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SOUVENIR

5th INTERNATIONAL CLIMATE SUMMIT

CORN REVOLUTION

LEADING TO

ETHANOL, ETHYLENE, SAF, BIO-PLASTICS, HYDROGEN & e-METHANOL

29th August 2025 | Hotel Le Méridien, New Delhi

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5th INTERNATIONAL CLIMATE SUMMIT:

CORN REVOLUTION

LEADING TO ETHANOL, ETHYLENE, SAF, BIO-PLASTICS, HYDROGEN & e-METHANOL

29th August 2025 | Hotel Le Méridien, New Delhi

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ABOUT THE SUMMIT

The International Climate Summit (ICS) 2025, scheduled for 29th August 2025 at Hotel Le Meridien, New Delhi, marks the fifth edition of this global platform on climate, energy transition, and sustainable growth. ICS has over the years evolved into a pioneering dialogue series that bridges policymakers, industry leaders, academia, innovators, and civil society to accelerate pathways towards a net-zero future.

Each edition of ICS has carried forward a transformative agenda: from initiating India's Green Hydrogen journey in 2021, to deepening Indo–Norwegian collaboration in 2022, championing the LiFE Mission (Lifestyle for Environment) in 2023, and catalyzing the Corn-to-Ethanol Revolution in 2024. This year, ICS 2025 builds on that strong legacy with a comprehensive theme—"Corn Revolution: From Dent Corn to Ethanol, SAF, Bio-ethylene, Bio-based Petrochemicals, Hydrogen, Carbon Economy & Energy Storage Systems."

The Summit will highlight India's ambition to reduce petroleum imports, strengthen food and energy security, and drive decarbonization through bio-based solutions. At its core, ICS 2025 is about positioning India's farmers as equal partners in the green transition—recognizing their role not just as producers of feedstock but as contributors to carbon reduction, value addition, and national prosperity.

Deliberations will bring together Union Ministers, global agencies, diplomats, corporate leaders, researchers, and innovators to address opportunities across the bioeconomy, process safety, digital platforms, and carbon credit markets. A special focus will be on technology transfer, international collaborations, investment frameworks, and farmer-centric carbon equity, ensuring that India's bioenergy pathway aligns with both climate goals and inclusive growth.

With its multi-stakeholder engagement and future-oriented agenda, ICS 2025 promises to be a landmark convening that reinforces India's leadership in the global climate and bioeconomy movement—an essential step towards building a large bioenergy economy.

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MESSAGES

MESSAGE

HON'BLE MINISTER OF ROAD TRANSPORT & HIGHWAYS GOVERNMENT OF INDIA

सत्यमेव जयते

Shri Nitin Gadkari

Hon'ble Minister of
Road Transport & Highways
Government of India

I am glad to know that the PHD Chambers of Commerce and Industry is organising the 'International Climate Summit, 2025', at Le Meridien, New Delhi, on 29th August, 2025 on the theme "Leading the Bioenergy Revolution", aligning closely with our nation's commitment to sustainable development and innovation in transportation infrastructure.

India's road transport industry is in the midst of a changeover, towards adopting cleaner, greener, and more efficient technologies. The inclusion of biofuels and bioenergy into our transport system not only helps us reach our climate objectives, but also mitigates dependence on fossil fuels, improves energy security, and facilitates rural development from the alternative sources of fuel production.

The Ministry of Road Transport and Highways is also proactively working towards the acceptance of bioenergy technologies like ethanol-blended fuels, compressed biogas, and next-generation biofuels for public transport, as well as freight carriage. These initiatives will go a long way in lowering vehicle emissions and meeting our 'Net Zero Emission' goals.

I extend my sincere congratulations to the organisers of the Summit and wish them achieve success in advancing the cause of sustainable mobility and advancing the vision of a 'Viksit Bharat'.

MESSAGE

Shri Shivraj Singh Chauhan

Hon'ble Minister of Agriculture and Farmers' Welfare
Government of India

Hon'ble Minister of Agriculture and Farmers Welfare Government of India

सत्यमेव जयते

I am pleased to learn that the PHD Chamber of Commerce and Industry is organising the International Climate Summit 2025 on the theme "Leading the Bioenergy Revolution", to be held at Le Meridien, New Delhi, on 29th August 2025. The summit's focus on revolution in bioenergy is not merely about technological advancements, it is about improving our agricultural practices, making use of waste and our vision to create a circular economy.

India's agriculture sector, with its vast diversity and rich tradition of innovation, stands at the heart of the bioenergy revolution. The government is committed to leveraging agricultural biomass, crop residues, and organic waste to create sustainable and renewable energy solutions.

Also, production of corn ethanol holds immense potential for India's economic growth, especially in rural areas. It will not only create substantial employment opportunities across the value chain-from crop cultivation to processing and distribution-but also enhance India's position as a global leader in corn-to-ethanol production.

I extend my heartfelt congratulations to the organisers of the Summit and wish them great success in advancing a greener future and contributing to the vision of a Viksit Bharat.

MESSAGE

Shri Hemant Jain

President, PHDCCI
& KLJ Group

PRESIDENT
PHD CHAMBER OF
COMMERCE AND INDUSTRY

It gives me immense pleasure to share this message on the occasion of the 5th International Climate Summit (ICS 2025) which is scheduled to be held on 29th of August 2025 at Le Meridien Delhi .The primary objective of ICS 2025 summit is to explore alternative energy strategies that contribute to India's decarbonization goals. It will bring together global leaders, policymakers, researchers, and industry pioneers to discuss and advance the role of bioenergy, green hydrogen, sustainable aviation fuels, and biorefineries in the global energy transition. The summit will serve as a platform for high-level discussions, policy frameworks, investment opportunities, and technological innovations that will shape the future of sustainable energy.

The theme of this year's summit captures the transformative potential of agricultural innovation in our national and global clean energy mission. Dent corn, once viewed solely as a feedstock, is now emerging as a strategic bio-resource. Its ability to yield high-quality ethanol, sustainable aviation fuel, green chemicals, and even hydrogen positions it at the heart of India's clean energy roadmap. As we strive to meet our net-zero goals, bio-based feedstocks such as dent corn offer a scalable, inclusive, and farmer-friendly solution for energy independence and climate resilience.

PHDCCI is proud to be part of this dialogue that integrates agriculture, industry, energy, and sustainability. We believe this convergence is not only essential for reducing our carbon footprint but also for creating green jobs, empowering rural communities, and strengthening India's leadership in climate innovation.

Let us use this summit as a platform to forge collaborations, promote technology transfer, and develop policies that unlock the full potential of biomass-based fuels and materials.

I am confident that will prove to be a rich resource for all summit participants and stakeholders, sparking meaningful conversations and collaborations well beyond the summit.

I wish the summit utmost success and lasting consequences.

MESSAGE

SECRETARY GENERAL & CEO

Dr. Ranjeet Mehta

Secretary General & CEO
PHDCCI

The world today stands at a crucial juncture faced with the dual challenge of mitigating climate change while ensuring inclusive economic growth. In this context, bioenergy has emerged as a cornerstone of the green transition, offering innovative solutions that are not only renewable but also rural-centric, employment-generating, and carbon-reducing.

The Bioenergy Revolution is no longer a vision. It is a reality taking shape across fields, laboratories, and industries. From ethanol and biodiesel to sustainable aviation fuel (SAF), green chemicals, bio-CNG, and hydrogen, bio-based energy systems are redefining the future of transportation, manufacturing, and power generation. Equally significant is their role in uplifting rural economies by adding value to agricultural residues, promoting circular practices, and enhancing energy access at the grassroots level.

At PHDCCI, we are deeply committed to facilitating this transformation. We recognize that the success of the bioenergy movement depends on an ecosystem of policy support, technological innovation, public-private collaboration, and knowledge sharing. Platforms like ICS 2025 and the Knowledge Book being unveiled are vital for capturing that collective wisdom and driving actionable outcomes.

MESSAGE

Dr. Jeewan Prakash Gupta

Summit Chair & Chair of
Environment & Climate Change
Committee, PHDCCI

SUMMIT CHAIR

Hon'ble Prime Minister of India, during the recent BRICS Summit in Brazil, outlined his vision for India's Bio-Economy to reach USD 300 Billion by 2030.

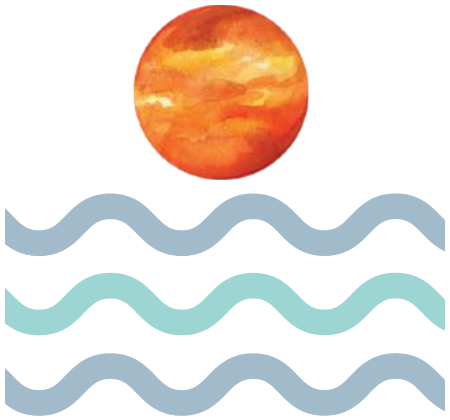
Currently, India imports nearly 90% of its crude oil, around 50% of its natural gas, and 60% of its LPG requirements. This heavy dependence on imports is a serious challenge to India's energy security—especially as fuel is the backbone of a growing economy poised to become the third-largest in the world.

Among the various energy sources, bio-energy is emerging as a preferred pathway for ensuring energy security and achieving decarbonization. India has already achieved 20% ethanol blending in petrol and targets to reach 27% in the near future. With the introduction of flex-fuel engines, automobiles will soon run entirely on ethanol, replacing gasoline altogether.

However, the availability of feedstock for ethanol production poses a significant challenge. While molasses, sugarcane juice, non-edible grains, and broken rice are currently used, their use affects food availability and raises concerns over food security.

In this context, maize (corn) presents a unique and strategic opportunity to ensure a reliable feedstock supply for ethanol production. The demand for maize is projected to rise sharply—from 8 lakh tonnes to 128 lakh tonnes by 2025. At the same time, the Government has discouraged the use of broken rice for ethanol, redirecting it towards food programs through Food Corporation of India subsidies.

Globally, ethanol is predominantly produced from Yellow Dent Corn (GM), which is non-edible and ideally suited for biofuel production. In fact, Yellow Dent Corn is considered the "crude oil" of bio-economies worldwide.



In light of this, India must urgently formulate clear policy guidelines to support the cultivation of GM-grade corn to launch a Corn Revolution. While sweet corn should be cultivated for exports to benefit farmers with better prices, GM-grade corn should be used specifically for setting up mega bio-refineries that produce bio-ethanol, bio-ethylene, Sustainable Aviation Fuel (SAF), bio-plastics, methanol, and green hydrogen.

The 5th International Climate Summit (ICS-2025) aims to highlight alternate energy strategies that support India's sustainable growth and energy transition. The Summit will bring together global leaders, policymakers, researchers, and industry pioneers to deliberate on the crucial role of corn in ensuring energy security, food security, and climate resilience.

I express my deepest gratitude to the leadership of PHD Chamber, the organizers of the Summit, and all the distinguished speakers and participants for their valuable contributions in charting strategic pathways to lead the Corn Revolution—ushering in a new era of Bio-Ethanol, Bio-Ethylene, SAF, Bio-Plastics, Methanol, and Hydrogen.

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SESSIONS & EXPERT SPEAKERS

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INAUGURAL SESSION

CHIEF GUESTS

Shri Bhupender Yadav

Hon'ble Minister
Ministry of Environment Forest and Climate Change
Government of India

Shri Nitin Jairam Gadkari

Hon'ble Minister
Ministry of Road Transport and Highways
Government of India

SPEAKERS

Mr. Hemant Jain

President
PHDCCI

Dr. J P Gupta

Summit Chair & Chair of Environment
& Climate Change Committee
PHDCCI

Dr. Ranjeet Mehta

CEO & Secretary General
PHDCCI

5th INTERNATIONAL CLIMATE SUMMIT

PLENARY SESSION

SPEAKERS

Mr. Om Pathak
Chairman
DPSG Society

Mr. Wagner Albuquerque de Almeida
Global Director, Manufacturing,
Agribusiness and Forestry (MA&F),
IFC-International Finance Corporation (World Bank Group)

Dr. Sadesh Sookraj
Global Decarbonization Advisor
IFC Washington (Part of World Bank)

Smt. Padma Jaiswal, IAS
Secretary
Union Territory of Puducherry

Dr. H.S. Jat
Director
IIMR

Mr. Rajnath Ram
Adviser (Energy)
NITI Aayog

Mr. Prabh Das
Managing Director & CEO
HPCL - Mittal Energy Limited

Mr. Alok B Shriram
Chairman, Dr. Bansi Dhar Institute
Sr. Managing Director & CEO
DCM Shriram Industries Limited

Dr. SSV Ramakumar
CTO & EVP, AM Green

Dr. Alok Sharma
Director (R&D) & Board Member
Indian Oil Corporation Ltd.

Mr. Sanjay Aggarwal
Chairman & CEO
Paramount Communications
Limited

Mr. Rajaram Pangavhane (Patil)
Founder President
Brahma Valley Group of Institutions
Nashik

Mr. Kamal Goel
Managing Director & CEO
Priserve Infrastructure Pvt Ltd

Mr. Ajay Dixit
ED- Chief Security
ONGC

5th INTERNATIONAL CLIMATE SUMMIT

TECHNICAL SESSION - 1
CORN REVOLUTION, SEED & SUPPLY CHAIN

SPEAKERS

Dr. J P Gupta
Summit Chair & Chair of Environment
& Climate Change Committee
PHDCCI

Mr. Mahendra Rustagi
Co-Chair, Environment &
Climate Change Committee
PHDCCI

Mr. Vijay Sardana
Techno-Legal Expert & Advocate
Supreme Court of India

Dr. Shankar Lal Jat
Senior Scientist
ICAR, IIMR

Dr. Surinder P. Singh
Sr. Principal Scientist and Head
Bharatiya Nirdeshak Dravya
(Indian Reference Materials) Division
CSIR -National Physical Laboratory

Dr. Bhupender Kumar
Senior Scientist
ICAR, IIMR

Dr. Mahesh Gathala
CIMMYT
India Representative

Dr. Ram Sirohi
Corn Product Lead, India
Bangladesh and Sri Lanka
Bayer Crop Science

Mr. Shyamkishore Choudhary
Associate Vice President
Process and Technology
Technip Energies

5th INTERNATIONAL CLIMATE SUMMIT

TECHNICAL SESSION - 2

2G ETHANOL, ETHYLENE, SAF, BIOPLASTICS, HYDROGEN, e-METHANOL & PROCESS SAFETY

SPEAKERS

Dr. J P Gupta
Summit Chair & Chair of Environment & Climate Change Committee
PHDCCI

Dr. J S Sharma
Co-Chair, Environment & Climate Change Committee
PHDCCI

Dr. R. K. Malhotra
President
Hydrogen Association of India

SPEAKERS - PART 1 : BIO-ETHANOL & BIO-ETHYLENE

Dr. Frank Liotta
President
Petron Scientech Inc.

