Advances in Science and Technology
ISSN: 1662-0356, Vol. 142, pp 15-24
doi:10.4028/p-Pv7uH9
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Submitted: 2023-10-16
Revised: 2023-11-12
Accepted: 2023-11-12
Online: 2024-03-15

Regulating Green and Low-Carbon Hydrogen in Africa: A Case Study of South Africa

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Keywords: climate change - regulation – hydrogen – energy transition - South Africa

Abstract. The production of the most abundant chemical element in the atmosphere, hydrogen, particularly green hydrogen (i.e., hydrogen in its cleanest and most sustainable form), is quickly becoming a priority for nations worldwide. This interest is mainly attributed to, among other factors, its potential to serve as a cornerstone of the global energy transition to low-carbon economies. Green hydrogen possesses the potential to decarbonize the so-called "hard-to-abate," sectors i.e., energy-intensive sectors, such as heavy industries, iron and steel production, and transportation - including aviation and shipping, among other economic sectors.

The growing focus on the adoption of green hydrogen as a viable decarbonization pathway must be viewed against the backdrop of global commitments and international imperatives to address the adverse effects of climate change. Such commitments emanate from instruments such as the Paris Agreement of 2015 and obligations towards meeting the United Nation's Sustainable Development Goals (SDGs). Further, the "Just Energy Transition" journey towards decarbonization must also be contextualized within different jurisdictions, in line with their situations and context-specific goals, geographic locations, and policy frameworks.

Much like other nations worldwide, the South African regulatory framework for hydrogen is still emerging, as it is presently dominated by soft law instruments such as roadmaps, strategies and guiding documents, as opposed to binding and enforceable hard law instruments. For example, the South African Hydrogen Society Roadmap of 2022, the Integrated Resource Plan, the Integrated Energy Plan, and the Renewable Energy Policy, among other significant policy documents, highlight the fundamental role that green hydrogen would play in South Africa's energy transition. Whilst other legal and policy documents may apply to the hydrogen value chain, such as the various safety requirements in the Occupational Health and Safety Act, 1996, there is a lacuna of hydrogen-specific hard law regulation, including, importantly, regulations regarding certification (which will need to be aligned internationally).

In light of the above, this paper discusses the potential of green hydrogen in the context of South Africa and explores the current position in the country. It further canvasses emerging developments within the hydrogen space. This analysis aims to identify gaps or lacunas in the law, risks, and challenges for South Africa's hydrogen economy. The article proceeds to provide recommendations for a policy and regulatory regime for hydrogen in Southern Africa. It draws on examples from countries and regions such as the European Union (EU), which are further along in terms of regulating hydrogen, but contextualizing this discussion within the African, and specifically Southern African context. This budding industry provides an opportunity to learn from past energy mistakes and create an appropriate regulatory and policy framework that works and benefits Africa.

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Introduction

Amidst a global energy crisis coupled with rapid climate change effects such as extreme weather conditions, nations are looking to different energy forms to ensure energy security and reliability, whilst simultaneously meeting their climate change goals. In this quagmire, hydrogen, and specifically green hydrogen, has emerged as a viable alternative to fossil fuel sources of energy. [1] Various institutions, including the International Energy Agency (IEA), have identified the African continent as having abundant potential to produce green hydrogen for both domestic use and export. [2] African nations are increasingly attempting to capitalize on this potential, and in 2022, the Africa Green Hydrogen Alliance was established by Egypt, Kenya, Morocco, Mauritania, Namibia and South Africa. [3] This Alliance is mandated with encouraging collaboration between countries and creating enabling environments that would see the African continent leading in the development of green and low carbon forms of hydrogen. Whilst there is no international alignment on defining different types of hydrogen, for the purposes of this article, low-carbon hydrogen speaks to what is commonly known as blue hydrogen, being hydrogen produced through natural gas or coal gasification, but incorporating carbon capture, use and storage technologies (CCUS). [4] Green hydrogen refers to hydrogen that is produced mainly through the electrolysis of water, using electricity generated from renewable sources such as wind and solar. Whilst hydrogen is being widely seen as an integral part of the energy transition, one of the most prominent risk factors in the hydrogen value chain is the absence of robust policies and regulatory regimes, given the growing nature of the hydrogen economy.

This article explores the key tenets of an effective policy and regulatory framework for hydrogen in Africa, using South Africa as a case study example. South Africa contributes more than 90% of Africa's coal production, and is the highest emitter of greenhouse gases (GHG) in Africa; [5] hence, it serves as an appropriate example of an African nation in need of decarbonization. The article further explores the potential of green hydrogen in the context of South Africa, and explores the current regulatory position. It identifies lacunas and provides recommendations to formulate an effective regulatory framework for South Africa.

