AVAADA

INDIA TO BECOME GREEN HYDROGEN MANUFACTURING HUB

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Avaada Group, India

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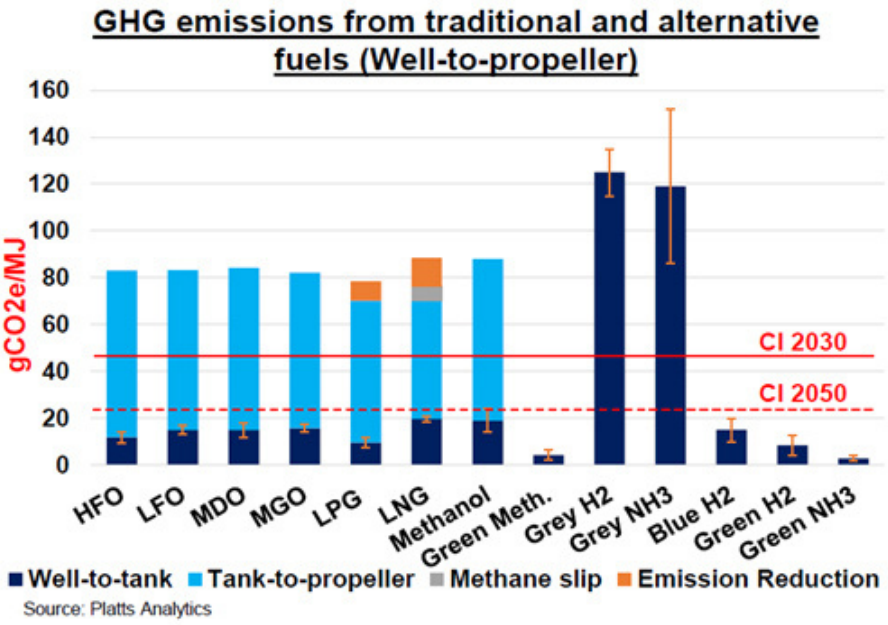
Introduction

Global industry is witnessing a massive significant shift toward decarbonization, driven largely by concerns around climate change caused by global warming.. Government, institutional bodies, businesses are taking major steps towards decarbonization by reducing their carbon footprint l. The credibility to the transition to greener and environment friendly steps is getting established given the large number of investments made by corporate houses, and financial institutions, targeted schemes like Production Linked Incentive ("PLI") by the governments and enabling policies. This has led to the development of various alternate low carbon emitting fuels and sources of energy. This paper highlights India's potential of developing these low carbon fuels and the advantages it inherits.

Global Green Hydrogen Market Scenario

The world stands at a crossroads, grappling with the pressing need to decarbonize its energy systems while ensuring sustainable economic growth. The momentum behind switching to low carbon fuels have been strong driven by targets to achieve the net zero GHG emissions commitments of various governments. Amidst this global challenge, green hydrogen has emerged as a promising energy vector, offering a zero-carbon energy carrier with the potential to decarbonise industries such as power generation, transportation, and heavy industry. GHG emissions of Green Hydrogen and its derivatives are comparatively negligible as compared to fossil fuels. The target carbon intensity levels for 2030 and 2050 is significantly lower than traditional fuels a well as the grey fuels.

Various governments across the globe have set hydrogen consumption and import targets (as shown in the Figure-3. Some of the countries that have targeted adoption of Green Hydrogen for decarbonisation include Japan, Korea, US, India, US etc.



Japan: To invest ~$107.5 Bn over the next 15 years to supply the country with hydrogen. Japan's target for GH2 is consumption is 12 MTPA by 2040.

The European Union aims to import 10 MTPA of renewable hydrogen and domestically produce 10 MTPA renewable hydrogen by 2030.

South Korea aims to consume ~ 28 MTPA of "clean hydrogen" by 2050, all of which will be either green or blue hydrogen.

