Office of the Principal Scientific Adviser
to the Government of India

Science & Technology Cluster

BCKIC
Bhubaneswar City
Knowledge Innovation
Cluster Foundation

DRIIV

BeST
CLUSTER

JCKIF

PKC

RICH
Research and Innovation
Circle of Hyderabad

Report Cum Technology Compendium for

Energy & Environment

A Joint Initiative by the S&T Clusters of the
Office of the Principal Scientific Adviser to the Govt. of India

Acknowledgement

The establishment of seven S&T Clusters across the nation by the **Office of the Principal Scientific Adviser (PSA)** to the Government of India on the recommendation of PMSTIAC, has been instrumental in fostering innovation and collaboration among various stakeholders. The structured and strategic approach enabled by the S&T Clusters has provided a robust framework for addressing pressing environmental and energy challenges through research, innovation, and implementation.

Delhi Research Implementation and Innovation **(DRIIV)**, the umbrella body of Delhi S&T Cluster, as the **nodal cluster for Energy & Environment**, wishes to express its sincere gratitude to **Professor Ajay Kumar Sood, Principal Scientific Adviser (PSA) to the Government of India**, for his invaluable support for the Clusters which culminated in the development of this report and technology compendium. DRIIV has compiled this comprehensive resource, which focuses on four key themes:

- Sustainable Waste Management & Renewables
- Waste Water Treatment
- Air Pollution Mitigation
- Sustainable Mobility and Energy Transition

This compendium is designed to be a valuable resource for researchers, policymakers, and stakeholders working towards a more sustainable future. We express our profound gratitude to **Prof. Ajay K. Sood** for his unwavering commitment to advancing these critical areas and for his instrumental role in leveraging S&T towards environmental sustainability. The information presented in this compendium aims to guide and inform ongoing efforts in sustainability and innovation, ultimately contributing to the realization of an Atmanirbhar Bharat.

Sincerely,
DRIIV Team

Acknowledgement

Delhi Research Implementation and Innovation **(DRIIV)**, the umbrella body of Delhi S&T Cluster, as the **nodal cluster for Energy & Environment** theme, wishes to express its sincere gratitude to **Dr. (Mrs.) Parvinder Maini, Scientific Secretary, Office of the Principal Scientific Adviser (PSA) to the Government of India**, whose vision, leadership, and unwavering support have been profound in fostering S&T driven environmental sustainability in the Nation. As DRIIV is emerging as local solution provider leveraging S&T towards solving pressing environmental and societal issues, Dr. Maini's role has been instrumental in driving its success.

As one of the seven S&T Clusters (flagship program of the Office of the PSA to the GoI), DRIIV envisages to continue playing a vital role in fostering collaboration and innovation within the Energy & Environment sector. DRIIV is serving as a thriving ecosystem to seamlessly connect R&D institutions, academia, industry, government bodies, MSMEs, and startups for 'Pilot to Plant' transition

As DRIIV collates the technology information in this compendium, it acknowledges Dr. Maini's pivotal role in bringing this project of technology compendium to fruition. We are deeply grateful for Dr. Maini's continued support and leadership in advancing the field of Energy & Environment. Her vision and guidance have been instrumental in the success of DRIIV and this report, while we continue our commitment towards the mission of building an Atmanirbhar Bharat through Science and Technology.

Sincerely,
DRIIV Team

Table of Contents

1. DRIIV (Delhi S&T Cluster): Executive Summary

1.1 Science & Technology Clusters in India

The role of science and technology (S&T) in the realm of green energy transition and environmental sustainability is pivotal. With the aim to promote collaboration and innovation for sustainable growth of the nation by bringing together academic institutions, research organizations, industry partners, and government bodies, S&T Clusters in India are seeded by the Office of the Principal Scientific Adviser to the Government of India, across the nation.

The seven S&T Clusters (BCKIC, BeST, DRIIV, JCKIC, Northern Region Cluster, PKC, RICH) serve as hubs for taking innovations from "Lab to market". The clusters envisage to contribute towards Atmanirbhar Bharat and promoting a culture of innovation and entrepreneurship through synergistic efforts and network externalities. With well-defined deliverables, by creating a shared ecosystem, and becoming regional solution providers the Clusters are making rapid strides towards becoming globally competitive. One of each of the seven Clusters has been identified to lead one of the six thematic areas (Healthcare, Energy & Environment, Agritech & Nutrition, STEM Education, Livelihood through S&T and NE Impact & Industry 4.0) discussed during the 'All Cluster Meet' in October2023. Presented below is the journey of the Clusters in driving the S&T growth in **sustainable energy and environment** spaces with DRIIV being the **nodal cluster**. Technologies from the Northern Region Cluster, being set up on the PU campus, are not included in the first edition of this compendium.

1.2 The importance of Energy and Environment in the wake of Climate Crises

1.2.1 A global picture

The integration of energy and environmental considerations into the UNSDGs highlights their essential role in fostering sustainable development. Several of the 17 UNSDGs, like Affordable and Clean Energy (Goal 7), Climate Action (Goal 13), Clean Water and Sanitation (Goal 6) etc. directly address issues related to energy and the environment, underscoring their critical role in achieving sustainable development globally.

On the verge of **'Energy Poverty'**, global investment in renewable energy reached $282.2 billion in 2019, showcasing a growing commitment to transitioning away from fossil fuels. Renewable energy has emerged as a defining factor in every country's energy advancement. Countries around the globe are working on building and incorporating greater amounts of renewable resources (wind, solar, hydro, storage) into their energy mix to save Mother Nature.

The **energy sector** is responsible for approximately 73% of global greenhouse gas emissions, making it a focal point for climate action. **Enhancing energy efficiency** can potentially reduce global energy demand by up to 40% by 2040, contributing significantly to emission reduction targets. Achieving these goals requires a concerted global effort to transition to clean energy, protect natural ecosystems, and build resilience against climate change impacts.

1.2.2 Indian perspective

India's focus on energy and the environment is shaped by its unique socio-economic context, rapid economic growth, and significant environmental challenges. The country's ambitious renewable energy targets, efforts to improve energy efficiency, and commitment to international climate agreements reflect its proactive approach. With a population of 1.3 billion, India has a massive demand for energy to fuel its rapidly growing economy. Currently, India spends over $160 billion of foreign exchange every year for energy imports. India's **energy demand is projected to double by 2040** without remedial action, driven by population growth and economic development.

Around **70%** of India's electricity generation comes from non-renewable source (coal), making it one of the largest consumers of coal globally. As per **'Paris Agreement'**, our nation is committed to reducing the emissions intensity of its GDP by 33-35% from 2005 levels by 2030 and increasing the share of non-fossil-based power capacity to 40% by 2030.

India's ambitious hydrogen missions are driven by its need to achieve emission reductions towards NET ZERO, economic development and technology innovation, secure energy independence and security.

- **National Green Hydrogen Mission:** demand creation, production, utilization and export. Presently, green-hydrogen accounts for just 0.1% of the overall energy production in the world (IEA, 2019). This huge underutilization of one of the best technological innovations to tackle climate change has to be overcome through investing in various R&D initiatives focusing on efficiency improvement, cost reduction etc. related to green hydrogen. The first financial commitment towards green hydrogen has been announced by PM Narendra Modi through the 'National Hydrogen Mission' (NGHM) followed by a cabinet approval of a total initial outlay of Rs 19,744 crore. NGHM, has set its sight on becoming energy independent by 2047 and achieving **Net Zero by 2070**. The mission aims to establish a Green H2 ecosystem by resolving challenges covering various aspects from transmission, storage, grid flexibility, (complementing alternatives such as batteries, demand response and vehicle-to-grid in smart electrification) to demand response. Although the task is substantial, but the benefits from zero-cost inputs, clean air, and energy security continue to provide impetus for this change. India's Green H2 production capacity is likely to reach at least 5 MMT per annum, with a related renewable energy capacity addition of about 125 GW.

- Towards this, India has made significant strides in renewable energy, with over **100 GW** of installed **renewable energy capacity**, aiming for **500 GW by 2030. 50GW solar power capacity** has already been achieved out of a target of 100GW. By increasing domestic renewable energy production, India can reduce its reliance on energy imports, enhancing energy security.

- Initiatives like the Perform, Achieve, and Trade **(PAT)** scheme aim to improve energy efficiency in industrial sectors, targeting significant energy savings. National Action Plan on Climate Change **(NAPCC)** includes eight missions focused on solar energy, enhanced energy efficiency, sustainable agriculture, water conservation, and more.

Aligned to all of above points, from an international perspective, India has made significant pledges in reaching the **COP28** goals which reflects the country's comprehensive approach to tackling climate change, balancing economic development with environmental sustainability. Some key points are:

- **Net Zero Emissions by 2070:** This is a long-term goal aimed at balancing the amount of greenhouse gases emitted and absorbed.
- **Reduction in Carbon Intensity:** India aims to reduce the carbon intensity of its economy by 45% by 2030, compared to 2005 levels.

- **Expansion of Renewable Energy Capacity:** By 2030, India plans to achieve 500 gigawatts (GW) of non-fossil fuel-based energy capacity. This target underscores a massive scale-up in renewable energy sources such as solar, wind, and hydropower, aiming to make these sources a significant part of India's energy mix.
- **Increase in Renewable Energy Share:** India aims to have 50% of its total energy requirements met from renewable energy sources by 2030. This ambitious target will promote cleaner energy alternatives.
- **Reduction in Projected Carbon Emissions:** India envisions to reduce its total projected carbon emissions by one billion tonnes by 2030. This commitment is part of broader efforts to curb the overall growth of emissions and mitigate climate change impacts.
- **Afforestation and Reforestation:** India continues to prioritize large-scale afforestation and reforestation projects as part of its climate strategy via help in carbon sequestration restoring ecological balance.
- **Promoting Sustainable Practices** in agriculture, enhancing energy efficiency in various sectors, and supporting the adoption of clean technologies across industries.
- **Climate Finance and Technology Transfer:** Our country is focusing its attention on increased climate finance and technology transfer from developed countries to support its climate actions.

1.2.3 Pivotal role of an 'Energy and Environment' technology compendium

The relationship between energy production and the environment is complex and significant. Conventional energy sources, such as coal, oil, and natural gas, have been providing the bulk of the world's energy needs but have also contributed to environmental degradation. The extraction, processing, and burning of non-renewable energy sources (fossil fuels) release pollutants and greenhouse gases, which lead to air and water pollution, habitat destruction, and climate change. This environmental impact has prompted a global shift toward more sustainable energy practices. The transition to renewable energy is crucial for mitigating environmental damage and improving public health. Embracing sustainable energy sources not only addresses the urgent need to combat climate change but also fosters a healthier, more resilient environment for future generations.

This 'energy and environment technology compendium' will serve as a critical resource in addressing the challenges of environmental sustainability as follows:

- **Knowledge Consolidation:** The compendium brings together a vast array of information on innovation in energy transition and environmental sustainability, offering a comprehensive reference for researchers/innovators and startups.
- **Promoting Sustainable Practices:** By documenting innovative technologies and practices in energy production and environmental management, the compendium promotes highlights advancements in renewable energy, energy efficiency, and pollution control.
- **Fostering Innovation and Collaboration:** By showcasing current research, technological innovations, and case studies, the compendium fosters a culture of collaboration among academia, industry, and government.
- **Support for Policy Development:** It will provide the scientific and technological foundation needed to address issues such as climate change.

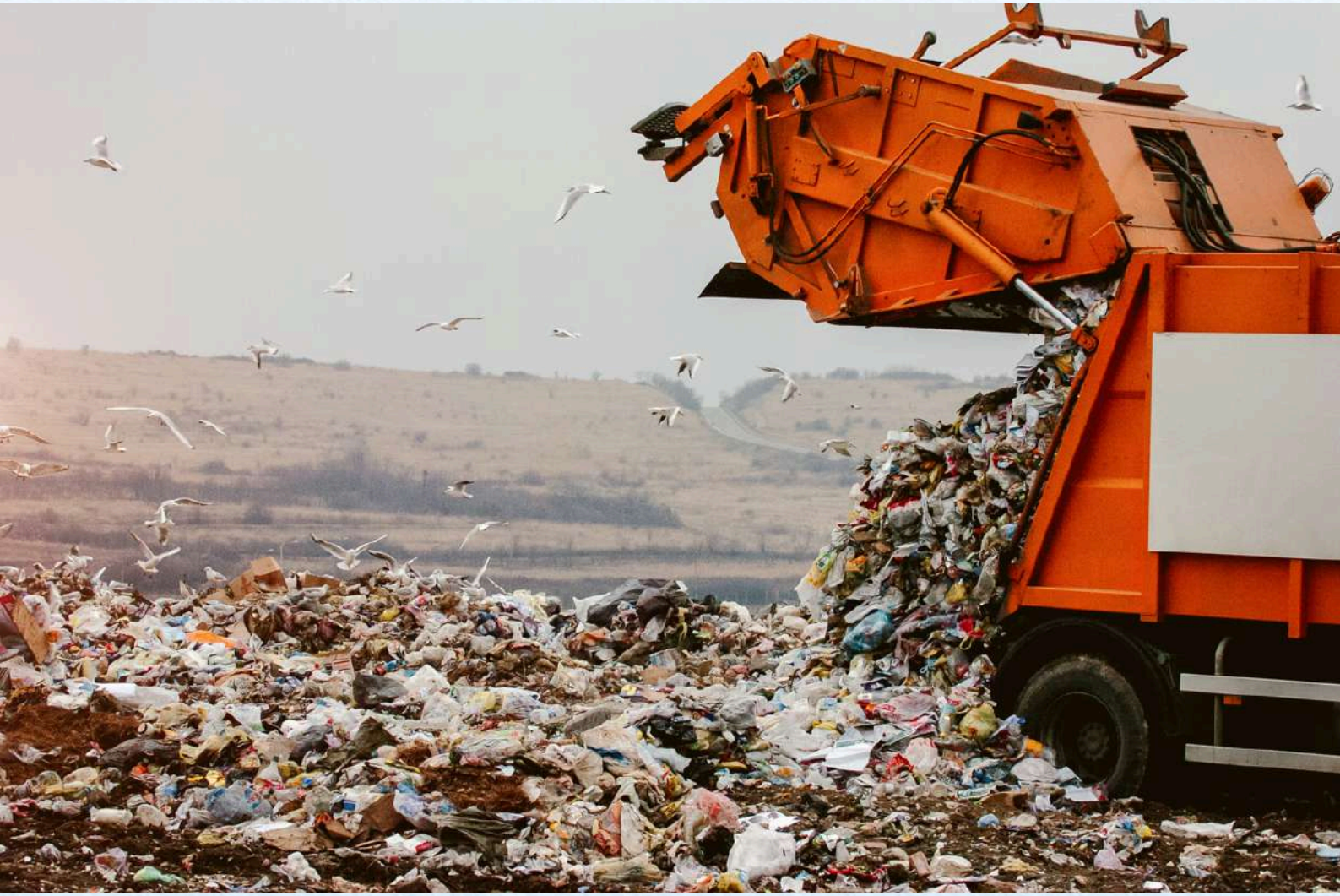
Technology Compendium for

"Energy & Environment"

The importance of a technology database on energy transition and environmental sustainability cannot be overstated in the contemporary global context. Presented here is a compendium that serves as a comprehensive repository of information, advancements, and innovations in the critical intersection of technology, energy, and environmental sustainability. The innovative solutions showcased in the following pages are developed by startups and innovators from the cluster communities and hold immense potential in empowering the nation to achieve its climate goals. We hope that the compendium becomes an invaluable resource for researchers, policymakers, businesses, and the public, offering solutions that can revolutionize energy production, consumption, and environmental conservation. Although the compendium is not exhaustive as technology scouting is in progress, this is just an attempt to provide a flavour of the suite technologies that exist in the Cluster ecosystem.

