: 10.54103/2612-6672/28852 ISSN 2612-6672 – Anno 2025 – vol. 7 (n. 1)

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Energia verde o colonialismo verde? Il caso dell'idrogeno verde in Namibia

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Abstract

[Eng.] Green hydrogen, promoted by institutions like the International Renewable Energy Agency and the European Union as pivotal to decarbonization, faces criticism through the lens of green colonialism. This paper argues that the energy transition often replicates neo-colonial resource extraction, particularly in Global South nations such as Namibia, where reliance on external technologies and investments risks perpetuating dependency and sidelining local communities. Through an interpretative analysis of global discourse and Namibia's green hydrogen project, the study underscores the need for a people-centered approach. It proposes justainability—merging justice with sustainability—to prioritize equitable benefits and participatory decision-making, challenging top-down models that neglect socio-environmental equity.

Keywords: Energy transition – green hydrogen – green colonialism – justainability – Namibia

[It.] L'idrogeno verde, promosso da istituzioni come l'Agenzia Internazionale per le Energie Rinnovabili e l'Unione europea come elemento chiave per la decarbonizzazione, viene criticato attraverso la lente del colonialismo verde. Questo articolo sostiene che la transizione energetica spesso replica modelli neocoloniali di estrazione delle risorse, in particolare nei paesi del Sud del mondo come la Namibia, dove la dipendenza da tecnologie e investimenti esterni rischia di perpetuare la subalternità ed emarginare le comunità locali. Attraverso un'analisi interpretativa del discorso globale e del progetto namibiano sull'idrogeno verde, lo studio sottolinea la necessità di un approccio centrato sulle persone. Propone la giustificabilità – fusione di giustizia e sostenibilità – per privilegiare benefici equi e processi decisionali partecipativi, sfidando i modelli top-down che trascurano l'equità socio-ambientale.

Parole chiave: Transizione energetica – idrogeno verde – colonialismo verde – giustificabilità – Namibia

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* Lecturer, University of Namibia (https://ror.org/016xje988). Research for this article was done with the support from project PRIN 2022, JUSTAINABILITY - Just sustainability. Rhizomatic social innovations, transformative knowledge, and prefigurative practices for a just transition - 2022HKE2CY. The essay was submitted to a double-blind peer-review procedure. Member of the Editorial Team who oversaw the essay: Christian Mosquera.

Published online: 25/06/2025

Milano University Press

1. INTRODUCTION

A set of legislative proposals adopted by the EU (European Union) in 2021 aims to reduce GHG (Green-House Gas) emissions by at least 55% by 2030 and reach NZE (Net Zero carbon Emission) by 2050, in alignment with the goals of the Paris Agreement[1]. Experts agree that achieving these targets is crucial to limiting global warming to no more than 1.5°C above pre-industrial levels, thereby mitigating climate change and its far-reaching impacts. With the energy sector accounting for approximately three-quarters of global GHG emissions, transitioning to renewable energy sources for electricity generation and reducing reliance on fossil fuels is imperative[2]. A crucial element of this transition is H_2 (Hydrogen), which is rarely found in its free form and must be produced through processes such as water electrolysis[3] or extracted from fossil fuels, minerals, and methane[4]. When hydrogen is produced using energy sources such as solar or wind power, it is classified as GH_2 (Green Hydrogen) and has little to no environmental impact releasing only water as a by-product, rather than CO_2 or other air pollutants. From this perspective, GH_2 stands out as an exceptional solution for advancing the energy transition, and achieving climate neutrality.

The potential of GH_2 to eliminate dependence on fossil fuels has been met with considerable enthusiasm and is often celebrated as a transformative step toward a sustainable energy future[5]. However, a closer investigation uncovers a multifaceted landscape fraught with both social and technical challenges that complicate this optimistic clean energy narrative. For example, the renewable energy needed for electrolysis can result in land-use changes, potentially competing with agricultural demands, impacting food security, or disrupting fragile and protected ecosystems.

Moreover, the hydrogen production, storage, and transport infrastructure must be carefully designed to minimize the risk of hydrogen escaping through even minor cracks and gaps in containment systems. Nevertheless, this positive narrative often ignores a critical truth: countries in the GN (Global North), historically the largest contributors to greenhouse gas emissions, are now shifting energy-intensive

[1] The Agreement, which entered into force on 4 November 2016, sets to reduce global greenhouse gas emissions and maintain global temperature increase to well below 2°C above pre-industrial levels.

[2] International Energy Agency, *Global Energy and Climate Model*, International Energy Agency, https://www.iea.org/reports/global-energy-and-climate-model, 2023a.

[3] C.M. Rupérez, *¿Por qué hidrógeno y por qué ahora?*, OBS Business School, 2022, https://marketing.onlinebschool.es/Prensa/Informes/Informe%20OBS%20Mercado%20del%20Hidrogeno%202022.pdf?no_link=1.

[4] Q. Hassan, A.M. Abdulateef, S.A. Hafedh, M. Jaszczur, *Renewable energy-to-green hydrogen: A review of main resources routes, processes and evaluation*, in *Int. J. Hydrogen Energy,* No. 48, 2023, 17383–17408.

[5] K. Taylor, *Hydrogen will be 'pivotal element' in the future economy, says EU climate chief*, Euractiv, 2022, https://www.euractiv.com/section/energy-environment/news/hydrogen-will-be-pivotal-element-in-future-economy-says-eu-climate-chief/.

Nuovi Autoritarismi e Democrazie: Diritto, Istituzioni e Società
ISSN 2612-6672 – n. 1/2025

industrial activities to nations in the GS (Global South). This practice creates an illusion of decoupling energy consumption from emissions, enabling Northern countries to present themselves as reducing their environmental impact while effectively transferring the burden—and the associated ecological costs—to the GS.

An analysis of greenhouse gas emissions reveals a significant disparity in per capita emissions and overall contributions to climate change. While economies in the GN continue to exhibit relatively high per capita emissions, the situation in the GS is marked by a concentration of emissions among a small number of countries. Notably, China and India are responsible for nearly 60% of the emissions from the GS. While many low-and middle-income countries in the region contribute minimally to global warming, with some accounting for less than 1% of total emissions. For instance, Sub-Saharan African nations, including Namibia[6], have historically emitted low levels of greenhouse gases while being among the most vulnerable to climate impacts[7]. At the same time, the natural resources of many countries in the GS are being used to develop large-scale green energy projects to address the emerging demand from the GN. Concurrently, local communities in the production countries often do not have access to the energy generated while bearing the effect of environmental degradation and social disruption. As a result, these countries, despite having contributed relatively little historically to global emissions, find themselves trapped in North-South power dynamics that may reflect new forms of colonialism. This raises significant ethical and practical concerns about equity and responsibility in the global energy transition. On the other hand, by framing these regions as mere sites for energy production, there is the risk of perpetuating a colonial mindset that views land and resources as commodities to be exploited to satisfy the energy demands of the Northern countries.

