PHD CHAMBER
OF COMMERCE AND INDUSTRY

KEY TAKE AWAYS FROM SUMMIT

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

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SPEARHEADING INDIA'S TRANSITION TO CLEAN ENERGY

The 6th Assessment Report (AR6) of the IPCC on Climate Change released on 9th August 2021, warns that the goal of 1.5 degree Celsius recommended in the Paris Agreement three years ago will be reached by 2030, a decade earlier than announced previously.

The warning signals of extreme events such as melting of permafrost, cyclones, torrential rains, floods, droughts, forest fires, and the scientific recommendations of international bodies on Climate Change regularly narrowing down the limits to restrict temperature rise, are perhaps not being taken seriously. We should not wait to reach the point of no return because temperature rise of 2 degree Celsius would result in the runaway reaction on earth, which will cause large-scale devastation. Further, scientific projections but more so the measures to restrict temperature rise will be crucial for the COP26 at Glasgow in less than three months from now. The United Nations Secretary General Antonio Guterres said that the report "must sound a death knell" for fossil fuels. Replacement of fossil fuels by new and alternate sources of energy needs to take place at a war footing.

Green Hydrogen as a clean fuel is a promising alternative. And the International Climate Summit 2021: Powering India's Hydrogen Ecosystem gains utmost importance in the present scenario.

Dr. J.P. Gupta
Summit Chair and
Chair - Environment Committee,
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TAKEAWAYS FROM THE INTERNATIONAL CLIMATE SUMMIT 2021- POWERING INDIA'S HYDROGEN ECOSYSTEM

This is a moment of tryst with destiny. Mother Earth, after millions of years of using fossil fuels is bidding farewell and shifting to the Sun God and Mother Nature to meet her energy needs.

1.0 India's Global Leadership Role to combat Climate Change.

- On 15 August 2021, Hon'ble Prime Minister of India Shri Narendra Modi announced the launch of National Hydrogen Mission (NHM) while commemorating the 75th years of independence with an **aim to cut down carbon emissions** and increase the use of renewable sources of energy. Also, Hon'ble Prime Minister visioned to make **India an Export Hub** for Green Hydrogen by 2030.

- India is beautifully positioned to take a lead in the global Green H2 economy, due to its position on Renewable Energy. Today, India has 141 GW of installed capacity of RE making it the fourth largest installed capacity globally- fourth largest for wind and fifth largest for solar. India has also set for itself the world's largest RE expansion plan to achieve 175 GW by 2022 and 450 GW by 2030 in installed capacity. The RE installed capacity has seen a 226 per cent increase in the last five years. India's RE sector has already received investments worth $70 billion in the last seven years and delivered capacities presents additional business prospects worth $20 billion for the next decade.

- Producing Green Hydrogen in India can become cost effective, which will not only guaranty energy security, but also gradually ensure self- sufficiency and savings of billions of dollars in oil imports.

- As one of the greatest nations in the world, India holds a strong moral responsibility when it comes to handling the climate- and nature crises that are upon us, despite the fact that emissions per capita are lower in India than other countries with a comparable size.

2.0 Why Hydrogen?

- Being one of the most abundant elements in the universe, hydrogen could be a key component in the global transition to net zero greenhouse gas emissions. Hydrogen can play a vital role in utilizing excess production of renewable energy from Solar and Wind to produce Green Hydrogen on-site for storage or distributed energy. On one hand this will improve financial viability of existing renewable energy assets and on the other, making available green Hydrogen at an economic price.

- Hydrogen has the clear potential to transform our existing large dependence on fossil-based energy to low carbon and green energy to facilitate process of decarbonization for our net zero transition.

- Green hydrogen is produced through electrolysis, a process that separates water into hydrogen and oxygen, using electricity generated from renewable sources. Today it accounts for just 0.1% of global hydrogen production. However, the declining cost of both renewable electricity (accounting for 70% of the cost of producing hydrogen) and electrolysis technology indicates that green hydrogen could be the next best investment in the world of clean energy.