Mr. Amit Bansal
Director -Marketing
BASF

Mr. Rahul Bammi
CEO & President
Verdagy

Mr. Vineet Bakshi
Director- Business Development
LanzaJet & LanzaTech

Mr. Sachin Chugh
Director, Energy & Hydrogen
ARUP

Dr. Piyali Das
Associate Director and Senior Fellow Advanced Biofuel (ABF) Division(TERI)

SPEAKERS - PART 2 : PROCESS SAFETY

Mr. Rajiv Agarwal
Director(Technical)
Engineers India Limited

Prof. (Dr.) P.S. Kulkarni
Director
Defence Institute of Advanced Technology

Dr. Sanjukta Subudhi
Associate Director & Sr. Fellow
TERI Center of excellence on Biochemicals, Advanced Biofuels Division

Dr. Suphiya Khan
Deputy Director
Dr Bansi Dhar Institute
Gurugram

Dr. Demudu Babu Gorle
Scientist 'C'
Dr Bansi Dhar Institute
Gurugram

Dr. Abhishek Kumar Patel
Scientist 'C'
Dr Bansi Dhar Institute
Gurugram

Ms. Yogita Patil
Deputy Chief Engineer,
Technip Energies

5th INTERNATIONAL CLIMATE SUMMIT

TECHNICAL SESSION - 3

LIFESTYLE FOR ENVIRONMENT / DECARBONISATION CARBON ECONOMY / SKILL DEVELOPMENT/ FINANCING

SPEAKERS

Dr. J P Gupta
Summit Chair & Chair of Environment & Climate Change Committee PHDCCI

Mr. Umesh Sahdev
Co-Chair, Environment & Climate Change Committee PHDCCI

Mr. Femi Akinrebiyo
Global Manager
Circular and agriculture economy
IFC (Washington DC)

Mr. Arpit Sharma
Chief Executive Officer
Skill Council For Green Jobs
(Skill India Mission)

Ms. Vineeta Hariharan
Public Policy Expert
Former Chief of External Missions

Lt Col Monish Ahuja (Retd)
Chairman & Managing Director
Punjab Renewable Energy Systems Private Limited (PRESPL)

Mr. Rajesh Kumar Mediratta
MD & CEO
Indian Gas Exchange

Ms. Mani Khurana
Sr Energy Specialist
The World Bank

Ms. Seema Shukla
Executive Director
TIC Council India

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GREEN LEADERSHIP AWARDS

5th INTERNATIONAL CLIMATE SUMMIT

GREEN LEADERSHIP AWARDS

28th August 2025 | PHD House, New Delhi

CHIEF GUESTS

Mr. Kartikeya Sharma
Founder, ITV Network
& Rajya Sabha MP

Mr. Rajnish Kumar
Ex-Chairman
State Bank of India

Mr. D K Sarraf
Former CMD
Oil and Natural Gas Corporation
Ltd

AWARDEES

Dr. Aishwarya Pandit Sharma
Chairperson, ITV Foundation

Dr. S. S. V. Ramakumar
CTO & EVP, AM Green

Dr. Bansidhar Institute Gurugram

Dr. Alok Sharma
Director (R&D),
Indian Oil Corporation

Mr. Rajaram Patil
Founder President,
Brahma Valley Group
of Institutions

Dr. K. K. Pant
Director, IIT Roorkee

GHES GREEN HYDROGEN ENERGY SERVICES PRIVATE LIMITED

Green Hydrogen Energy Services Private Limited

Prof. (Dr.) Tanu Jindal
Group Additional Pro VC (R&D),
Amity University and Director,
Amity Institute of Environmental
Sciences & Toxicology

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ARTICLES

Yellow Dent GM Corn Is purely a Crude Petroleum oil Substitute: AND NOT fit for Human consumption. Currently grown Corn in India (called sweet corn) is for human consumption.

It is essential to note that there are different grades of corn for different purposes, and they should not be mixed. Yellow dent corn is not inherently non-edible; it is used in processed food products. Not all yellow dent corn is GM. It has higher yield per acre, is much cheaper and is globally used for the production of industrial alcohol, Biofuels such as Ethanol, SAF while still providing high protein animal feed for Chicken (Poultry), Dairy and Cattle feed and also provides Corn oil for conversion to edible cooking oil or converted to Bio Diesel.

In contrast, sweet corn is not used for animal feed; it is grown primarily for direct human consumption. This high-quality sweet corn having lower yield per acre harvested is much more expensive. However, it is now being diverted toward ethanol production to meet the increasing demand required to achieve the E-20 target. This diversion is causing an imbalance and driving up prices of good quality sweet Corn.

Sweet corn is grown in Gujarat, Madhya Pradesh, Rajasthan, Uttar Pradesh, Bihar, Karnataka, and Maharashtra. India total sweet corn production is about 35 million tons/ year.

For example, in USA about 400-million-ton corn of both varieties is grown per year. Out of which only about 4 % (16-20 million ton/year) is sweet Corn for food use and balance 380 million/ ton year is yellow dent GM Corn for Biofuels, animal feed, corn oil production. USA typically exports 50 million tons/year of yellow dent corn to China, Japan, and other countries globally.

In the early 2000s, the U.S. saw a significant expansion in the use of yellow dent corn for ethanol production, driven by E10 mandate, favorable government policies leading to abundant corn supplies, and rising demand for ethanol as a gasoline additive. The phase-out of methyl tertiary-butyl ether (MTBE) led to increased demand for ethanol as a direct gasoline blending component in the U.S to boost Octane rating of Gasoline (Petrol) avoiding expansive processes as adopted in India and other countries by Petroleum refiners such as IOC. Ethanol has octane rating of over 115 and its direct blending improves Gasolines octane rating.

China uses a mix of feedstocks including cassava and sorghum; GM corn is regulated and not yet dominant in china. In the U.S. alone, ethanol production in 2022 accounted for nearly 79,000 direct jobs and over 330,000 indirect jobs, contributing $57 billion to GDP and $35 billion in household income, using GM yellow dent #2 corn exclusively for biofuel production. USA Corn production went up over 6+ X times from less land harvested than before.

The diversion of sweet corn for ethanol production in India has resulted in the country shifting from a surplus producer and exporter to an importer of corn for feed. From 2021 to 2023, India produced about 32–33

million tonnes (MT) of food-grade corn against a domestic demand of 28 MT, with the remainder available for export. The major demand in India for corn has traditionally been from the livestock feed industry—especially poultry and cattle feed.

The corn market in India is valued at USD 1.29 billion in 2024 and is expected to grow at a CAGR of 7.74% during the forecast period 2026–2030. Key growth drivers include rising demand for corn-based food products and increased utilization as livestock feed.

Much cheaper yellow dent corn is abundantly available in Brazil, Argentina and the U.S. and could be imported for ethanol production at a cost lower than equivalent fuel value crude oil. Also it is a sustainable solution for India in long run to increase domestic production. This imported yellow dent corn should be used exclusively for industrial/fuel ethanol production, thereby not competing with the edible corn grown by Indian farmers, which fetches higher prices. This will reduce India's for ever dependence on imported Petroleum with close to 800 billion $ import drain on country's economy. (biggest drain)

GM yellow dent corn is an excellent ethanol source due to its high starch content and the relatively simple process of converting it into ethanol. In the U.S., non-edible yellow dent corn is primarily used for ethanol production, animal feed, and industrial purposes such as starch and oil production. The USDA reports an average yield of 180 bushels per acre (approximately 4,580 Kg or 4.58 metric tons), with some hybrids reaching 250 bushels (about 6,350 Kg or 6.35 metric tons). Its value as feedstock for ethanol lies in its high carbohydrate content (~84.1%), particularly starch (~72%). Starch can be readily broken into simple sugars, which are then fermented by yeast to produce ethanol. Modern ethanol production can yield approximately 2.7 gallons of ethanol per bushel of corn. Most U.S. ethanol plants use the dry grind process.

Ethanol-blended fuel derived from yellow dent corn burns cleaner than gasoline and enhances the fuel's octane rating. Ethanol also has a higher oxygen content than MTBE, requiring only half the volume to achieve the same oxygenation level in gasoline.

With growing global focus on corn as a source of energy and innovation, the Indian government is increasingly turning its attention to maize, the third-most important crop in the country, traditionally cultivated for use in poultry feed.

While sweet corn has recently gained attention as a potential feedstock for ethanol production, its use for this purpose should be discouraged. As an edible and high-value crop, sweet corn is better suited for direct human consumption and export, where it can command premium prices and enhance farmers' incomes. Instead, ethanol production should prioritize non-edible varieties like yellow dent corn to ensure food security and economic sustainability.

India achieved its 10% ethanol blending target by June 2022. The E20 program now aims for 20% ethanol blending by 2025–26. To meet this target, India will likely require 165 lakh tonnes of maize—48% of the current production of 346 lakh tonnes. This means maize production must increase to 420–430 lakh tonnes by 2024–25 and 640–650 lakh tonnes by 2029–30. The Ministry of Agriculture aims to boost corn production by 10 million tonnes over the next five years. Eventually to be fully ESG focussed, E 30 and E100 should be considered as in Brazil and California USA (E85). India will not meet its crude oil demand in million years but with Corn being used as equivalent crude oil, goal to achieve biofuels mandate is possible by 2030 and beyond.

Another aspect is reducing pollution in our capital Delhi and other cities which is reduced by ethanol blending.

This significant jump is only feasible if ethanol production is supported

by adequate feedstock availability. India must allow duty-free imports of GM yellow dent corn for Ethanol and other biofuels production while still providing animal feed and corn Oil as coproducts, at duty free parity with duty free Petroleum crude oil and LNG import. This should be done until sufficient local Corn production becomes available.

India import of cooking oil is another major import duty free. (about 20 billion $/ year). Yellow dent Corn will also provide edible Corn oil besides biofuels and protein meal for animal feed.

Additionally, the government should permit the cultivation of GM yellow dent corn for ethanol production. This policy change offers a multi-dimensional opportunity—supporting farmers, enhancing sustainability, and boosting ethanol output. Clear policies differentiating sweet corn from GM dent corn are urgently needed. A precedent already exists in India with the approval of Bt cotton, a GM crop that significantly improved productivity and farmer incomes without impacting food consumption. Strategically segregating corn for food and fuel purposes could ignite a “Corn Revolution” in India – much like the Green Revolution in agriculture and the White Revolution in dairy – positioning the country as a major hub for ethanol production and exports.

Because yellow dent corn is not directly consumed by humans, it completely avoids food vs. fuel conflict, ensuring sustainable coexistence of food security and energy production. In fact a UNDP report indicated that Yellow dent production has improved food security.

Until local/ domestic farmers catch up with growing yellow dent corn, import should be allowed at either duty free or at parity with crude oil. Therefore, importing GM yellow dent corn for ethanol production is the most practical solution. GM and hybrid variety corn also require less water and less pesticides. Government should help farmers to secure seeds.

Clear, forward-looking policies are crucial to creating a conducive regulatory environment for ushering in a Corn and Ethanol Revolution, aligning with India's vision of achieving energy self-reliance.

Yellow dent corn is a first-generation (1G) feedstock; 2G ethanol uses non-food biomass like crop residues. Advances such as genetically engineered yeast and optimized fermentation conditions have boosted ethanol yields and reduced costs. Enzymatic hydrolysis has improved the conversion of dent corn into simple sugars, enhancing ethanol output. It has also enabled the use of alternative feedstocks such as agricultural residues and dedicated energy crops.

Incentivizing mega biorefineries of 1,250 to 1,500 KLPD, led by large PSUs and private oil refiners, along with duty-free import of dent corn, will be key to accelerating the 2G ethanol revolution and also downstream bio-Ethylene, Chemicals and polymers production vis a vis these being produced from imported crude oil/ Petroleum as huge capital and operating cost, emitting millions of ton of carbon to atmosphere diluting Netzero mission of the country..

India can emerge as an ethanol and biochemicals/ polymers export hub through liberalized policies that allow for both GM dent corn production and duty-free imports until domestic production can meet feedstock needs. Empowering Indian farmers with financial incentives and technological support is vital to foster a thriving environment for the Corn Revolution.

India stands as one of the most compelling success stories of ethanol blending in the present era driven by the visionary leadership of Mr. Hardeep Puri, Hon’ble Minister of Oil and Gas, Govt. of India. This momentum presents a transformative opportunity that must not be missed. By scaling up ethanol and Sustainable Aviation Fuel (SAF) production, India can position itself as a global export hub and take a

decisive step toward achieving true energy security.

The current success of ethanol blending can be leveraged to India's advantage as a springboard for launching a Corn Revolution. This moment presents India with a unique opportunity to make significant strides in energy security, food security, and decarbonization.

According to a Bloomberg report dated May 6, the United States is expected to request that India allow duty-free import of ethanol, and U.S. agricultural associations are pressuring the U.S. government to further request that India allow duty-free imports of GM yellow dent corn. India should agree to duty free GM dent Corn import as well as duty free grain Sorghum import which can also be used along with Corn.

However, rather than importing ethanol directly, it would be more strategic and economically prudent for India to allow the duty-free import of yellow dent corn for domestic production. This approach would better support India's ethanol blending targets, generate rural employment, enhance self-reliance and strengthen the domestic biofuel industry and add to GDP, reduce pollution and carbon emission/ global warming .

AUTHOR

Dr. J.P. Gupta

Chair - Environment & Climate Change Committee, PHDCCI

Former Chairman, EAC Ministry of Environment, Forest & Climate Change

Bioenergy is the Circular Economy:
Powering India's Green Growth from Farm to Flight

As India marches toward its Net Zero 2070 goal while simultaneously pursuing energy independence and rural prosperity, one transformative solution has emerged at the intersection of agriculture, industry, and climate action: Bioenergy.

Far from being just another clean energy stream, bioenergy is the very foundation of a circular economy. It seamlessly converts agricultural residues, energy crops, and urban-organic waste into value-added fuels, chemicals, and nutrients—creating wealth from waste, emissions from soil carbon, and opportunities from discarded biomass.

India's commitment to a Bioenergy-driven circular economy is not theoretical—it is now a national strategy, backed by bold policies, significant investments, and exponential demand growth across sectors like ethanol, compressed biogas (CBG), sustainable aviation fuel (SAF), and green chemicals. As per estimates from the Department of Biotechnology (DBT) and NITI Aayog, India's bioeconomy is projected to exceed USD 300 billion by 2030, with bioenergy being the cornerstone.

Policy and Mission Architecture: Building the Bioenergy Ecosystem

India's bioenergy journey has matured significantly over the last decade, supported by a dynamic policy environment:

- Ethanol Blending Programme (EBP): Accelerated from 1.5% in 2014 to 12.5% in 20242, with a 20% blending target by 2025, reducing dependence on imported petrol.
- SATAT Scheme: Targeting 5,000+ CBG plants3 using Agri-waste and municipal waste.
- PM-JI-VAN Yojana: Promotes 2G ethanol plants using crop residues, bagasse, and other lignocellulosic feedstocks4.
- National Bioenergy Mission: Supports integration of ethanol, CBG, and biomass cogeneration into mainstream energy supply.
- SAF Roadmap (under formulation): Aims to reduce aviation emissions and import dependence on jet fuel through bio-based blending mandates.
- Supportive State Policies: Maharashtra, UP, Bihar, Punjab, Gujarat, Karnataka, and others offer incentives for ethanol and CBG units, especially from grain and corn feedstocks.

These programmes demonstrate a clear convergence of energy, agriculture, transport, and climate policies—with bioenergy at the fulcrum.

A Circular System in Motion: The Bioenergy Value Chain

Bioenergy's circularity lies in its ability to continuously recycle biological material into energy, co-products, and carbon savings, benefiting every stakeholder involved:

1. Farmers and Feedstock Economy

- Residues like rice straw, sugarcane bagasse, corn stover, and now Dent Corn emerge as cash-generating assets.
- Minimum Support Prices (MSP) for maize, and direct procurement

by biorefineries, reduce market uncertainty.

- Crop diversification into energy crops improves soil health, reduces water use, and boosts income.
- Farmer cooperatives and FPOs are evolving into biomass aggregators.

2. Biorefineries and Industrial Value Addition

- Bioethanol plants now use molasses, grains, and lignocellulosic biomass, enabled by 1G and 2G technologies.
- CBG units digest urban and rural waste to produce clean fuel, organic manure, and biofertilizer.
- Bio-refineries produce multiple revenue streams: ethanol, SAF, green chemicals, CO_2, DDGS, and biohydrogen.
- Waste from one industry becomes feedstock for another—a defining trait of circularity.