Defining Green and Low-Carbon Hydrogen

Hydrogen is an energy carrier or a secondary energy source, [6] and not an energy source itself. Hydrogen needs to be physically produced through other forms of energy such as renewable energy in the form of electricity through a process of electrolysis. [7] Therefore, hydrogen is not always necessarily 'renewable', but rather, this depends on the primary energy source used. This article speaks of 'green' and 'low-carbon' hydrogen. There is no universal definition for these terms, although the term green hydrogen is widely understood and accepted. This lack of alignment internationally is a perfect example of the necessity of regulation – to create uniform systems across various regions.

One of the regulatory gaps that needs to be filled in the African and specifically, the South African contexts, relates to the definition and verifiability of the origin of the green hydrogen. The South African Hydrogen Society Roadmap of 2021 (Roadmap) defines green hydrogen by using the terms "green" and "renewable" hydrogen interchangeably. [8] The Roadmap further defines blue and grey hydrogen and envisages that the current dominance of grey hydrogen, which is produced from fossil fuels and therefore does not have the same climatic benefits as green hydrogen, will transition to blue (akin to low-carbon hydrogen for purposes of this article) in the short to medium-term, and eventually green/ renewable hydrogen in the long run. [9] This Roadmap, as well as South Africa's Draft Green Hydrogen Commercialisation Strategy (GHCS), [10] both acknowledge that for South Africa to be able to trade in green or low-carbon hydrogen, it will need to develop a certification process and framework that aligns with international standards. Hydrogen can be certified to show that it was generated, transported, and delivered with certain sustainability characteristics that make it 'green'.

Certification and verification

To verify certain criteria, such as renewable energy content, information on compliance with standards and regulatory requirements linked to hydrogen production, are required. This verification can be achieved in the form of certification. [11] There is however no uniform system of certification worldwide. [12] Importing and exporting hydrogen and other dealings internationally in hydrogen would be made easier if a uniform methodology for classifying hydrogen based on its emission intensity was adopted. [11] Such a system unfortunately, cannot be developed in a silo by South Africa or other African nations. A keen eye will need to be kept on different nations and regional bodies such as the European Union (EU), which recently released certain criteria for renewable hydrogen, [13] including imported hydrogen (Delegated Acts). African nations that have set their sights on exporting green hydrogen to the EU, will require compliance with these Delegated Acts. The Delegated Acts establish standards that hydrogen must satisfy to be recognized and traded in the EU, thus offering African producers a chance to distinguish their goods based on their sustainability credentials. African nations may also be able to obtain financing and assistance from the EU for initiatives involving green hydrogen by adhering to the Delegated Acts.

Accordingly, it would be prudent when preparing a certification scheme for South Africa's hydrogen to align it with the Delegated Acts. [14] Whilst the EU's Delegated Acts have no legal status in South Africa, this alignment would assist if South Africa intended to export green hydrogen to Member State of the EU or if South Africa wished to obtain financial assistance. This alignment will not come without difficulties, as the Delegated Acts consist of strict rules. These rules have drawn criticism and are said to increase the cost of green hydrogen production. [15] Furthermore, whilst the definitions set out in the Delegated Acts are now law in the EU, adherence to the Delegated Acts will be contingent upon certification protocols that are not yet known. [15] In South Africa, the concept of trading with renewable energy certificates is still in its nascent phase of development and is currently still completely voluntary. [10] Steps will need to be taken to provide for a compulsory certification scheme for green and low-carbon hydrogen. A certification scheme may not come without challenges including the costs and skills to comply with the stringent Delegated Acts and national certification schemes of other countries. It presents a conundrum where a certification scheme must be created in parallel with those schemes of countries which are earmarked for trade.

One way to overcome these challenges is to collaborate with the EU and other nations' businesses who have the necessary experience and expertise. This collaboration is already underway in multiple African countries, including South Africa. [15] Europe will also not count for all exports, and therefore Africa must also keep a keen eye on Japan, South Korea and South east Asia's requirements, if trade is envisaged. [16] Furthermore, it would be prudent to also align with neighbors on the African continent and promote regional cooperation. For example, the harmonization of rules between Namibia and South Africa. This harmonization could have the effect of increasing power relations lowering costs for investors. [14] Accordingly, there is a clear need for a certification framework and regulatory framework in Africa and South Africa which regulates hydrogen, attracts investment and enables trade.

