Stakeholder Engagement Workshop

on

Decentralizing Net Zero 2070

Co-organising institutions: IIMA and ITF under the aegis of

Energy and Petrochemicals Department, Government of Gujarat

Event Date: November 23, 2024

Event Day: Saturday

Venue: 2nd floor, Classroom, JSW-SPP, New Campus, IIMA

Provisional Agenda

Context and Objective:

India's Nationally Determined Contributions to the UNFCCC give impetus to energy transition for achieving India's targets of becoming energy independent by 2047 and Net Zero (NZ) by 2070. At COP26 in Glasgow in Nov 2021, Hon'ble Prime Minister of India Shri Narendra Modi, announced the need to follow the mantra of LiFE, i.e., Lifestyle For Environment – A global movement to affect paradigm shift from mindless and destructive consumption to deliberate utilization. LiFE mission should be seen as a guideline by India as well as the world, towards achieving Net Zero emission target.

Mission LiFE is a framework of simple behavioural nudges to transform the way individuals and communities work, and to make them more synchronous with nature. It aims to create a network of Pro Planet People who are committed to adopting and promoting environmentally conscious and sustainable lifestyles. It aligns with India's mitigation efforts to reduce the climate change impacts by influencing demand side behaviour of individuals. It comprised of comprehensive and non-exhaustive list of 75 individual LiFE actions spread across seven themes, such as energy saving, water saving, reducing single use plastic, adopting sustainable food systems, reducing waste, reducing e-waste and adopting healthy lifestyles)1.

India has embarked upon an ambitious energy transition journey with a target of 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 and achieving NZ by 2070. To attain the determined renewable energy (RE) targets and to achieve self-reliance in the energy sector it is imperative that domestically available RE sources should be utilised. One of such RE source is modern bioenergy due to large surplus of biomass and other waste available in the country and energy recovery from these resources could be a viable solution. Modern bioenergy is distinctive as it provides several social and environmental benefits apart from providing clean fuels. For example, applications bioenergy sources could mitigate air, water, and land pollution, create local jobs and business opportunities, reduce energy import bills, support development of decentralised and independent communities. Also, it could benefit to the private sector to decarbonise their businesses or industries. Other benefits include savings on fertiliser subsidies and a reduction in waste management costs2.

Distributed Renewable Energy (DRE) generation has gained a lot of attractions in the power sector due to its ability to reduce T & D losses, increased reliability, low investment cost, and utilise renewable energy resources, which produce power with low GHG emissions like wind, solar PV and micro turbines3. Framework for Promotion of DRE Livelihood Applications was developed by the Ministry of New and Renewable Energy (MNRE) in 2022 which aims to enable a market-oriented ecosystem to attract private sector investment, unlock easy access to end-user finance, leverage quality control standards, promote skill development and innovations, guided by monitoring and evaluation framework to ensure long term sustainability of DRE based livelihood solutions4. There are successful

pilots and business models of DRE livelihood applications in agriculture, agro-processing, dairy, poultry, fisheries, tailoring, etc., which have been tested at the field level and have the potential to be replicated in larger quantities5.

Green hydrogen (GH2) and green ammonia are the most promising alternative for energy transition and reducing GHG emissions from hard to abate sectors. GH2 can be utilized for long-duration storage of RE, replacement of fossil fuels in industry, clean transportation, and for decentralized power generation, aviation, and marine transport. Under Green H2 policy (2022), initiated by government of India, it aspires to establish manufacturing zones and further setting up of green hydrogen/ammonia production plant in those zones by offering various incentives and waivers to these projects6. Green Hydrogen Mission (2022) aims to make India the global hub for production, usage and export of GH2 and its derivatives which will further contribute to its "Aatmanirbhar" objective and enable to assume technology and market leadership in GH27.

The objective of this stakeholder engagement workshop is to discuss the current trends and innovative decentralized solutions in the field of bioenergy, DRE, green hydrogen, etc. towards realizing Net Zero 2070 target of India. This event aims to promote an open and meaningful deliberations between business/industry leaders, policymakers, academicians and researchers on the following themes:

1. What are the contemporary and innovative bioenergy solutions for realizing NZ 2070?
2. How could the use of Distributed Renewable Energy (DRE) across various sectors be accelerated for achieving NZ 2070?
3. What are the potential uses of green hydrogen in the domestic industries for achieving NZ 2070?
4. How would various innovative and sustainable solutions or strategies at local level assist the decentralization of NZ 2070?
5. How many (numbers) green jobs would be created through above decentralized innovative solutions (modern bioenergy, DRE and green hydrogen, etc.) for realizing Net Zero 2070