3.0 Objective of the Summit

- The sole objective of the international summit has been to create awareness and deliberate on, how to achieve success for our Hon'ble Prime Minister's vision to produce **Green Hydrogen** and **Make India not only Self Reliant but also a net exporter of Hydrogen Energy.**

- Another objective of the summit has been to create wider Institutional and Corporate, awareness about the importance of creating Hydrogen ecosystem. ICS 2021 could do so, very effectively, by connecting and bringing on board, committed key global technology players and experts within the Hydrogen value chain, triggering Indian Corporate sector to adapt and get involved, in larger plans to create an Indian Hydrogen Ecosystem.

4.0 International Climate Summit -2021: "Powering India's Hydrogen Ecosystem"

- The Environment Committee of the **PHD Chamber of Commerce and Industry** in partnership with **Invest India** organized International Climate Summit- 2021: Powering India's Hydrogen Ecosystem on 3rd September, 2021 at Hotel Taj Palace, New Delhi, India.

- GreenStat Asia Norway, Gexcon India Hydrogen Pvt. Ltd., Norway, Arena H2 Cluster Norway, India Hydrogen Alliance, and TERI were the committed knowledge partners of ICS 2021.

- Innovation Norway was the country partner for the summit. A large delegation, comprising of the senior professionals from very large corporate in Hydrogen from Norway, physically participated in the summit, extending their support to India, during Energy transition, to Green Hydrogen.

- Ministry of Environment, Forest & Climate Change, Department of Scientific & Industrial Research, CSIR and the Department of Science & Technology, Ministry of New & Renewable Energy, Power, Petroleum & Natural Gas, Coal and MSME, Government of India were the supporting partners of ICS 2021.

- More than 30,000 registered delegates worldwide ranging from Nobel Laureates to technical experts, policy makers and leaders of Industries participated and interacted through nine specialized technical sessions addressed by 60 revered experts from the entire spectrum of Hydrogen/sustainability business. Details of the summit session's topics and speakers are in **Annexure I and Annexure II.**

5.0 Background note on deliberations of Experts, who participated in ICS- 2021

- One main difference this time from previous large transitions, for India and for the global societies, is the time we have at our hand to act. The present decade has been described as a defining decade for humanity, indicating the need to half the global emissions by 2030, to avoid a temperature rise of more than 2 degrees Celsius.

- The strong policy push on hydrogen, from the allocations in the Union Budget, the suggested PLI scheme on hydrogen, the 10% demand on the refineries by 2023 by the Hon'ble PM's speech on Independence Day launching the National Hydrogen Energy Mission (NHEM), clearly paves the way for a rapid and strong deployment of a hydrogen economy/ industry in India.

- India has been through great societal transformations before and has proved its ability to manage changes on a large scale, putting people and society first. The ongoing green transition is closely linked to issues like water security and food security, emphasizing the need to tackle several crises simultaneously with a human centered approach. In further discussions on hydrogen, the link between ammonia production, fertilizer production and food security has been highlighted. A green energy shift will not happen if the basic human needs are not met in the transition.

6.0 Key Takeaways from the Summit.

6.1 Release of Book- Self Reliant India- Harnessing the Power of Hydrogen (Copy of the book enclosed).

- **Norwegian and Indian Scientists**, technocrats and titans of Industries authored the book, broadly covering the followings;

  - Towards Hydrogen Economy;
  - Technologies;
  - Hydrogen and Market segment;
  - Safety and Regulations;
  - Powering the way for a New Hydrogen road map.

6.2 National Hydrogen Portal

- Launch of the comprehensive National Hydrogen Portal www.greenhydrogen-India.com

One-stop information source for research, production, storage, transportation and application of hydrogen, it will be a repository of all academic and research work, and other significant developments in the field of hydrogen; with a focus on Green Hydrogen.

6.3 Proposal on International Hydrogen Alliance

- To succeed with rapid technology transfer for green hydrogen, increased global cooperation is needed. No single country can provide solutions to the entire value chain for hydrogen and thus, there is a need for cooperation among countries to make green energy available at the earliest opportunity. **'International Hydrogen Alliance'** is needed to help create a large investment, enabling environment into global Hydrogen ecosystem. Not only the partner countries will benefit immensely but would also accelerate & fast track global transition to Hydrogen economy worldwide.

