IN PARTNERSHIP WITH

NITI Aayog

Ministry of Environment, Forest and Climate Change
Government of India

विज्ञान और प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY

DSIR
DEPARTMENT OF SCIENCE AND INDUSTRIAL RESEARCH

SUMMIT SOUVENIR

ORGANISERS

PHD CHAMBER
OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION
& FACILITATION AGENCY

PARTNER COUNTRY
NORWAY

Innovation Norway

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021
TAJ PALACE, NEW DELHI
A PHYSICAL & VIRTUAL SUMMIT

WWW.ICS-HYDROGEN.COM

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

GREEN HYDROGEN INDIA

www.greenhydrogen-india.com

THE NATIONAL HYDROGEN PORTAL

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

The National Hydrogen Portal **www.greenhydrogen-india.com** will be launched at the International Climate Summit 2021.

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

An initiative of **PHD Chamber of Commerce and Industry** through its **Environment Committee**, the portal will be available to all registered members after the launch.

MESSAGE FROM SUMMIT CHAIR

Dr. J. P. Gupta

Summit Chair & Chairman, Environment Committee, PHDCCI

> India is uniquely placed to produce hydrogen not only for its own needs, but it could well become a global export hub.

India with a population of approximately 1.3 billion is the second most populous country and the third largest economy in the world. The country's total primary energy supply has a composition of coal 44.3%, oil 25.3%, bioenergy and waste 21.12% natural gas 5.8%, hydro 1.4% nuclear 1.1% and solar 0.4%. India's per capital energy consumption stands at 30% of the world average, and its energy system is largely dependent on fossil fuels i.e., coal for power generation, oil for transport and industrial sector and biomass for residential heating and cooking.

As the world's third largest consumer of oil, India is heavily dependent on imports. Its energy demand is likely to double and electricity demand triple by 2040. With the rise, the major impact will be on environment. The energy sector is considered to be a major source of atmospheric contamination and in turn is responsible for change in climate. In view of this, there is a dire need to look for non carbon based energy.

As one of the cleanest fuels with zero carbon emission, hydrogen has shown a ray of hope against climate change. It has high energy content per unit mass, that is three times higher than gasoline. It is being used for energy application with suitable fuel cells. Coking coal in steel plants is being replaced with hydrogen to get rid of Co2.

India is uniquely placed to produce hydrogen not only for its own needs but it could well become a global export hub, due to the availability of cheaper renewable energy.

There are, however, several challenges which India faces with respect to technology, storage, transportation, new materials development, electrolysis development, safety standards and regulatory regime.

contd/-

MESSAGE FROM SUMMIT CHAIR (CONTD/-)

We are pleased to receive support from NITI Aayog, Department of Science & Technology, Govt. of India, TERI, NEERI, India Hydrogen Alliance, Greenstat Norway, Gexcon Norway, Arena H2 Cluster Norway and several Ministries of the Govt. of India, for the **'International Climate Summit 2021: Powering India's Hydrogen Ecosystem'.**

Eminent global speakers on hydrogen representing the entire value chain will join to discuss various issues, which shall be useful for developing programmes and strategies, specific for India. Experts from academia, industries, and policy makers at a common platform is important for faster development of hydrogen energy.

We at PHDCCI suggest the need for an **'International Hydrogen Alliance'** on the lines of 'International Solar Alliance' for rapid introduction of hydrogen energy for various applications, as no single company or country can offer solutions for the entire value chain in hydrogen.

India also needs **Centres of Excellence** at various Universities with the support of Industry and knowledge partners for capacity building.

"There is a need for an 'International Hydrogen Alliance' for rapid introduction of hydrogen energy. India also needs 'Centres of Excellence' at various Universities with the support of Industry and knowledge partners for capacity building."

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

ORGANISERS

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

INTERNATIONAL CLIMATE SUMMIT 2021

PARTNER COUNTRY
NORWAY

Norwegian Embassy
New Delhi

Innovation Norway

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | A PHYSICAL & VIRTUAL SUMMIT

CONTENTS

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

Summit Organiser

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

In Partnership With

NITI Aayog

Ministry of Environment, Forest and Climate Change
Government of India

विज्ञान और प्रौद्योगिकी विभाग
DEPARTMENT OF SCIENCE & TECHNOLOGY

DSIR

Supporting Ministries

- NEW AND RENEWABLE ENERGY
- MICRO, SMALL & MEDIUM ENTERPRISES
- POWER
- COAL
- PETROLEUM & NATURAL GAS

सत्यमेव जयते
Government Of India

Partner Country Norway

Norwegian Embassy
New Delhi

Innovation Norway

Lead Partners

Reliance Industries Limited
Growth is Life

HINDUSTAN ZINC
Zinc & Silver of India

Diamond Partners

Veritas Polychem Pvt Ltd

UPL OpenAg™

Gold Partners

NAYARA ENERGY

GAIL (India) Limited

DEEPAK FERTILISERS AND PETROCHEMICALS CORPORATION LIMITED

epsilon carbon

CDET EXPLOSIVE INDUSTRIES

SHEELA GROUP 50 YEARS OF EXCELLENCE

Silver Partners

ONGC

IndianOil

IHB
A JOINT VENTURE OF INDIANOIL, HINDUSTAN PETROLEUM & BHARAT PETROLEUM

HMEL

ACME
Leading Through Innovation

Phillips Carbon Black Limited

MURUGESH R. NIRANI GROUP

PIONEER

Knowledge Partners

teri

IH2A
INDIA HYDROGEN ALLEANCE

NEERI

GREENSTAT Norway
Asia

GEXCON
Norway

GREENSTAT Norway
Hydrogen India

Arena H2Cluster
The Norwegian Hydrogen Cluster

Bronze Partners

EIL

KENT Mineral RO Water Purifiers
HOUSE of PURITY

BHARAT OMAN REFINERIES LIMITED

action TESA
PANELS | FLOORING | DOORS

MEGHMANI ORGANICS LIMITED

GSP

KELTECH ENERGIES LTD
A VISION FOR CONSERVATION

AARTI INDUSTRIES

NIRMA

Supporting Partner

SEPC
SERVICES EXPORT PROMOTION COUNCIL
www.servicesepc.org

Technical Partner

IAAPC
Indian Association for Air Pollution Control

Distinguished Partners

Oil India Limited
Conquering Newer Horizons

HOEC

HETERO

Godavari

Dalmia
Bharat Sugar

Triveni
ENGINEERING & INDUSTRIES LTD.

DCM SHRIRAM
Growing with trust

Balrampur
Chini Mills Limited

adventz
PARADEEP PHOSPHATES LIMITED

ANUPAM RASAYAN INDIA LTD.

Tagros
(a jhaver group company)
Tagros Chemicals India Pvt. Ltd.

International Advisor

KRESTON SNR

Co-Organiser

iTEN MEDIA™

Media Partners

CNBC TV18

newsX

ORGANISERS

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

INTERNATIONAL CLIMATE SUMMIT 2021

PARTNER COUNTRY
NORWAY

Norwegian Embassy
New Delhi

Innovation Norway

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | A PHYSICAL & VIRTUAL SUMMIT

WELCOME MESSAGES

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

MESSAGE FROM HON'BLE PRIME MINISTER OF INDIA

Shri Narendra Modi

Hon'ble Prime Minister of India

सत्यमेव जयते

As a climate-responsible developing country, India welcomes partners to create templates of sustainable development in India. These can also help other developing countries, who need affordable access to green finance and clean technologies.

Under the bold & visionary environmental leadership of Hon'ble Prime Minister Shri Narendra Modi, the summit will pave the way for India to expand its horizon in renewable and will help to tackle challenges related to Climate Change and reduce its dependency on fossil fuels.

MESSAGE FROM HON'BLE MINISTER OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

सत्यमेव जयते

Shri Bhupender Yadav

Hon'ble Minister of Environment, Forest and Climate Change and Labour and Employment, Government of India

> There is a critical need for an energy revolution with a transition to clean and green energy

I am glad to know that the PHD Chamber of Commerce and Industry, in partnership with NITI Aayog, NEERI and TERI is organizing 'International Climate Summit 2021 - Powering India's Hydrogen Ecosystem' on 3rd September 2021.

India has shown itself to be a global leader in climate actions reflecting its strong commitment to limiting the rise in global temperature and for adapting to the impacts of climate change. India has submitted its Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC), communicating 8 goals for the period 2021- 2030 under the Paris Agreement. We are also implementing one of the largest renewable energy expansion programmes with a target of achieving 175 GW of renewable energy capacity by 2022 and 450 GW by 2030.

There is a critical need for an energy revolution with a transition to clean and green energy system. India under the visionary and dynamic leadership of Hon'ble Prime Minister Shri Narendra Modi has championed the cause of cleaner energy. Under his decisive leadership, we are rapidly adopting clean energy alternatives like wind and solar. We have established the International Solar Alliance (ISA) with France, which is the world's first treaty-based multilateral organization headquartered in India. For a green and sustainable future, Government has also proposed to launch a comprehensive National Hydrogen Energy Mission in 2021-22 for generating Hydrogen from green power sources fulfilling the announcement made by Prime Minister in November 2020.

With best wishes.

MESSAGE FROM HON'BLE MINISTER OF POWER AND NEW & RENEWABLE ENERGY

सत्यमेव जयते

Shri Raj Kumar Singh

Hon'ble Minister of Power and New & Renewable Energy, Government of India

> The Summit will be an essential prelude to the National Hydrogen Energy Mission to draw up a road map for using Hydrogen as an energy source.

I am delighted to know that PHD Chamber of Commerce and Industry is organising the '**International Climate Summit 2021 - Powering India's Hydrogen Ecosystem**'.

Climate Change is a major environmental threat and one of the most important challenges of our time and demands our utmost attention now more than ever.

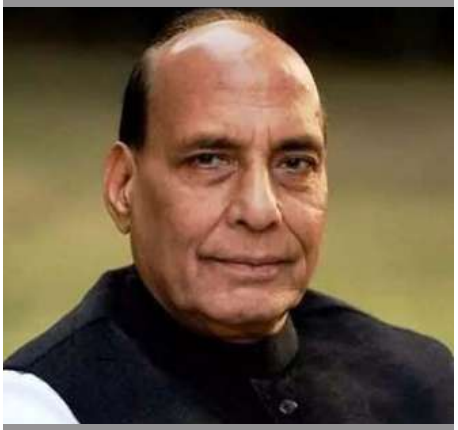
Our Carbon Footprint accounts for more than 50 percent of humanity's overall Ecological Footprint and is the most rapidly growing component. The Summit will prove to be an important platform to discuss these significant issues and also be an essential prelude to the **National Hydrogen Energy Mission** that the government is presently pursuing to draw up a road map for using Hydrogen as an energy source.

Green Hydrogen has the potential to provide clean power and mitigate our Carbon Footprint which is impacting human lives and livelihoods worldwide.

I extend my good wishes and wholehearted Congratulations to PHD Chamber, for organizing an event of profound eminence and wish them success.

MESSAGE FROM HON'BLE DEFENCE MINISTER

सत्यमेव जयते



Shri Rajnath Singh

Hon'ble Defence Minister, Government of India

> This summit is a timely step to discuss the global trends in the shift towards 'Renewable Energy'

I am delighted to know that PHD Chamber of Commerce and Industry, in partnership with NITI Aayog, NEERI and TERI, is planning to host 'International Climate Summit 2021 - Powering India's Hydrogen Ecosystem' in September 2021.

It is indeed heartening to note that the proposed summit will be a mega event to deliberate all the steps to be initiated for the entire hydrogen value chain. The aim of the summit to nurture discussions and collaborations among scholars, persons of eminence, subject experts and organisations, is also highly admirable.

India has emerged as global leader in climate actions. This summit is a timely step to discuss the global trends in the shift towards 'Renewable Energy'. I sincerely hope that the summit will offer a global platform for discussions and make recommendations for the way forward for carbon neutral economy using Hydrogen.

I extend my warm greeting and wish for the great success of the global summit.

MESSAGE FROM HON'BLE MINISTER OF AGRICULTURE & FARMERS' WELFARE

सत्यमेव जयते

Shri Narendra Singh Tomar

Hon'ble Minister of Agriculture & Farmers' Welfare, Rural Development and Panchayati Raj, Government of India

The summit aims to nurture discussion and collaborations among persons of eminence, experts and renowned organisations in the field.

I am happy to know that the **'International Climate Summit 2021 - Powering India's Hydrogen Ecosystem'** is being organized by PHD Chamber of Commerce and Industry in partnership with NITI Aayog, NEERI and TERI.

I have been told that this summit will discuss the global trends in the shift towards 'Renewable Energy' & provide global platform for discussion and make recommendations for the way forward for carbon neutral economy using Hydrogen.

I am happy to learn that this summit will be a mega event to deliberate all the steps to be initiated for the entire value chain in hydrogen. The summit aims to nurture discussion and collaborations among persons of eminence, experts and renowned organisations in the field.

I Congratulate the PHD Chamber of Commerce and Industry for organizing International Climate Summit 2021 and convey my best wishes for the grand success of the event.

MESSAGE FROM HON'BLE MINISTER OF PETROLEUM AND ENERGY, GOVT. OF NORWAY

Ms. Tina Bru

Minister of Petroleum and Energy, Govt. of Norway

"I am certain that an increase of hydrogen in the energy mix will be important to reduce greenhouse emissions globally. A closer collaboration between Indian and Norwegian companies can definitely accelerate our steps towards a common low-emission future."

MESSAGE FROM HON'BLE MINISTER OF STATE FOR SOCIAL JUSTICE & EMPOWERMENT

सत्यमेव जयते

Shri Ramdas Athawale

Hon'ble Minister of State Social Justice & Empowerment, Government of India

This one of a kind Summit will prove to be a vital platform to deliberate on the solutions to Combat Climate.

Glad to learn that PHD Chamber of Commerce and Industry is organizing **'International Climate Summit 2021 - Powering India's Hydrogen Ecosystem'.**

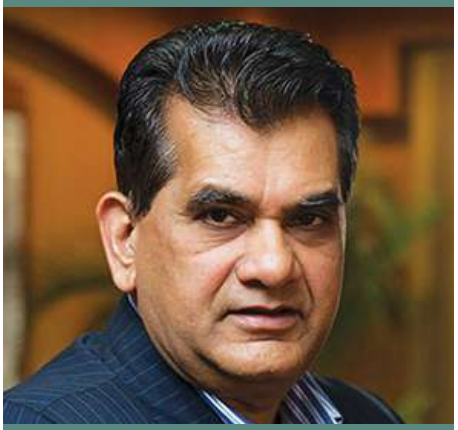
Climate change is affecting every country on every continent. It is disrupting national economies and affecting lives at a rate faster than expected. Climate justice is required to fight against the inequalities of carbon emission and their impacts. This one of a kind Summit will prove to be a vital platform to deliberate on the solutions to Combat Climate.

We should all back the vision of achieving Green economic growth by the use of Green Hydrogen. It could be an essentially to reduce emissions as well as an essential element in generation of important socio-economic and environmental benefits.

My best wishes for successful deliberations at the Summit and hearty Congratulations to PHD Chamber for organizing such an important event.

MESSAGE FROM CEO, NITI AAYOG

NITI Aayog



Shri Amitabh Kant

Chief Executive Officer, NITI Aayog

“**Green Hydrogen** is the future of the Indian energy and chemicals sector. Green Hydrogen will facilitate Indians to capture new avenues of growth and become global champions in this era, where the world is demanding green products.

Locally available Green hydrogen made from India's record low renewable power will help India create high-value green industries like green refining, green ammonia, green steel, and green chemicals.”

MESSAGE FROM HON'BLE GOVERNOR OF UTTAR PRADESH

सत्यमेव जयते

Smt. Anandiben Patel

Hon'ble Governor of Uttar Pradesh

I am pleased to know that PHD Chamber of Commerce and Industries in Partnership with NITI Aayog, NEERI and TERI have planned to host the "International Hydrogen Summit 2021 - Powering India's Hydrogen Ecosystem."

Hydrogen is the world's future energy. It has strategic importance in the pursuit of a low-emission, environment-benign, cleaner and more sustainable energy system. Hydrogen is an energy carrier and can be produced locally as well from a wide variety of sources. Keeping in mind today's global scenario, where on one hand the energy demand is growing, but on the other hand, the reserves of fossil fuels due to their serious environmental and health side effects is also rising. Hydrogen energy can be valuable option to prevent any further damages. The use of hydrogen can greatly reduce pollution, as event the waste resulting form it does not contaminate the environment.

I feel this summit is a commendable initiative towards climate change and hope that will pave way for great new ideas and plans that would help in betterment of the environment to curb down the current pollution rate. It will also be a step towards making our nation Aatmanirbhar.

I Wish the summit great success.

MESSAGE FROM HON'BLE GOVERNOR OF RAJASTHAN

सत्यमेव जयते

Shri Kalraj Mishra

Hon'ble Governor of Rajasthan

यह जानकर प्रसन्नता हुई है कि पीएचडी चैम्बर्स ऑफ कॉमर्स एण्ड इण्डस्ट्री द्वारा नीती आयोग, नीरी एवं टेरी के संयुक्त तत्वावधान में 'इन्टरनेशनल क्लाईमेट समिट २०२१ – पावरिंग इण्डियाज हाइड्रोजन इको सिस्टम' का आयोजन किया जा रहा है।

हमारा पारिस्थिलिकी तंत्र जैविक, भौतिक तथा रासायनिक घटकों से निर्मित होता है। हाल ही में आए ताउ ते, यास जैसे चक्रवात और जलवायु परिवर्तन के अंतर्गत मानवजन्य प्रभावों कं कारण हमारे पारिस्थितिकी तंत्र में भी तेजी से बदलाव आ रहा है। बढ़ती आबादी और देश में संसाधनों की बढ़ती हुई मांग के कारण वनावरण पर भी अत्यधिक प्रभाव पड़ा है और इससे पारिस्थितिकी तंत्र भी बहुत स्तरों पर गड़बड़ा रहा है।

मैं यह मानता हूँ कि वैश्वीकरण के इस दौर में जलवायु परिवर्तन से जुड़ी चुनौतियों का सामना करने के लिए हाइड्रोजन की महत्ता भी दिन-प्रतिदिन बढ़ती जा रही है। इस समय में यह एक मात्र ऐसा पारंपरिक ईंधन का स्रोत है जो ऊर्जा आवश्यकता की खाई को पाट सकता है।

यह सुखद है कि इस सबंध में आप द्वारा अन्तर्राष्ट्रीय स्तर पर संवाद की पहल की गयी है। मैं समझता हूं विश्व के महाद्वीपो पर मौजुद हाइड्रोजन की वर्त्तमान पारिस्थितिकी की प्रगती को समझने और सरकारों तथा उद्योग जगत के लिए यह एक ऐसा अवसर होगा जिसमें सभी पक्ष एक साथ आ सकेंगें और सस्ती टिकाऊ प्रौद्योगिकी विकसित करने के अभियान से जुड़ सकेंगें।

मेरी इस आयोजन के लिए हार्दिक शुभकामनाएं हैं।

MESSAGE FROM HON'BLE LT. GOVERNOR OF DELHI

सत्यमेव जयते

Shri Anil Baikal

Hon'ble Lt. Governor of Delhi

I am pleased to learn that the PHD Chamber of Commerce and Industry in partnership with NITI Aayog, Ministry of Environment, Forest & Climate Change along with other Ministries of Government of India, is organizing the "International Climate Summit 2021 - Powering India's Hydrogen Ecosystem" on 3rd September 2021.

Addressing Climate Change is both Complex and challenging. Emerging technologies offer possibilities for the use of naturally abundant Hydrogen as an alternative to expensive and limited fossil fuels. They are pathbreaking and have the potential of transforming not only the global environment but also the global economy and the way we live. The theme of the Summit *'Powering India's Hydrogen Ecosystem'* is therefore both contextual and timely.

Clean Hydrogen as it is beginning to appear, has vast potential in not only ensuring the reduction of emission of greenhouse gases, but also in decarbonising 'difficult to electrify' sectors such as long distance transport and heavy industry. It can also provide long term sustainable solutions to the challenges being faced by the energy sector today.

I extend my greetings to the PHD Chamber for organizing this event and I am certain that the forthcoming Summit, will provide a useful platform to bring together all stakeholders for meaningful deliberations on the subject and the summit will come out with constructive strategies and policy suggestions for use and promotion of Hydrogen as an effective solution for a sustainable energy system.

MESSAGE FROM HON'BLE GOVERNOR OF CHHATTISGARH

सत्यमेव जयते

Miss Anusuiya Uikey

Hon'ble Governor of Chhattisgarh

I am please to note that PHD Chamber of Commerce and Industry, in partnership with NITI Aayog, Ministry of Environment, Forest and Climate Change, Department of Science and Technology, Department of Science and Industrial Research and Council of Scientific and Industrial Research, is organizing the '**International Climate Summit 2021 - Powering India's Hydrogen Ecosystem'** on 3rd September, 2021.

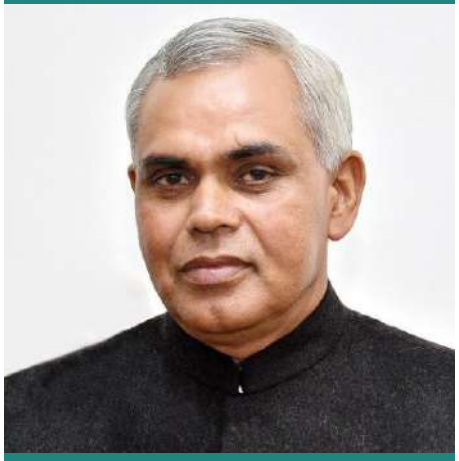
The National Hydrogen Energy Mission announced in the Union Budget of India 2021-22 provides further impetus towards promoting hydrogen as a new source of energy for a greener future, However, India is facing several challenges concerning technology, storage, transportation, new material's development, electrolysis, safety standards, and regulatory regime.

I hope that International Climate Summit 2021 will provide a global platform to jointly address these challenges, whilst finding solution for adoption and production of hydrogen as a preferred source of new energy.

I wish all best for the success of the event.

MESSAGE FROM HON'BLE GOVERNOR OF GUJARAT

सत्यमेव जयते



Shri Acharya Devvrat

Hon'ble Governor of Gujarat

I am pleased to learn that the PHD Chamber of Commerce and Industry, in partnership with NITI Aayog, NEERI and TERI, had planned to host **"International Climate Summit - 2021, Powering India's Hydrogen Ecosystem."**

We know that India has emerged as a global leader in climate Action. Green Hydrogen is a key player in energy transition in India and in the world as well. I hope this summit will be a global platform for discussions and to make recommendations for carbon neutral economy using Hydrogen.

I convey my best wishes for this International Climate Summit - 2021.

MESSAGE FROM HON'BLE GOVERNOR OF UTTARAKHAND

सत्यमेव जयते

Smt. Baby Rani Maurya

Hon'ble Governor of Uttarakhand

मुझे यह जानकर प्रसन्नता हुई है कि पीएचडी चैम्बर्स ऑफ कॉमर्स एण्ड इण्डस्ट्री द्वारा नीती आयोग, पर्यावरण, वन एवं जलवायु मंत्रालय के संयुक्त तत्वावधान में 'इन्टरनेशनल क्लाईमेट समिट २०२१ - पावरिंग इण्डियाज हाइड्रोजन इको सिस्टम' का आयोजन ३ सितम्बर, २०२१ को किया जा रहा है ।

हाइड्रोजन स्वच्छ एवं पर्यावरण हितैषी ईंधन के रूप में जाना जाता है। निश्चित ही हाइड्रोजन वर्तमान एवं भविष्य की धरोहर है। पर्यावरण संरक्षण हेतु इसें अधिक से अधिक प्रोत्साहित किया जाना चाहिये। हाइड्रोजन पर्यावरण अनुकूल ईंधन का सुरक्षित विकल्प भी है।

आशा है उक्त सम्मेलन के आयोजन से हाइड्रोजन के प्रसार, शोध, अनुसंधान एवं उपयोग को प्रोत्साहन मिलेगा। इस अवसर पर प्रकाशित पुस्तक "सेल्फ रिलाइन्ट इण्डिया - हार्नेस द पावर ऑफ हाइड्रोजन" सभी पाठकों के लिए ज्ञानवर्धक एवं उपयोगी सद्धि होगी।

सम्मेलन के सफल आयोजन हेतु शुभकामनाएँ।

MESSAGE FROM HON'BLE GOVERNOR OF BIHAR

सत्यमेव जयते

Shri Phagu Chauhan

Hon'ble Governor of Bihar

It is a matter of great pleasure that the PHD Chamber of Commerce and Industry in partnership with NITI Aayog, Ministry of Environment, Forest and Climate Change and with the support of several ministries of Govt. of India, is organizing an International event "International Climate Summit, 2021 - Powering India's Hydrogen Ecosystem" on 3rd September 2021.

