

Indo-U.S. Science and Technology Forum Connect

Newsletter

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IUSSTF

Indo-US Science and Technology Forum

NET ZERO

Initiatives for a greener tomorrow

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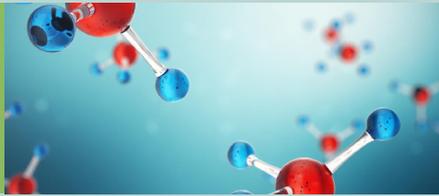
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Editor-in-Chief

Dr. Nisha Mendiratta
Executive Director, IUSSTF

Editor

Dr. Chaitali Bhattacharya
Principal Science Officer

Associate Editor

Dr. Divya Khatter
Project Coordinator, IUSSTF

Opinions

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Comments and Suggestions

Please email the Connect Team at connect@iusstf.org

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Fulbright House, 12 Hailey Road
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Creative Edge Media and Services Pvt. Ltd.
Aravali House, 431/D-22, Chhatarpur Hills
New Delhi-110074, India



FROM THE EDITOR-IN-CHIEF'S DESK

India and the United States of America continue to chart an ambitious course for the **Initiative on Critical and Emerging Technology (iCET)**, two years later since the announcement of the initiative by President Biden and Prime Minister Modi in May 2022. Since the formal launch of iCET in January 2023, both the countries have made significant strides toward deepening and expanding strategic cooperation across key technology sectors including biotechnology, space, semiconductors, advanced telecommunications, artificial intelligence, quantum, and clean energy.

In alignment with the strategic priorities of the two nations, the Indo-U.S. Science and Technology Forum (IUSSTF) has been leading programs and initiatives to mark its contribution towards the Net Zero goals. Through this edition of Connect, IUSSTF is proud to showcase remarkable innovations driving the building industry sector. With the mission "To make every building net-zero," the **Solar Decathlon India (SDI) Design Challenge**, the world's largest net-zero building challenge addresses the urgent need for climate action in our country through driving innovation, capacity building, industry engagement, raising public awareness, facilitating green jobs and opportunities, and creating an environment for policy change for accelerated climate action. SDI is a year-long competition where students are asked to design net-zero energy-water, affordable, and resilient solutions for live projects nominated by real estate developers. The spectrum of accomplishments encompasses numerous innovative, high-performance, and market-ready building design solutions that could be adopted by the construction and real estate industry.

We dedicate this issue of Connect to scientists and entrepreneurs from the Indo-U.S. scientific community who have embarked on a journey of discovery, innovation, and entrepreneurship to address some of the pressing climate challenges and accelerate progress in meeting the clean energy goals. We showcase success stories from two women scientist groups with a focus on **clean technologies for sustainable energy storage**, funded under the **Technology-based Energy Solutions: Innovations for Net Zero** initiative of United States-India Science and Technology Endowment Fund (USISTEF), in partnership with Social Alpha.

Gender gap in STEM has been perennially recognized. The presence of female role models and mentors who have made it can go a long way in guiding the younger generation and bridging this gap. IUSSTF reached out to its woman scientists to understand their perspectives and experiences on the issue at hand and the significant role that mentorship played in helping them overcome it.

IUSSTF is always buzzing with S&T stories emanating from the scientific research communities of India and the United States. Many of these stories are written by the budding scientists for most of whom IUSSTF happens to provide the first ever platform of cross-country learning, knowledge exchange, research training, and cultural exposure through programs such as the **Khorana Program for Scholars** and the **IUSSTF-Viterbi Program**. Through this issue, we share our interaction with the 2023 cohort of Khorana Scholars and their experiences in the U.S. We are also pleased to announce our 2023-24 cohort of the Viterbi awardees.

I hope you find this issue insightful and a delight to read. ●

Dr. Nisha Mendiratta
Executive Director, IUSSTF



SOLAR DECATHLON INDIA: INNOVATION FOR CLIMATE ACTION IN BUILDING SECTOR

The approach to net-zero building design and product innovation is how the building industry will support climate action. India, the site for the world's largest urbanisation and economic growth, is also where the world's largest net-zero building challenge, Solar Decathlon India (SDI), is showing climate resilient and sustainable building practices.

Solar Decathlon India: Innovation for Climate Action in Building Sector

What if you had an appliance at home, that produced clean drinking water from the humidity in the air? What if your building was made of materials that captured and stored carbon from the air, instead of materials that cause pollution and carbon emissions when they are made? What if you could get your Mumbai apartment building redeveloped so that it used only as much energy or water, as it produced on site? What if your building had smart shading that expanded and contracted with origami-like folding? These innovations are taking place right now.

India's Nationally Determined Contributions commit to a reduction of emissions by 45% by 2030, and the country aims for a net-zero target by 2070. The building industry plays a crucial role, contributing nearly 21% of its carbon emissions. As the sector grows, adding 70% of the floor area estimated for 2050 through new construction, it presents a huge opportunity for climate action. While the building industry is stuck in the construction paradigm of the 20th century, reflected by a bit dated educational curriculum in architecture and engineering colleges, SDI is injecting innovative design practices and products to rapidly change both education and industry.

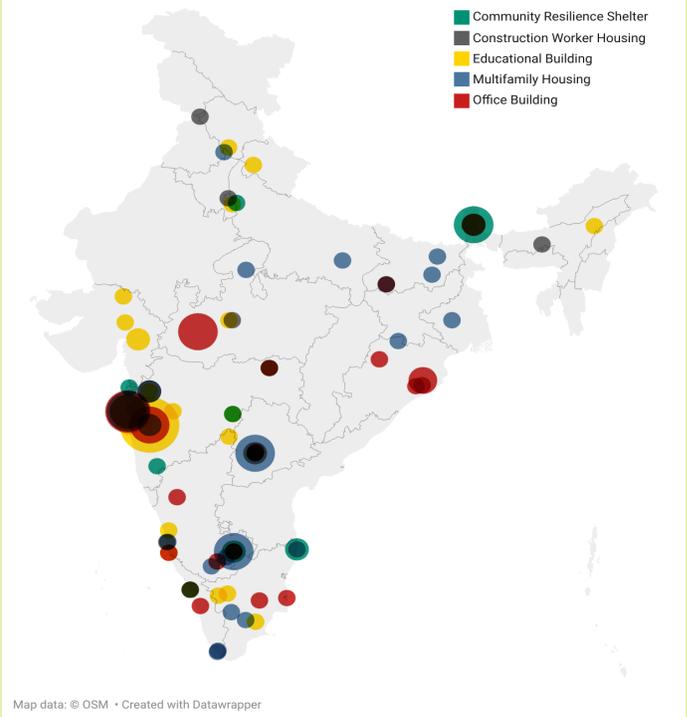
SOLAR DECATHLON INDIA DESIGN CHALLENGE

SDI is an annual competition that mobilises undergraduate and postgraduate students to create solutions with designs, technologies, and innovation that deliver net-zero and low-carbon performance. SDI also invites industry led innovations in the building sector that address climate change for the Climate Smart Innovation (CSI) Exhibition and Award. SDI's strategic objectives are the backbone of this transformation. With a primary focus on capacity building, the nine-month long challenge gives students essential knowledge and project-based opportunity to apply it. They collaborate with people and organisations from the building industry, bridging the gap between academic innovation and practical application, ensuring that solutions are both viable and scalable. The integration of SDI into educational curricula further enhances its impact, with over 35% of participating colleges incorporating SDI projects into their coursework. SDI also raises public awareness about the importance of net-zero buildings through dedicated campaigns and public engagement. With career fairs and investor exposure, SDI transforms the job market into a green-collar economy.