Table of Contents for Technology Compendium

1. Sustainable Waste Management & Renewables



India's burgeoning population generates massive amounts of waste daily, necessitating efficient disposal methods to prevent environmental degradation. Inadequate waste management contributes to pollution of air, water, and soil, exacerbating health issues and diminishing quality of life. Moreover, with rapid urbanization and industrialization, the strain on natural resources intensifies, underscoring the urgency for sustainable waste management practices to conserve resources and mitigate climate change impacts.

1.1 QUBE Renewables India Pvt Ltd

Paddy Waste Management Generating Biogas and Organic Fertilizers

Modular solution for scientific disposal of paddy waste to generate biogas and organic fertilizers

Application / Problem Addressed:

Solution to avoid stubble (paddy waste) burning. The solution includes scientific processing of paddy waste to generate biogas and fertilizer.

Technology Readiness Level (TRL): ***9***

About Technology:

The plant designed for the process is called dryQUBE which is one of our patented technologies which works on dry digestion process. The dry QUBE is an anaerobic dry digester that provides a cost-effective solution to your fibrous agricultural waste. Batch dry digestion is suitable for high lignocellulose agricultural crops, where wet digestion and stirring of feedstock is not viable.

Fund Raised / Achievements:

Deployed the solutions with Haryana Agriculture university, Hissar with successful results and operations.

USP:

Modular design with half the price and space requirements as compared to conventional wet digestion process. Requires no pre-treatments hence easy to operate.

SDG Goals (Aligning with Technology): ***3, 7, 9, 11, 12, 15***

End Users / Customers : Farmers, FPOs, Agro-Industries etc.

Founder: **Mr. Mark Clayton & Dr. (Mrs.) Jo Clayton**

Website: **www.quberenewables.co.uk**

Mr. Siddhartha Srivastava, siddhartha.srivastava@blue-planet.com, 9782916371

1.2 Blue Planet Integrated Waste Management Solutions

Municipal Waste Processing Solutions For Biological Degradation of Waste

Application / Problem Addressed:

- Promoting environmentally friendly practices on waste management.
- Maximizing the recovery of valuable materials from MSW.
- Minimizing waste generation at the source.
- Providing efficient and economical solutions.
- Supporting a circular model of resource usage.

Technology Readiness Level (TRL): ***9***

About Technology:

This technologies address the challenges of waste management effectively. It deals with advanced sorting and recycling technologies, such as automated sorting systems and material recovery facilities, to maximize the recovery of valuable materials from waste streams. The technology utilizes innovative waste-to-energy technologies, including gasification and pyrolysis, to convert non-recyclable waste into renewable energy sources like electricity or biofuels. By embracing technology-driven solutions, Blue Planet aims to revolutionize waste management practices, minimize environmental impact, and pave the way for a more sustainable future.

Fund Raised / Achievements :

- The compact bio-gas plant makes it possible for installation to deal with organic waste ranging from 100kg to 10 tonnes per day
- 4,537,800 M3/TON total quantity of waste processed
- 125,697 TONS methane generation saved per year

USP :

It adopts high standards of hygiene and cleanliness to mitigate public health issues and environmental degradation which can be caused by mismanagement of waste

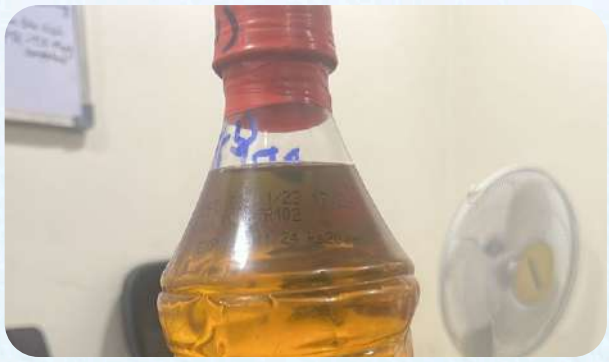
SDG Goals (Aligning with Technology): ***7, 8. 9, 11***

End Users / Customers : Govt. Agencies , Corporates, Institutions

Founder : **Mr. Prashant Singh** **Website :** **www.blue-planet.com**

Mr. Siddhartha Srivastava, siddhartha.srivastava@blue-planet.com, 9782916371

1.3 2 DEGREES CLICON Pvt. Ltd.



Converting End of Life Plastics to Diesel

The startup is working on upcycling of end of life plastic that would end up in landfills into valuable fuel for industrial use

Technology Readiness Level (TRL): **9**

About Technology:

The startup is working on upcycling of end of life plastic that would end up in landfills into valuable fuel for industrial use. They employ high temperature pyrolysis at 600 deg for Catalytic cracking thermal depolymerization of plastics.

USP:

Alternate to Diesel at low cost

SDG Goals (Aligning with Technology): ***13, 14, 15***

End Users / Customers:

Cement Industries, power plants, pharmaceutical and steel companies

Website: www.2degreesclicon.com **Founder:** **Mr. Vikas Agarwal**

Sheetal Agarwal, sheetal@2degreesclicon.com, 9959709900

1.4 Ossus Biorenewables

Green Hydrogen Using the Waste Carbon

Ossus Biorenewables is a green hydrogen company, supplying process industries with on-site, on-demand green hydrogen at US$ 0.5-1.2 per kilogram using the waste carbon in effluents available on-site

Application / Problem Addressed:

Green hydrogen production by splitting water is extremely expensive - both in cost and in power consumption. To meet India's 5 MTA target for indigenous green hydrogen production, we would require 150 MTA desalinated or ultra pure water, which in a country with 500 million people going without access to potable water, is likely to become a critical shortfall on hydrogen and water supply. Ossus' bioreactors have shifted the focus away from the use of ultra pure water to industrial effluents as feedstock and using designer microorganisms and lower power requirements to produce Green Hydrogen at less than USD1/kilogram.

Technology Readiness Level (TRL): ***9***

About Technology:

Ossus Bio has developed autonomous bioreactors named the OB HydraCel that use the organic content of industrial effluents as feedstock for green hydrogen production.

- The proprietary bioreactors carry out a patent pending process that combines microbial electron generation and electrochemical hydrogen production.
- The biocatalysts used within the bioreactor are native to the industrial effluent, but with the unique ability to produce electrons instead of carbon dioxide as is typical to commonly industrialized fermentative processes.
- Batch processes are employed for production of green hydrogen which may last anywhere between 30 mins to 6 hours depending on the type of organics being processed within the bioreactor.
- Typically, each gram of organic content in industrial effluent has the capacity to be converted to a gram of hydrogen gas (one g H2 per g of organic content measured as Chemical Oxygen Demand or COD).
- For the existing on-site deployment of the OB HydraCel (for Steel Plant Effluent), the carbon dioxide (produced as part of the biological process) is a single gram per gram of hydrogen produced.
- The added advantage of the process occurring within the bioreactors, is their potential to recycle effluent by consuming the organic as well as the inorganic content of effluent, making it available for reuse on site.

Fund Raised / Achievements:

$2M raised in grants / R&D capital (Bio CNG and Hydrogen)

USP:

Energy and water efficient, decentralised to Industrial scale model, drop-in solution to BioCNG, circular economy and diverse organic wastes

SDG Goals (Aligning with Technology): ***2, 7, 11, 13***

End Users / Customers: B2B (Industrial customers, gas grids, Oil and marketing companies, etc.)

Founder: **Kamar Suhail Basha, Suruchi Rao, Shanta Rao**

Website: **https://www.grassrootsenergy.co**

BCKIC
Bhubaneswar City Knowledge Innovation Cluster Foundation

MINIONLABS

Technology Readiness Level (TRL)

1.5 MinionLabs India Pvt. Ltd.

Minion Energy Management Solution

Application / Problem Addressed:

In order to save energy costs in any buildings and facilities, the MEP engineer or the facility maintenance should have each and every equipment level energy consumption data, then only the client can able to find out the problems and make necessary timely actions for energy savings. At current scenario, to get equipment level energy consumption data, Businesses has a choice of using traditional / smart energy meters for which there is a requirement of dedicated meters/sensors to be installed for every equipment which is high capital investment along with operational and implementation costs involved making no Return on Investment anywhere near to 5 years.

Technology Readiness Level (TRL): ***9***

About Technology:

Minion uses state-of-the-art Machine Learning and AI-Based EDGE Computing approach to detect energy signatures of individual electrical assets and study patterns of their energy consumption used inside the facility at single point of connect and also to generate real-time notifications of various events and reports on predictive analytics, enabling the users to save up to 30% of their energy consumption along with CAPEX & OPEX savings over traditional & smart metering solutions.

Fund Raised / Achievements:

Currently Raising INR 11.25 Crores in Seed Round at INR 63.75 Crores Pre-Money Valuation, March 2020 – INR 96 Lakhs INR Pre-Seed raised at INR 7.5 Crores Pre-Money Valuation from Indian Angel Network, Received MeiTY SASACT Grant worth INR 7 lakhs, Raised investment of INR 40 lakhs from TIDE2.0 Investment Scheme, Received DST NIDHI4COVID Fund worth INR 30 lakhs, Winner of Top Industry 4.0 - Internet of Things (IoT) award at the National Startup Awards 2020 ceremony.

USP:

- There is no need of device level sensors to get device level electricity consumption.
- Three steps Install – A Layman can install it as minion device is plug & play.
- No Plugins or Software needed, just login with a browser & start tracking.
- Personalised energy efficiency recommendations via WhatsApp at real-time.

SDG Goals (Aligning with Technology): ***7, 11, 13***

End Users / Customers:

Energy Contractors, Energy Consultants, Real Estate Players, Facility Maintenance Companies, EMS/BMS Resellers, Green Energy Source / Clean Tech Companies, HVAC Solution Providers, System Integrators, ESCO's (Energy Service Company), Energy Auditing Companies, etc.

Founder: **Gokul Shrinivas** **Website:** **www.minionlabs.tech**

Patent Details: **PPCT Application No. PCT/IB2020/055564, Indian Patent Granted No. 363286**

Technology Readiness Level (TRL)

1.6 Tan90 Thermal Solutions Pvt. Ltd.

Cold Storages with Proprietary Phase Change Material

Portable cold storages with proprietary phase change material for cold supply chain

Application / Problem Addressed:

Given the COVID19 scenario, the demand for refrigerated transport and storage exploded globally, with customers preferring retail food to restaurants. Hence, it is important for building infrastructure that can limit the food wastage along the supply chain and cold storage is one of the solutions. However, in most cases, a centralized cold storage model is followed where farmers and aggregators have to come to local cold storage. This model leaves out a majority of the small scale and marginal farmers.

Technology Readiness Level (TRL): ***9***

About Technology:

The portable cold storage capacity of 58 liters that are run by proprietary thermal batteries. As compared to other solutions available in the market, the proposed thermal batteries can be charged twice as fast, resulting in giving the users a faster turnaround time. Since, each of the boxes have self-standing cooling solutions, they can be stacked on top of each other and any logistics services can be used for transporting temperature-sensitive perishables. It can be a two-wheeler, three-wheelers or even scaled up in trucks. This negates the need for refrigerated trucks and reduces the operational costs by 32. In order to further increase the shelf life of the perishables, Tan 90 is introducing a hydantoin based anti-microbial polymers that can increase the lifetime of the perishables without a cold solution. This will further decrease the operational costs involved.

Fund Raised / Achievements:

- Received BIRAC BIG Grant worth INR 50 lakhs
- Equity fund from INVENT Program and Social Alpha worth INR 90 lakhs
- Received CSR funds worth 60 lakhs from CISCO and CINI (IAIN)
- Raised INR 5 Cr from Blue Ashva Capital and 3i Partners

USP:

- Portable storage capacity.
- Gets frozen thrice as fast as compared to existing product.
- Portable cold storages can extend the shelf life of greens to 2.5 to 3 days in transit. Being modular, users can stack these boxes and convert any room or vehicle to cold storage infrastructure.

SDG Goals (Aligning with Technology): ***7***

End Users / Customers:

Agricultural practitioners, Food industries, Govt. agencies

Founder: **Soumalya Mukherjee** **Website:** **www.tan90thermal.com**

Patent Details: **Fast freezing of PCM Aat -4 degrees centigrade, Patent No: 201941028298**

1.7 Kalinga Renewable Energy Manufactures (KARMA) Pvt Ltd

Solar Micro Pump

Affordable solar power for small and marginalized farmers

Application / Problem Addressed:

More than 50 % of farmers do not have access to year around irrigation thereby restricting their full potential Income while farmers with diesel powered pump spend more than 30 % of total input cost as recurring expenses. Earlier solar pumps were targeted for farmers with 5 hectares or more. In addition, KARMA solar micro pump uses surface water and does not exploit ground water. KARMA introduced portable solar water pumping systems for use in irrigating the large number of small farms- it is Unerization of Irrigation.

Technology Readiness Level (TRL): ***9***

About Technology:

The portable solar panel uses Copper Indium Gallium Selenide (CIGS) and uses AC/DC power through patented technology which minimizes solar panel cost. The lightweight and foldable panel allows a total pump system as a portable unit useful for multiple farmers and pumping at various locations. When the pump is not used panels are used to charge the battery, providing power to other items such as small flour mills, etc.

Fund Raised / Achievements:

- Supported under TDB Seed fund & NSTEDB Seed fund from KIIT TBI
- Raised Seed amount of INR 5 Cr from HNIs
- Onboarded 30+ customers including govt and private organizations like - Odisha Forest Dept, JK Paper, CSIR IMMT, Power Finance Corporation, Aditya Birla Groups, Kirloskar Pumps, Bharat Motors, etc.
- Introduced the first solar micro pump in the country certified by MNRE
- Leadership award for Green Future
- Recognized as Top 20 Startup from Eastern India by ET Now

USP:

First solar micro pump certified by MNRE and Industry standard. With flexible and light panels pump goes mobile. Tie up with Kirloskar service is provided within 48 hrs. With patented technology uses beyond pumping!