Innovative Thought Forum

Programme Details	
Saturday, November 23, 2024	
09:00 – 09:30	Registration
09:30 – 10:15	Inaugural Session • Context Setting: Prof Amit Garg, Professor and NIIF Chair in ESG, IIMA • Welcome Address: Mr Pinakin Patel, CEO, T2M, USA (Online) • Chief Guest: Mr Deepak Gadhia, Chairman, Sunrise CSP India Pvt Ltd *Vote of thanks: Dr. Jyoti Maheshwari, Post Doctoral Fellow, IIMA*
10:15 – 10:45	Photo Session followed by Tea/Coffee
10:45 – 12:00	Session 1: Modern Bioenergy Solutions for NZ 2070 Chair: Mr Gaurav Kedia, Chairman, IBA • Col Sumeet Malhan (Retd), Chief Technical Officer, PRESPL • Mr Gajanan Patil, MD, Urja Bio Systems Pvt Ltd, Pune (Online) • Mr Jayesh Parikh, Chem Systems, Ahmedabad *Q & A/Discussions*
12:00 – 13:15	Session 2: Accelerating Distributed Renewable Energy for NZ 2070 Chair: Prof Amit Garg, Professor and NIIF Chair in ESG, IIMA • Mr D Suresh, Eminent Solar Evangelist, Chennai • Mr Binit Das, Program Manager, CSE, Delhi (Online) • Mr Anshuman Lath, Founder, Gram Urja, Pune • Prof Saritha Sudharmma Vishwanathan, Assistant Professor, Kyoto University, Japan (Online) *Q & A/Discussions*
13:15 – 14:15	Lunch
14:15 – 15:30	Session 3: Innovative Solutions for Decentralizing NZ 2070 Chair: Mr S B Dangayach, Founder Trustee, ITF • Mr Deepak Gadhia, Chairman, Sunrise CSP India Pvt Ltd • Mr P S Goyal, GM, GIPCL, Vadodara (TBC) • Mr D P Mishra, Consultant in Renewable Energy • Mr Shwetal Shah, Consultant, GIZ • Mr Vivek Chabra, Manager-Food Security, Covestro • Dr Bijaya K Behera, Head Geoscience, Manan Oilfield Services Pvt Ltd • Mr Sumit Limbachiya, Sr. Manager, Ice Make Refrigeration Ltd, Gandhinagar *Q & A/Discussions*
15:30 – 15:45	Tea/Coffee
15:45 – 17.00	Session 4: Green Hydrogen for Domestic Industries for NZ 2070 Chair: Mr Rajat Seksaria, Adani Group • Prof Amit Garg, Professor and NIIF Chair in ESG, IIMA • Dr V K Shahi, Senior Principal Scientist, CSMCRI • Dr M Prakash, Senior VP- Legal & Compliance, Greenzo Energy India Ltd

	• Mr Ashok Chaudhari, Senior VP-Business Solutions, Ankur Scientific Energy Technologies Pvt Ltd, Vadodara • Mr Tulsi Tawari, Expert in Hydrogen Fuel Cells, Mumbai (Online) *Q & A/Discussions*
17.00 – 17:30	Way Forward • Prof Amit Garg, Professor & NIIF Chair in ESG, IIMA • Mr S B Dangayach, Founder Trustee, ITF • Mr Anshuman Lath, Founder, Gram Urja, Pune

Note: TBC: To Be Confirmed

*Please refer NZ India report on "Synchronizing energy transitions toward possible Net Zero for India: Affordable and clean energy for all" *https://psa.gov.in/CMS/web/sites/default/files/publication/ESN%20Report-2024_New-21032024.pdf*

Inaugural Session

Context Setting by Prof. Amit Garg, Professor and NIIF Chair in ESG, IIMA

- **Key Points:**
  - Transition led Development or Development led Transition?
  - Development led transition is the challenge.
  - Importance of innovative solutions for small scale industries and micro industries across the country.
  - Documentation of meeting highlights/summary and to be shared with all the speakers and stakeholders.

Welcome Address by Mr. Pinakin Patel, CEO, T2M, USA (Online)

- **Key Points:**
  - The U.S. Department of Energy's survey on stakeholder engagement in the hydrogen industry revealed that the most important concern is the cost to the end user, including capital costs, operating costs, and warranty costs.
  - China is the world leader in making hydrogen from coal. Competing with the hydrogen based export market, giving extremely low cost hydrogen, low cost syngas.
  - Cost of Hydrogen generation from solar wind is 2x costlier than fossil fuel.
  - Hydrogen, green hydrogen, made from water is most energy intensive.
  - It takes 60 megawatt hour of electricity per ton of hydrogen. Hydrogen value is 33 megawatt hour.
  - For every ton of hydrogen, eight tons of oxygen that's wasted.
  - 8 tons of oxygen can be used to promote gasifiers, refineries.
  - Oxygen free carriers of hydrogen promise 80% reduction in energy and lower capital cost.
  - The utility model, business model, is based on centralized hundreds of megawatt, thousands of megawatt size plants.
  - Utility and Industry should interact together.
  - Hydrogen compression and dispensing is complex and expensive, and has lots of failures, a lot of maintenance and repairs.
  - The intermittent renewables peak demand is observed at noon. Excess solar production creates problems for the grid, in terms of control. So, its solution is hybrid storage.