I hope, this summit will provide an opportunity to ail the participants to interact with each other and discuss different aspects of this relevant topic.

I extend my warm greetings and felicitation to the organizers and the participants and wish the summit all success.

MESSAGE FROM HON'BLE CHIEF MINISTER OF PUNJAB

Capt. Amarinder Singh

Hon'ble Chief Minister of Punjab

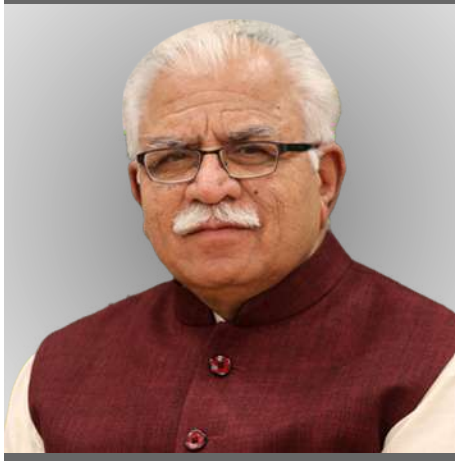
I am pleased to learn that PHD Chamber of Commerce & Industry is organizing 'International Climate Summit 2021 - Powering India's Hydrogen Ecosystem' on September 3, 2021 in partnership with NITI Aayog, Ministry of Environment, Forest & Climate and active support of several ministries of Government of India.

As overall demand for energy is ever rising globally, it is therefore the need of the hour to tap its alternate sources that are greener, renewable and abundant in supply. Hydrogen is one such source that is eco-friendly to ensure a sustainable future in the field of new and renewable energy. India's advantage due to its geographical location, climatic conditions and abundance of solar, wind and hydro energy can make it a global hydrogen hub by 2020 and spearhead its transition to clean energy.

I convey my best wishes for the success of the summit.

MESSAGE FROM HON'BLE CHIEF MINISTER OF HARYANA

सत्यमेव जयते



Shri Mahohar Lal

Hon'ble Chief Minister of Haryana

It gives me immense pleasure to know that PHD Chamber of Commerce and Industry in partnership with NITI Aayog and Ministry of Environment, Forest and Climate is organizing an international event 'International Climate Summit 2021 - Powering India's Hydrogen Ecosystem' on September 3, 2021.

I appreciate the decision of the PHD Chamber of Commerce and Industry to hold an international event on a topic of prime importance at an opportune time as it will prove a gateway to United Nations Framework Convention on Climate Change (UNFCC) to be held at Glasgow very soon where a number of world leaders will come together to discuss the matters pertaining to climate change and sustainability.

To fulfill the commitment to substantially reduce carbon footprint in the future, the Government of India has already announced its National Hydrogen Energy Mission to outline hydrogen centric policies and regulations to build India's capacity to become the cheapest hydrogen producer in the world. As far as Haryana is concerned the State Government has implementation a number of incentive based schemes to promote non-conventional sources of energy and to make the people conscious of the need for conservation of environment and other natural resources.

I am sure the summit will provide an apt platform to the eminent speakers and policy makers form across the globe to discuss threadbare on the importance of hydrogen and its use as a promising source of energy.

My best wishes

MESSAGE FROM HON'BLE CHIEF MINISTER OF JHARKHAND

Shri Hemant Soren

Hon'ble Chief Minister of Jharkhand

I am delighted to know that PHD Chamber of Commerce and Industry in partnership with NITI Aayog and other ministries of Government of India is organising an International event 'International Climate Summit 2021 - Powering India's Hydrogen Ecosystem' on 3rd September 2021.

The event it is hoped will go a long way in meeting the power needs of India, so crucial in the progress and prosperity of the nation.

The unveiling of knowledge book on 'Self - Reliant India - Harness the power of Hydrogen' and the development of dedicated portal (in process) on Hydrogen is a laudable step.

I hope the event proves to be a milestone in harnessing hydrogen power and wish the organizers all the very best in their endeavours.

MESSAGE FROM HON'BLE CHIEF MINISTER OF MIZORAM

सत्यमेव जयते
Government of Mizoram

Shri Zoramthanga

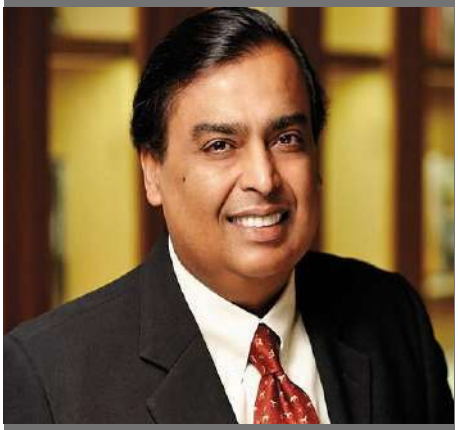
Hon'ble Chief Minister of Mizoram

I am delighted to have been invited to contribute a few words for the International Climate Summit 2021 - Powering India's Hydrogen Ecosystem.

As many experts in India and abroad have propounded, hydrogen is indeed the fuel that can power us into a greener future. We are all aware of the extensive damage that fossil fuels cause to our environment and in this regard, it is encouraging to note that the Government of India has announced the launch of National Hydrogen Mission which will put India amongst a select list of countries that are leading the way in promoting a hydrogen economy. needless to say, the issue is not with the production of hydrogen per se but rather, hydrogen that is green and clean. Adoption and growth of green hydrogen as a supplier of our energy needs shall reduce our dependency on traditional sources like fossil fuels. Further, favourable geographic conditions and a wealth of natural resources give us an advantage over other countries when it comes to green hydrogen production. This, in turn, puts India in a position where it can emerge as a true global leader in climate actions. Favourable Government policies and synergy between the private and public sector shall go a long way towards achieving this goal.

I am sanguine that despite the many challenges that we face as a nation today. not the least of which is COVID-19, this summit shall be a success.

MESSAGE FROM CHAIRMAN AND MANAGING DIRECTOR, RELIANCE INDUSTRIES LIMITED



Shri Mukesh D Ambani

Chairman and MD, Reliance Industries Limited

> RIL's overall initial investment from its own internal resources in the New Energy business will be INR 75,000 crore (over $10 billion), in three years.

I am delighted to know that an **'International Climate Summit 2021'** is being organised on 3rd September, with an ambitious agenda to **'Power India's Hydrogen Ecosystem'**. By actively patronising it, the Government of India has demonstrated its deep commitment to the agenda.

The world is today at the brink of a fundamental and disruptive transition in the way energy is sourced, produced, distributed and used. The era of fossil fuels, which powered economic growth globally for nearly three centuries, is transitioning to a new age of green, clean and renewable energy. This transition has been necessitated by two priorities. First, our planet's fragile ecology has been engendered by the huge quantities of carbon that the use of fossil fuels has emitted into the environment. Therefore, urgent action to overcome the climate crisis has become the prime responsibility of the international community. Second, the energy needs of a large section of the global population of over 7.5 billion and growing, are set to grow steeply. These needs can no longer be met by traditional hydrocarbon fuels.

These two factors are also relevant in the Indian context. As one of the only two countries in the world with a population of over one billion, India has to take the lead in bearing the flag of reversing climate change. At the same time, we also need more energy as we march confidently to become one of the three largest economies in the world. India's power consumption is currently only one third of the global average. This will vastly increase as we endeavor to improve the quality of life of our citizens, a vast majority of whom currently suffer from energy deprivation. Therefore, in order to meet these twin obligations, India must make a rapid transition to ensure ample and affordable clean energy to every Indian and to every sector of the Indian economy.

contd/-

Reliance
Industries Limited
Growth is Life

MESSAGE FROM CHAIRMAN AND MANAGING DIRECTOR, RELIANCE INDUSTRIES LIMITED (CONTD/-)

“Under the inspiring leadership of our Prime Minister Shri Narendra Modi ji, I have no doubt that India will emerge as a nation that shows the path of sustainability to the rest of the world while we make ourselves truly 'Atmanirbhar' in achieving energy security.”

Together with solar, wind, batteries and carbon capture, hydrogen will be an important element of India’s future ecosystem. Hydrogen, the ‘energy vector of the 21st century’, is the best and cleanest source of energy, which can play a fundamental role in our decarbonisation plans. It is also set to become affordable in the coming years. We can realise this vision with the adoption of breakthrough technologies and the right set of policies that promote an army of new energy entrepreneurs. The draft National Hydrogen Mission is a great leap in the right direction.

Under the inspiring leadership of our Prime Minister Shri. Narendra Modi ji, I have no doubt that India will emerge as a nation that shows the path of sustainability to the rest of the world while we make ourselves truly 'Atmanirbhar' in achieving energy security.

I congratulate the organisers of the ‘International Climate Summit 2021’ and wish the event full success.

MESSAGE FROM PRESIDENT, PHD CHAMBER OF COMMERCE AND INDUSTRY

Shri Sanjay Aggarwal

President,
PHD Chamber of Commerce & Industry

> Enabling regulatory framework will give a boost to the Make in India initiative in developing India's Hydrogen Ecosystem.

PHD Chamber of Commerce and Industry (PHDCCI), a National Apex Chamber, established in 1905, has been relentlessly working for the socio- economic development of India and for promotion of Indian industry, trade and entrepreneurship across the globe. PHDCCI has been an active participant in the India Growth Story through its Advocacy Role with Government of India and State Governments. It is one of the Premier Chambers in India to have been accredited with “Diamond Grade” by NABET(QCI), at national and international level. PHDCCI is reaching out to more than 1,50,000 companies through its direct and indirect membership base, and has a special focus on the development of small and medium businesses.

I am extremely pleased to convey my appreciation to Dr. J. P. Gupta, Chairman of PHDCCI Environment Committee, for conceiving, planning and executing the **'International Climate Summit 2021: Powering India’s Hydrogen Eco System'**. The summit is timely and important for the country in building India’s Hydrogen Economy, its policies and a roadmap for the future. Enabling regulatory framework is needed to give a boost to the **Make in India** initiative in production, supply chain and partnerships. Domestic opportunities for electrolysis and fuel cells storage, training and standards will certainly help in developing the hydrogen ecosystem in India.

I extend my warm welcome to all participants to **ICS 2021** from all over the world, for useful discussions and joining hands to make our planet a better place to live for future generations.

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

MESSAGE FROM DIRECTOR INNOVATION NORWAY

Innovation Norway

Cristian Valdes Carter

Director,
Innovation Norway, India
Commercial Counsellor
Royal Norwegian Embassy
in New Delhi

> Hydrogen has significant potential for reducing local, national and global emissions while creating economic value.

India and Norway are key players in the global energy transition, and energy cooperation is an essential component of our bilateral relationship. Norway is therefore delighted to actively participate in and contribute to the 'International Climate Summit 2021: Powering India's Hydrogen EcoSystem'.

Hydrogen has significant potential for reducing local, national and global emissions while creating economic value. India and Norway share visions and ambitions in this area, and we're keen to support the Government of India's ambitious targets for the transition to a green economy, with Hydrogen as a key component. Norway already has many years of industrial knowledge and experience across the entire hydrogen value chain. Based on this expertise, the Norwegian Government has developed a Hydrogen Strategy with the aim of further developing and scaling new low emission technologies and solutions.

I am pleased to see increasing Norwegian investment interests in India, particularly in renewable energy, an area where Norwegian businesses and clusters are world leaders and where India and Norway together can address global challenges. I welcome the guidance provided by Honourable Prime Minister Narendra Modi in launching the National Hydrogen Mission, as well as by the esteemed speakers and stakeholders at this Summit. Together we can build a collaborative Hydrogen ecosystem that can immensely benefit the industry, our countries and the world.

Lastly, I would like to extend my appreciation to Dr. J.P. Gupta, Chairman of PHDCCI Environment Committee, for a fruitful cooperation, and the planning of the ICS 2021.

With best wishes for the success of the event.

ORGANISERS

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

INTERNATIONAL CLIMATE SUMMIT 2021

PARTNER COUNTRY
NORWAY

Norwegian Embassy
New Delhi

Innovation Norway

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | A PHYSICAL & VIRTUAL SUMMIT

INDUSTRY ARTICLES

AUTHOR

Dr. J. P. Gupta

M.Tech (IIT Delhi), Ph.D (Toronto)
Distinguished Scientist
Chairman, Environment Committee, PHDCCI &
Chairman, Expert Appraisal Committee (Industry-II)
Ministry of Environment, Forest and Climate Change
Government of India

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

International Hydrogen Alliance

Published in The Statesman | Friday 26 March 2021
https://epaper.thestatesman.com/3039962/Delhi-The-Statesman/26-03-2021#page/6/2

In recent years, hydrogen has received increasing attention in connection with the transition from fossil energy sources to emission-free alternatives, in addition to the fact that hydrogen can also replace coal as a feedstock in the steel production industry. We argue in favor of an increased investment in hydrogen as a central part of the energy system in India and international cooperation, as a tool for sustainable development and a human-centered energy transition.

As India replaces coal power plants with renewable energy, the need to establish temporary energy storage will increase. At the same time as there is an expressed desire and goal to replace fossil fuels with emission-free alternatives within other market segments. India has a unique opportunity to play a leading role in the further development of hydrogen technology, expertise and systems. In order to take such a leading position, an increased alignment between the authorities, the business community and R&D institutions is of immense importance.

This article supports the suggestion of the establishment of an “International Hydrogen Alliance” to create greater synergies between science, technology and entrepreneurship to create win-win for all, inspired by the The International Solar Alliance (ISA). A tight collaboration with Norway will be a good starting point to gain momentum.

contd/-

Article - International Hydrogen Alliance (Contd/-)

Backdrop - a planet in peril - the potential role of clean hydrogen

The preconditions for the people on earth to be able to live meaningful lives in balance with nature are there. However, human intervention and distribution on earth and the utilization of resources are putting enormous stress on our ecosystems and their ability to provide the services on which we all depend.. We are in a hurry to make the necessary changes to restore what has already been broken and to avoid inflicting additional damage to our natural living world. Our energy systems are in the midst of this transition and done properly, a sustainable transition of our energy systems will benefit both our natural world and our societies.

The energy system's dominant starting point in fossil fuels is one of the biggest challenges we face. Almost all the energy that living beings on earth consume comes from the sun, and is captured in the energy pyramid in some hydrogen bonds, typically consisting of hydrocarbons. Solar energy is captured through photosynthesis in the plant kingdom, by e.g. plants on land and algae in the sea, which in turn form the basis for the herbivores and then the carnivores. The ecosystems have evolved over millions of years. Fossil fuels are part of one out of many different cycles in the ecosystem, but stand out as it takes millions of years, before plants can finally turn to coal and plankton into oil and gas. Humans' burning of these stored energy resources, in a relatively short time (200 years), has disrupted and already destroyed much of the biological diversity on our planet forever. However, we humans are far more adaptable than large parts of the wildlife. At the same time, no one is able to fathom the extent of how these sudden changes will affect the framework conditions for humanity over time, unless we manage to change developments sufficiently and in time.

It is beyond doubt, that the challenges we face are enormous. The effects of climate change are already visible and notable. Though not equally distributed, it will affect the living conditions of all of us over time. Hence, to be able to create a better and more fair future for ourselves and the future generations, we depend on global cooperation. In this way, the UN's sustainability goals and the Paris Agreement contribute greatly to raising the eye in a common direction.

Article - International Hydrogen Alliance (Contd/-)

Technologically, we already have the necessary means to solve the emission challenges in the energy sector. However, a rapid changeover is both demanding and complicated. Large parts of the global economy rely on existing value streams that are connected to oil, gas and coal. It is therefore a logic to the great opposition both politically and in business that the changes must not happen too quickly. Still, many countries are gradually beginning to realize the seriousness of the ongoing energy transformation, both in terms of sustainability for our planet, as well as for the prosperity and economic prospects of individuals, companies and nations.

81% of the world's energy consumption today is based on fossil fuels, while renewable energy represents about 14.1%. The remaining energy, 4.9%, comes from nuclear power plants (IEA, 2018). The energy transformation involves a transition from fossil fuels to new value chains, which are based on renewable energy. Solar and wind power are the renewable energy sources that are most invested in, and characteristic of these energy sources is that the electric power we are able to produce varies due to changing weather conditions. We are therefore dependent on converting energy from electricity to energy carriers, which enables us to store, transport and use the saved energy within traditional market areas similar to what we do with oil and gas today. Pure hydrogen is such an energy carrier, where the ratio between weight and energy density is optimal (33.3 kWh / kg). However, it is demanding to store the hydrogen in a pure state (compressed, liquified or in metal hydrides), and it will therefore be wise to consider producing alternative hydrogen bonds that are differently suited for different areas of use. Examples of alternative fuels that can be produced as alternative zero-emission energy carriers are ammonia, methanol and e-fuels.

Hydrogen - market segments:

The core components of hydrogen technology are not innovation in the first place. Electrolysers and fuel cells have been in active use for more than 100 years. Nel Hydrogen (formerly Norsk Hydro) in Norway had the world's largest production of hydrogen as early as 1927. And Norway is thus one of the countries with the longest operating time associated with the development of important components in hydrogen production and the handling of hydrogen. And NASA, since its inception in 1958, has been harnessing the unique properties of hydrogen to conduct missions. However, it has been very costly to further develop the technology with the aim of making it available for mass production and commercialization, and it is only in recent years that the technology has started to become competitive in price with conventional engines running on fossil fuels.

Article - International Hydrogen Alliance (Contd/-)

All markets are affected by the energy transformation, we have nevertheless chosen to distinguish between certain application areas / market segments that stand out in relation to different needs of characteristics: land transport, maritime, aviation, industry, stationary application and the energy system. Within each of these market areas, it is necessary to set up individually adapted strategies for implementing emission-free energy solutions. At the same time, it is important to have a perspective on a cross sectoral level, as there is a great potential for achieving synergy effects related to the use of hydrogen; core technology, facilitation of security (regulatory framework and adaptation to international standards) and common infrastructure.

Aviation: for smaller and shorter distances, batteries will probably be a good emission free alternative to hydrogen. But as soon the planes get loaded with typically more than 20 passengers and / or when the distances become longer than 1000 kilometers, hydrogen based fuels will probably be the most sustainable (compared to biofuels) and emission free solution. So for most of the air passenger kilometres, the emission free solution for the future will most probably be based on hydrogen, as expressed by Glenn Llewelyn at Airbus; “At Airbus, we strongly believe renewable energy needs to power future aviation. And hydrogen is potentially the best pathway through which to do so.”

Land based transport: Heavy- and medium duty trucks, buses, and trains are the most obvious energy-intensive transport means that will be first to achieve parity with conventional fuels. Large passenger cars and SUVs will also be better off with hydrogen in the long run - but is more demanding to facilitate as it, to a much greater extent, presupposes established hydrogen infrastructure.

Maritime: Similarly to aviation and land-transport, for shorter distances batteries is a good alternative to hydrogen, but as soon as you get bigger ships and/ or longer distances, hydrogen based fuel is expected to be the preferred emission free energy carrier. Norway has long traditions within all categories of ship design/-development, and has already a few years of experience in the use of hydrogen - and plans for the use of ammonia.

Industry: Production of fertilizer (ammonia), methanol and steel will be based on clean hydrogen in the future. How fast this transition will turn out, is solely based on willingness to cut emissions from the people in power. Both in Norway and in Sweden there has been invested in some large scale projects related to all these three, mentioned categories.

contd/-

Article - International Hydrogen Alliance (Contd/-)

Stationary: For stationary applications the end user will typically represent special needs of back-up power or secluded areas where it is difficult or very expensive to build power lines - like islands or smaller suburban villages.

Energy system: In the energy system hydrogen can be used to balance the grid and temporarily store the energy as back-up power.

In general it is all a matter of scale. Scaling up reduces the cost and increases the competency. When plans are made at a macro level, synergie effects across the different market segments can be achieved.
The ever-increasing change of pace also opens up a number of opportunities to do things differently and better. As the whole world is changing and (hopefully) working towards more common goals, this also opens up opportunities for the various countries to take new positions in the emerging, new economy. The change of the energy system will be one of the main drivers in the ongoing transformation.

Hydrogen is expected to play a key role in the transition to renewable energy. “Hydrogen will be part of emissions mitigation efforts in the coming decades. IRENA's Renewable Energy
Roadmap (REmap) analysis indicates an 6% hydrogen share of total final energy consumption by 2050 (IRENA, 2019a), while the Hydrogen Council in its roadmap suggests that an 18% share can be achieved by 2050 (Hydrogen Council, 2017).... Today, around 120 million tonnes of hydrogen are produced each year, of which two-thirds is pure hydrogen and one-third is in mixture with other gases. This equals 14.4 exajoules (EJ), about 4% of global final energy and non-energy use, according to International Energy Agency (IEA) statistics. Around 95% of all hydrogen is generated from natural gas and coal. Around 5% is generated as a by-product from chlorine production through electrolysis. In the iron and steel industry, coke oven gas also contains a high hydrogen share, some of which is recovered. Currently there is no significant hydrogen production from renewable sources.” (IRENA). This is about to change now.

The expectations have led to more than 30 countries today having prepared road maps for hydrogen, countries that together make up 73% (Hydrogen Council) of the world's GDP. The Hydrogen Council expresses the following: “228 large-scale hydrogen projects

contd/-

announced across the value chain, with 85% located in Europe, Asia, and Australia. If all projects come to fruition, total investments will reach more than $300 billion in spending through 2030, including $80 billion which can be considered “mature” – meaning that these projects are in the planning stage, have passed a final investment decision (FID), or are under construction, already commissioned, or operational. Governments worldwide have committed more than US $70 billion in public funding. On a company level, members in the Hydrogen Council are planning a sixfold increase in their total hydrogen investments through 2025 and a 16-fold increase through 2030. They plan to direct most of this investment toward capital expenditures (capex), followed by spending on merger and acquisition (M&A) and R&D activities.”

The Hydrogen Council expects that by 2030 the costs of renewable hydrogen production could be in the range of $2.3 per kilogram and $1.4 per kilogram (the range results from differences between optimal and average regions), while the CEO of the world's leading electrolyser manufacturer (Norwegian-owned, Nel ASA), Jon André Løkke, states that he believes the price will fall to $ 1.5 per kilogram by 2025, and at this point green hydrogen being priced at a lower level than even grey hydrogen.

The international pressure to tax emissions is steadily increasing and has been introduced in many countries in various variants in the form of tax reliefs / -exemptions and / or added CO2 taxes to the fuel costs. In the European Union's emissions trading system, the price of CO2 is in the range of €20 to €25 per ton. A growing number of European Union countries want to establish a minimum CO2 price that will gradually increase to around €30 to €40 per ton over the next 10 years. That means the cost of CO2 could eventually add almost €0.50 to the price of a kilo of grey hydrogen in Europe, bringing the total price to around €2 (IEA).

In Norway, gasoline was taxed with approximately €38 (544 NOK) pr ton CO2 in 2020 (the Norwegian Government). For private car owners you have to pay an additional one-off tax which amounts to an equivalent of around €287 per tonne of CO2 over the car's lifetime. For electric cars, the exemption from tax can correspond to an even higher price, the national budget for 2020 mentions several studies that point to a cost between around €500 to €1500 per tonne of CO2, but which are expected to fall in the years to come. For the latter reason Norway is the country with the most electric cars in relation to its

contd/-

population, and about half of the new cars being bought are electric cars, and the trend is growing rapidly.