This paper's thesis explores the research questions that seek to uncover the potential link between the green hydrogen hype and the emergence of new forms of extractive colonialism[8]. The Namibian case study provides critical insights into the intricate dynamics of green hydrogen development. As a country identified for large-scale green hydrogen production, Namibia's experience sheds light on the complex interplay between global energy demands, local development priorities, and environmental sustainability. Through a critical analysis of these factors, this case study seeks to determine whether green hydrogen initiatives in countries like Namibia present a genuine opportunity for sustainable development or risk devolving into another iteration of resource extraction that disproportionately benefits external actors.

Following this introduction, the paper outlines the study's methodology and theoretical framework. Section 3 explores the underlying motivations driving the prominence of GH_2 as a cornerstone of the energy transition. Section 4 examines the European angle on the green transition, analysing the rhetoric employed by stakeholders to determine whether it reflects a genuine commitment to sustainability or obscures underlying interests that may reinforce existing inequalities.

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[6] Namibia is a net carbon sink, it absorbs more GHGs than it emits, in 2019, prior to Covid, the country accounted just 0.01% of global emissions, R. Sherbourne, *Namibia's Green transition: A summary of the issues*, Democracy Report, Institute for Public Research, 2022.

[7] H. Fuhr, *The rise of the Global South and the rise in carbon emissions*, in *Third World Quarterly*, 42(11), 2021, 2724–2746; International Energy Agency, *CO_2 Emissions in 2023*, IEA, 2024, https://www.iea.org/reports/co2-emissions-in-2023.

[8] P. Ederhardt, *Germany's great hydrogen race, The corporate perpetuation of fossil fuels, energy colonialism and climate disaster*, Corporate Europe Observatory, 2023.

In Section 5, the focus shifts to the Namibian case, offering a detailed examination of Namibia's unique role in the global green hydrogen landscape. By integrating local perspectives and experiences, this section seeks to uncover the opportunities and challenges Namibia faces as it navigates this emerging energy frontier. Section 6 provides a critical analysis of the risks associated with the energy transition, including its potential to manifest as a new form of colonialism. Finally, the paper concludes by synthesizing the key findings and discussing their broader implications for policy and practice.

2. THE METHODOLOGY AND THE THEORETICAL FRAMEWORK

An interpretative desk study methodology has been employed in this study, the literature was gathered from a variety of academic platforms, including ResearchGate, Google Scholar, Academia, Science Direct, and Wiley Library. These resources were essential in obtaining credible and scholarly materials that enhanced our understanding of the complex relationship between energy transitions and the legacies of colonialism. Documents produced by the International Energy Agency, the EU's green hydrogen papers, green hydrogen agreements between Namibia and interested European partners, and Namibian government documents related to Namibia's green hydrogen policy, allowed the data collection. The review is further enriched by an analysis of a Namibia's ambitious multibillion-dollar green hydrogen projects. This project's importance is heightened by Germany's active interest and involvement, a connection that resonates deeply given its historical role as Namibia's colonizer. The case study explores the intersection of renewable energy development and historical patterns of exploitation, particularly within the framework of green colonialism, it also raises concerns about the implications for local communities and their rights to land and resources.

Research has shown that while the shift to renewable energy is essential for mitigating climate change, it can also perpetuate patterns of exploitation reminiscent of historical colonial practices. This duality highlights the critical need to evaluate how renewable energy projects are implemented, particularly in GS countries where resource extraction frequently results in the exploitation of land, resources, and labour[9]. These initiatives often disproportionately cater to the energy demands of industrialized nations, further widening the disparities between communities in the GS and the GN.

The transition to green energy is often celebrated as a critical step toward achieving sustainability. However, the concept of "green colonialism" or "energy colonialism," as articulated by Contreras et al.[10], emerges as a central theme in contemporary discourse. This concept highlights how renewable energy initiatives can sometimes replicate colonial dynamics[11], perpetuating historical patterns of exploitation and inequality under the guise of sustainability. Appropriating natural resources has been a fundamental production process since the Industrial Revolution. This practice evolved into a systematic and organized form during the conquest and colonization of the Americas, persisting through the colonization of numerous countries in Asia and Africa under the capitalist system. It has led to an unequal relationship between center and periphery, or between colonized and colonizing countries, based on the extraction

[9] H. Hamouchene, *The Energy transition in North Africa. Neocolonialism again*, TNI, Friedrich Ebert Stiftung, 2022.
[10] J.S. Contreras, A. Mataran Ruiz, A. Campos-Celador, E.M. Fjellheim, *Energy colonialism: A category to analyse the corporate energy transition in the Global South and North*, in *Land*, No. 12, 2023, 1241.
[11] E.I. Archibong, A.P. Afolabi, *From colonial exploitation to renewable transition: A critical analysis of Africa's energy paradigm*, in *European Journal of Sustainable Development Research*, No. 7, 2023.

and export of raw and agricultural materials and the import of manufactured goods, which have led to an unequal term of trade between the countries of the South and the GN, and which development scholars have defined as dependency theory[12].

This legacy persists through ongoing colonial dynamics even after the colonies gained political independence. Generally, extractive activities are associated with the use of non-renewable resources and typically exhibit three key attributes[13]:

- a high level and vigorous-intensity in the process of resource extraction
- a low or minimal level of processing local resources and
- a significant quantity of extracted resources destined for export.

This model is intrinsically tied to globalization, characterized by the inflow of capital, technology, and specialized labour from developed nations, exporting raw materials, and repatriating profits to foreign countries. However, such extractive economies often remain poorly integrated with the broader national economy and show minimal linkage to domestic industries. A typical example involves the large-scale extraction of minerals or hydrocarbons, primarily for export, with little to no local value addition. For instance, many major oil-exporting countries in the GS lack refining capabilities, necessitating crude oil export to refineries in the GN. Nigeria, one of Africa's largest oil producers, is a prime example of this trend[14].

However, extractive activities include those linked to using other natural resources, such as wood, marine, or agricultural products, when the extracted resources exceed their regeneration capabilities[15]. So, the concept of extractive activities can be expanded to include appropriating resources from natural elements such as sunlight, wind, and rivers, often harnessed for generating clean energy through localized project implementations. This mode of resource extraction can be associated with a modern form of colonialism, as it frequently involves exploiting local resources to benefit external entities while providing limited returns to the host communities. It often prioritizes the energy transition requirements of GN nations, displaces local communities through land expropriation, and perpetuates existing energy-intensive global production and consumption patterns. While commodification of resources may function effectively within capitalist systems, it poses significant challenges to environmental sustainability and social equity. Assigning economic value to natural resources previously regarded solely for their intrinsic use value and their quantification for financialization creates a paradox: the notion of selling nature to save it[16]. Such a process can promote neo-colonialism, where wealthier nations or corporations exploit resources in the GS countries without adequately addressing local needs or rights.

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[12] F.H. Cardoso, E. Faletto, *Dependency and development in Latin América*, University of California Press, 1979; S. Chaturvedi, M. Chakrabarti (eds), *Raul Prebish and development strategy*, RIS, 2019; B.N. Ghosh, *Dependency theory revisited*, Routledge, 2019.