- Battery storage for a long duration gets expensive. Battery plus hydrogen is a good solution.
- Biomass in India has a good opportunity. 100 million tons of waste biomass can produce 200 million megawatt hour.
- Hence, liability caused by this agriculture waste, forest fire is converted into profit.
- Temperature fuel cells can make their own hydrogen and can make syngas also.

Context setting by Mr S B Dangayach, Founder Trustee, ITF

- **Key Points:**
  - Resolution to achieve Net Zero.
  - Highlighted the need to involve/engage a wide spectrum of stakeholders - starting from individuals to businesses to government
  - Renewable energies are modular.
  - Decentralization of Net Zero 2070 and going forward Democratization of Net Zero 2070.
  - Mission of our government "Sabka Saath Sabka Vikas".
  - Reliance announced an investment proposal of 65,000 crores in 500 decentralized biogas plants in the state of Andhra Pradesh over the next two years.
  - Purpose of this workshop is to create models that can be created for the entrepreneurial community, for the investment community, for the business community to invest.
  - Access to energy, in the villages or the tribal areas or the agricultural areas rather than only to the developed areas.

Chief Guest speech by Mr Deepak Gadhia, Chairman, Sunrise CSP India Pvt Ltd

- Key Points:
  - Worked for NGO Muni Seva Ashram near Baroda as supplier and technology provider.
  - Installed India's first solar steam cooking system, centralized the steams.
  - The steam was piped and could cook for 50,000 people.
  - India's first air conditioning plant using solar energy.
  - Centralized biogas plant pressurizes and supplies the gas.
  - Developed India's first biogas plant where the gas is pressurized and bottled gas supplied to villages of 430 km for cooking.

- Highlighted the objective of PUARA (Providing Urban Amenities to Rural Areas)
- The company Sunrise CSP is installing the system and has entered into Heat Purchase Agreements, Cooling Purchase Agreements, and Power Purchase Agreements.
- Mr. Gadhia shared his experience on the use of Public Private Partnership - Build-Own-Operate-Transfer (PPP BOOT) model to scale the projects.

Session 1: Modern Bioenergy Solutions for NZ 2070

Session Chair: MR. Gaurav Kedia, Chairman, IBA

- Key Points:
  - Net Zero target cannot be achieved without bioenergy.
  - Suggested that biomass should be used in totality.
  - Job creation, direct and indirect jobs
  - Biomass as a nature's battery.
  - Discussed about Biomass gasification, bioethanol, biodiesel, biogas, compressed biogas.
  - Millions of years ago, crude was also a form of biomass.
  - Highlighted the importance of checking 3 buckets: financial feasibility, technical feasibility, and social visibility.

Speaker: Col Sumeet Malhan (Retd), Chief Technical Officer, PRESPL

- **Key Points:**
  - The availability of biomass was discussed, with estimates ranging from 700 to 1,000 million metric tonnes. However, only 5 to 6 million metric tonnes of biomass are currently being utilized.
  - Biomass can give round the clock base load.
  - Biomass is used only in states of Punjab, Haryana, UP.
  - North India has paddy, Madhya Pradesh there is wheat, Gujarat has a lot of cotton, Karnataka there is corn crop.
  - Highlighted the need to combine agriculture waste and city green waste and convert them at the source and then use them as biomass.
  - Different forms of energy can be generated from biomass.
  - Biomass is 1.2x costlier than coal.

- Biomass is 30- 40% cheaper furnace oil, diesel, etc. So, people are running towards biomass where coal has been banned.
- Camps are arranged in villages to explain what is to be done, why it is to be done, how it will benefit them and how it will benefit the environment.
- VLE (village level entrepreneur) trained by PRESPL.
- VLE picks the biomass using supply chain management equipment and brings it to collection centres.