3. Clean Mobility and Energy Security

The circular economy created by bioenergy goes beyond transport—it is the bedrock for a new wave of green industrialization. A flagship example is Corn to Ethanol, where high-starch Dent Corn is converted into fuel-grade ethanol, which not only powers blended petrol (E10, E20) but also serves as a precursor for a wide range of downstream products. Ethanol is increasingly being used as a feedstock to produce green ethylene, which in turn supports the manufacturing of bio-based plastics, detergents, and industrial solvents—forming the backbone of a bio-refinery economy.

Additionally, through catalytic and thermochemical upgrades, ethanol is being converted into Sustainable Aviation Fuel (SAF) to decarbonise the aviation sector, aligning with global mandates under CORSIA and ICAO. Furthermore, biomass gasification and fermentation pathways are now being used to produce green hydrogen, enabling deep decarbonisation of hard-to-abate sectors.

These cascading conversions of biomass into multiple product streams enhance resource efficiency, reduce fossil input dependency, and generate high-value green outputs. In essence, corn and energy crops are no longer just agricultural commodities—they are climate-positive industrial building blocks powering clean fuel, clean chemicals, and clean skies.

- E20 petrol (20% ethanol blend) is being rolled out across India.
- CBG is powering transport fleets, city buses, and decentralised microgrids.
- SAF trials are underway, positioning India to decarbonise its rapidly growing aviation sector.
- Scope 3 emission compliance for corporates will increasingly rely on bio-based fuels and feedstocks.

4. Waste Valorisation and Carbon Sequestration

- Organic municipal solid waste, sludge, and food waste are converted into fuel or fertiliser—reducing landfills.
- CO_2 from fermentation or biomass gasification can be captured and reused.
- Agricultural systems built on regenerative practices are increasing soil carbon sequestration—qualifying for climate finance.

Carbon Credits: Unlocking Climate Value for Farmers

One of the most transformative aspects of the bioenergy-driven circular economy lies in its ability to monetize carbon savings—not just for industrial players, but also for farmers, who are the first and foundational actors in the value chain.

Today, carbon credits are largely accrued by fuel users, such as fleet operators or refiners, who reduce

their emissions by using low-carbon fuels. However, in the case of bioenergy—particularly Corn-to-Ethanol and SAF production—the true climate benefit begins at the farm. This is where a structural correction is needed in the current carbon market architecture.

The Need for Methodology Development

To enable farmers to benefit directly from carbon revenues, the following must be urgently prioritised:

- The Bureau of Energy Efficiency (BEE), as the administrator of the Indian Carbon Market, should collaborate with global standards like Verra and Gold Standard to develop farm-level methodologies specific to:

- Cultivation of Dent Corn and energy grasses

- Low-emission farming practices

- Soil carbon retention and biomass enhancement

- Crop residue repurposing for ethanol or biogas

- • These standardised, verifiable protocols will allow carbon savings at the agricultural level to be quantified, certified, and monetised, creating a structured pathway for farmer participation in the carbon market.

Ensuring Co-Beneficiation for Farmers

While the final user (e.g., petrol consumer using E20 or an airline using SAF) technically displaces fossil emissions, the entire emissions savings journey starts with the farmer. Therefore, it is only just and economically sound that farmers become co-beneficiaries in the following scenarios:

- Ethanol blending into petrol: A share of the lifecycle GHG reductions—currently attributed entirely to the fuel user—should be allocated to the grower of the energy crop (e.g., Dent Corn).

- SAF production: Farmers providing the feedstock for aviation biofuels should be recognized in the CI (Carbon Intensity) credit chain.

- 2G Ethanol and Biogas: Use of crop residues, if verifiably replacing burning or landfilling, should qualify for offset claims.

Revenue Potential and Aggregation Models

- With proper MRV (Monitoring, Reporting, and Verification) and digital traceability, farmer carbon credits can be pooled and aggregated by bio-refineries or cooperatives, creating bankable and tradable carbon assets.

- This could generate an additional ₹2,000–₹4,000 per acre per year, transforming marginal lands and conventional farms into carbon asset zones.

By institutionalising this co-benefit structure, bioenergy becomes not just a fuel strategy—but a farmer-first climate solution, reinforcing inclusivity, equity, and rural wealth creation.

Reducing Crude Oil Imports: Economic and Strategic Impact

India imported over 232 million tonnes of crude oil in FY 2023–24, costing upwards of ₹12 lakh crore[5]. Bioenergy offers a pathway to strategic import reduction through blended and alternative fuels.

Achievable Outcomes:

Milestone	Ethanol Supplied	Petrol Offset	Crude Saved	Forex Savings
2024	~600 crore litres	~12.5% EBP	3.6 MT	₹24,000 crore[6]
2025 (E20 target)	~1,000 crore litres	20%	6 MT	₹40,000–45,000 crore[6]
2030	1,500–1,800 crore litres (incl. SAF, 2G, corn)	~25% fuel pool	8–10 MT	₹60,000–70,000 crore annually[7]

Additional SAF blending by 2035 (targeting 10–15% blend for aviation) could save another ₹10,000–15,000 crore annually8.

Moreover, these savings are recirculated into the rural economy, creating a self-sustaining economic loop—the very essence of a circular economy.

Stakeholders in the Bioenergy Circular Economy

Farmers – New income from feedstock + carbon credits

Biorefineries – Multi-product revenue, CI credit monetisation

Industries – Scope 3 reduction, ESG compliance

Startups – Digital MRV, carbon trading, biomass logistics

Governments – Crude import reduction, rural development

Consumers – Cleaner fuels, reduced urban pollution

Bioenergy is the Circular Economy India Needs - Its Bio-Economy

India's bioenergy strategy is not a peripheral environmental plan—it is a foundational economic reengineering strategy that unites:

- Decentralised energy production
- Carbon-negative agriculture
- Green industrial transformation
- Import substitution
- Rural empowerment

It closes material and financial loops, transforms emissions into earnings, and generates prosperity without pollution.

As ICS 2025 catalyses global dialogues on climate action, let us boldly affirm that Bioenergy is not part of the Circular Economy—it is the Bio-Economy.

A fully integrated, regenerative, inclusive system that can deliver energy security, climate stability, and economic resilience for India in the decades ahead.

Footnotes

1. Department of Biotechnology (DBT), Bioeconomy Report 2023; NITI Aayog, India's Bioeconomy Roadmap.
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4. Ministry of New and Renewable Energy, PM-JI-VAN Scheme Guidelines (2022).
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AUTHOR

Mr. Umesh Sahdev
Co-Chair, Environment & Climate Change Committee, PHDCCI
Executive Chairman, Hydrogenium Resources Pvt. Ltd.

Bioenergy – The Most Feasible Option to Combat Climate Change for India

India is privileged to have considerable biomass resources, which can be utilised to replace crude oil and corn. By increasing resource allocation to the bioenergy sector, the country can reduce dependence on fossil fuels, lower import bills, and achieve a drastic reduction in carbon footprints.

According to the International Energy Agency (IEA), once the right policies are in place, bioenergy may produce 130 million tonnes of oil equivalent (Mtoe) by 2040 – representing 15% of India's total energy demand estimated for that year.

India's Bioenergy Potential

- Power Generation – 28 GW
- Additional Bagasse-based Co-generation Potential – 14 GW
- Bioethanol Potential from Agri-Waste:
  - o From Sugarcane – 44,000 KLPD
  - o From Rice – 897 KLPD
  - o From Maize – 395 KLPD
- Compressed Biogas (CBG) Production Potential – 60,000 TPD

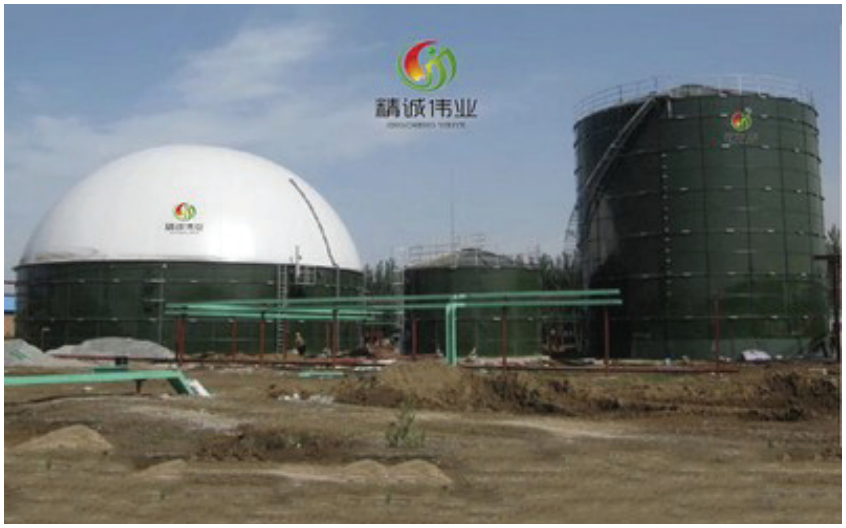
Forms of Usage and Future Potential

Power Generation

- Biomass Power Plants – Using raw biomass for combustion to generate electricity.
- Coal-fired Thermal Power Plants – Processing biomass into pellets for co-firing with coal to reduce coal usage.
- Waste-to-Energy Plants – Treating industrial and agricultural waste to produce biogas and CBG for power generation.

Non-Power Applications

- Compressed Biogas (CBG) – Produced from organic and municipal solid waste, serving as a substitute for petrol and diesel.
- Bioethanol – Produced from biomass with high starch or sugar content, blended with petrol.
- Biodiesel – Produced from plant seeds, vegetable oils, animal fats, and jatropha for blending with diesel.
- Biojet Aviation Turbine Fuel (ATF) – Produced from agricultural waste and vegetable oils.
- Pellets and Briquettes for Industrial Use – Compressed and refined biomass as an alternative to coal in industries.



Challenges in the Bioenergy Sector

Despite its vast potential, less than 5% of India's installed power generation capacity currently comes from biomass.

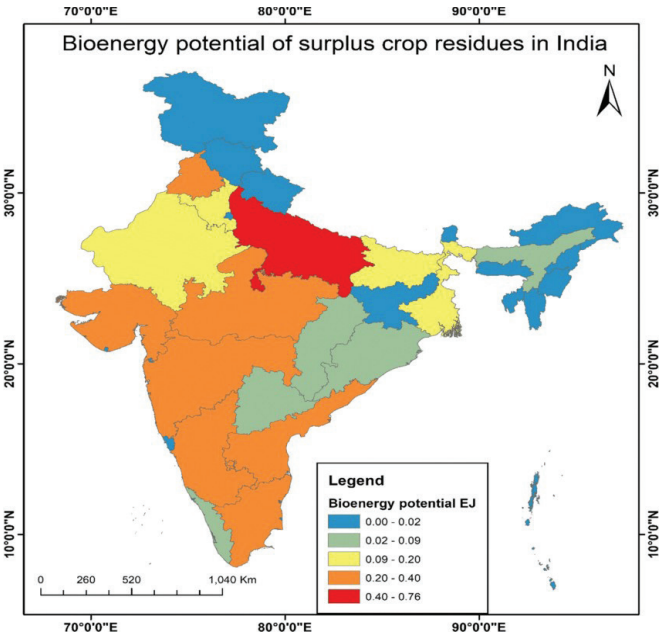
- Inadequate Feedstock Supply – Long-term uncertainty in feedstock availability impacts project viability.
- Lack of Public Data – Limited reliable data on biomass availability at district/block levels.
- Limited Storage Options – Inadequate infrastructure leads to stubble burning.
- Low Offtake of Biofertilisers – Limited awareness among farmers of their benefits.
- Limited Biomass Trading Platforms – Absence of efficient platforms for aggregators, producers, and agents.
- Lack of Adequate Financing Mechanisms – Financial institutions remain hesitant to extend loans to bioenergy projects.

Government Initiatives to Develop the Bioenergy Sector

The Government has been focusing on the development of the bioenergy sector, particularly addressing challenges related to biomass management, including agricultural waste and municipal solid waste.

- Over 800 biomass power projects, bagasse cogeneration and non-bagasse cogeneration projects have been set up with a total capacity of 10.6 MW for power generation and 140 TPD of compressed biogas (CBG).
- There are about 230 biomass pellet manufacturers and over 1,000 briquette manufacturers across different states, supplying these products to power plants and industries.
- The Government has supplemented sectoral growth through various schemes and policies, such as:
- Policy for Co-firing of Biomass in Thermal Power Plants – mandating a minimum 5% co-firing of biomass.
- Sustainable Alternative towards Affordable Transportation (SATAT) Scheme – promoting CBG in the transport sector.
- Scheme to Support Promotion of Biomass-Based Cogeneration in sugar mills and other industries.

- CPCB Fund of ₹50 crore – providing subsidies to pellet manufacturers to curb stubble burning.
- 20% blending of ethanol in petrol.
- Exemption of applicable charges on the sale of power from municipal solid waste to power plants.
- Financial grant of ₹9 lakh per metric tonne/hour capacity for pellet/briquette manufacturing, subject to a maximum assistance of ₹45 lakh.
- Allowing maize and surplus rice available with the Food Corporation of India (FCI) for ethanol production.
- Mission Innovation 2.0 – under which India and the US are co-leading the Mission Innovation for Sustainable Aviation Fuel (SAF).



Way Forward

To achieve the target of scaling up bioenergy solutions and mitigating the environmental impact of energy generation, the following action plans are suggested:

- Devolving a market mechanism for biofertilisers.
- Concessional financing for the bioenergy sector.
- Support bioenergy projects under partial risk sharing facility of SIDBI.
- Devise avenues for waste management.
- Collaborative efforts with vehicle manufactures to support higher biofuel blends.
- Ensure efficient aggregation of biomass.
- Collaboration between industry and academia on sectoral R&D.
- Capacity building of FIs around bioenergy project.

Enable soft loans/lines of credit for bioethanol, CBG, biomass cogeneration, and power plants through financial institutions/PSUs. Provide interest subvention/subsidy to encourage technology adoption and to develop state-of-the-art depots at block and district levels.

Enhance FI and bank capabilities to assess biomass and organic waste projects, evaluate financial viability, develop sustainable business models, and manage off taker arrangements. This will reduce perceived risk and improve funding flow to the sector.

AUTHOR

Mr. Mahendra Rustagi
Chair - Environment & Climate Change Committee, PHDCCI
President, Sainik Industries Limited
(Kreston SNR Advisors LLP)

India's Option for Energy Security Pathway for Climate Mitigation

"We urgently need to respond to the growing impact of climate change on energy systems if we are to maintain energy security while accelerating the transition to net-zero. This requires long-term planning and bold policy action to spur investment, which in turn needs to be underpinned by comprehensive and reliable weather and climate data."

-Dr Fatih Birol, International Energy Agency Executive Director.

"Now is the time to accelerate the transition to a renewable energy future. Anything short of radical and immediate action will ultimately eliminate the chance of staying on the 1.5°C path. The intertwined energy and climate crises have dramatically exposed the weaknesses and vulnerabilities of an economic system heavily reliant on fossil fuels. Advancing the transition to renewables is a strategic choice to bring affordable energy, jobs, economic growth and a resilient environment to the people and communities on the ground,"

-Francesco La Camera, IRENA's Director-General.

"More can and must be done. Bold climate action could deliver US$26 trillion in economic benefits by 2030. And yet, investment in renewable energy is much too low, especially in developing countries and too little attention is paid to the importance of climate services for energy to support both climate adaptation and decisions on how to reduce greenhouse gases."