[13] A. Acosta, *Extractivism and neoextractism: two sides of the same course*, in M. Lang, D. Mokrani, (eds), *Beyond development. Alternative visions from Latin America*, Transnational Institute / Rosa Luxemburg Foundation, 2013.

[14] Historically, Nigeria has relied heavily on foreign refineries to process its crude oil, which has limited its ability to benefit fully from its natural resources. Only recently in January 2024, the country has moved toward self-sufficiency in refining by constructing the Dangote refinery. Cfr. This Day, *We build our $ 20Bn refinery without single incentive from FG*, 14 November 2024, https://www.thisdaylive.com/index.php/2024/10/08/dangote-we-built-our-20bn-refinery-without-single-incentive-from-fg/.

[15] E. Gudynas, *Neo-extractivismo y crisis civilizatoria*, in G. Ortega, (ed.) *América Latina: avanzando hacia la construcción de alternativas*, Base IS, 2017.

[16] X. Dunlap, *The system is killing us, land grabbing, the green economy and ecological conflict*, Pluto Press 2024.

This dynamic often leads to ecological harm, exacerbating community inequalities and maintaining the same political, economic, and social structures perpetuating inequality[17].

3. ENERGY TRANSITION AND THE GREEN HYDROGEN HYPE

Energy transition is the move from one form of energy production and use to another. In the past, such transitions were caused by a scarcity of one resource, leading to using an alternative resource. The term energy transition was first used in the late 1970s by US President Carter in his address on the nation of energy, where he said: «Twice in the last several hundred years, there has been a transition in the way people use energy [...] Because we are now running out of gas and oil, we must prepare quickly for a third change to strict conservation and the renewed use of coal and to permanent renewable energy sources like solar power»[18].

The expression gained traction in Germany during the 1980s, indicating that it was possible to achieve economic growth with lower energy consumption and a shift from oil and nuclear power to renewable energies[19]. However, it was not until the 1990s that a broader consensus emerged on the risks associated with climate change. This period marked the beginning of international efforts to address greenhouse gas emissions through agreements to promote the urgent adoption of renewable energy. One of the most significant milestones was the Kyoto Protocol, adopted on 11 December 1997. The protocol aimed at combatting global warming by reducing greenhouse gas concentrations in the atmosphere to «a level that would prevent dangerous anthropogenic interference with the climate system»[20]. Nevertheless, the Paris Agreement, established during the COP21 in 2015, sent a strong message to move away from fossil fuels. In Paris, representatives from 196 nations committed to achieving carbon neutrality by 2050, to limit global warming to well below 2°C, and preferably 1.5°C above pre-industrial levels[21].

The new energy transition is markedly different from the early 1970s, primarily driven by concerns over oil scarcity. Today, oil production and consumption dynamics have evolved significantly, with fears of resource depletion playing a less central role. The continued discovery of new oil reserves[22] and advancements in extraction technologies have mitigated immediate concerns about shortages and significantly reshaped global energy priorities. Accordingly, the current transition towards renewable energy sources is fundamentally driven by the urgent need to address climate change, highlighting a growing awareness of its severe impacts on natural ecosystems and human societies: coal, oil, and gas combustion

[17] L. Pellizzoni, *Commodifying the planet? Beyond the economy of ecosystem services*, in *Stato e Mercato*, No. 121, 2021.

[18] J. Carter, *Address to the nation of energy*, https://www.presidency.ucsb.edu/documents/address-the-nation-energy (para. 10 and 13), 1997.

[19] F. Krause, H. Bossel, K.F. Müller-Reißmann, *Energie-Wende: Wachstum und wohlstand ohne Erdöl und Uran* (in English *Energy transition: Growth and prosperity without oil and uranium*), Öko-Inst, 1980.

[20] United Nations, *Kyoto Protocol on the United Nations framework convention on climate change*, (art. 2), 1997, https://unfccc.int/resource/docs/convkp/kpeng.pdf.

[21] United Nations, *The Paris Agreement*, 2015, https://unfccc.int/process-and-meetings/the-paris-agreement.

[22] Namibia has become an oil exploration hotspot after several discoveries in recent years along its coast, overall an estimated 11 billion barrels in oil reserves have been found putting Namibia on par with neighboring Angola, whose reserves are estimated at around 13 billion barrels and whose production rivals Africa's top producer, Nigeria, Reuter, Oil exploration boom in Namibia, https://www.reuters.com/business/energy/oil-exploration-boom-namibia-2024-06-21/. A cumulative 3.76 billion barrels of oil equivalent was discovered in Guyana between 2022 and 2023, Statista, https://www.statista.com/statistics/1463293/new-oil-and-gas-discoveries-by-country/. In September 2024, a substantial deposit of petroleum and natural gas has been discovered in Pakistan's territorial waters, The Hindu, *Massive oil, gas reserves found in Pakistani water*: Report, https://www.thehindu.com/news/international/massive-oil-gas-reserves-found-in-pakistani-waters-report/article68616690.ece.

accounts, in fact, for 89% of all CO_2 emissions[23]. Meeting the NZE's target and moving away from fossil fuels requires cleaner energy sources. Hydrogen seems to fit perfectly; it has the same functionalities as any other fuel gas, such as natural gas, butane, propane, etc., but it has the advantage of only emitting water. GH_2, produced using only renewable energy, is by far the best alternative in addressing the need to use and not emit CO_2 energy sources.

Currently, there are very few operational green hydrogen projects, most of which are small in production capacity and predominantly located in the GN, where most hydrogen production occurs. The cost of GH_2 production is heavily influenced by the level of technology employed and the process of electrolysis central to green hydrogen production. While theoretically clean, this method faces significant challenges. The efficiency of electrolysers remains a key concern, as achieving optimal performance requires advanced technologies designed for large-scale production. Moreover, such projects demand vast amounts of land for the electrolysis facilities and the solar and wind energy infrastructure needed to power the process. This explains the current rush by the countries of the GN towards the investment and development of sizeable green hydrogen production projects in the GS's countries and in Africa[24], where both land and natural resources such as wind and solar power are easily accessible (fig. 1)[25].

Figure 1. Main Green Hydrogen projects planned in Africa

Country	Project	Operator	Start-up*	Capacity (MW)
	Aman Project	CWP Global	Phase I – 2030 Phase II – 2034 Phase III – 2036	15000
	Project Nour	Chariot Ltd	Phase I – 2026 Phase II – 2029 Phase III – 2032	10000
	Amun Project	CWP Global	Phase I – 2028 Phase II – 2032 Phase III – 2035	9000
	Guelmim-Oued Nour Plant	Total Eren	Phase I – 2027 Phase II – 2031	6000
	Scatec Green ammonia Ain Sokhna	Scatec	Phase I – 2026 Phase II – 2030	4329
	Masdar Ain-Sokhna	Hassan Allam Holding	Ph I – 2026 Ph II – 2026 Ph III – 2030 Ph IV – 2030	3450
	Tsau Khaeb	Nicholas Holdings	Ph I – 2026 Ph II – 2026 Ph III – 2028 Ph IV – 2028	3000
	Hive Energy Green Ammonia Plant		Phase I – 2025 Phase II – 2035	1200

Source: International Energy Agency[26]

[23] Client Earth, *Fossil fuels and climate change: the facts*, Client Earth, https://www.clientearth.org/latest/news/fossil-fuels-and-climate-change-the-facts/, 2022.
[24] International Energy Agency, *Global Hydrogen Review 2023*, International Energy Agency, 2023b.
[25] M. Noussan, P.P. Raimondi, R. Scita, M. Hafner, *The role of green and blue hydrogen in the energy transition—A technological and geopolitical perspective*, in *Sustainability*, No. 13, 2021, 298, https://doi.org/10.3390/su13010298.
[26] International Energy Agency, *Global Hydrogen Review 2023*, cit.