Speaker: Mr. Gajanan Patil, MD, Urja Bio Systems Pvt Ltd, Pune (Online)

o Key Points:

- More than 250 installations of captive biogas to power, and more than 12,000 installations of biogas plants.
- Discussed about benefits of a decentralized system is energy access to all in rural and urban areas and local employment generation.
- Reduction in the huge cost of logistics and transmission.
- Support in sustainable agriculture by providing the solid and liquid fertilizer back to the farmers in the rural area.
- Supplied 12,000 units to the dairy farmers who are supplying milk to the cooperative.
- For 40 kg dung farmers are getting 2 cubic meter biogas plant for cooking.
- Implemented 12,000 systems, replacing more than 1,40,000 LPG cylinders we are replacing a year.
- Slurry filters used to separate the solids and liquid. Separated solids are getting converted into vermicompost and the liquid.
- Captive biogas to power projects along with the value-added phosphatase organic manure implemented in all Goshala to facilitate fodder costs.
- More than 44 projects on biogas to power for poultry in the range of 100 kilowatt to 400-kilowatt power.

Speaker: Mr Jayesh Parikh, Chem Systems, Ahmedabad

o Key Points:

- Spoke about packaging, transportation, and possible challenges related to the market costs.

- Highlighted the importance of making localized Indigenous solutions.
- Bio fraction for the cotton stock. No burning, no transportation is required.
- How mobilizing financial resources was a challenge when the technology used was not well-established.
- What challenges may arise when setting up new technologies, and how can these technologies be scaled?

Session 2: Accelerating Distributed Renewable Energy for NZ 2070 Session Chair: Prof Amit Garg, Professor and NIIF Chair in ESG, IIMA

Speaker: Mr D Suresh, Eminent Solar Evangelist, Chennai

- **Key Points:**
  - Solar adopted or Solar installed, mainly in the residential sectors or smaller sectors.
  - Focus on the kilowatt scale, not the megawatt scale.
  - IIM Ahmedabad's philosophy of case method.
  - Installed Solar at half a kilowatt, with one battery, costing 30,000 rupees.
  - Installed solar off grid system with a battery backup.
  - Installed a panel on the balcony and gave a connection in the parking to charge the scooter.
  - Prime Minister's URJA scheme and Tamil Nadu Clean Energy.
  - Installed rooftop solar 15 years ago.
  - Discussed about two systems, off grid and on grid. Each one has its own plus and minus points.
  - Introduce all these concepts into schools and colleges as a syllabus.
  - 50-60 installations of Biogas bags in flats and connected to a stove.
  - Producing biogas using human waste.
  - Sustainability means avoiding using up natural resources.

Speaker: Mr Binit Das, Program Manager, CSE, Delhi (Online)

- Key Points:

<u>Global Energy Access Challenges</u>

- 660 million people (9%) lack electricity access globally; 1.9 billion lack clean cooking solutions.
- If unaddressed, energy access issues could impact half of the world's population.

India's Progress in Energy Access

- National Rural Electrification Policy (2005-06) set benchmarks for universal household electrification and a minimum of 1 unit/day/household.
- By 2019-20, India achieved 100% household and village electrification.
- Average consumption remains low: 3.5 units/day or 107 units/month per household.

Energy Disparities and Rural Needs

- Rural households consume 60 units/month; urban households consume 120 units/month.
- Villages with 300 households consume an estimated 1,000 units/day, with agriculture and public utilities driving demand.
- REC estimates 1,830 units/day: 52% for households, 41% for agriculture, 7% for enterprises.

The Role of Decentralized Renewable Energy (DRE)

- Electrification alone doesn't ensure reliable or equitable energy access, particularly in rural areas.
- DRE systems (mini/microgrids) can complement the national grid, meeting localized energy and livelihood needs.
- DRE supports community demands: agro-processing, irrigation, cold storage, and clean cooking.

Challenges in DRE Implementation

- Disparities in tariffs between grid and mini-grid power.
- High upfront costs and operational uncertainties (grid extension, political factors).
- Community preferences for grid power over DRE solutions.
- Shorter project tenures leading to higher tariffs.

Solutions and Opportunities

- Hybrid systems and flexible tariffs to make energy affordable for diverse consumers.

- Design flexibility to enable integration with the national grid and adapt to changing rural needs.
- Extended project lifecycles to lower annual recovery rates, reducing costs for rural users.
- Build partnerships with SHGs, VLEs, and VECs to foster community ownership.

Sustainability and Policy Directions

- Invest in training and awareness programs to improve energy efficiency and reduce waste.
- Encourage Public-Private Partnerships (PPPs) with Feed-in-Tariff (FiT) models and clean energy incentives.
- Align mini-grid tariffs with the national grid through subsidies, ensuring equitable energy access.

Long-Term Impact of DRE

- Address future energy needs in agriculture, cold storage, rural enterprises, and clean cooking.
- Transform rural electrification by balancing affordability, sustainability, and scalability.
- Ensure community-driven solutions with inclusive planning and policy interventions.