The world is changing rapidly and the ever-increasing pace of change is understandable due to several factors. Developments in both digitalisation and technology enable changes in our lifestyles. At the same time, we are experiencing a collective, global pressure to make changes to balance consumption to a sustainable level, as the negative consequences become a larger part of our environment, in the form of natural disasters and reduced quality of air, water and reproductive organic life.

India - challenges and potential:

Within the energy transition, India is already one of the global spearheads, with the fastest growth in renewable energy and as the fastest growing consumer of energy. However, the current energy system in India is still strongly dominated by fossil fuels (76%,IEA) and the third largest importer of oil - correspondingly in excess of ⅘ part of the country's consumption. In a white paper written by Nature Communications it is said in relation to India's power system; “With emissions of 2.5 Gt CO2 in 2017, India ranked third globally, trailing only China (9.8 Gt) and the US (5.3 Gt). Coal accounts for the bulk of India's contemporary primary energy supply, 58.1% in 2015, and is projected to continue to play an important role indefinitely into the future, 42–50% by 2047. The share of electricity in the overall energy system is predicted to rise from the current level of 16 to 25–29% in 2047. The capacity for power generation in India amounted to 344 GW in 2018 of which coal accounted for 197 GW (57%), hydro 49.8 GW (14%), wind 34.0 GW (10%), gas 24.9 GW (7%), and solar 21.7 GW (6%) with the balance represented by a combination of biomass 8.8 GW (3%) and nuclear 6.8 GW (2%)”

Furthermore, Nature Communications, has calculated the potential of renewable electricity production capacity: “Overall, the physical annual potentials for offshore wind, onshore wind, and solar PV are estimated at 1546, 22,200, and 20,900 TWh, respectively. In projecting future demand for power, we assumed a growth rate of 6.5% per year leading to requirements for a source of 3800 TWh in 2040. The combination of available onshore wind and solar PV, according to the current analysis, should be more than sufficient to account for any conceivable long-term demand for power in India, with a margin of safety that could allow for displacement of fossil sources of energy in other segments of the

contd/-

Indian economy with benefits in terms of further reductions in emissions of CO2." In the final discussion of the paper: "The striking conclusion is that investments in renewables could play an important role in reducing the overall costs for delivery of electricity in India's future power system. In particular, assuming a commitment to 80% renewables using the standard model, the overall costs for delivery of power in 2040 were projected to be lower by as much as $50 billion compared with expenses for the 0% renewable reference case, equivalent to a decline of 0.5 cent/kWh for retail electricity prices. Emissions of CO2 are reduced by as much as 85% with renewables at 80%, a potential cut in emissions of 3.4 Gt CO2 per year, slightly higher than the level of emissions, 2.5 Gt CO2, that applied in 2017."

India has ideal conditions for utilizing wind and solar, as renewable energy sources, this is also clear in the study of Hydrogen Council.

India - societal and educational opportunities

Above, we have lifted some of the technological, and hence commercial opportunities the transition to a "hydrogen economy" might entail. But there is also an important human and societal side of all great transitions. An energy transition based on renewable energy sources to a zero net society therefore holds opportunities and challenges for the Indian society as a whole, as well as for the overall global society. With the national hydrogen mission, India sets ambitious targets towards developing brand new, or radically altering old industries.The human resource part of this transition needs to be addressed alongside with the development of new technology. The skills and competence needed to build a "hydrogen economy" can to a certain degree be transferred from emission heavy industries like oil and gas. This will, done properly, secure jobs and secure the necessary speed in the green shift. Still, there are competencies that hold particular relevance for the production and utilisation of clean hydrogen. India hosts a large number of well known universities and educational institutions, and highly qualified Masters and PhD scientists (ref?) and these needs for specific knowledge, skill sets and qualifications when it comes boosting a hydrogen economy, should be addressed through the educational system. In addition to using already existing laboratories, the continuous development of CoE-H's throughout India would be beneficial, allowing and facilitating international R&D cooperation in relevant fields.

contd/-

Article - International Hydrogen Alliance (Contd/-)

Building a clean hydrogen industry in India, could also address the high unemployment rate (ref?) amongst the younger generations. The first clean hydrogen projects and plants can be developed to also facilitate practical training in maintenance, operations and security.
Maybe a paragraph linking India's world-leading position in digitalisation to the development of new industries?

We argue in favour of a green transition that takes into account the potential societal benefits, where public policy addresses climate change along with achieving other social aims like job creation and reducing economic inequality, and that the hydrogen mission supports the development of an overall "Green New Deal" for India.

India - alternative roadmaps
It is unlikely that it will be profitable to invest in hydrogen in the short term. If one only considers costs against what one can achieve from reduced climate emissions, it is more appropriate to take a wait-and-see attitude in relation to implementing hydrogen as part of the energy system, to finance entire value chains when it demonstrably outperforms short-term calculated climate quotas for temporary emissions. Still, we believe strongly that there are several reasons why it will pay off in the long run to have a strongly proactive attitude towards both the development and implementation of hydrogen value chains in India.

With a proactive attitude towards the implementation of hydrogen value chains in India, the country will gain advantages by becoming less dependent on other countries that have technological expertise, systems and technology. By taking an early offensive position in the battle for the hydrogen economy, India will be able to become a net exporter in these areas. India will also more quickly be able to become self-sufficient with emission-free energy. It will have positive ripple effects in relation to technology competence and development in connection with both the energy sector as well as adjacent sectors, such as the development of end products. From this point of view, there is therefore no doubt that the countries that have the opportunity to take an offensive position in the hydrogen race will achieve strategic long-term economic advantages globally.

contd/-

Article - International Hydrogen Alliance (Contd/-)

Success factors

In order to take a clear position in investing in hydrogen, there are several critical success factors that we believe to be of immense importance:

- as soon as possible prepare a long-term road map, including;
  - substantial plans with government long-term grants for government initiatives and business
  - taking into account infrastructure (production, transport, storage and refueling stations/HRS)
  - emphasize effective facilitation of regulatory provisions and frameworks in line with international standards
- establish international cooperation with established, global hydrogen organizations (example: PATH, Hydrogen Global, Hydrogen Europe)
- establish strategic cooperation with countries and companies with cutting-edge expertise in hydrogen (such as Norway)

Recommended actions

First, it is recommended that the Indian Government advocate policy actions for fast penetration of Hydrogen. It will be important to establish a framework of a long-term collaboration between the authorities, R&D and the business community. The business community will be dependent on certainty about the authorities to support long-term plans by financing directly and indirectly (through procurement agreements) in order to create a predictability for the business community to enter into otherwise too risky long-term investments. The authorities must also contribute to and facilitate the preparation of regulatory framework conditions, which are based on international standards, in the restructuring of the energy system. In order to get started quickly, it will be appropriate to work in parallel with establishing long-term plans (hydrogen roadmaps), while at the same time facilitating kick-starting of strategic projects within selected market areas and geographical areas. These start-up projects will be important catalysts for stimulating investment interest from the business community, while at the same time providing an important basis for connecting the business community, the authorities and R&D.

contd/-

Article - International Hydrogen Alliance (Contd/-)

Cooperation within the hydrogen field between Norway and India is in an early stage, and has already gained a strong position with the establishment of a common, physical point of contact in Delhi, “The Norwegian – Indo Center of Excellence in Hydrogen (CoE-H India)”. The Norwegian energy company, Greenstat, together with its partners within H2Cluster Norway India represent a growing cluster of businesses, R&D and governmental contacts across both nations. We are very optimistic about this being a genuine starting point for a long and fruitful collaboration that will make a strong contribution to implementing hydrogen as an important part of the energy system in India.

International cooperation will also be crucial for the successful implementation of hydrogen in the energy system in India. In order to take an international position, it will be essential to succeed with international cooperation. Some countries and companies have advantages that make them particularly important partners, at the same time we believe it to be of importance to further develop new collaboration constellations over time. It will also be important to reconcile national ambitions with national goals, which contribute to a faster shift towards sustainable consumption of the planet's resources and in balance with the plant's ecological ecosystems. In the early phase of a hydrogen investment for India, it is recommended to establish relationships with existing, established hydrogen organizations. It should also be considered to establish own regional or global cooperation through the establishment of a new organization, in order to promote international cooperation that will contribute to faster acceleration of the transition to an emission-free energy society, where hydrogen plays a key role. The establishment of an “International Hydrogen Alliance” to create greater synergies between science, technology and entrepreneurship to create win-win for all, inspired by the The International Solar Alliance (ISA) would be a good way to attract partnerships with countries with common goals and complimentary competency. Norway should be taking part in such a venture.

contd/-

Article - International Hydrogen Alliance (Contd/-)

At a macro level, we could suggest the following actions:

1. Establishment of International Hydrogen Alliance, initiated by Mr Modi
2. Establish some selected pilot projects with a goal of scaling up to a level where it is possible to achieve economies of scale, e.g. by selecting a strategic "hydrogen city/ region" for the implementation of various types of hydrogen investments.
    a. The authorities must establish incentive schemes that enable the business community to commit to long-term investments.
    b. Establish regulatory framework for safety conditions based on international standards
    c. Infrastructure:
        i. centralized production of hydrogen
        ii. distribution system
        iii. storage system
        iv. Hydrogen Refueling Stations (HRS)
    d. 5000 buses / trucks / taxis
    e. hydrogen implemented in steel production / refinery / fertilizer production
    f. 200 boats
    g. balancing the energy system
    h. back-up solutions for critical installations
    i. Establish a R&D center for testing and development of hydrogen solutions on a large scale
3. Prepare a roadmap for hydrogen, with a long-term plan for upscaling in other cities and in the long term throughout the country, with the aim of covering all market segments over a period of 10-30 years from now.

contd/-

Hydrogen becoming a key enabler for a self-reliant India

Hydrogen is an important resource of energy, both naturally (through photosynthesis), through production in electrolysis (renewable energy) and through chemical production (e.g. reforming natural gas). As a part of the multifaceted puzzle of a green energy transition, hydrogen plays a vital role. It is one of the key factors for producing renewable energy and working as a carrier for the emission-free energy system of the future. Hydrogen serves as the roadmap for today which shall eventually lead the economy towards a new high. Impacting industries by making things and processes cost-efficient, it also ensures that the nations relying solely on coal utility are supported in an eco-friendly way. Production of renewable hydrogen is imperative to scale up the production of hydrogen and thus help governments, companies and others to seize this chance to enable clean hydrogen to fulfil its long-term potential.

With growing economic activities, the energy demand too will increase in the form of electricity and transportation fuels. To cater to the increasing demand for fuels and with the absence of renewables, the dependence on fossil fuels rises which not only increases local pollution in the form of particulate matter emission that can pose serious health impacts, it also leads to CO2 emission, the primary cause of global warming. Hydrogen can prove to be a game changer. It has the potential to find its environmental benefits in sectors and applications like power generation, transportation and indoor heating in the commercial and residential sector.

contd/-

Article - Hydrogen becoming a key enabler for..... (Contd/-)

Hydrogen storage is a key enabling technology. None of the current technologies satisfies all the hydrogen storage attributes sought by manufacturers and end users. On this front, Government-Industry coordination on research and development is needed to lower the costs, improve performance, and develop advanced materials. Once produced, hydrogen can be in the form of a compressed gas, cryogenic liquid or chemical, each requiring specific methods of storage essential to successful distribution.

India can decarbonize its energy-intensive sectors such as industry, transport, and power by using green hydrogen. India given its terrestrial location and abundance of natural resources, favourable climatic and geographical conditions are among the best-suited countries to produce renewable energy from solar and wind. Use of green hydrogen that is produced locally can be a promising sustainable source of energy. Local production of hydrogen will significantly reduce the transportation fuel cost while reducing emissions. It will also explore possibilities in blue and green hydrogen production and storage for heavy-duty transportation of hydrogen use in industrial, steel, refinery, cement and logistics clusters. Producing hydrogen through renewable energy will not only be cost-effective but will also help India in reaching a step closer to net-zero carbon emission. Increasing the share of hydrogen in the country's energy mix would take it towards greater self-reliance in its energy needs.

India, as one of the world leaders in the production of renewable energy, is in a unique position to take a lead role in the development of a global hydrogen economy. The country's total renewable energy generation potential is estimated to be 1097.465 GW. Over the last seven years, India has invested more than USD 70 billion in renewable energy. This amounts to 1.89 % of the total investments received across all sectors during the same time period.

Hydrogen's potential as a clean fuel, energy storage medium and renewable energy enabler has captured the attention of energy sector players, governments, environmental advocacy groups, and users. In February 2021, PM Narendra Modi, invited global firms to take advantage of the Rs 1.97 trillion (Production Linked Initiatives) PLI schemes for 13 sectors and expand their manufacturing in India. Against the backdrop of the proposed National Hydrogen Energy Mission supporting India's green energy initiatives with green hydrogen, several hydrogen initiatives and projects are emerging in India. Today, strong

contd/-

Article - Hydrogen becoming a key enabler for..... (Contd/-)

voices are advocating for hydrogen both from the private sector and from the government side, providing a clear momentum.

Ninety countries, representing 80% of the world's GDP, are now committed to Net Zero targets.

More than 30 countries have concrete hydrogen strategies and have allocated $76 billion of government funding. India has some obvious competitive advantages that should be utilized to push the national hydrogen initiatives, both to accelerate the decarbonization of the world, as one of the greatest emitters of CO2, but also to take part in the value creation that lies ahead in the green energy transition. India is well positioned to take a lead role in the global hydrogen economy, with its extremely ambitious target of 450 gigawatts of renewable energy by 2030.

However, there are some challenges to succeed. The way forward would need a strong alliance between industries, academia, R&D institutes and government to catalyze the process of making hydrogen as the fuel of the future. The above alliance will have to work on challenging mindsets, bringing collaborators, finding alternatives and most important formulate guidelines and policies for harnessing the power of this green fuel for reducing the impacts of climate change and promote Atmanirbhar Bharat (Self-Reliant India). Government, in harmony with the private sector, should work cohesively and ensure that the investment in the energy market is inclined towards green hydrogen. Matching the global standards, the process will not only create a healthier today for businesses and minimise the impact of past record of anthropogenic interferences but also preserve the natural cover and secure the future with to-be introduced hydrogen practices such as transportation and storage along with tracing and eliminating the ill-impact of carbon footprint.

With a strategic vision and administration to make India more sustainable, establishing the green hydrogen system will aid the country in becoming energy-self reliant and achieve greater things across several verticals.

Towards a Self-Reliant India- Hydrogen as a key enabler

This event - the International Climate Summit 2021: Powering India's Hydrogen Ecosystem marks a great opportunity for India and for the world, to strengthen the energy transition - placing hydrogen in the centre of events.

Although our planet still provides in abundance, the signs of stress and imbalance become more and more obvious. Environmental degradation and increasing differences between people and countries fuel discontent and challenge global stability. We are in a hurry to find both societaland technological solutions, and international collaboration is more important than ever.

As part of the multifaceted puzzle of a green energy transition, hydrogen plays a vital role. Hydrogen is an important part of the current energy system, both naturally (through photosynthesis), through production in electrolysis (renewable energy) and through chemical production (e.g. reforming natural gas). Hydrogen has been identified as a key factor, as an energy carrier in the context of renewable energy, in the emission-free energy system of the future.

India, as one of the world leaders in the production of renewable energy, is in a unique position to take a lead role in the development of a global hydrogen economy. The country's total renewable energy generation potential is estimated to be 1097.465 GW. Over the last seven years, India has invested more than USD 70 billion in renewable energy. This amounts to 1.89 % of the total investments received across all sectors during the same time period.

Already in 2006, India developed its first roadmap for Hydrogen and Fuel Cells, but although this process led to increased R&D activities in hydrogen- related areas, the road map was not followed up with actual pilot/ demo projects. Today, Europe and the US are moving fast on hydrogen initiatives and projects, and Japan, Australia and Korea are closely following those who are ahead.

Ninety countries, representing 80% of the world's GDP, are now committed to Net Zero targets. More than 30 countries have concrete hydrogen strategies and have allocated $76 billion of government funding. India has some obvious competitive advantages that should be utilized topush the national hydrogen initiatives, both to accelerate the decarbonization of the world, as one of the greatest emitters of CO2, but also to take part in the value creation that lies ahead in the green energy transition.

contd/-

Article - Towards a Self-Reliant India- Hydrogen..... (Contd/-)

Against the backdrop of the proposed National Hydrogen Energy Mission supporting India's green energy initiatives with green hydrogen, several hydrogen initiatives and projects are emerging in India. Today, strong voices are advocating for hydrogen both from the private sector and from the government side, providing a clear momentum.

In February 2021, Hon'ble Prime Minister Narendra Modi invited global firms to take advantage of the Rs 1.97 trillion (Production Linked Initiatives) PLI schemes for 13 sectors and expand their manufacturing in India. In an interview related to this event, Mr. Amitabh Kant, CEO of NITI Aayog stated, "My belief is that the world is going to pay a premium for green products.

This is going to happen in the next three to four years. You will see huge thrust which is being given to net zero emission by the US and China. What is going to happen as a consequence of this is that it will be accelerating the decarbonization of the world. That gives you a huge opportunity."

So, to summarize - India is well positioned to take a lead role in the global hydrogen economy, with its extremely ambitious target of 450 gigawatts of renewable energy by 2030.

India have:

- an strong position in renewable energy
- a government apparatus suitable for continuing RE+ H2
- clear visions of making India's society sustainable
- and a goal of becoming energy self-reliant

However, there are some challenges to succeed. The way forward would need a strong alliance between industries, academia, R&D institutes and government to catalyze the process of making hydrogen as the fuel of the future. The above alliance will have to work on challenging mindsets, bringing collaborators, finding alternatives and most important formulate guidelines and policies for harnessing the power of this green fuel for reducing the impacts of climate change and promote Atmanirbhar Bharat (Self-Reliant India).

Green Hydrogen: A key step towards the development of sustainable energy sources

Published in The Optimist News | Firday 13 August 2021:
https://theoptimist.news/green-hydrogen-a-key-step-towards-the-development-of-sustainable-energy-sources/

The vast range of applications for green hydrogen make it a crucial part of the decarbonization arsenal, given the increasing need to meet global climate pledges and pursue even quicker reduction. Furthermore, hydrogen is a versatile energy carrier that may be converted into power and heat for use in carbon-reduction efforts.

Green hydrogen is produced by the electrolysis of water using renewable energy and has a lower carbon footprint. It is one of the few technologies that can now deliver seasonal energy storage in all markets, particularly in areas where large-scale pumped hydro solutions are not feasible. Furthermore, green hydrogen and its derivative fuels, such as ammonia and methanol, are among the only technical options capable of decreasing emissions in heavy-duty transportation industries such as construction and agriculture. It can enable energy-intensive, hard-to-decarbonize industries, including steel, chemicals, long-haul transportation, power, shipping, and aviation, to achieve net-zero CO2 emissions. Green hydrogen can be blended up to 10 per cent by city gas distribution networks for broader acceptance.

Green hydrogen generation will help to battle climate change and reduce the country's reliance on imports. As technology progresses, green hydrogen is poised to become more affordable and accessible sooner than previously believed. The development of green

contd/-

Green Hydrogen: A key step towards the development.... (Contd/-)

hydrogen projects and the localization of electrolyzer production can create a new green technologies industry worth billions of dollars and generate jobs. Green Hydrogen, with its cross-sectoral applications, could be a critical future option, allowing for a steady diversification of the energy system while also increasing renewable energy demand.

Because the cost of creating hydrogen from clean sources has dropped considerably, hydrogen has been highlighted as a potential energy source, resulting in tremendous growth in interest and investment in green hydrogen. Electrolysers and fuel cell systems now have much longer operational lifetimes, resulting in a powerful positive feedback loop in which green hydrogen production prices benefit from a downward cost spiral on both the renewable power supply and the electrolyzer equipment sides.

India will account for the most significant share of energy demand growth over the next two decades. To meet the demand for clean energy and sustainable resource consumption, India has the opportunity to reimagine its energy economy radically, which may be accomplished by utilizing the results of decadal progress in sustainable energy innovation. By staying ahead of the curve in technological progress, investing early in the research, and ramping up production capacity to meet domestic needs to the meet the committed RE capacity targets of 450 GW by 2030, it is imperative that India's energy grid includes green hydrogen driven solution on a medium-to-long-term basis.

Strategies to engage MSME towards Green Hydrogen apart from Big Corporates

In the current times, it has been seen that India's largest corporations like Reliance Industries Ltd (RIL), are announcing plans to invest Rs 75,000 crore in renewable energy projects, a part of which shall be used to construct an electrolyser and a fuel cell Giga plant, giving the country's fledgling hydrogen sector a significant boost. Similarly, Indian Oil Corporation, is working on developing hydrogen-spiked compressed natural gas or H-CNG and others big energy players like GAIL, NTPC, Aditya Birla chemicals, INOX Air are investing in green hydrogen technologies.

As the adoption of Green hydrogen increases in the big corporates, it is becoming essential to also engage MSMEs as part of the process. The need for building expensive electrolysers for green hydrogen generation has made the process unsustainably expensive and logistically complex for small players to invest in the green hydrogen technologies, especially w.r.t. generation aspects. Secondly, in addition to existing regulations and market design, the cost of production has also been a significant barrier to the uptake of green hydrogen, as the green hydrogen is still 2-3 times more expensive than blue hydrogen (produced from fossil fuels with carbon capture and storage), and further cost reductions to match up with the other energy sources becomes one of the critical issues to be addressed to increase the uptake of green hydrogen in small industries and MSMEs.

Although the infrastructure economic complexity may act as an impediment for MSME, however the MSME could be an important part of hydrogen growth engine by supporting the hydrogen energy economy with infrastructures in the domain of ancillaries around the green hydrogen ecosystem. The MSME can help develop an improved cross-sectoral applications of green hydrogen by coupling sectors through local manufacturing/ services of various hydrogen value chain elements – e.g. fuel cells, carbon fibre, vessels, equipment, power electronics etc.

Considering the above, it will also be crucial to simultaneously develop stimulating sustainable energy policy ecosystem of green hydrogen for MSME by the taking following action steps:

- subsiding the cost differential between green hydrogen production and fossil fuel cost.
- duty-free import of plant machinery and technologies for renewable energies
- Tax holidays for green hydrogen use for initial technology adoption years.
- By improving the cost and performance of hydrogen supply-chain at a large scale.

These actions will now only help achieve economic stimulus around sustainable energy policies in green hydrogen but will also help engage MSME in the green hydrogen ecosystem in a inclusiveness manner.

Hydrogen To Drive India's Energy Self-Reliance - Hydrogen to play key role in making India a net-zero economy

Published in Outlook | Saturday 14 August 2021:
https://www.outlookindia.com/website/story/business-news-guest-column-hydrogen-to-drive-indias-energy-self-reliance/391466

Hydrogen is an important resource of energy produced both naturally and chemical production and as a part of the multifaceted puzzle of a green energy transition, hydrogen plays a vital role.

It is one of the key factors for producing renewable energy and working as a carrier for the emission-free energy system of the future. Hydrogen serves as the roadmap for today which shall eventually lead the economy towards a new high.

Impacting industries by making things and processes cost-efficient, it also ensures that the nations relying solely on coal utility are supported in an eco-friendly way. Production of renewable hydrogen is imperative to scale up the production of hydrogen and thus help governments, companies and others to seize this chance to enable clean hydrogen to fulfil its long-term potential.

With growing economic activities, the energy demand too will increase in the form of electricity and transportation fuels. To cater to the increasing demand for fuels and with the absence of renewables, the dependence on fossil fuels rises which not only increases local pollution in the form of particulate matter emission that can pose serious health impacts, it also leads to CO2 emission, the primary cause of global warming.

Hydrogen can prove to be a game changer. It has the potential to find its environmental benefits in sectors and applications like power generation, transportation and indoor heating in the commercial and residential sector.

contd/-

Hydrogen To Drive India's Energy Self-Reliance..... (Contd/-)

Hydrogen storage is a key enabling technology. None of the current technologies satisfies all the hydrogen storage attributes sought by manufacturers and end users. On this front, Government-Industry coordination on research and development is needed to lower the costs, improve performance, and develop advanced materials.