-UN Secretary-General Antonio Guterres

Climate Impacts and Energy Security

- India recognizes that climate change is a significant global problem and an issue of great socio-economic and political importance. Currently, the global average temperature has already risen over 1 degree Celsius (°C) since the pre-industrial period, increasing at a rate of about 0.2 degrees Celsius per decade. At the current rate, the global average temperature rise is likely to exceed more than 1.5 °C by 2030, ten years earlier than it was projected by the IPCC AR5 in 2014.
- The latest IPCC report warned that a threshold of 1.5 °C will lead to serious and irreversible consequences for several centuries. Warming of 1°C is already causing widespread disruptions globally, in various sectors, including agriculture, human health, infrastructure, water management, biodiversity management, etc.
- It is now well-established that the magnitude and rate of contemporary warming of the atmosphere, land and oceans

are predominantly due to human activities such as the burning of fossil fuels, deforestation and changes in land use and land cover (LULC) during the industrial period which has substantially changed the atmospheric composition of greenhouse gases. The increasing rise in global temperature has already contributed to a significant increase in weather extremes globally, such as heatwaves, heavy rainfall events, tropical cyclones, and changes in wind and ocean currents. Global warming has also led to large scale changes such as degradation of marine and terrestrial ecosystems, acidification of the global ocean, melting of sea ice, glaciers and polar ice caps, and rise in sea levels, most of these changes are now unavoidable and irreversible over hundreds or even thousands of years.

- Recent events and expert analyses suggest the impacts of climate change have the potential to cause significant political and social disruptions at the national, regional and global levels, driven by increasing competition for scarce resources, market fluctuations, forced human migration, infectious diseases, etc.

- India's participation in the global climate discourse has been shaped primarily by a scientific understanding of its domestic vulnerabilities to climate change and the adverse impacts on the country's environment, economy, and society. Its approach is grounded in the principles of common but differentiated responsibilities, climate justice and equity but outlined by a more flexible outlook towards emissions reductions. Over the last three decades of climate change negotiations, India has emerged as a global leader in climate action, balancing its national-level development goals with urgent actions to fulfil its climate change commitments.

- India's positions at the UNFCCC negotiations have been supported by commensurate action at the national level in terms of ambitious climate change policies, a consistent push renewable energy capacity augmentation toward energy security including low carbon energy for preservation of natural ecosystems and promotion of disaster risk reduction and climate change adaptation measures.

Energy Security: India's Quest for Clean Energy

India, the third-largest energy consumer and the third-largest oil importer is working aggressively to provide affordable energy, ensuring energy access to all and ensuring high efficiencies in the operations. The intent to provide energy security to its 1.3 billion people will have far-reaching impact on India's energy portfolio as its embraces clean energy pathways. Prime Minister Narendra Modi at the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom has announced the following five nectar elements (Panchamrit) of India's climate action:

i. Reach 500 GW Non-fossil energy capacity by 2030.

ii. 50 per cent of its energy requirements from renewable energy by 2030.

iii. Reduction of total projected carbon emissions by one billion tonnes from now to 2030.

iv. Reduction of the carbon intensity of the economy by 45 per cent by 2030, over 2005 levels.

Including (V th) that India will attain the Net Zero Emission target by 2070. This has brought the Indian position in alignment with the international mainstream, including that of a large number of developing countries. India has opted for a longer transition period. This is justified because we are at a low point in our development

trajectory. India, China, US and Australia have refrained from joining the pledge to phase out coal.

India has strengthened its position in the market not only as a popular consumer but also as a transforming nation with some outstanding far-reaching above referred key agendas as PANCHAMRIT. India has a flourishing diversity with 28 states and 8 Union territories that cover a range of geographical complexities. The per capita energy consumption of India is one-third of the world average. More efforts are required to raise this per capita energy consumption for the inclusive development of the country.

Basically India's energy security is intricately linked to economic and population growth, accessibility, availability, affordability, acceptability and supply and demand. India's quest for energy security is going at its full pace. India embraced various domestic efforts and has drawn up supplier relationships around the globe in coal, oil, gas, nuclear, hydroelectric power, solar and renewable energy including green hydrogen.

The energy sector contributes to about 75% of the total greenhouse gas emissions of the country. The paradigm shift in the clean energy transition has a twin-fold objective:

i) ensure affordable and reliable energy to all and

ii) reduce its dependence on fossil-based energy by accelerating the clean energy transition.

Looking at the trend of energy consumption and dependence on imported oil & gas, it appears India is not likely to be fully independent of external sources of supply for its energy requirements in the short-term and medium-term.

There is no major technological breakthrough in alternative energy to free the country from its energy predicament, thus, India to meet aforementioned objectives, needs to adopt multi-dimensional strategic energy security approaches.

The key focus here is to examine and understand what is the energy security including the key concerns, trends, challenges, and various options available to India to face the challenges in energy security and simultaneously addressing challenges of climate change issues.

An Understanding - What is Energy Security?

The concept and definitions of energy security have widened over time, most studies, however, address policies combating energy insecurity and mitigating externalities of energy supply disruptions without explicitly explaining the concept of energy (in-) security and how to measure the level of insecurity however, an exact definition of energy security is hard to give as it has different meanings to different people at different moments in time. Since the idea of energy security is not precisely defined, it seems even more challenging, if not premature, to attempt to define it. Indeed, the deputy chairman of the planning commission has said that "it was never clear in anybody's mind what energy security is". Let us look at different references to prices in defining energy security.

- A 1999 UNDP report defined Energy Security as the continuous availability of energy in varied forms in sufficient quantities at reasonable prices.
- From Wall Street Journal in which Daniel Yergin defined energy security as "the security and integrity of the whole supply chain and infrastructure, from production to the consumer."
- Dr A.P.J Abdul Kalam as Indian president defines it as "ensuring that our country can supply lifeline energy to all its citizens, at affordable costs at all times." He sees energy security as based on a few principles: conservation; secure access to all sources of energy globally (even though he

believes “the end of the a fossil fuel era is fast approaching”); and access to “reliable, affordable, and environmentally sustainable energy.” But he views energy security as merely a transitory step toward what he believes should really be India‘s first and highest priority “energy independence” which he thinks should be achievable by 2030.

- For India, the Parikh Committee report stated that a country is energy secure when it can supply energy to all its citizens and meet their demand for safe and convenient energy at affordable costs at all times with a prescribed confidence level considering shocks and disruptions that can be expected.
- The Neeti Aayog (the than Planning Commission of India) has probably come closest to providing a comprehensive and official Indian definition of energy security to date: “The country is energy secure when we can supply lifeline energy to all our citizens as well as meet their effective demand for safe and convenient energy to satisfy various needs at affordable costs at all times with a prescribed confidence level considering shocks and disruptions that can be reasonably expected.” While talk of “energy security” has increased, clarity about its meaning has not necessarily improved and includes a wide range of interpretations. Security of supply of oil and natural gas; secure lines of interdependence.

  » Oil security—some in this camp further believe energy security is more than merely protecting against temporary disruptions; it should take into account price volatility, which poses a risk to India’s economic security.

  » Independence from imports, or “oil self-sufficiency,” though most experts dismiss this idea as one promoted by people who either have not assessed India‘s situation realistically or have little grasp of technical facts.

  » Going beyond the country’s overall requirements as a whole and looking at the requirements of individuals.

Message From COP 27

An editor of “The Economist” Mr. Vijay Vaitheeswaran for energy and climate has given a very specific remark at COP27 in Sharm El-Sheikh, Egypt, that “We will see a much stronger focus on how the energy industry itself can play a role as a decarboniser. It's about, in my view, a grown-up way of understanding that the oil and gas is here to stay. A number of countries, especially emerging markets, are going to rely on it.”

This resonates strongly in India – a rich emerging market that caters to a population of 1.32 billion and is expanding. For countries such as ours, especially, understanding the true scope and potential of the traditional energy industry will be pivotal to long-term sustainable energy transition.

With energy continue to occupy the center stage for the livelihoods of billions of people, switching off the tap is not an option; the real deal is to ensure that the energy sector transitions into a ‘clean regime’ and that is happening already. India has been unequivocal in this stance. It has always advocated for clean energy transition that does not stymie development, and this is reflected in the Long-Term Low Emission Development Strategy launched by Hon’ble Union Minister for Environment, Forest and Climate Change, Govt. of India . This is also reflected in the nation’s commitment to the rational utilization of national resources with due regard to energy security.

India’s position at COP27 is a message to the world – especially on the need to accept the realities of all developing nations – that low carbon development transition in the energy sector should not impact

energy security, energy access and development. Energy security is not at odds with climate action as UAE's Special Envoy for Climate Change, Dr Sultan Al Jaber observed, "We need maximum energy, minimum emissions." For this, it is important to pursue all pathways, without wavering on the commitment to cut emissions of the current energy infrastructure

Government Policies and Initiatives

To meet net zero carbon emission by 2070, the Indian government has introduced robust policies and reforms to enable domestic energy players in the country to ramp up renewable infrastructure capacities. These policies and reforms are enabling the transition to a more sustainable and resilient energy ecosystem through investments, subsidies, and opportunities for domestic and international players to craft technologies. Let's take a closer look on the several initiatives taken by the government at policy and technology level that are enabling India's transition to clean energy.

Focus on Non-Fossil Fuels

One of India's government's priorities to decarbonize the country and meet the clean energy targets is to diversify its energy sources, specifically renewable energy sources. The alternatives that they have turned to are green hydrogen, solar and wind energy. The government has introduced policies to facilitate this adoption.

National Hydrogen Mission

The National Green Hydrogen Mission aims to provide a comprehensive action plan for establishing a Green Hydrogen ecosystem and catalyzing a systemic response to the opportunities and challenges of this sunrise sector. The Green Hydrogen pathway can be a key enabler for India's aspirations of building a low-carbon and self-reliant economy. It is therefore an opportune moment for India to launch the National Green Hydrogen Mission to scale up Green Hydrogen production and utilization across multiple sectors and align with global trends in technology, applications, policy and regulation.

The Union Cabinet, chaired by the Hon'ble Prime Minister Shri Narendra Modi, has approved National Green Hydrogen Mission in January 2023. The initial outlay for the Mission will be Rs.19,744 crore, including an outlay of Rs.17,490 crore for the Strategic Interventions for Green Hydrogen Transition (SIGHT) program, Rs.1,466 crore for pilot projects, Rs.400 crore for R&D, and Rs. 388 crore towards other Mission components. MNRE will formulate the scheme guidelines for implementation of the respective components.

The Mission will result in the following likely outcomes by 2030:

- Development of green hydrogen production capacity of at least 5 MMT (Million Metric Tonne) per annum with an associated renewable energy capacity addition of about 125 GW in the country
- Over Rs. Eight lakh crores in total investments
- Creation of over Six lakh jobs
- Cumulative reduction in fossil fuel imports over Rs. One lakh crore
- Abatement of nearly 50 MMT of annual greenhouse gas emissions

To harness green hydrogen, the Indian Government recently approved the Green Hydrogen Policy which aims to make India the world's largest hydrogen hub produced through electrolysis of water using renewable energy, green hydrogen will significantly reduce emissions; approximately 3.6 giga tons (this is the equivalent of traveling 133.2 trillion kms in an average car) of CO2 by 2050. With the right facilitates, the Green Hydrogen Policy will not only play a critical role in India's transition to clean energy, enabling the country to become self-reliant, but also allow the country to carve a niche by capitalizing on this

development to become a world leader in the production of green hydrogen and its applications.

Solar City Program

The Ministry of New and Renewable Energy is implementing a program to develop solar cities in the country. The aim is to have "Green City in Every State" where these smart cities are powered by solar energy or renewable energy. The objective of this initiative is to empower local governments to address their energy requirements and challenges at city-level. Financial provision of up to Rs. 50 lakh per city/town will be provided, depending upon population and initiatives to be undertaken. The UP Government recently announced that they will be developing 20 solar cities in the next five years.

Wind Solar Projects

Another initiative to increase India's renewable energy capacity that is taking off well is the hybrid solar-wind combined projects. Hybrid solar projects use batteries to store excess energy produced. The key advantage of this system is uninterrupted access to power despite poor sunlight, especially during monsoon season. Other advantages associated with this system are high efficiency and better load management at low maintenance cost. These hybrid projects help in maintaining grid stability while optimizing the use of the same land. Adani Hybrid Energy Jaisalmer One and Tata Power Green Energy are some of the prime examples of hybrid power projects.

Product Linked Incentives (PLI) for Battery Manufacturing

To help boost the country's domestic manufacturing capacity of batteries, the Government of India launched Production Linked Incentive (PLI) Program for Advanced Chemistry Cell (ACC) Battery Storage. Under this initiative, the companies that signed the agreement will be provided with incentives to set up Advanced Chemistry Cells for battery storage. The manufacturing facility will have to be set up within 2 years and the companies will be receiving incentives. Reliance New Energy, Ola Electric Mobility and Rajesh Exports recently signed the program agreement.

Technology

India's ace in the country's pursuit of energy independence is solar energy. Owing to the efforts of the government, several startups, and industry leaders, the rooftop solar energy sector has been rampant with technological advancements. Two key advancements that need special attention are advanced photovoltaic and energy storage systems.

- Advancements in Photovoltaics

  Technological advancements around solar cells are largely focused on increasing its efficiency and durability. Some of the key advancements in solar cells include half-cell technology, building integrated photovoltaic panels and floating solar photovoltaic panels. Known to perform in high heat conditions and less prone to panel malfunction, half-cell technology works on the principle that more PV cells mean less resistance to the flow of electrons in the circuit.

  In India where real estate is valuable, building integrated photovoltaics and floating solar photovoltaic panels offer better alternatives. To help buildings and skyscrapers adopt solar panels without detracting from its aesthetic appeal, building integrated photovoltaics are customized to be incorporated into architectural features such as canopies and terraces. Floating solar photovoltaic panels on the other hand are installed over lakes and reservoirs as it has some of the largest unobstructed available surface areas allowing them to produce solar energy. Recently in India, a fully operational solar power plant has been set up in Tuticorin,

Tamil Nadu with Andhra Pradesh following its footsteps closely.

- Energy Storage Systems

  Though nascent, energy storage plays a critical role in grid integration by increasing the flexibility of the grid overall. If residential and industrial users leverage energy storage systems with especially renewable energy sources, it has immense potential to improve power quality. It not only offers a reliable alternate source of energy but also reduces peak demand, enhancing the capacity of distribution/transmission grids while helping avoid/reduce deviation penalties. To balance the grid, the Central Electricity Authority (CEA) has begun a process of creating rules to enable participation of energy storage and demand response in ancillary services markets. The PIL scheme is aimed to boost the country's domestic production of advanced chemistry cell battery manufacturing.

Bio Fuels

The energy demand in India is growing at a rapid rate, which makes switching to biofuels the need of the hour. As per a recent report by the International Energy Agency, the country is projected to add the largest percentage increase in coal use globally, ahead of China and the European Union. Its coal use is expected to increase by 7% or about 70 million tons (Mt). The country still largely depends on fossil fuels, close to 50% of which is still imported. This is further expected to increase to 53% by 2030. With depleting resources, climate change, rising fuel prices and power demand, the country needs to shift gears and integrate cleaner alternatives like biofuel for a sustained growth.

Bio fuels are fast cutting its reliance on fossil fuels not only to combat climate change but also to achieve energy security, achieve self-reliance and gain benefits on socio-economic fronts. In its efforts towards developing alternative, clean, and green fuels, it has increased focus on producing biofuels to meet its current and future needs.

A key advantage of increasing reliance on biofuels is they are generated from waste which is easily available everywhere. Generally, produced from agriculture , food or human-generated waste and is a reliable and efficient replacement for conventional, carbon-emitting fuels. These are non-polluting, biodegradable and cost-friendly. By making ethanol blending a part of its strategy to switch to cleaner alternatives, India aspires to reach the 20 per cent ethanol blending target by 2025. In addition, the country is also likely to pitch for a global alliance on biofuels. These developments are not just an acknowledgement of the immense benefits biofuels but are also a realization of its importance in ensuring sustainable development, lowering pollution, empowering communities, and strengthening the economy.