Singapore's vision for a green corridor translates to an anticipated demand of 1 MTPA of ammonia for every 0.3 GW gas-based power plant. For a capacity of 5 GW, this totals 16.7 MTPA of Green Ammonia.

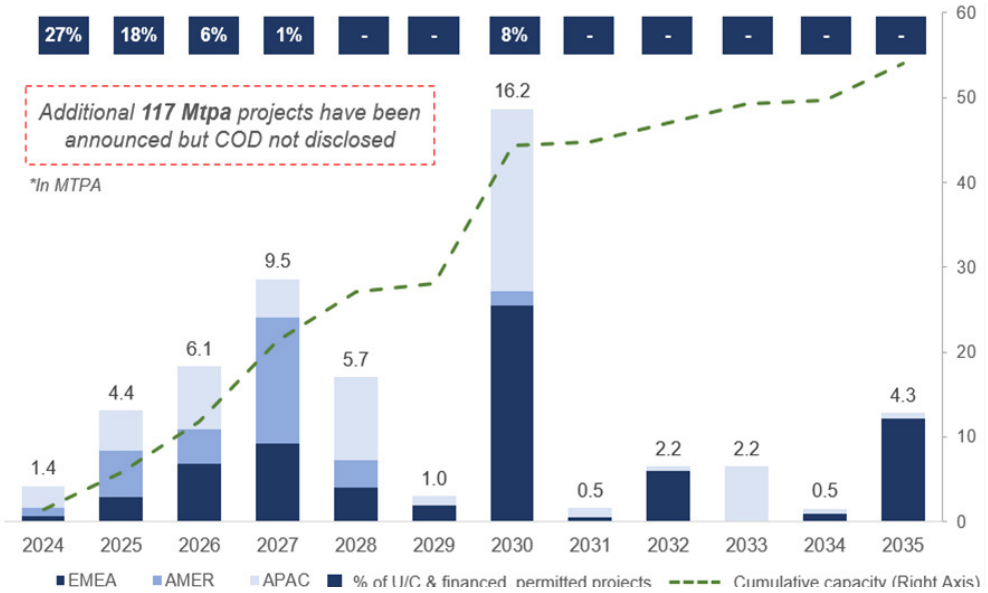
United States: According to a 2022 report by the Hydrogen Council, US demand for green hydrogen could reach 12 MTPA by 2030 and 100 MTPA per year by 2050. The US, with its projected maximum supply of 10 MTPA of green products by 2030, won't meet the skyrocketing demand.

Share of RE capacity in the power mix	45%	80%	36%	22%	82%	30% through imports	55%
GH_2 production / import(By 2030)	5 MTPA	10 MTPA	3 MTPA	Domestic 2 MTPA; Import - 2 MTPA	9 MTPA	50% of the projected electricity demand (by 2050)	Domestic 10 MTPA; Import 10 MTPA
Reduction in emissions (%)	45%	52%	46%	436.6 Mn ton CO_2 by 2030, or 40% from 2018 levels	43%	36%	55%
Net Zero	2070	2050	2050	2050	2050	2050	2050

The skyrocketing demand from these countries call for vast supply of hydrogen. To reach net zero emission targets, forecasts suggest demand of clean hydrogen (and derivatives) to be ~660 Mtpa by 2050.For Ammonia, a derivative of hydrogen the market gap between demand and supply is showcased below.

Total nameplate capacity of projects that have been announced for the green hydrogen production in the AMER, APAC, EMEA regions is 173 MTPA.