SDG Goals (Aligning with Technology): ***6, 7, 11, 13***

End Users / Customers:

More than INR 10 crores has been raised so far from various govt funding programs and private investments

Founder: **Saroj Nayak**

Patent Details: **Multiple Patents**

1.8 Timarpur-Okhla Waste Management Company Ltd.

Power Generation From Urban MSW

Power generation from urban MSW. WtE handles waste by reducing its volume and recovering energy, hence preventing major environmental degradation.

Application / Problem Addressed :

Timarpur Okhla Waste Management Company Ltd. (TOWMCL) has processed more than 6 million metric tons of waste till date since the inception of the plant operation Solid Waste and hence prevented major environmental degradation.

Technology Readiness Level (TRL): ***8***

About Technology:

- Power generation from urban MSW and WtE handles waste by reducing its volume and recovering energy
- From 1950 MT of waste/day to 23 MW of green energy, specifically managing the MSW of Delhi.
- Renewable electricity directly supplies to grids
- Managed 6 MMT of MSW till date
- Generation of 1 billion units of green electricity till date
- Aiming towards managing Ghazipur landfill

Fund Raised / Achievements:

- Waste to Energy Deal of the Year Award in 2010 by Frost & Sullivan
- CII-JCB Clean Earth Award in 2013
- Global Waste Met Award in 2017
- Gold Award for best performing Waste to Energy Project in 2017
- Best Management Excellence Award in 2019 by ASSOCHAM

USP:

Timarpur Okhla Waste Management Company Ltd. (TOWMCL) has processed more than 6 million metric tons of waste till date since the inception of the plant operation and hence prevented major environmental degradation.

SDG Goals (Aligning with Technology): ***7, 11, 13***

End Users / Customers:

MNRE, Municipal Corporation of Delhi (MCD), Ministry of Housing and Urban Affairs (MoHUA)

Founder: **Sandip Dutt, Umesh Chopra** **Website:** **https://www.towmcl.com/**

91-565-232001/232002/232003

1.9 Smart Tiles from recycled Plastic Waste

Designing smart tiles from recycled plastics (LDPE, HDPE, PP, MLP) for building wall, floors, and pavement

Application / Problem Addressed:

India generates 3.5 MT/y plastic waste (CPCB) nationwide, with the national capital contributing towards a staggering high 690 TPD. Sustainable management of plastic waste is extremely crucial. This technology manufactures smart tiles from recycled plastic waste for societal application.

Technology Readiness Level (TRL): ***8***

About Technology:

The disposal of plastic waste is a major problem. It is non-biodegradable, & it mainly consists of low-density polyethylene plastic bags, bottles, etc. Burning of these waste plastic bags causes environmental pollution. The main objective of the present project is to utilize waste plastic bags for designing of materials for the utilization of tiles in the building of toilets and rooms for the general public for societal benefits. WP RM composites developed upon the blending of red mud and LD/PP which were then subjected to further compression molding to give rise to wall, floor, and paver tiles. Smart tiles have superior mechanical strength, flame retardancy, water permeability, UV protection, and antistatic response to conventional structures.

Fund Raised / Achievements:

- Technology transferred to 7 startups Nationwide
- Smart Fifty Innovation Award

USP :

- Tiles were tested as per ASTM standards for skid resistance
- Surface friction: compatible for both dry & wet conditions
- Ecofriendly
- Contribution to the Circular Economy

SDG Goals (Aligning with Technology): ***12***

End Users / Customers:

- Public Bodies: Adoption of this eco-friendly technology for the building of structures, paving footpaths thereby impacting air pollution by reducing GHG emissions and road dust.
- Private players: Building of eco-friendly structures and rooms through sustainable management of plastic scrap.

Founder: **Dr. Rajiv K Singh** **Website:** **https://www.nplindia.org/**

1.10 Cities Innovative Biofuels Pvt. Ltd.

Dry Digestion

management of agricultural biomass resource for fuel production with a goal of green energy transition by producing bioCNG.

Application / Problem Addressed:

Crop residue burning and disposal of cow dung and poultry litter in suburban dairy farms in the region, as well as creating tons of green jobs

About Technology:

An anaerobic digestion plant using rice straw, cattle dung, and poultry litter as substrates is proposed to be set up at Village Malaheri, Fatehgarh Sahib, Punjab. It seeks to utilize the large biomass resource of India to produce biofuels such as bioCNG, renewable hydrogen, etc

Technology Readiness Level (TRL): ***8***

Fund Raised / Achievements:

The project has also been selected by the United Nations Industrial Development Organization as an innovative waste-to-energy plant and given an interest subsidy of 3.93%

USP:

Dry digestion has many advantages over wet digestion that make it well-suited to the Indian context:

- Modular design – The fermenter boxes allow for a plant of any capacity to be built, from 10 TPD to 1,000 TPD. The capacity can be increased simply by adding more boxes. Smaller capacity plants are suitable for rural areas where biomass is decentralized and its storage and transport can be challenging.
- Substrate flexibility – dry digestion can handle a wide range of substrates with DM up to 40% and high lignocellulosic content. No preprocessing is required except coarse grinding and mixing.
- High tolerance to impurities – The fermenter boxes have no moving parts and are not affected by impurities like stone, plastic, metal, etc. that can later be sieved out of the compost.
- Low maintenance and energy use.
- Minimal water requirement and zero effluent.
- All plant components are sourced in India.

SDG Goals (Aligning with Technology): ***7, 13***

End Users / Customers:

Agricultural Sector, Livestock Farmers, Local Industries and Businesses, Government Agencies and Municipalities, Environmental Organizations

Founder: **Gurjot Singh** ***Gurjot Singh, Gurjot.singh@bioshakti.in***

1.11 Eco Orbit AI Solutions Pvt. Ltd.

Automation of Waste Identification And Segregation

Automation of waste identification and segregation using deep learning powered Robots

Application

- Eco Monitor: It is a SAAS product that makes use of our proprietary Deep Learning based Machine vision system to identify different waste materials. It digitizes the incoming waste streams and helps clients in identifying quality material sources.
- Eco Arm: A Smart robotics solution that identifies various types of dry waste and segregates 60-70 % of dry materials like plastics, paper, and cardboard etc., as per the colour and type. It decreases the sorting cost by atleast 2 times and scales up client's plant capacity. Deep learning-based machine vision cameras identify the waste and robots segregate waste present on the conveyor belts.

Problem Addressed:

India generates 50,000 Tones of dry waste per day but only 50% of it gets segregated and processed and the rest goes into landfills; the main bottle neck being Improper waste segregation. Material Recovery Facilities(MRFs) segregate waste and sell to recycling companies. Scaling up these facilities is not easy. Why? Segregation is manually driven and thus labour-intensive. MRF's could not scale up profitably due to the unavailability of skilled labour, higher unit economics due to manual segregation, inconsistencies in sorting quality and quantity etc. Our Solutions help MRFs in decreasing sorting costs and scaleup faster compared to current methods used

Technology Readiness Level (TRL): ***8***

About Technology:

- Eco Monitor: It is a SAAS product that makes use of our proprietary Deep Learning based Machine vision system to identify different waste materials. Deep learning based machine vision cameras are used for material identification.
- Eco Arm: Deep learning based machine vision cameras identify the waste and robots segregate waste present on the conveyor belts.

Fund Raised / Achievements:

- Equity Funding: 11 Lakhs from Friends and Family.
- TSIC's T-Spark Grant: 2 Lakhs.
- Startup India Seed Fund: Total Grant 16.5 Lakhs; 6.6 Lakhs is released.
- Achievement: We secured our first client and are revenue positive in this financial year.

USP:

- Standardization of Waste Segregation processes is needed before scaling up the plants; as the Indian Waste management industry is in a nascent stage. We are among the first movers to realize this and bring our solutions Eco Monitor product which standardizes the operations of MRFs.
- We are developing specialized End Effectors for the Industry with the investments from our grants so as to sort at least 90% of the materials unlike other companies which sort only 60-70% of materials.

SDG Goals (Aligning with Technology): ***12***

End Users / Customers: Secondary sorting companies (MRFs) and Bio Medical waste treatment plants

Founder: **Abhishek Gorle** **Website:** **https://www.ecoorbitsolutions.com/**

1.12 APChemi Pvt. Ltd.

Pyrolysis Oil Purification Technology

Application / Problem Addressed:

Globally 300 million metric tons per annum of plastic waste generated and less than 9% of plastic waste is currently recycled. Most of the plastic waste generated today is mechanically non-recyclable. Hence needs to be recycled chemically by converting this plastic waste into circular economy plastics and sustainable chemicals via pyrolysis technology. The key problem in pyrolysis of plastic waste is production of oil with very high impurities of oxygen, chlorine, asphalt, silica, nitrogen and Sulphur. APChemi's PUREMAX™ technology drastically reduces these impurities from pyrolysis oil to manufacturing PUROIL™. PUROIL™ can replace petroleum naphtha and crude oil for production of circular economy plastics and sustainable chemicals.

Technology Readiness Level (TRL): ***8***

About Technology:

APChemi's pyrolysis oil purification technology, PUREMAX, removes organic as well as inorganic impurities of Chlorine, Nitrogen, Oxygen, and Sulphur from pyrolysis oil. Patent-granted PUREMAX™ technology has a very unique novel and inventive step. APChemi is actively looking for partners to synergistically exploit this technology. Pyrolysis oil, produced from Mumbai's post-consumer laminate (Packaging + Carry bags) waste, had a Chlorine content of 2900ppm, Sulphur of 200ppm and Total Acid Number (TAN) of 14.5 mgKOH/gm. After application of APChemi's PUREMAX™ technology, the oil quality was improved to Chlorine < 50ppm, Sulphur < 50ppm, TAN mgKOH/gm, n-Heptane Insoluble <0.1%mass. Thus, PUREMAX™ technology truly unlocks pyrolysis based chemical recycling of plastic waste.

Fund Raised / Achievements:

- Raised INR 30 lakhs in CCD from Startup India Seed Fund Scheme at KIITTBI.
- Winner of Clean Air India Challenge hosted by Smart Cities Procurement, ACT Grants and Social Alpha (April 2022)
- Received Grant in aid of USD 1.2 million Indo-Danish Green Hydrogen Call

USP:

Drastically reduce oil impurities due to PVC/ PVDC/ PET/ Nylon/ PUR/ Acrylates contaminated polyolefin feedstock'. Enable use of landfill and post-consumer plastics waste for plastic pyrolysis

SDG Goals (Aligning with Technology): ***7, 12, 13***

End Users / Customers:

Petrochemical Companies, FMCG Companies, Packaging Companies & Industries, Biofuels, Carbon Transition, Plastic circularity and Material Recovery facilities

Founder: **Suhas Dixit** **Website:** **www.apchemi.com**

Patent Details: **Granted Indian Patent (374847)**

1.13 Pro-Biokem India Pvt. Ltd.

Value-Added Products (Cellulose and Amorphous Silica) From Rice Husk

Application / Problem Addressed:

India is the second largest rice growing country in the world. A large quantity of rice husk is generated as a by-product in Rice mills during the milling process, which is used as solid fuel, which leading to wastage of naturally produced valuable Biochemical/ fine chemical products like cellulose and amorphous silica. Burning rice husk has a greater environmental footprint. Currently available cellulose powder is largely produced from wood pulp, using KRAFT Process, which is highly polluting and utilizes wood as a feed stock leading to deforestation. Currently available synthetic amorphous silica is manufactured from sand (crystalline silica). Sand in crystalline powder form is a well-known health hazard (Silicosis) for operating personnel and poses health hazard to the nearby localities

Technology Readiness Level (TRL): ***8***

About Technology:

Pro-biokem has developed a process to extract cellulose and silica from raw rice husk. The proposed process has already been developed in pilot scale, to isolate Cellulose and amorphous Silica in homogenous form with high purity and yield. The feedstock was processed to generate cellulose pulp. The cellulose pulp was further processed Bio/chemically to generate Microcrystalline cellulose. Silica was isolated from the pulp filtrate liquor. The proposed process will also be effective if rice stubble is used as a feedstock since the composition (qualitative and quantitative) of rice husk and rice stubble are very similar. The proposed process shall resolve majority of the above issues, while also generating local employment, minimizing energy use, reducing stubble burning and better management of agricultural and agro-Industrial waste.

Fund Raised / Achievements:

- BIRAC BIG Grant of INR 50 lakhs
- BIRAC SEED fund of INR 25 lakhs
- Startup Odisha Product Development Fund of INR 12.5 lakhs

USP:

Multi-product Isolation from single feedstock with wider applications. Non-Wood/ Non-Cotton derived products. Low pollution compared to currently used process technology. Products derived from Agro residue/waste. Offer better margin to supply chain. Lower cost of feedstock and Production cost

SDG Goals (Aligning with Technology): ***12***

End Users / Customers:

Processed food industries, Pharmaceutical industries, Feed industries, Construction and paint industries, Breweries, etc.

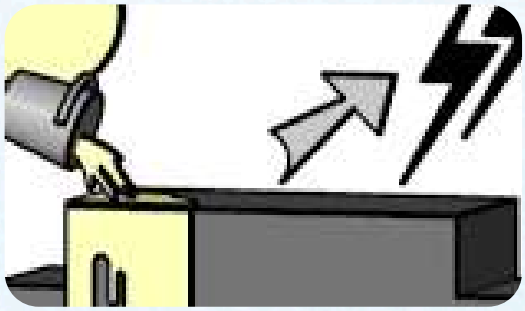
Founder: **Mahammad Gulbahar Sheikh** **Website:** **www.pro-biokemindia.com**

Patent Details: **Application No: 201831027208**

1.14 Pavakah Energy

Developing Photovoltaic Paint or Solar Paint

Solar energy painted on every surface



Application

Pavakah Energy is a material science start-up in the clean energy space developing photovoltaic paint or solar paint, which can turn any surface into a solar panel. This solution enables widespread harvesting of solar energy into electricity, without imposing on existing infrastructure and ensuring low-carbon use of energy. The founders are committed to making Pavakah a leading technology company in the solar energy market with affordable, scalable, and environment friendly products and solutions.

Problem Addressed:

Solar photovoltaic technologies are not sustainable.

