

Workshop on “Cooperation in Green Hydrogen Towards Sustainable Energy Transition: India-EU Connectivity Partnership and the Global Gateway”



On 2nd June 2022, Research and Information System for Developing Countries (RIS) in collaboration with the Ministry of External Affairs, India, and the Delegation of the European Union to India, organized a hybrid event “Cooperation in Green Hydrogen Towards Sustainable Energy Transition”. The workshop was held at Juniper Hall, India Habitat Centre, New Delhi.

The main objective of the workshop was to bring together the stakeholders from India and European Union on a common platform to discuss the technology, business and financing related to the green hydrogen establishment in India, to address the challenges related to the commercial establishments, and to promote the business partnerships. In order to make green hydrogen commercially viable, the major focus is to decrease the cost of green hydrogen from around \$3.5-4.5 per kg today to \$1 per kg in a decade’s time, India needs to augment its capacity in green hydrogen electrolyzers and in storage units. Building close ties with the EU can help especially since European firms are among the leaders in technologies including those related to electrolyzers.

The event intended to explore the following key issues for collating specific inputs for policy actions:

- Identifying potential joint pilot projects in India, especially in the critical areas of electrolyzer manufacturing, as well as green hydrogen and green ammonia production - which can be taken up by both sides for the early-stage implementation
- Developing effective and efficient mechanisms to ensure a long-term pipeline of viable projects and build a robust green hydrogen ecosystem
- Ascertaining the policy and regulatory changes required to boost private sector collaboration
- Strategizing ways to mobilize adequate funding for pilot projects
- Addressing the key risks involved in the financing of green hydrogen
- Role of the Development Finance Institutions in risk-mitigation

The workshop consisted of an inaugural session followed by a panel discussion on Business and Technology Collaboration and on Financing Green Hydrogen Development.

1.1. Inaugural Session



Dr. Seshadri Chari, Distinguished Member of Governing Council, RIS:

Green Hydrogen is a very rich potential source of energy across the world. It is easy to obtain, however, it is very difficult to transport and store. These are the initial challenges that exist for almost all sources of energy. The research and development should be increased in this field and the contribution should come from across the world.

Mr. Ugo Astuto, Ambassador of the European Union to India:

- Both Europe and India have committed to becoming climate neutral and maintaining the temperature within 1.5 degrees Celsius. Climate and energy will remain at the top of our domestic and external agenda.
- EU and India have been working together on a variety of critical issues such as energy efficiency, renewables, smart grid storage and now also green hydrogen. EU has launched a policy initiative that is the global gateway and with India, EU has adopted a connectivity partnership that also offers an additional avenue for cooperation on climate action. The **connectivity partnership** is about sustainable, digital, transport and energy network and shaping the landscape in a sustainable manner. The **global gateway** is actually the European strategy to boost smart, clean and secure links in fields as diverse as digital energy transport and also to strengthen health education and research across the world. Under the Global Gateway the EU aims at mobilizing an investment of upto 300 million Euro from now upto 2027. Europe is also looking to move away from the dependency on Russian fossil fuels in the context of the Russia-Ukraine war.

- Hydrogen is expected to play a key role in decarbonizing sectors as the chemical industry, heavy transport and energy-intensive industrial processes. The EU is also promoting research and innovation in green hydrogen under its Horizon 2020 Research Programme and under Mission Innovation. India is doing the same.
- Hence, there exists great potential for collaboration between the EU and India in the area of green hydrogen.

Mr. Sandeep Chakravorty, Joint Secretary, Ministry of External Affairs (Opening Remarks):

- Green hydrogen is a pathway for mitigating climate change and huge investments have to be made in electrolyzers capacity. There is a need to overcome the technological and investment challenges that are needed to be addressed to realize the dream of green hydrogen. The way to store renewable energy will be through the production of green hydrogen. India has a partnership on green hydrogen with Denmark and now the possibility of a partnership is being explored with France. The focus of the Ministry of External Affairs is to tie up with developed countries on green hydrogen initiatives.
- A body of experts is needed such that to bring them together and promote the development of green hydrogen in India

Dr. Vandana Kumar, Additional Secretary, Ministry of New and Renewable Energy:

- Europe has set up net-zero targets by 2050 backed by the legislation and a European Climate Law. Europe has set up 20 million metric tonnes of hydrogen of which 50% will come from domestic sources and the remaining 50% through imports.
- India is working on energy transition very actively for the last 8 years. Currently, India has ~158 GW of renewable energy installed capacity. In the next 2-3 years, we are looking for ~192 GW installed renewable capacity. Also, we are looking to set up a manufacturing base in the country. Currently, we have a module manufacturing capacity of 20 GW and now we are trying to set up an integrated solar module manufacturing capacity in the country over the next 3 to 4 years. Subsequently, we are planning to ramp to green hydrogen establishments in the country. India is launching the *National Green Hydrogen Mission* which is in the advanced stages of approval. A variety of measures like demand creation, strengthening the supply side, establishing the supportive regulatory framework and innovative methodologies are being put into action to create the supportive infrastructure for green hydrogen.
- The economy of scale is one such way through which green hydrogen can become affordable. It is important that all countries should come together, pool the resources and synergize the effort for the success of the project.

Mr. Tudor Constantinescu, Principal Adviser to the Directorate General for Energy, European Commission briefly discussed the following points:

- We have seen a lot of developments in green hydrogen recently. We need to focus not only on sustainable energy transition but also on affordable energy transition. There is a need to modernize the energy infrastructure, energy economy and build new value chains. Europe has targeted to install 60 GW of electrolyzers by 2030 and Europe's budget of about 1.8 trillion Euros for helping energy transition will play a big role in supporting the bigger picture.
- A business case needs to be created for the energy transition. The net-zero targets set by both Europe and India will give a major push to renewable energy installation in the countries. The plan should be built concerning the hydrogen pipeline, market regulatory, etc. especially before 2030. Market arrangements and regulatory regimes should be in favour of the targets set. In the short term, there is a requirement to diversify the sources of gas and to make more solidarity for the storage arrangements of the gas. There is a need for a medium to long-term action plan on energy savings, RE penetration and green renewable hydrogen.

- EU is targeting to produce around 5.6 million tonnes of green hydrogen by 2039 for industrial and transport applications. There is a possibility to import around 10 million tonnes of green hydrogen making Europe one of the biggest markets for green hydrogen. The potential for export also needs to be developed in India in the long term. EU has launched a clean hydrogen alliance where over 1500 companies are contributing and partnering.

1.2. Technical Session 1: Business and Technology Collaboration



Mr. Shashi Shekhar, Director General, Independent Green Hydrogen Producers' Association:

- Green Hydrogen and Green Ammonia will have a vital role in achieving the green energy targets that the country has set for itself. Currently, transportation and storage of green hydrogen involve very high costs. Once it becomes viable, the export and import will mostly be in the form of green ammonia. India has certain advantages like vast wastelands, good solar irradiation, and O&M and EPC costs are the lowest in the world. Banking arrangements in the country will increase the capacity utilization of electrolyzers from 30% to anywhere between 90-95%. Aggregating the demand, competitive process for procurement and continuous effort in research & development.
- The tariff on green ammonia will constitute nearly 65% of the solar tariff cost. Solar tariff can cost Rs. 1.75 – 2 per unit within 2-3 years. Green ammonia will find its usage in fertilizers, marine fuel, and power generation (mixing with gas and coal).
- As Europe is planning for 20 million tons of green hydrogen, 10 million tons of hydrogen would translate to about 50 million tons of green ammonia. A part of the green hydrogen which Europe plans to import can be reserved for India if the country is able to reach the competitive tariffs.
- Banking and ISTS waiver have played a key role in increasing the interest of the stakeholders. Hence if the policy falls in line the generation of electricity through RE can take place in states like Rajasthan, and Gujarat where high solar irradiation is available, and it can be consumed anywhere in the country for the production of green hydrogen. Banking would help in bringing down the cost of production. Initial support and incentive would be required from the government to de-risk the investment.

Dr. Ashish K. Lele, Director, National Chemical Laboratory:

- The major challenge with hydrogen is to make it cost-effective and reach parity with fossil fuels. Policies and regulations should be such that to push standards and certifications in the country. Customers' awareness of green hydrogen must also be increased. The pilots should be started to demonstrate the benefits/challenges associated with green hydrogen. Hydrogen hubs can be created in the areas where there are a huge number of chemical fertilizers industries. Hence specific pilots can play a huge role in understanding the hydrogen aspects and subsequently help in further policy & regulatory developments.