Once produced, hydrogen can be in the form of a compressed gas, cryogenic liquid or chemical, each requiring specific methods of storage essential to successful distribution. India can decarbonize its energy-intensive sectors such as industry, transport, and power by using green hydrogen. India given its terrestrial location and abundance of natural resources, favourable climatic and geographical conditions are among the best-suited countries to produce renewable energy from solar and wind. Use of green hydrogen that is produced locally can be a promising sustainable source of energy.

Local production of hydrogen will significantly reduce the transportation fuel cost while reducing emissions. It will also explore possibilities in blue and green hydrogen production and storage for heavy-duty transportation of hydrogen use in industrial, steel, refinery, cement and logistics clusters.

Producing hydrogen through renewable energy will not only be cost-effective but will also help India in reaching a step closer to net-zero carbon emission. Increasing the share of hydrogen in the country's energy mix would take it towards greater self-reliance in its energy needs.

India, as one of the world leaders in the production of renewable energy, is in a unique position to take a lead role in the development of a global hydrogen economy. The country's total renewable energy generation potential is estimated to be 1097.465 GW.

Over the last seven years, India has invested more than $70 billion in renewable energy. This amounts to 1.89 % of the total investments received across all sectors during the same time period.

Hydrogen's potential as a clean fuel, energy storage medium and renewable energy enabler has captured the attention of energy sector players, governments, environmental advocacy groups, and users.
In February 2021, PM Narendra Modi, invited global firms to take advantage of the Rs 1.97 trillion (Production Linked Initiatives) PLI schemes for 13 sectors and expand their manufacturing in India.

Hydrogen To Drive India’s Energy Self-Reliance…….. (Contd/-)

Against the backdrop of the proposed National Hydrogen Energy Mission supporting India's green energy initiatives with green hydrogen, several hydrogen initiatives and projects are emerging in India.
Today, strong voices are advocating for hydrogen both from the private sector and from the government side, providing a clear momentum. Ninety countries, representing 80% of the world's GDP, are now committed to Net Zero targets.

More than 30 countries have concrete hydrogen strategies and have allocated $76 billion of government funding. India has some obvious competitive advantages that should be utilized to push the national hydrogen initiatives, both to accelerate the decarbonization of the world, as one of the greatest emitters of CO2, but also to take part in the value creation that lies ahead in the green energy transition.

India is well positioned to take a lead role in the global hydrogen economy, with its extremely ambitious target of 450 gigawatts of renewable energy by 2030.

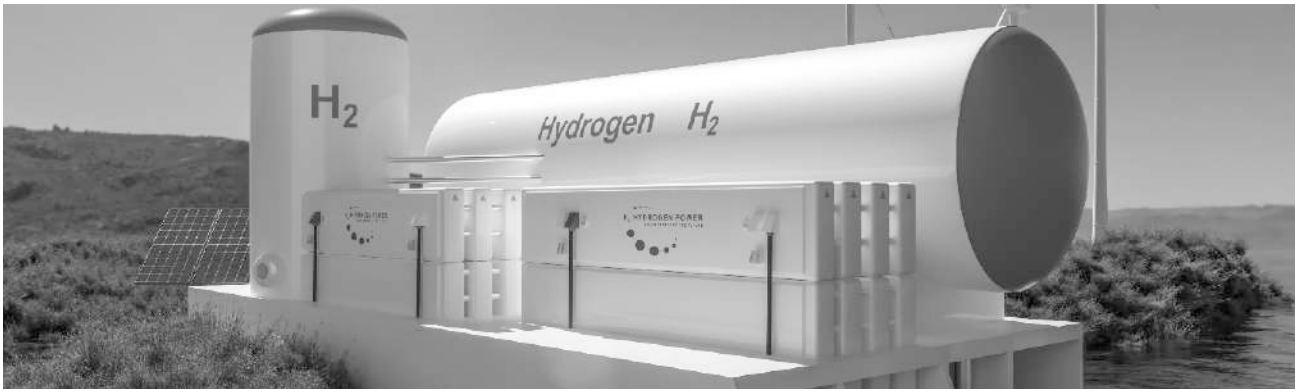
However, there are some challenges to succeed. The way forward would need a strong alliance between industries, academia, R&D institutes and government to catalyze the process of making hydrogen as the fuel of the future.

The above alliance will have to work on challenging mindsets, bringing collaborators, finding alternatives and most important formulate guidelines and policies for harnessing the power of this green fuel for reducing the impacts of climate change and promote Atmanirbhar Bharat (Self-Reliant India).

Government, in harmony with the private sector, should work cohesively and ensure that the investment in the energy market is inclined towards green hydrogen. Matching the global standards, the process will not only create a healthier today for businesses and minimise the impact of past record of anthropogenic interferences but also preserve the natural cover and secure the future with to-be introduced hydrogen practices such as transportation and storage along with tracing and eliminating the ill-impact of carbon footprint.

With a strategic vision and administration to make India more sustainable, establishing the green hydrogen system will aid the country in becoming energy-self reliant and achieve greater things across several verticals.

Powering Indian Green Hydrogen Ecosystem Through Centres of Excellence Across India



Abstract: This article reviews current situation regarding India's Renewable Energy (RE)achievements in past and ambitious targets set for 2030 to make India as global hub for Green Hydrogen/Chemicals production and export. These targets can be achieved by developing adequate ecosystem in synchronization of RE achievements along with various issues related with Green Hydrogen / Chemicals such as production technologies, storage systems, transportation and handling. It is concluded that India needs to build Centres of Excellence in each state to support these growth targets by focussing on technology development and Human capital developments.

1: INTRODUCTION

Today, India has 141 GW of installed capacity of Renewable Energy [RE] making it the fourth largest installed capacity globally – with fourth largest for wind and fifth largest for solar. India has also set for itself, the world's largest RE expansion plan – achieving 175 GW by 2022 and 450 GW by 2030 in installed capacity. The RE installed capacity has already seen a 226 percent increase in the last 5 years. India has also been designated as a 'Global Champion' for energy transition at the UN High Level Dialogue on Energy and also ranked 3rd in EY Renewable Energy Country Attractiveness Index. India's RE sector has already received investments worth $70 billion in the last 7 years and presents additional business prospects worth $20 billion for the next decade.

France-based Total Group acquired 20 percent stake in Adani Green Energy Limited worth $ 2.5 billion last year. ORIX Corp invested $980 million in wind assets of Greenko Energy Holdings, which has existing investments from sovereign funds GIC & ADIA worth $2.2 billion. In May 2021, Virescent Infrastructure acquired 76 percent of India's solar asset portfolio of Singapore-based Sindicatum Renewable Energy Company Pte Ltd.

contd/-

Powering Indian Green Hydrogen Ecosystem....(Contd/-)

Reliance Industries, intends to develop four huge " giga factories" to manufacture photovoltaic modules, batteries, fuel cells, and—importantly—electrolysers to produce hydrogen. It's a big and bridges two aspects of decarbonization: technologies that exist today and are economical at scale, and those that need a major effort to get to that point.

Hydrogen is an energy carrier that can transform our fossil-fuel dependent economy into a hydrogen economy, which can provide an emissions-free transportation fuel.A renewable energy -hydrogen system canprovide the means of a totally emissions-freemethod of producing energy and can reduce fossil fuel use. Many environmental issues have been caused due to increased use of fossil fuel during generation, transformation and use of energy, for example, acid rain, stratospheric ozone depletion and global climate change.

Around the world storms, floods andwildfires are intensifying. Air pollutionsadly affects the health of tens ofmillions of people and unpredictableweather causes untold damage tohomes and livelihoods too. But whilethe impacts of climate change aredevastating, advances in tackling it areleading to cleaner air, creating goodjobs, restoring nature and at the sametime unleashing economic growth.

Under leadership of Prime Minister Narendra Modi Ji,India is looking to kick-start the Green hydrogen ecosystem development. Various initiatives with respect to the greater use of hydrogen in India's energy mix are already started. National Hydrogen Mission has made a hydrogen roadmap for the country. Pilot project on Blue Hydrogen, Hydrogen CNG (H-CNG) and Green Hydrogen already initiated. Through technological advancements, blending hydrogen with compressed natural gas for use as transportation fuel as well as an industrial input to refineries is started. 50 buses in Delhi are plying on blended hydrogen in Compressed Natural Gas on a pilot basis. There is plan to scale it up in the coming months across the major cities of India."

Honourable Prime Minister in his Independence Day speech on 15 August 2021 said "Energy is integral to support our fast-growing economy, and we are developing an energy sector which will be growth-centric, industry-friendly and environment-conscious. He said that we have the onerous task of ensuring energy justice and to end energy poverty in the country. This requires ample access to affordable energy to improve the lives of Indians coupled with the need to have a smaller carbon footprint.He further announced India becoming a global hub for green hydrogen production and exports.

Powering Indian Green Hydrogen Ecosystem....(Contd/-)

Recently COP26 president Alok Sharma said that he has requested the Indian government to consider raising ambitions in emission reduction targets and reiterated that a delivery plan on finance for developing countries is being put in place ahead of the conference in Glasgow later this year.India is the only country among G-20 nations whose actions are at par with the nationally determined contributions (NDCs) set by them under the Paris Agreement in 2015. Negotiators from both India and the UK expressed their willingness to explore the possibility of establishing a Green Climate Fund which could materialise the proposal for climate finance to the tune of $100 billion pledged by the developed countries under the Paris Agreement.

Green hydrogen is the biggest goal and will help provide a quantum jump to India. India's strategy will be to leverage scale for its ambitious green hydrogen plan in the likes of its renewable energy programme, leading the country to run the world's largest clean energy programme.India is on track to achieve its renewable energy target of 450 gigawatt (GW) by 2030.

India's total hydrogen demand is expected to touch 11.7 million tonnes (mt) by 2029-30 from the current 6.7 mt. With the current cost of green hydrogen produced by electrolysis estimated at around ₹350 per kg, the plan is to more than halve it to ₹160 per kg by 2029-30. The government also aims to extend the production-linked incentive (PLI) scheme for manufacturing electrolysers to produce green hydrogen. This initiative on green hydrogen can help us to build an ecosystem of a 2-3 trillion dollar industry in the next 20-25 years.

Hydrogen gas is colourless, odourless, and non-toxic. The gas is classified as a flammable gas, and the ignition of hydrogen mixed with air can result in explosion. Hydrogen is combustible when mixed with air in concentrations ranging from 4 to 75 per cent by volume, and compared with other flammable substances, very low energy input is required to ignite the gas. For example, hydrogen gas can be ignited by static discharge from clothing and equipment and by spontaneous combustion. Hydrogen is lighter than air – which means that a leak will rise quickly. In the outdoor use of hydrogen, this is positive in terms of safety, because a leak will quickly dissipate. However, it is still important to focus on preventing accidental discharge.

To achieve these goals and bring renewable - Hydrogen ecosystem in India, we need to develop Centres of Excellence in each state in India and train engineers and technicians immediately.

Powering Indian Green Hydrogen Ecosystem....(Contd/-)

2: CENTER OF EXCELLENCE (COE)

Centre of Excellence (COE)is based upon the collaboration of three major pillars of Hydrogen ecosystem i.e. research institutes, industries and regulatory authorities and should focus on Green Hydrogen Technologies:

Currently there is no formal degree courses in renewable energy, Green hydrogen technologies and hydrogen applications. It is expected that Indian will need more than 100,000 qualified and trained renewable energy/ Green Hydrogen engineers to achieve ambitious targets.

To achieve above India need to develop human capital by formation of Center of excellence at every state. The opportunity of renewable energy and Hydrogen technology will be relevant to location and requirements. COEs will address

India needs to build Centers of Excellence (COEs) attached to Universities to focus on:

- Decentralization of renewable energy production
- Hydrogen production technologies with respect to scale of production
- Hydrogen storage systems
- Hydrogen transport and applications
- Hydrogen Safety in production, storage, transportation and dispensing.

Several countries initiated clear long-term investment signals in green hydrogen, and address these challenges strategically.

Norway. Unveiled in June 2020, Norway's strategy seeks to expand the use of hydrogen as an energy carrier in the maritime sector, but it also funds innovation for subsea storage of hydrogen from offshore wind under the Deep Purple project.

South Korea, Australia, Netherlands, Japan, Germany, EU, France , Spain Canada announced Hydrogen Economy Roadmap, which outlines a goal of producing fuel cell electric vehicles, rolling out refilling stations and supplying of fuel cells for power generation.

The use of hydrogen and hydrogen-based systems must be safe. Safe use is critical if potential users are to adopt new technology and new solutions, and if hydrogen and hydrogen-based solutions are to become viable alternatives for users.

Powering Indian Green Hydrogen Ecosystem....(Contd/-)

Suggested verticals of Centre of Excellence

- Advanced laboratory for research.
- Training in process safety and extensive use of Virtual Reality and Augmented Virtual Reality.
- Risk Assessment.
- Advanced Research in development of models based upon field data and forensic audit post-accident.
- Forensic audits pre and post accidents.
- Research in process safety and risk assessment for M.Tech& Ph. D. Students.
- Development of Hydrogen production, storage, transportation, dispensing Codes and Standards.

COE Objectives:

- Develop Bachelor, Master and Ph. D. programs relevant to Green Hydrogen production, storage, transportation and dispensing.
- R&D on materials and equipment used by the industry in Hydrogen energy value chain at progressive educational Institute with support from Norwegian Hydrogen Cluster.
- Advise on alternative choices of technology being adopted and bring out the techno commercial feasibility of such choices based upon best practices
- Advise on regulatory and policy matters related to Hydrogen energy industry in India and provide support to the industry
- Develop a data base for pilot and demo projects data to assist industry in simulating Hydrogen energy potential, solutions at various potential locations – “lesson learned”
- Assisting in commercialization of Hydrogen technologies or applications of relevance to India – set target for new JV and project in key industries
- Assist in developing policy and technological solutions to India's transition from fossil to non-fossil fuel and zero-emission society, focus upon key area related to safety, storage, transportation, and end-user application
- To contribute towards awareness and increased knowledge for Hydrogen Issues at State, National and International Level
- Explore the potential of clean hydrogen to help the process of decarbonizing the Indianeconomy in a cost-effective way, in line with the 2050 climate-neutrality goal
- Assist in the Decarbonizing of the energy sector
- Provide consulting services to industry, utilities, and regulators on choice of technology, economics, and policy.

- Disasters leading to Hydrogen leaks, fire and explosion are due to technology changes, equipment wear & tear and other factors. We have seen several times the industries and response agencies (security, medical and Govt authorities) are not prepared to respond such disasters. Globally there has been lot of R&D taken place and capability of information technology is used to develop real time disaster response modules.
- Virtual Reality training to feel actual reality to response personnel. The visualization for toxic leaks, fires and explosion can be displayed in the heads-up display is read from the 3D model data. The objectives of VR training is to experience hazards related to gas dispersion, liquid release (pools), fire and gas explosions in industrial environments. This helps in enhancement of risk awareness through education/training as a supplement to traditional book based education and real practical training. The users of VR will experience the possible consequences of leaks in an industrial plant and can take actions as per the plan.
- Virtual Reality (VR) training modules help in building awareness and adequate response. It has been observed in India that most of the accidents are never imagined and accordingly response planned. Global trend is to use VR training frequently to build awareness and planned response. This help in saving precocious lives, environmental damage and property. Centre of Excellence (COE) will provide training to research students, industries, Disaster response agencies such as police/medical etc.

3: CONCLUSION

India has opportunity in making global Green Hydrogen / Chemicals hub and can tap the advantages of high load factors from massive projects that have helped deliver some of the world's cheapest green power, claiming renewable hydrogen costs could fall by 50% by 2030 and by then compete with the fossil variety in some applications. This will need combination of using existing technology, developing it to suit Indian conditions, innovations, safety , codes & standards This will need an ecosystem which can be achieved by Centres of Excellence at each state.

International Climate Summit 2021 leading India's Transition to Clean Energy

Published in The Telegraph | Friday 13 August 2021:
https://www.telegraphindia.com/india/international-climate-summit-2021-leading-indias-transition-to-clean-energy/cid/1826413

India is the world's second most populated country and the world's third largest economy. Its energy system is heavily reliant on fossil fuels, such as coal for power generation, oil for transportation and industry, and biomass for heating and cooking. India's per capita energy usage is 30% of the global average.

India, being the world's third-largest oil consumer, is largely reliant on imports. By 2040, its energy demand will have doubled and its electricity demand will have tripled. The environment will suffer the most as a result of the rise. The energy sector is a major producer of pollution in the atmosphere, which contributes to climate change. In this view, **International Climate Summit (ICS 2021)**. ICS 2021 will bring together distinguished speakers, academics, industry experts, and policymakers from around the world for sessions and discussions on hydrogen and its potential as an energy source. The summit is a timely endeavour that will send a favourable message to the United Nations Framework Convention on Climate Change in Glasgow in November 2021.

The eminent **Summit Chair & Chairman, Environment Committee, PHDCCI, Dr. J. P. Gupta**, shares his insights and objectives behind introducing such an exquisite summit.

1. **Tell us briefly about the event International Climate Summit, and it's objective?**

   The International Climate Summit 2021 is a virtual event scheduled for 3rd September, 2021 in an effort to position India as a leader in the field of renewable energy, specifically Green Hydrogen. The global summit is being organised by the PHD

contd/-

Chamber of Commerce and Industry's Environment Committee in collaboration with NITI Aayog, the Ministry of Environment, Forests and Climate Change, the Department of Scientific and Industrial Research, and the Government of India's Department of Science and Technology. Greenstat Asia Norway, Gexcon Norway, Arena H2 Cluster Norway, India Hydrogen Alliance, and TERI are supporting the event by being the knowledge partners.

This Global Summit will build a dialogue for India's transition to clean energy with a special focus on 'Powering India's Hydrogen Ecosystem.' The summit sessions will focus on cooperative efforts that will help establish solutions for storing and transporting pressurised and liquefied hydrogen, to build a hydrogen economy and supply chain in India.

The International Climate Summit (ICS 2021) is a precursor to the 26th Conference of Parties (COP) to the UN Framework Convention on Climate Change (UNFCCC), which will be held in Glasgow in November 2021. The summit will allow worldwide collaboration in establishing sustainable routes for production, storage, transportation, distribution, and ambitious deployment of hydrogen technologies, with the goal of moving towards a cleaner, greener, and more sustainable future. Addressing these factors, the International Climate Summit 2021 aspires to move India to the forefront of renewable energy.

2. **How does the International Climate Summit intend to address the climatic concerns through a consolidated approach and timely interventions, ahead of the United Nations Framework Convention on Climate Change (UNFCCC) meeting in Glasgow in November 2021?**

There has been an evident increase in the global energy consumption and thus the dire need to harness alternative energy sources that are not just green, but also renewable and plentiful. One such source with a substantially higher energy output per unit mass is hydrogen.

Given that hydrogen development is at its nascent stage and there remains a lot of uncertainty surrounding its safety, it is pertinent to deliberate and understand the legal and regulatory requirements, investment cases, financing structures, operational requirements, revenue stream, sharing and other elements that need to be considered to formulate an effective acceptable commercialisation model. A gradual transition with adequate policy and safety standards will help build confidence among stakeholders and provide a conducive environment for a Hydrogen based economy.

India is one of the best-suited countries for producing renewable energy from solar

contd/-

panels and the wind, making the manufacturing of hydrogen from renewables cost-effective. India has a competitive advantage due to abundant natural resources and favourable meteorological and geographical circumstances. To accelerate the adoption of hydrogen technologies in India, a step-change in government policy and business actions is required.

National Hydrogen Energy Mission under the aegis of Government of India has set up National Hydrogen Portal - www.greenhydrogen-india.com, a single information source for research, production, storage, transportation and application of hydrogen across the country.

3. **Given that the Indian government has already declared the National Hydrogen Energy Mission, how do you see hydrogen energy becoming economically and technically viable in the near future?**

   In recent years, hydrogen has received a lot of attention as part of the transition from fossil fuels to emission-free alternatives. Moreover, hydrogen investment is being boosted to become a fundamental part of India's energy system and international collaboration as a tool for sustainable development and a transition of energy centered around human beings. By implementing smart grids and announcing notable investments in R&D, technology upgrades, and capacity creation, the government has already taken a significant step in this direction.

   Hydrogen is used as a fuel in the production, transport and energy storage. It has the potential to play a crucial cross-cutting role in the future low carbon economy, with applications across the industrial, transport, and power sectors. There has been a growing appreciation that complete electrification of our current energy systems could be prohibitively expensive and technologically challenging, given the important storage, flexibility, chemical, and heating attributes of current fossil fuels. Based on this, the experts have predicted that the hydrogen demand could increase five-fold by 2050, with use in the industry sector being the major driver. In power, hydrogen could be a cost-effective way of providing inter-seasonal storage in a highly variable renewable electricity system from 2040. Scaling up the use of domestically produced hydrogen can significantly reduce energy imports.

4. **Who are the speakers, and what will be the takeaways from the summit?**

   The International Climate Summit 2021 will take a step ahead in the mission of the 26th CoP summit, allowing for a unified approach and timely interventions to address climate concerns. The Summit will bring together stakeholders from across the global clean energy industry, along with other world leaders, in order to reach an agreement on climate change and sustainability issues.

contd/-

The summit includes some eminent speakers like Prof. Vijay Raghavan, PSA to Govt. of India; Amitabh Kant, CEO NITI Aayog; Dr. Vijay Saraswat, Member (Energy), NITI Aayog; R. R. Rashmi, Former Special Secretary, MoEFCC & Distinguished fellow TERI; Sturle Harald Pederson, Chairman, Greenstat Hydrogen Asia, Bergen; Prof. Ashutosh Sharma, Secretary Department of Science & Technology; Nobuo Tanaka, Ex ED, IEA, Japan; Dr. SSV Ramakumar, Director (R&D) IOCL; Dr. Karen Landmark, Chair of the Board Greenstat Asia, Norway; Dr. Ashish Lele, Director National Laboratory Pune; and many more, all of whom would share their leadership insights on the Hydrogen economy. The summit's proceedings will be broadcast to a global audience of more than 150 countries.

Hence, the meet will aim to build an India-centric and action-oriented approach for building self-reliance in the hydrogen ecosystem and solutions.

5. **How India intends to position itself as the world's cheapest hydrogen hub?**

Within the energy transition, India is already one of the global spearheads, with the fastest growth in renewable energy and as the fastest-growing consumer of energy.

However, the current energy system in India is still strongly dominated by fossil fuels (76%,IEA) and the third-largest importer of oil - correspondingly in excess of ⅘ part of the country's consumption. The establishment of an “International Hydrogen Alliance” will create greater synergies between science, technology and entrepreneurship to create a win-win situation for all, inspired by The International Solar Alliance (ISA). A tight collaboration with Norway will be a good starting point to gain momentum.

With a proactive attitude towards the implementation of hydrogen value chains in India, the country will gain advantages by becoming less dependent on other countries that have technological expertise, systems and technology. By taking an early offensive position in the battle for the hydrogen economy, India will be able to become a net exporter in this sector.

Due to its geographical location, climate conditions, and quantity of renewable energy sources such as solar, wind, and hydro, India is well positioned to become the world's cheapest hydrogen centre by 2050.

Having introduced such an innovative summit, International Climate Summit (ICS 2021) will address all issues pertaining to clean energy together, in order to find a set of balanced, positive and beneficial solutions for the future.

Financing Hydrogen – Challenges and Avenues

With a growing awareness about climate change and the challenges that arise thereof, there has been a significant shift towards green energy. Among the cleaner energy options, the hydrogen sector has gained accelerated significance in recent years and is now seen as a viable option for decarbonisation of an entire range of industries and the mobility sector.

In cognisance of the Paris Agreement, all countries need to achieve carbon neutrality by 2030. Ahead of 'The 2021 United Nations Climate Change Conference' (COP 26) scheduled on November 21 in Glasgow, many have pledged to reduce their carbon footprint and keep global temperature rise within 1.5°C. Surpassing this level would mean devastation.

As the world now shifts towards reduced dependence on fossil fuels and a carbon-emitting ecosystem on SOS basis, hydrogen is poised to become a multi-billion industry in the coming decades. Therefore, substantial investment commitments are required in the field.

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.