The Solar Decathlon, started by the U.S. Department of Energy (DOE) in 2002, is a collegiate competition with ten contests that participating teams have to excel in. The success of the Solar Decathlon in the U.S. spawned six official versions across the world – regional decathlons in Africa, Europe, Latin America and the Caribbean, and the Middle East, and country level decathlons in China and India. In 2020, the Indo- U.S. Science and Technology Forum signed an MoU with the DOE to conduct the Solar Decathlon in India, and **within four years, SDI has attracted more than 6,000 students from 300 academic institutions across India.** SDI has larger participation than

any of the other Solar Decathlons anywhere else in the world. The organising team of SDI regularly interacts with the DOE and the organisers of the other Solar Decathlons in other countries. SDI's collaboration with the DOE and the National Renewable Energy Laboratory has led to an exchange of knowledge and best practices on mentoring innovation, and capacity building towards building science and research. The DOE has been particularly interested in SDI's experiments with innovation on the new Product Development Division that was launched in the fourth year, and the Climate Smart Innovation Award for the industry.

Project Locations 2023-24



Student teams in the 2023-24 challenge worked on real projects in 70 cities across India

Student teams participating in SDI work on problems of different types and scales through the competition divisions. In 2023-24, these included designs for building projects from 70 cities across India for residential apartments, schools, colleges, offices, construction worker housing, and resilience shelters. The product division challenged the students to develop and prototype sustainable cooling solutions that could be retrofitted into residential spaces.

The winner of the product division, Team Resolution from IES College of Architecture, developed COOLA, an innovative cooling solution aimed at the urban demographic. The Indian household AC market, which makes up 54.6% of the total AC market, is expected to reach \$5 billion USD by 2028. Through a comprehensive background study, Team Resolution interviewed over 150 households. They identified redundancy of multiple units in an apartment as a waste of resources, and problems

with installation and maintenance of outdoors units hung outside in precarious positions. COOALA, a 1-ton water-cooled machine has no outdoor unit, can be rolled from room to room as needed, and eliminates holes and pipes through walls. It uses temporal heat dissipation principles with a dual compressor cycle and matches the cooling performance of a typical 1.5-ton room AC. Team Resolution's next steps include developing user-friendly UI/UX interfaces, integrating advanced sensors, HEPA filters, and inbuilt mosquito repellents. They aim to create a comprehensive financial strategy and seek investment to expand their presence in both online and offline marketplaces.

SDI WINNERS 2023-24

Team Genesis from NMIMS's Balwant Sheth School of Architecture and Mukesh Patel School of Technology Management & Engineering, was the Grand Winner of the 2023-24 challenge. The team designed a net-zero energy and water building for Bhagnari Co-Operative Housing Society, as a high-density, high-rise residential project in Chunabhatti, Mumbai. Their design focused on sustainability, community, and connectivity, addressing key issues such as water use reduction, optimal light and ventilation, and flexibility in configuration of the living units.



Team Resolution presenting their prototype at the SDI finals 2024



COOALA, an innovative cooling solution by Team Resolution of the 2023-24 challenge

Solar Decathlon India: Innovation for Climate Action in Building Sector

As a part of their project, the team developed an app to enable users to interact efficiently with the smart building, incorporating various innovative features. The app tracks energy consumption, suggesting strategies for energy savings and improving living conditions. It offers other energy-saving tips, like using furniture that reduces cooling loads, and automates HVAC and natural ventilation schedules. Rain windows, synced with the AC system, open and close automatically. The app also allows residents to monitor and adjust their unit temperatures, offering

recommendations based on external conditions. The team aimed to enhance community engagement through features that facilitate resource-sharing for sustainable living and track activities like urban farming. They also innovated bedroom windows that address noise and mosquito issues while allowing cross-ventilation, as well as monsoon windows with removable screens to keep out mosquitoes, maintaining comfortable living conditions, ensuring ventilation even during heavy rain.



A high-density multi-family housing project by Team Genesis of the 2023-24 challenge



Team Genesis: grand winner of the 2023-24 challenge

CLIMATE SMART INNOVATION AWARD 2024

SDI's Climate Smart Innovation Award is for businesses that are developing products and services to address climate change. They exhibit their innovations at the SDI Finals and pitch their products to an expert jury. The 2024 edition of the exhibition and pitch presentations were attended by potential investors, real estate developers, asset managers, and industry professionals. The jury for the award included Aruna Newton, VP- Global Head- Diversity, Equity & Inclusion, ESG Governance and Reporting at Infosys; Guruprakash Sastry, AVP Head, Climate Action at Infosys; and Dr Chaitali Bhattacharya, Principal Science Officer at IUSSTF. Of the 44 applications received by SDI, 25 were shortlisted for the exhibition and 8 innovators pitched to the jury.

VayuJal Technologies Pvt. Ltd. and Hexpressions Megatech Pvt. Ltd. were declared joint winners of the SDI Climate Smart Innovation Award 2024.



VayuJal Technologies Pvt. Ltd. and Hexpressions Megatech Pvt. Ltd. were declared joint winners of the SDI Climate Smart Innovation Award 2024

VayuJal, an IIT Madras-incubated and ISO 9001-2015 certified company, developed innovative **Atmospheric Water Generators (AWGs)**. These devices extract moisture from the air, producing up to 2,900 litres of water daily, with an energy efficiency of 0.24 kWh per litre, with a payback of less than 2.5 years. This technology offers a significant improvement in water production per unit area and energy used, making it a viable alternative to traditional water sources. VayuJal AWGs incorporate a seven-stage water filtration system, ensuring the output meets BIS-10500:2012 standards for both drinking and lab-grade water. The technology mimics the water-harvesting morphology of cacti, which effectively captures water in arid conditions. This innovation by VayuJal addresses water scarcity, the high waste associated with RO systems, and microplastics in bottled water. The Total Addressable Market (TAM) for such solutions is substantial, valued at INR 2,522 Cr. VayuJal's AWGs are versatile, catering to both domestic and industrial needs. VayuJal emphasises sustainability, promoting recycling and refurbishment of components, and ensuring responsible disposal at end-of-

life.



The Atmospheric Water Generator by VayuJal Technologies Pvt. Ltd. on display at the Climate Smart Innovation Exhibition at SDI Finals 2024

Hexpressions is a social impact venture that focuses on housing affordability crisis through innovative design and construction technologies. Their **Composite Paper Honeycomb Panels** consist of an inner core made from recycled paper and an outer layer made from locally sourced materials like cement boards, wood, or stone. This innovative material significantly reduces the environmental impact by replacing typical high-carbon construction materials like concrete blocks, panels, or bricks, lowering the carbon footprint by 80%. The panels are fabricated on-site, which reduces transportation costs and installation time. They ensure that the construction is ten times faster and 30% more economical than traditional methods. At the end of their life, the panels can be dismantled and recycled, promoting a circular economy and sustainable practices. Their solution empowers underserved communities by offering training and skill development, enabling them to build their homes and improve their living conditions.



Composite Paper Honeycomb Panels by Hexpressions Megatech Pvt. Ltd. on display at the Climate Smart Innovation Exhibition at SDI Finals 2024

The jury members were enthralled by the energy, innovation and spirit on display at the SDI Finals in May. Guruprakash Sastry invited all the competing organisations

Solar Decathlon India: Innovation for Climate Action in Building Sector

to pilot their innovation across Infosys' campuses. Priyank Garg, Managing Partner at IAN Alpha Fund, committed to further conversations regarding investment opportunities

with Angirus Ind, Hexpressions, StrautX Technologies, and Vayujal Technologies.



