# THE CHALLENGES OF PERMITTING GREEN HYDROGEN AND AMMONIA PROJECTS IN SOUTH AFRICA

Over the past 10 years the growth in the Renewable Energy Sector in South Africa has dramatically increased with approximately 6,422 MW of electricity procured from Independent Power Producers (IPPs) and of that 4,276 MW of electricity generation capacity having been made available to the grid. The MW procured together with the significant decrease in the price per kwh has resulted in the benefits of renewable energy being undisputed. The Integrated Resource Plan (IRP2019) sets out a clear plan for the way forward for South Africa with 17,742 MW of wind energy to be installed by 2030 and 8,288 MW of solar PV. A decrease in the price per kwh with zero carbon emission presents the ideal opportunity to produce green hydrogen.

From an environmental permitting perspective, a plethora of wind energy and solar PV guidelines and policies have been developed and the practice of assessing the environmental and social impacts of these renewable energy technologies has matured significantly. For example, as part of the very first Environmental Impact Assessment (EIA) SLR's Power Sector Lead in Africa, Stuart Heather-Clark, led for a wind energy facility in 2002 the field work for the ornithologist was pegged at three days and there was not a thought about bats. This has matured with the publication of Bird and Bat Best Practice Guidelines and subsequent gazetted Avifauna Screening Protocol where multi-seasonal baseline data gathering is required before the impacts of a wind farm can be assessed. Will we need similar guidance in South Africa for the development of green hydrogen projects?

Just as the sector was settling down and getting used to the introduction of the Renewable Energy Development Zones (REDZ), Transmission Corridors, Bird and Bat Best Practice Guidelines, Screening Protocols, REIPPPP timeframes and bidding requirements, and then the introduction of Battery Energy Storage Systems (BESS), the playing field changed with the introduction of green hydrogen. Green hydrogen is a carbon-free fuel generated by the electrolysis process using renewable energy to split hydrogen and oxygen molecules. Alongside this process, separated hydrogen molecules can react with nitrogen molecules (produced from air separation units) to produce green ammonia through the Haber-Bosch process.

The Green Hydrogen Economy has gained significant momentum at a global scale with fossil fuel copious nations such as Saudi Arabia planning developments that will be powered by green hydrogen and not oil . South Africa has followed suit in exploring the generation of green hydrogen and ammonia (including other fuels) using renewable energy as a power source. Green hydrogen presents a real solution to decarbonise industrial processes (such as steel, cement, and chemical production) and other sectors of the economy (such as heavy transport) where reducing carbon emissions is both urgent and hard to achieve. As well as this, there are also export opportunities.

The use of electrolysis to produce green hydrogen and the Haber-Bosch processes to produce ammonia, as a way of storing and transporting hydrogen in a more efficient manner, through renewable energy presents new risks and environmental impacts that renewable energy developers are often not familiar with. SLR works across the renewable energy and oil & gas sectors. Assessing the impacts resulting from green hydrogen and ammonia plants presents a good mix of renewable and gas issues. However, engaging with developers on the need to assess these additional impacts for their proposed projects is not always easy. Some of these challenges are unpacked and discussed in more detail below.

To identify potential environmental and social impacts of green hydrogen and ammonia production and storage, it is important to understand the main process inputs and outputs. The layout of a typical green hydrogen and ammonia production plant is illustrated in Figure 1 below with three main components:

- Generation – wind/solar (including battery energy storage)
- Transmission – if selling electricity to a 3rd party or bidding as part of the REIPPPP
- Hydrogen/ammonia plant and associated infrastructure such as well field for water supply and RO Plant and brine disposal.

