



AVAADA

Green Hydrogen and Green Fuels:

*The Strategic Role of Long-term Offtake
Agreements, Article 6, and Production
Quotas for Emerging Economies.*

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Executive Summary

Green hydrogen and green fuels stand at the forefront of the global energy transition, propelled by an urgent need to decarbonize hard-to-abate sectors and achieve net-zero emissions. These sustainable fuels, produced exclusively using renewable energy sources, offer an unprecedented opportunity to reduce dependence on fossil fuels, particularly in sectors such as heavy industry, aviation, and maritime transport, where alternative decarbonization pathways are limited. As the technology surrounding green hydrogen and fuel production matures, structuring long-term offtake agreements, implementing supportive mechanisms through frameworks like Article 6 of the Paris Agreement, and establishing production quotas for emerging economies such as India are critical to scaling these solutions globally.

This white paper presents an in-depth analysis of these mechanisms, exploring how they collectively enable the adoption and scaling of green hydrogen and green fuels while contributing to global climate goals.



Introduction

The global climate crisis has necessitated a transformative shift in energy systems, driving the deployment of sustainable, renewable energy alternatives. Green hydrogen, produced through electrolysis using renewable electricity, has emerged as a versatile energy carrier and industrial feedstock. Its derivative, green fuels—including green ammonia, methanol, and synthetic hydrocarbons—are similarly positioned as viable substitutes for conventional fossil fuels. The scalability and widespread adoption of green hydrogen and green fuels are contingent on establishing a robust market infrastructure that includes long-term offtake agreements, structured support through mechanisms such as Article 6, JCM, and tailored production incentives for developing economies.



Green Hydrogen and Green Fuels:

Technology and Market Landscape

Green hydrogen and its associated fuels possess a unique ability to store and transport energy derived from renewable sources, making them particularly suitable for use cases that demand high energy density or continuous power supply. Advances in electrolysis technology have driven production costs down, with projections indicating that green hydrogen could reach price parity with grey hydrogen (produced from natural gas) by 2030.



The global market for green hydrogen is expected to reach \$89.18 billion by 2030 driven by both industrial and transport sector demands. Critical to this growth trajectory is the development of long-term contracts, policy incentives, and supportive market mechanisms that provide stability to producers and consumers alike.



Role of Long-term Offtake Agreements

Long-term offtake agreements are crucial to de-risking investments in green hydrogen infrastructure. These agreements, typically spanning 20 to 25 years, provide a guaranteed market for green hydrogen producers, enabling them to secure financing for large-scale projects. Offtake agreements help to lock in a baseline demand, incentivizing producers to invest in capacity expansion and allowing economies of scale to drive down costs. Key sectors for these agreements include industrial entities in steel and chemical production, fertilizer production, aviation, and maritime sectors. Notably, recent agreements by large global corporations, including European and Asian industrial giants, have shown the potential for such contracts to support and secure the supply of green hydrogen for decarbonization purposes.



Article 6 of the Paris Agreement: Facilitating Cross-Border Cooperation

Article 6 of the Paris Agreement provides a mechanism for countries to collaborate on emission reductions through internationally transferred mitigation outcomes (ITMOs). By leveraging Article 6, countries with abundant renewable resources, such as India, can export green hydrogen or its derivatives to other nations, contributing to global emissions reduction while advancing domestic economic growth. For instance, India's high solar irradiance and vast land resources present an unparalleled opportunity to produce cost-effective green hydrogen, which could be exported to other nations seeking to offset their emissions. Through Article 6, India and similar countries can engage in mutually beneficial partnerships with developed nations, receiving financial and technological support in return for exporting green fuels.

Under the provision of Article 6 of the Paris Agreement, Govt. of India can engage with the EU to conclude G2G agreements under which an import quota for India and other developing nations may be established to cater to the 10 MT import target for renewable hydrogen. In addition green hydrogen projects could be setup in the developing nations with technical and financial assistance from the EU. The carbon credits generated from such projects can be traded with the EU through a bilaterally determined price or linked to a market-based instrument.



The deployment of ITMOs through Article 6 can also address discrepancies in carbon accounting and ensure environmental integrity by establishing a transparent and verifiable framework for emissions reductions across borders. This allows countries to achieve their Nationally Determined Contributions (NDCs) in a cost-effective and collaborative manner, accelerating the global shift towards net-zero.

Production Quotas for Developing Economies

To ensure equitable access to green hydrogen technology and market participation, implementing production quotas for emerging economies is a strategic policy tool. India, as a leading renewable energy producer, is well-positioned to establish itself as a global hub for green hydrogen production. Setting national quotas for green hydrogen and green fuel production would create a predictable supply framework, further de-risking investment and supporting national decarbonization goals. These quotas could be aligned with international market demands, facilitated by offtake agreements, and augmented by Article 6 provisions, creating a synergistic approach that amplifies India's role in the global green hydrogen economy.

Production quotas also encourage technological innovation by creating a secure market base. By mandating a specific production target, developing economies can attract technology transfers, foreign direct investment, and capacity-building support, which are essential for establishing a competitive green hydrogen industry.



Economic and Environmental Implications



The convergence of long-term offtake agreements, Article 6, and production quotas creates a robust framework for scaling green hydrogen production while ensuring economic and environmental sustainability. For emerging economies, these mechanisms offer pathways to industrial growth, job creation, and energy security, while simultaneously addressing climate change. Moreover, for industries with limited decarbonization options, green hydrogen provides a practical solution to reduce emissions without sacrificing operational efficiency.

A global shift towards green hydrogen and green fuels will likely result in significant emissions reductions, estimated at 6 gigatons of CO₂ annually by 2050, according to the International Energy Agency.



Conclusion and Recommendations

- The pathway to a sustainable green hydrogen economy is predicated on creating favourable market conditions, supportive policy frameworks, and equitable opportunities for emerging economies.
- Long-term offtake agreements provide the market security necessary for investment, while Article 6 offers a means for countries to collaborate in achieving emissions reduction targets.
- Additionally, production quotas can enable countries like India to lead in green hydrogen production, supporting both national and global climate objectives.
- For policymakers, energy stakeholders, and climate advocates, the time is ripe to integrate these mechanisms into a cohesive strategy that accelerates the adoption of green hydrogen and green fuels.
- Given the urgency of climate action, it is imperative that countries and corporations work together to transform the energy landscape with green hydrogen at its core.



Sources and Further Reading

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- World Bank (2022). Harnessing the Hydrogen Economy for Developing Countries.*
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About Avaada Group

Avaada Group is at the forefront of the global energy transition, with expertise in solar module manufacturing, renewable power generation, and the development of green hydrogen, green methanol, green ammonia, and sustainable aviation fuel projects.

Under the leadership of Mr. Vineet Mittal, Avaada has emerged as a major global energy player. Avaada Energy, its renewable power generation arm, aims to reach an installed capacity of 11 GWp by 2026.

The group's strong execution capabilities and proven track record have attracted significant international investments, including a US \$1.3 billion funding commitment in early 2023, comprising US \$1 billion from Brookfield's Energy Transition Fund and \$300 million from GPSC, a subsidiary of Thailand's PTT Group.



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AVAADA GROUP

406, Hubtown Solaris,
NS Phadke Marg, Andheri East,
Mumbai - 400069

www.avaada.com