SDI Finals 2024 was a carbon neutral event at Infosys campus in Mysuru

IMPACT

Since its inception in 2020, SDI has grown into the world's largest net-zero building challenge, with over 6,000 students from 300+ institutions collaborating with 270+ partners in the building industry. The SDI Finals, on May 17, 18, and 19 was a carbon neutral event, at Infosys' campus in Mysuru, one of the most sustainably operated campuses in the world. Infosys hosted the event pro bono and provided accommodation and food for all attendees for 4 days. The 37 finalist projects were exhibited at the finals to the audience of about 800 people. The Finals included a career fair where over 50 leading organisations working on climate change and net-zero buildings looked to hire the best and brightest minds.

Nandan Nilekani, Chairman and Co-founder, Infosys and Founding Chairman UIDAI (Aadhaar), spoke to the audience about the opportunity SDI provides for industry and academia to come together and brainstorm ideas and share best practices to tackle climate change. Dr Yash Shukla, Principal Researcher & Centre Head - Centre for Advanced Research in Building Science and Energy CRDF, CEPT University, and a jury member, noted the impressive potential of students and their work, while Nilesh Sonawane, Business Development Leader - Owens Corning, also a jury member, praised the innovations

demonstrated by the students, highlighting the promising future of India's building sector. Dr Satish Kumar, Founder and President, Alliance for and Energy Efficient Economy, called this year's introduction of the residential cooling retrofit category a game-changer, offering solutions for enhanced cooling performance with minimal need for disruption. Dr Nisha Mendiratta, Director, IUSSTF, was delighted to see the industry stepping up with innovations, amplifying the impact of the funding for STEM integration in buildings, something she had been involved in at the Department of Science & Technology.

By nurturing collaboration between academia and the industry, and actively fostering innovation and a generation of environmentally-conscious leaders in the building industry, SDI is helping India realise its climate goals. The future is net-zero, and SDI is at the forefront of this movement, continuing its growth and impact.

The Solar Decathlon India 2024-25 challenge was launched in July 2024.

Solar Decathlon India is conducted by the Alliance for an Energy Efficient Economy (AEEE) and the Indian Institute for Human Settlements (IIHS) under the aegis of the Indo- U.S. Science and Technology Forum (IUSSTF). Solar Decathlon India is supported by the Department of Science and Technology (DST), Government of India. ●



ECONOMICAL SOLAR ROOFING SOLUTION FOR RESIDENTIAL COMMUNITIES

Innovations for Net Zero, U.S.-India S&T Endowment Fund, 2023

Installation of solar panels on tilted roof poses installation challenges and has inherent system inefficiency due to the pitch and tilt of the sloped roof. The roofs do not have the perfect south facing orientation for getting maximum solar irradiation falling on the panel. In addition, the slope of the roof does not permit installation at latitude tilt and hence solar panels do not give the peak performance. Solar trackers that use mechanical motors and gears tend to improve the performance of solar panels but are not applicable for sloped roofs.

OBJECTIVE

To address the above issue, **Dr. Lakshmi Santhanam and Mr. Balaji Bangolae, Co-Founders at Renkuba Pvt. Ltd., a Bengaluru-based startup** joined hands with **Mr. Rajesh Manapat at Arka Energy, California** to provide solar panel roofing solution for residential communities also known as Building-integrated photovoltaics (BIPV) and channelize efforts to make it as efficient as possible. The team's project entitled **"Motion-Free Optical Tracking to reduce the cost of electricity by 25%"** received support through the **U.S.-India Science and Technology Endowment Fund in 2023**. The proposed solution intends to integrate a motion-free optical tracking solution from Renkuba in the integrated solar roofing solution developed by Arka Energy. The unique design and geometry of Renkuba's light redirecting glass is designed to collect more sunshine in a motion-free manner and thereby improve the energy yield in the solar tile. The innovation here is the 3D prism design - an innovative light harvesting glass that tracks sunlight and bends it towards the solar cells thereby increasing the energy yield of the solar panel.

With motion-free optical tracking embedded inside the solar tiles, the team aims to lower the cost of energy generation in rooftop BIPV by increasing the energy yield by up to 40% irrespective of the facing of the roof at 10-



Arka's Solar Tile

15% increase in capital cost. Just like a sunflower keeps moving to face the sun and maximize its gain, the rooftop integrated solar tiles developed by the team are designed to track the sun sans any movements to maximize the intensity of sunlight incident on it. This is achieved without



The Renkuba Team



Renkuba's AgriPV (Aerial View)

any electrical or mechanical components and purely by the virtue of the glass design. The quantum of energy gain is expected to be same for any geography from Singapore to New Delhi to London and is applicable for any orientation of the roof (East/West/South/North).

OUTCOME

The team has demonstrated a proof-of-concept of working on Renkuba light redirecting prisms in a half meter panel and is currently running pre-certification BIS tests for the same. Arka Energy has demonstrated a proof of concept of the solar tile for BIPV at its office in Bangalore and is currently running pre-certification BIS test for them.

The team has filed patents in multiple geographies like U.S., Europe, India, China and Australia and filed two trademarks and published several IEEE papers on this work.

IMPACT

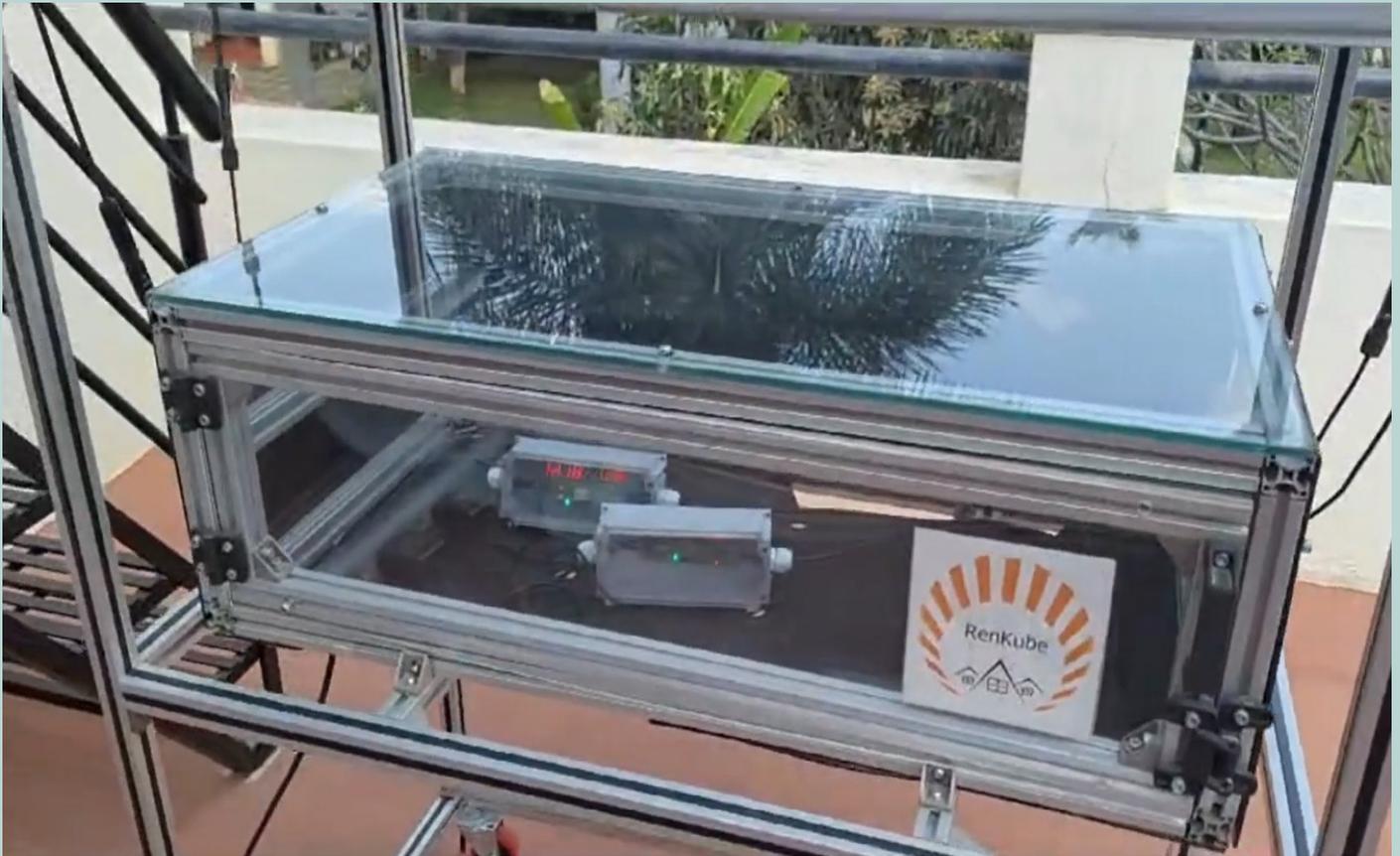
The capital expenditure involved in a solar installation is typically 4 crores for a 3-acre farm, which is beyond the means of small and marginal farmers. This cost factor becomes critical when dealing with small land holdings,