- Manufacturing panels is energy intensive
- It is expensive for small scale applications
- Recycling of panels is expensive and energy intensive

Technology Readiness Level (TRL): ***8***

About Technology:

We are developing a paint which has the same photovoltaic characteristics as a solar panel which is

- Cost-effective for small scale applications
- Paint can be made sustainably
- Recycling of paint is simple

Fund Raised / Achievements:

We are backed by UK based organization called Wilbe, who help scientists become entrepreneurs. We have received Nidhi Prayas grant, from Department of Science and Technology, GoI for development of a prototype, facilitated by IIT-Hyderabad. We have been selected for Shell E4 cohort 2023. We're currently in the middle of angel funding round

USP:

Our USP is our deployment technique and instrument used to paint a multi layered paint on any surface to generate electricity using solar energy

SDG Goals (Aligning with Technology): ***7***

End Users / Customers:

Our target market is all established area where some form of construction has occurred and is incident to solar rays for sizeable portion of the year

Founder: **Vikram Bakaraju** **Website:** **https://www.pavakahenergy.com/**

Vikram Bakaraju, 9959837476, bakaraju_vikram@yahoo.com

1.15 Eco Wrap Solutions

Technology for Source Segregation of Waste

Empowering India with the right technology for Source Segregation, paving the path to a Zero Waste Future.

Application / Problem Addressed:

- Promoting waste segregation at source.
- Efficient waste collection systems.
- Compliance with environmental regulations on waste management.
- Environmental awareness and education on waste management.

Technology Readiness Level (TRL): ***7***

About Technology:

An IOT and SaaS-based one-stop solution for waste segregation, collection, tracking, recycling, and up-cycling generated by HORECA (hotel, restaurant, cafe, bar, and so on) units. Leveraging data analytics, ECOWRAP optimizes collection routes through APIs, reducing travel time and emissions. Real- time tracking ensures efficiency, resembling the Uber experience. We also offer notifications for waste pickups and auto-generated audit reports to empower users. ECOWRAP extends beyond waste audit services and access to the carbon credit market, bolstering sustainability. Our four-category primary segregation preserves waste value, envisioning a future where waste transforms into a valuable resource through innovation and sustainability.

Fund Raised / Achievements:

1000+ clients connected, including hotel, restaurant, cafe, bar, and so on

USP:

- 11561+ MT tonnes of waste collected from you that saves our mother nature.
- Investors are: Social Alpha, Villgro
- ECOWRAP is promoting: Circular Economy, Recycling, Save Environment, Sustainable waste Management, Green startup, Startup, Istart, Jaipur startup, Startup India, Rajasthan startup, waste Recycling Startup, Smart City Startup, Green City Startup, Hotel waste, Sustainable Development Startup, waste Management, Smart Dustbins, Women Empowerment, Up- Cycling, Climate Change, Environmental Services, Climate, nature, Save The Planet, Save The Earth, Reverse supply chain, Eco-Friendly, Reduce recycle reuse, Climate crisis, SDG2030, Waste to value, Swachh Bharat Swasth Bharat, Climate Change, And Zero Dumping

SDG Goals (Aligning with Technology) : ***5, 8, 10, 11, 12, 13, 14, 15***

End Users / Customers:

Municipalities and Local Governments, Waste Management Companies, Residential Communities, Commercial and Industrial Sectors, Educational Institutions, Non-Profit Organizations and NGO, Individual Households

Founder: **Angraj Swami** **Website:** **https://ecowrap.in**

1.16 Biodiesel from used Cooking Oil

Application / Problem Addressed :

Fossil fuel depletion and environmental degradation are concerns of entire world. Alternative fuels, energy conservation and management, energy efficiency, and greenhouse gas emission issues have become especially important in recent years. India's increasing import bill has necessitated the search for liquid fuels as a substitute to Petro-diesel, which is being used in large quantities in transport, agriculture, industrial and commercial sectors.

Technology Readiness Level (TRL): **7**

About Technology:

- Consumption of UCO is harmful to health and may lead to heart problems and liver diseases. Therefore, it can be collected from various sources, such as households, military establishments, hotels, restaurants, caterers, bakeries, etc., for conversion to biodiesel.
- Transesterification is carried out at ambient conditions (room temperature and atmospheric pressure) with minimum consumption of energy in the form of heat and mechanical stirring in the presence of a catalyst.
- Biodiesel is purified by distillation after glycerin separation.

Fund Raised / Achievements :

- Collaboration with the Social Development for Communities (SDC) Foundation (local NGO) for the collection of UCO from more than 30 (caterers, hotels, halwais, and restaurants) in Dehradun, Rishikesh, and nearby regions.
- Received more than 20,000 L of UCO till 15th Nov, 2023 Out of which 15000L ofBiojet and Green diesel and 4500L UCO-Biodiesel have already been prepared.

USP :

- Health and Environmental Impact: Addressing the health hazards associated with consuming used cooking oil (UCO)
- Mitigating India's Import Dependency
- Efficient Biodiesel Purification

SDG Goals (Aligning with Technology): **7**

End Users / Customers:

Households and individuals, commercial establishments, agricultural sector, industrial and commercial sectors, government initiatives, environmental and health organizations

Founder: **Dr. Neeraj Atray** **Website:** **https://www.nplindia.org/**

Neeraj Atray, neeraj@iip.res.in, 9458131017

1.17 Strawcture Eco

Agribiopanels From Straw for Interior Decoration

Application / Problem Addressed:

With the increasing intensity of stubble burning effects, this technology opens the possibilities for reinventing the existing practices of the construction industry. It harnesses the potential of agricultural residue to build structures that are durable, affordable, and sustainable.

Technology Readiness Level (TRL): ***6***

About Technology:

- Strawcture Eco builds - Agribiopanels, which are a replacement of fibre cement board, plasterboard, and clay burnt brick to make walls, ceiling, doors, and engineered flooring.
- The panels store carbon instead of emitting it, has very low toxicity index, are E1 Certified, and when used in a building envelope, lead to a more thermally and acoustically comfortable environment.

Fund Raised / Achievements:

NABL certified products for thermal conductivity, fire resistance, moisture resistance, toxicity, screw holding capacity, tensile strength, and breaking load. i.e., meet all the required government standards.

USP:

- It will boost local economy by using 100% local resources, avoiding cement and valorizing waste of local industries
- ZEROCEM material has the potential to save 3 trees from being cut and save 30 m2 of forest, which otherwise is cut down to fire and bake clay bricks.
- On scaling up to a larger scale, It is also possible to set-up a new industry and people will be trained to build with ZEROCEM

SDG Goals (Aligning with Technology): ***6***

End Users / Customers:

Interior designers and architects, homeowners and renters, hotels and hospitality Industry, corporate offices, educational institutions, and event planners

Founder: **Shriti Pandey** **Website:** **https://strawcture.com**

1.18 Mangla Eco Mix Innovations

Eco-friendly Zero-Cement Geopolymer Concrete

Development of a rigid pavement prototype from Ecofriendly zero-cement geopolymer concrete in India

Application / Problem Addressed:

- Environmental Impact of Cement Production.
- Depletion of natural resources.
- Cost Efficiency
- Climate Resilience

Technology Readiness Level (TRL): ***6***

About Technology:

ZEROCEM Concrete and ZEROCEM Earth Blocks, respectively, are based on geopolymer technology

- ZEROCEM concrete is a cementless geopolymer concrete that is an eco-friendly alternative to cement concrete.
- ZEROCEM Earth blocks are compacted mud bricks that are made by adding Geopolymers, i.e. blast furnace slag or fly ash and an alkali activator, to (non-fertile) soil excavated on-site. These blocks are unfired and dry at room temperature.

Fund Raised / Achievements:

Geopolymer concrete pavement in Wellcamp airport, Australia

USP:

- It reduces CO2 emission by 90% and more over, it will boost the local economy by using 100% local resources, avoiding cement, and valorizing the waste of local industries
- It will boost the local economy by using 100% local resources, avoiding cement, and valorizing the waste of local industries
- ZEROCEM material has the potential to save 3 trees from being cut and save 30m2 of forest, which otherwise is cut down to fire and bake clay bricks.
- On a large scale, it is also possible to set up a new industry, and people will be trained to build with ZEROCEM.

SDG Goals (Aligning with Technology): ***6***

End Users / Customers:

Government Infrastructure Projects, Construction Companies and Contractors, Urban Development Authorities, Environmental Agencies, Research and Educational Institutions

Founder: **Mr. Deepanshu Mangla and Dr. Yash Kulshreshtha**

1.19 CanvaLoop Fibre Pvt. Ltd

Building the Backend of the Global Textile Supply Chain

A material sciences company that is building the backend of the global textile supply chain

Application / Problem Addressed :

Agricultural waste burning is a major environmental problem in India. It is estimated that over 90 million tons of agricultural waste are burned in India each year. This contributes to air pollution, climate change, and water pollution. It is also a major health hazard, causing respiratory problems and other health problems.

Technology Readiness Level (TRL): ***6***

About Technology:

- Sustainable textile alternatives to the global textile industry by using agricultural waste
- Preventing waste from burning
- Increase income of farmers
- Uses less than 10 litres of water/kg
- Low impact closed loop technology

Fund Raised / Achievements:

- Winner: Atal Innovation Mission Medal
- Innovator: Lakme Fashion Week
- Winner - Positive Impact Startup: TiE Silicon Valley
- Winner: Asian Hemp Summit 2019
- Exhibitor: Army Technology Seminar by Dept. of Defense, GoI
- Exhibitor: Materi-O Material Library

USP :

- No use of solvents
- Heat is captured by using bio-waste
- Water is recycled back into the system

SDG Goals (Aligning with Technology) : ***13***

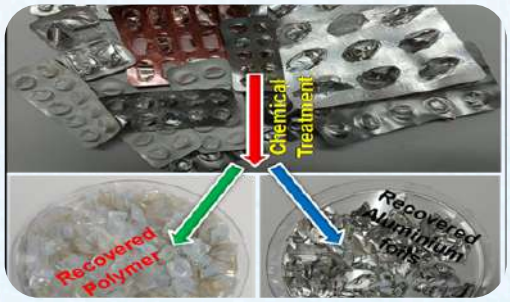
End Users / Customers:

Textile manufacturers, fashion and apparel brands, eco-friendly product manufacturers, sportswear and outdoor gear manufacturers, non-governmental organizations (NGOs), educational institutions

Founder: **Shreyans Kokra** **Website:** **https://www.canvaloop.com**

1.20 Waste Pharmaceutical Blisters (WPBs)

A scalable and environment friendly process for recovery of polymer and aluminium fractions from Waste Pharmaceutical Blisters (WPBs)



Application / Problem Addressed:

The present invention deals with the management of waste MLPs comprising laminated polymeric packaging's for storage of foods/edibles (like chocolates, coffee/tea, biscuits, wafers, toffees, etc.), gifts wrapping materials, shampoo pouches, ketchup sachets, other packets, etc., and development of scalable, facile, safe and environment friendly process for their recycling via wet chemical route for recovery of polymeric fraction(s) through regulated delamination and dementalization processes. The recovered polymer can be recycled via the solution/melt processing route into granules or finished products or converted into value-added products via a suitable compounding/processing approach.

Technology Readiness Level (TRL): ***6***

About Technology:

The present invention deals with the management of waste MLPs comprising laminated polymeric packaging's for storage of foods/edibles (like chocolates, coffee/tea, biscuits, wafers, toffees, etc.), gifts wrapping materials, shampoo pouches, ketchup sachets, other packets, etc., and development of scalable, facile, safe and environment friendly process for their recycling via wet chemical route for recovery of polymeric fraction(s) through regulated delamination and dementalization processes. The recovered polymer can be recycled via the solution/melt processing route into granules or finished products or converted into value-added products via a suitable compounding/processing approach.

USP:

Specifications: Scalability of the process; High recovery rates (>99%); No damage to the structure of recovered polymeric and aluminium foil fractions; High purity of recovered phases (~100%); Complete delamination with 15 mins; No fume hazards; No affluent discharges; Recovery, Regeneration and Reuse (Recyclability) of the used liquid medium etc.

SDG Goals (Aligning with Technology): ***13, 14, 15***

End Users / Customers:

Pharmaceutical Blisters Packaging Industries and anyone selling Packaged Medicines/Drugs in Blister Packs, both under CSR and EPR obligations

Founder: **Dr. Parveen Saini (c/o Director, CSIR-NPL)** **Website:** **www.nplindia.org**

Patent Details: **202311042898 [0162NF2022]**

Dr. Parveen Saini, pksaini@nplindia.org, 9810344856

1.21 Biomass to Bio Coal

Reduces energy consumption: sustainable operation through released volatiles. Eco-friendly: Potential to replace fossil fuel. Similar to coal properties, i.e., customizable (by changing the source to meet industrial requirements).

Application / Problem Addressed:

Reduces energy consumption and promotes sustainable operation through released volatiles

Technology Readiness Level (TRL): ***5***

About Technology:

- Torrefaction technology (250 ˚C-400 ˚C) to convert the waste biomass to biocoal
- Torrefied product with a GCV of 5339 kCal/kg
- Biocoal having calorific value equivalent to that of bituminous coal used in thermal power plants
- Can partially replace coal in existing thermal power plants, blast furnace in steel industry, boilers in small-scale industries, etc
- 10 WT % of torrefied product with coal can consume 140 MT of rice straw; this reduces the consumption of fossil fuels and GHG emission
- Commercialization of the technology will support running the plant (capacity: 10 tonnes/day) by releasing volatile matter and biomass instead of LPG

USP:

- It reduces the volume of crop residue significantly and alters the physical and chemical properties of waste biomass; the calorific value is equivalent to that of sub bituminous coal, hydrophobic coal, etc.
- Reduces energy consumption
- Eco-friendly. It has the potential to replace fossil fuel

SDG Goals (Aligning with Technology): ***12***

End Users / Customers:

Thermal Power Plants, Small-Scale Industry, Rice Mills, Steel Industry, etc.

Founder: **Dr. Sanjay Dhakate** **Website:** **https://www.nplindia.org/**

1.22 Rudra Blue Planet Environmental Solutions (India)

Plastic Waste to Oil Conversion

Technology to process plastic waste to convert it into oil through thermocatalytic depolymerisation method.

Application / Problem Addressed:

Unscientific disposal of plastic waste causes environmental issues. The technology processes plastic waste to convert it into oil and reintroduce the same as fuel into the economy.

Technology Readiness Level (TRL): ***5***

About Technology:

Rudra's process converts waste plastics to valuable products using Thermo Catalytic De-Polymerization (TCD) Technology/method. This is the most environment friendly way of disposing plastics and converting waste plastics to products like fuel oil, flammable gases, residual char etc. The conversion process is safe and economically viable.

Fund Raised / Achievements:

The solution was featured on discovery channel under an iconic program called " Planet Healers"

USP:

Can process non recyclable plastics to give around 450 ltr. to 800 ltr. of oil from 1000 Kgs of plastics.

SDG Goals (Aligning with Technology): ***3, 6, 7, 9, 11***

End Users / Customers:

Bulk plastic waste generators like industries, FMCGs, Municipal corporations etc. The oil generated can be used in Boilers, Incinerators, Burners, Heavy Oil Generators for Power Generation and In future can be used as Automotive Fuel.