Speaker: Prof Saritha Sudharmma Vishwanathan, Assistant Professor, Kyoto University, Japan (Online)

- **Key Points:**
  - Thermal coal production is the highest in India. We are the third largest consumer of energy.
  - Our kilowatts per capita compared to Canada, USA is just 1000 kilowatts per hour.
  - Coal is projected as the main source of electricity generation in India.
  - 500 gigawatt non fossil fuel based target, which is five times than the 2021 capacity.
  - 15% CO_2 emissions coming from LULUCF.
  - Adaptation, resilience, resilient infrastructure are important.
  - Policy questions at national level:
    - how much energy is required?
    - what are the alternative pathways?
    - what are the energy mix, cost of electricity, carbon emissions, investment, and challenges?

- Discussed 7 scenarios based on the GDP population NDC targets.
- Main challenge is grid integration.
- Emission intensity decreases if we move towards an electricity generated infrastructure.
- Critical minerals, bioenergy, battery storage and carbon dioxide removal technologies.
- India's HDI ~0.645 in 2019, consuming 21 GJ per capita.
- Developed country states have 75 GJ per capita.

Speaker: Mr Anshuman Lath, Founder, Gram Oorja, Pune

o Key Points:

- Gram Oorja Solutions Pvt. Ltd. rural energy company for community and institutional scale work.
- Working with remote communities across the central belt of India, Jharkhand, Orissa, parts of Chhattisgarh, Madhya Pradesh, Melghat, Nandurbar, Chandrapur, Palghar till south of Gujarat.
- First microgrid was set up in a village called Dharavadi, four hours north of Pune.
- More than 140 microgrids in India and 2 in Africa also.
- In remote areas the last mile village could be some 40 houses.
- Grid would be the strongest at the main area and weaker in remote areas.
- Due to lack of infrastructure, reporting, money the last mile village will get less energy.
- Whole dependence is only on the solar now.

Session 3: Role of Green Building Rating Programs

Session Chair: Mr S B Dangayach, Founder Trustee, ITF

Speaker: Mr Deepak Gadhia, Chairman, Sunrise CSP India Pvt Ltd

o Key Points:

- 50% of the world's local population cooks on local fire.
- 3.2 million women and children die because of smoke in the kitchen.
- Parabolic dish reflects the light at one point at high concentration facilitates cooking.
- Poor could not afford solar cookers because it would cost 7,000 rupees.

- Parabolic dish reflected light through the small opening in the kitchen, for cooking.
- Community cooker cooks for 200 children in a mid-day meal program.
- Developed a storage system to heat up the block and instantly cook at night.
- Reflected light onto a water body to generate steam in the kitchen to cook.
- 30,000 meals at Tirupati temple & 50,000 people at Shirdi temple.
- IBM in Manyata, a parking place where the car is below the solar cooker.
- World's highest solar cooking system, developed at the Indian Army, works at minus 40 degree centigrade.
- Big Dish at the Australian National University makes super-heated steam of 560˚C at 110 bar pressure. Thermal energy temperature to >1,700˚C.

Speaker: Mr P S Goyal, GM, GIPCL, Vadodara (Online)

- Key Points:
  - Dual purpose use of agricultural land.
  - Large scale farming land converted to solar installation.
  - Farmers can also grow crops on the same land.
  - 2 pilot projects, in Surat Lignite plant and near Anand, Amrol village.
  - 2 hectares of barren land, solar panels installed for the farm.
  - MOU with Ghanan Agricultural University and Navsari Agriculture University.
  - Research on crops to be grown between the panel and fertilizers used to not affect solar and irrigation.
  - Shadow analysis for plants to get 1.5 hours of sun for photosynthesis.

Speaker: Mr D P Mishra, Consultant in Renewable Energy

- Key Points:
  - Any plant in lifetime, captures around 40% of carbon and 6 percent of hydrogen.
  - In 1 hectare, there can be at least 400 kgs of carbon sequestration.
  - Challenge is that everyone can't have farming land.
  - Carbon is taken away from soil and has to be recycled.

- Agriculture land is worth 178.53 million hectares.
- Total wasteland worth 55.77 million hectares.
- Degraded forest land 36.4 million hectares.
- Sequestration of at least 500 kg of carbon, we can mitigate at least 10 percent of our current emission level.
- Energy plantations like bamboo, forest species, now it is a horticultural species, Napier grass, even cactus.