After outlining the key characteristics of GH_2 production, this paper focuses on exploring the significance of green hydrogen for European countries before delving into the Namibian case study.

4. THE EUROPEAN PERSPECTIVE

Policymakers in Europe have advocated for green hydrogen to be recognized as an ideal energy source to achieve net-zero emissions by 2050, fostering the development of climate-neutral economies and expanding clean energy technologies across Europe[27]. Germany has been at the forefront of this initiative since 2014, when it opened its first hydrogen fuelling station, marking a significant step toward integrating hydrogen into its transportation sector[28]. The country's need for green hydrogen has become increasingly urgent, driven by strategic, environmental, and geopolitical factors. As the country navigates its energy transition amid climate commitments and recent geopolitical upheavals, particularly the war in Ukraine, green hydrogen has emerged as a cornerstone of its future energy strategy.

On the one hand, the NHS[29] (National Hydrogen Strategy) underscores the critical importance of this clean energy source in significantly reducing greenhouse gas emissions by 2030 and meeting climate neutrality objectives by 2045. The Federal Government anticipates that the national demand for hydrogen and its derivatives will reach between 95 and 130 TWh (Terawatt-hours) by 2030. According to Shaw, approximately 50 to 70 percent of this demand, equating to 45 and 90 TWh, will need to be fulfilled through imports from other countries, as local conditions are unfavourable for hydrogen production[30].

On the other hand, Germany has historically relied heavily on fossil fuels to meet its energy needs, with a substantial portion imported from countries like Russia. However, the invasion of Ukraine and the subsequent sanctions have exposed significant vulnerabilities in this dependency. The ongoing crisis has underscored the substantial risks associated with relying on limited sources for energy imports, prompting Germany to explore alternatives that can enhance its energy security.

This shift is not occurring in isolation; many EU countries share similar energy concerns and objectives, particularly the commitment to achieving climate neutrality. In September 2022, Ursula von der Leyen, President of the European Commission, announced the establishment of the EHB (European Hydrogen Bank)[31]. This initiative is designed to stimulate the hydrogen sector by providing financial support to renewable hydrogen producers within the EU, Norway, and Iceland[32]. The primary goal of

[27] In its strategic vision for a climate-neutral EU, published in November 2018, the share of hydrogen in Europe's energy mix is projected to grow from less than 2% to 13-14% by 2050, COM, *A Clean Planet for All. A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy*, 2018, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0773; Fuel Cells and Hydrogen 2 Joint Undertaking, *Hydrogen roadmap Europe: a sustainable pathway for the European energy transition*, Publications Office of the European Union, 2016.

[28] The world's first two hydrogen trains have been in service in Lower Saxony since 2018, K. Berg, *Mobile with hydrogen*, https://www.deutschland.de/en/topic/environment/hydrogen-engines-for-buses-trains-and-cars-in-germany.

[29] Federal Ministry for economic Affairs and Climate Action, *The National Hydrogen Strategy*, https://www.bmwk.de/Redaktion/EN/Hydrogen/Dossiers/national-hydrogen-strategy.html.

[30] A. Shaw, *German government approves hydrogen import strategy, industry raises concerns*, in *Power Technology*, 2024, https://www.power-technology.com/news/german-government-approves-hydrogen-import-strategy/.

[31] European Commission, *State of the Union*, European Commission 2022, https://ec.europa.eu/commission/presscorner/detail/en/speech_22_5493.

[32] France, Germany, Italy, the Netherlands, Poland, Portugal, and Slovakia are to spend a collective €6.9 billion to deploy hydrogen infrastructure in the Union, R. Parkers, *Biggest yet EU green-lights €7bn in hydrogen infrastructure subsidies for seven members states*, in *Hydrogen Insight*, 2024.

the EHB is to reduce supply costs associated with green hydrogen production, thereby making it competitive with fossil fuels. The purpose of this project is to facilitate investment in hydrogen production and infrastructure, promoting a more resilient energy landscape across member states. Establishing the EHB reflects a broader commitment within the EU to foster cooperation among member states in developing sustainable energy solutions. One key aspect is its focus on minimizing the cost disparity between renewable hydrogen and fossil-based alternatives. By offering subsidies in the form of a fixed premium per kilogram of hydrogen produced, the EHB aims to bridge the funding gap that currently hinders establishing a robust green hydrogen market[33].

Furthermore, the EHB seeks to facilitate imports of renewable hydrogen by establishing a coordinated EU strategy that incentivizes imports through a green premium system. This initiative gained momentum in 2022 with the European Commission REPowerEU communication to import an additional 10 million tons of renewable hydrogen by 2030, complementing domestic production[34]. This approach aims to secure a stable supply of green hydrogen and positions the EU as a potential global renewable hydrogen market leader.

However, notwithstanding the number of subsidies projected[35] to increase the supply and demand of GH_2, it is ultimately necessary to have direct or indirect control of the critical factors of either the production of GH_2 or its distribution, or both. While the EU's countries are well positioned regarding technologies that can drive the development and deployment of cost-effective hydrogen solutions, they are less positioned regarding the raw materials to be used in the electrolyser system necessary to produce GH_2 and in the fuel cell. A third of mineral reserves, including platinum, coltan, cobalt, tantalum, lithium, copper, and rare earth, to name the best known, are necessary for the creation of green technologies[36], such as photovoltaic panels, wind turbines, microchips, digital meters, batteries, hydrolysers, and other devices that support clean energy, are present in the African soil[37]. At the same time, Europe at large is not well endowed with land and low-cost renewable sources of energy, such as solar and wind power, which are essential for constructing the large GH_2 plants needed to maintain low production costs.

Therefore, European policymakers driven by the urgent need for sustainable energy solutions increasingly view the African continent as a key player in the green hydrogen economy, thanks to its abundant natural potential and geographic proximity. However, while the European public discourse emphasizes the benefits of green hydrogen for Western economies, it often overlooks critical issues surrounding project ownership, state sovereignty, and the potential impacts on local communities and ecosystems in the Global South, where the proposed large GH_2 plants will be established. Such a perspective raises critical questions

[33] CATF, *The European Hydrogen Bank – Europe's Latest Effort to Enable the Continent's Hydrogen Revolution*, 2023, https://www.catf.us/2023/11/european-hydrogen-bank-europes-latest-effort-enable-continents-hydrogen-revolution/; European Commission, *Commission outlines European hydrogen bank to boost renewable hydrogen*, European Commission, 2023, https://ec.europa.eu/commission/presscorner/detail/en/IP_23_5982.