Modern bioenergy is the largest source of renewable energy globally, accounting for 55% of renewable energy and over 6% of global energy supply. The Net Zero Emissions by 2070 Scenario sees a rapid increase in the use of bioenergy to displace fossil fuels by 2030. More efforts are needed to accelerate modern bioenergy deployment to get Net Zero scenario on fast track, which sees deployment increase by 10% per year between 2021 and 2030, while simultaneously ensuring that bioenergy production does not incur negative social and environmental consequences.

Biofuels for 3Es: Environment, Economy and Empowerment

A recent study by the International Energy Agency says that India's annual import bill for fossil fuels is projected to triple by 2040 because the country is set to experience the largest energy demand increase in the world over the next two decades. Rising consumption of fossil fuels is a reason for increasing stress on the Indian economy and

thus it makes it urgent to look for sustainable alternatives. Going for biofuels can massively benefit the Indian exchequer and lower its dependence on oil producing countries for imports which is currently an obstacle for India to achieve energy security and economic prosperity.

Biofuels can provide much-required self-sufficiency in energy and are also a game changer in the fight against alarming rise in air pollution levels . A study by Harvard School states that 30% of fatalities in India are due to air pollution caused by fossil fuels which makes it crucial to look for instant solutions to address the challenges. Thus, ethanol blending becomes the best way to lower carbon emissions and fossil fuel imports.

Biofuels are produced from agricultural waste and this presents a great opportunity to empower farmers and transform the rural economy. Turning food producers to fuel producers can improve the quality of life of people majorly residing in the rural areas, create revenue and generate more employment. Also, a large portion of harvested crops like rice, wheat, vegetables, etc. get destroyed due to bad or uncertain weather conditions or lack of storage facilities. Earlier, farmers had to dump the damaged crops but now they can be used to produce biofuels. Similarly, stubble burning is a major challenge which has resulted in thick smog enveloping metropolises like Delhi. Crop stubble can be made a source of income with biofuel production and it can also support in reducing air pollution levels.

It is promising and encouraging that the efforts made to promote the production of biofuels with government support are bringing results. As per projections, India is expected to overtake China to become the third largest ethanol consumer by 2026. Biofuels for India have great importance. Increase in biofuel consumption can increase energy security, reduce crude oil import, reduce GHG emissions but most importantly delink India from geopolitical turmoil caused by rising fuel prices and give a strategic and competitive edge globally. It can turn out to be a boon for small entrepreneurs and farmers who can be directly linked to the huge economic opportunities that exist in the sector. The year 2023 will definitely witness significant progress in biofuel production which will accelerate India's progress towards its sustainability targets.

Bioenergy Pathway for Net Zero

Bioenergy is an important pillar of decarbonisation in the energy transition as a near zero-emission fuel. Bioenergy is useful because there is flexibility in the contexts and sectors it can be used in, from solid bioenergy and biogases combusted for power and heat in homes and industrial plants to liquid biofuels used in cars, ships and airplanes. Furthermore, it can often take advantage of existing infrastructure – for instance, biomethane can use existing natural gas pipelines and end-user equipment, while many drop-in liquid biofuels can use existing oil distribution networks and be used in vehicles with only minor alterations.

Bioenergy use needs to increase in a wide variety of applications by 2030 for Net Zero destination. In addition following applications are progressing well in the direction of net zero:

- Biojet kerosene used in air travel increases from nearly zero in 2021 to account for over 7% of all aviation fuel demand in 2030.
- Liquid biofuel consumption quadruples from 2.1 mboe/d in 2021 to over 8 mboe/d in 2030, mainly for road transport.
- Bioenergy use in industry increases substantially, from supplying a little over 11 EJ of energy in 2021 to over 17 EJ in 2030, mostly in cement, pulp and paper, and light industry.
- Bioenergy used for electricity generation provides

dispatchable, low-emission power to complement generation from variable renewables. Its use nearly doubles, from creating about 750 TWh of electricity (about 2.5% of total demand) in 2021 to about 1 350 TWh (about 3.5% of total demand) in 2030.

- Bioenergy with carbon capture and storage (BECCS) – which creates negative emissions by capturing and storing bioenergy emissions that are already carbon-neutral – also plays a critical role. BECCS captured and stored 2 Mt of CO2 in 2021, and increases to around 250 Mt of CO2 in 2030, offsetting emissions from sectors where abatement will be most difficult.

Ethanol Blending

The government of India has advanced the target for 20 per cent ethanol blending in petrol (also called E20) to 2025 from 2030. E20 will be rolled out from April 2023.

This measure is aimed at reducing the country's oil import bill and combat environment-related challenges including reduction in carbon dioxide. This new initiative is also part of measures to improve energy security and self-sufficiency measures. The technology is almost the same as internal combustion engines and simpler modifications can make the engines ready to use the new fuel.

Nuclear Power:

- Nuclear power is produced from uranium. However, we have very limited deposits of uranium within the country. The alternative is to convert thorium into uranium and then use it for the generation of nuclear power. We have adequate sources of thorium.

- India has the world's third-largest reserves of thorium. Thorium, however, cannot be used as a fuel in its natural state. It needs to be converted into its usable "fissile" form after a series of reactions. In 2022, nuclear power capacity stands at 6,885 MWe.

- Concerns: Out of India's 23 nuclear power reactors, 18 have a capacity of fewer than 300 MWe which means that most are "small" reactors. The nuclear power sector has the slowest growth rate amongst fuels despite ambitious targets, strong protection, and generous budgetary allocations.

An MIT study in 2018 pointed out that without nuclear as part of the energy mix, 'the cost of achieving deep decarbonization targets increases significantly.' This has significance for India. Nuclear power will remain a major part of the energy mix of the US (20 %), EU (20 %), and China (10%) in the future. Recently, Japan's new Prime Minister Fumio Kishida stated: 'It's crucial that we re-start nuclear power plants. Beijing plans to bring 150 new nuclear reactors online over the next 15 years. In India's case, nuclear power accounts for less than 2 % of the generation currently.

Nuclear tariff of Rs. 3.47 per unit in 2019 is already lower than the tariff of more than Rs 4 per unit for solar with a storage solution in contracts awarded to Renew Power and Greenco. India needs to enhance the share of nuclear in the generation mix to achieve lower emissions and ensure energy security. Bill Gates in his book 'How To Avert A Climate Disaster' says that nuclear fission is 'the only carbon-free energy source that can reliably deliver power day and night. This will need government intervention to provide 'must-run' status and benefits to renewables and to nuclear power as well.

Other Measures for Strengthening Energy Security

1. Diversification of the sources of Imports:

- To ensure the security of crude supplies and to mitigate the risk of dependence on crude oil from a single region, oil PSUs have diversified petroleum baskets. Indian government working on diversifying the country's energy basket with crude oil supplies from non-OPEC sources.

- State-run Indian oil companies have started importing crude oil from the US, Russia, Canada, Australia, Brazil, Guyana, Norway, Egypt, Gabon, Ghana, Congo, Equatorial Guinea, Libya and Nigeria.

2. Discovering and Exploiting own Energy Resources:

- Boosting oil and gas production has been a key part of the government's Aatmanirbhar Bharat initiative. It has set a goal to boost the use of natural gas in India's primary energy mix from the current 6.2% to 15% by 2030.

- To promote oil and gas production at the domestic level, the Indian Government has been taking several steps which range from encouraging the Indian companies to increase their domestic activities and widening their engagement with multinational companies, broadening opportunities for them to participate in oil and gas exploration in India.

3. Exploiting Shale and Its Potential in India:

- India has got technically recoverable shale gas of 96 trillion cubic feet. The, Damodar Valley, Upper Assam, Pranahita – Godavari, Rajasthan and Vindhya Basins.

4. Building Strategic Reserves:

- Strategic Petroleum Reserves are stockpiles of crude oil, held by the government of a particular country or a private industry, to use in case of any crisis or emergency. It can act as insurance against imported supplies. Presently, India has three strategic petroleum reserves with a combined storage capacity of 5.33 million tons (about 38 million barrels).

i. Visakhapatnam (1.33 million tons)

ii. Mangalore (1.5 million tons)

iii. Padur (2.5 million tons)

5. Increasing Domestic Production of Coal:

- Coal is the only fuel that India has in abundance and the geopolitics of India's coal sector have led to an increase in domestic production of coal by 9.01 per cent and the overall production of the dry fuel rose to 447.54 million tons (MT) till November this fiscal, compared to 410.55 MT in the corresponding months of FY'20.

- Thermal Power Plants accounted for only 59.7% of the total installed generation capacity of 395 GW (as of January 2022). Coal, therefore, plays a vital role in India's ongoing efforts to achieve Sustainable Development Goal 7, which is "to ensure access to affordable, reliable, sustainable and modern energy for all" and while doing to will help us to strengthen our energy security.

Conclusion

India's quest for energy security is off to a good start. The combined efforts of government, startups and industry leaders will usher in a new era of clean energy through policies and tech advancements. This will help India achieve climate-resilient energy independence.

Energy security is a multidisciplinary field that overlaps with engineering and energy systems analysis, earth sciences, economics, technology studies, political science, international relations, and security and military studies. Climate change, globalization, and the uncertain future of fossil fuels have added new dimensions, such as sustainability, energy efficiency, mitigation of greenhouse gas emissions, accessibility of energy services (energy poverty), etc. Thus, the concept of energy security became interconnected with other environmental, social, political, and security issues.

Though the government has made significant reforms in the energy

sector, a lot needs to be done to achieve these objectives. This requires a robust roadmap and active involvement of the states. The government has given thrust to improve downstream delivery with an aim to improve transmission, distribution infrastructure and financial position of distribution companies; access to clean cooking fuel through efficient and affordable fuel and ensure uninterrupted supply of electricity. All these efforts require differential planning and execution.

AUTHOR

Dr. J . S. Sharma, Ph. D.
STA Fellow (Environment), METI, Govt. of Japan
Co-Chair, Environment Committee, PHD Chamber of Commerce and Industry,
President, Indian Association of Air Pollution Control, Delhi ,
Former Group General Manager - Head Environment,
Oil and Natural Gas Corporation Ltd. (ONGC),
sharmajswarup@hotmail.com

Need of "Dent Corn Revolution in the country for Energy Security, Food Security, and Decarbonization."

1.0 Introduction

Dent Corn is a non-edible variety of corn used as a feedstock to produce bioethanol. All the bioethanol and animal protein produced in USA in over 200 Biorefineries is from dent corn in the US which is 95 % of all (about 400 million ton/ year) corn grown in USA. Dent Corn with 70-75 % starch content is particularly advantageous for production of valuable by products (protein meal and Corn Oil) and the starch residue and ingrained cellulosic fibre is converted to Ethanol. This higher starch content results in a much greater ethanol yield, producing 425-450 litters ethanol per ton of dry Corn.

Dent Corn is the most produced crop globally with 1.2 billion tons/ year, followed by wheat and Rice at about 760 million tons each.

India is an agriculture focussed society leading in Wheat, excessive water requiring Rice and sugarcane crops. India also leads in Milk production with high protein requirements of Dairy cows. However, it is unfortunate that fast-growing dent corn with good protein content has not received the attention of the Indian community, and farmers in particular, despite the distinct advantages of corn for ethanol, Protein meal and corn oil (cooking) production. Ethanol offers a complete solution for our country's energy security. Ethanol can fully replace gasoline in automobiles with flex engines. It is also used to produce Synthetic Aviation Fuel and can be a replacement for LPG in household cooking.

Ethanol is also a feedstock to produce bio-ethylene and ethylene derivatives for vast Petrochemical industry, reducing carbon emissions significantly towards net zero, and at a fraction of investment (CAPEX) cost for similar size Naphtha or Gas steam crackers, including specialty chemicals and Hydrogen.

Ethanol contributes to a reduction of around 80% in Greenhouse Gas emissions compared to fossil fuels. In production of ethylene, about 3-ton carbon/ ton is saved compared to Naphtha or Ethane cracker.

The use of dent corn for ethanol production will free up broken rice, grains, sugarcane juice, even molasses etc., which are presently being used for ethanol production, ensuring food security. Also, ethanol production from dent corn will offer corn oil, animal proteins, and DGCA for animal feed which are being imported in the country besides growing industrial ethanol import. (about 2 million tons/year recently).

The increasing demand for ethanol will lead to better remuneration to farmers, thereby improving their socio-economic condition.

Dent Corn is a fuel and should have parity with crude oil. Unfortunately, India has remained misguided, confusing dent corn with food grain corn. Edible corn is being taken care of by the Agriculture Ministry with a focus on increasing its cultivation.

The need of the hour is to lead a "Dent Corn Revolution" for fuel purposes. This is not our expertise now, but we can seek support from the USDA and Brazil, both US and Brazil are leaders in Corn and corn-based ethanol production.

The Indian government should allow, for a limited period of 5-10 years, the import of dent corn with zero duty to enable the establishment of large ethanol biorefineries in the country. By doing so, the requirement for bioethanol will be locally met, and the demand for dent corn will increase exponentially, giving farmers an incentive to grow dent corn leading to "Dent Corn Revolution." This will reduce higher $ amount of crude oil and LNG import and thus will give net forex saving and reduce drain on Indian budget.

On September 18, 2024, US and India joined hands on SAF development alliance during visit of Hon. Petroleum Minister Hardeep Puri with US energy secretary Jennifer Granholm. Dent Corn provides robust supply chain for production of SAF in India and its use to decarbonize rapidly growing aviation sector. This is in continuation of G 20 Biofuels alliance launched by India on September 10, 2023. Ethanol and Ethylene are preferred pathways to SAF production. (ATJ route)

A comparative analysis with the United States, a global leader and now Brazil in corn-to-ethanol production, underscores the importance of robust government support and incentives in the beginning to enable realizing this potential. The United States has become a leading producer of corn-based ethanol due to extensive federal support, including the Renewable Fuel Standard (RFS) that mandates renewable fuel use in transportation. Enforced laws requiring ethanol blending, tax credits, grants, and loan guarantees have spurred investment in ethanol production, reducing financial risks for investors. California does E85 and Brazil it is E100 for flex cars.

The production of bioethanol in the United States over the past three years has been as follows. This data indicates a steady increase in fuel grade bioethanol production over these years:

2021: 45 million tons; 2022: 46.5 million tons 2023: 47.5 million tons (installed capacity: 55 million ton/ year)

The US corn-to-ethanol industry has created flourishing farmland, millions of farming and other industry jobs and provided farmers with a stable market, boosting rural economic development and circular economy. It has also diversified the energy supply, reducing reliance on imported oil, and enhancing energy security. This also reduces Carbon imbalance as increased Corn crop would absorb higher amount of Co2 from atmosphere.

The United States is the world's largest producer and exporter of corn. About 50 millions /year is exported globally. Brazil, Argentina, and Ukraine are other corn exporters. A huge portion of the corn harvested in the U.S., EU and now Brazil is used for ethanol production.

2.0 Policy recommendations to achieve above objectives:

2.1 "Dent Corn Revolution"

- Allow duty free import of fuel grade dent corn. Ethanol import from USA, Brazil, Argentina, Ukraine, and other countries, for a period of 5 years, for those companies which are keen for setting up Biorefineries in India. The duty-free import of non-food grade dent corn must be kept at par with duty free Petroleum imports for 5 years. (for example; Crude oil import has total duty of Rs 2 /ton). Corn import will cut down e petroleum imports in a big way and provide better economics as well as environmental solution and less dependence on OPEC.
- Policy enactment to help farmers to double the Corn productivity in India in next 5 years.

- India's current corn production yield is around 3.5 tons vs above 8-15 tons/hectare in USA, EU/ Brazil/Argentina.

- Enormous potential to double the crop from the same amount of land as now being harvested for corn with better seeds).

- Corn harvesting requires much less water than sugarcane of rice (water is getting scarce) and can be grown partly in unirrigated land.