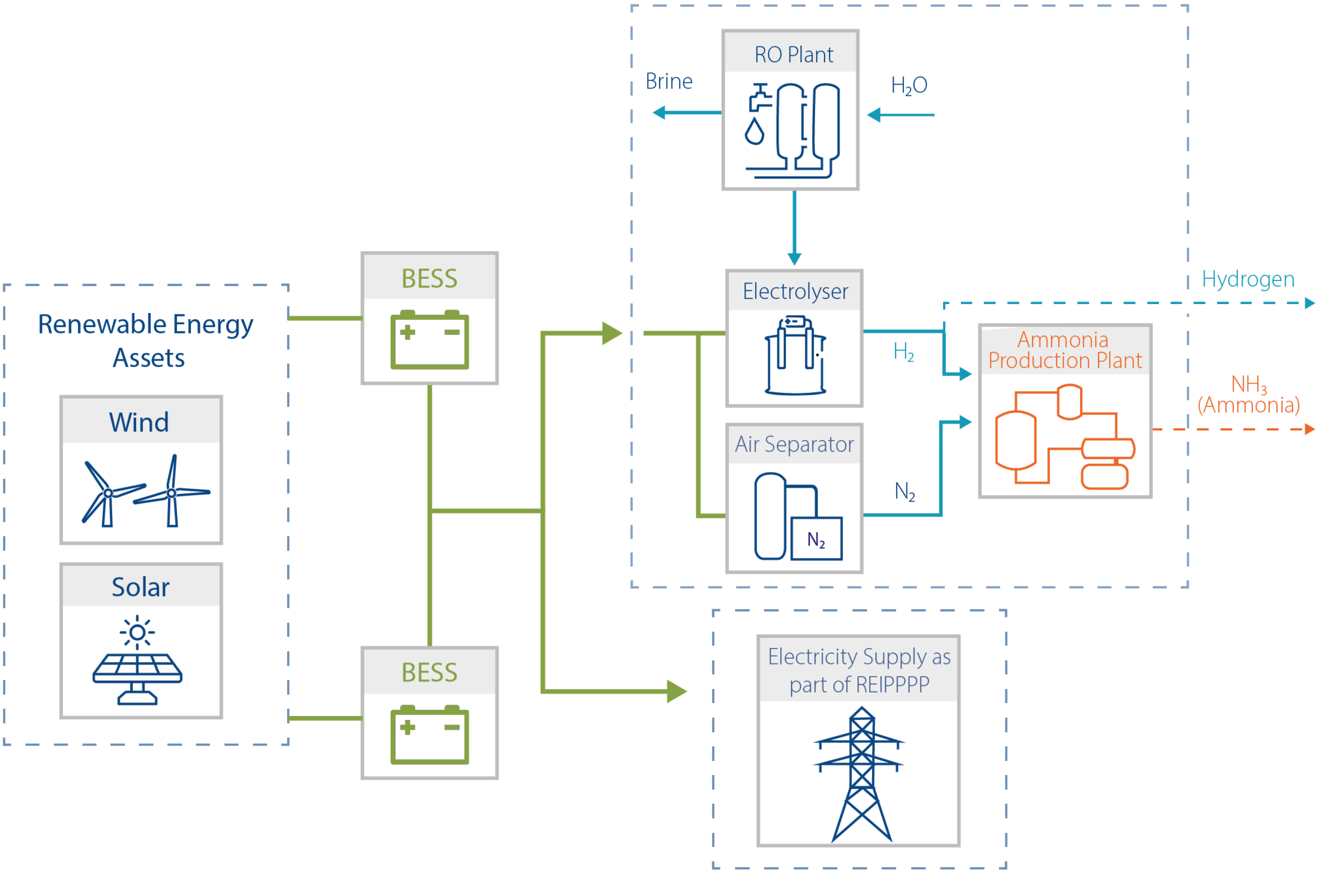


**Figure 1: Configuration of a hydrogen and ammonia plant that is powered by renewable energy**

From the diagram above, several key environmental and social risks are evident, that are not typically issues when developing wind and solar PV projects.

**Water supply**: In a water scarce country like South Africa, the use of water for industry is always an issue, even when it is for "green development". Every 1 kg of green hydrogen produced through electrolysis requires 9.1 kg (litres) of distilled water. Water consumption is therefore a very significant consideration. Developers commonly include "water supply" as an "environmental issue" to be assessed as part of the EIA, when in fact it is a key technical/feasibility issue that should be examined prior to initiating the EIA for a project. The long-term availability and sustainability of water (both quantity and quality) is a mission critical issue for projects that produce hydrogen through water electrolysis. The right level of technical investigation is required for both ground and surface water, including understanding the Water Use License (WUL) requirements for authorising the water supply.

**Water purification and brine effluent management:** Using large volumes of drinking quality water suitable for producing hydrogen using electrolysis comes with the requirement to treat the water prior to its use. The use of Reverse Osmosis (RO) plants to treat water to be used in the electrolysis modules will lead to the production and discharge of potentially large quantities of brine. As a result, the need to understand the design of an RO Plant prior to the commencement of the EIA process is important and will require a certain level of design input. Defining the quantity and quality of brine discharges along with mitigation measures / strategies for dealing with this effluent are important and require upfront investment in the conceptual design of the RO plant and the effluent treatment system. Again, the link to the requirements of the WUL process is important.