- Just like our Hon'ble Prime Minister Narendra Modi proposed & initiated highly successful 'International Solar Alliance', in 2015 - ahead of COP 21 at Paris, Indian government should put forward the proposal for initiation & development of International Hydrogen Alliance at the forthcoming UN Climate Change Conference (COP 26) in Glasgow this November.

- Proposed Alliance would bring different countries - the key global stakeholders, on one platform to facilitate international corporation to fast track Hydrogen Energy transition, through aligned policies, shared plans, wider sharing of technical knowledge through technology transfers & collaborations, global capacity building for sharing and balancing demand and supply side matrix and the most important one - creating a large investment environment for creation of a structured global Hydrogen Economy.

6.4 Indo- Norwegian Center of Excellence- Hydrogen (CoE-H)- Offerfrom Norway.

- Co-operation within the hydrogen field between Norway and India, has already gained a strong position with the offer of setting up "**The Norwegian-Indo Center of Excellence in Hydrogen (CoE-H India)".**

- The Norwegian energy company, GreenStat, together with its partner Companies within H2Cluster from Norway & India represent a growing

co-operation of businesses, R&D and governmental contacts across both nations. This can be the trigger point for a long and fruitful collaboration that will make strong contributions towards implementing hydrogen as an important part of the energy system in India.

- CoE-H would be world's leading competence center for Green Hydrogen-making the shift from fossil to renewable energy for Net Zero transition.

7.0 Key Drivers to the success of the Hydrogen Mission.

7.1 Availability of India-Centric and Local-Centric Technologies for Green Hydrogen Production.

- The success of Hon'ble Prime Minister's announcement on the launch of National Hydrogen Mission depends upon the development of local knowhow and technologies for Green Hydrogen production, storage and transportation. India has to be Self Reliant in Green Hydrogen Production Technologies as a National Mission, on war footing.

- Hydrogen Production and storage companies throughout the world are booked with advance orders, for two to three years. It is extremely important and urgent that India declares a national mission to develop India-centric cost effective technologies and knowhow for production, storage and application of Green Hydrogen. This can be achieved through R&D as well as adaptation of developing technologies to Indian conditions.

- On a clarion call of our Hon'ble Prime Minister, Indian-made Covid Vaccines were made available in record time of 12 months. India became Self Reliant in nuclear technologies, within a record time, although sanctions were imposed by Western World at the time of nuclear tests conducted by India. We, in India are fully capable to achieve the same traction for developing Hydrogen ecosystem, not only becoming self-reliant in short time but also by being a net exporter of Hydrogen energy as per the call of our Hon'ble PM.

7.2 Technology constraints and opportunities for India

- The technologies needed for green hydrogen is at present a bottle-neck in unleashing the hydrogen economy. Globally, the technology providers are few and unable to provide the global market fast enough. The existing technology needs rapid deployment and in parallel there is a need to develop new technology and stimulate competition between the players.

- India's ambition to becoming self-reliant on Hydrogen, calls for domestic manufacturing of efficient & cost-effective electrolysers, development of fuel-cells, R&D and adaption of compression technologies, whole range of storage solutions, cost effective safety and handling technologies, on-site production for hydrogen dispensing, and of course range of applications.

- The challenges linked to green hydrogen when it comes to infrastructure needs, design, technological development, workforce, and off take/ markets, offers both limitations and a potential competitive advantage for India. For example, the infrastructure used for Gas distribution, is an opportunity more than a limitation if one allows a "smooth transition"- hydrogen, mixed with natural gas. Further, many large industrial players have indicated that they have started developing electrolyser technologies and capacities, and also fuel-cells and batteries, enabling India to become self-reliant on essential technologies needed to manage the green shift.

- Combined with increased investment, government support, engineering advancements and a skilled workforce, India also holds a competitive advantage linked to its IT sector and global position on digitalization i.e. artificial intelligence solutions will be vital in enabling the transition to green hydrogen and will play a critical role in the global decarbonization effort by decreasing the CAPEX and OPEX.