Below is a graph showing the vast gap between the supply and demand of Green Ammonia (a derivate of Green hydrogen)

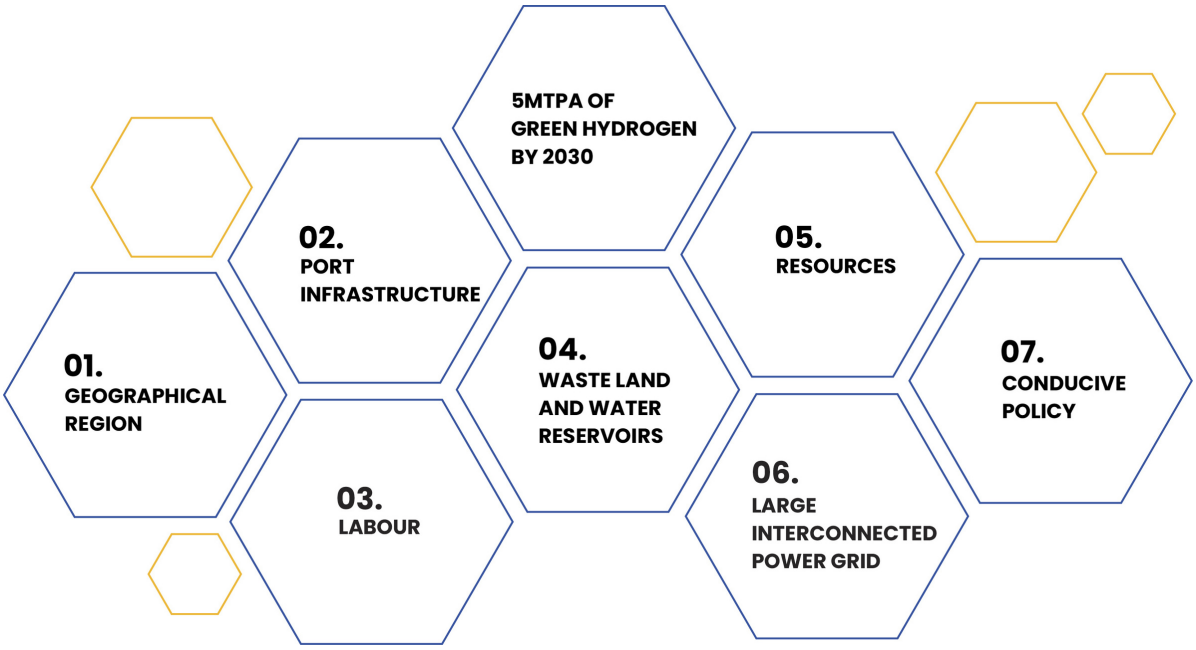


This whole situation creates the so-called chicken and egg problem: at USD 4–6 per kg – compared to the USD 1–2/kg for fossil fuels-based hydrogen – green hydrogen production costs inhibit demand. But without demand/offtake agreements, investors hesitate and investments remain too risky for wide-scale green hydrogen production that could compress costs.

How is India poised to emerge as a leader in the Green Hydrogen space?

Green hydrogen and its derivatives have emerged as a key component in the global fight against climate change, especially decarbonizing the hard-to-abate sectors such as fertilizer, steel, cement etc. Government across the globe are increasingly focusing on using green hydrogen which is expected to drive demand for green hydrogen is expected to surge by approx. 100 per cent globally from 2021 to 2030.

India has various strategic advantages to become a leader in the trade of emerging green fuel technologies. Under the National Green Hydrogen Mission, India has also set ambitious targets of at least 5 MTPA of green hydrogen (GH2) production capacity by 2030, which could increase up to 10 MTPA with export aspirations. Its domestic hydrogen demand is expected to reach 11 MTPA by 2030 including 46 % share of green hydrogen, according to Niti Aayog and RMI. The important advantages of India as a preferred country for production of Green hydrogen and its derivatives are listed below:



Geographical Region

India's is strategically located at the centre of the Trans- Indian Ocean route; this makes it convenient to export to European countries in the west and the countries of East Asia. Its long coastline of 7,500 km enables it to build a competitive port infrastructure.

Port Infrastructure

India has identified 3 major ports Paradip, Deendayal and V.O. Chidambaranar to build the necessary infrastructure: storage, handling and bunkering of green hydrogen, green ammonia in order to accelerate the green hydrogen and its derivatives exports.