**Air emissions and regulatory requirements:** From a South African permitting context, Air Emission Licenses (AEL) are required if a listed activity is triggered. Ammonia production (in excess of 100 tonnes per annum) is listed as an activity (Subcategory 7.1 ) of the National Environmental Management: Air Quality Act (NEM:AQA), 2004 (Act 39 of 2004). Typical green ammonia production is not associated with the production of greenhouse gas emissions and other criteria pollutants, as traditional ammonia production requires the use of fossil fuel fired steam reformers and boilers which are a significant source of both NOx and GHGs. Project developers may be able to motivate from a risk-based viewpoint for exemption from the requirements for an AEL, however this depends on the technical design of the plant. Engagement with the relevant authorities is critical at an early stage to establish the need for an AEL.

**Risk assessment as part of the EIA:** The production and storage of green hydrogen and ammonia is associated with risks that are not present in wind energy and solar PV projects. The risk of a hydrogen explosion or a leak of ammonia are key risks and need to be appropriately addressed as part of the EIA process. Apart from this, the need to register the site as a Major Hazardous Installation in accordance with the Hazardous Chemical Substances Regulations (GNR 1179 of 1995) is also required. This typically requires a more detailed design information during the EIA process to inform an appropriate level of assessment.

**Integrated permitting process to meet regulatory requirements:** An integrated permitting process needs to be undertaken to meet the various legal requirements, including the requirements of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998), Environmental Impact Assessment (EIA) Regulations, 2014 (Government Notice (GN) No. 982 of 4 December 2014), as amended, National Environmental Management: Waste Act (NEM:WA), 2008 (Act 59 of 2008), National Water Act (NWA), 1998 (Act 36 of 1998), National Environmental Management: Air Quality Act (NEM:AQA), 2004 (Act 39 of 2004), and National Heritage Resources Act (NHRA), 1999 (Act 25 of 1999). The requirement for an integrated process presents complexities that need to be carefully planned for before initiating the EIA process.

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**Need for separate EIAs:** Apart from the complexity of an integrated permitting process, renewable energy developers and their EAPs are used to undertaking separate EIA applications for the generation and transmission components of their REIPPPP projects. The incorporation of an electrolyser and ammonia plant results in an additional level of complexity, requiring a third EIA to be performed in parallel. With no clear regulatory framework or guidance in place for this type of green energy project, it also presents challenges in identifying the correct competent authority for the various project components. Should the developer want to sell electricity to Eskom as part of the next REIPPPP bidding rounds, then as usual, the competent authority is the National Department of Environment, Forestry and Fisheries (DEFF). However, does this apply to the hydrogen/ammonia plant? The production of green hydrogen and ammonia are not part of the REIPPPP. It is key to explore this aspect of the project upfront, through engagement with the competent authorities before initiating an EIA process.

Apart from identifying the competent authority, understanding the very strict EIA timeframes that are imposed on developers is critical. Initiating the EIA process (by submitting an Application for Environmental Authorisation form) too early before sufficient design information is available, can spell disaster and result in additional cost and time wastage. Careful consideration should be given to when to commence the EIA process, with the initiation progressing only once a clear understanding of the design and the impacts on the environment have been established.

The introduction of green hydrogen and ammonia into the global and South African economy is an exciting development. Decarbonising our economy is now within our reach as technology continues to develop and deliver. However, understanding the regulatory environment is essential to ensure that these projects are not unnecessarily delayed, but rather quickly brought online to deliver the obvious benefits both locally and globally.

SLR has developed tailored approaches to support our clients in de-risking their projects from early concept phase, through detailed feasibility, construction and ultimately operation. For the concept phase of new green technologies, we have developed screening capabilities to assist with identifying regulatory, environmental, and social risks at the earliest stages of the project. In this way we work with our clients to manage these risks and to develop appropriate strategies that will facilitate an uninterrupted permitting process.

**For more information please contact:**
**Stuart Heather-Clark (Africa Power Sector Lead)**
**Email: shclark@slrconsulting.com**
**Mobile: +27 (0)82 324 3483**

Written by Stuart Heather-Clark (Africa Power Sector Lead)

Contributing authors: Sharon Meyer (Johannesburg), Nicholas Arnott (Cape Town), Mavisha Nariansamy (Johannesburg), Reuben Maroga (Johannesburg), Ashley Gibson (Canada), Paul Wilkinson (UK).