Speaker: Mr Shwetal Shah, Consultant, GIZ

- Key Points:
  - NDC commitments achieving 500 gigawatts of RE by 2030 and creating an additional 2.5- 3 billion ton carbon sink by 2030.
  - Practical method of carbon sequestration through trees and forest cover.
  - Geological and Chemical carbon removal methods aren't viable for large-scale carbon removal.
  - Importance of conserving land to combat desertification and maintain soil organic carbon and biodiversity.
  - India imports 25,000 crore worth of wood annually.
  - India's underperformance in agroforestry with only 7% of agricultural land having trees, compared to the world average of 43%.
  - Encouraging various ecosystems like mangroves, grasslands, and different tree species contribute to biomass requirements and have market value.
  - Need for both small-scale and large-scale approaches.
  - Government's compressed biogas scheme providing PLI's instead of capital subsidies.
  - Need for investment in tissue culture and identifying healthy seedlings.
  - Need for sustainable practices in ethanol blending and crop residue utilization.
  - Collaboration between academia, industry to enhance the value of biomass initiatives.

Speaker: Dr Bijaya K Behera, Head Geoscience, Manan Oilfield Services Pvt Ltd

- Key Points:

- Importance of Geothermal Energy.
- Every hour earth emits 44 ±244 terawatts of energy escapes to the atmosphere.
- Capacity of energy stored in 10 kilometres just below our feet is 50,000 times more energy that is stored than oil, natural gas and resources of the world. (Note: the radius of the Earth is 6,378km).
- Geothermal energy has a very small land-use footprint – as compared to coal, nuclear, and other renewable energy resources but has the highest efficiency of almost 90-95%.
- There are many geothermal sites discovered in India and six geothermal sites have been identified in Gujarat state alone for power generation. A serious thought may be given to develop those sites commercially.
- Geothermal heating and cooling are most pronounced so far as direct usage of geothermal energy is concerned.
- Geothermal heating and cooling is cost effective and anywhere possible as it uses only 5' to 10' deep below earth's surface as the source of heat generation as well as heat sink depending on geographic
- location.
- Geothermal heat pumps which are the main component of the system provide sustainable heating and cooling by utilizing the earth's constant underground temperature.
- Geothermal heating and cooling works 24hrs/7 days per week /365 days a year.
- It can be used as small units as deployed in a room or as big as district heating and cooling.
- In India, a very little Geothermal Heating and Cooling system have been conducted and tested.
- Given the extreme nature of climatic ranges in India, it is proposed to conduct at least two pilot projects:
    - One in cold region e.g. in the Himalayan region
    - One in peninsular India
- This would help establish the following:
    - The logistics, operational issues and economically viable
    - geothermal heating and cooling equipment such as heat pump,

- underground pipe, etc
- Choice of technology under various environmental conditions.
- Complying Government rules and regulations and obtaining Government approvals.
- Site selection.
- Techno-economics of the projects.
- Understanding the Geothermal heating and cooling nuances to minimize the cost and time overrun while optimizing the efficiency of the system.

Speaker: Mr Vivek Chabra, Manager-Food Security, Covestro

- Key Points:
  - To create sustainable business model empowering small and marginal farmers /fisherfolks from underserved communities.
  - Committed towards the Food security vertical segment of inclusive business.
  - Focus on the horticulture & Fisheries segment.
  - India is the second largest producer of fruits & vegetables.
  - Spoke about Government support to develop post-harvest management infrastructure.
  - Indian Council of Agriculture says almost 40% of the fruit, vegetables, grown are not reaching the plate.
  - Out of the 12 Cr farmer population 80%are small and marginal farmers
  - According to FAO, 194 million people are malnourished.
  - Need to work on Nutritional food insecurity.
  - Global food loss and waste generate annually 4.4 GtCO2 eq.*
  - Horticulture post-harvest loss in India is estimated to be approx. 55 million tons which leads to substantial amount of carbon footprints.
  - Fruits and vegetables have a different kind of carbon emission when spoiled varies from 1 kg and to the meat products up to 20 kgs.
  - By reducing the post-harvest losses & improving the shelf life this losses can be reduced.
  - Covestro is focussing upon decentralised climate smart post-harvest management solutions to overcome these challenges.
  - Shelf life of the produce can be increased by dehydration of produce or by keeping the

produced in controlled temperature and humidity environment.

- Polycarbonate cladding based solar dryers support to dehydrate the produce & prolong its shelf life enabling farmers to reduce their loses and improve their earning capabilities These dryers are designed to harness solar energy and retain heat inside the dryer for longer periods of time.
- Solar cold storage is a promising technology that can help farmers to store their fresh produce at regulated temperatures and humidity, thereby improving the shelf life of the produce up to 3-4 weeks. These cold storages are equipped with thermal energy storage backup of 24 to 36 hours, which stores the energy in phase changing material and provides energy backup to the unit at night hours and during non-solar days.
- There is success story booklet developed to create awareness on these technologies.