Major investments are needed to enhance H2 production capacities using electrolysis powered by electricity from Renewable Energy (RE). Funds are required to develop H2 end uses across industries and the energy sector, where H2 is seen as the only alternative to gas for generating electricity and heat for climate neutrality. Investments are needed through the entire value chain starting from upstream (manufacture of H2 production equipment), mid-stream (Green H2 production through electrolysis) and down-stream (end uses for mobility–fuel cell car, trucks, etc., and industry for power and heating requirement). Financial input is also required for logistics chain in transportation, storage and distribution involving refuelling stations like HRS (Hydrogen Refuelling Stations).

Government assistance via direct and indirect subsidies to facilitate deployment of assets/ equipment across the value chain, and support for large scale electrolysis projects - the so called giga factories, will help in lowering the production cost of green hydrogen and infuse demand.

Government intervention in developing a local green hydrogen ecosystem through

contd/-

Financing Hydrogen – Challenges and Avenues....(Contd/-)

hydrogen-centric project financing, involving public sector banks and institutions; direct subsidies to users of H2-powered vehicles; and tax incentives for the industrial sectors replacing gas and electricity with H2 will further boost the hydrogen sector.

Furthermore, guaranteeing the origin of hydrogen production and H2 traceability can also be undertaken through Instruments and certificates that help the buyer make conscious low carbon choices. To achieve carbon neutrality by 2050, EU has already introduced Emission Trading Schemes (ETS) targeted to significantly reduce emissions.

Government regulations and subsidy policies to cover the difference between the cost of green hydrogen produced, and the reference cost of production are necessary. As the cost of electricity accounts for about 70% of the total cost of H2 produced through the electrolysis process, governments need to introduce a regulated price for electricity obtained from renewable energy sources employed for producing green hydrogen.

Private financing is envisaged as a major source of funding for the H2 ecosystem from production to end usage.

While public authorities' involvement is indispensable at the take-off stage, it may not be enough to cover the investments needed for maintaining and operating the value chain. Fortunately, private players in the financing sector are showing enhanced interest to invest in the process of decarbonisation. Climate issues have become important factors for banks and institutions to draw up investment policies. Many nations have announced policies to gradually replace fossil fuels like coal, oil, and gases with cleaner energy options. Such decisions are expected to free up considerable amount of private capital, ready to be channelised for funding the transition to green hydrogen.

Although, the financial sector intends to participate in the development of clean energy by allocating funds and capital for new initiatives like green hydrogen, cost competitiveness and negative cash flows are some of the challenges that need immediate redressal.

Secured senior debts are well suited for hydrogen production and infrastructure activities of the entire value chain, like fuelling stations and hydrogen power connecting instruments.

contd/-

Financing Hydrogen – Challenges and Avenues....(Contd/-)

Secured senior debts are generally based on the cash flow profile of the asset equipment rather than the credit quality of the companies they finance. The servicing of these instruments is based on the cash flow generated solely by the assets financed.

Unsecured senior debt and **common equity** are some other conventional means of corporate financing. In the hydrogen sector, manufacturers of electrolyzers are expected to depend on this source of financing.

Leasing or Pay-per-Use is also a good option for financing the equipment to produce hydrogen and its end uses.

Leasing is provided directly by the supplier of the equipment or by commercial banks. It could be a leasing agreement with a flat annual payment or pay-per-use agreement where annual payment will be linked to the use of the assets being financed. A fine example of this would be of a car and truck manufacturer selling an equipment fitted with fuel cell. Here, pay-per-use would be a good finance option for him to avoid making an upfront payment.

In the last 15 years, there has been substantial development in the field of renewable energy. This period of awakening and acknowledgment of climate change can be utilised as the stepping stone for future prospects and a guide for hydrogen.

It is pertinent to know that private financing has been instrumental in developing renewable energies where different segments of the value chain are funded through asset-based financing via ad hoc legal entities, and not carried by the balance sheet of private corporate sponsors. Hence, the risk linked to the assets is ring-fenced and moderately curtailed as compared to the risk attached with general purpose corporate loans.

Another type of financing instrument for renewable energy projects is **Green Bonds**. Large portions of global savings are now being channelised through green bonds into projects addressing climate change.

Green bond funded instrument has two main characteristics. Firstly, the proceeds from the issuance of green bonds are specially earmarked for the assets. Secondly, the project and assets are identified in advance. The issuer of green bonds remains accountable to the investor not only for how the proceeds are applied, but also for the environmental and

contd/-

social impact of the project and the assets being financed/ refinanced.

A robust financing support system, scaled-up technology and progressive approach are the key to a sustainable hydrogen-based future.

Both public and private financing are needed as potential sources to meet the huge demand for a hydrogen-based energy ecosystem. Support of public authorities is needed to invite, inspire and motivate private financing for this sector. Sufficient public funding and endorsement are needed to create an infrastructure for H2 to lower the cost of production and bring it closer to existing energy cost using non-green technologies/ solutions. The end users in industrial and mobility sectors also need to be motivated to switch to clean and green energy options.

AUTHOR
Mr. Mahendra Rustagi, Co-Chairman, Environment committee, PHD Chamber of Commerce and Industry.

Hydrogen Promise – where we are heading to.....(Contd/-)

World is already up and seriously started thinking of Hydrogen as the possible key energy player in the race for net zero and is likely to become the 'Freedom Fuel' for many countries who are dependent upon imported Oil and Gas for their energy needs which is a big drain on their economic resources.

Suddenly large numbers of countries have taken up Hydrogen as the game changer in decarbonisation of economy and Net Zero targets. Number of such countries have brought in National Policy documents, Hydrogen Strategy documents, creating international alliances and more ambitious commitments like Hydrogen Mission in India. Renewable energy, once dismissed as too unreliable, unpredictable, or expensive to produce at scale, has now become commonplace driving the Green Hydrogen potential.

According to Hydrogen Council report - at the beginning of 2021 over 30 countries have released hydrogen road maps, industry has announced more than 200 hydrogen projects and ambitious investment plans with governments worldwide committed US$ 70 billion in public funding.

In fact, with Hydrogen getting unprecedented interest and investors' interest, Global Hydrogen revolution has already been initiated and banking and Investors circles are viewing this as the next big investment opportunity. BofA security Analyst reports compared investments opportunities in Hydrogen to be at par to Internet pre.dot.com in nineties and Smartphone revolution before 2007. It mentions that Hydrogen would account for 24 percent of world' power use by 2050 and sees three main drivers behind the growth of industry- falling costs of green hydrogen, new technologies and government incentives to promote decarbonisation.

CNBC supplements that, after decades of false starts, hydrogen technology is poised to take off as falling production costs, technological improvements, and a global push toward sustainability converge and refers to same report that this will generate $2.5 trillion in direct revenue- or $4 trillion of revenue from associated products such as fuel cell vehicles is counted — with the total market potential reaching $11 trillion by 2050.

India recognises Green Hydrogen as the future of the world and very recently announced the setting up of the National Hydrogen Mission to define compete Hydrogen Road map with the ambitious aim to becoming the new global hub of Green Hydrogen, and largest exporter. With India achieving one of world' lowest costs of Renewable energy particularly

contd/-

Hydrogen Promise – where we are heading to……(Contd/-)

solar around US$ 27-30/MW, and ~200 GW of Renewable Power production in 2022, is well placed to achieve status of low-cost producer of Green Hydrogen. Subject to availability of cost-effective technologies and process equipment, and right regulatory framework it can achieve its targets in appropriate time. It has already started working in the direction by setting up numbers of 'Centres of Excellences' with leading Technical Institutes, Research Centres and Corporates as well as tens of companies entering collaborations with leading world players in hydrogen.

Britain just few days back launched its first ever Hydrogen Strategy that spelled out 10-point program to lay foundation to target for 5 GW of low carbon production by 2030 and which could achieve about 25% of all energy from Hydrogen in UK.

Similarly European Commission wants to make the EU as the pioneer in the use of hydrogen as an energy carrier when it presented "A Hydrogen Strategy for a Climate-Neutral Europe", says hydrogen is the key to achieve European Green Deal and Europe' Clean energy transition. It is considered as a technology that can bridge the gap between energy from renewable sources and its goal of decarbonising large part of EU energy consumption by 2050. So, setting the tone towards this, it took the first step on 8th July 2020 to define as to how green hydrogen to be used toward decarbonisation, its energy transition and defining framework for a Hydrogen Market in Europe.

Canada, US, and Japan are way ahead in their national approach on Hydrogen and its entire ecosystem with private sector actively exploring the futures of Hydrogen more focussed on production processes, storage and transportation and the momentum exists along the entire value chain and is accelerating cost reductions for hydrogen production, transmission, distribution, retail, and end applications.

At this moment case for hydrogen is more compelling from environmental than economic considerations, but as Hydrogen has already been taken up as the global environmental project, bringing down the cost of production of Green Hydrogen for consumers would be the key to its worldwide adaptation and use leading to quicker net zero targets. There are various assumptions by the experts but the Tipping point for Hydrogen use is when it's possible to achieve price parity with fossil energy that lies anywhere between US$ 2-4 per kg of pure Green Hydrogen according to various experts and analysts. though US$ 2/kg is thought of as the tipping point for Hydrogen market to commercially explode.

contd/-

Hydrogen Promise – where we are heading to……(Contd/-)

To optimising existing infrastructure for renewable enegy can play a direct role in reducing hydrogen costs. The cost of producing green hydrogen is largely dependent on the cost of the renewable energy used to create it. Electricity storage is a constant challenge in solar and wind production, even with the advent of more sophisticated battery storage. Rather than curtailing assets during periods where electricity generation exceeds demand, this green electricity could instead be rerouted into hydrogen production. Essentially, this would provide a free source of electricity that dramatically reduces the costs. This is best suited to Indian scenario.

In its drive for Industry to work full hog to achieve lower cost driven consumer acceptance for hydrogen, EU clearly points out that the key would be regulatory support schemes for some initial time to enable. renewable / green hydrogen to become cost effective on the envisaged scale. EU is proposing ETS which shall be interesting resumption of Carbon Trading, a big boost towards incentivizing Hydrogen in tackling climate change and its mitigation.

Governments have big role to play in pushing Hydrogen ecosystem through strong government resolve and commitment for decarbonization backed by financial support, regulation and clear hydrogen policy, strategy & targets - has started unprecedented momentum in the industry. This momentum needs to be sustained and the long-term regulatory framework set.

Governments should prepare Industrywide user and deployment policy of low carbon hydrogen – be it for Steel, Fertiliser or Marine. Hydrogen Council document suggests that one place to support deployment is the development of clusters with large-scale hydrogen off takers at their core. These will drive scale through the equipment value chain and reduce the cost of hydrogen production. By combining multiple off takers, suppliers can share both investments and risks while establishing positive reinforcing loops. Other smaller hydrogen off takers in the vicinity of such clusters can then piggy-back on the lower-cost hydrogen supply, making their operations breakeven faster. Several cluster types gaining traction, including Port areas for fuel bunkering, port logistics, and transportation, Industrial centres that support refining, power generation, and fertilizer and steel production and Export hubs in resource-rich countries.

Successful clusters will likely involve players along the entire value chain to optimize costs,

contd/-

tap into multiple revenue streams and maximize the utilization of shared assets. They should be open to additional players and infrastructure should allow for ready access where possible.

One such cluster of green hydrogen 'leaders' unite to drive 50-fold scale-up in six years, - Green Car Congress mentions in one of their paper. World's biggest green hydrogen project developers and partners come together to launch Green Hydrogen Catapult Initiative that aims to drive down costs to below $2 per kilogram, to transform energy across most carbon intensive industries, accelerating race to zero emissions. The new "Green Hydrogen Catapult" initiative will see green hydrogen industry leaders target the deployment of 25 gigawatts through 2026 of renewables-based hydrogen production, with a view to halve the current cost of hydrogen to below US$2 per kilogram.

Hydrogen Industry Cluster (Waterstof Industrie Cluster or WIC) grew to over 70 players with 12 new members. The WIC is an industrial partnership in the field of hydrogen. The cluster brings together companies, authorities and knowledge institutions that cooperate on hydrogen. Big players like Solvay, Alstom, Capgemini are few to name few.

To wrap up, just to say that the next few years will be decisive for the development of the hydrogen ecosystem, for achieving the energy transition and for attaining the decarbonization objective. It's seen, progress over the past years has been impressive, with unprecedented momentum. But much lies ahead. The time is right to tap into hydrogen's potential to play a key role in a clean, secure, and affordable energy, Hydrogen can help tackle various critical energy challenges. Hydrogen can enable renewables to provide an even greater contribution.

Global companies are committed to deploying hydrogen as a critical part of the solution to the climate challenge but International co-operation in Hydrogen is vital to accelerate the growth of versatile, clean hydrogen around the world.

AUTHOR
Mr. Umesh Sahdev, Executive Chairman, Hydrogenium Resources Pvt Ltd.

contd/-

ORGANISERS

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

INTERNATIONAL CLIMATE SUMMIT 2021

PARTNER COUNTRY
NORWAY

Norwegian Embassy
New Delhi

Innovation Norway

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | A PHYSICAL & VIRTUAL SUMMIT

SUMMIT PROGRAMME

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

SWACHH BHARAT NEELA AKASH — CONQUERING GREEN FRONTIERS

PHDCCI ENVIRONMENT COMMITTEE

03 SEPTEMBER 2021 | NEW DELHI

INAUGURAL/ OPENING SESSION

PHYSICAL & VIRTUAL SESSIONS

INDIAN STANDARD TIME

9:00 - 10:00 HRS. — **ASSEMBLY/ REGISTRATION**

10:00 - 13:00 HRS. — **INAUGURAL/ OPENING SESSION (HYBRID MODE)**

Arrival of Chief Guest	Lamp Lighting & Ganesh Vandana
Presidential Address	**Shri. Sanjay Aggarwal** President, PHDCCI
Theme Address	**Dr. J. P. Gupta** Summit Chair, International Climate Summit
Address by the Chief Guest • Release of Knowledge Book "Self-Reliant India harnessing the power of hydrogen" by Dr. Karen Landmark, Dr. J. P. Gupta, et al. • Launch of National Hydrogen Portal www.greenhydrogen-india.com	**Shri Narendra Modi*** Hon'ble Prime Minister of India
Special Address India's Commitments towards UN Sustainability - Goal - 17	**Shri Bhupender Yadav** Hon'ble Minister of Environment, Forest and Climate Change and Labour and Employment, Govt. of India
Special Address National Hydrogen Energy Mission	**Shri Raj Kumar Singh*** Hon'ble Minister of Power and New & Renewable Energy, Govt. of India
Keynote Speaker National Hydrogen Energy Mission	**Dr. Jitendra Singh** Hon'ble Union Minister of State (IC) Science & Technology, Govt. of India
Special Address	**Ms. Tina Bru** Minister of Petroleum and Energy Govt. of Norway
Keynote Address	**H.E. Mr. Hans Jacob Frydenlund** Royal Norwegian Embassy in India
Blue Hydrogen as an enabler to the Green Hydrogen Economy	**Dr. V. K. Saraswat** Member (Energy), NITI Aayog
Keynote Address	**Mr. Deepak Bagla** Managing Director & CEO Invest India

***To be confirmed**

INAUGURAL/ OPENING SESSION

INDIAN STANDARD TIME

10:00 - 13:00 HRS	**INAUGURAL/ OPENING SESSION (HYBRID MODE)** *contd/-*	
	Keynote Address	**Shri Mukesh Dhirubhai Ambani** Chairman & MD, Reliance Industries Limited
	Is the Golden Age of Hydrogen Coming?	**Mr. Nobuo Tanaka** Special Advisor, The Sasakawa Peace Foundation (SPF) Tokyo, Japan; Former Executive Director, International Energy Agency (IEA)
	Challenges and Solutions in introducing Hydrogen Energy	**Mr. Sturle Harald Pedersen** Chairman Greenstat India, Norway
	Felicitation & Conferring of Award	**Shri. Gopal Krishan Agarwal** President, Jaladhikar Foundation
	Keynote Address	**Mr. Cristian Valdes Carter** Director, Innovation Norway India
	Vote of Thanks	**Shri. Pradeep Multani** Sr. Vice President, PHDCCI
13:00-14:00 HRS		**LUNCH BREAK**
	VIRTUAL SESSIONS	
14:00-16:00 HRS	**SESSION 01**	International Alliances and Coalitions
14:00-16:30 HRS	**SESSION 02**	International, Private Sector Funding and Green Bond Market
14:00-18:30 HRS	**SESSION 03**	MAKE IN INDIA A. Policy Regulations B. Fuel Cell and Hydrogen in Transportation C. Hydrogen Storage
14:00-18:30 HRS	**SESSION 04**	A. Hydrogen Production Technologies B. Setting up Centres of Excellence in Hydrogen (CoE-H2)
14:00-18:30 HRS	**SESSION 05**	A. Ecology, Agriculture & Climate Change Mitigation B. Role of Hydrogen for a Carbon Neutral Ladakh

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021
WWW.ICS-HYDROGEN.COM

Session - 01

14:00 - 16:00 HRS (IST)
VIRTUAL MODE

International Alliances and Coalitions

International alliances and coalitions are important to meet the ambitious deployment of hydrogen technologies by 2040 / 2050, bringing together renewable and low-carbon hydrogen production, demand in industry, mobility and other sectors, and hydrogen.

With such alliances, India can build its hydrogen leadership similar to the International Solar Alliance for carbon neutrality. Global energy and other industrial firms led by Indian private-sector conglomerate Reliance Industries (RIL) and US-based engineering company Chart Industries have already formed an energy transition coalition - the India H2 Alliance (IH2A) - to commercialize hydrogen technology and systems that will help develop a netzero carbon pathway in India.

The session will focus on cooperative efforts that will help provide solutions for storing and transporting pressurized and liquefied hydrogen, in order to build a hydrogen economy and supply chain in India. It will also explore possibilities in blue and green hydrogen production & storage; transport powered by hydrogen fuel cells & other heavy duty transportation; hydrogen-use clusters including industrial clusters - specifically for steel, refineries, fertilizers, cement, ports and logistics.

KEYNOTE SPEAKER:
Prof. K. Vijay Raghavan
Principal Scientific Advisor
Govt. of India

Moderator

Sturle Harald Pedersen
Chairman, Greenstat India, Norway

Speakers

Anurag Pandey
India H2 Alliance (IH2A) Co-Lead; R&D Team Lead
Reliance Industries Limited, India

Deepesh Nanda
Chief Executive Officer
GE Gas Power South Asia

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

Ms. Ravneet Mann
Vice President
Invest India

Kowtham Raj VS
Fellow,
World Energy Council

Alberto Di Lullo
Senior Knowledge Owner
Advanced Engineering System and troubleshooting, Eni S.p.A

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | NEW DELHI

Session - 02

14:00 - 16:30 HRS (IST) | VIRTUAL MODE

International, Private Sector Funding and Green Bond Market

Countries globally work for their high GDP for accelerated economic growth. At the same time, countries need to discharge their climate mitigation obligations. In this regard, it is important to consider the vital role of finance. Funding will always be a key driver to put new low carbon technologies in place.

In this session panelists will share viewpoints from a multilateral, government and public finance, as well as private sector investor perspective.

KEYNOTE SPEAKER:
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

Moderator

Rajnish Kumar
Former Chairman,
State Bank Of India

Speakers

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

Dr. Sunita Satyapal
Director, Hydrogen and Fuel Cell Technologies Office, Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

Surbhi Goyal
Senior Energy Specialist
World Bank

Takeo KONISHI
Country Director, India Resident Mission (INRM) - Asian Development Bank (ADB), New Delhi

Kailash Vasvani
President, Corporate Finance
Renew Power, New Delhi

Neeraj Gupta
CFO,
ACME Solar

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

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021
WWW.ICS-HYDROGEN.COM

Session - 03

14:00 - 15:30 HRS (IST)
VIRTUAL MODE

MAKE IN INDIA

A. Hydrogen Production Technologies

Currently, over 95% of hydrogen is produced from hydrocarbons and about 4% is produced through electrolysis of water. Hydrogen is also produced as a byproduct in chloralkali industries. There are several other methods to produce hydrogen that are at different stages of research and demonstration. These methods include hydrogen production through:

a) Biomass and biological route
b) Photo electrochemical route
c) Thermo-chemical decomposition of water using nuclear energy or solar energy
d) Electrolysis using renewable energy (solar, wind)

Globally, there is increasing trend toward climate mitigation and increasing concern with associated issues of air pollution. In this context hydrogen offers compelling benefits. It supports a gradual transition towards lower-carbon sources of energy as it can be generated from natural gas. And the other is by nonrenewable by-products. Demand for hydrogen production technologies is rising given its potential to accelerate the transition to more sustainable forms of energy.

This session will discuss various elements of hydrogen production technologies, cost aspects including hydrogen value chain from source to service.

KEYNOTE SPEAKER:
Ms. Prerna Soni
Vice President, Invest India
Topic: 'Make in India' to augment opportunities in Green Hydrogen

Moderator

Prof. S. Dasappa
IISc Bangalore, India

Speakers

Dr. Ashish Lele
Director, National Chemical Laboratory, Pune, India

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

Dr. SSV Ramakumar
Director (R&D),
IOCL, India

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

Rajat Seksaria
CEO,
ACME Solar

Bjørn Holsen
Senior Vice President,
Head of New Business
Statkraft

Dr. Desikan Sundararajan
Managing Director – India,
Equinor

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | WWW.ICS-HYDROGEN.COM

Session - 04

14:00 - 16:00 HRS (IST)

VIRTUAL MODE

SWACHH BHARAT NEELA AKASH

CONQUERING GREEN FRONTIERS

PHDCCI ENVIRONMENT COMMITTEE

A. Policy Regulations

Developing a framework for policies, regulations and safety standards

Hydrogen's potential as a clean fuel, energy storage medium and renewable energy enabler has captured the attention of energy sector players, governments, environmental advocacy groups, and users. Given that hydrogen development is at its nascent stage and there remains a lot of uncertainty surrounding its safety, it is pertinent and important to deliberate and understand the legal and regulatory requirements, investment cases, financing structures, operational requirements, revenue stream, sharing and other elements that need to be considered to formulate an effective acceptable commercialization model. A gradual transition with adequate policy and safety standards will help build confidence among stakeholders and provide a conducive environment for a Hydrogen based economy.

KEYNOTE SPEAKER:

Mats Rinaldo
Principal Researcher &
Deputy Programme Director
DNV, Norway

Moderator

Ajay Shankar
Distinguished Fellow,
TERI

Speakers

S. C. Gupta
Joint Advisor,
Petroleum and Natural Gas
Regulatory Board (PNGRB)

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

P. K. Banerjee
Executive Director
Society of Indian
Automobile Manufacturers, India

Anshu Bhardwaj
CEO
Shakti Sustainable
Energy Foundation, India

Dipesh Pherwani
Scientific Officer
Ministry of New and Renewable
Energy, India

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | WWW.ICS-HYDROGEN.COM

Session - 05

14:00 - 16:00 HRS (IST)

VIRTUAL MODE

SWACHH BHARAT NEELA AKASH

CONQUERING GREEN FRONTIERS

PHDCCI ENVIRONMENT COMMITTEE

A. Ecology, Agriculture & Climate Change Mitigation

In the past few decades, there has been a growing realization about the importance of living in harmony with nature. Today, there is a greater need for ecological principles to be implemented in our civic actions.

Population growth has been putting undue stress on our natural systems which have supported humanity for a long time. Now is the time for ecologizing economy, in order to save the earth from environmental degradation and the catastrophic effects of climate change.

India's agricultural sector faces grave challenges of climate change and the impact is likely to continue in the form of dry spells, heat waves and erratic rainfall. Climate induced temperature & rainfall variations and the frequency and intensity of extreme weather events are adding to pressures on global agricultural and food systems. Climate change is expected to negatively affect both crop and livestock production systems in most regions, although some countries may actually benefit from the changing conditions. The changing climate is also adding to resource problems, such as water scarcity, pollution and soil degradation.

In this session experts will discuss the impact of changing climatic conditions on crops, livestock & seafood, and the importance of ecology for a sustainable economy and overall wellbeing of society.

