ANNUAL REPORT 2023/24

CLIMATE AND AIR

ENERGY

INDUSTRIAL BIOTECHNOLOGY

GREEN PORTS AND SHIPPING

SOCIAL TRANSFORMATION AND STRATEGIC ALLIANCE

SUSTAINABLE AGRICULTURE

SUSTAINABLE INFRASTRUCTURE

WASTE, WATER, AND NATURAL RESOURCES

THE ENERGY AND RESOURCES INSTITUTE

Creating Innovative Solutions for a Sustainable Future

Vision

Creating Innovative Solutions for a Sustainable Future

Mission

Tackle issues of concern to Indian society, and the world at large, and develop innovative and cost effective solutions

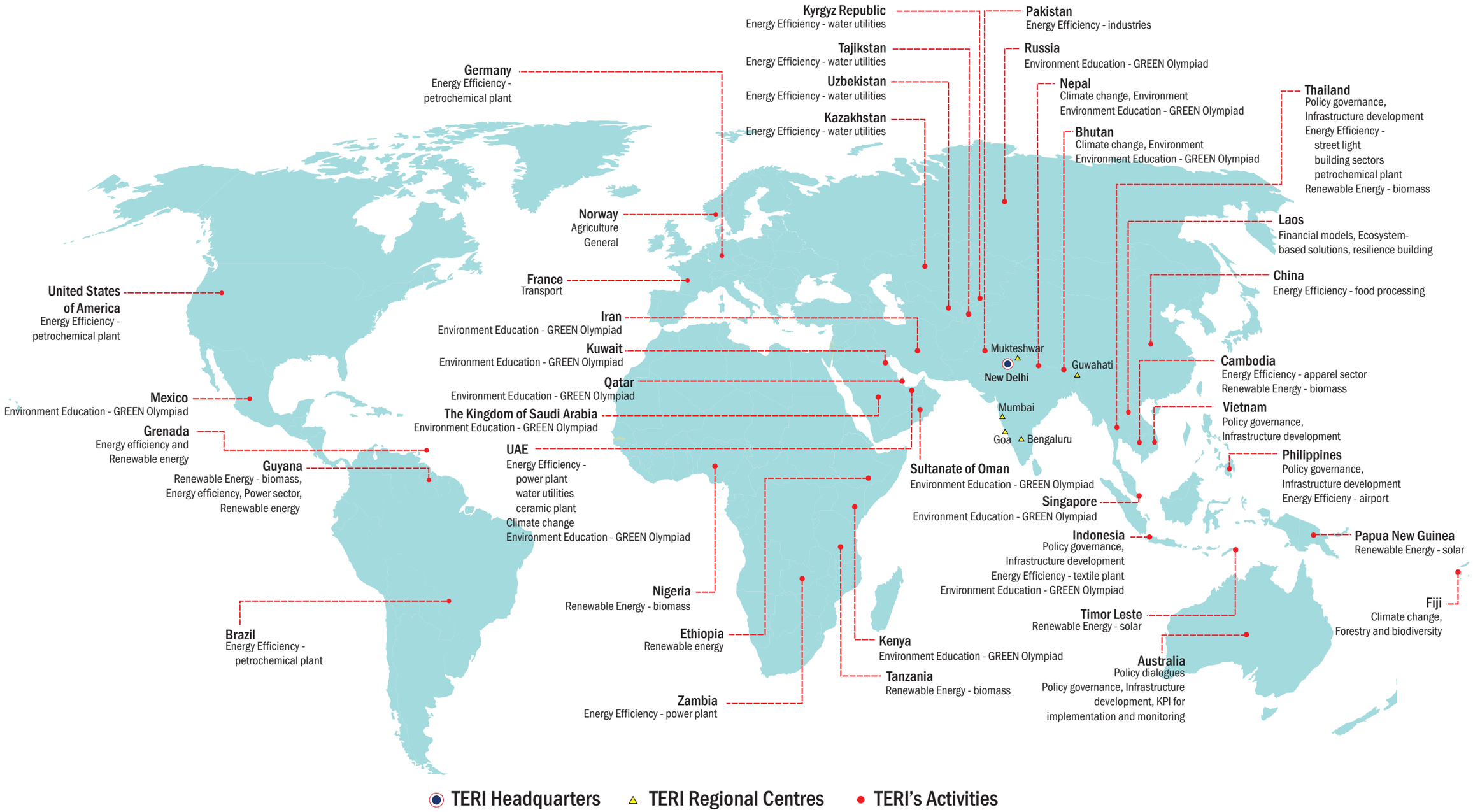
Enhance networking for sustainable interventions