Speaker: Mr Sumit Limbachiya, Sr. Manager, Ice Make Refrigeration Ltd

o Key Points:

- After harvesting, fruits or vegetables start emitting Co2.
- Pre-cooling will reduce this waste.
- Usage of Pure water as a thermal storage.
- PCM has a lower freezing point reducing the efficiency of machines. Cannot efficiently use the solar energy to store.
- Latent heat stores the energy.
- All day and night up to 30 hours of backup at 2 degrees centigrade.

Session 4: Green Hydrogen for Domestic Industries for NZ 2070

Session Chair: Mr Rajat Seksaria, Adani Group

o Key Points:

- Signatory to the Paris Agreement and self-declaration of net zero commitment.
- Energy used in the form of electricity.
- Difficulty lies in sectors, where electrification is not easy, elimination of hydrocarbons is very difficult.
- Green hydrogen denotes hydrogen produced electricity which is green.
- Energy in hydrocarbons, coal, oil, and gas continues to be the driver of civilization.

Speaker: Dr V K Shahi, Senior Principal Scientist, CSMCRI

- Key Points:
  - Discussed about membranes and their use.
  - His research work focuses on the membranes and how local production can be very useful in the field.
  - As a country, we should focus on developing indigenous membranes.
  - Avoid using Chinese membranes.

Speaker: Dr M Prakash, Senior VP- Legal & Compliance, Greenzo Energy India Ltd

- Key Points:
  - Energy production and consumption to the doorstep of rural areas.
  - Electrolysers transform the water into hydrogen and oxygen.
  - It helps split the water into two cylinders.
  - Each cylinder has one megawatt of hydrogen.
  - Cylinder connected to the Electricity generator produces electricity.
  - In Rural areas, supply of these cylinders and generators to produce electricity.
  - Target at least 20 percent of the rural areas, within five years.
  - The Government of India and Government of Gujarat are requested to consider the hardships in setting up Hydrogen Industries by medium scale industrial units owing to the tough competition from Large industrial units due to the "Economies of Scale" principle. This issue can be resolved by providing the “Incentives and tax exemption to the small and medium scale units”.

Speaker: Mr Tulsi Tawari, Expert in Hydrogen Fuel Cells, Mumbai (Online)

- Key Points:
  - Green hydrogen is crucial for sustainability goal.
  - Biogas uses two kinds of raw materials, cow dung and biomass for all kinds of agriculture, forest, even human waste.
  - USA can be a great market for Indian biogas technology,
  - Biogas with about 65 to 70% methane is a possible fuel.

- Biogas can provide at least 10 to 20 kilowatt power modular units.
- Biogas coupled with fuel cells has opportunities in the USA as well as the Indian market.

Speaker: Mr Ashok Chaudhari, Senior VP-Business Solutions, Ankur Scientific

Energy Technologies Pvt Ltd, Vadodara

o Key Points:

- Gasification to convert solid fuel to a gas. The syngas can be used for generation of fuel, power, heat and chemicals and the by product is biochar.
- Gas to fuels and chemicals like ethanol, hydrogen, methanol, methane.
- Internal section of gasifier waste comes from the top and the gas generated at the bottom. Biochar is obtained at bottom as by product.
- For generation of power or biofuels like hydrogen or ethanol, gas needs to be cooled and cleaned.
- Designed gasifiers to handle more than 50- 60 different types of biomass, Agri residues and waste including municipal solid waste, waste tyres, poultry waste, palm waste etc.
- Biochar plays a very important role in carbon sequestration. It helps reduce greenhouse gases and soil enhancement. The fixed carbon in the biochar is high to the tune of 75 to 90% levels depending on the biomass properties.
- Generating Hydrogen from Biomass has significant advantage over other options – particularly in the Indian context.
- Developed a highly efficient technology for generating Hydrogen from biomass at attractive prices.
- In general, biomass is available on a sustainable basis. It can be large potential for decentralized generation of Hydrogen which can make business sense for the end consumers.
- India generates 500 Mt/year of agricultural residue. At least 200 Mt of this is unutilized and can be available for Hydrogen production of about 5 Mts
- Potentially upto 5,000 plants of 2.5 TPD Hydrogen capacity can be setup across India.

Way Forward Session

- Professor Amit Garg discussed the importance of promoting businesses small scale enterprises/businesses and developing case studies.