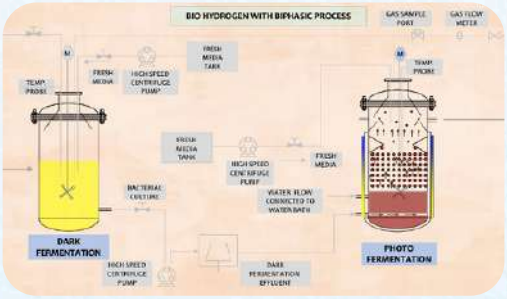
Founder: **Dr. Medha Tadapatrikar, Mr. Shirish Padtare** **Website:** **www.rudraenvsolution.com**

Dr. Medha Tadpatrikar, medha@blue-planet.com, 9370223365)

1.23 Grassroots Energy Technologies India Pvt Ltd

Waste to Energy

Biphasic model of Hydrogen generation from diverse agricultural feedstocks



Application / Problem Addressed:

Waste to Energy, Decentralized Hydrogen Generation, Circular economy, Energy/water efficient Hydrogen generation, Decarbonization, Climate Change / neutral goals, Scope1-2-3 emissions

Technology Readiness Level (TRL): ***5***

About Technology:

Convert biomass to Biohydrogen via bi-phasic fermentation process and has innovations including proprietary microbes, reactor design, lack of need for sterilization of biomass, zero residues and modular system. The by-products can be processed into fertilizer or pigments. The process is highly energy efficient over alternate green Hydrogen solutions. The carbon from the Biohydrogen generation is captured and passed through the algae cultures making the entire process carbon negative.

Fund Raised / Achievements:

$2M raised in grants / R&D capital (Bio CNG and Hydrogen)

USP:

Energy and water efficient, decentralised to Industrial scale model, drop-in solution to BioCNG, circular economy and diverse organic wastes

SDG Goals (Aligning with Technology): ***2, 7, 11, 13***

End Users / Customers:

B2B (Industrial customers, gas grids, Oil and marketing companies, etc.)

Founder: **Mateen Abdul, Shyamali Sarma, Firas Ahmad**

Website: **https://www.grassrootsenergy.co**

Mateen Abdul, mateen@grassrootsenergy.co, 9916298362

2. Wastewater Treatment

Wastewater management is critical for addressing the pressing issues like water scarcity, environmental degradation, and public health concerns. With rapid urbanization and industrialization, the demand for water has escalated, while freshwater sources are increasingly strained. Sustainable wastewater technologies offer a dual solution by conserving water resources and mitigating pollution. Adoption of eco-friendly approaches such as decentralized treatment systems and water reuse practices, will propel India towards ensuring water security and protecting ecosystems.

2.1 Trinity International Ltd.

Phycoremediation Technology

Treatment of wastewater using phycoremediation technology

Application / Problem Addressed:

Rejuvenating and restoring waterbodies such as lakes, ponds, and rivers and reducing air pollution by sequestering industrial carbon emissions. We are on a mission to provide sustainable, cost-effective solutions that benefit both businesses and the environment. We believe that by using the power of nature, we can create a healthier and more sustainable world for generations to come

Technology Readiness Level (TRL): ***9***

About Technology:

Our technology, Phycoremediation, uses microalgae, diatoms, and bio-cultures to remove pollutants from wastewater. This method is highly effective in removing nutrients and contaminants, which makes it an ideal solution for businesses looking for sustainable wastewater treatment options.

Fund Raised / Achievements:

- Rejuvenated Kyrhuhkhla River in East Jaintia Hills, Meghalaya
- Currently cleaning the Lukha River in Meghalaya.
- Very effective in cleaning industrial effluent and recovering value-added products in UP and Tamil Nadu.

USP:

- Specialize in developing and implementing green natural technology solutions for treating wastewater and carbon sequestration.
- Serving both domestic and global clients.
- Dedicated to ensuring water security by sustainable and eco-friendly treatment (compliant with CPCB regulations) of wastewater.

SDG Goals (Aligning with Technology): ***6***

End Users / Customers:

Municipalities, Industrial Facilities, Agriculture, Aquaculture, and Research Institutions

Founder: **Sukhdev Singh** **Website:** **https://www.trinityalgae.com/**

info@trinityalgae.com, +91 9685 852 321

2.2 Elico Ltd.

e - Jal Mini

Disruptive Patented Technology in Waterless Solar Panels Self Cleaning System

Application / Problem Addressed:

In many parts of the world, water is not safe enough to drink. There are basic qualitative observations that quickly determine if water is not safe to consume. However, there are also many "invisible" substances that must be tested for professionally to identify the contaminants and to figure out how the specific polluted water can be purified. Depending on the manufacturer and funding, portable tool kits can be very pricey for local organizations or NGO's. However, Elico Ltd. Has developed this affordable and portable water testing device that can be carried to fields or used in a laboratory setting.

Technology Readiness Level (TRL): ***9***

About Technology:

This unique innovation uses 4 different measurement techniques that are Potentiometric, Electrical Conductivity, Colorimetric & Nephelometric. Their devices are IoT & Cloud enabled systems that "Bringing Lab to Field" instead "Sample going to Lab". The mobile application connected to the devices make the testing easier and provides instant reports to the users.

Fund Raised / Achievements:

INR 20 lakhs grant-in-aid from National Jal Jeevan Mission challenge.

USP:

- Pre-calibrated for water parameters.
- Supports ready to use liquid, powder and tablet reagents.
- Online data transfer and cloud storage.
- Step by step guidance to user provided in mobile app.
- Mobile app supports local languages.

SDG Goals (Aligning with Technology): ***6***

End Users / Customers:

Government agencies to monitor water quality (state level & panchayat level requirements), Water purifiers company, Domestic Households, CSR Activities

Founder: **K.V.S.N. Raju** **Website:** **www.elico.co**

Patent Details: **1. Trademark Registration, Application No: 5358974, 5358974, 5358976**
2. Design Registration, Application No: 359319-001

2.3 Bariflo Labs Pvt. Ltd.

Intelligent Waterbody Management System

Intelligent waterbody management system for water body rejuvenation and inland shrimp aquaculture

Application / Problem Addressed:

The approach of novel invention focused on farmers who are unable to produce a profitable output because of hypoxic circumstances caused by excess feed and excreta accumulation in the sediment in moderate density shrimp farming. Also, traditional farmers use a time-consuming manual procedure of tying a rope in the middle of a pond and spraying feed by traveling around it in a dinghy, which prevents farmers from providing feed precisely in the habitable space. To address the issue, an intelligent mobile multipurpose feed spraying dispenser AIMSD for feeding shrimps and probiotic administration in a livable space has been developed.

Technology Readiness Level (TRL): ***9***

About Technology:

The invention discloses an intelligent manoeuvring hypolimnetic aerator with an internet of things monitoring system that can autonomously navigate to different coordinates and aerate the hypolimnetic region of a water body to improve dissolved oxygen demand (DO) and thus maintain water quality standards.. The data so transmitted can be used to rebuild a 3D image of the bathymetry, temperature distribution, DO distribution, and ORP distribution of the waterbody. Furthermore, the aeration system oscillates vertically in a sinusoidal way, resulting in the generation of standing waves horizontally, resulting in wave propagation to transmit DO farther from the device position and It also improves mixing at the sediment-water interface, allowing DO to penetrate into the sediment.

Fund Raised / Achievements:

BIRAC BIG of INR 50 Lakhs, BIRAC SEED fund of INR 25 lakhs, DST NIDHI PRAYAS of INR 7 lakhs, MeitY TIDE 2.0 Grant of INR 7 lakhs, MeitY SASACT of INR 20 lakhs, Startup Odisha Fund of INR 15 lakhs, RKVY RAFTAAR Grant of INR 20 lakhs, Recognized as top 10 Agri-startup in Agri-Udaan

USP:

Intelligent Sediment aeration system, Intelligent weather and water quality monitoring system, Intelligent nutrient control module, Auto-corrected dissolved oxygen, Un-ionized ammonia, phosphate sensors, carbon dioxide, methane sensors, Disease and water quality prediction DSS

SDG Goals (Aligning with Technology): ***6, 11***

End Users / Customers:

Brackish water farmers, Freshwater aqua farmers, FPOs, Contractors, Govt bodies

Founder: **Mrutyunjaya Sahu** **Website:** **www.bariflolabs.com**

Patent Details: **PCT Application No. PCT/IN2021/050611 Indian Patent Application No. 202031026797, 202031026796, 201831031000, 34443-(1-6)**

2.4 Cluix Pvt. Ltd.

Strip Based Water Quality Testing Device

Disruptive Patented Technology in Waterless Solar Panels Self Cleaning System

Application / Problem Addressed:

Due to the limited drinking water resources, intensive money requirements, growing population, urban change in rural areas, and the excessive use of sea resources for salt extraction has significantly worsened the water quality available to people. The high use of chemicals in manufacturing, construction and other industries, fertilizers in farms and also directly leaving the polluted water from industries into nearby water bodies have made a huge contribution to the global water quality reduction, which has become an important problem Even due to containment water various water born are increasing day by day, due to which many human beings are losing their lives.

Technology Readiness Level (TRL): **9**

About Technology:

This innovative technology entails the reader circuit can measure the change in conductivity and excess charge caused when a drop of sample and an oxidase are mixed on the strip. The reaction on the strip is recorded and shown on the screen by a reader similar to a glucose meter. The meter also indicates if the test sample is permitted or not. They evaluated the known levels of lead by mixing Dimethyl Sulphoxide water with the test sample, and the oxidation reaction was recorded by the reader, which precisely displayed the quantities.

Fund Raised / Achievements:

- INR 24.45 lakhs grant-in-aid from National Jal Jeevan Mission challenge.
- INR 35 lakhs under SISFS Scheme
- INR 60 lakh under NIDHI SSS

USP:

- Multiple parameter testing with no reagent which makes it more user friendly.
- Easy to use device with one step method.
- AI Analysis of result with permissible levels.
- Portable hand held device- Can be carried across the field.
- IoT based data storage transfer.
- Low cost device for mass adoption of technology.

SDG Goals (Aligning with Technology): **6**

End Users / Customers:

Domestic Household customers, Government agencies to monitor water quality, Industrial bodies

Founder: **Robin Singh** **Website:** **www.cluix.in**

2.5 DetoXYFi

Xylem-Based Water Filtration System

Providing everyone with access to clean drinking water by commercializing low-cost, natural, comprehensive water filtration devices.

Application / Problem Addressed:

Xylem-based filtration towards reducing the barriers of access, affordability, and social acceptance to serve as an attractive HWT option for low-income communities that are at the highest risk of water-borne diseases, field tested in India, USA, Uganda, Madagascar.

Technology Readiness Level (TRL): ***8***

About Technology:

Detoxyfi, a next-generation drinking water technology, converts waste wood into drinking water pitchers and filters. These sustainable, patent-pending water pitchers for individuals and households can for the first time ever efficiently filter without using electricity and has the potential to substantially improve the lives of the ~3 Billion people suffering from water contamination and poor water quality across the world by 2030.

Fund Raised / Achievements:

- Jacobson Social Impact Prize $25k
- Penn New Venture Competition $15k
- Founders Capital $10k

USP:

- WHO quality filtration: superior performance.
- Eco-friendly: zero waste; fully circular economy.
- Zero economic burden: simple to make, cost-effective.

SDG Goals (Aligning with Technology): ***6***

End Users / Customers:

Urban population, Municipal Corporations, Ministry of Housing and Urban Affairs (MoHUA), during disaster management

Founder: **Dhananjay Goel, Rishon Benjamin** **Website:** **https://www.detoxyfi.com/**

dhananjaygoel@hks.harvard.edu

2.6 Jalopchar

Wastewater Treatment Technology

An eco-friendly wastewater treatment Technology, augmenting irrigation water supplies

Application / Problem Addressed:

Compared to conventional technologies, this is 1500 times more sustainable and results in at least 33 times less environmental stress.

Technology Readiness Level (TRL): ***8***

About Technology:

- Natural biogeochemical treatment, augmenting irrigation water supplies
- Works on plant-microbial-media interactions involving emergent macrophytes, media, and the associated microbial assemblages. Pollutant Reduction Efficiency: Reduction in turbidity (90-99%), pathogen load (99.8-99.9%), BOD (78-88%), heavy metals (57-100%), nitrates and phosphates (30-57%)
- Ecological efficiency and sustainability: The technology utilizes 27x more renewable resources and, thus, 1500x more sustainable conventional sewage treatment technology.
- Compliance with CPCB discharge, ZLD, low HRT, reduced CAPEX and OPEX

Fund Raised / Achievements:

Natural biogeochemical treatment, augmenting irrigation water supplies

USP:

Ecological efficiency and sustainability: The technology utilizes 27x more renewable resources and, thus, 1500x more sustainable conventional sewage treatment technology.

SDG Goals (Aligning with Technology): ***6***

End Users / Customers:

Delhi parks, gardens, city forest, archeological park, or peri-urban areas/ or towns having no sewerage network.

Founder: **Dr. Ravinder Kaur** **Website:** **https://icar.org.in/**

2.7 Liqsure Systems Pvt. Ltd.

Generating Microbubbles To Destroy Microorganisms in Waste Water

The system developed by LiqSure works on the principle of cavitation, where micro-bubbles are generated by the pressure difference.

Application:

Industrial wastewater treatment is a burning problem today. Outdated technologies are used for the treatment which is not sufficient to clean the new generation complex chemicals. LiqSure systems Pvt Ltd is a technology driven organization which brings a new approach to solve this problem by providing innovative and cost-effective solutions for industrial wastewater treatment which works on the principle of cavitation.

Technology Readiness Level (TRL): ***8***

Problem Addressed:

Industrial wastewater treatment is a burning problem today. Outdated technologies are used for the treatment which is not sufficient to clean the new generation complex chemicals. LiqSure systems Pvt Ltd is a technology driven organization which brings a new approach to solve this problem by providing innovative and cost-effective solutions for industrial wastewater treatment which works on the principle of cavitation.

About Technology:

The system developed by LiqSure works on the principle of cavitation, where micro-bubbles are generated by the pressure difference. These micro-bubbles subsequently grow and collapse violently to release large amounts of energy, which kills the microorganisms and destroys organic chemicals present in the wastewater. It does not require any chemical, filter, or membrane to purify the wastewater. Only electricity is required to pump the wastewater through the developed system which makes it energy efficient and provides an economical solution for the treatment of industrial wastewater. Several industries including regional and multi-national are looking for solutions to change the current industrial wastewater scenario.

Fund Raised / Achievements: 50,00,000

USP:

- Low footprint
- No secondary waste
- Easily Retrofittable
- Saves 30% of overall processing cost
- Works at any pH scale from 0-14
- No use of membranes and filters
- Low maintenance
- Faster treatment

SDG Goals (Aligning with Technology): ***6***

End Users / Customers:

Target customers with issue of wastewater like STP, ETP, textile, pharmaceutical, dairy, food processing.