typically ranging from 2.5 to 5 acres, as is common among small and marginal Indian farmers.

Generally, traditional solar installations in traditional dry arid lands typically have a return on investment (ROI) in about five to eight years. However, implementing solar on agricultural land involves an additional capital expenditure of 50 lakhs/MW to raise the structure and provide necessary reinforcements, which depend on soil conditions, terrain, etc. These structural adjustments can extend the ROI period by a year. Balancing the potential benefits of our technology with the financial constraints of these farmers is crucial.

At Renkuba, the team is building a technology that would address these challenges and provide more energy generation to offset the additional capital investment for AgriPV. The dual use of land guarantees 140% energy generation and 100% agricultural yield which is expected to provide an attractive ROI.

Although the team's goal is to empower marginal farmers, their initial approach is to work with high-income group farmers who have larger land holdings (100+ acres) due to their financial capability to invest in AgriPV. Once they demonstrate the benefits, they plan to collaborate with the



Data measurement in the Renkuba's AgriPV model

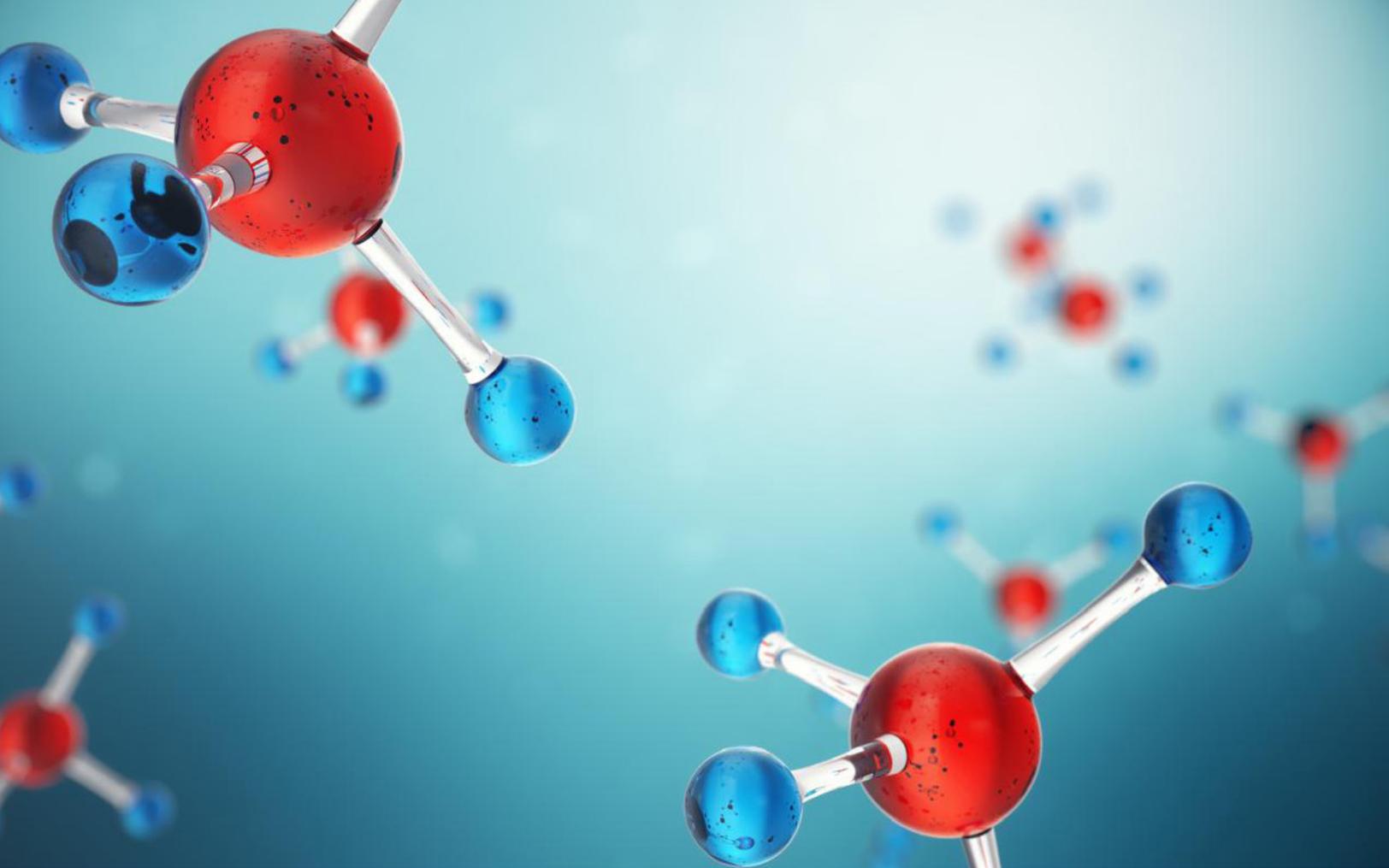
government and suggest land policy recommendations for solar on agricultural land, provide preferential feed-in-tariffs for AgriPV, and provide upfront capital subsidy for solar developers to do AgriPV. This would build an ecosystem for AgriPV to flourish, where the technology benefits could extend to all the small and marginal farmers who comprise the majority of the farming community in India by giving a guaranteed lease income.

LEVERAGING INDO-U.S. PARTNERSHIPS

The Indo-U.S. partnership developed through the project supported by IUSSTF has been instrumental in driving outcomes under this project. The Indian partner developed the optimal geometric design of light redirecting glass for the solar tiles using its proprietary software and provided a detailed SOP for manufacturing of the prism and its assembly on the solar tiles. The U.S. partner's expertise in

solar enabled to make the product better by fine tuning the material choices for mounting systems and providing the necessary infrastructure to test, validate, and check the reliability of the product; providing guidance on integration of the solar roof into residential roofs; and a detailed SOP for solar tile manufacturing. In the future, the team intends to make the product more aesthetically appealing to suit the needs of developed markets like U.S. to provide better efficiency and provide earlier payback for doing solar.

The team plans to expand their collaboration to other U.S. companies like ICARUSRT led by Mark Anderson which will explore the applicability of motion-free optical tracking technology for solar thermal solutions for which the team has an upcoming pilot scheduled in New York. With Renkuba's offering of increased energy generation, the long-term goal is to accelerate the transition to net-zero homes in U.S. and India. ●



CARBON SEQUESTRATION

Innovations for Net Zero, U.S.-India S&T Endowment Fund, 2023

The Dry Reforming of Methane (DRM) is a process that involves a strong reaction between methane and carbon dioxide to produce an equimolar synthesis (syn) gas which consists of hydrogen (H_2) and carbon monoxide (CO). However, high endothermicity, coking, and high reaction temperatures remain as major challenges of DRM. DRM is also not capable of producing syngas ratio greater than or equivalent to 2. Recently, an alternate process called Bi-reforming of Methane (BRM) that combines dry and steam reforming is proposed for syngas production.