2.2 Bioethanol

- 100% replacement of gasoline in flex-fuel engines (E-100), feed for SAF (sustainable aviation Fuel), and replacement of LPG.

- Ethanol has an Octane rating of 115 compared to superior Petrol with carcinogenic Aromatics having an Octane rating of 96 and normal Petrol with Octane rating of 88.

- In the US, 95% of bioethanol is produced in 200 large Biorefineries, from dent corn grown as energy / animal feed crop.

- Agriculture Research Institute and other Maize R&D centres should be empowered to lead India in the 'Dented Corn Revolution' by 2030, working closely with US agencies, who are far ahead in Dented Corn Production.

- Major and low-cost solution to produce Ethylene for entire petrochemical ethylene derivative chain such as Polyethylene, PVC, EO/MEG/ PET, Polycarbonate, PS, and others,

3.0 "Creation of entity "Bharat prakriti Indhan (biofuels) Corporation"

- A corporation with participation of PSUs and Petroleum sector companies, large private companies, and State-owned companies, who will be responsible to build and operate large ethanol biorefineries to produce Ethanol, Ethylene, and derivatives such as SAF and other Chemicals and polymers.

- Mission would be to install global scale biorefineries in the range of 1000 KLPD to 1500 KLPD. India would need 50-100 such global scale projects in next 10-15 years to meet its biofuel mandates and achieve E-100 for Petrol vehicles, blending in Diesel, SAF, bio-Chemical and bio-polymer production for consumer industry.

- Participation on selected basis, of USA based pioneering companies who can bring efficient technology solution collaborating with Indian companies in Ethanol, Ethylene, derivatives and SAF production.

4.0 Financial Support

- Dent Corn Revolution and Bioethanol refineries including SAF should be taken on mission mode with massive government incentives and investment with the PLI schemes. 'Dent Corn Ethanol' and bioethanol production need a massive incentive matching pie to pie with Green Hydrogen.

5.0 Conclusion

- 'Yellow Dent Corn Ethanol' embodies the four Fs: Food, Feed, Fuel and Financial security. It represents a technologically proven and economically competitive pathway for India's decarbonization and sustainable development. This initiative is a gold mine for both energy and food security and will be a game changer for the nation, ushering in the 'Yellow Dent Corn Revolution' for India. Ethylene produced via Ethanol at a fraction of fossil-based investment will provide the base of modern Petrochemical industry which utilizes capital intensive and polluting Naphtha and Gas stream crackers.

- In 5 years, with above policies, with duty free import of dent

corn for 5 years backed in policy, and empowering farmers, India would have enough domestic dent corn production to reduce/ or eliminate dent corn import. Corn is currently in OGL, and duty should be eliminated for dent corn in parity with Crude Petroleum oil.

- There is little chance of domestic crude oil, LNG (Petroleum) production to match demand even in 100+ future years and import dependency/$ drain will continue and grow if Biofuels are not attended with utmost seriousness.

AUTHOR

Dr. J.P. Gupta
Chair - Environment & Climate Change Committee, PHDCCI
Former Chairman, EAC Ministry of Environment, Forest & Climate Change

Seizing the Corn Revolution: India's Window to Secure the Biofuel Economy

Maize has long been recognized as a staple food and an essential feed for poultry and livestock. In India, demand for maize is driven primarily by the poultry industry, resulting in a consistent and growing market. Now, with the government's E20 order mandating 20% ethanol blending by 2025 and 30% by 2029-30, maize has become central to the country's energy security strategy. This shift sets the stage for a Corn Revolution, a movement that aligns agriculture with renewable energy and sustainability.

Unlike sweet corn that is consumed as food, dent corn offers a distinct advantage for the energy sector. With 70–75% starch content, dent corn produces 425–450 liters of ethanol per ton, making it one of the most efficient crops for biofuel production. Globally, dent corn accounts for 95% of corn grown in the United States, powering more than 200 biorefineries and yielding high-value byproducts such as corn oil and protein meal. The use of dent corn for ethanol production could free up food grains, such as rice and wheat, that are currently being diverted for fuel, while also reducing dependence on imports of corn oil and protein meal. This shift could provide farmers with better returns, ensure food security, and transform dent corn into a true fuel crop deserving parity with crude oil.

Ethanol lies at the heart of India's decarbonisation journey. It reduces greenhouse gas emissions by up to 80% compared to petrol and saves nearly three tons of carbon per ton of ethylene produced compared to traditional naphtha crackers. Beyond being a fuel, ethanol is a versatile feedstock that supports the production of bio-ethylene, sustainable aviation fuel (SAF), bioplastics, hydrogen, and e-methanol. In this way, ethanol not only reduces vehicle emissions but also helps decarbonize entire industries, from aviation to packaging. Every liter of ethanol produced serves as both an energy source and a carbon asset, reinforcing India's transition to a carbon-neutral economy.

The integration of bio-ethanol and bio-ethylene into petrochemical supply chains has far-reaching benefits. Ethanol can be converted into bio-ethylene, serving as a low-carbon alternative to the petrochemical industry. From bioplastics used in packaging to specialty chemicals and synthetic aviation fuels, ethanol-derived products reduce dependence on fossil-based feedstocks. This supports India's "Lifestyle for Environment" (LiFE) mission by enabling cleaner energy, greener materials, and more sustainable consumption patterns.

Aligned with the LiFE mission, the Corn Revolution also directly advances the United Nations Sustainable Development Goals (SDGs). It supports SDG 7 (Affordable and Clean Energy) by promoting renewable energy, SDG 13 (Climate Action) by reducing greenhouse gas emissions, and SDG 2 (Zero Hunger) by ensuring food security through smarter crop allocation. Additionally, it drives SDG 8 (Decent Work and Economic Growth) by creating rural jobs and new green industries, while contributing to SDG 12 (Responsible Consumption and Production) by

encouraging bioplastics and circular economy practices. By linking national energy security with global development goals, India positions itself as both a regional leader and a responsible international partner.

For such a transformation to succeed, seed and supply chain infrastructure must be strengthened. High-yield dent corn hybrids, efficient procurement systems, and strong farmer incentives are necessary to ensure consistent production and process safety. Expanding biorefineries introduces industrial risks, making strict process safety standards essential for environmental protection and operational reliability. Together, robust supply chains and safety measures will create a stable foundation for India's biofuel expansion.

The National Policy on Biofuels allows grain-based ethanol, creating new opportunities for corn. Financing through government incentives, green bonds, and international collaborations can de-risk investments, especially in the early stages. India's oil import bill is projected to surpass USD 100 billion, and ethanol blending could save as much as USD 4 billion annually in foreign exchange. This shift not only improves energy security but also boosts rural incomes and reduces forex outflows.

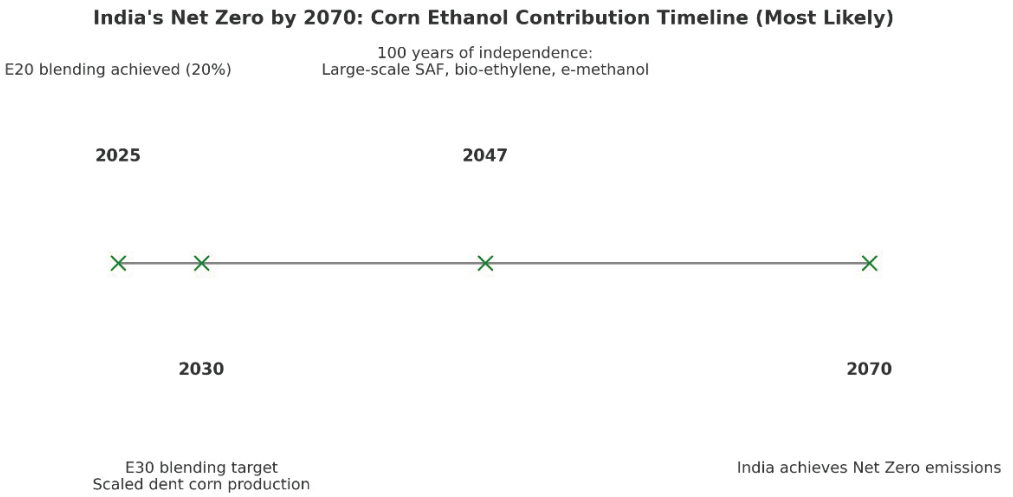
Startups are emerging as critical players in India's Corn Revolution and biofuel sector, bringing agility, innovation, and fresh capital to an industry traditionally dominated by large corporations and state-owned enterprises. They are pioneering advanced technologies such as precision farming tools for dent corn cultivation, AI-driven supply chain platforms to link farmers directly with distilleries, and process optimization solutions to improve ethanol yields while ensuring process safety. Many are also venturing into second-generation (2G) ethanol by converting agricultural residues into fuel and developing integrated biorefineries capable of producing not only bio-ethanol but also bio-ethylene, SAF, hydrogen, e-methanol, and bioplastics. Beyond technology, startups play a vital role in financing models, leveraging green bonds, carbon credits, and ESG-linked investments to de-risk projects and attract global investors. By focusing on scalable solutions that empower farmers, reduce dependence on imports, and align with the Lifestyle for Environment (LiFE) mission, startups are helping to accelerate India's transition toward a sustainable, low-carbon economy while carving out new opportunities in the global carbon economy.

The benefits of a Corn Revolution extend deeply into the rural economy. Farmers cultivating dent corn can expect higher remuneration than from traditional crops, alongside opportunities to supply corn oil and protein meal that currently rely on imports. Diversified income streams through fuel, feed, and food co-products stabilize farm incomes and create resilience in the rural economy. This agricultural diversification also helps manage crop surpluses, stabilizing commodity prices while enhancing food security.

Scaling dent corn production is therefore essential to meet the rising demand while safeguarding food supply. An integrated approach combining corn ethanol, 2G ethanol, SAF, hydrogen, e-methanol, and bioplastics will build a resilient and low-carbon economy. With the right balance of farmer participation, financing, process safety, and international partnerships, the Corn Revolution can secure India's energy independence, boost rural prosperity, and drive the country toward net-zero emissions.

India's pledge to achieve Net Zero by 2070 sets a clear long-term direction for its energy transition, and corn-based ethanol will play a crucial role in enabling this journey. By replacing fossil fuels with bio-ethanol and expanding into bio-ethylene, India can steadily decarbonize high-emission sectors, such as transportation, aviation, and

petrochemicals, through the use of SAF, hydrogen, and e-methanol. This shift not only addresses near-term goals, such as E20 blending, but also aligns with the broader roadmap of reducing cumulative carbon emissions over the coming decades. The Corn Revolution, therefore, is not an isolated policy move—it is a cornerstone of India's pathway to achieving its net-zero vision, creating a bridge between its present agricultural strengths and future climate commitments.



India stands at the threshold of this transformation today. Dent corn is more than just a crop—it is the foundation of a biofuel economy that supports energy security, industrial growth, environmental sustainability, and farmer empowerment. By leading a Corn Revolution, India can position itself at the forefront of global biofuel leadership while realizing its vision of a Lifestyle for the environment.

AUTHOR

Dr. Jatinder Singh
Deputy Secretary General, PHDCCI

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CORN REVOLUTION

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HMEL is a Board run company which at present operates an 11.3 MMTPA refinery and associated facilities at Bathinda. It also operates a 1017 km long crude pipeline from Gujarat to Punjab and a crude oil terminal at Mundra, Gujarat along with a Single Point Mooring System (SPM) for import of the crude oil feedstock.

HMEL's Refinery is an energy-efficient, digitally evolved, high distillate yielding complex designed to produce high-value-added petroleum products. It holds the unique distinction of being a 'Zero Bottoms Refinery' with various measures in place to minimize gaseous, liquid or solid waste. It has one of the highest Nelson Complexity Indices in the region and is designed to process a wide variety of crude oil including heavy, sour and other opportunity crudes. The Refinery produces Bharat Stage-VI compliant transportation fuels viz, Motor Spirit & High Speed Diesel apart from other liquid products such as Superior Kerosene Oil, Aviation Turbine Fuel, LPG, Naphtha, Mineral Turpentine Oil & Hexane. The solid product portfolio comprises of the polymer Polypropylene as well as the by-products Petcoke, Bitumen & Sulphur.

HMEL is responding to reduce the country's dependence on imports and meet the ever-growing local demand for Polypropylene (PP) and Polyethylene (PE) and has undertaken a massive over US$ 3 Billion expansion in petrochemicals at Bathinda. The new complex features a world-class Dual Feed Cracker Unit of 1.2 Million MT/annum of Polyethylene (PE) and 0.5 Million MT/annum of Polypropylene (PP) capacity to cater to all major application segments.

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www.hmel.in

Brahma Valley Education Campus

Nashik Gramin Shikshan Prasarak Mandal (NGSPM) was established on 8th February 2001 and is registered in Maharashtra. The trust is led by Founder President Mr. Rajaram D. Pangavhane (Patil), along with the other senior officials including Mr. Gaurav Rajaram Patil, Mrs. Ashwini Akhilesh Bhosale, Mrs. Dhanisha Gaurav Pangavhane-Patil, Mrs. Prabhavati R Pangavhane (Patil), and Mrs. Rohini Arjun Bhosale and Mrs. Shital Yuvraj Mule. NGSPM operates 10 primary, secondary, and higher secondary schools across Nashik, an arts, commerce, and science senior college, a polytechnic college, an engineering college, an MBA college, two B. Pharmacy colleges, a D. Ed. college, a B. Ed. college, and programs like MCM, PGDBM, and PGDCM. Currently, about 9,000 students study under its institutions.

Notable institutions under the trust include Brahma Valley College of Engineering & Research Institute, Brahma Valley College of Technical Education (Polytechnic), Brahma Valley Institute of Management (MBA), NGSPM's College of Pharmacy, and Brahma Valley Public School & Junior College (Residential).

The trust currently manages a range of colleges and schools with affiliations to Savitribai Phule Pune University, Maharashtra State Board of Secondary & Higher Secondary Education, and approval from AICTE, MSBTE, and the National Council for Teacher Education. Collectively, its educational network serves thousands of students annually and offers diverse academic programs in engineering, pharmacy, management, arts, commerce, science, and teacher education.

Rajaram Pangavhane (Patil)

Founder President
Brahma Valley Group of Institutions, Nashik

Priserve Infrastructure Pvt Ltd (PIPL)

Kamal Goel

Managing Director & CEO
Priserve Infrastructure Pvt Ltd

Engineering Excellence Driven by IITians

Priserve Infrastructure Pvt Ltd (PIPL), founded and promoted by a team of IIT alumni, is a dynamic and innovation-led company specializing in comprehensive solutions for the process plant industry. We deliver end-to-end services across the entire project lifecycle—from design and engineering to commissioning and operations & maintenance (O&M)—with a strong focus on cost efficiency and technical excellence.

Core Competencies: Design & Engineering; Project Management; Procurement & Site Construction; Pre-Commissioning & Commissioning; Operations & Maintenance (O&M)

Industry Expertise

We serve a wide spectrum of industries, including:

- Traditional Energy & Process Industries:

o Oil & Gas Production (Onshore & Offshore)
o Pipeline Infrastructure
o Petroleum & Marine Refining
o Petrochemical Projects
o Chemical & Fertilizer Plants

- Sustainable & Green Energy:

o Carbon-Neutral Energy Solutions
o Renewable Energy Projects
o Green Hydrogen and Clean Fuel Technologies

Our Evolution

Having built a strong foundation in traditional energy sectors, PIPL is now actively expanding into the green energy and carbon-neutral domain, aligning with global sustainability goals and the future of clean energy.