7.3 Setting up Centers of Excellence: Powering India's HydrogenEcosystem.

- India hosts several world-leading R&D institutions that play a vital role in all societal development and transformations. The complexities linked to a green shift, calls for a strong cooperation between governmental bodies, industries and R&D Institutes. It also calls for an advanced international cooperation.

- To facilitate this domestic and international cooperation, it is suggested to set up a number of Centres of Excellence- Hydrogen (CoE-H) throughout the country. These centers would be instrumental in creating requisite critical mass for holistic development of Hydrogen economy in the country.

- For emerging hydrogen industries and wide spread use in society, new knowledge methods and technologies are required to achieve tolerable levels of safety. Compliance with applicable international, national and regional regulations, codes and standards (RCS) will facilitate a better understanding of the safety related properties of Hydrogen; The safety-related properties of hydrogen and the characteristic operating conditions of technical systems for producing, storing, transporting and

using hydrogen implies that fires and explosions represent a significant hazard for people, installations and the environment.

- These CoE-H partner ups with the best foreign R&D centers, and hence would also facilitate bilateral cooperation on hydrogen related fields. The CoE-H's should be based around pilot/ demo hydrogen plants, allowing on-site R&D and technology testing and development. An international co-operation would allow the exchange of personnel and capacity building.

- The CoE-H's should offer masters and PhDs in related areas, Provide training of manpower in production, storage and transportation of Hydrogen. A minimum of 1,00,000 trained and skilled manpower is needed that may be achieved through virtual reality and augmented reality.

- The Centers of Excellence (CoEs) attached to universities should focus on:

  - Masters and PhDs programmes
  - Hydrogen production technologies with respect to scale of production
  - Hydrogen storage systems
  - Hydrogen transport and applications
  - Hydrogen Safety in production, storage, transportation anddispensing.
  - For emerging hydrogen industries and widespread use in society, new knowledge methods and technologies are required to achieve tolerable levels of safety. Compliance with applicable international, national and regional regulations, codes and standards (RCS) will facilitate a better understanding of the safety related properties of Hydrogen.
  - The safety-related properties of hydrogen and the characteristic operating conditions of technical systems for producing, storing transporting and using hydrogen implies that fires and explosions represent a significant hazard for people, property installations and the environment.

7.4 Areas for Research & Development

- The proton exchange membrane accounts for the major cost in the total cost of an electrolyser. To reduce costs and increase manufacturing in India, developing alternate membranes should be prioritized. Another issue is of critical minerals. Also, Electrolyzers use Iridium, a by-product of platinum, which in turn is primarily used in conventional vehicles. As auto demand shifts to EVs, there will be excess platinum supply if Iridium has to be produced for electrolyzers. So, research is needed for alternative materials.

- Heavy industry boilers, furnaces and (cement, sponge iron) kilns would have to be adapted to absorb changing hydrogen and natural gas mixtures. The cost of transporting hydrogen by road is high. Distributed production with modular electrolyzers would, in theory, lower the expenses. But fiber-reinforced plastic or higher-grade steel pipelines could be installed, and older ones lined for corrosion resistance. India must evaluate if extending pipelines life span this way could justify the additional cost.

- A dedicated research project is needed to target replacement of LPG cylinders with Green Hydrogen, for cooking in villages.

7.5 Creating, Facilitating policy environment

- Government should prepare the policy road map and regulatory framework in line with International Standards to restructure energy system. Policy road map should be based upon optimal utilization of existing infrastructure as we plan of new infrastructure for green hydrogen. In view of this, blending Green Hydrogen with existing natural gas infrastructure would be the best option in the short run/ immediate future.