Founder: **Dr. Sarjerao Doltade** **Website:** **https://www.liqsure.com**

2.8 IIT Jodhpur

Sorption Assisted Ultrafiltration Membrane

Sorption assisted ultrafiltration membrane based water purification unit

Application / Problem Addressed:

Removal of bacteria, virus, colour, order, suspended solids and turbidity from raw water to provide clean drinking water.

Technology Readiness Level (TRL): ***8***

About Technology:

Sorption assisted ultrafilteration membrane based water purification unit

Fund Raised / Achievements:

Water purification system were installed in more than 15 rural Schools and Anganwadis in rural area.

USP:

- Does not required electricity;
- No waste of water

SDG Goals (Aligning with Technology): ***6***

End Users / Customers:

Domestic Household customers, Government agencies to monitor water quality, Industrial bodies

Prof. Pradip K Tewari; pradiptewari@iitj.ac.in; 9819573369

2.9 IpanelKlean Solar Pvt. Ltd.

Disruptive Patented Technology in Waterless Solar Panels

Disruptive Patented Technology in Waterless Solar Panels Self Cleaning System

Application / Problem Addressed:

Solar Plants are loosing power generation upto 70% due to Dust, there is scarcity of Water in cleaning it and Cleaning manpower runs the risk of life due to high voltage DC electrocution and falling while working.

Technology Readiness Level (TRL): ***8***

About Technology:

IpanelKlean has disrupted solar panel cleaning with its award winning waterless patented technology. Our research has resulted in upto doubling power generation of solar plants, reducing payback period upto 40%. Our work enables compliance with ESG and SDGs of UN by creating annual economic impact of extra 8 Billion USD, save 100 Billion litres water, save 60 Million tons carbon emissions and save numerous lives of solar panel cleaning workers from electrocution or falling while working. Our innovation combines nano technology, pneumatics, IOT, automation, wireless and mobile app to create value. We work with solar plant owners and investors to increase their ROIs upto 15X.

Fund Raised / Achievements:

- BIG BIRAC grant – KIIT Incubation- 2021
- Recognized by NITI Ayog, digit.in, Yourstory, Share America and Mckinsey & Company
- Got investment commitment worth INR 2 Cr from multiple investor groups in the SEED round.

USP:

- Saves Water upto 100% in Air mode
- Saves Carbon Emissions by doubling solar power generation
- Saves Human lives from electrocution or falling while working
- Brushless and no moving parts on solar panels
- Extra 15X ROI over 25 years system life
- Saves investment in Rooftop space or Land Area

SDG Goals (Aligning with Technology): ***7, 9, 11, 13***

End Users / Customers:

Solar Plant Owners, Equity investors in Rooftop and Utility Categories across India, Middle East, US, Africa, SE Asia, Australia, South Korea & Japan

Founder: **Suchin Jain** **Website:** **www.ipanelklean.com**

Patent Details: **An Indian Patent granted and PCT Application has been filed**

2.10 TADOX- TERI

Advanced Oxidation Technology For Industrial Wastewater Treatment

Application / Problem Addressed:

Industrial wastewater treatment with integration at pre- and post-biological stage

Technology Readiness Level (TRL): ***7***

About Technology:

- TADOX® involves Nanotechnology in combination with Advanced Oxidation Processes (AOPs), which in-situ generates hydroxyl radicals, leading to oxidative degradation and mineralization of targeted pollutants
- Ecofriendly solution to sludge/wastewater, end-to-end treatment for highly polluted industrial & municipal wastewater, open drains, enhancing water reuse.
- Clean & green: chemical, sludge & secondary pollution free, improves biodegradability & prevents biofouling of RO membranes.
- Compliance with CPCB discharge norms [for COD, BOD, POP etc], and Zero Liquid Discharge, low Hydraulic Retention Time, reduced CAPEX and OPEX.
- Small footprint: modular & retrofittable to existing STPs and ETPs.
- Supported by the Water Technology Initiative (WTI), Department of Science & Technology; selected as the treatment of choice for "Namami Gange" project

Fund Raised / Achievements:

The technology has been adopted by an MSME company to scale up to a 10 Kilo Litre per day continuous running plant on the TERI Gurugram campus. TADOX® technology has been chosen for pilot trials and augmentation plan for identified industrial sectors under the 'Namami Gange' Programme of the Ministry of Jal Shakti, Govt. of India.

USP:

Eco Friendly indigenous technology to treat municipal Sludge/ highly polluted industrial wastewater/ open Drains.

SDG Goals (Aligning with Technology): ***6, 12***

End Users / Customers:

Infrastructural projects, townships, commercial complexes, green buildings, and smart cities

Founder: **Dr. Nupur Bahadur** **Website:** **https://www.teriin.org/**

2.11 JSP Enviro

Sustainable Industrial Effluent Treatment.

Bio-electrochemical system (BES) for low cost and sustainable industrial effluent treatment.

Application / Problem Addressed:

Textile effluent pollution accounts for 20% of the total water pollution and contributes to 3 billion tons of annual carbon emissions. This has multilevel impacts on socioeconomics, health, and the environment. Due to its complex nature, textile effluent treatment has always been an expensive operation, with high capital, operating and maintenance costs. Large textiles units manage these costs through the establishment of common effluent treatment plants (CETPs) with other similar size industries. In most of the cases, this is done with substantial support from the state governments. For small and medium-scale dyeing units, establishments of these CETPs are unaffordable. This results in the implementation of ineffective technology or resort to unregulated discharge into the waterbody. We aim to provide low cost water treatment technology for MSMEs in the textile industry.

Technology Readiness Level (TRL): ***7***

About Technology:

BES consists of a microbial fuel cell (MFC) which is a biological process that utilizes microorganisms to degrade the organic contaminants in the wastewater and produce energy in the form of electricity. It reduces the colour, COD/BOD (organic content), nitrates, sulphates in the water while generating electricity. The MFC is designed as a modular system that can be scaled based on the capacity and COD reduction requirement. The BES technology will aim to replace the conventional activated sludge process which is energy intensive in nature.

Fund Raised / Achievements:

BIG BIRAC- 50 Lakhs, Social Alpha/Rainmatter investment - 1.6 Cr, MeiTy TIDE Scaleup Grant - 35 lakhs

USP:

Our USP is the simultaneous treatment of wastewater together with electricity production. The cost savings from energy production and no chemical usage or sludge production are the USP for BES compared to conventional systems. This technology is novel and the first of its kind in the field of effluent treatment in India

SDG Goals (Aligning with Technology): ***6, 12***

End Users / Customers:

Textile and Dyeing industries

Founder: **Priyadharshini Mani, Fidal Kumar, Suresh Paul Jones**

Website: **https://www.jspenviro.com/**

3. Air Pollution Mitigation

In the Indian context, particularly in all the major cities, where air pollution levels often reach alarming highs, technological interventions play a pivotal role in mitigating this pressing issue. Tech interventions offer a multifaceted approach to tackling air pollution. Advanced air quality monitoring systems provide real-time data, enabling authorities to identify pollution hotspots and implement targeted measures. Innovative air purifiers, pollution-absorbing materials, also contribute to improving urban air quality. While Delhi's designation as the "pollution capital" underscores the severity of the problem, tech interventions offer hope for effective solutions.

3.1 Indus Scientific Pvt. Ltd.

Outdoor AAQMS for measuring pollutants

Outdoor AAQMS for measuring pollutants and gases in the atmosphere.

Application / Problem Addressed:

Through AAQMS, the quality of air and other environmental factors can be analyzed over a selected period of time.

Technology Readiness Level (TRL): ***9***

About Technology:

- Measures PM 2.5 & 10
- Measures O2, CO2, CO, NO2, SO2
- Measures Environmental parameters like
  - Atmospheric pressure
  - Temperature
  - Decibel meter
  - Wind speed and direction
  - Sampling air Volume: 1m/s air flow rate, volume of air sampled at 2.8 mm^3 / Sec

Fund Raised / Achievements:

Product Endorsement: NABL accredited laboratories awarded satisfactory calibration certificates.

USP:

- Real time data capture and monitoring.
- 24x7 customizable data capture andanalysis.
- Can access real time data over multiple internet, Wi-Fi Enabled devices.
- Android app to access real-time data from anywhere (Data is sent to Cloud server) continuously, and this data can be accessed anytime from the portal).
- Based on the trend analysis that the AAQMS tracks, the quality of air and other environmental factors can be analyzed over a selected period of time.
- Reasons / causes for unfavorable readings can be identified, and corrective actions can be taken.

SDG Goals (Aligning with Technology): ***13***

End Users / Customers:

Government Transportation Departments, Municipalities and Smart City Initiatives, Environmental Agencies, Energy and Environmental Consultancies, Educational and Research Institutions

Founder: **Anil G Mathews** **Website:** **https://indisscientific.com/**

anil@indusscientific.com

3.2 Shudhvayu Air Filter for Vehicle Roof-Tops

Automatic Filtration with Moving Vehicles

Shudhvayu filter will convert your car into air purifier

Application / Problem Addressed:

Dust filtration foam layers capture carbon particles, PM 2.5 and PM 10 from air on moving vehicles

Technology Readiness Level (TRL): ***8***

About Technology:

- Shudvayu Air Filter on 4 wheelers, silent and effective, cleans the surrounding air by using moving vehicles like big and small cars
- Dust filtration foam layers capture carbon particles ,PM 2.5 and PM 10 from air on moving vehicles
- Automatic filtration with moving vehicles, no need of artificial power source
- Easy to install on the roof of vehicles with the provided mounting support, no scratches on vehicle's surface.

USP:

Removes total suspended PM in ambient air on non-foggy days in the range of 0.012 - 0.049 g/km, while moving

SDG Goals (Aligning with Technology): ***13***

End Users / Customers:

Residential, Commercial, Industrial and Government Transportation Departments, Municipalities and Smart City Initiatives, Environmental Agencies, Energy and Environmental Consultancies, Educational and Research Institutions

Founder: **Amit Bhatnagar** **Website:** **www.shudhvayu.com**

support@shudhvayu.com,+918750740000

3.3 Aurassure

Smart Air Quality Monitoring System

A Retrofit Model which provides multimode connectivity

About Technology:

- Easily determines the exposure of air pollution to health and the environment.
- Ensures the city meets compliance with national ambient air quality standards.
- Helps identify areas and sources contributing to air pollution.
- Raise the information level of citizens through display boards and send periodic notifications and alerts to individuals sensitive to health whenever air quality deteriorates.

Technology Readiness Level (TRL): ***8***

USP:

A Retrofit Model which provides multimode connectivity

SDG Goals (Aligning with Technology): ***13***

End Users / Customers:

Smart cities, offices, hospitals, etc.

Founder: **Akansha Priyadarshini**

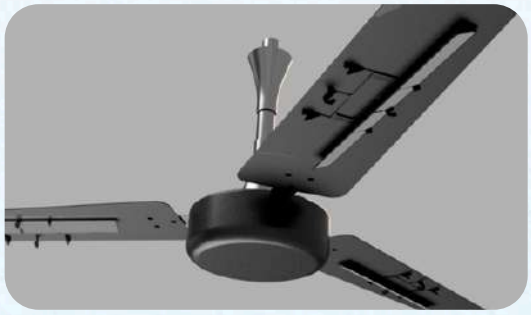
Website: **https://aurassure.com/**

Akanksha, +91-8763983619 /+91-7008358799, contact@aurassure.com

3.4 Swachh-Rena

Affordable Indoor Air Cleaner Retrofit

Convert your existing ceiling fan to an air purifier by attaching Rena. Attach the adapter to your fan and install washable and single use filters.



About Technology:

- Rena is a retrofit that can convert most ceiling fans into an affordable air purifier.
- As most households in India already have ceiling fans this makes the total cost of ownership very low. Rena has a base or adapter that is placed on each of the blades of a fan. Removable filters are then latched onto the base which are either washable or single use fine filters.

Technology Readiness Level (TRL): ***8***

USP:

- Summer & winter operation - The device reduces air circulation in winter and barely affects it in summer.
- Biodegradable filter options
- Washable filters for low operation cost
- Low total cost of ownership

SDG Goals (Aligning with Technology): ***7, 11, 12, 13***

End Users / Customers:

- Low / medium income households
- Schools, colleges and offices.
- Recovering patients, PHCs etc

Founder: **Karan Rao**

Website: **https://swachh.io/**

karan@swachh.io

3.5 Airth

Converts Normal AC into an Air-Purifying AC

Central AC-based air purifier: proven technology to purify the air in your room, providing protection from harmful pollutants, germs, smog, and PM2.5 and PM10 particles.

Application / Problem Addressed:

HEPA filter that removes 99% of pollutants as small as 0.3 microns, including dust, pollen, smoke, allergens, and other airborne particles.

Technology Readiness Level (TRL): ***8***

About Technology:

- Proven technology to purify the air in your room, providing protection from harmful pollutants, germs, smog, and PM2.5 and PM10 particles.
- The filter is coated with a plant-based coating that deactivates germs and bacteria, making the air in your room fresher and healthier.
- Easy to install and requires no electrical supply or batteries. It fits on the top of your AC's inlet grill and can be installed in just a few minutes
- Cost-effective alternative to expensive air purifiers, as it purifies the air at a fraction of the cost.

SDG Goals (Aligning with Technology): ***13***

End Users / Customers:

Residential, Commercial, Industrial and Government

Founder: **Ravi Kaushik - Founder & CEO**

Website: **https://airth.in/**

hello@airth.in, 8700529995

3.6 Umeandus Technologies

Air Purification System (APS)

Filter-less, modular & scalable solution for outdoor ambient air pollution control at Industrial hotspots.

Application / Problem Addressed:

The APS is an innovation to address PM with a filter-less technology with flexibility of deployment either as a large-scale centralized system in hotspots or in a modular fashion reducing harmful exposure.

Technology Readiness Level (TRL): ***8***

About Technology:

The Air Purification System (APS) segregates particulate matter (PM) from the air to reduce pollution by concentrating and collecting the particles and removing them through a depositor. The product is filter-less, easy to operate 24x7x365, and deployable in the most optimal manner to reduce people's exposure from pollution. The product is capable of running unattended over a long period of time and performs better at higher pollution levels. It is configurable for both enclosed and open spaces. Once deployed, the product does not need frequent attention or maintenance.