BASF

Amit Bansal

Director- Marketing
BASF

We create chemistry for a sustainable future. Our ambition: We want to be the preferred chemical company to enable our customers' green transformation. We combine economic success with environmental protection and social responsibility. Around 112,000 employees in the BASF Group contribute to the success of our customers in nearly all sectors and almost every country in the world. Our portfolio comprises, as core businesses, the segments Chemicals, Materials, Industrial Solutions, and Nutrition & Care; our standalone businesses are bundled in the segments Surface Technologies and Agricultural Solutions. BASF generated sales of €65.3 billion in 2024. BASF shares are traded on the stock exchange in Frankfurt (BAS) and as American Depositary Receipts (BASFY) in the United States. Further information at www.basf.com.

About BASF in India

BASF has successfully partnered India's progress for more than 130 years. As of the end of 2024, BASF had 2,411 employees in India with 8 production sites and 42 offices throughout the country. The Innovation Campus Mumbai and the Coatings Technical Center in Mangalore are both part of BASF's global technology platform. In 2024, BASF registered sales of approximately €2.4 billion to customers in India. Further information is available on www.basf.com/in.

Dr. Bansi Dhar Institute
(Gurugram)

Dr. Bansi Dhar Institute (DBDI)

The Dr. Bansi Dhar Institute (DBDI) traces its lineage to the prestigious Shriram Institute for Industrial Research, established in 1947 in New Delhi. Founded by the distinguished Sir Shriram, the institute formally began operations in 1950, built on his visionary belief that India's progress must be driven by the assimilation and innovation of contemporary technologies through focused research.

With a strong foundation laid by Sir Shriram, the institute grew into a leading center of excellence, supported by a team of competent professionals, a seasoned and expert Governing Board, and forward-thinking management strategies. Over the decades, Shriram Institute expanded its footprint in Materials Science, pioneering innovations across diverse domains such as blood bags, cactus latex products, biomaterials, aerospace materials, electronic polymers, advanced adhesives, composites, specialty chemicals, renewable resources, radiation technologies, herbal products, waste utilization, and technical consultancy.

Carrying this rich legacy forward, the Dr. Bansi Dhar Institute (DBDI) is envisioned as a dynamic, interdisciplinary hub for research and innovation. DBDI addresses some of the most critical technological and environmental challenges of our time, with a strong emphasis on application driven research and societal impact.

DBDI's specialized laboratories and cutting-edge infrastructure focus on the following domains:

- Clean Energy: advancing hydrogen technologies and sustainable energy solutions
- Nanomaterials & Environmental Engineering: innovating for environmental protection and resource efficiency
- Infrastructure & New Materials: enhancing the resilience and sustainability of construction materials

Supporting these initiatives is a Central Instrumentation Facility, equipped with advanced analytical systems including XRD, BET, FTIR, ICP-OES, GC-MS, STA, DSC, and HPLC, ensuring precision, quality, and reliability in research outcomes.

A key highlight of the institute is the Dr. Bansi Dhar Incubation Centre (DBDIC), which serves as a vibrant hub for innovative startups. DBDIC's core mission is to empower entrepreneurs by transforming their groundbreaking ideas into successful and sustainable businesses. It offers a comprehensive ecosystem that provides startups with essential resources, expert mentorship from seasoned industry professionals, and access to state-of-the-art facilities, including high-tech labs and collaborative workspaces.

At DBDI, our vision is clear: to bridge the gap between fundamental research and real-world application, delivering innovations that contribute to a more sustainable, technologically advanced, and resilient future.

Alok B. Shriram

Chairman
Dr. Bansi Dhar Institute

Sr. Managing Director & CEO
DCM Shriram Industries Limited.

Indian Oil Corporation Ltd

A S Sahney

Chairman and Director (Marketing)
Indian Oil Corporation Limited

IndianOil is a leading force in the global energy sector. As a diversified and integrated energy major, IndianOil spans across oil, gas, petrochemicals, and alternative energy sources. IndianOil's relentless pursuit of excellence has garnered prestigious accolades across the global stage. The company is the leading oil and gas PSU from India featuring on 127 position in the Fortune 'Global 500' list. It has maintained its leadership in the 'BW Top 500' for the third consecutive year and has been recognized as the most respected oil and gas company by Business World. Additionally, IndianOil achieved the third spot for brand strength in the oil and gas sector in the 'Brand Finance' rankings.

IndianOil is steadfast in its commitment to shaping the future of energy. The company has set a visionary goal to achieve operational Net-Zero Emissions by 2046, aligning with India's broader target of Net-Zero by 2070. This ambitious objective highlights IndianOil's dedication to setting new benchmarks in environmental sustainability. As it leads the charge in India's energy transition, IndianOil is embarking on a bold journey to become a 'One Trillion Dollar Giant by 2047.' This goal aligns with India's vision to evolve into a $30 trillion economy by the same year.

On the international front, IndianOil has enhanced its presence in neighboring countries including Nepal, Sri Lanka, the Maldives, and the Middle East. A notable achievement includes a Joint Venture (JV) agreement for establishing a lube plant in Nepal. In the UAE, IndianOil has made significant advancements in the lubricants sector with the introduction of two new grades of SERVO lubricants, further solidifying its global footprint.

Kajaria
Create Grow Innovate...

Kajaria Ceramics

Kajaria Ceramics is the largest manufacturer of ceramic and vitrified tiles in India, and the 8th largest in the world. It has an annual aggregate capacity of 90.5 mn. sq. meters, distributed across nine plants - Sikandrabad in Uttar Pradesh, Gailpur & Malootana in Rajasthan, Srikalahasti in Andhra Pradesh, Balanagar in Telangana, three plants in Morbi, Gujarat and recently opened first overseas plant in Nepal.

Founded more than 3 decades ago, Kajaria has continuously grown stronger since then through hard work, innovation, and patronage from its discerning customers.

The new age consumers' rapidly growing appetite for style and aesthetics is the inspiration behind every Kajaria design. It has helped the company to keep pace with customer and market demands - not only in the domestic market but in the international market too.

Kajaria Ceramics has increased its capacity from 1 mn. sq. mtrs to 90.5 mn. sq. mtrs. in the last 35 years and offers more than 4000 designs in ceramic wall & floor tiles, glazed vitrified tiles and polished vitrified tiles. These tiles come in a wide range of colours and textures from 20x30 cm to 120x240 cm to complement every residential & commercial space. With an unparalleled commitment to quality, Kajaria has always strived to adopt the latest technologies, research, designs, quality and standards with the changing times.

Endorsed by super star Ranveer Singh, Brand has taken new height with its Desh Ki mitti Campaign, underline its commitment of national building through its business development. Kajaria has also diversified into the bathware with the brand name Kerovit, with manufacturing facility located at Gailpur Rajasthan for faucets and two plants in Morbi, Gujarat for Sanitary ware.

Kajaria has also forayed in to tile adhesive category with brand name of Gresbond. Built on the same foundation of reliability and excellence that defines Kajaria. GRESBOND delivers world class tile fixing solutions.

Kajaria is the only tile company in India to win the Super brand 14 times in a row and it's the most certified tile company in the world.

As a new-age progressive brand Kajaria supports women empowerment and sports in general. It is the Principal Sponsor of the RCB women's cricket team. Kajaria is also associated with leading athletes who represented India in recent Olympic.

Ashok Kajaria

Chairman and Managing Director Kajaria Ceramics

Nayara Energy

Nayara Energy is a new-age downstream energy and petrochemicals company with a formidable presence spanning across the entire hydrocarbon value chain, from Refining to Retail. Nayara Energy operates in India for India driven by a relentless commitment to fuel the nation's energy aspirations. At the heart of our operations lies the Vadinar refinery, India's second-largest single-site refinery with a capacity of 20MMTPA.With over 6,500+ Retail Outlets, we cater to the need for reliable and safe mobility across the length and breadth of the country. We have adopted a phase wise asset development strategy to enter the petrochemicals sector which will be a significant step in our crude to chemicals journey. Through sustainable development projects in Health and Nutrition, Education and Skill Development, and Sustainable Livelihoods, Nayara Energy enhances the quality of life in the communities it operates in. Delivering value for all our stakeholders is at the very core of our beliefs and we are committed to providing the energy that fuels the dreams of our employees, customers, partners and communities.

Prasad K Panicker

Executive Chairman

PARAMOUNT COMMUNICATIONS LIMITED (PCL)

Sanjay Aggarwal

Chairman & CEO
Paramount Communications Limited

BRIEF INTRODUCTION : Established in the year 1955. The Company was converted into a Public Limited Company in 1994. During FY 1996, the Company came out with a public issue. Its shares are listed on BSE and NSE since 1995 and are actively traded. Paramount Communications Limited ("Paramount" or "The Company") is a prominent player in the India's wire and cable industry, renowned for manufacturing high-quality products catering to diverse infrastructure segments.

The Company has a market cap of Rs. 1659 cr. as on May 30, 2025, with a 52-week high of Rs. 100.63 on NSE. Paid Up Share Capital as on 31st March 2025

The Company has a Paid-up share capital of Rs. 61.01 Cr. divided into 30,50,32,928 Equity shares of Rs. 2/- each. Promoter And Promoter Group Shareholding

Mr. Sanjay Aggarwal (Chairman and CEO) and Mr. Sandeep Aggarwal (Managing Director) are Promoter Directors of the Company. The promoters Directors and their relatives and associate Companies are holding 49.06% equity shares of the Company.

MANUFACTURING FACILITIES :The Company operates through two state of art manufacturing situated in Khushkhera, Rajasthan and Dharuhera, Haryana. These facilities hold certifications from various Indian and global agencies, ensuring stringent compliance with high quality standards.

INNOVATIVE R & D CAPABILITIES: Highly skilled and qualified R & D team, industrial trail blazer in laying and repairing undersea cables, introducing non- toxic lead -free house wires, offering 20 years warranties and suppling Axle counter cables to Railways .

PRODUCTS : PCL has a complete range of products for every segment of the market that includes LT power, HT power, LT aerial bunch cables, HT aerial bunch cables, UL certified cables for housing and renewables, Optic fibre, Jelly filled, FTTH, jumpers, thermocouple, solar cables, railway cables, fire survival cables, building wire, underwater submarine cable, multicore and television cables. It also serves multiple industries that include power, telecom, railway, domestic wires, special cables and turnkey services. This diverse selection serves a wide spectrum of markets, including government, B2B, and B2C segments.

EXPORTS :During the FY 2019, the Company started exploring the US market and has established a strong base in US market. During FY 23, the Company has achieved an export revenue of Rs. 400 cr. In FY 24, the Company has exports of Rs. 276 cr. the reduction is mainly because of steep reduction in Input Cost i.e., Raw material and Freight Shipping Cost. In FY 25, the Company has exports of Rs. 483 cr. However, in the current FY26, exports of Rs. 600 Cr. and in FY 27 export of Rs. 750 cr. is targeted. Extensive pre-qualification credentials and competencies has been instrumental in establishing its nationwide and international presence, notably in USA. Paramount hold the prestigious status of Three-Star Export House by the Government of India.

PETRON SCIENTECH INC.

Petron Scientech, Inc.

Petron Scientech is a Technology and R&D focused company with significant patents and IP portfolio, providing ESG focused solutions as global Leader in Renewable & sustainable low carbon technologies for chemicals and fuel industries, and offering cost efficient biorefinery technology solutions, products for low carbon biofuels, CO2 utilization, SAF, Green Hydrogen, and Renewable chemicals/polymers, including Green Ethylene & derivatives. Petron is laser focused on contributing to the global mandate for Net Zero by 2050, by providing safe cost-effective technologies and process design to minimize climate change through its differentiated commercial and new technologies.

Since its formation over 34 years ago, Petron Scientech, www.petronscientech.com, has been an innovative technology company in key low carbon emitting and sustainable green technologies. Together with local partners, Petron is in the process of developing energy efficient integrated biorefineries to produce renewable chemicals, polymers and fuels worldwide, including India and Asia Pacific region.

Working with our multinational and reputed detailed engineering and EPC partners, Petron is involved globally as a developer for sustainable technology Projects from concept to commissioning globally, acting as a complete Solution Integrator for technology developments (R&D), process Licensing, engineering design preparation, catalyst development & supply, project management, EPC supervision, plant startups/operations, and operator training. For these 34+ years Petron has been the leader in developing and implementing sustainable green technology alternatives to fossil-based (petroleum) feedstock-based products for its current and prospective customers and JV partners.

Petron is in advantageous position to expand its dominant market share in the renewable green chemical industry including industrial conversion of biomass into ethanol, ethanol to a variety of important chemical feedstocks, specifically, ethylene production which is at heart of trillion-plus dollar global petrochemical, plastics, and essential consumer industries. Petron's Ethylene technology has been independently acknowledged as the most energy efficient and cost-effective solution available to manufacture bio-Ethylene from ethanol. Over the last 5 years, Petron has added cellulosic ethanol produced from biomass feedstocks including agricultural residuals, and Green Hydrogen technologies to its portfolio with 80 + patents globally.

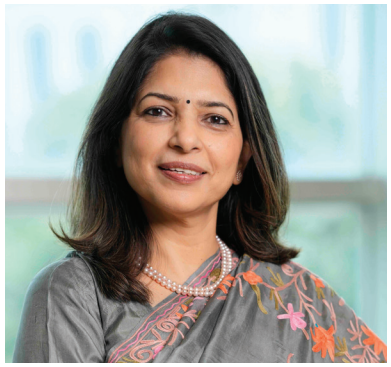
With over 30+ years of firsthand experience across 25+ licensed projects around the world, and joint ventures, Petron is recognized by the industry as the leading innovator/ solution provider for biofuels, clean energy, renewable ethylene, and its derivatives such as ethylene oxide/ glycols and other consumer focused sustainable products.

Locations: Petron maintains its headquarters in Princeton, New Jersey, USA. Petron maintains qualified engineering personnel in Portugal and India. The Petron staff in these locations bring a combined industry experience exceeding 200+ years in design, engineering, and plant operations.

Yogendra Sarin

Founder &
Chief Executive Officer

Engineers India Limited



Vartika Shukla

Chairman & Managing Director
Engineers India Limited

Engineers India Limited (EIL) is a prestigious Navratna public sector consultancy company under the Ministry of Petroleum and Natural Gas, Government of India. Since its inception in 1965, EIL has been instrumental in shaping India's national energy infrastructure and has established itself as a comprehensive engineering and consultancy firm. The company offers a complete range of services, including Technology, Design, Engineering, Procurement, Construction, and Integrated Project Management, from 'Concept to Commissioning,' adhering to the highest standards of quality and safety.

EIL's journey began with the 200 KTPA Lube Blending Plant for Madras Refinery in 1965 and continued with landmark projects such as the 1967 Indian Petrochemicals Corporation Limited (IPCL) project. Other significant milestones include India's first offshore oil terminal and Single Buoy Mooring (SBM) at the Gulf of Kutch in 1978, and the world's largest single-train Dangote Refinery in Nigeria. EIL's extensive portfolio also includes major projects like the integration of HPCL Mittal Energy Limited (HMEL) petrochemical project, BPCL Kochi's propylene derivative project, complex bottom-upgradation facilities for HPCL Vizag and IOCL Panipat, and the largest grassroots integrated refinery and petrochemical complex for HPCL Rajasthan Refineries Limited (HRRL).

EIL has also implemented India's first Propane Dehydrogenation facility for GAIL. Over the years, EIL has diversified into related sectors, including energy-efficient infrastructure, state-of-the-art data centers, LNG terminals, fertilizers, ports and harbours, mining and metallurgy, and underground storage for crude oil and petroleum products. Additionally, the company has recently ventured into the defence consultancy and steel sectors, while also re-entering the nuclear energy domain. EIL has firmly positioned itself to be at the forefront of offering sustainable energy solutions. The company is actively working on projects in areas such as 2G Ethanol, Sustainable Aviation Fuel (SAF), and Green Hydrogen, while striving to drive innovation in carbon capture and energy storage technologies.