- **Hydrogen does not represent added energy- rather it is the opposite, as we lose some of the energy from the electric grid when we transform it to hydrogen as an energy carrier. Using RE to produce hydrogen, it takes to multiply the capacity of the electrolysers by 2 to 3 times of the RE source (based on solar, which is most predictable). This is of course making it harder to get green hydrogen in parity with grey hydrogen. This is unwarranted as it does not really contribute to a quicker energy transformation. The Government should accept other low carbon alternatives as an equally good option instead of 100% usage of electricity from RE to produce green hydrogen including combined usage of electricity from RE and coal, where estimated usage of coal is compensated by equally added net efficiency of RE to the existing grid. As well as thinking of transition from Gray to Blue hydrogen through carbon capture and sequestration. This in turn would make it easier and cost-effective alternatives to accelerate implementation of green hydrogen transition.**

- This needs to be perceived in conjunction with expanding the RE capacity with combined usage of fossil fuels (Coal) and RE to produce low carbon hydrogen with balanced production circadian cycle and seasonal variations.

- Hydrogen is vital in many instances such as;
  Balancing the grid (duck curve challenge- approximately 20% of RE gets wasted because of excess energy received in the most productive hours of the day in PV and wind),

Industrial usage (6,7 Mt consumption of grey hydrogen with demand doubling in the next decade),
In the transportation (aviation, land transport and maritime), and **agriculture** (decentralized energy demand+ fertilizer).

- The Government should create an inter-ministerial green hydrogen agency or department for holistic management, administration and structured development of Hydrogen ecosystem in the country. It will be important to ensure co-ordination between new energy policies and national demonstration projects requiring strong centre-state collaboration, adequate clean energy funding, vigorous initiatives under 'Make-In-India' for domestic manufacturing activities in FAME and Renewable capacity expansion.

- It is essential to develop national standards for safety regulations and policies, based on the best practices as adopted internationally.

- Incentivizing Capex and Opex, during the initiation and capacity building phase on the lines of incentives to Wind and Solar energy, would be a big enabling factor for the faster development of the low carbon / green Hydrogen economy in the country.

- Policy incentives as of follows could be a useful push for expecting exponential growth.

  CAPEX:
  - Direct Capex Subsidies
  - Creating Hydrogen decade –Tax Holiday linked to cost of investment
  - Lower interest debts

  OPEX
  - Feed -in tariff scheme,
  - Variable production incentives, and
  - On Site production of Green Hydrogen for distributed energy
  - Linking existing Solar and Wind PPAs with on-site Hydrogen Production

- It is extremely important to provide subsidies to green hydrogen as being done to the fertilizer production. This will enable narrowing down of the production costs for Green Hydrogen, which in turn will facilitate substantial in-flow of investment in green hydrogen.

- Offer Minimum Support Price for green hydrogen procurement every year till there is price parity between Grey Hydrogen and Green Hydrogen.

- Government should incentivize strategic pilot/ demo projects in geographical

areas, as a part of Hydrogen R&D initiatives.

- Support to the technology oriented hydrogen start-up projects, will be an important catalyst, for stimulating investment.

- India already in a short time has built up a very large production of renewable energy, which requires storage solutions to reduce significant losses in periods where production is higher than consumption.

- Investing in Hydrogen based crackers in India should be discouraged in favor of bio-ethanol based ethylene (significant CAPAX, OPEX reduction).

- Major investment in petroleum based ethylene cracks should be discussed (GAIL, IOC, BPCL and HPCL) including evaluating Super Critical Steam cracking, Green Bio-ethylene technology using bagasse where in carbon emission reduction almost 3-5 ton/ ton ethylene could be achieved.

- Planning Low Carbon and Green Hydrogen road map should aligned with national RE and EV (Hydrogen and battery based) growth plans.

- The transmission cost of energy in India is extremely high, making green hydrogen production commercially unviable. So rationalization of Grid, smart grid and development of micro grids would be important ingredients for green hydrogen development.

- Decentralized hydrogen production must be promoted through open access of renewable power to an electrolyzer.

- Hydrogen through ammonia as carrier should be incentivized as India is agriculture based economy. Industrial clusters including steel, refineries, fertilizers and cement can follow.

8.0 Creating Indian- ETS (Indian Hydrogen, Carbon Emissions &Offset Trading Scheme)

- Given the size and quality of mature trading markets of India, creating the Indian ETS could be a cornerstone of the India earnest policy to combat climate change and one of its key tools for reducing greenhouse gas emissions **cost-effectively**.

- A large market size likes of India, has the inherent viability to create such scheme that would in short future could support or even ultimately replace government's financial support to Hydrogen Industry.