KEYNOTE SPEAKER:

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

Moderator

Dr. Rakesh Kumar
Director, CSIR

Speakers

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 wellbeing economy and society*

Prof. Ashutosh Sharma
Secretary, Department of Science and Technology, India

Dr. Adrian Percy
UPL, USA
Topic: *The role of agriculture in mitigating the effects of climate change*

Dhruv Sawhney
Business Head & COO, Nurture Farm
Topic: *Scaling and Solving for Sustainable Agriculture*

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | WWW.ICS-HYDROGEN.COM

SWACHH BHARAT NEELA AKASH — CONQUERING GREEN FRONTIERS

PHDCCI ENVIRONMENT COMMITTEE

Session - 03

16:00 - 17:30 HRS (IST)

VIRTUAL MODE

MAKE IN INDIA

B. Fuel Cell and Hydrogen in Transportation

Hydrogen has the potential to play a significant role the transportation sector. IEA estimates while batteries are seen as a viable technology for passenger vehicles, as seen through the uptake of EVs globally, hydrogen-based mobility is a complimentary option. Hydrogen can have a wide range of transport sector application that include local public passenger transport, heavy-duty road transport and commercial vehicles, as well as in marine, rail, and possibly, even in aviation. However, challenges are many that include reducing delivery cost, increasing energy efficiency, maintaining purity, and leakages. Hence a number of important challenges must need to be overcome if it has to make a major energy contribution in the transport sector.

The esteemed panelists of the session will discuss and take forward the session theme.

KEYNOTE SPEAKER:

Bernt Skeie
CEO, Prototech
Norway

Moderator

Shri Prakash
Distinguished Fellow,
Transport & Urban Governance,
TERI, India

Speakers

Vikram Gulati
Senior Vice President
Toyota Kirloskar Motors (KTM)

Davide Cirelli
Country Manager & CEO
Snam India, Snam S.p.A

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

Sanjay Khatri
Country Head-
Corporate and Government Affairs,
Bosch

Mohit Bhargava
Executive Director,
NTPC Limited

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

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | WWW.ICS-HYDROGEN.COM

Session - 03

17:30 - 18:30 HRS (IST)

VIRTUAL MODE

SWACHH BHARAT NEELA AKASH

CONQUERING GREEN FRONTIERS

PHDCCI ENVIRONMENT COMMITTEE

MAKE IN INDIA

C. Hydrogen Storage

Hydrogen storage is a key enabling technology. None of the current technologies satisfies all the hydrogen storage attributes sought by manufacturers and end users. On this front, Government-Industry coordination on research and development is needed to lower the costs, improve performance, and develop advanced materials. Once produced, hydrogen can be in the form of a compressed gas, cryogenic liquid or chemical, each requiring specific methods of storage essential to successful distribution. The unusual physical characteristics of hydrogen present particular problems with regard to its storage. A number of methods have already been outlined. Some amplification is necessary e.g. pressurized hydrogen gas storage involves two major methods of containment.

- metal tanks using iron or iron compounds as materials of construction
- natural containers including depleted oil and gas fields, mines caverns and aquifers

Salt caverns are used for storage of natural gas in many parts of the world. Cryogenic liquid hydrogen storage may not be practical, at present, due to high energy consumption required for the liquefaction process. Exploring higher-risk storage technologies involving advanced materials such as lightweight metal hydrides and carbon nanotubes, etc. is imperative.

The panelists of this session will share insights into the latest developments for hydrogen storage and challenges.

KEYNOTE SPEAKER:

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

Moderator

Dr. N. Rajalakshmi
Senior Scientist & Head
Centre for Fuel Cell Technology
ARCI, IIT Madras Research Park
India

Speakers

Prof. Jayant K. Singh
Professor
IIT Kanpur, India

Dr. T. P. Yadav
Scientist
BHU, India

Ravindra Vasisht
Regional Director - India
Hexagon Agility India

James Collins
Head-Investor Relations,
ITM Power

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | WWW.ICS-HYDROGEN.COM

Session - 04

16:30 - 18:30 HRS (IST)

VIRTUAL MODE

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

B. Setting up of Centres of Excellence in Hydrogen (CoE - H2)

There is a shortage of qualified engineers who can install, monitor, operate and maintain integrated fuel-cells and hydrogen systems. Centres of Excellence (CoE) are the need of the hour in order to have capacity building in the entire value chain in hydrogen.

CoE-H2 will be a collaborative hydrogen competence center established by joint efforts between Government institutions and agencies, industry, research institutions and academia from both Norway and India.

KEYNOTE SPEAKER:
Cristian Valdes Carter
Director
Innovation Norway
India

Moderator

Ambassador Ajai Malhotra
Distinguished Fellow,
TERI

Speakers

Eli Aamot
Executive Vice President
SINTEF

Dr. Scott Davis
President
Gexcon US

Prof. Jan Roar Bakke
Executive Vice President
Process Safety, Gexcon AS,
Norway

Umesh Sahdev
Executive Chairman
Hydrogenium Resources Private
Limited

INTERNATIONAL CLIMATE SUMMIT 2021

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | WWW.ICS-HYDROGEN.COM

Session - 05

16:30 - 18:30 HRS (IST)

VIRTUAL MODE

SWACHH BHARAT NEELA AKASH

CONQUERING GREEN FRONTIERS

PHDCCI ENVIRONMENT COMMITTEE

B. Role of Hydrogen for a Carbon Neutral Ladakh

Ladakh is a mountainous region and a Union Territory (UT) in the north India, in the area known as the Trans-Himalaya. Leh is the largest urban zone having a population of 30,870 (census 2011). Compared to the national average of 69% Ladakh has a significantly higher share of the rural population of 89%. Nearly 58% of the total population depends on agriculture indicating that the region agriculture provides the main source of the livelihoods. With growing economic activities energy demand too will increase in the form of electricity and transportation fuels. Because of the absence of renewables, to cater to the increasing demand for fuels, the dependence on fossil fuels will rise which will not only increase local pollution in the form of particulate matter emission that can pose serious health impacts, it also leads to CO2 emission, the primary cause of global warming.

Hydrogen can prove to be game changer. It has the potential to find its environmental benefits in sectors and application like power generation, transportation and indoor heating in commercial and residential sector. Use of Green hydrogen that is produced locally can be promising sustainable source of energy in Ladakh. Local production of Hydrogen will significantly reduce the transportation fuel cost while reducing emissions.

Moderator

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

Speakers

Jamyang Tsering Namgyal
Member of Parliament
UT of Ladakh

Sonam Wangchuk
Founding Member,
Himalayan Institute of Alternatives

Souvik Bhattacharjya
Associate Director
TERI, India

Dr. Pankaj Agarwal
CEO,
Panitek Power AG

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

ORGANISERS

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

INTERNATIONAL CLIMATE SUMMIT 2021

PARTNER COUNTRY
NORWAY

Norwegian Embassy
New Delhi

Innovation Norway

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | A PHYSICAL & VIRTUAL SUMMIT

KEYNOTE SPEAKER & MODERATOR'S PROFILE

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

Ms. Tina Bru

Minister of Petroleum and Energy, Govt. of Norway

Ms. Tina Bru was appointed Minister of Petroleum and Energy on 24 January 2020. Bru is a member of the Norwegian parliament (Stortinget) for the Conservative Party (Høyre) from Rogaland county (elected 2013 and 2017). Until her appointment, Bru was a member of the parliament's Standing Committee on Energy and the Environment. Bru is married, has one child and lives in Stavanger.

H.E. Mr. Hans Jacob Frydenlund

Norway Ambassador to India

Hans Jacob Frydenlund is presently the Norwegian Ambassador to India. Prior to this, he was Director for UN Policy in the Norwegian Ministry of Foreign Affairs. Frydenlund has served in Chile, at the Norwegian Mission to the European Union in Brussels, at the Norwegian Mission to the United Nations in New York and has been Norwegian Representative to the Palestinian Authority. He has worked for thirteen years in different capacities with conflict resolution in Africa. He has also served as the Press Spokesperson for International Development in the Ministry of Foreign Affairs. Frydenlund was born in 1959, is an economist by education, is married and has three grown-up children.

Dr. V. K. Saraswat

Member, Niti Aayog & Chancellor, Jawaharlal Nehru University

Dr. Vijay Kumar Saraswat is a distinguished scientist with vast experience in defence research—in both basic and applied sciences—spanning several decades. He retired as Secretary, Defence Research and Development Organisation (DRDO), after more than four decades of government service. He holds a PhD from Osmania University and an ME degree from Indian Institute of Science, Bengaluru.

Prof. K. Vijay Raghavan

Principal Scientific Advisor, Govt. of India

Prof K. Vijay Raghavan is a distinguished professor in the field of developmental genetics and former director of the National Centre of Biological Sciences. His fields of specialization are developmental biology, genetics, and neurogenetics.

Mukesh Ambani

Chairman and MD, Reliance Industries Limited

Mr. Mukesh D. Ambani is a Chemical Engineer from the Institute of Chemical Technology, Mumbai (erstwhile the University Department of Chemical Technology, University of Mumbai). He pursued an MBA from Stanford University in the US. He has been on the Board of Reliance since 1977. He initiated Reliance's backward integration journey – from textiles to polyester fibres and further onto petrochemicals and petroleum refining, and going upstream into oil and gas exploration and production. He created multiple new world-class manufacturing facilities involving diverse technologies that have raised Reliance's petrochemicals manufacturing capacities from less than a million tonnes to about 21 million tonnes per year.

Nobuo Tanaka

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

Degree in Economics, University of Tokyo; MBA, Case Western Reserve University, Cleveland, US. 1973, with Ministry of Economy, Trade and Industry (METI), Tokyo; 1989, Deputy Director then 1992, Director, Directorate for Science, Technology and Industry, OECD; 1995, rejoined METI including: Director-General, Multilateral Trade System Department, Trade Policy Bureau, led many trade negotiations with World Trade Organization, worked on formulating international strategy and coordinating domestic environment policy and energy policy in Kyoto COP 3 negotiation; 1998-2000, Minister for Industry, Trade and Energy, Embassy of Japan, Washington DC; Director, Science, Technology and Industry, OECD; 2007-11, Executive Director, International Energy Agency (IEA); since 2011 Global Associate for Energy Security and Sustainability, Institute of Energy Economics Japan (IEEJ).

Håkon Haugli, *CEO, Innovation Norway*

Håkon Haugli is the CEO of Innovation Norway, the government's most important instrument for innovation and development of Norwegian enterprises and industry. Prior to joining Innovation Norway in May 2019 he was the Managing Director of Abelia, the business association for Norwegian knowledge and technology based enterprises. The association is part of the Norwegian Confederation of Enterprise (NHO).

Deepak Bagla, *MD & CEO, Invest India*

Mr. Deepak Bagla has a professional career of over three decades, with the World Bank, Citibank, and Private Equity having responsibilities across Europe, Africa and Asia. He is currently the Managing Director and CEO of Invest India, the National Investment Promotion and Facilitation Agency promoted by the Government of India. Invest India is also the execution agency for Start-up India and the Prime Minister's Science and Technology initiative.

Sturle Harald Pedersen, *Chairman, Greenstat India, Norway*

Experienced Chief Executive Officer with more than 30 years of global experience in leading successful businesses initiatives and ventures through conceptualizing ideas and seizing opportunities. Extensive experience of initiating and leading international government negotiations, mergers and acquisitions, as well as securing funding and strategic partnership with global industry leaders.

Jillian Evanko, *President and CEO, Chart Industries*

Jillian Evanko is President and Chief Executive Officer of Chart Industries, Inc. (NYSE: GTLS), serving in this capacity since June of 2018. Ms. Evanko joined Chart in February of 2017 as Chief Financial Officer. Prior to joining Chart, Jill was the Chief Financial Officer of Truck-Lite Co., LLC as well as having held multiple operational and financial executive positions at Dover Corporation (NYSE: DOV) and its subsidiaries. Prior to joining Dover in 2004, Ms. Evanko held financial and operational roles at Arthur Andersen, LLP, Honeywell Corporation and Sony Corporation. In addition to serving on Chart's Board of Directors, Ms. Evanko also serves as an independent director of the Board of Parker Hannifin Corporation (NYSE: PH).

Rajnish Kumar, *Former Chairman, State Bank of India*

Rajnish Kumar was the Chairman of India's largest lender, State Bank of India. Previously, Mr Rajnish Kumar was the Managing Director (National Banking Group) looking after Retail Banking and initiatives in Payments and Digital Banking since November 2015. Prior to becoming Managing Director in SBI, Mr Rajnish Kumar was heading SBI Capital Markets Limited (the Merchant Banking arm of State Bank of India) as Managing Director & Chief Executive Officer.

Prof. Dr. Arthur Riedacker, *Honorary Professor, INRA, France*

"Co-Nobel Peace prize winner 2007 with IPCC Honorary Professor, Scientist at INRA (French National Agronomical Research Institute) from 1968 up to 2006, first in the Department of Forestry and later on in the Department of Economics and Sociology.Responsible of the Priority cross cutting program "From forest to final use of wood" (bioenergy, buildings, and raw material), at AFME (French Agency for Energy Management , now ADEME), between 1982 and 1987"

Ambassador Ajai Malhotra, *Dist. Fellow & Sr. Advisor (Climate Change), Project Management Unit, TERI*

Ambassador Ajai Malhotra is a Distinguished Fellow with TERI since April 2014. He is also presently an Independent Director of the Oil and Natural Gas Corporation, as well as Chairman and Managing Trustee of CHIKITSA and SHIKSHA (which provide free primary health care, education and vocational training to the underprivileged), Chairman of the Nehru Trust for the Indian Collections at the Victoria & Albert Museum, Chairman of the NAB Centre for Blind Women and Disability Studies, and Member of the Editorial Board of "World Economy and International Relations" ("MEMO Journal") brought out by the Institute of World Economy and International Relations, Moscow.

Prof. S. Dasappa , *Professor,IISc Bangalore*

Professor S Dasappa, Indian Institute of Science, Bangalore, India Professor Dasappa is currently the Chair of ICER and at Centre for Sustainable Technologies. His major area of research is in combustion of solid, liquid and gaseous fuels. With the emphasis on energy conversion processes, the R and D activities address both scientific and technological challenges. The research outputs have contributed towards engineering domain addressing – “Process to Product philosophy” including sustainability through the translational research. He has been involved in technology transfers across the globe.

Bernt Skeie, *CEO, Prototech AS*

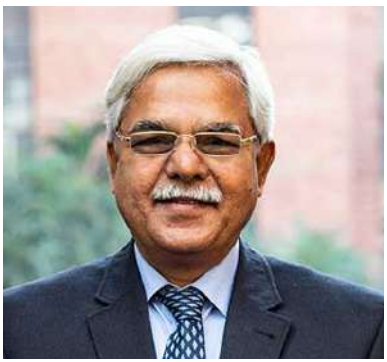
Experienced chief executive with large personal network towards renewable energy, clean tech, finance and R&D. Key role in establishing and developing innovative companies, clusters and catapults in Norway and very familiar with funding schemes both nationally and in the EU. Skeie has line management experience from Technology development, Renewable energy, Oil Services and Top Tier consulting firms. Current responsibilities include identifying, financing, planning and delivering international research and development projects within Space and Ocean Space.

Dr. Rakesh Kumar, *Director, CSIR*

Dr. Rakesh Kumar, Director, Council of Industrial and Scientific Research (CSIR) Former Director- CSIR-National Environmental Engineering Research Institute (CSIR-NEERI) After acquiring basic qualification of Environment Science and Engineering from IIT Bombay in 1987, pursued work on developing technologies for automobile pollution control in Paramount PCL as Environment Engineer which also led to Ph.D. in Environment Engineering.

Dr. Akira Yabe, *Director General, Energy System & Hyrogen Unit, Technology Strategy Centre (TSC), (NEDO), Japan*

Dr. Akira Yabe, Before entering NEDO as a Director General of Technology Strategy Center for Energy System & Hydrogen Units in April 2015, Mr. Yabe had been a Vice-President of AIST for 7 years as a Director General for Environment and Energy Research Fields. He completed his PhD in Mechanical Science and Engineering, Tokyo Institute of Technology at 1979 and joined the Mechanical Engineering Laboratory (MEL) of the Ministry of International Trade and Industry (MITI).



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

Rajani Ranjan Rashmi is a former member of Indian Administrative Service (1983) batch. He was India's principal negotiator for climate change negotiations under the UN Framework Convention on Climate Change for several years and has been part of climate change policy-making in India in the run-up to and after the Paris Agreement. As Special Secretary in the Ministry of Environment, Forest & Climate Change in the Government of India, he has been closely associated with formulation and implementation of policies relating to Climate Change, Pollution, Montreal Protocol on ODS, and Environmental Clearances, besides being the Project Director of Green India Mission.

Shri Prakash, *Distinguished Fellow, TERI*

Shri Prakash joined TERI in July 2011 as Distinguished Fellow, after a long and distinguished career in Indian Railways. His association with TERI goes back to 2003-2004 as a Visiting Senior Fellow. For over 9 years he is guiding research in sustainable transport policies in Centre for Research in Sustainable Mobility in TERI.

Dr. N. Rajalakshmi, *Senior Scientist & Head, ARCI*

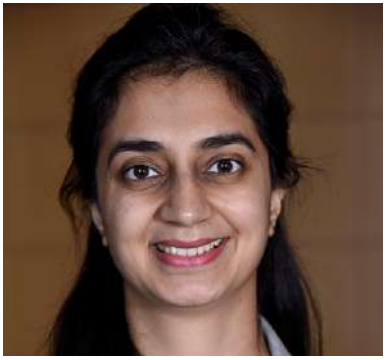
Dr. N. Rajalakshmi has chaired many sessions and given invited talks in various International conferences on Fuel cell science, Engineering technology, Gordon Research Conference on Fuel cells, Society of Automobile Engineers etc., in India and Abroad. She is a reviewer for many journals related to Hydrogen and / Fuel cells.

Cristian Valdes Carter, *Country Director, Innovation Norway India*

Cristian Valdes Carter is the Director of Innovation Norway in India and Commercial Counsellor at the Royal Norwegian Embassy in New Delhi. Mr. Carter has held various leadership roles and board positions in both privately held companies and public-private partnerships and comes with broad experience from the Norwegian business community. His career expands over several industries including Fisheries, Smart Cities, Tourism, Transport & Communications, Port Developments, Offshore Energy and Subsea. Mr. Carter holds a master's degree in Law from the University of Bergen and an Executive Programme in Innovation & Transition Leadership from the Norwegian School of Economics (NHH Executive). He has also completed the AFF Solstrand program for Young Leaders.

Ajay Shankar, *Distinguished Fellow, TERI*

Ajay Shankar is a Distinguished Fellow at TERI. He has rich and varied experience in public service for over forty years as a member of the Indian Administrative Service. He has served in the Government of India in key policy making positions in the areas of industry and energy. He has been Secretary, DIPP (Department of Industrial, Policy and Promotion) in the Government of India as well as Member Secretary, NMCC (National Manufacturing Competitiveness Council).



Prerna Soni, *Vice President, Invest India*

Prerna Soni holds over a decade of experience in Financial Services including Infrastructure Financing and Treasury. Currently, Prerna Co-Leads the Financial Investors Initiative, Infrastructure, Real Estate and Energy verticals at Invest India, the National Investment Promotion and Facilitation Agency of India. Her focus at Invest India has been on attracting institutional investors such as Sovereign Wealth Funds, Pension Funds and Private Equity to invest in India. Prerna contributed to India's first asset recycling project which saw investments of $1.5 Billion and has been working with Government and private entities across sectors to introduce new asset classes and create investment opportunities in the country including rolling stock PPP and opportunities in the distressed space amongst others.

Mats Rinaldo, *Principal Researcher & Deputy Programme Director, DNV, Norway*

Mats Rinaldo is deputy programme director and a principal researcher in DNV GL's Energy Transition Programme.

Mats holds a Master's degree in Sustainability Leadership from Cambridge University and a Master of Science in Marine Technology from Norwegian University of Science and Technology (NTNU) in Trondheim, Norway.

Mats has spent most of his professional career at DNV GL. His experience includes various positions within DNV GL's Maritime, Software, Business Assurance and Sustainability Business Areas, located in Australia, Japan and currently now in Oslo, Norway.

ORGANISERS

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

INTERNATIONAL CLIMATE SUMMIT 2021

PARTNER COUNTRY
NORWAY

Norwegian Embassy
New Delhi

Innovation Norway

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | A PHYSICAL & VIRTUAL SUMMIT

SPEAKER'S PROFILE

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

Dr. Adrian Percy, *Chief Technology Officer, UPL, USA*

Adrian currently serves as the CTO of UPL Ltd, a major crop protection company that is a leader in global food systems. He also serves as a Venture Partner at Finistere Ventures LLC, a technology and life sciences venture capital investor, focused on transforming the food value chain.

Previously, Adrian served as the head of research and development for the Crop Science division of Bayer as part of their executive committee. In this role, he had responsibility for internal and open innovation activities in the areas of crop protection chemistry and biologicals, as well as seeds and traits.

Dr. Anshu Bhardwaj, *CEO, Shakti Foundation*

Dr. Anshu Bharadwaj was a member of the Indian Administrative Services (IAS, 1992 batch, Karnataka cadre). He worked in the state government in various capacities. In 2007, he joined as Executive Director of Centre of Study of Science, Technology and Policy (CSTEP) and helped establish CSTEP as a leading technology policy Think Tank. He functioned as ED of CSTEP till 2020. He has expertise in technology and policy aspects of energy and environmental sectors. He is a member of several government committees in these areas.

Dr. Ashish Lele, *Director, National Chemical Laboratory*

Dr. Ashish Kishore Lele is an Indian chemical engineer, rheologist and the chief scientist at the National Chemical Laboratory, Pune. He is known for his researches on micro and mesostructure of polymers and is an elected fellow of the Indian Academy of Sciences, and the Indian National Academy of Engineering.

Anurag Pandey

Lead, R&T, Hydrogen Economy, Reliance Industries Limited

Currently, He leads R&T activities in Hydrogen Economy at RIL. Have close to two decades of S&T experience in various aspects of materials-and-process engineering, hydrogen-and-fuel cell technology, and alternate energy. Using scientific-analytical skills, I enjoy analysing technologies and their symbiotic relationship to draw important inferences, enabling him to find a holistic and sustainable solution using sound first principles, an important feature of his role in the VUCA world of alternate energy.

For the last 9–10 years, He has been ardently working on clean energy solutions, particularly, fuel-cell technology and the hydrogen economy, and have explored various aspects of hydrogen economy for its techno-commercial viability in detail. He wishes to contribute significantly to developing and establishing a renewable hydrogen economy so that as a country we can finally be energy secure. Look forward to a future where energy, the fundamental aspect of our lives, is available to everyone on-demand in the most affordable and sustainable way.

Prof. Ashutosh Sharma

Secretary, Department of Science & Technology

"Ashutosh Sharma is a Secretary to the Government of India since January 2015, heading the Department of Science and Technology (DST), where he helped initiate several new programs related to: infrastructure and human capacity building; innovation and startups; R&D in advanced manufacturing, waste processing, clean energy and cyber-physical systems; industry-academia cooperation; science communication; women scientists; and major international collaborations in the areas of priority for the nation.

Bjørn Holsen, *Senior Vice President, Head of New Business Statkraft*

Bjørn Holsen is responsible for business development and heads the New Business unit in Statkraft's European Wind and Solar business area.

Chintan Shah, *Director (Technical), IREDA*

Mr. Chintan Navinbhai Shah is currently working as Director (Technical) with M/s Indian Renewable Energy Development Agency Ltd. (IREDA) and handling different portfolios since 5th March, 2018 at IREDA. IREDA is primarily a Non-Banking Financial Company and the only dedicated financial institution for financing and promoting Renewable Energy and Energy Efficiency and Conservation Projects in the country.

Deepesh Nanda, *Chief Executive Officer, GE Gas Power South Asia*

Deepesh Nanda is the Chief Executive Officer for GE Gas Power in South Asia, responsible for GE's business in countries such as India, Bangladesh, Sri Lanka, Mauritius, and Nepal. At the Asia level, he leads strategic initiatives to providing highly efficient, reliable and fast powering solutions to the areas that need them the most.