Labour

India already has an abundant labour force of highly skilled, semi-skilled and unskilled labour. India is also home to engineering talent pool of leading licensors for Green Hydrogen and its derivatives technologies which include likes of KBR, Topsoe Haldor, ThyssenKrupp and EPC contractors like L&T, Toyo Engg, Technip Energies etc.

Waste Land and Water Reservoirs

India is blessed with various natural resources. It has abundant of waste land available especially in as well as water reservoirs that can be used for development of the large-scale renewable energy projects (RE) such as solar or wind energy parks. India enjoys around 3000 hours of sunshine. India's geographical surface receives around 5,000 trillion kWh of incident energy annually, with the majority of areas receiving 4–7 kWh per square metre each day. Solar PV can cover 3% of India's wastelands.

Resource

Globally, India is ranked 5th in the installed solar capacity and 4th in the installed wind capacity. With its relatively lower cost of energy and availability of water, India will scale up green hydrogen production in India there is wind power has a potential of 700 GW at 120 meters and 1,164 GW at 150 meters above ground level and solar power has a potential of 750 GW.

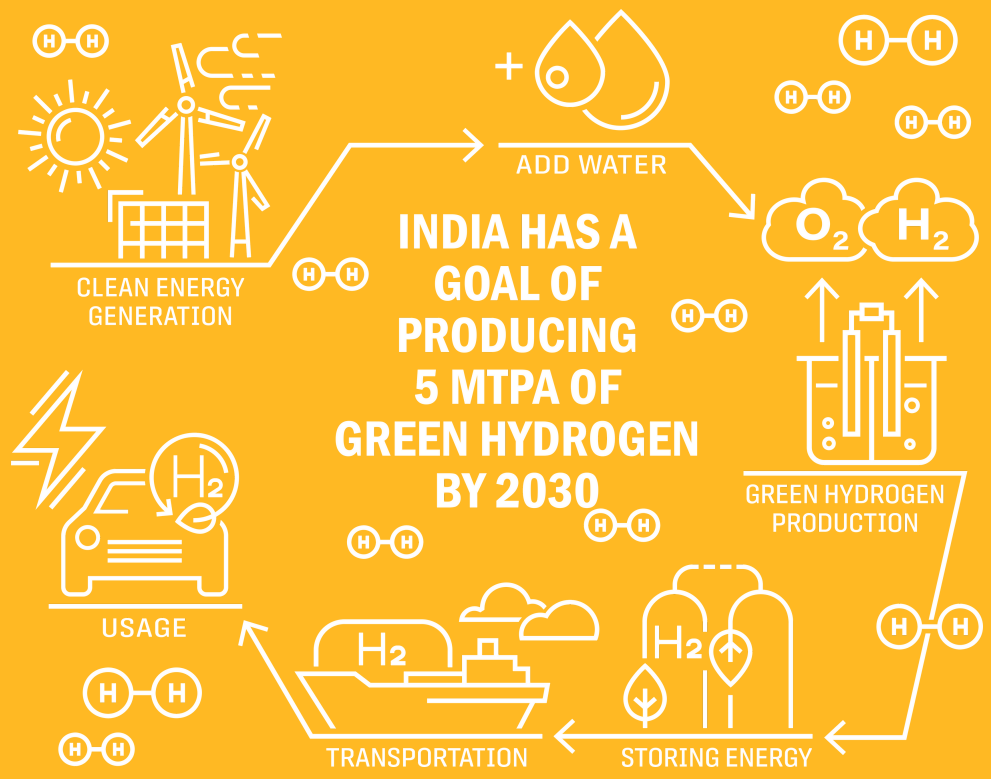
Large Interconnected Power Grid

India has one of the largest interconnected grids available in the world, and this grid capacity is being expanded to the tune of 500 GWs. The country has an interconnected and single frequency grid which ensures that we can realize the true potential of RE from one place and can export it to the National Grid.