Mr. Daniel Fraile, Chief Policy Officer, Hydrogen Europe:

- There are hydrogen targets in Europe sector-wise too mostly for transportation and heavy industries. Long-term strategy is needed for clarity. India should not only plan for export of the green hydrogen but should also plan for developing its economy based on green hydrogen.

Mr. R.V. Shahi, Co-Chair, South Asia Group on Energy, RIS:

- India's per capita consumption stands at 1200 kWh per year which is less than one-third of the global average. A lot has to be done in 30-40 years as power demand is likely to rise in the time to come. India is targeting a 500 GW RE capacity addition by 2030. Economic viability of the technology needs to be achieved. 70% of generation from fossil fuels today might have to go down to 30% by 2040-2050. Hydrogen has to compete with other sources both technically and financially to establish its place in the market.
- The mindset should be created among people in India to accept hydrogen as an important source of energy. Approx 2 units of hydrogen are needed to produce 1 unit of power. Hence, equipment prices have to come down to support the hydrogen ecosystem in the country.

Mr. Bart Biebuyck, Executive Director, Fuel Cell and Hydrogen Joint Undertaking:

- Europe is funding green hydrogen infrastructure mainly in 3 pillars namely production, distribution, and end-use applications. 300.5 million Euro has been announced for different initiatives including renewable hydrogen production, hydrogen distribution and storage, transport, heat and power etc. International cooperation is needed around the world. 23 hydrogen valleys have been identified in 10 European countries. We have 34 hydrogen valleys all over the world across 19 countries. Hopefully, in the coming years, hydrogen valley can be seen in India as well.

Mr. R.K. Malhotra, President, Hydrogen Association of India:

- The cost competitiveness of green hydrogen with other sources is a major barrier that needs to be addressed. Currently, we are using alkaline-based electrolyzers. We can collaborate with European Union on the best technology practices. Biomass gasification through green hydrogen is also an appreciable approach. Sometimes, the cost of supply and distribution of hydrogen at times can be more than the cost of production and hence cost needs to come down. Best practices and standards followed in European Union can be adopted in India as well. Both creating green hydrogen infrastructure and demand aggregation should go hand in hand.

Mr. Vivek Bhide, Managing Director, John Cockerill:

- The company is planning to invest more than 100 million Euros in R&D and in hydrogen development. The company has a manufacturing facility in China and a new facility is coming up in France. In India, the company has recently announced the JV with Greenko to set up the Gigafactory to produce electrolyzers in India. Intent vs Action should be tracked from time to time to keep the targets in place. Support from the government and larger participation is really important to contribute significantly in this sector.

Mr. Davide Cirelli, CEO, Snam Energy India:

- The company is the largest gas infrastructure company in Europe and second-largest gas network in the world in terms of transmission pipelines and one of the largest underground gas storage capacities in the world and is very active in green hydrogen.
- In India, there is 13000 km of existing gas pipeline. The approach should accommodate the blend of natural gas and green hydrogen in the pipeline itself. Step by step, the percentage of the blend must be increased. A new pipeline to be set up in the country should be 100% hydrogen ready. Infrastructure should be hydrogen ready. In India, underground gas storage has a very big potential and unfortunately, it is not present in the country yet.

Dr. S. Nand, Additional Director General, Fertilizer Association of India:

- 15.5 million tons of ammonia are produced in India in the present year. This will go up by 19 million tons by 2023-24. We are importing nearly 3 million tons; hence the country will reach the capacity of 22 million tons by 2023-24.
- As a low-hanging fruit, we should attempt to make fertilizers where carbon dioxide is not required. To make Urea, carbon dioxide is required. Urea accounts for 82% of nitrogen applications. Large infrastructure exists for the storage of ammonia. Viability gap funding should be introduced to make green ammonia cost competitive. The fertilizer industry will be in a different shape on the introduction of green ammonia and green hydrogen in the industry.