Realize potential for national and international leadership as a knowledge-based agent of change in the fields of energy, environment, other natural resources, and sustainable development

Inspire and reach out to diverse stakeholders for realizing a shared vision of global sustainable development, which could be translated into action

Our growing commitment to a sustainable future

Research and outreach activities in over 40 countries



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FROM THE DIRECTOR GENERAL'S DESK

> It is our collective and individual responsibility to preserve and tend to the world in which we all live.
>
> – Dalai Lama

This quote resonates deeply with me, underscoring the shared responsibility of caring for the planet. Reflecting on the challenges humans face globally, the key concerns around rising temperatures, diminishing resources, and increasing ecological instability are mind boggling—it is clear that incremental actions are no longer enough. We need collective efforts, grounded not only in innovation but also in a

shared vision for sustainability and proactive planning to mitigate risks and maximize impacts.

As a think tank, TERI has aligned itself with global and national priorities, including India's ambitious net zero targets, and chosen to add value through the twin pathways of policy advocacy and on-ground demonstrations. I believe that charting a sustainable pathway calls for a greater convergence among businesses, governments, and communities to build need-based and people-centric solutions that are both sustainable and inclusive. From scaling innovations in clean energy and sustainable agriculture to promoting waste valorization and biodiversity conservation, we are committed to creating long-term impact that benefits people and the planet.

Over the past year, we have deepened our engagement with partners at all levels—local, national, and international, while expanding our organizational outreach to amplify our thought leadership. These efforts have enabled us to align research with real-world aspirations and build capacities across sectors, ensuring that each of our programmes embodies a holistic and forward-looking vision of inclusion and sustainable future.

Looking ahead, I remain optimistic that collective action will continue to drive the transformation we seek. TERI's journey reflects our core belief—'true progress is only possible when environmental stewardship is integrated into every aspect of development'. The accomplishments of the financial year 2023–24 highlight the meaningful strides we have made towards shaping a future that is both sustainable and inclusive.

Over the past year, TERI's Energy programme made significant advances in driving low-carbon transitions and advancing renewable technologies nationally and internationally. Numerous projects, pertaining to the relevant topics such as low-carbon pathways, energy efficiency, promotion of renewable technologies and studies, just transition, battery energy storage, e-mobility, RE integration, and capacity building were carried out on both national and international levels.

It is with pleasure and pride I share some of the success stories of the Institute in this area. TERI leads Task Force 1 of the India Climate Energy Modelling Forum (ICEMF), developing net-zero pathways using the MARKAL model in collaboration with NITI Aayog. We have completed a comprehensive energy audit of IGI Airport Terminal 3, New Delhi, focussing on systems like air conditioning, baggage handling, and electrical infrastructure. The Institute also supports the Ministry of Steel in formulating VISION 2047 and the Green Steel Mission, contributing to seven task forces for the sector's low-carbon transition. Additionally, the 'women-centred economic diversification' initiative in coal-affected villages of Jharkhand has aimed to empower women by identifying business opportunities and offering need-based skills training.