- This could become key financial tradable instrument for sustainability investments and covering entire Hydrogen economy.

- Utilizing India's IT back-bone and creating digital Offset Trading platform could transform the nascent Hydrogen industry into a much-matured developed industry in comparatively much quicker time.

  In case of in-principle interest, further detailed plan can be presented.

9.0 Key Suggestions

- Government Policy road map should be based on the use of current infrastructure before thinking of new infrastructure for green hydrogen. In view of this, the mix of Green Hydrogen with existing natural gas infrastructure is the best course to follow.

- Globally, Hydrogen storage at 750 bars is permitted. Indian regulatory authorities have not permitted at more than 250 to 350 bars.

- The industry and government should collaborate to expand the H2 truck fleet along this corridor, with the goal of converting 10% of long-haul trucking along the DMIC route to hydrogen-fueled truck FCEVs. This would help both existing and new FCEV truck manufacturers to plan for additional investments and make well-informed decisions about building mobile FCEV stations. H2 can help heavy-duty transport switch from diesel.

- The technology employed in the production and use of blue hydrogen (based on carbon capture and storage, CCS) is still in its early stages and is expensive, raising the cost of hydrogen generation for scaling up commercial productions.

10.0 Funding

- Industrial clusters including steel, refineries, fertilizers and cement can be early adopters;

- According to Industry estimates, investment of over 300 billion USD is estimated in the Hydrogen sector by 2030. Globally, more than 200 hydrogen projects have been announced, many of which are already under progress.

- Availability of Funds with the Banks, Institutions and private funding is not a big challenge as there is decent amount of liquidity available in the system. However, due to viability challenges on account of higher cost of production as compared to conventional fossil fuel source, there is no incentive or encouragement to private

sector to come forward and make investment in Hydrogen unless public sector support comes before hand in the following forms-

- Extending direct or indirect subsidies on the investment made in producing equipment specially on manufacturing of Electrolysers and in the entire value chain of H2 namely production, storage and transportation.

- Fiscal incentives rewarding the use of GH2 in the Industrial sector, in the form of GST concession.

- Income Tax Exemption for the companies replacing Grey H2 with Green H2, till the time the process is profitable.

- Implement financial instruments to attract commercialization in combination of CO2 taxes.

- Supporting the nascent market for Fuel Cell electric vehicle FCEV by providing direct subsidies to the manufactures and GST reduction &for end- users.

- Encourage the use of public transport system to guarantee of the H2 production and to inform the buyer that H2 is Green/ Low carbon.

- Subsidy for use of Green H2 linked to carbon allowance.

- Creating Indian-ETS and Digital trading platform.

- To regulate the price of electricity required for production of Green H2

- Expanding Green Banking operations and development of Green Bond market.

- Creating enabling environment including Financial and Management support from Incubation till Maturity to Technology Linked Hydrogen Star-ups.

- The country should establish green hydrogen Investment Fund, supported by bilateral and multilateral agencies, to take the critical step towards scoping, funding and executing large development stage projects, over the next five years.

Annexure- I

INAUGURAL SESSION

List of Speakers

Dr. Jitendra Singh,
Hon'ble Union Minister of State (IC) Science & Technology,
Govt. of India

Shri. Ashwani Kumar Choubey,
Union Minister of State for Ministry of Consumer Affairs,
Food and Public Distribution; and
Ministry of Environment, Forest and Climate

Ms. Tina Bru,
Minister of Petroleum and Energy,
Govt. of Norway

H.E. Mr. Hans Jacob Frydenlund,
Norway Ambassador to India

Mr. Mukesh Dhirubhai Ambani,
Chairman,
Reliance Industries Limited

Mr. Deepak Bagla,
MD & CEO, Invest India

Mr. Nobuo Tanaka,
Special Advisor,
The Sasakawa Peace Foundation (SPF) Tokyo, Japan;
Former Executive Director, IEA