Mr. Kartik Reddy, Head of Energy Strategy, Adani Group India:

- Technology partnerships across the value chain between India and Europe should take place actively. Right kind of carriers to be used for storage and transportation. Coordinating across technology pathways will enable coordinated investment in certain technologies which can bring down the cost. Supply-demand gap needs to be bridged.

Mr. Patrick Cnubben, Director of Strategy Hydrogen, New Energy Coalition, Netherlands:

- The integrated hydrogen economy is required to be built across the world. To achieve the same there are plans to build hydrogen valley connecting different regions. Hydrogen valley is a way to designate a geographical area – a city, a region, an island or an industrial cluster - where several hydrogen applications are combined together into an integrated hydrogen ecosystem that consumes a significant amount of hydrogen, improving the economics behind the project. It covers the entire hydrogen value chain: production, storage, distribution and final use. These hydrogen valleys in Europe can be connected to India as well for better flow of the technology.
- Underground storage caverns can be used for the storage of hydrogen. In the Netherlands, a 100 MW electrolyzer is being perceived at the moment. In the Netherlands, it is planned to use hydrogen in municipal applications to produce low-temperature heat for residences. Several hydrogen fuelling stations are also in place and the country is also exploring green hydrogen applications in aviation.

1.3. Technical Session 2: Financing Green Hydrogen Development



Mr. Chintan Shah, Director (Technical), Indian Renewable Energy Development Agency (IREDA):

- 5 million tons is the target that the Indian govt. has set for 2030. This would require an additional 25-30 GW of renewable capacity and 50-60 billion dollars of investment which can be scaled upto 120-130

billion dollars by 2030. Hydrogen is deregulated in the country, unlike electricity which means its price is market determined. With the economy of scale going up in the future with better technologies like solid oxide electrolyzers, India has huge potential for hydrogen manufacturing for domestic needs as well as for exports. The 3 sectors namely fertilizer, refinery and steel alone could constitute a demand of 15 million tons of hydrogen demand equivalent.

- There are some challenges associated with the financing perspective as the hydrogen is deregulated, hence there are no long-term offtake contracts which create uncertainty on the part of banks/FIs. The market for green hydrogen does not exist as of today and is yet to be evolved so there is uncertainty regarding what premium it will draw. On the way forward, the infrastructure of green hydrogen should be set up in place to convert it into ammonia, and methanol among others and arrangements for technology transfer to be made. Hence, to evolve the green hydrogen development, there should be proper offtake structures, regulations, permitting as well as labelling of hydrogen to be in place.

Ms. Nina Fenton, Head of Regional Representation, South Asia, EIB:

- EIB has already invested 2 billion dollars in hydrogen and a 6 billion dollar investment is in pipeline. Most of the investment has been in research & development projects. Advisory services and technical assistance can be very important to enhance hydrogen establishments in the country. There is big potential in this market if the right kind of structures and resources are pooled.

Mr. Laurent le Danois, Team Leader, Cooperation Section, EU Delegation to India:

- Global Gateway is the EU strategy to boost sustainable high quality infrastructure investments in 5 key sectors including climate & energy, digitalization, transport, education and research. It is important to bring different partners together who can add value to the issue. Big, medium and small size players all will play a crucial role in scaling up the hydrogen development in the country. Global actions and global standards are required to reach technology across the world. Indian Solar Alliance (ISA) can also contribute significantly to this sector. It is required to give confidence and guarantee to investors so that a big sum of money can flow in this sector.

Mr. Bruno Bosle, Country Director, AFD:

- Energy sector in India has a portfolio of around 2.5 billion euros. Banks mainly have two roles as far as the hydrogen sector is concerned: to provide long term financing such that providing visibility across the sector and to provide technical support & assistance including risk sharing mechanisms. The guarantee mechanisms if exists give confidence to private financial sectors. The target is to make this sector technically and financially viable. For example, AFD started working in India over a decade ago in renewable energies. Today this sector in India has matured, consists of low risk and is mainly supported financially by commercial and private sector banks.
- For the hydrogen sector to boost, it is important that long-term financing options should be there. A proper regulatory framework should exist which gives confidence to the investors. International standards should be clearly defined and there should be access to low-cost renewable energy financing. In today's scenario, the key challenges behind the high cost of green hydrogen compared to grey hydrogen include not having access to low-cost of energy and the technical & financial support for scaling up with new technology.