The initiatives taken have created a significant impact by advancing South Asia's renewable energy transition, with TERI promoting cross-border electricity trade as a cost-effective alternative to storage, fostering regional decarbonization and economic growth. In Guyana, the Solar Home Energy (SHE) systems electrified 269 remote communities, benefiting 135,366 people and mitigating 45,000 tonnes of CO□. Additionally, TERI's collaborative research with Carleton University explored low-carbon industrial clusters, ensuring sustainable growth with socio-economic benefits for the workforce.

The Earth Science and Climate Change (ESCC) Programme at TERI has continued to lead impactful climate action and pioneer innovative solutions, addressing some of the most critical environmental challenges of our time. Throughout the year, the Programme has made remarkable strides in shaping policy frameworks, enhancing disaster preparedness, and strengthening climate governance. Evidence-based guidance for national and sub-national climate plans focussed on heat stress, agriculture, health, and water sectors was provided consistently, ensuring alignment with emerging climate priorities, enhancing resilience, and supporting sustainable development goals across regions. Tools like the TERI Climate Tool and early warning systems have bolstered disaster resilience, while contributions to India's Cooling Action Plan and the development of GHG inventories and heat action plans further advanced mitigation efforts.

The ESCC's active engagement at COP28 underscored its critical role in climate finance and governance. Collaborative projects, including the hydro-meteorological network in Bhutan and the airshed management project in Uttar Pradesh, enhanced environmental monitoring and air quality management. I am proud to share that the health-climate research undertaken in the ESCC, engaged with 12 Indo-Pacific countries, fostering region-specific solutions and driving policy alignment.

I am delighted to share that TERI has been recognized as a national leader in source apportionment and honoured as an Institute of Repute by the MoEFCC. Its unique national emission inventory development and participation in real-time assessments have earned global recognition for advancing effective air quality interventions and innovative methodologies. With impactful contributions to the IPCC, advisory roles with ICAO, and multi-country collaborations, the ESCC continues to shape sustainable cooling, climate policy, and actionable strategies worldwide.

This year, TERI's Waste, Water, and Natural Resources (WWNR) Programme successfully executed 64 projects, advancing afforestation, reforestation, and REDD+ initiatives within the AFOLU sector. It provided livelihood support to over 2 lakh farmers and forest-dependent communities, with ARR-based carbon projects in Punjab issuing 684,620 carbon credits, generating INR 350 million for 3,686 farmers. In the Northeast, impactful carbon finance projects were launched in Nagaland, Assam, and Sikkim, enhancing biodiversity and community resilience. I am happy to share that we advanced wastewater management through a strategic partnership with Ion Exchange, bringing our TADOX® technology to commercial scale. Additionally, our collaborative efforts with the EU and RMI promoted circularity in textiles and methane mitigation in municipal solid waste (MSW), collectively showcasing the Programme's commitment to fostering sustainability across various sectors in the last financial year.

The initiatives under carbon finance projects had a significant impact, benefiting over 35,000 farmers across five states and generating additional income to the tune of INR 115 crore. Our REDD+ initiatives provided INR 29.5 crore incentives to support 700 forest-dependent villages, while mine reclamation efforts transformed red mud dumps into usable land. Collaborations with GIZ, NMCG, and the World Bank advanced circular economy and wastewater solutions in cities such as Panaji, Varanasi, and Bengaluru. Additionally, TERI empowered small and medium-sized enterprises (SMEs) in Uzbekistan, Sri Lanka, and India through circular economy initiatives, fostering sustainable development on an international scale.

Sustainable agriculture is at the heart of our research efforts, where we focus on developing plant- and microbe-derived products to enhance crop yields and reduce the carbon footprint in agricultural practices.

This year, we have made significant strides through innovative research, technology transfer, and impactful partnerships.

Noteworthy innovations include the development of mycorrhiza-based biofertilizers, as we are the only R&D unit utilizing the entire microbiome in our bioformulation products, powered by TERI's Germplasm Bank, the largest bank for mycorrhiza and associated microbes in Asia. Additionally, we have created a global biomass database under the TERI-Shell initiative, both of which aim to reduce dependence on chemical fertilizers, lower irrigation water consumption, and enhance crop productivity.