Conducive Policy

The Government of India has already set the stage for scaling and investing in the GH2 ecosystem in the country. Under the National Green Hydrogen Mission, the Govt has announced financial outlay of INR 17,490 crore for supply-side incentives for electrolyzer manufacturing and GH2 production. The move encourages manufacturers and project developers to invest in GH2 and has put India among those leading countries, such as - the US and the EU, which has allocated public funding for GH2.

Offtake opportunity with India



The most affluent countries of the world, also referred to as the “Global North”, are responsible for around half of all emissions in the world. As per the Paris agreement, these countries have set NDC targets for mitigating the greenhouse gas emissions that cause climate change. The countries have also set national targets to achieve net zero emissions by 2050. To achieve these targets, it is essential to decarbonize the hard to abate sectors in the country. This is possible through electrification and use of green fuels. Electrification is a capital-intensive method which requires high investments in the across the entire country, whereas green fuels is a more cost effective and viable method to achieve these goals. The global north due to several constraints like lack of land, lack of renewable resources, lack of financial capital and skilled labour, will be unable to achieve these targets on their own.

Here, India plays an important role. With its abundant renewable resources, land availability, skilled labour and national one grid system it offers a viable and cost-effective solution. India has a goal of producing 5 MTPA of Green Hydrogen by 2030. Government of India has extended the support to achieve this target with various policies including the National Green Hydrogen Mission with a financial of outlay of INR 197.4bn and aims to make India the Global Hub for production, usage & export of GH2 in 2 phases:

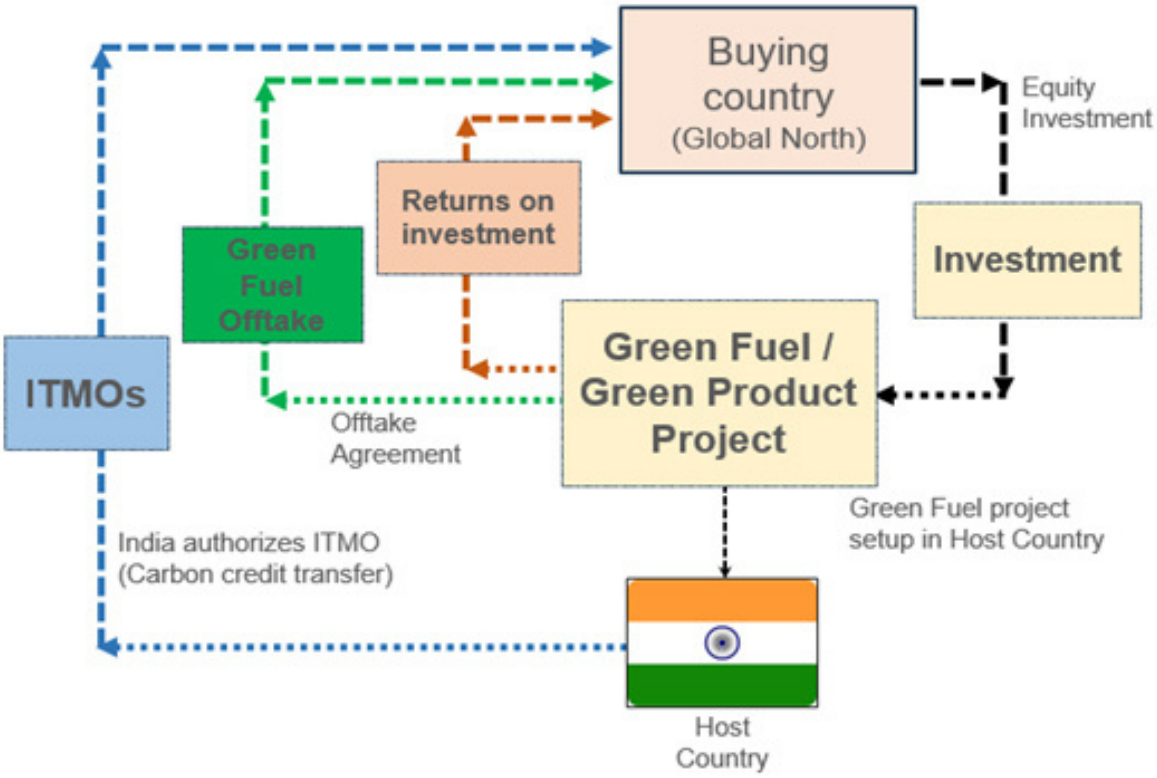
PHASE - 1

Indigenization of the value chain & increasing GH2 production

PHASE - 2

Scaling up production, deeper R&D & undertake pilot projects in potential sectors like railways, aviation

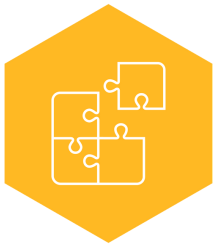
The private sector in India has taken advantages of these policies and is actively participating in the production of green hydrogen. In India, the gaols of the private sector exceed the national target pushing it higher upto 10 MTPA.



Under article 6, a foreign country (global north) which signs an agreement with an Indian entity for a Green fuel project is guaranteed an offtake of green fuels. At a country level, India will transfer ITMOs (Carbon credit transfer) to the country of origin of the foreign entity. Green hydrogen and its derivatives have been classified under the list of eligible opportunities for trading in ITMOs. Currently, India and Japan have entered into an aide memoire for ITMO transfer. India is also in discussions with other countries like Singapore, S. Korea and EU for a similar arrangement.

A case study has been taken to throw light on the value of ITMO than can be traded between countries. Avaada Group can help countries like Japan to meet its NDC commitments. Assuming a transfer rate of 90-100% under the offtake arrangement, it is estimated that USD 250-275 mn worth of ITMOs can be transferred per annum for each MTPA capacity of gNH3 as follows:

Assumptions for a 1 MT Green Ammonia Project:



Project lifespan:
25 years

Project investment:
10bn US$

Emission Factor/Ton of NH3 as per EU taxonomy: 1.60 Therefore, total emissions reductions: 1.60 * 1000000 = 1,601,000 MT or 1,601,000 ITMOs

ITMOs to be transferred: (90-100% under offtake approach**): 14,40,900 – 1,601,000 ITMOs.....(A)

EU ETS Price: 171 $/tCO2...(B)

Value of ITMOs:
(A) * (B)= € 246 – 274 Mn per Annum

Cumulative Value over 25 years = € 6 - 7 bn

* Long term forecast of EU ETS by Morgan Stanley
** Transfer estimated based on country level agreement and company level negotiations

Case Study on Avaada Green Ammonia Project Odisha

Avaada Group is implementing an integrated renewable energy, green hydrogen and green ammonia project with storage infrastructure at port. The capacity of this plant is pegged at 0.5 MTPA in the eastern coast of India in the state of Odisha. The project location is selected considering proximity to the port to cater to export market in Asia (Japan, South Korea etc.) and other developed markets of EU. Avaada has acquired land in a SEZ (Special Economic Zone) for setting up the facilities which is just 5 kilometres away from the Gopalpur Port.

Odisha offers one of best policy frameworks for Green Hydrogen projects. Odisha is the largest producer of electricity based on coal-based facilities, and is the house of minerals like Bauxite, Iron Ore, Manganese ore, and Lime. To achieve its larger agenda of sustainable development, state is promoting green hydrogen-based projects. Avaada's Green Ammonia project will achieve zero emission due to its unique design and power sourcing arrangement.