Towards a Regulatory Framework for Southern Africa

The current position

South Africa is currently the continent's and one of the world's largest emitters of GHG.[17] It however has a wealth of renewable energy resources, especially wind and solar, giving it a comparative advantage in manufacturing green hydrogen. [18] It is also a leading producer of platinum group metals (PGMs), essential components in the electrolysis process. [18] Lastly, the nation is proficient and possesses capabilities in the *Fischer Tropsch* (FT) Process, as demonstrated by companies such as Sasol. [19] South Africa, therefore, has the basis for a thriving green hydrogen economy. However, one way to ensure that the resources are translated to benefits for nations and the continent as a whole, as opposed to repeating the past such as with the *resource curse* in mining, is

through effective regulation. [20] What follows is a brief explanation of the current regulatory position of hydrogen in South Africa.

South Africa's dedicated hydrogen regulatory framework currently consists of 'soft' law instruments. Below is a timeline setting out the events and policy documents constituting the hydrogen regulatory framework in South Africa. [21]

No.	Date	Event/Document
1.	2008	Hydrogen South Africa (HySA) was launched. [22] At this stage, no hydrogen economy was envisaged, but it shows a commitment to investing in hydrogen technologies.
2.	2016	A draft updated Integrated Energy Plan was published for public comment. Hydrogen is mentioned as both an alternative energy source and as an energy carrier, with the Integrated Energy Plan stating that "the hydrogen economy is undergoing serious consideration in South Africa, in an effort to develop safe, clean and reliable alternative energy sources to fossil fuels." [23] This document is in need of an update since its 2003 version and the subsequent 2016 iteration that was never adopted. This update is even more necessary to align it with the fast-moving changes since the release of the Roadmap discussed below.
3.	2019	Integrated Resource Plan (IRP) was adopted. It provides *inter alia* that "*South Africa's specific focus on the hydrogen economy and the progress achieved by the hydrogen initiative (or Hy-Sa) based at the University of the Western Cape, should be supported with more research and the chance for practical application within the power system*." Therefore, whilst not a priority at that point, green hydrogen was already on the radar and was envisioned as an energy source of the future. The IRP further considers hydrogen fuel cells in relation to storage. [24] Again, much like the Integrated Energy Plan, this document is in need of an update to align it with the focus on hydrogen in the Roadmap.
4.	July 2021	An agreement between Sasol and the Industrial Development Corporation was signed, wherein the two corporations committed to work together to create the right conditions for South Africa's green hydrogen economy. [21]
5.	October 2021	Pursuant to a feasibility study, the South African government and its private-sector partners identified three green hydrogen hubs that had the capability to form a hydrogen valley. The study also looked at prospects for the export of green hydrogen and identified nine pilot projects in the various sectors. [25] It was found that these hydrogen hubs and accompanying projects would kick-start the hydrogen economy in South Africa. To export green or low-carbon energy, infrastructure will need to be built that allows for the production, storage and transportation of hydrogen. [21]
6.	November 2021	South Africa secures a commitment at COP26 of $ (USD) 8.5 billion from the United States (USA), the United Kingdom (UK), France, Germany and the EU to be used for the country's transition to a green economy. [26] Whilst no explicit mention is made of hydrogen, given hydrogen's role in the transition, it is probable that such funds will be used to support green hydrogen projects.
7.	February 2022	The Roadmap is adopted. This Roadmap offers the framework for advancing and integrating hydrogen-related technology across multiple economic sectors and realizing the desired green hydrogen economy by 2050. It shows how fuel cell and hydrogen technology could revolutionize the nation's energy sector and help it to achieve its

		domestic and international climate change mitigation goals. Its secondary goal is to promote economic growth in accordance with the nation's Economic Reconstruction and Recovery Plan. As a result, the Roadmap both facilitates the nation's equitable transition away from coal and fosters the post-COVID-19 economic rebound. [21]
8.	May 2022	The Africa Green Hydrogen Alliance (AGHA) was formed in May 2022 by six African countries, i.e., Egypt, Kenya, Mauritania, Morocco, Namibia and South Africa. [27] The primary goals of AGHA are to support hydrogen activities across member nations and to act as a catalyst for pan-African momentum in the industry. [16]
9.	December 2022	Draft GHCS was released for public comment, with comments due on February 2023. As at the date of writing, no final version has been published. The adoption of a final GHCS will be integrally important in order to ensure that a hydrogen economy is able to progress.
10.	June 2023	Netherlands and Denmark launched a $1 billion green hydrogen fund in South Africa. [28] In a separate agreement, Germany and South Africa agreed to collaborate in business opportunities between developers as well as off-takers in Germany and South Africa. [29]
11.	September 2023	South Africa awarded chairship of the AGHA. [30]