Deepesh has more than two decades of experience in the Energy sector. Before starting his stint with GE, he served as Tyco Sanmar's Vice President & Business Manager from 2005 to 2010 and headed Flowserve's regional office from 2000 to 2005.

Dr. Desikan Sundararajan, *Managing Director – India, Equinor*

Dr. Desikan Sundararajan is the MD and Country Head for Equinor India. Desikan has several years of experience in research, technology and operations in Equinor's Oil and Gas and Renewables businesses in the US and Norway. Desikan has been an advisor on various climate and sustainability issues in the energy industry. He has served on the Advisory Committees for several US Department of Energy studies on climate and environment. In addition, he has served an editor and reviewer for reputed international scientific publications.

Dhruv Sawhney, *Business Head & COO, Nurture Farm*

Building Next Generation AgriTech platform to disrupt and innovate the end to end ecosystem for the original entrepreneurs and true magicians - the Farmers!

24+ years of professional experience in Technology led organisations having held leadership roles in Business, Product and Operations across E-commerce, Fin-Tech, Food-Tech and Ag-Tech. Has worked globally and brings extensive entrepreneurial experience as Founder and Business Head for WOTU/Hyperpure by Zomato- a B2B platform that significantly bridges the gap between farm to fork. Brings a strong focus on putting People and Organisation Culture first.

Dipesh Pherwani, *Scientific Officer, MNRE, Govt. of India*

Dipesh Pherwani is a Renewable Energy Specialist with 12 years' experience spanning national policy, technology programmes, projects, contracts, engineering, research and analysis | Searching for solutions to the Climate Conundrum | Tormented by an everlasting itch for all things unknown, backyard physicist, dabbling blogger, a story at each turn.

Eli Aamot, *Executive Vice President, SINTEF*

Experienced Executive Vice President with a demonstrated history of working in the research industry. Skilled in Petroleum, Gas, Occupational Health, Leadership, and Research and Development (R&D). Strong business development professional with a cand.scient focused in Analytical Chemistry from NTNU.

Prof. G. D. Yadav, *Emeritus Professor Eminence, Institute of Chemical Technology*

Prof. Ganapati Dadasaheb Yadav (born 14 September 1952) is an Indian chemical engineer, inventor and academic, known for his research on nanomaterials, gas absorption with chemical reaction and phase transfer catalysis. He served as the vice chancellor of the Institute of Chemical Technology, Mumbai (erstwhile UDCT) from 2009 until November 2019.He is currently the Emeritus Professor of Eminence at ICT Mumbai.

The Government of India awarded him the fourth highest civilian honour of the Padma Shri, in 2016, for his contributions to science and engineering.

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

Isabelle Laurent is the Deputy Treasurer and Head of Funding at the European Bank for Reconstruction and Development (EBRD). Isabelle spent 13 years in London and Hong Kong in treasury, fixed income origination, and swaps trading and marketing with Swiss Bank Corporation International, Nomura International and latterly at NatWest Markets where she was Director of Debt and Derivatives Marketing.

Dr. Jan Roar Bakke, *Executive VP, Gexcon AS, Norway*

Key qualifications

- Explosion and fire safety
- Process safety / technical safety
- Risk analysis

Experience (highlights)

- Chairman of Process Safety Subcommittee, Int. Organization of Oil and Gas Producers (IOGP)
- Project and operations support in Statoil as a safety technology specialist, incl. technical safety mentoring/ support to Peregrino Plant Integrity, Statoil Brazil

Prof. Jayant K Singh, *Professor, IIT Kanpur*

Prof. Jayant K Singh works in the area of material and bio molecular modeling, thermodynamics of complex fluids, machine learning, discovery of materials and speciality chemical/drugs. The group develop tools, algorithm and also work on product develop in the lab scale. Co-authored over 150 peer reviewed articles in the international journals of repute and few patents. Established supercomputing facility of IIT Kanpur along with other colleagues and has been the coordinator of the national super computing facility till 2020. In 2019, co-founded a company Prescience Insilico Pvt. Ltd. to create tools which can accelerate the discovery of drugs, materials and chemicals.

Kailash Vasvani, *President Corporate Finance, Renew Power*

Kailash Vasvani Experienced professional with a demonstrated history of working in the renewables and environment industry. Skilled in Fund Raising, Negotiation, Business Planning, Leveraged Finance, Asset Management, and Management. Strong finance professional with leadership training from Harvard Business School.

Dr. Karen Landmark

Chair of the Board
Greenstat Asia,
Norway

Experience in management and development of RD&I projects in the areas of renewable energy, corporate sustainability and circular economy. She holds a PhD in Sustainability Transitions and International Management and serves as the Chair of the Board (COB) of Greenstat AS.

Kowtham Raj VS

Fellow,
World Energy Council

Current Roles: Director New Initiatives, CES Ltd.
FEL fellow: World Energy Council.

Formerly, team member of Energy & International Cooperation team of NITI Aayog.
Lead Author: Green Hydrogen White Paper of NITI Aayog.

Kristian Eikeland Holmefjord

EVP & Project Director - Fuel Cells,
Corvus Energy

Specialist on marine fuel cell solutions, energy storage systems and power systems for zero and low-emission vessels.

Born and raised in Fusa, a small district between Hardanger and Bergen in Norway. I am very interested in how we can resolve the growing need for energy in a sustainable way. I like to stay active in my spare time by playing soccer, hiking, diving and skiing, as well as maintaining my old VW 1303s.

Neeraj Gupta

CFO, ACME Solar

Neeraj Gupta, is the Chief Finance Officer of ACME Solar and is part of the executive committee of the company. He has over 15 years of experience inequity capital markets, debt capital markets, mergers and acquisition and refinancing of projects and has spent about 5 years in the company. . He is responsible for equity raising, mergers & acquisitions and dollar bond placement for the Company. He has successfully raised approximately US$.... billion of equity from marquee investors, US$.... billion of debt through domestic Fund raise and has led multiple asset transactions including Actis, Petronas, SCATEC, UNOPS which was 0.5 GW of solar assets. Prior to joining the Company, he worked at Hindustan Power, Tech Mahindra in their Private Equity & Investment Banking divisions. He holds an MBA in Finance and Strategy from Indian Institute of Management, Indore and B.Tech from Indian Institute of Technology Delhi.

P. K. Banerjee

Executive Director, Society of Indian Automobile Manufacturers (SIAM)

Mr P K Banerjee is Executive Director (Tech) in SIAM, He has 26 years of work experience in the Indian Automobile Industry, His work experience is with Tata Motor Limited, Daewoo Motor Limited, DCM Toyota Limited Etc.

Dr. R. K. Malhotra

Director General, The Federation of Indian Petroleum Industry (FIPI)

Dr. R. K. Malhotra is a Mechanical Engineer from IIT, BHU and Ph.D. (Energy Studies) from IIT, Delhi. He is presently Director General of the Federation of Indian Petroleum Industry (FIPI). He was earlier Board member at Indian Oil Corporation Ltd. as Director (R&D) and also held additional charge as Chairman before superannuation in June, 2014. He has more than 42 years of experience in the oil industry. He is also the Chairman of the Divisional Council of Bureau of Indian Standards (BIS) responsible for formulating specifications of Petroleum, Coal and Related Products in India, Chairman of the Central Pollution Control Board (CPCB) Committee for formulations of emission standards for gensets and Chairman of the Research Council of CSIR-Indian Institute of Petroleum.

Rajat Seksaria

CEO, ACME Solar

Rajat Seksaria is the Chief Executive Officer of the solar business at ACME and in this role is managing a solar portfolio of more than 5 GW (Operational and Under Development Project) which is among the largest such portfolio in India presently . He has more than 16 years of experience of working in Power (Renewable & Conventional), Infrastructure and Oil & Gas sectors working in areas of Management Leadership, Project Finance, Project Execution & Operations, Strategy & Investments. At the age of 40, he is among the youngest business leader in the sector. Prior to ACME he has worked in India Power Corporation Limited as President of Renewables Business. He has also worked at Punj Lloyd Group for 10 years where he set up Group's Infrastructure and Renewable Project Development business with cumulative Infrastructure and Solar assets development of more than $ 400 million. Rajat started his career as a Business Analyst with Shell (then BG Group).

Ravindra Vasisht

Regional Director - India,
Hexagon Agility India

- Electrical Engineer and a Post Graduate from the Institute of Rural Management in 1985
- Since then 36 years of corporate experience in the field of Sales, Business Development and Corporate Strategy
- Wide industry experience in Food, Plastics, Automotive, Healthcare, Defence and since the last 11 years in Natural Gas, clean energy with Hexagon Agility.,
- Have worked in Reputed organisations like NDDB, Alfa Laval, Nypro, Tata Group in the past.
- In Hexagon Agility introduced the concept of composite Type 4 CNG and Hydrogen cylinders to India, the first CNG bus with a range of over 1,000 Kms in India.
- A voracious reader, write a blog, keen interest in Defence, Biz Strategy & Politics, good sense of humour and enjoy traveling.

Ravneet Mann

Vice President, Invest India

Ravneet Mann is currently a Vice President at Invest India with 13 years of experience in market – entry and business expansion strategy Ravneet Mann. In her role as VP, Ravneet is leading investment promotion and facilitation into the Consumer Goods, Leather &Footwear, Metals &Mining, Oil &Gas and Auto industry in India. Ravneet has led multiple public–private engagements at global platforms as a part of the outreach strategy to highlight investment opportunities and drive FDI into India. Additionally, she has also worked in close capacity with the Office of the Prime Minister of India and with senior officials from Federal Ministries and State Governments to work on policy and develop an investor outreach strategy. Ravneet has had a professional career of over 13 years, starting with Merrill Lynch and then moving on to Strategy Consulting at a boutique Consultancy from New York. Ravneet has a Bachelor's degree with Honors in Economics from St Stephens College, New Delhi and an MBA from the Indian School of Business in Hyderabad.

Prof. Dr. Robert Costanza

American/Australian Ecological Economist, Chair in Public Policy, The Australian National University

Robert Costanza is an American/Australian ecological economist and Professor of Public Policy at the Crawford School of Public Policy at The Australian National University. He is a Fellow of the Academy of the Social Sciences in Australia and a Full Member of the Club of Rome.

S.C Gupta

Joint Adviser, PNGRB

Mr. Gupta holds Bachelor of Engineering in Mechanical Engineering from Delhi College of Engineering and Master of Business Administration from Faculty of Management Studies, Delhi University. He holds over 33 years of experience in the oil and gas industry, including experience in operations, infrastructure development, inspection, project monitoring, budgeting, and marketing at Bharat Petroleum Corporation Limited; and development of safety standards, audits, incident investigations, and training at the Oil Industry Safety Directorate and Petroleum and Natural Gas Regulatory Board.

Dr. Scott Davis

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

Dr. Scott Davis specializes in mechanical and aerospace engineering, and the engineering analysis and testing of combustion, thermal, and fluid processes. Dr. Davis applies his expertise to the investigation, prevention, and risk assessment of fires, explosions, and dispersion hazards such as flammable vapors and carbon monoxide exposures. He is responsible for fire and explosion related consulting activities, which include post-incident investigative work as well as performing risk assessments and safety studies for offshore Oil & Gas installations, petrochemical facilities, and various other industries. These studies include explosion risk assessment, blast and venting analyses, assessment of combustible dust explosions and ignition, toxic and flammable gas releases and dispersion, hydrogen safety, ventilation, detector placement, and carbon monoxide dispersion with the assistance of the world-leading FLACS software developed by GexCon

Souvik Bhattacharjya

Associate Director, Integrated Policy Analysis Division, TERI

Souvik Bhattacharjya has more than 15 years' experience in energy and environmental research and management consulting. He has undertaken and led various consultancy and research assignments for ministries, bilateral, and multilateral organisations, and multinational corporations. His areas of work include resource efficiency and circular economy, developing policies and strategies along product and service value chains for promoting 6Rs, industrial ecology, material demand/supply assessments, material flow analysis, life cycle analysis, life cycle cost analysis, impact assessments of industrial/infrastructure projects, price build up for environmental goods and services, trade in environment and resources, etc.

Dr. SSV Ramakumar

Director (R&D), Indian Oil Corporation Limited.

Dr. SSV Ramakumar is Director (Research & Development) on the Board of Indian Oil Corporation Ltd. (IndianOil), a Fortune 500 company. With a doctorate in Chemistry from IIT-Roorkee (erstwhile University of Roorkee), Dr. Ramakumar has more than three decades of uninterrupted R&D experience in downstream hydrocarbon sector, notably in the areas of lubricant technology, refinery process research streams, including catalyst development. He is instrumental in developing India's home-grown, OEM-approved marine lubricant technology, which catapulted IndianOil's SERVO lubes into the select league of five MNC oil companies.

Dr. Sunita Satyapal

Director,
Hydrogen and Fuel Cell Technologies Office,
U. S. Department of Energy

Sunita Satyapal is the Director of the U.S. Department of Energy's Hydrogen and Fuel Cell Technologies Office within the Office of Energy Efficiency and Renewable Energy (EERE). In this capacity, she is responsible for the overall strategy and execution of hydrogen and fuel cell activities, including oversight and coordination of about $150 million per year of research and development (R&D) programs, as well as staff. She has about two and a half decades of experience, including academia, industry and government.

Surbhi Goyal

Senior Energy Specialist,
World Bank
Delhi Office

Surbhi Goyal is a Senior Energy Specialist with the World Bank's Delhi office. She is leading some of most innovative projects/technologies in renewable energy sector and been recognized as one of the 'Asia's Most Influential Women in Renewable Energy'. Some such projects/technologies involve grid-connected large-scale solar parks, floating solar, solar-wind hybrid, solar in snow, battery energy storage solutions, hydropower, repurposing of coal-fired thermal power project sites Green Hydrogen.

Dr. Sushil S. Ramdasi

Deputy Director, Powertrain Engineering, ARAI

In charge - Power Train Design Department, ARAI and responsible for execution of various projects in design & development of engines, transmissions, live axles from concept up to series production for meeting various emission norms, strength, durability and structural dynamics requirements. He has developed Hybrid Electric Vehicle architectures / supervisory controller for HEV operations / Indigenous development of AMT controller software and microcontroller hardware with power electronics from concept / Development of Hydrogen and SOFC based Fuel Cell Vehicle Architectures and Controls/ Prototype development of engines, transmissions, axles, Swirl and Transmission test rigs Microcontrollers , Power electronics for AMT and electric drive operations, Developed Induction / PMDC / BLDC motors plant mathematical models from concept along with FOC and DTC control algorithms for electric drives to work in parallel computing environment

Dr. T. P. Yadav

Scientist, Banaras Hindu University (BHU)

Dr. T. P. Yadav's area of specialization are Physics of materials, structure property correlations in various advanced materials for structural and functional applications, nanocrystalline materials, quasicrystalline materials, 2D materials, amorphous (bulk metallic glasses), Materials for energy harvesting, energy storage (Hydrogen storage), energy conversion, sensor and actuator, High strength Al alloys through grain refinement & modification etc.

Takeo Konishi

Country Director, India Resident Mission (INRM), Asian Development Bank (ADB), New Delhi

Konishi has 22 years of professional experience, including almost two decades with ADB in many senior roles including as Country Director of Uzbekistan and Advisor in the Central and West Asia Department. In his latest role as the Director of Public Management, Financial Sector, and Trade Division (SAPF) in ADB's South Asia Department, Mr. Konishi has proactively supported fast-tracking of ADB's COVID-19 programs in the South Asia region.

Umesh Sahdev

Executive Chairman. Hydrogenium Resources Pvt. Ltd.

Umesh Sahdev has almost five decades of professional expertise in planning & development of Renewable Energy, Climate Change Mitigation, and Industrial projects in very wide spectrum of industries, managing businesses of global companies, International Collaborations & Joint Ventures and Private Equity Fund. Widely travelled globally, Umesh has large internationally professional network. Textile Engineer with DIM has undertaken several specialized continued credits from leading global institutes like Imperial College, London and ADB.

Umesh has served as India head & Vice Chairman of Sindicatum Sustainable Resources - a leading Singapore based developer and owner of clean energy and sustainability projects worldwide and a producer of sustainable products from natural resources and waste. Umesh was part of co-founder group and Director of Operations of PMCI Plc-a LSE Listed Platinum Mining Company at London. He also served as CEO of the Projects Division of India's major merchant banking company Bajaj Capital Ltd. and Head of Merchant Banking Operations of Mefcom.

Vegard Frihammer

Founder & CEO, Greenstat Chair H2 Cluster, Norway

Founder/CEO of Greenstat ASA and Chairman of Arena H2Cluster -The Norwegian Hydrogen Cluster. Holds several board positions, both as Chairman of the board and member of the board member in subsidiaries and companies partially owned by Greenstat, such as Greensight, Greenstation, Glomfjord Hydrogen, Meraker Hydrogen, Viken Hydrogen and H2 Marine.

Mr. Frihammer has a background from the oil and gas, and maritime industry, before fully embracing the renewable energy sector. He started his career as an electrician at Aker Stord, a maritime/offshore yard at the West cost of Norway, and has later held positions as an engineer, project manager and manager at companies like Aker Solutions, Siemens, Bergen Group and Aibel. After joining Christian Michelsen Research (now Norce) in 2010 he has worked within the renewable space, primarily focusing on hydrogen and offshore wind. In 2015 he was the founder of Greenstat where he still is the CEO/GEO (Green Executive Officer)

Vikram Gulati

Senior Vice President, Toyota Kirloskar Motor (KTM)

Currently working as Country Head & Sr. Vice President (Corporate Affairs & Governance) at Toyota Kirloskar Motor Pvt. Limited (TKM). He is a postgraduate in Chemistry from St Stephen's College, Delhi University and holds a management degree from Management Development Institute, Gurgaon, Haryana, India. Earlier while serving as a Civil Servant (IRPS: 1992 batch), he has a rich and varied experience of over 22 years of working in the Government in various capacities.

ORGANISERS

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

INTERNATIONAL CLIMATE SUMMIT 2021

PARTNER COUNTRY
NORWAY

Norwegian Embassy
New Delhi

Innovation Norway

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | A PHYSICAL & VIRTUAL SUMMIT

INDUSTRY PARTNERS PROFILE

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

Norwegian Embassy

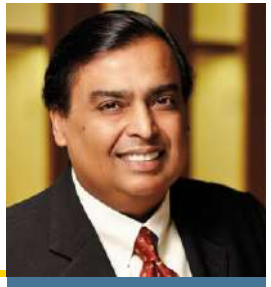
New Delhi

Partner Country - Norway

Ties between Norway and India have deep historical roots, which continue getting strengthened with time. The Norwegian government recently launched a new 'India Strategy' that sets clear our priorities until 2030 for the bilateral relationship with India. A key component of that is our cooperation in the energy sector, where both our countries are important players in the global energy transition. The Norwegian Government has developed a Hydrogen Strategy with the aim of further developing and scaling new low emission technologies and solutions given our years of industrial experience across the entire hydrogen value chain. This fits well into India's vision to have 450 GW capacity of renewable energy by 2030, with Hydrogen as a key component. We also continue working with India in other areas of importance such as the oceans, blue economy, research and higher education and global health.

Reliance Industries Limited

Growth is Life



Mukesh Dhirubhai Ambani
Chairman & Managing Director

About Reliance Industries Limited (RIL)

RIL is India's largest private sector company, with a consolidated turnover of INR 659,205 crore ($87.1 billion), cash profit of INR 71,446 crore ($9.4 billion), and net profit of INR 39,880 crore ($5.3 billion) for the year ended March 31, 2020.

HINDUSTAN ZINC

Zinc & Silver of India

Mr. Arun Misra
Chief Executive Officer

About Hindustan Zinc Limited

Hindustan Zinc, a Vedanta Group Company, is one of the world's largest and India's only integrated producer of Zinc-Lead and Silver. The Company has its Headquarter at Udaipur in the State of Rajasthan where it has its Zinc-Lead mines and smelting complexes.

UPL

OpenAg™

Jai Shroff
Group Chief Executive Officer

About UPL Ltd.

UPL Ltd. is a global provider of sustainable agriculture products & solutions, with annual revenue exceeding $5 billion. We are a purpose-led company. Through OpenAg, UPL is focused on facilitating progress for the entire agricultural value chain.

Veritas Polychem Pvt Ltd

Nitin Kumar Didwania
Managing Director

About Veritas Polychem Private Limited (VPPL)

VPPL is wholly owned subsidiary of Veritas (India) Limited a listed Indian company, part of Groupe Veritas (GV) promoted by a young entrepreneur. Groupe Veritas with its worldwide presence, is focused on International Trade & Distribution, Infrastructure & Logistics and Alternate Fuel & Energy - Wind Turbines and Solar Panels.

GAIL (India) Limited

Manoj Jain
Managing Director

About GAIL (India) Limited

GAIL (India) Limited is India's largest natural gas company having a market share of over 75% in natural gas transmission. GAIL possesses over 13,389 km of natural gas pipeline transmission network with a capacity of 204 MMSCMD.

Dr. Alois Virag
Chief Executive Officer

About Nayara Energy

Nayara Energy is a downstream energy and petrochemicals company of international scale with strong presence across the hydrocarbon value chain from refining to retail. Nayara Energy's fuel retail network consists of 6000+ outlets across India and is the fastest growing private retailer in the energy sector.

Rahul Gautam
Chairman and Managing Director

About Sheela Foam Limited

Sheela Foam Limited ("Sheela Foam" or the "Company") established in 1971, listed on Bombay Stock (BSE) and National Stock Exchange(NSE), manufactures mattresses, other foam-based home comfort products and technical grades of PU Foam.

Vikram Handa
Managing Director

About Epsilon Carbon

Established in 2010, Epsilon Carbon, India's first integrated coal chemicals complex which is strategically located near raw material sources, our core advantage is 100% captive input materials. Epsilon Carbon has always partnered as important part of supply chain for many of India's biggest names in aluminium, carbon black, tyres and mechanical rubber goods, & other specialty chemicals.

Ashok Vithaldas Rathi
Managing Director

About CDET Explosive Industries Private Limited

CDET Explosive Industries Private Limited is a leading manufacturer and exporter of Explosive Initiation Systems and Packaged Explosives, located in Central India. Founded by Mr. Ashok Vithaldas Rathi in 1998, CDET has grown to be a trusted and recognized provider of blasting solutions for the mining industry.

DEEPAK FERTILISERS AND PETROCHEMICALS CORPORATION LIMITED

S C Mehta
Chairman and Managing Director

About Deepak Fertilisers and Petrochemicals Corporation Limited

Founded in 1979, Deepak Fertilisers and Petrochemicals Corporation Limited (DFPCL) is India's leading producer of Fertilisers and Industrial Chemicals. Since its inception, DFPCL has leveraged the power of science and innovation to enable not only its customer base, but also the nation, to progress substantially.

IndianOil

Shrikant Madhav Vaidya
Chairman

About Indian Oil Corporation Ltd

As India's flagship national oil company in the downstream petroleum sector, IndianOil has been fuelling the energy demands of India for over five decades. With a 33,000-plus work-force, extensive refining, distribution & marketing infrastructure and advanced R&D facilities, IndianOil plays a significant role in fuelling the socio-economic development of the country.

Subhash Kumar
Chairman & Managing Director

About Oil and Natural Gas Corporation Ltd.

Maharatna ONGC is the largest producer of crude oil and natural gas in India, contributing around 70 per cent of Indian domestic production. The crude oil is the raw material used by downstream companies like IOC, BPCL, HPCL to produce petroleum products like Petrol, Diesel, Kerosene, Naphtha, Cooking Gas-LPG.

Deepesh Nanda
CEO, GE Gas Power South Asia

About GE

GE rises to the challenge of building a world that works. For more than 126 years, GE has invented the future of industry, and today the company's dedicated team, leading technology, and global reach and capabilities help the world work more efficiently, reliably, and safely. GE's people are diverse and dedicated, operating with the highest level of integrity and focus to fulfill GE's mission and deliver for its customers.