Avaada's Innovative approach to execution of its Green Ammonia Project

01. Technology selection

Avaada has taken technology agnostic approach electrolysers, air separation unit and ammonia synthesis loop. The EPC bid is structured in a manner to ensure that LEPC bidders are free to develop and offer their best design, based on their experience and technical solutions prepared for similar other projects worldwide. Our technology-agnostic approach will bring in more inputs, which will help us select a tailor-made solution which is not only technically the best but also cost-effective.

02. Electrolysers supplies

Based on feedback from LEPC bidders, it is felt that timely supply of adequate quantities of electrolyser stacks is crucial. Avaada Group has engaged and entered into strategic long-term agreement for technology tie-up and stake ownership with leading electrolyser manufacturers which will provide it competitive advantage in sourcing electrolysers.

03. Renewable Energy on Round-The-Clock basis

Indian regulations allow storage of renewable energy (RE) in national grid on 30 days accounting basis which is commonly known as energy banking. To minimise the energy banking requirement and ensure the round the clock power availability, we are planning significant wind capacity.

04. Raw water supplies

Govt. of Odisha has committed to supply required raw water quantity i.e., 15 MLD to the project, but to safeguard itself from risk, Avaada is carrying our prefeasibility studies to identify additional raw water sources based on surface water. There are water bodies and a river near to the project site. We intend to retain a small part of rainwater at riverbed of perennial river located ready by construction of a low height rainwater harvesting structure to store raw water. Such harvested quantity can suffice raw water supplies for the entire year from rainy period to next rainy period.

05. Flare stack design without use of fossil fuel

Typically, all flare stacks use natural gas or LPG to sustain pilot burner flame. As we intend to keep the facilities as Zero-carbon on gate-to-gate basis, we are working with our engineering company to design a flare stack based on electrical ignitors, to be ignited in case of flared gases are to be burnt. Gas based ammonia sensors are being planned for igniting the electrical ignitors.

06. Green certification

Avaada has already engaged an international consultant for design certification for the production of Green ammonia as per various internationally acceptable standards and regulations

07. Financing tie-up

Avaada Group will be main Sponsor for the project and has already arranged Equity funding. For Debt, Avaada has signed an MoU with a leading financial institution.

Summary

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What distinguishes Avaada from the other players in the industry?
The group excels in India with a portfolio of wind and solar assets exceeding of ~8 GW.
Some of the unique features that differentiate from its competitors include:

- In-house EPC & O&M services for Renewable Energy
- Proprietary weather and site data, use of AI and data analytics
- Presence of localized teams for land acquisition (development of renewable energy assets are land intensive and purchase are time consuming), thus eliminating delays in the process.
- Experience leadership team for existing as well as new lines of businesses like manufacturing and production of green molecules (drawn from diverse field which include EPC, utilities, fertiliser industry, chemicals, petrochemicals, hydrogen production industry, R&D)
- Long standing relationship with supply chain partners and vendors, licensors and sub-contractors

With its presence across the integrated value chain (module manufacturing, RE generation, & long duration storage capabilities through the new vertical for pumped hydro storage plants), Avaada has an edge in the green transition business giving it visibility on input availability & cost.
With our GNH3 manufacturing capacity in Odisha, Avaada various benefits including financial incentives (tax benefits from SEZ and incentives from the state government like capital subsidy, waiver of transmission and wheeling charges) as well as non-monetary benefits (expertise in RE generation covering a significant cost component of ammonia manufacturing, proximity to port resulting in ease of exports, banking arrangement, low storage requirements).

Avaada's contribution to decarbonization of hard-to-abate sectors

The Green Fuels business gives Avaada a chance makes a substantial contribution towards decarbonization of hard-to-abate industries like Iron & steel, international shipping, Oil & gas, fertilizers and chemicals. With usage of low carbon methods in production, these industries can achieve a significant reduction in carbon emissions and making the product CBAM compliant. With the rising focus on decarbonization, it also makes the cost of the product competitive as they can avoid the carbon tax which is imposed on exporting carbon emitting products to the EU.

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THANK YOU

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