[34] Enerdata, *The EU's renewable hydrogen policy frameworkk*, Enerdata 2024.

[35] European Commission estimates that a budget of EUR 1 billion will enable 40-60 thousand tons of renewable hydrogen production capacity per year.

[36] Europe is fully dependent on the supply of 19 of 29 raw materials such as the platinum group metals relevant to develop the fuel cells and electrolyser technologies and also relies on several critical raw materials for various renewable power generation technologies. China and many countries in the GS are the principal suppliers of the necessary raw materials, European Commission, *Report from the Commission to the European Parliament and the Council on progress of clean energy competitiveness*, 2020b; European Commission, *Clean Energy Transition – Technologies and Innovations*, 2020c.

[37] N. Sartori, L. Spinosa, S. Burgo Rodriguez, *Terre rare e materiali critici al centro della transizione energetica*, ECCO Climate, 2022, https://eccoclimate.org/it/terre-rare-e-materiali-critici-al-centro-della-transizione-energetica.

about equity and local participation in decision-making processes related to resource management. Historically, many African nations have faced similar scenarios where external actors exploited their natural resources without adequately considering the rights and needs of local communities. The energy transition risks perpetuating this pattern, potentially reinforcing a hegemonic North-South dynamic characterized by resource extraction and the marginalization of local populations. Namibia's emerging green hydrogen sector is a compelling example of these concerns. The country has signed significant agreements with European partners to develop its green hydrogen potential, promising to transform its economy. However, this transformation is not without substantial challenges.

5. THE NAMIBIAN CASE STUDY

Germany's colonial rule over Namibia, then known as German South West Africa, spanned from 1884 to 1915, a period characterized by the extraction of natural resources and severe oppression of the indigenous populations. This era reached its most brutal apex during the Herero and Nama genocide of 1904 to 1908, where German colonial forces waged a campaign of extermination that resulted in the deaths of tens of thousands of Herero and Nama people. The survivors were forcibly dispossessed of their ancestral lands, subjected to inhumane treatment in concentration camps, and used as forced labor to further colonial interests. These atrocities have left a profound and enduring impact on Namibian society, shaping land ownership patterns, economic disparities, and historical grievances.

The legacy of this dark colonial chapter continues to shape contemporary relations between Germany and Namibia. Efforts to address historical injustices, including reparations and formal apologies, remain contentious and central to diplomatic interactions. Following Germany's defeat in World War I, Namibia became a League of Nations mandate territory under South African administration. South Africa imposed its apartheid regime, entrenching racial segregation, systemic oppression, and economic exploitation. Indigenous Namibians faced widespread land dispossession, exclusion from political power, and limited access to education and essential services. The exploitation of Namibia's resources persisted, benefitting South Africa's economy while perpetuating inequality in the territory.

The struggle for Namibian independence, led primarily by the SWAPO (South West Africa People's Organization), was a protracted and multifaceted resistance involving armed conflict, international advocacy, and grassroots mobilization. After decades of liberation efforts and growing international pressure, Namibia finally gained independence in 1990 under United Nations supervision. Although independent, the lingering effects of colonialism and apartheid continue to influence Namibia's socio-economic development, land reform policies, and its relationships with former colonial powers.

With 3 million inhabitants, distributed over 824,292 km2 bordering Angola, Botswana, Zambia, and South Africa, Namibia is among the countries with the lowest population density in the world[38]. Has abundant mineral and renewable energy resources, coupled with large-scale availability of non-arable land. Two third of the land is covered by the Kalahari and Namib deserts, which are among the most excellent solar resources in the world[39], and strong winds batter the 1,570 km of coastline. These harsh climates create an

[38] Namibia Statistic Agency, *2023 Population & housing census. Preliminary report*, Namibia Statistic Agency, 2024.

[39] UKIRI, *Country Guide: Namibia*, Energy Catalyst, UK AID 2020. Namibia has more than 3,000 sun hours per year and an annual solar irradiation of 2,200 to 2,400 kWh/m2 in many regions, T. Altenburg, A. Kantel, *Green hydrogen in Namibia: Opportunities and risks*, in *IDOS*, No. 6, 2024, https://doi.org/10.23661/idp6.2024.

optimal environment for producing wind and solar energy. The vast, non-arable, arid lands across the country are technically well suited for establishing large photovoltaic plants to generate the clean energy necessary for powering green hydrogen production plants. On the other hand, the country is also one of the driest in Africa; water is a scarce resource[40] and a critical concern in the GH_2 electrolysis process.

The juxtaposition of abundant renewable energy potential and limited water resources raises significant challenges that must be addressed to ensure sustainable development. In addition to water scarcity, other pressing concerns are associated with implementing green hydrogen initiatives in Namibia. One major issue is the potential impact on protected areas and biodiversity. Large-scale renewable energy projects, while necessary for clean energy production, can disrupt local ecosystems and threaten wildlife habitats if not carefully planned and managed. Furthermore, Namibia currently lacks a robust industrial and productive sector that could benefit from green hydrogen as a form of energy. While the country has ambitious plans for hydrogen production, it is essential to consider how this energy source can be integrated into existing economic structures and whether local industries are ready to utilize green hydrogen effectively. Without a clear pathway for domestic consumption or industrial application, the benefits of green hydrogen may primarily accrue to foreign investors rather than local communities. The lack of a clear and comprehensive legal framework to regulate green hydrogen projects and the absence of specific laws to address critical issues such as land allocation, water use rights, environmental protection, and community benefits heightening the risk of unsustainable practices within green hydrogen development.

5.1. *The Hyphen Hydrogen Project*

On 23 May 2023, the GRN (Government of Namibia) signed a Feasibility and Implementation Agreement with HHE (Hyphen Hydrogen Energy) for the development, implementation and operation of a state-of-the-art facility with a capacity of 5 gigawatts to produce 350,000 tonnes of green hydrogen annually through advanced electrolysis technologies powered by wind and solar energy sources. With a comprehensive investment value of approximately $10 billion[41], this initiative aims to become one of sub-Saharan Africa's most prominent green hydrogen projects, reflecting Namibia's aspirations to position itself at the forefront of global green hydrogen production[42]. The consortium HHE[43] will be responsible for the realization of the project, leveraging its expertise in renewable energy and hydrogen production. At the same time, the GRN will play a critical role by providing the land necessary for establishing the facility and developing the required legal, fiscal, and regulatory framework for establishing Namibia's green hydrogen industry. The initial development phase will occur within the SCDI (Southern Corridor Development Initiative) framework, which encompasses an extensive area of 26,000 km² designed to cluster supply chain components and essential infrastructure. Within this initiative, approximately 4,000 km² inside the Tsau//

[40] 83% of the rainfall received is evaporated, 14% is lost through transpiration, 2% is runoff in the rivers and only 1% seeps underground, Namwater website, https://www.namwater.com.na/index.php/services/56-hydrologicalservices?showall=1#:~:text=four%20Northern%20Regions.,EVAPORATION,through%20evaporation%20within%20one%20season.