USP:

- Portable and scalable as per requirement
- 75% efficient without any degradation over long usage
- Sustainable solution
- Low power consumption
- IOT-enabled remote monitoring & control

SDG Goals (Aligning with Technology): ***13***

End Users / Customers:

Government Transportation Departments, Municipalities and Smart City Initiatives, Environmental Agencies and NGOs, Energy and Environmental Consultancies, Educational and Research Institutions

Founder: **Rajeev Chanan** **Website:** **http://www.umeandus.in/**

info@umeandus.in

3.7 Open-Source Air Purifier & Sensors

RESET-Certified IAQ sensor

Application / Problem Addressed:

Indoor air pollution can arise from various sources, including dust, allergens, pet dander, pollutants from cooking, and more. Poor indoor air quality can lead to health issues, especially for individuals with respiratory conditions or allergies. By addressing these issues, a ceiling fan retrofit with air purifier capabilities aims to create a healthier and more comfortable indoor environment for individuals and families, particularly in regions where air quality is a concern.

Technology Readiness Level (TRL): ***7***

About Technology:

- Bubble CR Box: An adaptation of the Open-Source Corsi-Rosenthal Box (CR box) design,
- designed to capture particle virus-laden aerosols in indoor environments, specifically designed for the Indian context. The cost of a single unit is $45 to cover ~50 sq.mtrs of indoor space
- Active ED CO2 Monitor: A miniature version of the RESET-certified IAQ sensor (active buildings), that can monitor, display, & record CO2 readings in real-time to assess the risk of airborne pathogens in their indoor environment. The cost of a single unit is $85 to cover ~200 sq.mtrs of indoor space
- RESET Certified Technology
- Handy Plug And play sensors

Fund Raised / Achievements:

- Installation of odor sensors in Vande Bharat trains.
- Successfully running a pilot with DRIIV in collaboration with DPCC
- Multiple installments of solutions with BMC.

USP:

- Simple and effective design
- Affordable sensor
- Open data over a network
- Medium/low power consumption

SDG Goals (Aligning with Technology): ***3, 7***

End Users / Customers:

Home owners, Eco-Conscious consumers, small businesses, academic institutions, healthcare facilities, hotels and hospitality industry, government and NGOs

Founder: **Mr. Abhinav Gupta** **Website:** **https://www.activebuildings.io/about**

contact@activebuildings.in, +91 81690 20990

3.8 Oizom Technologies

Smart Air Quality Monitoring for Sustainable Future

Application / Problem Addressed:

The air filter has been deployed in a highly polluted hotspot in Delhi, NCR. The technology has been validated by Prof. Sagnik Dey, IIT Delhi.

Technology Readiness Level (TRL): ***7***

About Technology:

- End-to-end solution: 3rd-party control equipment, when integrated with Oizom's urban air pollution monitoring systems, provides a complete solution.
- Secured Data Integration: Hassle-free API integration, along with HTTPS Secure Socket Layers and AES encryption assures secured data transfer.
- Solar Compatibility: All Oizom monitors can function on solar power with a battery backup of a minimum of 10-12 hours.

USP:

- Accurate air quality data
- 30+ environmental parameters
- Integrated sensors
- End-to-end solution
- Supports Multiple Data Communication & Traceable Calibration
- Advanced Data Management Platform, works in extreme climate
- Low cost of ownership

SDG Goals (Aligning with Technology): ***13***

End Users / Customers:

Government Agencies and Environmental Authorities, Industries and Businesses, Healthcare Facilities, Educational Institutions, Residential Communities, Transportation Authorities, Smart Cities Initiatives, Individual consumers

Founder: **Ankit Vyas (CEO), Vrushank Vyas (COO)** **Website:** **https://www.oizom.com**

contact@oizom.com, +91-8866660025

4. Sustainable Mobility & Energy Transition

India's burgeoning population generates massive amounts of waste daily, necessitating efficient disposal methods to prevent environmental degradation. Inadequate waste management contributes to pollution of air, water, and soil, exacerbating health issues and diminishing quality of life. Moreover, with rapid urbanization and industrialization, the strain on natural resources intensifies, underscoring the urgency for sustainable waste management practices to conserve resources and mitigate climate change impacts.

4.1 Chartr (One Delhi App)

Digitization of Public Transport, Increasing Ridership and Lowering GHG Emissions

Application / Problem Addressed:

Chartr addresses urban challenges by providing Delhi residents with a comprehensive app for transportation navigation, local service discovery, emergency assistance etc

Technology Readiness Level (TRL): ***9***

About Technology:

- The 'One Delhi App' offered by the Delhi government has been a comprehensive repository for bus service details and ticketing options,"
- By using timetable and real-time GPS data, our algorithm allocates the current route in real-time for all buses.
- Dashboards displaying all kinds of operational data for agencies.
- Ticketing reports with various filters for easy monitoring and management

Fund Raised / Achievements:

- Adopted by Delhi government and installed in DTC buses

USP:

Its adopted by Delhi government and operational DTC depot automation and Open data for all 6700 buses

SDG Goals (Aligning with Technology): ***8,9,11***

End Users / Customers:

Tourist and visitors, Residents of Delhi, Students

Founder: **Dr. Pravesh Biyani**

Website: **https://www.iiitd.ac.in/**

4.2 Log9 Technologies Pvt. Ltd

Deep Tech Innovations Empowering EV Batteries

Log9 Materials has developed Aluminium–air battery, aluminium fuel cells for both mobility and stationary energy applications

Application / Problem Addressed:

With significant reductions in carbon emission and production cost, Log9's manufacturing process for the cells are highly sustainable, efficient and economic. State-of-the-art tables cell design tackles internal resistance and enhances thermal dissipation hence restraining overheating etc., for EVs running in tropical countries.

Technology Readiness Level (TRL): ***8***

About Technology:

- Designed to efficiently power electric vehicles in all Indian and other tropical conditions.
- LTO (Lithium titanate) & LFP (Lithium ferro phosphate) based
- Fast-charging, thermal management, extended lifespan (9x), >10,000 charge-discharge cycles
- Excellent reliability & longevity: Ideal for last-mile logistics & in demanding conditions
- Multi-pronged engagement with Log9, including development in new battery technologies

Fund Raised / Achievements:

- Log 9 Materials has won the Top Innovator award
- Log 9 Materials has raised USD 8.5m in Series A+ funding round led by Amara Raja Battery.
- Omega Seiki Mobility and Log9 Materials, today announced a partnership to deploy 10,000 3-Wheeler Rage+ Rapid EVs in Tier II and III markets of India.
- Log 9 Materials has raised $2 million from Petronas Ventures

USP:

Log9 Materials has developed Aluminium–air battery, and aluminum fuel cells for both mobility and stationary energy applications. They operate in the areas of sustainable energy and filtration

SDG Goals (Aligning with Technology): ***7, 9, 13***

End Users / Customers:

Energy Storage

Founder: **Akshay V. Singhal (CEO), Karthik Hajela (COO)**

Website: **https://www.log9materials.com/**

reachus@log9materials.com

4.3 Capattery Technologies

Graphene-based Battery Cells

Capattery is the leading nano-technology company to have developed and proven graphene batteries commercially.

Application / Problem Addressed:

Ultrafast charging in less time, Effective alternative for lithium ion batteries in tropical countries.

Technology Readiness Level (TRL): ***8***

About Technology:

- 3C Charging, 3X improvement, stable at higher temp. (c. 350˚C)
- 1.5-2X Mileage –high mileage for same capacity
- Cost effective, can be retrofitted, 2/3/4 wheelers
- Charges in 20 mins as compared to 4hrs
- Ideal for energy/grid storage

Fund Raised / Achievements:

Graphene batteries offer charging speeds that are 3 to 6 times faster, a lifespan that is 2 to 3 times longer, and a range increase of 1.3 to 1.8 times compared to traditional Lithium batteries. Additionally, they maintain safety even at extreme temperatures of up to 350°C

USP:

Graphene battery are an effective alternative to lithium Ion battery at an extreme temperatures of up to 350°C

SDG Goals (Aligning with Technology): ***7, 9, 13***

End Users / Customers:

Energy Storage, Aerospace, Smart cities, Electronics, Construction, Defense and Space

Founder: **Sushant Pattnaik, Gopi Latpate**

Website: **https://capattery.co/**

info@capattery.co

4.4 BATX Energies

Recycling end-of-life Lithium-Ion Batteries

Producing battery grade materials by recycling end-of-life Lithium Ion Batteries to create a sustainable energy source which is also eco-friendly.

Application / Problem Addressed:

Efficiently managing e waste, recycling lithium ion batteries, EV Infra more greener by integrating solar panels

Technology Readiness Level (TRL): ***8***

About Technology:

- Recycling of used Lithium-ion batteries from across the world
- Extracting the highest quality Lithium, Nickel, Cobalt and Manganese from used Lithium-ion cells.
- Secondary products include high grade Plastic, Aluminium, Copper, Stainless Steel, which are bought by recyclers contributing to circular economy.
- Can be used as home energy storage systems
- Can be used to store energy in commercial buildings,
- Reducing the amount of energy that needs to be drawn from the grid during peak times.
- Electric vehicle charging stations: Second-life batteries can be used to store energy at electric vehicle charging stations, reducing the strain on the grid during peak times.

Fund Raised / Achievements:

- $5 million pre-series A funding, led by Zephyr Peacock to advance lithium battery recycling operations
- $1.6 million seed funding from JITO Angel Network
- Recycled about 220 million batteries

USP:

Smart energy management system, reduction of grid dependency

SDG Goals (Aligning with Technology): ***7, 11, 12, 13, 15***

End Users / Customers:

Energy Storage, Aerospace, Smart cities

Founder: **Utkarsh Singh (CEO), Vikrant Singh (CTO)**

Website: **https://batxenergies.com/**

info@batx.in,+91-9667723923

4.5 BATX Energies

Solarized 2nd Life EV Charging Station

Solar EV Charging Stations: A promising cost effective, sustainable solution for India

Application / Problem Addressed:

Solar charging station (6 Kw, 20 Kwh) with capacity of solar and battery bank to charge E-rickshaw/ two wheeler/ EV Car with AC type 2 and normal 48V system charging coupled with AC charging. Reducing Grid dependency based on Peak & Off Peak Hours

Technology Readiness Level (TRL): ***8***

About Technology:

- Solar capacity -6.6 Kwp.
- Battery capacity: 20 KWh -100 KWh.
- AC power Availability upto 5 KW.
- DC _DC Vehicle charging Availability.
- 4 Stations of battery swapping
- Bi-directional Energy control systems for Grid Stabilization at peak hours
- High tech second life stationery battery storage systems integrated with enhanced IOT
- EV stations are powered by MG Motor India's 2nd life EV batteries

Fund Raised / Achievements:

- Successfully running a pilot with DRIIV in collaboration with IIT Delhi in campus
- Smart EV infra proposal submitted to Delhi Transport
- Prospective installation in remote areas (J&K).

USP:

- Making Ev infra more greener by integrating solar panels

SDG Goals (Aligning with Technology): ***7, 11, 12, 13, 15***

End Users / Customers:

Smart EV infra, Aerospace, Smart cities

Founder: **Utkarsh Singh (CEO), Vikrant Singh (CTO)**

Website: **https://batxenergies.com/**

info@batx.in,+91-9667723923

4.6 EVI Technologies

EV Charging-as-a-Service network

Promoting e-mobility in the country through a suite of EV chargers for 2/3/4W and battery swapping stations.

Application / Problem Addressed:

Contributing to clean mobility through innovations towards a smart, sustainable and secure EV infrastructure in the nation.

Technology Readiness Level (TRL): ***8***

About Technology:

- A range of Type 2 EV chargers for 2/3/4 W
- LEV-AC Charger: Can charge all-EVs compliant with AIS 138 Part-1 standards and OCPP 1.6J, user-friendly and safe
- AC Type 2 Charger 22 kW: Ideal for EV 4-w at commercial and residential parking areas, compatible for load management/demand, mobile cum web app based connectivity with server through Wifi or Cellular Network (2G/3G/4G) to locate the nearest charging facility and book charging slot.
- AC Type 2 home charger: This single output AC charger is perfect for charging (2/3/4 Wheelers) at home or in residential societies where parking is available for longer hours, scheduling for night charging using mobile/web app, equipped with class 1 metering for grid responsive billing.
- Charger Management Server & mobile app for end-to-end solution
- Battery swapping station: at Ranibagh caters to the daily charging requirements of 10-12 EVs resulting in a cumulative 60 battery swaps/per day

Fund Raised / Achievements:

- 1800+ EVIT charging points of 13+ variants installed nationwide in 20+ states
- Battery swapping stations in NCR (Ranibagh), 3000 EV chargers at BSES Rajdhani territory
- EV charging stations at HPCL fuel pumps on major highways and cities in Bihar, Uttarakhand, and Uttar Pradesh are being set up in collaboration with EVI Technologies.

USP:

EV charging as a service

SDG Goals (Aligning with Technology): ***7, 11, 12, 13***

Website: **https://evitpl.com/**

End Users / Customers:

Smart cities, EV Industries

rahul@evitpl.com,+91-8826341150

Founder: **Rahul Soni (Co-Founder)**

4.7 ATLAST

Hydrogen Fuel Cell Technology

It uses hydrogen as a fuel and oxygen from ambient air to produce electricity. The Exhaust is just water and there are no tailpipe emissions

Application / Problem Addressed:

- We are applying this technology for a Motorcycle and other light mobility applications.
- In India around 49% of House holds own a 2-wheeler. Currently most of the 2 wheelers are powered by petrol which is causing a lot of emissions and increasing Indian oil dependency on other nations . However The current electric motorcycles, scooty's have a limited range of 100-120 km and taking 4-5 hours to full charge. This limited options are causing the users and buyers either to switch to electric 2 wheelers or not

Technology Readiness Level (TRL): **7**

About Technology:

With our technology , hydrogen can be used as fuel to power the electric motor . With hydrogen as a fuel there is no problem of range anxiety and hours of charging time.

Fund Raised / Achievements:

The company supported by Vignana Jyothi Society's Educational Wing VNR Vignana Jyothi Institute of Eng & Technology with a grant of 6,14,401 INR. Along with 10 lakh INR grant received through TiHAN EiR from ITIC-IIT Hyderabad. The startup won multiple pitching competitions at IIT-BHU, IIT Gandhi Nagar, IEEE Ideathon & Pitchfest, E-Summit 23 at Mahindra University .

USP:

The USP of Technology is we are forecasting that the motorcycle can reach more than 250 km range with IDC (Indian Driving Conditions) and can be refueled in just 2 minutes @350 bar pressure.

SDG Goals (Aligning with Technology): **7**

End Users / Customers:

Currently our target users are long distance adventure tourers i.e motorcycle enthusiasts who go to long rides . The adventure motorcycle segment market currently is around $1.9 billion from total $16 billion motorcycle market in India . Our Initial Focus is on the long distance travelling segment then eventually in the long run will make models to address the mass market needs as well.