Mr. Sturle Harald Pedersen,
Chairman, Greenstat India, Norway

Mr. Cristian Valdes Carter,
Director, Innovation Norway India

Mr. Hakon Haugli,
CEO, Innovation Norway

Annexure- II

VIRTUAL SESSIONS

List of the Speakers

1.0 International Alliances and Coalitions

Prof. K. Vijay Raghavan
Principal Scientific Advisor,
Govt. of India

Mr. Sturle Harald Pedersen
Chairman,
Greenstat Hydrogen, India, Norway

Mr. Anurag Pandey
RIL R&D Lead and India H2 Alliance (IH2A), RIL

Dr. Karen Landmark
Chair of the Board,
Greenstat Asia, Norway

Mr. Kowtham Raj VS
Fellow, World Energy Council

Ms. Ravneet Mann
Vice President,
Invest India

Mr. Deepesh Nanda
Chief Executive Officer,
GE Gas Power in South Asia

Mr. Alberto Di Lullo
Senior Knowledge Owner,
Advanced Engineering System

2.0 International and Private Sector Funding

Ms. Jillian Evanko
President and CEO,
Chart Industries, Strategic Investor into FiveT H2 Fund (world's first H2 dedicated Investment Fund), India H2 Alliance (IH2A) Co-Lead, Chart Industries

Mr. Rajnish Kumar
Former Chairman, State Bank of India

Ms. Isabelle Laurent
Deputy Treasurer and Head of Funding, European Bank for Reconstruction and Development (EBRD), London

Dr. Sunita Satyapal
Director Hydrogen Fuel Cell Technology Office, Office of Energy Efficiency and Renewable Energy, US Department of Energy

Mr. Kailash Vaswani
President,
Corporate Finance Renew Power, New Delhi

Ms. Surbhi Goyal
Senior Energy Specialist,
World Bank Delhi Office

Mr. Neeraj Gupta
CFO, Acme Solar

Mr. Chintan Shah
Director (Technical),
Indian Renewable Energy Development Agency Ltd., New Delhi

3.0 Hydrogen Production Technologies

Ms. Prerna Soni
Vice President, Invest India

Prof. S. Dasappa
Professor IISc Bangalore

Dr. Ashish Lele
Director, National Chemical Laboratory

Dr. SSV Ramakumar
Director R&D, Indian Oil Corporation

Mr. Vegard Frihammer
Founder & CEO, Greenstat Chair H2 Cluster, Norway

Mr. Rajat Seksaria
CEO, ACME Solar
Mr. Ulf Eriksen

VP and Head of Hydrogen, Statkraft

Prof. G.D. Yadav
Emeritus Professor Eminence, Institute of Chemical Technology (ICT), Mumbai

Dr. Desikan Sundararajan
Managing Director – India, Equinor

4.0 Make in India - Hydrogen Storage

Dr. Akira Yabe
Director General, Energy System & amp; Hydrogen Unit, Technology Strategy Centre (TSC), New Energy and Industrial Technology Development Organization (NEDO), Japan

Dr. N. Rajalakshmi
Senior Scientist & Head, ARCI

Prof. Jayant K Singh
Professor, IIT Kanpur

Dr. T.P. Yadav
Scientist, BHU

Mr. Ravindra Vasisht
Regional Director - India, Hexagon Agility India

5.0 Fuel Cell and Hydrogen in Transportation

Mr. Bernt Skeie
CEO Prototech

Mr. Shri Prakash
Distinguished Fellow, TERI

Mr. Vikram Gulati
Senior Vice President Toyota Kirloskar Motors (KTM)

Dr. N. Saravanan
Principal Engineer R&D, Mahindra & Mahindra

Dr. Sushil S. Ramdasi
Deputy Director, Powertrain Engineering, ARAI

Mr Helge Vandel Jensen
Senior Business Development Manager, Danfoss Drives

Mr. Kristian Eikeland Holmefjord
EVP & Project Director - Fuel Cells, Corvus Energy