[41] Hydrogen-news.it, Hyphen Hydrogen Energy sviluppa il più grande progetto a idrogeno verde dell'Africa sub-Sahariana, *Hydrogen-news.it*, 2023, https://hydrogen-news.it/hyphen-hydrogen-energy-sviluppa-il-piu-grande-progetto-a-idrogeno-verde-dellafrica-sub-sahariana/, 10 billion US $ is the equivalent of the country GDP in 2022.

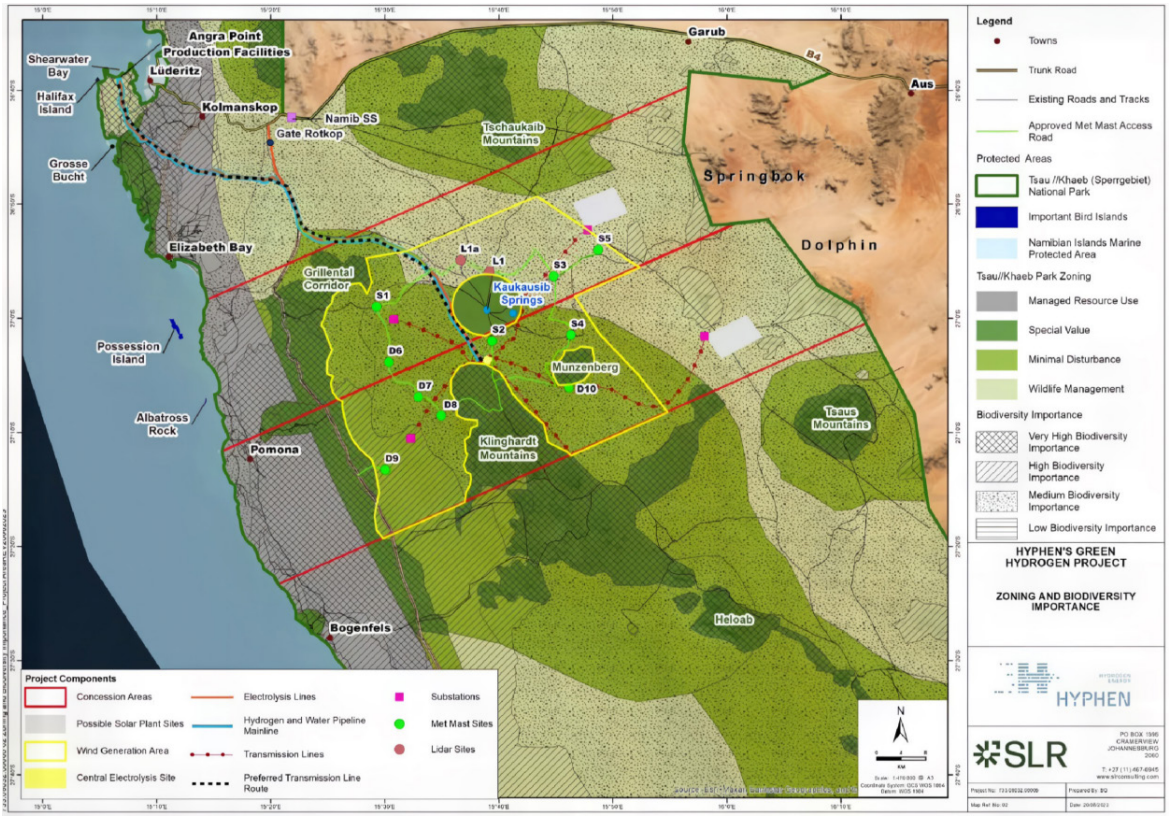
[42] B. Khors, *Green hydrogen: reality or fantasy*?, in *Namibian Journal of Social* Justice, No. 3, 2023, 208-216.

[43] Hyphen Hydrogen Energy is a joint venture between the UK-registered Nicholas Holdings Limited, parent company of the Europe base investment group Principal Capital and ENERTRAG, a German headquartered international renewable energy company.

Khaeb National Park —equivalent to nearly 19% of the park's total size—have been identified for establishing the green hydrogen and ammonia production facility alongside wind and solar generation plants (fig. 2). So, the GRN has granted a 40-year concession to HHE.

In addition to the hydrogen production facility, there is a project for a desalination plant to supply the necessary water for the electrolysis process. This component is critical, given Namibia's status as one of the driest countries in Africa, where water resources are limited. Furthermore, the SCDI envisions a comprehensive portfolio of complementary projects and infrastructure to accelerate and improve Namibia's industrial capabilities[44]. The portfolio includes the development of an enhanced deep-water port in Luderitz, which should facilitate the export of green hydrogen and its derivatives to international markets. Additionally, the SCDI plans to integrate an advanced green steel plant into its operations. This facility will utilize locally sourced iron ore and renewable energy from the hydrogen production process to manufacture green steel—a vital material for various industries.

Figure 2. Hyphen's development plans superimposed on the park zonation



Source: Namibian Chamber of Environment[45]

[44] J. Gelede, *Namibia's green hydrogen bet: Mapping out a green future*, Republikein, 2022, https://www.republikein.com.na/focus-manufacturing-/namibia%E2%80%99s-green-hydrogen-bet2022-11-2239052.

[45] Namibian Chamber of Environment, *When green hydrogen turn red: Threatening a global biodiversity hotspot*, Namibian Chamber of Environment, 2024. Note the overlap between the pale green Minimal Disturbance zone and the Wind Generation Area (yellow outline) that will involve many roads and turbines.

Concurrently, there is a plan for adding two hydrogen corridors to enhance Namibia's green hydrogen initiatives[46]: the Central Corridor, which is currently home to two small pilot projects: a GH_2 refuelling station[47], and the Dâures Green Hydrogen Village[48]. These two are designed to produce green hydrogen and ammonia, will serve local and international markets, and are associated with developing an export infrastructure at the Walvis Bay Port.

On the other hand, the Northern Corridor aims to establish a refuelling station and a green hydrogen plant that will complement the operations of the Southern Corridor. This corridor will also focus on building port infrastructure to export green hydrogen and its derivatives[49].

By establishing this integrated approach and enhancing connectivity between these corridors, Namibia aims to optimize its production capabilities and create value-added products to drive economic growth and industrialization while fostering local economic resilience. The question is: Is the reliance on green hydrogen initiatives a truly win-win situation for all parties involved? This raises important considerations regarding the distribution of benefits among investors, the European countries that will import green hydrogen products, and the host country itself. Investors stand to gain substantial returns from their investments in green hydrogen production, particularly if global demand for clean energy rises. On the other hand, European nations may benefit from reduced carbon emissions and enhanced energy security by importing affordable green hydrogen. Yet, this dynamic raises concerns about whether Namibia will receive a fair share of the economic benefits generated by these projects.

6. DISCUSSION

One of the critical challenges in advancing renewable energy and implementing green hydrogen projects is securing the necessary funding beyond the concessional loans already earmarked for these initiatives. To this end, Namibia has already signed a Memorandum of Understanding with the EU, which facilitates access to a loan from the European Investment Bank of up to Euro 500 million[50]. To kickstart its ambitious green hydrogen project, HHE is actively seeking 100 million Euros. This funding is essential for developing the infrastructure and technology required to produce and export green hydrogen. So far, while a letter of intent has been obtained, there is no solid commitment to concessional and soft loan funding[51].