In addition, EIL offers in-house expertise in specialised services, including Energy Efficiency Improvement studies, environmental assessments, and specialist materials and maintenance services (such as CRA and RLA). The company also provides specialised HSE studies, Fire & Gas Mapping Studies, CFD studies, equipment and structural analysis, dynamic fluid analysis/FEA, power system studies, and transient flow analysis. The company has significantly expanded its operations into new geographies, including providing EPCM services for the implementation of the Dangote Oil Refinery Project (DORC) in Nigeria.

With a total capital investment of nearly $20 billion, the project boasts the largest single-train refining capacity in the world. Additionally, the company is offering PMC services for the 1.5 MMTPA Mongol Refinery project in Mongolia, funded through a Line of Credit (LoC) from the Government of India. This project highlights EIL's ability to successfully implement projects in challenging climates and global business environments. The organization's international presence also extends to Guyana, where it is providing PMC services for the supervision of the Guyana Integrated NGL Plant and the 300MW CCGT Power Plant.

The organization's international operations are flourishing, with ongoing projects in engineering, design, and construction supervision for refineries, pipelines, and power plants across Africa, Asia, and the Middle East. EIL has a dynamic office in Abu Dhabi, fostering successful collaborations with ADNOC in the UAE. In recent years, the EIL Abu Dhabi office has undergone significant expansion to support localization efforts and enhance In-Country Value (ICV), enabling the company to better serve UAE clients directly from the local office.

With its expertise and forward-thinking vision, EIL is not only driving engineering excellence in India but also solidifying its position as a key player in the global energy consulting landscape. The company is committed to innovation, sustainability, and fostering impactful collaborations worldwide.

Hindustan Petroleum Corporation Limited

Vikas Kaushal

Chairman & Managing Director
Hindustan Petroleum Corporation Limited

Hindustan Petroleum Corporation Limited (HPCL) was formed on July 15, 1974. HPCL is a Maharatna Central Public Sector Enterprise (CPSE) with annual Gross sales of Rs. 4,64,247 crore during 2024-25.

HPCL achieved the highest-ever sales volume of 49.8 MMT and processed the highest-ever 25.3 million tonnes of crude during 2024-25 with 109% refinery capacity utilization and achieved the highest-ever pipeline throughput of 26.9 MMT during the year. HPCL enjoys approximately 20.5% market share in India and has a strong presence in refining and marketing petroleum products in the country. During 2024-25, HPCL recorded the standalone PAT of ₹ 7,365 crore.

HPCL owns and operates Refineries at Mumbai and Visakhapatnam with designed capacities of 9.5 MMTPA and 15.0 MMTPA, respectively. HPCL also owns the largest Lube Refinery in the country at Mumbai for producing Lube Oil Base Stocks with a capacity of 428 TMTPA. HPCL holds a 48.99% equity stake in JV Company, HMEL, which operates an 11.3 MMTPA capacity refinery in Punjab, and also has a 16.96% equity stake in MRPL, which operates a 15 MMTPA capacity refinery in Karnataka.

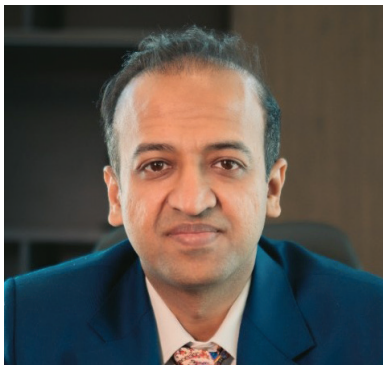
HPCL has a vast marketing network consisting of 19 Zonal offices in major cities and 147 Regional Offices facilitated by a Supply and distribution infrastructure comprising 43 Terminals/Installations/ Tap Off Points, 37 Depots & 29 Exclusive Lube Depots, 57 Aviation Fuel Stations, 55 LPG Bottling Plants, 4 Lube Blending plants. The customer touch points constitute 24,011 Retail Outlets, 1,638 SKO/LDO dealers, 367 Bazar Lube distributors, 155 Industrial Lube Distributors, 2,078 CNG facilities at Retail Outlets, 5,350 EV charging stations, 884 Door-to-door delivery dispensers and 6,385 LPG Distributorships with a customer base of above 9.77 crore LPG consumers as of July '25.

HPCL has the second-largest petroleum product pipeline network in India, with a network length of 5,134 km. HPCL also conducts business through 20 JV and Subsidiary companies operating across the oil and gas value chain.

HPCL has its Research & Development Centre named 'HP Green R&D Centre' in Bengaluru. The Centre provides advanced technical support to the Refineries and Marketing SBUs for operational improvement, absorbing new technologies, developing innovative and path-breaking technologies, and license technologies, and becoming a knowledge hub. HPCL is committed to conducting business to preserve the environment, sustainable development, being a safe workplace, and enriching the quality of life of employees, customers, and the community. HPCL's CSR reaffirms the continuing commitment of the corporation toward societal development. The key focus areas are in the fields of Child Care, Education, Health Care, Skill Development, Sports, Environment and Community Development, Contribution to Incubators/R&D and Public Funded Universities and positively influencing the lives of the less privileged.

Louis Dreyfus Company (LDC)

Louis Dreyfus Company is a leading merchant and processor of agricultural goods, founded in 1851. We leverage our global reach and extensive asset network to serve our customers and consumers around the world, delivering the right products to the right location, at the right time – safely, reliably and responsibly. Our activities span the entire value chain, from farm to fork, across a broad range of business lines (platforms): Carbon Solutions, Coffee, Cotton, Food & Feed Solutions, Freight, Global Markets, Grains & Oilseeds, Pulses, Juice, Rice and Sugar. We help feed and clothe some 500 million people every year by originating, processing and transporting approximately 80 million tons of products. Louis Dreyfus Company is active in over 100 countries across six geographical regions, and employs approximately 18,000 people globally.



Sumeet Mittal

CEO
Louis Dreyfus Company

Life Insurance Corporation of India (LIC)

Life Insurance Corporation of India (LIC) is a statutory Corporation established under Section 3 of LIC Act, 1956. The Life Insurance Corporation of India came into existence on 1st September, 1956, with the objective of spreading life insurance more widely and in particular to the rural areas with a view to reach all insurable persons in the country, providing them adequate financial cover at a reasonable cost .

From then to now, LIC has crossed many milestones and has set unprecedented performance records in various aspects of life insurance business. LIC continues to be the dominant life insurer even in the liberalized scenario of Indian insurance and is moving fast on a new growth trajectory surpassing its own past records. In its 69 years of existence, LIC, agency network, branch office network, new business premium and has a significant role in spreading life insurance widely across the country.

Marble City India Ltd.

Since the early 1980's, Marble City has had an unparalleled legacy of providing the finest calibre authentic Marble and Natural Stone from all around the world.

Marble City's commitment to Quality, Authenticity and our desire to bring you the best from around the world have made the company pioneers in importing carefully curated Premier Quality Marble from the quarry straight to customers' homes, sourced from countries like Italy, Spain, Greece, Turkey, Brazil, Norway Etc.

Their proven Track record of being one of the finest suppliers of Marble and impressive list of successful Projects, have made them the preferred suppliers to some of the most Opulent and Luxurious living spaces in the country.

The company looks forward to a successful collaboration on customer's next project and assure them that their commitment to core principles will leave them satisfied

Saket Dalmia

Chairman & Managing Director
Marble City India Ltd.

Uttar Pradesh Distillers' Association (UPDA)

Uttar Pradesh Distillers' Association (UPDA), since 1983 is an apex body representing prominent & Global Distillery industries of UP namely Radico Khaitan, India Glycols, Wave Group, Superior Industry, DCM. The Association renders Advocacy role, it has garnered official recognition from numerous State & Central Government bodies on Policy & Regulatory matters. As active participant in the UP-Liquor Growth story, UPDA stand tall with unwavering dedication to quality and Innovation. With an annual production of over 100 million cases of Branded Country Liquor, UPDA Members take immense pride in producing over 90% of the State's potable Country liquor, truly igniting the spirit of the region.

UPDA plays a crucial role in India's Ethanol Blending Programme (EBP) and has actively engaged in initiatives like representing India at Global Ethanol Summits, collaborating with Research institutions for Maize development, and fostering partnerships with Invest India for investment and technology influx in Biofuels and Grain-based distilleries. This collective effort underscores UPDA's commitment to industry growth, innovation, and technological advancement.

Rajneesh Agarwal

Secretary General
Uttar Pradesh Distillers' Association (UPDA)

Sheela Foam

Sheela Foam Limited was 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.

The Company manufactures various foam-based home comfort products like mattresses and furniture cushions, as well as technical grades of polyurethane foams for end-use in a range of industries like automobiles, acoustics, etc.

The flagship household brands include: 'Sleepwell' for mattresses and home comfort, 'Feather Foam' a pure PU Foam and 'Lamiflex' a polyester foam for lamination.

The Company also sells its products through online channels under the brand name SleepX through aggregators and its own website.

The company has a global manufacturing footprint with 12 nationwide manufacturing plants in India, 5 in Australia, and 1 in Spain The company has an integrated manufacturing facility, 123,000 MTPA with a robust distribution network of 110+ exclusive distributors, 5,400+ exclusive retail dealers, and 6,100+ multi-brand outlets.

The Company is also exporting technical foam to Middle East, South Asia, Europe, United States, Brazil, and Argentina etc.

It has a strong presence and market share in Australia through its wholly owned subsidiary, Joyce Foam Pty Ltd. and also in Spain through its subsidiary, Interplasp S.L.

Rahul Gautam

Executive Chairman
Sheela Foam Ltd.

HYDROGENIUM RESOURCES
CHANGE PARTNERS TO NET ZERO

Hydrogenium Resources Pvt. Ltd.

Catalysing the Net Zero & Carbon Economy Future

Umesh Sahdev

Executive Chairman

At Hydrogenium Resources, our mission is to accelerate the global transition towards a sustainable, carbon-neutral future. We specialize in pioneering decarbonization strategies, Net Zero roadmaps, and Carbon Economy solutions that empower businesses, industries, and governments to achieve ambitious sustainability goals.

What sets us apart is our one-stop holistic approach—delivering solutions across the full spectrum of sustainability, energy transition, and nature-based solutions.

Decarbonization, Net Zero Solutions & the Carbon Economy:

Our strength lies in offering end-to-end pathways in the Carbon Mitigation Economy, covering: Carbon footprint assessment & decarbonization roadmaps; Carbon Projects development, offset generation & trading strategies; Net Zero transition pathways tailored to industry needs; Integration with carbon markets for credit monetization

By enabling organizations to participate effectively in the Carbon Economy, we make climate action impactful, measurable, and commercially viable.

Leadership in Green Hydrogen & Bioenergy.

As transformative clean energy vectors, Green Hydrogen and Bioenergy are central to our vision. We guide enterprises across the entire value chain—from concept development and feasibility to execution, financing, and integration with credit-linked revenue models.

Our expertise unlocks the potential of hydrogen and bioenergy as cornerstones of a cleaner energy future.

Collaborative Advantage: Hydrogenium goes beyond offering individual services. We have built a unique collaborative structure with leading sector experts for delivery of services. This alliance enables us to provide seamless, integrated solutions, spanning: Strategic Planning & Policy Advisory for Decarbonisation and Net Zero; Decarbonisation Pathway Design & Implementation; Comprehensive Sustainability Reporting and Certification (SBTi, EcoVadis, CDS, GRI, Saab, ISOs etc); Carbon Credit Project Development; Financial Structuring & Offset Trading

Together, we empower organizations to navigate complex sustainability challenges with confidence.

Expertise & Experience: Our multi-disciplinary team of veterans, with a collective 200+ years of global experience, brings expertise in: Renewable Energy & Sustainability; Engineering & Technology Interventions; International Collaboration; Policy & Climate Finance; Carbon Credits & Market Mechanisms; This depth of knowledge ensures practical, future-ready solutions tailored to client needs.

Our Commitment: We are more than consultants—we are partners in transformation. By embracing innovation, collaboration, and sustainability, Hydrogenium Resources champions the shift towards a green and carbon-neutral economy, paving the way for a cleaner, resilient, and prosperous future.

Hydrogenium Resources — Driving Decarbonization, Carbon Credits & Clean Energy Transitions

Sainik Industries Private Limited

Mahendra Rustogi

Chief Executive Officer

Sainik Industries Private Limited, is a fast-growing and innovation-driven company engaged in the manufacturing of Lithium-Ion Batteries for a wide range of applications. With a strong focus on quality, reliability, and sustainability, we are committed to powering the future of clean and efficient energy solutions.

Our Product Applications: Home Energy Storage (Invertor Battery); Electric Vehicles (EVs); Telecom Tower Battery; Solar Street Lights Battery; High-Voltage Energy Storage

It has a state-of-the-art manufacturing facility, located at Noida, equipped with modern technology and advanced testing capabilities to ensure global quality standards. We combine innovation with precision engineering to deliver batteries that are safe, durable, and efficient.

Together, the R&D and Competent Teams embody the spirit of innovation and excellence, driving our mission forward every single day, and energy-efficient future through innovation, quality, and reliability also focus for complete customer satisfaction with regard to need, product quality, value for money and after sales services for its products.

At Sainik Industries, we are driving the transition from traditional lead-acid batteries to Lithium-Ion technology, offering products that are lighter, longer-lasting, more efficient, and maintenance-free. This shift not only enhances performance for customers but also reduces lifecycle costs, making Lithium-Ion the preferred choice for the future of energy storage.

We at Sainik are also deeply committed to creating an environment-friendly energy ecosystem. By providing clean and sustainable battery solutions, we contribute to reducing carbon footprints, supporting renewable energy adoption, and ensuring safer disposal practices compared to conventional technologies. Our mission is aligned with India's vision of a greener tomorrow, and we take pride in offering energy solutions that balance innovation with sustainability.

Indian Association for Air Pollution Control - Delhi

Dr. J. S. Sharma

President

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, President and eminent scientist with Vast experience in Environment.

evvolv.ai

Rahul Gupta

Founder & CEO, Chief AI Strategist

evvolv.ai is an AI-transformation consultancy founded by leaders from IIT with deep experience at Amazon, Uber, and Goldman Sachs. We help companies reimagine how they work in the age of AI. We don't just add tools - we transform teams to become truly AI-native, where every workflow, decision, and product can harness intelligence at scale.

By combining cutting-edge technology with change management, we enable organizations to move faster, unlock creativity, and adopt a new way of working. Our mission is simple yet ambitious: to embed AI into the very culture of organizations and help them thrive in the future of work.

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PHD CHAMBER OF COMMERCE AND INDUSTRY

PHD House, 4/2 Siri Institutional Area,
August Kranti Marg, New Delhi - 110 016
(W) www.phdcci.in

About PHDCCI

PHDCCI has been working as a catalyst for the promotion of Indian industry, trade and entrepreneurship for the past 120 years. It is a forward looking, proactive and dynamic PAN-India apex organization. As a partner in progress with industry and government, PHDCCI works at the grass roots level with strong national and international linkages for propelling progress, harmony and integrated development of the Indian economy.

PHDCCI, acting as the "Voice of Industry & Trade" reaching out to more than 1,50,000 large, medium and small industries, has forged ahead leveraging its legacy with the industry knowledge across multiple sectors to take Indian Economy to the next level.

At the global level, we have been working with the Embassies and High Commissions in India and overseas to bring in the International Best Practices and Business Opportunities.

PHD CHAMBER OF COMMERCE AND INDUSTRY

PHD House, 4/2 Siri Institutional Area, August Kranti Marg, New Delhi - 110 016 (India)
• Tel. : +91-11-2686 3801-04, 49545454, 49545400 • Fax : +91-11-2685 5450
E-mail : sg@phdcci.in • Website : www.phdcci.in