The reforming of methane with a combination of CO₂ and steam is known as bi-reforming. Similar to dry reforming, syngas from bi-reforming can convert CO₂ into higher value products. However, high reaction temperatures, catalyst deactivation, low product selectivity, high endothermicity, formation of coke and hot spots remain the major unaddressed challenges. Moreover, development of active and stable catalysts for BRM with CO₂ to produce syngas ratio of 2 at milder reaction conditions remains a daunting task, which is an essential step for the process to be commercialized. However, high reaction temperatures, catalyst deactivation, low product selectivity, high endothermicity, formation of coke and hot spots remain the major unaddressed challenges. Moreover, development of active and stable catalysts for BRM with CO₂ to produce syngas ratio of 2 at milder reaction conditions remains a daunting task, which is an essential step for the process to be commercialized.

OBJECTIVE

Dr. Sumana Chenna, Senior Principal Scientist, **Dr. Lingaiah Nakka**, Chief Scientist, **Dr. Soujanya Yarasi** Senior Principal Scientist, CSIR-Indian Institute of Chemical Technology, India and **Prof. Vemuri Balakotaiah**, **Hugh Roy** and **Lillie Cranz Cullen Distinguished University Chair**, **University of Houston, U.S.** partnered under the project "**Integrated Solution to convert Two GHGs CO₂ And CH₄ to H₂ rich synGas (ISTAG)**" supported by the **U.S.-India Science and Technology Endowment Fund in 2023** to develop an efficient catalytic BRM process that contributes to mitigating global warming and climate change through utilization of two major greenhouse gases (GHGs), CH₄ and CO₂ for the production of H₂ rich syngas, with the syngas ratio (H₂/CO) of 2 - a critical parameter to produce several industrial chemicals such as methanol, ethanol, and other synthetic fuels. The project is focused towards solving the aforementioned challenges by developing efficient heterogeneous catalysts that are active and stable through an intensified, integrated approach of quantum mechanics (QM), AI/ML, and experimental studies with the objective of producing syngas ratio (~2) at moderate reaction conditions, thereby contributing to the reduction

of carbon footprint and secondary pollution.

OUTCOME

Thus far, the project team has developed a database based on the detailed literature review performed on the experimental studies reported on BRM catalysts. Further detailed multivariate analysis was carried out and the key input parameters that influence the methane conversion were identified. Also, AI models were developed for accurate prediction of methane conversion which would be further used in the inverse design of catalyst with the objective of maximizing CO₂ and methane conversions and achieving desired syngas ratio.

Simultaneously, experimental studies were carried out at CSIR-IICT for developing La- and Sr-based perovskite oxides La_{1-x}Sr_xNi_{0.8}Zr_{0.2}O₃ (x=0.1, 0.2, 0.4, 0.6, 0.8) as potential BRM catalysts. These catalysts were prepared via the sol-gel method, characterized using X-ray diffraction, H₂-Temperature Programmed Reduction, BET, CO₂-Temperature Programmed Desorption, and CHNS analysis. The BRM reaction was tested at various temperatures with a feed ratio of CH₄:CO₂:H₂O:N₂ = 1:0.5:0.8:1. The results revealed La_{0.8}Sr_{0.2}Ni_{0.8}Zr_{0.2}O₃ as the most promising catalyst. Its characterization indicated that increasing Sr enhances metal-support interaction and alters Ni reduction behavior. CO₂-TPD results showed that small amounts of Sr modified the support's basicity. These catalysts demonstrated reduced carbon deposition, increased dispersion, smaller crystal size, optimal support basicity, and excellent stability over 100 hours.

Further, the experimental studies were complimented with First principles calculations using spin-polarized density functional theory (DFT) in VASP to investigate the structural stability of pristine perovskite LaNiO₃ (LN), Zr-doped LN (LNZ), and Sr-doped LNZ models. Total energy calculations revealed that Zr-doping increases stability, while Sr-doping gradually reduces stability due to a decrease in atomic radius and an increase in ionic radius of Sr compared to La, leading to decreased volume and increased total energy in Sr-doped systems.



Prof. Balakotaiah
PI, US



Dr. Sumana
PI, India



Dr. Lingaiah
Co-PI, India



Dr. S. Yarasi
Co-PI, India



Dr. Kishan
Industry Partner, India



Dr. Sagar
Industry Partner, US

In addition, thermodynamic equilibrium studies were performed at University of Houston to determine the optimal input conditions (temperature, pressure, and inlet composition) to prevent the carbon deposition in electrified BRM reactors. The modelling results indicated that programmed heating rates tend to achieve higher conversion without exceeding catalyst/substrate failure limits.

To date, the key project accomplishments are summarized below.

❖ AI-BASED PREDICTIVE MODELS

The team created a database (input catalyst and process parameters vs CO_2 , methane conversion and syngas ratio) that provides a comprehensive overview of the experimental studies reporting different BRM catalysts. Further, the data was classified using decision tree analysis and key variables were identified. An extra tree regression-based model was developed that could accurately predict the methane conversion.

❖ POTENTIAL BRM CATALYST CANDIDATES

With the team's efforts, potential Ni-based perovskite catalysts were designed, synthesized, characterized and tested for BRM reaction to produce H_2 rich syngas with H_2/CO molar ratio of 2. DFT studies performed complemented the experimental studies to understand the mechanism of the catalyst. $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ni}_{0.8}\text{Zr}_{0.2}\text{O}_3$ showed highest CH_4 and CO_2 conversion with H_2 yield of 70.2%. The active catalysts exhibited excellent stability with consistent yield for a studied period of 100 hours.

❖ DFT BASED COMPUTATIONAL MODELS

A systematic investigation was carried out on $\text{La}_{1-x}\text{Sr}_x\text{Ni}_{0.8}\text{Zr}_{0.2}\text{O}_3$ perovskite catalysts using First principles calculations to complement the in-house experiments.

❖ THERMODYNAMIC MODELLING AND ANALYSIS

Comprehensive thermodynamic equilibrium studies performed by the team identified optimal operating conditions that led to high methane and CO_2 conversions, high energy efficiency, and zero (or practically zero) carbon deposition on the catalyst. These optimal conditions correspond to a narrow range of feed composition and the corresponding temperature and pressure windows which are in the practical range of interest.

Two peer-reviewed research publications and several conference proceedings have emerged out of this work.

IMPACT

Using electricity generated from renewable sources for large-scale chemical production is crucial for energy transition. Bi-reforming methane with Joule heating shows

a promise for a net-zero economy provided the operational challenges are addressed. Results show that dry reforming of methane requires very high temperatures of operation to avoid carbon deposition, while BRM with close to or slightly excess stoichiometric reformer to methane ratio (values in the range of 1.0 to 1.1) and more steam than CO_2 (values in the range of 0.3 to 0.5) appears to be the optimal range where it is feasible at temperatures and pressures of practical interest. These results can serve as a guide to experimental validation, catalyst, and reactor design and scale up studies for the BRM process. The proposed process would offer substantial reduction in the carbon footprint, capital expenditure, and operating expenses and therefore is suitable for successful scale-up and commercialization.

LEVERAGING INDO-U.S. PARTNERSHIPS

This project, focused on converting two major greenhouse gases into value-added syngas, aligns with the climate and clean energy commitments of both India and the United States. The collaboration between Indian and U.S. partners, leveraging complementary expertise in molecular modelling, AI/ML, kinetic and thermodynamic modelling, and catalyst synthesis, characterization, and testing, has strengthened bilateral ties. This partnership has provided more accurate and rapid solutions to the challenges associated with the existing BRM process.