Founder: **Gopichand Anumolu** **Website:** **https://linktr.ee/atlast.inc**

Gopichand Anumolu, 9959586681, gopichand.connects@gmail.com

3. Outcome and Major achievements

3.1 Phycoremediation from Trinity International for waterbody rejuvenation

Phycoremediation is a highly advanced technology that involves the remediation of contaminants in a water body using micro and macroalgae. Algae fix carbon dioxide by photosynthesis and remove excess nutrients effectively. It removes pathogens and toxic materials from wastewater. Xenobiotics, chemicals, and heavy metals are known to be detoxified, transformed, accumulated, or volatilized by algal metabolism. It offers multiple advantages over conventional methods of remediation because of its effectiveness, efficiency, and eco-friendly nature.

It is a nature-based, carbon-negative, and chemical-free treatment method for the restoration and rejuvenation of waterbodies polluted by domestic, agricultural, and even industrial discharges within the drains and waterbody.

Phycoremediation Promotes:

1. Complete restoration of the ecosystem around the drains flowing into ponds, rivers, and surrounding areas.
2. Removal of harmful aquatic weeds as well as other toxic species from the subsequent water system.
3. Increasing Dissolved Oxygen to more than the stipulated 6mg/L, and bringing the BOD, COD, TC, FC, and pH Levels within the CPCB requirements.
4. Consumption of excess nutrient elements like Nitrogen, Phosphorus, Sulphates etc., along with heavy metals and metals to balance the ecology.
5. Comprehensive remedial solution for both treatment methods for polluted water, as well as preventive measures for ecological restoration.
6. The algal treatment is a highly carbon-negative technology and will also lead to natural air purification, resulting in an Oxygen-rich environment.
7. It creates multiple new revenue generation avenues like fish farming, algal farming, bio-fertilizers, organic animal feed, bio-food, biofuel etc., which can lead to exponential holistic economic development of the local communities as well as the state.

The entire process is implemented without chemical usage or hampering the current flow or topography of the waterbodies. The technology will ensure sustainable water quality improvement along with improvements in ecology and natural restoration.

Management of water bodies in South Delhi using phycoremediation

The potential of phycoremediation from Trinity International, a Cluster partner, in conservation and management of waterbodies was discussed with MoEFCC, and Department of Forest and Wildlife Conservation, Govt. of NCT Delhi. The potential of phycoremediation from Trinity International, a Cluster partner, in conservation and management of wetland was discussed with senior officials of MoEFCC and Department of Forest and Wildlife Conservation. After site visits, Nebsarai waterbody was selected to initiate the cleaning/managing exercise through the ecofriendly and sustainable phycoremediation technology.

Treating of oil sludge from Oil India Plant

Based on initial experiments done at Trinity's research lab for the degradation of sludge from OIL, Assam, it can be inferred that the potential of phycoremediation technology can be effectively utilized for management of oil-based sludge sample from oil industries.

Phycoremediation as an effective methodology for leachate treatment

Landfill leachate is high-strength wastewater saturated with various compounds leaching from the decomposing municipal waste during degradation and precipitation. It generally comprises a high concentration of dissolved organic and inorganic compounds, toxic heavy metals (THMs), ammonia and xenobiotic organic compounds (XOC), which are highly toxic to living organisms and the environment. Leachate generated from the landfill sites percolates through the disposed waste contaminating the soil, surface water and groundwater, thus posing a serious challenge to landfill operators and local governing bodies. A Variety of physicochemical treatment methods such as Multi effective Evaporators (MEEs) have been employed for leachate treatment. While these conventional treatment systems have good efficiency, they are not sustainable as they involve substantial costs in materials, equipment, chemical and electrical consumption without any remarkable energy recovery. Phycoremediation can be effectively utilized as a sustainable, nature-friendly technology for the effective treatment of leachate for physio-chemical parameters such as organic load (BOD and COD), inorganics (sulphates, phosphates, nitrates), pH, TDS/TSS, toxic heavy metal contents, coliforms (EC, FC, and TC), xenobiotics and odour. Trinity International has completed a pilot leachate treatment project with Zigma Global Environ Ltd., at its Noida location in Sector 145.

3.2 Waste management by Blue Planet Environmental Solutions and QUBE Renewables

Blue Planet Environmental Solutions and QUBE Renewables are pioneering advancements in sustainable technology with their cutting-edge waste management systems. Blue Planet's Integrated End to End Waste Management solutions in converting waste-to-energy technology and QUBE Renewables' dryQUBE converting paddy straw-to-biogas solution utilizing dry-digestion, are giant leaps towards achieving environmental sustainability and circular economy.

Blue Planet - Integrated End to End Waste Management Solutions

Blue Planet offers a comprehensive waste management system emphasizing source segregation, efficient collection, and responsible processing. Their approach incorporates several key aspects:

- **Public awareness and education:** Blue Planet promotes proper waste segregation at the source through awareness drives and public announcements.
- **Advanced collection:** Door-to-door collection utilizes twin-compartment, GPS-enabled vehicles for efficient waste separation. A mobile application facilitates communication between citizens, supervisors, and waste management teams.
- **Multi-stream processing:** State-of-the-art technologies handle various waste components. An Enterprise Resource Planning (ERP) system with biometrics, live video feed, and data generation ensures real-time monitoring.
- **Sustainable disposal:** Blue Planet prioritizes a circular economy model by upcycling waste and extracting maximum value. Biogas generated from organic waste fuels CNG vehicles, while hazardous waste processing utilizes a "Manufacture, Like for Like / Solve, Like for Like" (MLP/SLP) approach for oil generation.
- **Centralized monitoring:** A mobile app, WhatsApp integration, and a toll-free number with a ticketing system enables efficient complaint redressal. Biometric attendance and compliance monitoring ensures system integrity. Real-time data collection and monthly reports are generated through centralized ERP software. Finally, last-mile traceability tracks incoming waste and outgoing byproducts.

QUBE Renewables - DryQUBE Technology

DryQUBE is a novel technology for biogas production specifically designed for paddy straw, a challenging feedstock due to its high lignin content. This technology offers several advantages:

- **Simplified process:** DryQUBE eliminates the need for feedstock pre-treatment, simplifying the process.
- **Optimized biological processes:** QUBE technology employs in-depth bacterial DNA sequencing to optimize the biological processes for efficient biogas production.
- **Efficient digestion:** The digestion process for each batch is completed within 90-100 days, allowing for three cycles per year. Multiple batches can be installed for a continuous gas supply.
- **Loading flexibility:** DryQUBE offers both manual and mechanical loading options, with open or bailed straw configurations.
- **Closed-loop anaerobic digestion:** The closed digester facilitates efficient biogas generation through anaerobic digestion.
- **Valuable end products:** The process yields biogas with a 50-55% methane purity and organic manure as byproducts.

Blue Planet's comprehensive approach tackles waste management holistically, from source segregation to responsible disposal. The DryQUBE system offers a unique solution for converting challenging waste like paddy straw into valuable biogas. By implementing these technologies, we can move towards a more sustainable future with reduced waste footprints and renewable energy generation.

Collaborating with CPCB, MOEFCC and Oil India

Blue Planet's integrated waste-to-energy technology, which harnesses the potential of treating solid waste and converting it to energy, and QUBE Renewables' innovative paddy straw-to-biogas solution, employing advanced dry-digestion methods, represent significant strides towards environmental sustainability and a circular economy. These technologies are set to revolutionize agricultural waste management, particularly through the in-situ technology for parali (paddy straw) management. This initiative, supported by the **Central Pollution Control Board (CPCB)** and the **Ministry of Environment, Forest and Climate Change (MOEFCC)**, is poised for implementation in Haryana's villages, addressing a critical environmental issue.

In addition, Blue Planet is exploring the potential for establishing waste-to-energy plants at **Oil India's** campuses in Assam, with an Expression of Interest (EOI) already submitted for the prospective installation of an Integrated Waste Management Plant at Oil India's Duliajan site. These initiatives underscore a commitment to innovative, sustainable solutions that not only mitigate waste but also generate renewable energy, propelling us towards a greener future.

3.3 BATX Energies: generation solarized EV charging infra powered by 2nd life EV batteries

Solar powered charging station to cater the need of EV Charging for all types of EVs (2/3/4w). The system uses exclusively second life lithium ion batteries (batteries which are not suitable for EV and equipped wit battery swapping facilities. Bifacial solar panels effectively trap solar energy which is then converted to electric energy to charge the EVs. This way the dependency on grid is minimized. There is also the provision of integrating the charging station with grids, so that unused energy can be supplied to the grid reducing load and offering stability.

Pilot at IIT Delhi

This Solarized EV infrastructure, where sunlight fuels our vehicles and repurposed batteries serve as efficient energy storage devices, is a great example of delivering on India's commitment to sustainable energy and creating a circular economy. This 'first of its kind' initiative, to make EV infra green, was **inaugurated by Prof. Ajay K Sood**, Hon'ble PSA to GoI and is currently operational as a pilot in IIT Delhi campus. The innovation depicts of a fruitful industry-academia collaboration, wherein, MG Motor India via its portfolio startup BATX Energies, co-created the system under the expert mentorship of Prof. B. K. Panigrahi from IIT Delhi. A larger pilot with DTC buses is in pipeline.

4. Way forward

S&T Clusters, seeded across the nation by the Office of PSA to the GoI, are crucial to achieving the country's climate and energy goals by fostering innovation, facilitating technology transfer, and enabling collaboration between diverse stakeholders. Emerging as local solution providers leveraging S&T, their contributions span renewable energy development, energy efficiency, sustainable transportation, and climate resilience, positioning India to meet its ambitious targets effectively.

Going forward, the Clusters can contribute towards:

Renewable Energy:

- ***Green H2***

1. With NGHM, the stage is set for India to become a global champion in green hydrogen. This can only be achieved by collaborative effort by key industry players and renowned academic institutions.
2. RICH, BKIC, JKIC, PKC, BeST leading the consortia of startups, research institutes and industry partners to establish Green Hydrogen Valley clusters in various regions which can significantly contribute to the NGHM.

- **In this regard DRIIV can:**

1. Introduce high TRL technologies for converting biomass to hydrogen that are available with the research institutes within the country (IITs, TERI, NISE, NPL etc.).
2. Facilitate relative assessment of those technologies on their efficacy and efficiency such as yield, cost (capex/opex), scalability etc.
3. Facilitate engagement with researchers/experts for feasibility studies and pilots.
4. Facilitate pilots via Centre of Excellence or any other mode of industry-academia partnership
5. Providing technical expertise on hydrogen storage and transport (in addition to production)
6. Facilitate policy interventions to create appropriate incentives, such as viability gap funding, assured input of biomass feed, soft cost reductions etc. for industry partners for early adoption.

- **Solar and Wind Technology:**

Clusters can foster innovations in photovoltaic cells, wind turbine efficiency, and energy storage systems, making renewable energy more cost-effective and efficient. Collaboration between academia and industry within clusters can lead to pilot projects that test new renewable energy technologies at a smaller scale before broader deployment.

- **Biomass and Bioenergy:**

Research institutions like CSIR-IIP, startups etc. under the umbrella of clusters can develop advanced biofuels from agricultural residues and other biomass, providing sustainable energy sources and reducing waste.

Energy Storage and Grid Management

- **Battery Technology:**

Development of next-generation batteries, such as solid-state batteries and advanced lithium-ion batteries, are in progress where DRIIV joined hands with LOG9 Materials to establish advanced R & D activities on EV battery packs together with CART (The Centre for Automotive Research and Tribology), IIT Delhi. The trio also envision to impart high-end industrial training and creating skilled human resource in various fields related to energy storage solutions.

India's first indigenous battery cells based on LTO (Lithium titanate) & LFP (Lithium ferrophosphate) has been developed by LOG 9Materials, a DRIIV portfolio startup. Likewise, RICH-led startup DREAMS demonstrates applications of technology for Demand Side Energy Management with multiple Power distribution companies.

- **Grid Integration:**

Research on integrating renewable energy into the grid more effectively, including smart grid technologies and energy management systems, can enhance grid stability and reliability. Towards this, graphene-based off-grid Battery Energy Storage System (BESS) is being piloted that efficiently captures, stores, and releases electrical energy under the aegis of DRIIV.

Energy Efficiency and Conservation

- Clusters can drive the development of IoT devices and AI solutions for energy management, leading to significant energy savings in industrial and residential sectors. From BCKIC, Minion Energy Management Solution, is utilizing AI/ML based EDGE Computing approach to detect energy signatures of electrical assets and their energy consumption. PKC also focuses on energy efficiency technologies and industrial automation, contributing to reduced energy consumption in manufacturing.

- By providing expertise and tools for conducting **energy audits** and implementing energy-efficient practices across various sectors, Clusters can play a pivotal role in energy conservation.

Sustainable Urban Mobility

- EV Infrastructure: DRIIV has contributed significantly to the development of a robust EV charging infrastructure, supported by research from institutions like IIT Delhi aligned with **National Electric Mobility Mission**. This includes Clusters development of battery swapping technologies, CMS, fast chargers facilitating the adoption of EVs.

- Battery Recycling: Innovations in battery recycling technologies is being pioneered within these clusters, ensuring sustainable disposal and reuse of EV batteries. BATX Energies, together with MG MOTOR India and IIT Delhi has developed a solar-powered EV charging infra powered by 2nd life batteries which is being piloted under the DRIIV umbrella.

- Digitizing public transport through **'One Delhi'**: This multi-modal transit app, adopted by the Delhi Government to improve access to public transportation for **DIMTS buses** with features such as real time arrivals tracking and e-ticketing The app currently experiences daily ticket sale of **1.5 lakh**, with around **3 lakh active users**. Ticketing service for **DMRC** has also been integrated with this app. DRIIV contributed towards the development of the 'One Delhi' app, jointly with IIIT Delhi.

Climate Resilience and Adaptation

Relevant innovations like research on developing climate-resilient crop varieties can help ensure food security in the face of changing climate conditions. Advanced irrigation techniques, innovative solutions for waste and water management and reducing air pollution like Jalopchar, Phycoremediation, Bariflo Labs, Smart Graded Water Supply Grid, management of wetland ecosystem through "Phragmites Karka" based Technological Interventions, decentralized parali management by dry digestion, integrated waste management system, unique fliterless air purifier and smart AQI monitors respectively. DRIIV, leveraging its impactful member base is in the process of drafting a roadmap for **'Yamuna Cleaning'** on the 22km Delhi stretch **(Wazirabad to Okhla Barrage)** based on an integrated holistic approach leveraging S&T, with a vision to replicate the success of **National Clean Ganga Mission (NMCG)** as on Ganga.

Public-Private Partnerships

DRIIV has set a successful example of how S&T Cluster can establish PPP model through its air pollution pilot, **Project SAMEER**, in collaboration with DPCC. This model can be replicated to can facilitate partnerships between public research institutions and private companies to accelerate the commercialization of sustainable technologies.

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