Prabh Das
Managing Director & Chief Executive Officer

About HPCL-Mittal Energy Limited (HMEL)

HPCL-Mittal Energy Limited (HMEL) is a joint venture between Hindustan Petroleum Corporation Limited (HPCL) and Mittal Energy Investment Pte Ltd, Singapore, a Lakshmi N Mittal Company. HMEL owns and operates the Guru Gobind Singh Refinery (GGSR) of 11.3 MMTPA capacity at Bathinda, Punjab. HMEL's wholly owned subsidiary, HPCL-Mittal Pipelines Limited (HMPL), owns and operates a Single Point Mooring (SPM), Crude Oil Terminal (COT) and 1017 km cross country pipeline for transportation of the crude from Mundra, Gujarat to the refinery at Bathinda.

Sanjay Kumar Jha
Chief Executive Officer

About IHB limited

IHB limited is a Joint Venture Company of 3 leading Oil & Gas Central Public Sector Undertakings namely Indian Oil Corporation Limited, Hindustan Petroleum Corporation Limited and Bharat Petroleum Corporation Limited. The Joint Venture Company, incorporated on 9th July 2019, has been formed to implement the prestigious Kandla-Gorakhpur LPG pipeline Project and thereafter operate and manage the pipeline. This 2800 KM long LPG pipeline, once constructed, is expected to be World's Longest LPG Pipeline.

ACME

Leading Through Innovation

Manoj K Upadhyay
Founder & Chairman

About ACME Group

The ACME Group is one of the India's fastest growing companies in solar energy sector. ACME provides innovative green energy and energy management solutions for Telecom Passive Infrastructure and is one of the largest Solar Power developer with cumulative capacity of more than 5500+ MWp Solar Photovoltaic Power Projects across the country.

Phillips Carbon Black Limited

Sanjiv Goenka
Chairman

About Phillips Carbon Black Limited

Phillips Carbon Black Limited (PCBL), a part of RP-Sanjiv Goenka Group, was set up by Mr. K. P. Goenka in 1960, with the core objective of substitution of the import of carbon black. The company started production at Durgapur with a production capacity of 14,000 MT per annum. As PCBL celebrated its diamond jubilee in 2020, it has been playing a pioneering role in the carbon black industry for over six decades, with a current production capacity of 6,03,000 MT per annum and generating 84 MW per hour of green power. Today, PCBL is the largest carbon black manufacturer in India and a strong global player with a significant customer base in 40+ countries.

MURUGESH R. NIRANI GROUP

Murugesh R. Nirani
Founder & Chairman

About MRN Group

Established in 1995, MRN group is a successful business conglomerate with headquartered presence at Mudhol, Karnataka. Under the visionary of Founder Mr. Murugesh R. Nirani, the group has been striking the balance between reimagining & advancing industrialization and improving people's lives not only across Karnataka state but various parts of India. At MRN Group, we constantly work to make the future a reality by staying connected to our roots of rich resources and combining integrity, creativity and smart innovation with the utmost consideration for our people, their families, the local communities around us, our valued customers and the country at large.

PIONEER

About Pioneer Industries Private Limited

Pioneer Industries Private Limited was incorporated in the year 1997, under the Companies Act 1956, with an objective of promoting agricultural activities and development of Agro Based Industries at Pathankot (Punjab). We are a young and vibrant organization engaged in the manufacture and export of various cereal based products.

We manufacture safe and hygienic products of natural organoleptic and nutritive value which meet international quality standards and customer's expectations. Our products are a result of our strong and sound infrastructural base. The whole setup is managed by highly experienced, dedicated, disciplined and diligent work force.

R. K. Sabharwal
Director - Commercial and C&MD (Addl. Charge)

About Engineers India Ltd

EIL, a Navratna PSU, is one of the leading design and engineering organizations in South Asia. Established in 1965, EIL provides engineering consultancy and EPC services principally focused on the oil & gas and petrochemical industries. The Company has also diversified into sectors like Infrastructure, Water and Waste Management, Solar & Nuclear Power and Fertilizers to leverage its strong technical competencies and track record.

Hideji Hosoda
Chairman & Managing Director

About Nichino India Pvt. Ltd.

Since its inception in 1928, it has been building on its accumulated research and development activities as Japan's first manufacturer of agrochemicals, as well as its well-earned position of trust, NNC-Nichino has extended its operations beyond the shores of Japan to actively enter overseas markets, particularly in India adopting Make in India policy.

BHARAT OMAN REFINERIES LIMITED

K. Padmakar
Chairman

About Bharat Oman Refineries Limited

Bharat Oman Refineries Limited was incorporated in 1994 as a Public Limited Company with equal equity participation of Bharat Petroleum Corporation Limited ("BPCL", a Government of India Undertaking) and OQ (formerly OOC). Presently, BPCL is holding 63.4% and OQ is holding 36.6% equity in the Company. The company has become subsidiary of BPCL effective from 1st April, 2020. The Government of Madhya Pradesh is also stakeholder in the Company.

KENT Mineral RO™ Water Purifiers
HOUSE of PURITY

Dr. Mahesh Gupta
Managing Director

About Kent RO Systems Limited

Kent RO Systems Limited is a 21st century health care products company with a vision for making the world a healthy and a happy family. It provides innovative health care products that purify the water we drink, the food we eat and the air we breathe, thus help people live healthier.

MEGHMANI ORGANICS LIMITED

Ankit Patel
Chief Executive Officer

About Meghmani Organics Limited

Meghmani Organics Limited established in the year 1986 is a leading diversified Chemical Company poised for growth across its three (Pigment, Agrochemicals and Chlor-Alkali and Derivatives) high potential businesses. MOL is among top 3 Pigment manufacturers globally with 14% global market share in Phthalocyanine Pigments, among top 10 vertically integrated Agrochemical players in India having products across entire value chain.

action TESA
PANELS | FLOORING | DOORS

Vivek Jain
Managing Director

About Action TESA

Balaji Action Buildwell laid its manufacturing for MDF/HDHMR & Particle Board and their allied value added products namely Pre-laminated Particle Board, MDF, & HDHMR, HDF Laminate Wooden Flooring, Embossed HDF, UV Coated Panel, Acrylic Hi Gloss Boards, HDHMR Doors under the brand name Action TESA.

Hirenbhai K Patel
Managing Director

About Nirma Ltd.

Nirma Group, today, is a Multi-product, Multi-location Conglomerate with revenues in excess of USD 1.20 billion and presence in Consumer Products, Chemicals, Cement, Healthcare, Packaging, Real Estate, Agro Products, Fertilizers, Castor Oil and Mining - with exports to more than 50 countries across 6 continents from its plants at more than 10 locations in India, MENA and North America. The one-man entity has now grown to more than an 25000 strong dedicated team.

Chandrakant V. Gogri
Chairman Emeritus

About Aarti Industries Limited (AIL)

AIL is a leading Indian manufacturer of specialty chemicals and pharmaceuticals with a global footprint. It combines process chemistry competence (recipe focus) with a scale-up engineering competence (asset utilization) for creating a sustainable future. AIL manufactures chemicals used in the downstream manufacturing of pharmaceuticals, agrochemicals, polymers, additives, surfactants, pigments and dyes. The company globally ranks 1st – 4th position for 75% of its portfolio -- and is a 'partner of choice' for various major global and domestic customers. AIL has a de-risked portfolio that is multi-product, multi-geography, multi-customer and multi-industry. Over the past 3 decades, AIL has emerged as a Global Partner of choice with 250 + products for over 400+ Global and 700+ domestic customers across the globe in 60 countries with a major presence in the USA, Europe, Japan, China, and India.

KELTECH ENERGIES LTD

A VISION FOR CONSERVATION

Santosh Chowgule
Managing Director

About Keltech Energies Limited

KEL was incorporated in the year 1977 by the Chowgule Group a flagship companies, Goa. KEL is an listed company and is in the manufacture of industrial explosives.The Company has manufacturing units at Vishwasnagar, Udupi Karnataka, Nagpur and Chandrapur (Maharashtra) with technological collaboration from DuPont Water-gel Technology.

Chandrakant V. Gogri
Chairman Emeritus

About GSP Crop Science Pvt Ltd

GSP Crop Science Private Ltd Cultivate a sustainable legacy of safe and environment-friendly agricultural growth and work for farmers' well-being. As an Agro Chemicals Company in India, GSP manufactures advanced and Eco-friendly agrochemical products in India, pestisides and crop protection products with a vision to help farmers and consumer at large.

ऑयल इंडिया लिमिटेड
(भारत सरकार का उद्यम)
Oil India Limited
(A Government of India Enterprise)

Conquering Newer Horizons

Sushil Chandra Mishra
Chairman and Managing Director

About Oil India Limited (OIL)

Oil India Limited (OIL) is a fully integrated Exploration &Production company in the upstream sector, with origin dating back to the glorious year (1889) of oil discovery in India. It is a state-owned enterprise of the Government of India, under the administrative control of the Ministry of Petroleum and Natural Gas.

HOEC®

P Elango
Managing Director

About Hindustan Oil Exploration Co. Ltd.

HOEC's story began in 1983, when the great visionary, the late Shri. H.T. Parekh, foresaw the need for private participation in the Indian Oil & Gas sector. After more than 3 decades of existence, HOEC has now emerged as a fast-growing and independent E&P player in India. HOEC now, through its operations contributes 10,000 boe of products everyday to the nation, from 4 of the 7 producing basins in India. We have turned around our fortunes by adopting a low-cost, fast-track development model with a focus on local content, innovation and sustainable practices. We aim to create long-term stakeholder value while ensuring that we 'Grow Responsibly'.

HETERO

Dr. B. Partha Saradhi Reddy
Chairman and Managing Director

About Hetero Labs

Hetero is one of India's leading generic pharmaceutical companies and the world's largest producer of anti-retroviral drugs. Backed by 25years of expertise in the pharmaceutical industry, Hetero's strategic business areas spread across APIs, generics, biosimilars, custom pharmaceutical services and branded generics.

ANUPAM RASAYAN INDIA LTD.

Anand Desai
Managing Director

About Anupam Rasayan India Limited

Anupam Rasayan India Limited is renowned group for in the custom synthesis and manufacturing of specialty chemicals in India since 1984. We have established strong relationship with some reputed customer for supply of life science related specialty chemicals comprising products related to agrochemicals, personal care and pharmaceuticals, and other specialty chemicals, comprising specialty pigment and dyes, and polymer additives.

Tagros
(a jhaver group company)
Tagros Chemicals India Pvt. Ltd.

Parikshith Jhaver
Director

About Tagros Chemicals India Pvt. Ltd .

Tagros is today one of India's fast growing agrochemical companies. It's the subsidiary of the centenary celebrating business conglomerate – The Jhaver Group. It is the leading manufacturer of Synthetic Pyrethroids, Herbicides, Fungicides, Pesticide Intermediates and Special Formulations, producing 2,500 metric tons of active ingredients and exporting them to over 90 countries.

Balrampur
Chini Mills Limited

Vivek Saraogi
Managing Director

About Balrampur Chini Mills Limited

Balrampur Chini Mills Limited founded in 1975, is one of the largest sugar manufacturing company in India. It is one of the first sugar companies in the country to diversify its business from sugar to distillery and cogeneration. BCML has successfully created a wide range of co-products ranging from Molasses, Alcohol, Ethanol and Bagasse to Power Generation.

adventz

PARADEEP PHOSPHATES LIMITED

Saroj Kumar Poddar
Chairman & & Non Executive Director

About Paradeep Phosphates Ltd .

Paradeep Phosphates Ltd (PPL) is a leading fertilizer company with an annual turnover close to Rs. 5, 500 crores. PPL is part of Adventz Group of Companies led by the group Chairman ***Mr Saroj Kumar Poddar****. The government of India holds 19.55% of shares while 80.45 % shares are held by Zuari Maroc Phosphates Pvt Ltd, a joint venture between the Adventz group company, Zuari Agro Chemicals Ltd. and Maroc Phosphore S.A., a wholly owned subsidiary of OCP, Morocco. PPL's primary focus is the production and marketing of complex phosphatic fertilizers. PPL is committed to improving agricultural productivity and for the betterment of the farming community.*

Dalmia
Bharat Sugar

Deepak Singhal
Chief Executive Officer

Dalmia Bharat Sugar and Industries Limited (DBSIL)

Dalmia Bharat Sugar and Industries Limited(DBSIL) is a part of Dalmia Bharat Group which was founded in 1939. Having been around for more than 80 years, the group now enjoys leadership in core sectors such as Cement, Refractories and Sugar.

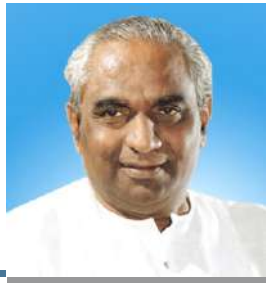
DCM SHRIRAM

Growing with trust

Ajay S. Shriram
Chairman & Sr. Managing Director

About DCM Shriram Ltd.

DCM Shriram Ltd. is a leading business conglomerate with a group turnover of Rs. 8308 crores. The business portfolio of DCM Shriram comprises primarily of Agri-Rural Business, Chlor-Vinyl Business and Value added business (Fenesta Building Systems). DCM Shriram, a spin-off from trifurcation of the reputed erstwhile DCM Group in 1990.



Kallappa Baburao Awade
Chairman

About Jawahar Shetkari Sahakari Sakhar Karkhana Limited

JSK was established in 1990 under The Maharashtra Co-operative Society Act 1960. In 1994, its status was converted into a 'Multi-State Co-operative Society' by incorporating a total of 220 villages in its area of operations, including 80 villages in Karnataka and 140 villages in Maharashtra. JSK's sugar factory is located at Hupari Village in Kolhapur District, on the southern border of Maharashtra adjoining Karnataka. The first sugar season of the company was 1993-94 with a crushing capacity of 2,500 tonnes crushed per day (TCD) and a cogeneration capacity of 1.5 megawatt (MW). The crushing capacity was subsequently enhanced in stages, with the present installed capacity as of February 2020 standing at 12,000 TCD and bagasse-based cogeneration of 27 MW. In SY2018-191 , JSK crushed 17.6 lakh MT of sugarcane to produce 2.2 lakh MT of sugar with an average recovery rate of 12.75%.

Triveni
ENGINEERING & INDUSTRIES LTD.

Dhruv Sawhney
Chairman & Managing Director

About Triveni Engineering & Industries Limited

The Company produces premium quality multi-grade crystal sugar, raw, refined and pharmaceutical sugar. All of the Sugar units are FSSC 22000 certified. It also has a strong presence in the branded sugar market through its brand "Shagun". The distillery at Muzaffarnagar produces Ethanol, Extra Neutral Alcohol (ENA), alcoholic beverages IMIL and Hand Sanitizers". The distillery at Sabitgarh produces Fuel-grade Ethanol.

Godavari
Biorefineries Ltd

Samir Somaiya
Chairman and Managing Director

About Godavari Biorefineries Limited

Somaiya Group has been working in the field of Sugar Production & Agricultural Products Business since 1939. Godavari Biorefineries Limited is the Flagship Company of The Somaiya Group. The Company was further expanded by diversification into Chemicals and forward integration of Sugar Business to Cogeneration of Power and Alcohol Manufacturing.

Sameer Kadam
Joint Managing Director

Sangram Kadam
Joint Managing Director

About Kadam Environmental Consultants (KEC)

Established in April 1981, Kadam Environmental Consultants (KEC) is one of the oldest and largest Environment, Health and Safety (EHS) consulting companies in India, providing comprehensive environmental solutions from concept to commissioning under one roof.

SEPC
SERVICES EXPORT PROMOTION COUNCIL
(Setup by Ministry of Commerce and Industry, Government of India)
www.servicesepc.org

Maneck E. Davar
Chairman

Dalmia Services Export Promotion Council

SEPC is an Export Promotion Council set by Ministry of Commerce & Industry, Government of India. It is an apex trade body which facilitates service exporters of India. As an advisory body it actively contributes to the formulation of policies of Government of India and acts as an interface between the Services Industry and the Government.

About Indian Association for Air Pollution Control - Delhi

Indian Association for Air Pollution Control

The Indian Association for Air Pollution Control was formed at B.H.U. Varanasi, India on 18th September 1976. The Association has been very active in promoting an understanding of the Air environment and of its pollution, its effects on human beings, animals, plants and materials and control of such pollution. It is an active and effective forum for exchange of views and information on the air quality and its conservation. Association publishes a technical journal titled "Indian Journal of Air Pollution Control" and recognises contribution of scientific professionals.

The Association has organised Conferences on some very important topics, which have contributed in development of standards on Ambient Air Quality standards in 2009, Air Pollution problems due to burning of Agricultural residues (2006), Evolving stretegis for improving Air quality of Indian cities (2008) and Indoor Air Quality (2014). Association also organizes an annual event in the month of September in the memory of some Late eminent scientist.

This is a unique body of professionals in this field and is silently playing a very constructive role in the society. It has may eminent persons as its member. One of our president (Late) Prof. Delip Biswas received Padma Shree in 2007 in recognition of his out-standing contributions for Environment Protection. Currently, Association is headed by Dr. J. S. Sharma, an eminent scientist with able support from Shri S. K. Gupta, a pioneering entrepreneur, as its Hony. Secretary.

KRESTON SNR

Mahendra Rustagi
CEO

About KRESTON SNR

Kreston SNR *head quartered at New Delhi is a member of* ***"Kreston International"*** *a Global Network of Independent Accounting Firms having presence in over 120 countries.* ***Kreston SNR*** *assists clients in the areas of Assurance & Risk Advisory, India Entry Support, Tax Advisory, Transaction & Business Advisory, Corporate & Allied Laws, Forensic Services, Renewable energy, Process safety and Management Consultancy and Outsourcing Services.*

ORGANISERS

PHD CHAMBER OF COMMERCE AND INDUSTRY

INVEST INDIA
NATIONAL INVESTMENT PROMOTION & FACILITATION AGENCY

INTERNATIONAL CLIMATE SUMMIT 2021

PARTNER COUNTRY
NORWAY

Norwegian Embassy
New Delhi

Innovation Norway

Powering India's Hydrogen Ecosystem

03 SEPTEMBER 2021 | A PHYSICAL & VIRTUAL SUMMIT

ADVERTISEMENTS

CO-ORGANISER

iTEN MEDIA™

MEDIA PARTNERS

CNBC TV18

newsX

SWACHH BHARAT NEELA AKASH
CONQUERING GREEN FRONTIERS
PHDCCI ENVIRONMENT COMMITTEE

AN INITIATIVE BY THE ENVIRONMENT COMMITTEE,
PHD CHAMBER OF COMMERCE AND INDUSTRY

adventz

DEFINING A NEW PRESENT ENVISAGING A BETTER FUTURE

PARADEEP PHOSPHATES LIMITED
www.paradeepphosphates.com

canonfire

#CelebratePurity

Dalmia utsav

PURITY KA UTSAV

Celebrate the pure sweetness of every occasion with Dalmia Utsav

HYGIENICALLY PACKED · SULPHUR FREE · UNTOUCHED BY HAND

INTRODUCING

Dalmia Bharat Group

Dalmia Sanjeevani™

THE PUREST FORM OF SAFETY

Keep yourself protected from germs, viruses & the diseases they cause.

DRDO · KILLS 99.9% GERMS · 80% ALCOHOL CONTENT · WHO RECOMMENDED FORMULA

To know more, call us on **9555145610** or mail us at **customercare.cb@dalmiasugar.com**

Triveni
ENGINEERING & INDUSTRIES LTD.

SUSTAINABILITY IS IN OUR DNA

We use world-class technologies to help us focus on being sustainable and to achieve high levels of efficiency. We have **Zero Liquid Discharge (ZLD)** at our distilleries, **10 billion litres of Water Treatment** across 100+ facilities in India, **Green Power** and **Biofuel Ethanol** generation with sugarcane co-products. We are also the leaders in Industrial Gearbox Solutions for renewable energy-based power generation.

At Triveni, sustainability is what makes us who we are.

SUGAR | ALCOHOL | POWER TRANSMISSION | WATER SOLUTIONS | DEFENCE | BRANDS

+91 120 4308000 info@trivenigroup.com www.trivenigroup.com

POWERGEN INDIA | Indian Utility Week | DISTRIBUTECH INDIA

DIGITAL SERIES

SEASON II

Amplify your Thought Leadership, Stakeholder Engagement & Demand Generation Initiatives!

We are now pleased to offer our clients the opportunity to work with us to produce digital content in a number of different formats.

- **STRATEGIC PANEL** — DISCUSSIONS
- **LEADERSHIP ROUNDTABLE** — DISCUSSIONS
- **TECHNOLOGY** — SHOWCASE
- **TECHNICAL** — PRESENTATIONS
- **FIRE SIDE** — CHATS
- **DIGITAL BOOTH** — EXHIBITION MARKETPLACE

Live, On-demand & Free to Attend!

Helping You Engage with the Indian Power & Utility Industry 24X7, 365 days a year!

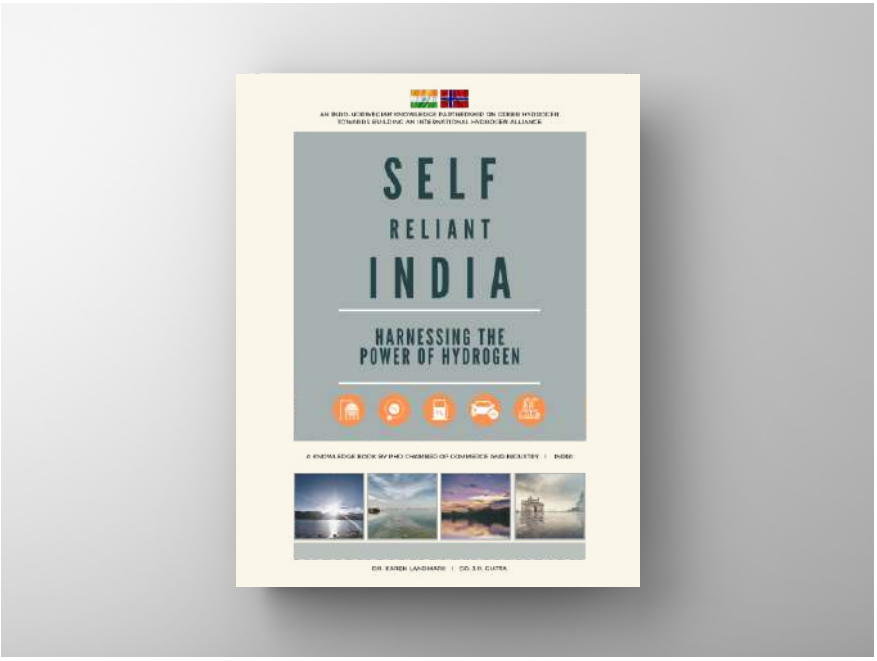
WWW.POWERGEN-INDIA.COM/DIGITAL | WWW.INDIAN-UTILITY-WEEK.COM/DIGITAL

Organised by: iTEN MEDIA™

International Partner: CLARION ENERGY — POWER & ENERGY SERIES

PHD CHAMBER
OF COMMERCE AND INDUSTRY

SWACHH BHARAT NEELA AKASH
PHDCCI ENVIRONMENT COMMITTEE



KNOWLEDGE BOOK ON GREEN HYDROGEN

AN INDO-NORWEGIAN KNOWLEDGE PARTNERSHIP ON GREEN HYDROGEN
TOWARDS BUILDING AN INTERNATIONAL HYDROGEN ALLIANCE

PHD Chamber of Commerce and Industry through its **Environment Committee** is bringing out a Knowledge Book titled **'Self Reliant India - Harnessing the Power of Hydrogen',** to be released at the **International Climate Summit 2021.**

Jointly authored by an Indo-Norwegian team of scientists, researchers and academicians led by Dr. Karen Landmark, Chair of the Board, Greenstat Asia, Norway and Dr. J.P. Gupta, Chairman, Environment Committee, PHD Chamber of Commerce and Industry and Managing Director, Greenstat Hydrogen India Private Limited; the book is dedicated to the Hon'ble Prime Minister of India, Shri Narendra Modi.

A repository of information and a useful guide for every institution or company embarking on energy transformation and making a transition from fossil fuels to new value chains which are based on renewable energy, the book reflects India's mission of achieving energy security through Green Hydrogen and its vision of becoming truly ‘AatmaNirbhar' (self-reliant) in all its energy needs.