6.0 Policy Regulations

Mr. Mats Rinaldo
Principal Researcher and Deputy Programme Director, DNV

Mr Ajay Shankar
Distinguished Fellow, TERI

Dr. R.K. Malhotra
Director General, The Federation of Indian
Petroleum Industry

Mr. P.K. Banerjee
Executive Director, SIAM

Mr. Anshu Bhardwaj
CEO, Shakti Foundation

Mr. Dipesh Pherwani
Scientific Officer, MNRE

Mr. Praveer Kumar
General Manager,
GAIL (India) Limited

7.0 Setting up of Centre of Excellence in Hydrogen (CoE-H2)

Mr. Cristian Valdes Carter
Director, Innovation Norway India
Ambassador Ajai Malhotra, Distinguished Fellow, TERI

Ms. Eli Aamot
Executive Vice President, SINTEF

Dr. Scott Davis
President Gexcon US Technical Advisory Committee Members Mary Kay O'Connor
Process Safety Center, Texas A&M University, USA Gexcon Norway

Prof. Dr. Jan Roar Bakke
Chairman Process Safety Subcommittee, IOGP, Chairman of Explosion Working Group Gexcon Norway

Mr. Umesh Sahdev
Executive Chairman, Hydrogenium Resources Private Limited

8.0 Ecology, Agriculture & Climate Change Mitigation

Prof. Dr. Arthur Riedacker
(IPCC Co-Nobel Prize laureate as a contributor since 1990),
Honorary Professor, INRA, France

Dr. Rakesh Kumar
Director, CSIR

Prof. Ashutosh Sharma
Secretary,
Department of Science & Technology

Prof. Dr. Robert Costanza
American/Australian Ecological Economist, Chair in Public Policy, The Australian National University and a Full
Member of the Club of Rome
Topic: Building a Sustainable
Well being economy and society

Dr. Adrian Percy
Chief Technology Officer, UPL, USA

Mr. Dhruv Sawhney
Business Head & COO, Nurture Farm

Dr Paravastu Rambabu
Advisor, Greeko Group

9.0 Role of Hydrogen for a Carbon Neutral Ladakh

Mr. R.R. Rashmi
Distinguished Fellow and Programme Director,
Earth Science and Climate Change, TERI

Mr. Souvik Bhattacharjya
Associate Director, TERI

Mr. Sonam Wangchuk
Founding Member,
Himalayan Institute of Alternatives

Mr. Debashisa Manasa Ranjan Panda
General Manager (Hydrogen RE), NTPC Ltd.

Mr. Rajat Sud
MD, EESL

Dr. Parag Vyas
Managing Director,
Panitek Power Private Limited

Notes

TOWARDS A GREENER FUTURE TOGETHER

There is an urgent need to address all issues pertaining to clean energy together, in order to find a set of balanced, positive and beneficial solutions for the future. Global cooperation is needed in exchange for technologies. All the countries need to come together to make green energy available at the earliest opportunity.

Dr. J.P. Gupta
Summit Chair and
Chair - Environment Committee,
PHDCCI

PHD CHAMBER
OF COMMERCE AND INDUSTRY

About Us

PHD Chamber of Commerce & Industry, a leading Industry Chamber of India, ever since its inception in 1905, has been an active participant in the India Growth Story through its Advocacy Role for the Policy Makers and Regulators of the Country. Regular interactions, Seminars, Conference and Conclaves allow healthy and constructive discussions between the Government, Industry and International Agencies bringing out the Vitals for Growth. As a true representative of the Industry with a large membership base of 1,30,000 direct and indirect members, PHD Chamber has forged ahead leveraging its legacy with the Industry knowledge across sectors (58 Industry verticals being covered through Expert Committees), a deep understanding of the Economy at large and the populace at the micro level.

At the National level, the PHD Chamber is well represented in 16 States with its own offices and MOUs with eleven Partner Chambers in different States.

At the Global level we have been working with the Concerned Ministries, Embassies and High Commissions to bring in the International Best Practices and Business Opportunity.

PHD Chamber has special focus on the following thrust areas:

- **Economic & Business Policy Advocacy**
- **Industry**
- **Infrastructure**
- **Housing**
- **Health**
- **Education & Skill Development**
- **Agriculture & Agri-business**
- **ICT**
- **International Trade**
- **Defence & HLS**

"Voice of Industry & Trade"

PHD CHAMBER OF COMMERCE AND INDUSTRY

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