The AI/ML work by the Indian partner (CSIR-IICT) resulted in a generalized database for BRM and predictive models for methane and CO_2 conversions. Furthermore, experimental studies carried out by the Indian partner aimed at maximizing CO_2 and methane conversions and achieving the desired syngas ratio which revealed a stable and active perovskite-based BRM catalyst, $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ni}_{0.8}\text{Zr}_{0.2}\text{O}_3$. This catalyst demonstrated reduced carbon deposition, increased dispersion, smaller crystal size, and optimal support basicity, showing excellent stability over 100 hours. Additionally, detailed catalyst characterizations and DFT studies were performed to understand the catalyst's mechanism.

Thermodynamic modelling studies performed by the U.S. partner (UH) revealed the optimum operating conditions for preventing carbon formation in BRM conducted in an electrically heated reactor, achieving nearly complete conversion of both methane and CO_2 . BRM required higher heating rates than steam methane reforming but lower rates than dry reforming due to the stability of CO_2 . Electrically heated BRM showed higher selectivity for CO and H_2 and greater conversions of methane and CO_2 compared to isothermal or adiabatic pathways, although constant heating could cause excessive temperatures.

The findings from the studies conducted in India and the U.S. in this joint project will contribute to kinetic model development, reactor design, and scale-up. This brought the team one step closer to commercializing one of the most promising technologies for addressing climate and clean energy challenges. ●

PERSPECTIVE...

Bridging the Gender Gap in STEM

It is well-recognized that the presence of female role models and mentors at senior positions can encourage career progression and promote gender equality in the field. **Kavya Illath Kandy**, one of the scholars from the 2023 Khorana cohort went above and beyond her research experience and shared how she looked upon her mentor, **Prof. Jo Handelsman** as a role model to navigating a critical challenge to the progress of women in STEM careers – **the gender gap**. It was heartwarming to note how the Khorana program presented a platform to young budding scientists to not only augment their scientific research skills but also enabled them seek guidance, encouragement, motivation, and support, and develop life-long relationships with mentors in their careers and lives.



Prof. Jo Handelsman

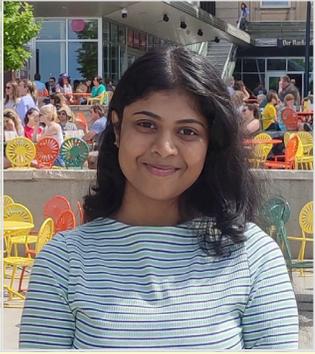
Prof. Jo Handelsman is the Director of the Wisconsin Institute for Discovery at the University of Wisconsin-Madison, a Vilas Research Professor, and Howard Hughes Medical Institute Professor. She previously served as a science advisor to President Barack Obama as the Associate Director for Science at the White House Office of Science and Technology Policy (OSTP) for three years until January 2017. She received the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring from President Obama in 2011, and in 2012, Nature named her one of “ten people who mattered this year” for her research on gender bias in science. Handelsman was inducted into the American Academy of Arts and Sciences in 2019 and was elected to the National Academy of Sciences, and the National Academy of Inventors.

“ When I started my faculty position decades ago, there were very few women on the faculty at the University of Wisconsin-Madison. People often confused me with other women faculty members because we all “looked the same” to many men. No one wanted to believe that sexism was a factor in anything, so women usually just acted happy even when they were feeling crushed by the prejudice. We watched men of the same accomplishments get awards and promotions that we didn’t get. Women were assigned more committee work and often less interesting committee work than the men. About 20 years ago, things began to change. Some men became partners with women in making change. They too saw the inequities and wanted to fix them. The university started programs to help everyone recognize their biases, offered men and women tenure extensions for having childcare responsibilities, it was easier to ask the simple question, “are we holding everyone to the same standard” and demand equitable treatment for all. Slowly, things started to change, and more opportunities were offered to women and women started to advocate for themselves and each other. Today, there are still informal clubs that only men are invited to, and that’s a disadvantage to women. Small groups of men set policy and exchange information. The hardest part of doing my job is being excluded from the informal information networks that men easily access when socializing with other men. When asked why they didn’t share certain key information with me, they often say, “it was an oversight” or “it never occurred to me.” It’s truly maddening.

I have found that the biggest contributors to success are hard work, persistence, and finding friends and mentors who can help and advise you. So many women get disgusted with the system and give up on academia, but academic science is a fantastic thing to be part of. We have freedom to study interesting problems, we get to train fabulous students at all phases of their careers, and we have great colleagues doing interesting science all around us. What a privilege! I love my job and wouldn’t trade it for any other occupation in the world. So, I’m very grateful that I had the energy to persist in science and the friends and colleagues to encourage me to do so. Now I spend a lot of time helping other women deal with the barriers that are still commonplace, but so much easier than 20 or 30 years ago. And one thing that makes it easier is having a lot more women in senior roles to look to as role models and mentors.

My advice to young women just starting their careers is to not let the barriers get you down or slow you down. Fight against inequities that are impeding your progress, help other women succeed, and find mentors who believe in you and can show you the way or even fight for you. If you don’t think you face any gender barriers, be grateful for your good fortune and offer to help other women. Sometimes it can be as simple as letting a woman vent about unfair treatment, others it’s telling them that you know they can succeed, and other times you may be the one to go to the people creating the barriers and point them out. But mostly, get energy, strength, and joy from the science you do. It’s the beauty of a career in science that will ultimately make it all worthwhile.





Ms. Kavya Illath Kandy



I consider my mentor, Prof. Jo Handelsman as a true role model in STEM. As a woman scientist, she has carved her niche in the field of science and still remains relevant through all these years solely because she has never given up. I admire how she speaks up against gender bias and for engaging more women in STEM. Her efforts to improve the participation of women in science is remarkable and she has been recognized many times for her research on gender inequity. She has been working towards gender equity since a very early time which includes the publication of the article "More women in Science" in 2005. In 2012, she was also named as one of "ten people who mattered this year" by Nature for her research on gender bias in science.

Her words hold the power to encourage young women to come up without doubting themselves. I still remember the eve of celebrating her being elected to National Academy of Sciences, and how she shared her experience, of starting her career as one of the few women faculties and how constant hard work helped her reach here. I had goosebumps when she spoke about how thankful she was to people who believed in her and motivated her to never give up. In a world where men's voices still echo the most, we need people who can guide us, support us and give us a push to speak up and put forward our ideas. Prof. Jo Handelsman is that person who helps us come out of our shells and urges us to voice our ideas without any hesitation. One quality that I admire a lot as her mentee is the space she gives every single person to put their opinions out there, personally, academically and socially. In a world where everyone is in a rush to establish one's own opinion as the best, we need more people like Prof. Jo Handelsman who can give us the space to grow as well as guide us to the right direction. As I look up to her, I would like to imbibe her kindness to help others, courage to speak up and her love and passion for science. ●



Prof. Jo Handelsman with her research team

An IUSSTF and Lockheed Martin India Pvt. Ltd. Event

UNLOCKING POTENTIAL : INTEGRATING ARTIFICIAL INTELLIGENCE IN UAV APPLICATIONS

An endeavor motivated by the Initiative on Critical and Emerging Technology (iCET)

The Indo-U.S. strategic technology partnership received a significant boost with the launch of the iCET (The Initiative on Critical and Emerging Technology) in May 2022. In June 2023, President Biden and Prime Minister Modi met in Washington DC, and reaffirmed their shared commitment to strengthen bilateral science and technology cooperation, including for emerging technologies like artificial intelligence (AI) and its various applications such as in unmanned aerial vehicles (UAVs), also known as drones.