Dr. Martin Lux, Head Energy, KfW:

- There exists uncertainty in the market and the off-taker risks as well. The major role of development banks in supporting the hydrogen sector includes providing grant money for advisory as a preparation of this kind of innovative project, facilitating technology and knowledge transfer, normal concessionary funding through our loans and providing viability gap funding. The guarantee mechanisms are also needed to gain the confidence of the investors.

Mr. Sturle Harald Pedersen, Chairman of the Board, Greenstad Hydrogen India:

- The private sector needs to get in hydrogen sector financing to scale up the establishments. There are country-specific challenges that need to be communicated so that these can be mitigated. India has the potential to become a net exporter of hydrogen. Currently, grey hydrogen has a demand of 5-6 million barrels in a year, hence already demand exists. This will give off take security for investors to step in.

Mr. Pim van Dijke, Investment officer, Energy Asia and Eastern Europe, FMO:

- India has made great efforts in reducing the cost of solar energy. Since the market is at the very beginning stage presently, hence it is difficult to predict the long-term hydrogen cost. Hence, by making the global market connected to each other and by reducing the off-taker risk, the bankability of the product must be increased. In 2020, there was only 0.3 GW of electrolyzers installed globally. Big players have now started entering the market and contributing to the capacity addition of the green hydrogen facility.

Mr. Shashank Adlakha, Senior Vice President and Head of Green Hydrogen Business, Renew Power:

- Green Hydrogen is an area of diversification for the company. Nearly 70% of the power cost of green hydrogen is coming from RE side. The risks associated include related to technology and related to the entire value chain holistically. Offtake arrangements and the shipment of green hydrogen to the port arrangement should be made proper. Developers on their part can start engaging with the banks and financial institutions. Compliance and standards should be followed and they should be calibrated based on the usage in India.

Mr. Deepak Jain, Power Finance Corporation:

- Bankability of the project and analyzing the key risk will be the most important parameters. There are 3 types of risks including demand risk. 75% of the cost of hydrogen is coming from the cost of renewable energy, 15% is coming from the cost of capital recovery of electrolyzers and the remaining 10% is coming from the cost recovery of the balance of the plant. Hence, RE plays a major role
- 50 - 60% is the average electrolyzer's efficiency, however, it can go as high as 90%. Hence, better technology would lead to cost reduction. Offtake risk and have long-term fixed price contracts with bankable entities. The govt. should play an active role in creating the demand through mandatory limits for the usage of green hydrogen in petrol refining or production of ammonia. Uncertainty in long-term pricing for the off takers has to be dealt with proper regulatory and financing measures. GW scale electrolyzers will have their own challenges and issues which are needed to be addressed. Another risk which is needed to be addressed is related to the life of the electrolyzers which is around 5000 – 8000 hours. Hence O&M or replacement of the components should take place at regular intervals. The balance sheet type of financing should be promoted.

Ms. Surbhi Goyal, Senior Energy Specialist, World Bank:

- The role of DFI is important because they pitch in when commercial investments are not coming adequately. DFIs step in when early mover risks are still there. World Bank has already identified the 5 potential sectors to invest in India for green hydrogen which include refineries, fertilizers, methanol, long haul trucking and the steel sector. The World Bank is also working on identifying and mapping where the early investments should come in. World bank is already working with Niti Aayog, MNRE and at the state level also indulgences have been there. Hence, promoting commercial investments.

Conclusion

The closing remarks were delivered by Mr Edwin Koekkoek, First Counsellor Energy and Climate Action, EU Delegation to India and Dr. Priyadarshi Dash, Associate Professor, RIS, thanking all the participants for attending the session. The workshop connected the European and Indian financial and hydrogen community and offered a valuable platform for exchanging ideas on how to create a pipeline of green hydrogen in India.