- Five case studies on net zero initiatives, possibly submitting them to Harvard University for wider dissemination.
- Focus on decision dilemmas, business models, and methods for decentralization and expansion in their case studies.
- Decentralization in energy and society, citing global trends post-COVID.
- Energy independence vs. energy security
- Democratic nature of above-ground energy sources compared to below-ground sources.
- Creation of both profit-driven and social business models. Emphasized to package these models for entrepreneurs, investors, and Vcs.
- Importance of communicating successful projects to the masses and involving stakeholders in decision making processes.
- Prashant Gadhvi from "The Secretariat" introduced that the Secretariat is a potential liaison to convert innovative strategies/ideas into government policy documents through government officials.
- Digital media product facilitating dialogue between policymakers, academia, and industry.
- Distributed solar with agriculture: Dual use of land generating solar electricity along with agriculture activity on the same land. Providing opportunities to increase farm income as well as contribute to national energy needs.
- Modernizing grid infrastructure through smart grid technologies can enhance the efficiency of decentralized systems.
- Mr. Dangayach highlighted the importance of equitable and fair opportunity to MSME sector along with large enterprises in allocation of all common resources like land, water, finance, schemes etc. for spreading renewables and decarbonisation solutions.
- Policy to motivate or compel all new enterprises and institutions to meet a part of their energy needs through captive renewables like rooftop solar on own or leased premises.
- Dedicated incubation and innovation centres for net zero solutions.
- Work towards democratisation of net zero.

Innovative Thought Forum

List of Panelists/Participants participated in Workshop

Sr. No.	Participants	Name Organisation
1	Amit Garg	IIM Ahmedabad
2	Anil Soni	ITF
3	Anshuman Lath	Gram Urja, Pune
4	Anukul Prakash Anurag	IIM Ahmedabad
5	Ashok Chaudhari	Ankur Scientific Energy Technologies Pvt Ltd
6	Bhargav C Mehta	Clean Energy Evangelist
7	Bhavin Pandya	S V Institute of Management
8	Bijaya Krushna Behera	Manan Oilfield Services Pvt Ltd
9	Binit Das	Centre for Science and Environment (Online)
10	Col Sumeet Malhan (Retd)	Punjab Renewable Energy Systems Pvt. Ltd
11	D P Mishra	
12	D Suresh	Eminent Solar Evangelist, Chennai
13	Deepak Gadhia	Sunrise CSP India pvt. Ltd
14	Dhara Thakkar	IIM Ahmedabad
15	Gajanan Patil	Urja Bio Systems Pvt Ltd, Pune (Online)
16	Gaurav Kumar Kedia	Indian Biogas Association
17	Hitendra Joshi	CRISP
18	Jayesh Parikh	Chem Systems, Ahmedabad
19	Jigar Shah	IIM Ahmedabad
20	Jyoti Maheshwari	IIM Ahmedabad
21	Kruti Upadhyay	IIM Ahmedabad
22	M R Prakash	Greenzo Energy India Ltd
23	Mayur Parikh	Ice Make
24	Nazima Malek	IIM Ahmedabad
25	Neeraj Yagnik	Kriyasiddhi
26	P S Goyal	GIPCL, Vadodara (Online)
27	Pinakin Patel	T2M, USA (Online)
28	Prashant Gadhvi	The Secretariat
29	Rajat Seksaria	Adani Group

Sr. No.	Participants	Name Organisation
30	Ravi Teja Bhamidipati	IIM Ahmedabad
31	Rutva Patel	IIM Ahmedabad
32	S B Dangayach	ITF
33	Sagar Verma	IIM Ahmedabad
34	Saritha Sudharmma Vishwanathan	Kyoto University (Online)
35	Sarosh Ginwala	Chem Process Systems
36	Shoyeb Khan	IIM Ahmedabad
37	Shwetal shah	GIZ
38	Somnath Mitra	IIT Delhi
39	Sudhanshu Jangir	IIS
40	Sumit Limbachiya	Ice Make Refrigeration Ltd
41	Tulsi Tawari	Expert in Hydrogen Fuel Cells (Online)
42	V K Shahi	CSMCRI, Bhavnagar
43	Vidhee Avashia	IIM Ahmedabad
44	Vivek Chabra	Covestro
45	Dhiraj Ninje	Chem Process Systems
46	Bipin Shah	
47	Atul Upadhyay	
48	Ashok Mulani	Mahalaxmi Electric
49	Utkarsh Acharya	Aptel Consultancy Pvt Ltd
50	Anant Somaiya	Ankur Scientific Energy Technologies Pvt Ltd
51	Kalpesh Agrawal	Catalyst Tech
52	Saurabh Pandya	Sewa International
53	Deep Patel	Ice Make Pvt Ltd
54	Praveen Das	Pluss Advanced Technologies Ltd (Online)