Building on this momentum, the Indo-U.S. Science and Technology Forum (IUSSTF), in collaboration with Lockheed Martin, organized a panel discussion and felicitation ceremony titled “**Unlocking Potential: Integrating**

Artificial Intelligence in UAV Applications” on February 20, 2024 at Bharat Mandapam, New Delhi.

Unmanned Aerial Vehicles (UAVs) are experiencing a surge in popularity and utility across diverse industries. The integration of Artificial Intelligence (AI) has played a significant role in improving UAV capabilities and broadening their applications. This thematic exploration delved into the synergies between UAVs and AI, highlighting their transformational impact across sectors such as Precision Agriculture, Surveillance and Security, Search and Rescue Operations, Environmental Monitoring, Humanitarian Aid, and Medical Science, among others. The event captured a comprehensive overview of the diverse applications of UAVs and the critical role that AI can play in unlocking their full potential across various



Dignitaries at the event L-R: AVM Michael Fernandez (Retd.), Mr. Randall Howard, Dr. Nisha Mendiratta, Mr. Mahaveer Singhvi, Dr. Praveen Somasundaram, Mr. Drew Schufletowski



Attendees at the event having representation from federal agencies, industry and academia

industries. It also explored the challenges, ethical issues, and opportunities that thrive in the evolving landscape of UAV applications with AI integration. The panel brought together representatives from academia, big industry players, startups, and federal agencies who discussed unlocking the potential of UAV applications by integrating artificial intelligence, working under the above thematic areas. They deliberated on the various strengths that the United States and India might leverage to potentially collaborate.

Mr. Mahaveer Singhvi, Joint Secretary (New Emerging and Strategic Technologies Division), Ministry of External Affairs, Government of India; **Mr. Drew Schufletowski**, Minister-Counselor, Economic Affairs Environment, Science and Technology, U.S. Embassy; **Dr. Praveen Somasundaram**, Head International Division, Department of Science and Technology, GOI and **Mr. Randall Howard**, Vice President – Global Pursuits, Strategy and Business Development, Lockheed Martin Aeronautics, **AVM Michael Fernandez (Retd.)**, India Country Head, Lockheed Martin, and **Dr. Nisha Mendiratta**, Executive Director, IUSSTF addressed the gathering during the inaugural session. Our eminent guests shed light on how the iCET provides a framework for joint research, development, and commercialization efforts between the two countries, with AI-integrated UAVs

representing a rapidly evolving technology with immense potential for various applications. Collaborations on AI-integrated UAVs can lead to faster advancements and unlock a wide range of applications that benefit both India and the U.S., addressing societal challenges and leading to groundbreaking solutions.

The **panel discussion** brought together a diverse group of experts from India and the U.S., including representatives from academia, industry giants, innovative startups, and government agencies. The discussion explored the vast potential of Unmanned Aerial Vehicles (UAVs) and how integrating Artificial Intelligence (AI) can unlock even greater possibilities across various sectors.

■ Transforming Agriculture and Healthcare

Mr. Anshuman Tripathi, Member of India's National Security Advisory Board set the stage by highlighting the transformative potential of AI-powered UAVs for India's agricultural sector. He emphasized the ability of these systems to significantly reduce water usage and optimize processing times, leading to increased efficiency and productivity. **Dr. Shirshendu Mukherjee**, Mission Director at BIRAC (Biotechnology Industry Research Assistance



Panel discussion on Unlocking Potential: Integrating Artificial Intelligence in UAV applications

Council), echoed this sentiment, focusing on healthcare delivery. He highlighted the initiatives being actively supported by BIRAC that leverage AI-integrated UAVs to overcome logistical challenges and ensure “last-mile” healthcare delivery in remote areas. These drones could deliver essential supplies like vaccines, medicines, and even milk and protein, empowering frontline healthcare workers and improving overall healthcare accessibility.

■ Beyond Civilian Applications: Security and Infrastructure

The discussion expanded beyond civilian applications with **Mr. Randall Howard**, Vice President at Lockheed Martin Aeronautics, highlighting the critical role of AI in defense-related UAV applications. Lockheed Martin, a key industry stakeholder in the aerospace and defense domain, is at the forefront of leveraging AI to develop advanced UAVs that address 21st-century security needs. **Ms. Swati Tiwari**, Founder and CEO of Arcturus Business Solutions, noted a unique application: utilizing AI-integrated UAVs for power line inspection in Odisha, India. These drones map transmission lines, monitor system processes, and identify potential safety hazards, contributing to a more reliable and efficient power grid.



Team Drovengers Quad, Bengaluru

■ Funding Innovation & Addressing Challenges

The panel also delved into the crucial role of funding and support for nurturing innovation in this field. **Prof. S.K. Saha** from the IIT Delhi’s I-Hub Foundation for Cobotics shed light on initiatives actively funding promising startups developing groundbreaking UAV technologies. Additionally, **Dr. Sapana Kaushik**, a scientist at the Department of Science and Technology (DST) in India, highlighted government programs like National Initiative



Team Thanos Technologies, Hyderabad



Team UAS, DTU, Delhi

for Developing and Harnessing Innovations (NIDHI) and NIDHI-PRomotion and Acceleration of Young and ASpiring technology entrepreneurs (NIDHI-PRAYAS), along with accelerator programs that support startups focusing on drone and AI-powered UAV technologies.

The discussion did not shy away from the challenges

faced by UAV technology. **Mr. Vikram Bansal**, Founder and CEO of Asatrobo, an IIT Kanpur incubated company, emphasized that AI holds immense potential to address limitations like dependence on the Global Navigation Satellite System (GNSS) and overall reliability issues. By integrating AI capabilities like autonomous navigation and

Unmanned Aerial Vehicles (UAVs) made a spectacular entry at the Aero-India 2019 with the first ever '**Drone Olympics**' competition conducted by the Ministry of Defence. To encourage and support start-ups and small businesses to develop UAV/drone technologies for both Indian and global markets, Lockheed Martin agreed to sponsor three Autonomous Drone Racing Kits to three winners of the competition. The event felicitated the winners of the Drone Olympics Competition in the adjoining categories:

- **Drovengers Quad, Bengaluru (Surveillance Fixed VTOL (Multirotor) > 4 kg challenge)**
- **Thanos Technologies Private Limited, Hyderabad (Supply Drop Challenge)**
- **Team UAS, Delhi Technological University (Flying Formation Challenge)**



Felicitations of the Drone Olympics competition winners

Event Diary | Panel Discussion & Felicitation

improved decision-making, UAV technology can become more robust and adaptable.

The Indo-U.S. collaboration exemplified by this event signifies the importance of fostering international partnerships in advancing AI-integrated UAV technology. The iCET plays a key role in propelling this collaboration by focusing on joint research, development, and commercialization efforts. By fostering knowledge sharing and facilitating partnerships between Indian and U.S. industries and research institutions, iCET can accelerate advancements in both AI and UAV development.

The Indo-U.S. panel discussion on “Unlocking Potential: Integrating Artificial Intelligence in UAV Applications” underscored the immense potential of this technology.

From revolutionizing agriculture and healthcare delivery to enhancing security and infrastructure management, AI-powered UAVs are poised to transform numerous sectors. By addressing existing challenges through focused innovation and fostering international collaboration, this technology can unlock a future filled with enhanced efficiency, improved accessibility, and groundbreaking solutions for various societal challenges.