1.4. Agenda of the Workshop

<p>2.00 p.m. - 2.30 p.m. IST 10.30 - 11.00 CEST</p>	<p>Inaugural session</p> <p>Welcome Remarks: Dr. Seshadri Chari, Distinguished Member of Governing Council, RIS (4 min)</p> <p>H.E. Ugo Astuto, Ambassador of the European Union to India (4 min)</p> <p>Opening Remarks: Shri. Sandeep Chakravorty, Joint Secretary (Europe West), Ministry of External Affairs, Government of India (4 min)</p> <p>Special Remarks: Dr. Vandana Kumar, Additional Secretary, Ministry of New and Renewable Energy, Government of India (9 min)</p> <p>Mr. Tudor Constantinescu, Principal Adviser to the Director General, Directorate-General for Energy, European Commission (9 min)</p>
<p>2.30 p.m. - 3.55 p.m. IST 11.00 - 12.25 CEST</p> <p>Key Discussion Points:</p> <p><i>Identifying potential joint pilot projects</i></p> <p><i>Developing effective and efficient mechanisms to ensure a long-term pipeline of viable projects and build a robust green hydrogen ecosystem</i></p> <p><i>Ascertaining the policy and regulatory changes required to boost private sector collaboration</i></p>	<p>Business and Technology Collaborations</p> <p>Co-Chair: Mr. Shashi Shekhar, Director General, Independent Green Hydrogen Producers' Association (5 min)</p> <p>Co-Chair: Mr. Daniel Fraile, Chief Policy Officer, Hydrogen Europe (5 min)</p> <p>Lead Presenter: Dr. Ashish. K. Lele, Director, National Chemical Laboratory (8-9 min)</p> <p>Roundtable (4-5 min per speaker):</p> <p>Mr. R. V. Shahi, Co-Chair, South Asia Group on Energy Mr. Bart Biebuyck, Executive Director, Fuel Cells and Hydrogen Joint Undertaking Dr. R. K. Malhotra, President, Hydrogen Association of India Mr. Vivek Bhide, Managing Director, John Cockerill India Mr. Davide Cirelli, CEO, Snam Energy India Dr. S. Nand, Additional Director General, Fertiliser Association of India Mr. Kartik Reddy, Head (Energy Strategy), Adani Group Mr. Patrick Cnubben, Director Strategy Hydrogen, New Energy Coalition*</p> <p>Q and A (10 min)</p> <p>Conclusions by the Co-Chairs (2 x 5 min)</p>
<p>3.55 p.m. - 5.20 p.m. IST 12.25 - 13.50 CEST</p> <p>Key Discussion Points:</p> <p><i>Strategizing ways to mobilize adequate funding for pilot projects</i></p> <p><i>Addressing the key risks involved in the financing of green hydrogen</i></p>	<p>Financing for Green Hydrogen Development</p> <p>Co-Chair: Ms. Nina Fenton, Head of Regional Representation, South Asia, EIB (5 min)</p> <p>Co-Chair: Mr. Chintan Shah, Director (Technical), Indian Renewable Energy Development Agency (5 min)</p> <p>Lead Presenter: Mr. Laurent le Danois, Attaché, Team Leader, Cooperation Section, EU Delegation to India (8-9 min)</p> <p>Roundtable (4-5 min per speaker):</p> <p>Mr. Bruno Bosle, Country Director, AFD</p>

<p><i>Role of Development Finance Institutions in risk-mitigation</i></p>	<p>Dr. Sturle Harald Pedersen, Chairman of the Board, Greenstat Hydrogen India Dr. Martin Lux, Head-Energy, KfW Mr. Pim van Dijke, Investment Officer, Energy Asia and Eastern Europe, FMO Mr. Shashank Adlakha, Senior Vice President (Green Hydrogen Business), ReNew Power Mr. Deepak Jain, Power Finance Corporation Ms. Surbhi Goyal, Senior Energy Specialist, World Bank</p> <p>Q and A (10 min)</p> <p><i>Conclusions by the Co-Chairs (2 x 5 min)</i></p>
<p>5.20 p.m. - 5.30 p.m. IST 13.50 - 14.00 CEST</p>	<p><i>Concluding Remarks and Way Forward:</i></p> <p>Mr. Edwin Koekkoek, First Counsellor, Energy and Climate Action, Delegation of the European Union to India (5 min)</p> <p>Dr Priyadarshi Dash, Associate Professor, RIS (5 min)</p>
<p>5.30 p.m. - 6.00 p.m. IST</p>	<p><i>High Tea</i></p>