At the heart of this strategy is the concept of derisking, whose core idea is to minimize financial risk by securing public guarantees and creating investable assets that attract private capital. This point is particularly relevant for large-scale initiatives like HHP, requiring substantial upfront investments. By implementing derisking strategies, the HHP aims to establish itself as a profitable investment opportunity for private investors, thus mitigating risks for both primary and government investors. This approach

[46] Ministry of Mines and Energy, *Namibia green hydrogen and derivatives strategy*, Republic of Namibia, 2022.

[47] Clean Energy Namibia, 2024, https://www.cleanergynamibia.com/news/cleanergy-solutions-namibia-hosts-distinguished-guests-h-m-the-king-of-the-belgians-and-h-e-president-of-the-republic-of-namibia.

[48] Dâures Green Hydrogen Village, https://daures.green/wp-content/uploads/2023/10/DGHC-A4-Brochure_Print_0-Bleed.pdf.

[49] Ministry of Mines and Energy, *Namibia green hydrogen and derivatives strategy*, cit.

[50] I. Shumkov, *Namibia formally enters into raw materials, green H_2 partnership with EU*, 2022, https://renewablesnow.com/news/namibia-formally-enters-into-raw-materials-green-h2-partnership-with-eu-803983/.

[51] J. Grobler, J. Lo, M. Civillini, *Namibia's $10bn green hydrogen project raises myriad concerns*, in *African Arguments*, 16 November 2023, https://africanarguments.org/2023/11/namibia-10bn-green-hydrogen-project-raises-myriad-concerns/.

is designed to finance the development of strategic sectors and infrastructure without incurring public debt. To achieve this, the Namibian government is acquiring a 24% equity stake in the project through the Namibia One Fund, its sovereign wealth fund. Most of the money is expected to come through concessional loans. This strategic investment is also sustained by the government's plan to utilize potential revenues generated from recent oil and gas discoveries as a financial guarantee for backing the project[52].

However, linking the 24% equity stake in the HHP to oil and gas extraction revenues introduces several significant risks. The oil and gas sector is nascent, with important discoveries in the Orange Basin but no production yet underway. As a result, the anticipated revenues meant to support the HHP may not materialize in the short term, leading to financial and broader economic instability. Furthermore, Namibia risks perpetuating patterns of extractive colonialism where resource-rich countries remain dependent on foreign investments and technologies, as extractive colonialism and dependency on fossil fuels demonstrate. This dependency may lead to a scenario where economic decisions are influenced more by fossil fuel markets than by the long-term benefits of green hydrogen production. Concurrently, focusing on oil and gas revenue contradicts the project's goal of transitioning to renewable energy sources. Tying a renewable energy project to fossil fuel revenues may negatively affect market perception and investor confidence, and it could deter environmentally conscious investors who support genuinely green initiatives. Suppose the Namibian government cannot maximize its equity stake in the Hyphen project. In that case, it will collect less public revenue, lowering the amount of money it can redistribute to the general public.

Another consideration is associated with the project's environmental risks and biodiversity impacts, as some of the core activities will be located in the TKNP (Tsau//Khaeb National Park).

Formally known as the Sperrgebiet National Park, created in 1908 during the colonial period to ensure the control of the mineral wealth of the area, primarily diamonds, the TKNP presents a new idea of protected areas, combining the protection of biodiversity with the promotion of the national economy through tourism development and local community support. The area has an affluent avian population, including almost 60 wetland birds along the Orange River and 120 terrestrial bird species recorded. Moreover, this area has nearly 100 reptile species, 16 frog species, and many insects and other invertebrates. Some 1,050 plant species are known to live in the park, which is almost 25% of Namibia's entire flora. Hence, the park is among the world's top 25 biodiversity hotspots. The park has giant rock arches, meteor craters, fossil and archaeological sites, including Africa's most crucial shipwreck discovery and some of the planet's most pristine and wild landscapes[53]. There is already an urgent need for conservation efforts to mitigate the effects of climate change, which is expected to exert significant pressure on biodiversity within the TKNP, particularly affecting endemic species and vegetation structure[54].

Although Namibian legislation prohibits infrastructure and urbanization interventions within protected areas, in the case of the TKNP, this regulation does not apply when such interventions are linked to renewable energy production. From the angle of green colonialism, introducing extractive activities within protected areas raises significant concerns regarding environmental integrity and social

[52] D. Matthys, *Govt eyes oil money to finance 24% Hyphen stake*, in *The Namibian*, 25 October 2023, https://www.namibian.com.na/govt-eyes-oil-money-to-finance-24-hyphen-stake/.

[53] Ministry of Environment, https://www.meft.gov.na/national-parks/tsau-khaeb-sperrgebiet-national-park/229/.

[54] W. Thuiller, W.G.F. Midgley, G.O. Hughes, B. Bomhard, G. Drew, M.C. Rutherford, F.I. Woodward, *Endemic species and ecosystem sensitivity to climate change in Namibia*, in *Global Change Biology*, No. 12, 2006, 759–776.

equity[55]. Protected areas, established to conserve biodiversity and safeguard sensitive habitats, may face encroachment from industries prioritizing short-term economic gains over long-term ecological integrity. Likewise, allowing extractive projects in protected sites further commodifies natural resources, setting an alarming precedent whereby similar exemptions may be invoked for other projects in different areas across the country. This normalizes the idea that economic development can take precedence over conservation efforts. The TKNP is an example: it hosts a project claiming to promote renewable energy that seemingly, simultaneously may degrade the environment. The potential for environmental degradation is particularly concerning in Namibia, where protected areas cover approximately 17% of the country's land surface[56]. These areas are vital for conserving biodiversity and play a crucial role in national development through community tourism and ecosystem services. Bearing in mind that the construction of the plant and the works associated with it will require the use of 15,000 people for 5 years, it is evident that, overall, the anthropic presence can further have a damaging impact not only on the park's fragile environment but on the availability of the already scarce resources in the area[57]. Although temporary workers will not reside inside the park, to house the influx of workers, a new town will have to be constructed immediately south of the historic Kolmanskop ghost town, almost doubling the current population of Luderitz.

Additionally, the Hyphen project encompasses further significant industrial development on the Lüderitz Peninsula. It is classified as an important bird area and a key biodiversity hotspot, making it a vital tourist attraction. It is the only publicly accessible part of the Namibian coastline between Walvis Bay and Oranjemund[58], drawing visitors with its unique landscapes and rich wildlife. The proposed developments associated with the Hyphen project threaten to undermine the ecological integrity of this area and its appeal as a tourist destination. The anticipated industrial activities and the new deep-water port to accommodate tankers for shipping green hydrogen and ammonia pose significant risks to the fragile marine ecosystem. The introduction of heavy machinery, increased shipping traffic, and potential pollution from industrial processes could disrupt local wildlife habitats and lead to declines in biodiversity with cascading effects on both terrestrial and marine life.