The session and the event formally closed with a vote of thanks presented by Dr. Chaitali Bhattacharya, Principal Science Officer, IUSSTF. She took the opportunity to express her gratitude to the dignitaries, and the organizing teams from IUSSTF and Lockheed Martin for their contributions in making the event a grand success. ●



Organizing team at IUSSTF

An interaction with the 2023 cohort of scholars

KHORANA PROGRAM FOR SCHOLARS

IUSSTF organized an interaction with the Khorana Program for Scholars 2023 cohort – 66 young scholars, placed across leading research institutions in the U.S. – to assess and evaluate the impact of the program. The event was organized at two leading research institutes in India, namely:

- National Institute of Plant Genome Research (NIPGR) in New Delhi on May 31, 2024
- National Centre for Biological Sciences (NCBS) Bengaluru on June 7, 2024

The event brought together 47 Khorana Awardees of the 2023 cohort along with Members of the Selection Committee, officials from the Department of Biotechnology (DBT), Government of India, WINStep Forward, the Directors of NIPGR and NCBS, and IUSSTF.

The event aimed to provide an overview of the program's performance after the 2023 call by interacting with the awardees who had returned from their tenure in the U.S. The goal was to evaluate whether the program's objectives had been achieved and to learn about the scholars' personal and professional experiences, achievements, and any challenges they faced during their stay, as well as to gauge the level of proficiency enhancement attained through the program. In addition, the event marked the presentation of

certificates to the scholars by the dignitaries.

Dr. Nisha Mendiratta, Executive Director, IUSSTF, welcomed the attendees and provided an overview of the Khorana Program, highlighting its popularity and collaboration with the Department of Biotechnology and WINStep Forward. **Dr. Sanjay Mishra**, Scientist H, DBT, emphasized the importance of scholar feedback for evaluating the program's success and updated participants on the program's funding by DBT, highlighting the importance of Human Resource Development in Biotechnology and allied areas. **Dr. Aseem Ansari**, Founder of WINStep Forward, joined virtually for the introductory sessions on both days, praising the scholars' potential and accomplishments. **Dr. Chandrabhas Narayana**, Director, RGCN in his remarks during the inaugural session of 31st May 2024, emphasized DBT and IUSSTF's commitment and dedication towards organizing the crucial feedback event, which will guide the committee in recommending any necessary course corrections. **Dr. Chaitali Bhattacharya**, Principal Science Officer, IUSSTF steered the discussions and moderated the closed-door session of the committee members. **Ms. Subhashree Basu** from IUSSTF facilitated the presentation sessions of scholars.

The event included scholar presentations and discussions focusing on the following aspects:



Dr. Sanjay Mishra, Adviser/Scientist-H, DBT; Professor Chandrabhas Narayana, Director, RGCN; Dr. Nisha Mendiratta, Executive Director, IUSSTF; and Subhra Chakraborty, Director, NIPGR

- Project accomplishments
- Professional and personal experiences gained during the internship
- Best practices learnt and future plan for collaboration
- Impact on academic and career aspirations
- Challenges faced, both professional and personal
- Suggestions for future Khorana Scholar Cohorts

The research conducted by the cohort underscored the interdisciplinary approach to solving global health and environmental challenges, showcasing innovation across molecular biology, engineering, computational sciences, and public health. The committee appreciated the

vision of students for further engagement in pioneering research across various fields of Biotechnology, including biofuels, cancer biology, stem cell biology, protein design and therapeutics, artificial intelligence, cancer biology, neuroscience, bioethanol production, and mathematical biology, highlighting the diversity and breadth of research done in varied technical fields.

The event successfully fostered cohesiveness among the scholars, encouraging them to look beyond immediate goals and consider long-term aspirations. The Khorana Program for Scholars continues to be a beacon of academic and professional development, paving the way for future leaders in Biotechnology and allied areas. ●



Khorana Feedback Session at NIPGR, New Delhi



Khorana Feedback Session at NCBS, Bangalore



Interaction with scholars at NIPGR



Scholar presentation in progress at the NCBS

Award Announcement

IUSSTF – VITERBI PROGRAM 2023-24

IUSSTF and the Viterbi School of Engineering at the University of Southern California (USC) are committed to nurturing contacts between Engineering students from India and USC through a dynamic student internship program called the **IUSSTF-Viterbi Program**. This program provides an opportunity to Indian students pursuing a Bachelors or Masters Degree in the fields of **Electrical Engineering (EE), Electronics and Communication Engineering (ECE), Computer Science Engineering (CSE), and Computational Sciences** to undertake a research internship at the **Viterbi School of Engineering** in the summer for a period of 8 weeks.

The program is currently in its twelfth year of implementation. Out of a pool of more than 400+ Indian applicants each year, 190 students have interned under the program from 2011-2023. The program's goals have been to provide an opportunity for Indian scholars to pursue research, interact with students from all over the world, and foster education and research collaborations between students and faculty from the U.S. and India. Students from Indian institutions and USC faculty participating in this program have expressed strong sentiments about the value and impact of the program.

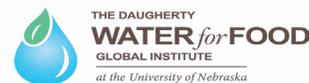
For the 2023-24 call announced with a submission deadline of 15 November 2023, IUSSTF received an overwhelming response. After a multi-tier screening and review process, **15 students were selected for the 2024 internship**. It was fascinating to note that budding engineers from engineering institutions pan-India including IITs, IIIT, NIT, BITS, private and public universities were seeking out state-of-the-art research experience in the U.S. through the prestigious IUSSTF-Viterbi program. ●



Viterbi 2024 cohort at the Viterbi School of Engineering, USC

S. No.	Institution	Number of Applications
1.	IIT	96
2.	IIIT	11
3.	NIT	26
4.	BITS	16
5.	Private Universities	139
6.	Public Universities	55
	Total	343

CALL TO BE ANNOUNCED SOON



WATER

Advanced Research and Innovation (WARI) Fellowship

Water is of fundamental importance to human development, environment and economy, and therefore needs to feature prominently in the development agenda of both India and the United States. The **Department of Science and Technology (DST)**, Government of India, the **University of Nebraska-Lincoln (UNL)**, the **Daugherty Water for Food Global Institute (DWFI)** at the University of Nebraska and the **Indo-U.S. Science and Technology Forum (IUSSTF)** have partnered to nurture cooperation between students and scientists from both countries through the Water Advanced Research and Innovation (WARI) Fellowship Program - a dynamic and transformative program developed to foster long term Indo-American science and technology partnerships in the field of water sciences and engineering.

Objectives

- Provide opportunity to promising Indian students and scientists to gain exposure and access to world class research facilities at the University of Nebraska-Lincoln; Daugherty Water for Food Global Institute, Purdue University, Texas Tech University, Oklahoma State University, and the University of Idaho;
- Promote research and capacity building in the areas related to water;
- Encourage and motivate students to take up research as a career path; and
- Pave way for the next-generation scientists and technologists from India to interact with American peers, thus helping to build long-term R&D linkages and collaborations.

Eligibility

Internship (for students)

- Indian citizens currently pursuing a Ph.D. in any field of Science / Engineering. It is mandatory that they are engaged in research in areas related to water at a recognized institution of higher education and learning in India.
- The applicants should be enrolled in their first, second, or third year of Ph.D. at the time of application.
- Age: Up to 32 years as on 31 December 2024

Fellowship (for scientists)

- Indian citizens having a Ph.D. in any field of Science / Engineering with demonstrated research experience in areas related to water.
- The applicants should be holding a regular position at any public- or private-funded R&D laboratory / S&T institution / recognized University / college in India and engaged in water-related research.
- The applicants must be capable of doing independent research work and have publications in internationally recognized academic journals in the given area.
- Age: Up to 40 years as on 31 December 2024

Internship/ fellowship offerings

- Monthly stipend
- Return airfare
- Contingency
- Conference Allowance
- Health insurance

Duration

- Internship: 3 – 6 months
- Fellowship: 3 – 12 months