Regulatory gaps

Of note in the Roadmap is the transitory approach towards green hydrogen. South Africa envisages transitioning from grey hydrogen, which it currently produces, to blue and eventually green hydrogen. Whilst at first blush this may seem to be problematic, given the international focus on green or renewable hydrogen, countries such as Germany are also using forms of low-carbon hydrogen in their transition. Germany's Hydrogen Strategy and update envisage the use of blue hydrogen in the short term towards the use of green hydrogen in the long term, and Germany's recent agreement with Norway in respect of blue hydrogen bolsters this transitory support. [31] However, notably the Roadmap speaks of exports in relation to green hydrogen. [8] There is perhaps a lacuna in this thinking, and some research should go into short-term benefits of trading in low-carbon hydrogen during the transition phase. The GHCS, mentions in passing Japan's importation of blue ammonia, however its focus is clearly green hydrogen. [10] Whilst the high-level policy documents being formulated show progress in regulating hydrogen, there is no dedicated 'hard' hydrogen law in South Africa.

One of the glaring issues with even the 'soft' law framework as it stands is the lack of alignment between different energy policies. Some policies such as the Roadmap place green hydrogen front and center, whilst others such as the IRP still see hydrogen as a nascent industry which needs research and others like the Integrated Energy Plan only mention it in passing. Clear alignment is required in order to understand the role of green hydrogen in South Africa's energy transition.

South Africa has taken some steps in enabling green hydrogen production for example, by lifting the cap on private power production, which was previously limited to 100MW. [32] This will enable sufficient renewable energy to be produced for the process of electrolysis. The Roadmap and the Draft GHCS indicate that South Africa has identified some regulatory enablers to make green hydrogen a reality for both export and domestic use. [14] For example, the GHCS provides that under current legislation, renewable energy deployment related to green hydrogen production will be exempted from both electricity policy planning and licensing, as long as it is "islanded" from the grid. [10] Exemptions are not a long-term solution and the GHCS maps out some of the regulatory requirements to create a coherent and robust regulatory framework. These include incentivization schemes such as tax and carbon pricing mechanisms.

For the hydrogen market to be successful, the correct balance of incentives and penalties ought to be used. The establishment of pilot projects that feed into current processes and establish independent

production that can be scaled up once commercial viability is shown, would benefit greatly from incentives, especially on the supply side. [33] For instance, section 11D of the Income Tax Act in South Africa offers benefits for research and development (R&D) activities, among other incentives. To enhance their R&D efforts, hydrogen manufacturers are using this provision as a tax incentive. [34] In similar vein, Nigeria permits investors to deduct up to 120% of their R&D costs from their taxable income. [35]

An area which has been largely ignored in South Africa related to green hydrogen is the role of water. A large amount of purified water is required to generate one tonne of green hydrogen. [36] Furthermore, the process of purifying water can result in a loss of up to 50 % of the initial feedstock of water. Accordingly, eighteen tonnes of water may be required to create one tonne of green hydrogen. [36] This is no small amount and South Africa, like many African nations, is water scarce. To prevent further depletion of existing scarce freshwater resources and to support a truly just transition, alternative water sources, such as desalinated water or treated contaminated water (such as acid mine drainage), may be explored. However, the commercial viability of green hydrogen may be lowered due to the high cost of desalinating seawater or treating contaminated freshwater, as well as any related transportation expenses. The use of water for hydrogen would be governed by the existing water law framework in South Africa and accordingly would be mainly governed by the National Water Act, 1998 and its supporting regulations. It would, in most cases, require a water use licence. Two considerations come to mind when discussing the use of water for hydrogen under the current framework. The first would be that obtaining a water use licence in South Africa currently takes a very long time. [37] Secondly, if hydrogen production is seen to be a necessity, some form of fast-track process for green hydrogen projects could be considered. This would create a specific process which is set out for renewable energy projects linked to green hydrogen projects in order to assist with the progression of the hydrogen economy in South Africa.