Moreover, as these areas become less accessible to tourists due to industrial encroachment, Namibia risks losing an essential source of revenue generated from eco-tourism. The potential environmental pollution from associated projects, such as desalination plants designed to supply fresh water for hydrogen production, further complicates this scenario. Desalination processes can introduce pollutants into marine environments if advanced technologies are not employed to minimize brine production and ensure proper controls during discharge into the ocean. Aquatic ecosystems and local fishing industries, lobster fishing, and rock angling - two crucial attractions for tourism in the area and informal sources of income for local communities - can be heavily impacted. Additionally, while the energy transition seeks to mitigate greenhouse gas emissions and reduce pollution, it can generate toxic or hazardous waste.

[55] M.A. Manahan, B. Bringel, M. Lang, *Unmasking green colonialism behind the decarbonization consensus*, Fian International, 2023.

[56] Ministry of Environment and Tourism, *National policy on prospecting and mining in protected areas,* Republic of Namibia, 2018.

[57] B. Khors, *Green hydrogen: reality or fantasy?*, cit.

[58] The coastline from Walvis Bay to Oranjemund is severely limited to the public due to current regulations aimed at preserving sensitive ecological areas and safeguard alluvial diamond deposits. Entry in the area is typically restricted to authorized personnel involved in mining and related activities.

Thus, critical questions arise about environmental justice and equity in distributing ecological burdens. Disruption from industrial activities could jeopardize vital industries[59], displacing environmental costs from wealthier nations to poorer communities in the GS.

It is also vital to notice that the ambitious targets set forth by the HHP, which aims for 90% of jobs to be filled by Namibians, highlight the importance of local capacity building. However, given the current low skill availability within the Namibian workforce, achieving this goal presents considerable challenges, as many positions may require specialized training that local workers currently do not possess. So far, the only concrete step toward this objective has been a funding program from Germany to support the education and training of 200 Namibian students[60]. Hence, questions remain about how much of the promised economic benefit will materialize for the local population.

Lastly, a significant concern is the lack of community involvement in decision-making processes related to green hydrogen initiatives. Civil society groups have expressed their dissatisfaction regarding inadequate community consultation and the lack of information about the social implications of the Hyphen. This sentiment reflects a broader unease about the transparency of the process, particularly highlighted by Hopwood[61], who points out that the opacity surrounding access to financing and land poses significant risks since these factors are critical in assessing the viability and sustainability of the project. The opaque nature of tender processes and negotiations raises alarms about who controls these resources and how profits will be distributed. Additionally, the lack of transparency and accountability in governance and oversight mechanisms exacerbates public mistrust. Without clear frameworks to monitor the equitable allocation of resources, address grievances, and prevent conflicts of interest, there is a heightened risk of corruption and elite capture. This absence of robust accountability measures undermines public confidence, alienating communities who fear the project's benefits will disproportionately favor politically connected entities, leaving them to shoulder the environmental and social costs.

7. CONCLUSIONS

Based on the critical observations, we can posit that the shift to renewable energy might result in a new form of green colonialism characterized by its extractive nature[62]. In the context of Namibia, this concept suggests that while the country may appear to benefit from foreign investments in renewable energy, it risks becoming overly dependent on external entities for technology and market access. This dependency can lead to a scenario where the host country's resources are exploited primarily for the profit of foreign investors and importing nations rather than fostering sustainable development for local communities. If not managed carefully, this could perpetuate existing inequalities and undermine local economic development.

[59] The fishing sector is crucial for Lüderitz's economy, providing over 80% of employment in the area, Luderitz Town Council, *Economic Profile*, https://www.luderitz-tc.com/?page_id=276.

[60] BMBF, *Grüner wasserstoff aus Afrika: Namibia wird forschungspartner. Bundesministerium für Bildung und Forschung, 2022*, https://www.bmbf.de/bmbf/shareddocs/kurzmeldungen/de/2022/10/gruener-wasserstoff-aus-namibia.html, last checked 03.09.2024.

[61] G. Hopwood, *Green is not necessarily clean*, in G. Hopwood, F. Links, (eds), *Green Hydrogen Monitor*, IPPR, 2024, 7-8.

[62] H. Hamouchene, *Energy transitions and colonialism*, https://www.cadtm.org/Energy-transitions-and-colonialism, 2020; N. Bruna, *The rise of green extractivism. Extractivism, rural livelihoods and accumulation in a climate-smart world*, Routledge, 2023.

As we have argued, the push by Germany and other European nations towards green hydrogen projects, often framed as mutually beneficial for Europe and Namibia, overlooks several critical issues. There are concerns that Namibia's anticipated employment and economic benefits may be overstated, especially as the country continues to rely heavily on imports of high-value goods and faces a significant shortage of skilled workers. This situation reinforces existing unequal trade relationships.

Additionally, what can be termed the paradox of the energy transition plays a role. It is grounded in the understanding that the transition relies heavily on technologies and infrastructures, whose access is based on the exploitation of natural and mineral resources found in the GS, often with little regard for the needs or rights of local populations[63]. This reliance frequently perpetuates the colonial exploitative practices associated with economic extractivism that have characterized previous decades[64]. So, although good intentions may drive energy transition, the disconnection between social justice and sustainability can result in socially unsustainable outcomes. This situation risks entrenching developing countries in a cycle of economic dependence on natural resources, effectively extending a form of energy neo-colonialism indefinitely.

This rush towards developing green hydrogen initiatives also prompts essential questions regarding equity and sustainability. The partnerships must prioritize local benefits and community involvement to ensure that the advantages of green hydrogen production extend beyond mere hypothetical export revenues. It involves prioritizing local knowledge, perspectives, and leadership in decision-making. By amplifying local voices, one can ensure that local communities' unique insights and experiences are integrated into policies and practices that affect their lands and resources. To achieve what can be termed just sustainability or "justainability", it is crucial to pursue holistic solutions that emphasize equity and inclusion. Placing principles of justice, equity, and self-determination at the forefront can promote more inclusive and sustainable approaches to green energy management that respect all peoples' and communities' rights and dignity.

At a global level, the transition from a hydrocarbon-based economy to one rooted in renewable energy requires a fundamental paradigm shift. It is insufficient merely to replace fossil fuel sources with renewable alternatives; this new energy landscape demands innovative production systems compatible with renewable energy sources. Additionally, it calls for a transformation in consumption patterns and the promotion of circular economy models that encourage sustainability in using the planet's natural resources. A circular economy emphasizes minimizing waste and maximizing resource efficiency by rethinking how products are designed, used, and disposed of. This approach reduces environmental impact and fosters economic resilience by creating new opportunities for local communities. By integrating these principles into our energy transition strategies, we can make a more sustainable future that respects the rights and needs of all communities involved in this critical transition.

[63] H. Hamouchene, K. Sandwell, *Dismantling Green Colonialism Energy and Climate Justice in the Arab Region*, Pluto Press, 2023.

[64] J. Allan, H. Lakhal, M. Lemaadel, *An Unjust Transition: Energy, Colonialism and Extractivism in Occupied Western Sahara*, Transnational Institute, 2021.