Another area that is necessary to focus on is permitting, licencing and authorization. Often, the licensing and approval processes in South Africa are too lengthy, thereby hindering the implementation of projects. [10] There is a necessity to establish a single "one-stop" system to simplify all licensing and authorization processes that are necessary for a green hydrogen project to succeed. This streamlined authorization process would make it possible for South Africa to act quickly and seize the opportunities that the hydrogen economy offers. [10] Ideas for streamlining the timeframes for licencing and authorization include (i) combining the application processes where an environmental authorisation under the National Environmental Management Act, 1998 as well as a water use licence under the National Water Act, 1998; (ii) the identification of "hydrogen zones" which have easy access to water resources and renewable energy. Prior to the declaration of these zones, the government would need to conduct strategic impact assessments, which could be done in a manner similar to that used to define Renewable Energy Development Zones (REDZ). Since the government would have already evaluated the effects of these operations, developers of hydrogen projects may be eligible to follow a quicker basic impact assessment process in these "hydrogen zones", once they have been declared. Axiomatically, simpler and more streamlined application processes, with fewer delays would follow. The GHCS also identifies that certification, discussed above, is a very important regulatory step.

As can be seen from the above, the regulatory landscape for hydrogen in South Africa lacks ‘hard’ and binding laws. It instead consists of soft law instruments, many of which are outdated. If the development of hydrogen is to be a focus area for South Africa, documents such as the IRP and Integrated Energy Plan need to be updated to make room for hydrogen to play its role in the country’s energy system - no longer as mere passing statements as to its possibilities. Furthermore, South Africa should leverage its leadership of the AGHA to create uniform standards across African nations, going some way in assisting with power imbalances between African exporting and importing countries, as well as assisting to promote competitiveness. There are accordingly various regulatory gaps which need to be seen to in order to enable South Africa and Africa to emerge as players in the global hydrogen economy.

Whilst there exist various regulatory gaps in South Africa's legislative framework for hydrogen, there exists an opportunity to create a legal framework which ensures a just transition whilst developing the nation's economy.

Future regulatory framework

Focusing on how to develop suitable legal and policy frameworks to draw investors and open up their hydrogen economy, should be a priority for African nations. Six basic pillars for effective policy design for clean/ green hydrogen were established by the Hydrogen Council in November 2021. [38] These pillars should be taken into consideration by African nations when creating their national hydrogen policies and the regulatory frameworks required to draw in both domestic and foreign investment. These pillars provide guidance for a coherent and effective regulatory regime and some of them are set out below in the context of South Africa.

The first guiding principle is that countries should leverage their local strengths in policy design and complement this with cross-border cooperation and trade. South Africa has strong opportunities for renewable energy. It does not, as with some other African counterparts, have much existing gas infrastructure to repurpose, so that new investment will need to be made. Furthermore, there is an opportunity to create regional bodies and frameworks that support Africa and bolster power relations. The African Continental Free Trade Area Agreement (AfCFTA), for example, came into effect in January 2021 to bolster inter-African trade. Harmonised regional policies will need to be developed regionally, and eventually trickle down to inform domestic laws. There is an opportunity for African nations to unite, using tools and bodies such as the AGHA to achieve this harmonisation.

The second guiding principle is the creation of certainty for investors. Governments can give investors security by passing laws with precise language that lowers risks and ambiguity for their businesses. The clarity of the applicable legislation to mitigate policy risk is one of the most crucial variables that affect investors' choices in any economic sector. South Africa has had some troubles in its mining sectors related to investor certainty, and to avoid these pitfalls, investors will want to see a coherent regulatory framework for hydrogen in place. This will include ensuring that practical processes are also able to happen without delay. This framework should include financial, environmental, permitting and planning, health and safety etc. This should also include updating South Africa's energy plans so that they are coherent and speak to one another in relation to green and low-carbon hydrogen.

The final guiding principle speaks to societal values. Countries would benefit from taking into account the complete spectrum of societal repercussions and the advantages that can be unleashed through the growth of the hydrogen economy, in addition to the transition towards carbon neutrality. The GHCS envisages that the development of technical safety standards for hydrogen and the hydrogen industry should be given special consideration and priority, with an initial focus likely on interactions with the gas network and important gas industry stakeholders, hydrogen safety requirements related to storage, handling, and transport, and adoption of hydrogen fuel cell technology. The view is that technical standards can be "built into" law and policy with regard to the hydrogen industry by prioritizing and creating them before regulatory responses are formed. This approach may however affect investor confidence and it is recommended that formal standards are adopted.

Conclusion

South Africa and the African nation at large have all of the crucial ingredients to create successful hydrogen economies which could service their own energy needs and be traded. However, in order to do this, coherent and aligned policies are required. A clear permitting regime, without delays will also be an integral requirement. Hydrogen seems to be the next big focus in energy internationally and Africa has the opportunity to be a big player in this, if regulatory progress can occur without delays.

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