Our collaboration with Hindustan Rasayan Pvt Ltd led to the launch of India's first chemical-free biogenic nano-fertilizer production facility in Bathinda, further minimizing the carbon footprint of agricultural practices. Through our Micropropagation Technology Park, we have provided farmers access to high yield planting materials, generating INR 9,000 million in revenue while creating 124,000 man-days of skilled employment. Furthermore, our microbial biofertilizers have helped farmers across India increase farm productivity by 10–18%. These accomplishments reaffirm our commitment to sustainable agriculture, soil health, and improving food production across diverse agro-climatic conditions.

As we reflect on another year of meaningful progress, I am proud to highlight that our Green Shipping Programme stands as a testament to our commitment to promoting sustainable resource utilization in the maritime sector. Through the National Centre of Excellence in Green Ports and Shipping (NCoEGPS), we have supported the Ministry of Ports, Shipping, and Waterways in driving carbon neutrality and building a circular economy in line with evolving global standards.

The Resource Efficiency and Governance Division has spearheaded several transformative projects, including life cycle assessments of beverage packaging in Vietnam and Thailand, as well as a comprehensive study of compressed biogas as vehicular fuel in India. We have also developed a national roadmap for circular economy practices to tackle plastic waste. Our partnerships with Australian organizations on plastics research and policy workshops on crop diversification in Punjab further strengthen our commitment to addressing key environmental challenges.

I am pleased to share that the work in the Pyrolytic

Biofuels, Biochar, and Green Chemicals (PBGC) initiative has truly set new standards in low-carbon technologies. Leveraging our patented pyrolysis technology, we have successfully transformed agro-residues and marine algal biomass into sustainable aviation fuel (SAF) and high-quality bio-oil. The development of eco-friendly biochar pellets, which reduce air pollutants by up to 93%, and our efforts in bio-oil refinement for aviation fuel, are prime examples of how TERI is shaping the future of renewable energy. Some valuable partnerships have been forged with organizations like the MoEFCC for G20 initiatives, NITI Aayog, and leaders in industry such as Ball Corporation and Maruti Suzuki, to name a few.

With a steadfast commitment to research and innovation over three decades, the Industrial Biotechnology (IB) Programme has made remarkable contributions to environmental protection and sustainable industrial practices. Among its key accomplishments is the development of "Oilzapper," a groundbreaking solution for oil spill bioremediation, and "Paraffin Degrading Bacteria" (PDB), which prevents paraffin deposition in oil wells. These innovations have led to successful large-scale bioremediation projects in Assam and Arunachal Pradesh.

In the financial year 2023–24, the IB Programme achieved significant milestones, including the bioremediation of 618 tonnes of oil-contaminated soil using "Oilzapper" and the effective treatment of 500 metric tonnes of oily sludge at Chennai Petroleum Corporation Ltd. Additionally, the Programme enhanced methane production in coalbed methane wells and developed microbial solutions for polymer degradation in oil fields. Environmental assessments following Cyclone Michaung and advancements in microplastics abatement further highlight the programme's impact. These efforts not only improved environmental quality but also fostered sustainable industrial practices, showcasing TERI's unwavering commitment to innovative and eco-friendly solutions.

In response to the pressing need for sustainable infrastructure amidst extensive urbanization, the Sustainable Infrastructure Programme (SIP) focuses on minimizing urban carbon footprints by embedding sustainability principles within the built environment. This year, SIP has made significant progress, successfully executing 26 projects encompassing green building consultancy, energy efficiency implementations, and resource audits.

I would like to put on record 12 impactful projects pertaining to transport and urban governance carried out in the past year revolving around research, training, and environmental analysis. The GRIHA Council registered over 4,100 projects, covering 1 billion square feet, while also rating 830 projects and training 1,088 participants through 19 capacity-building programmes. Furthermore, 1,240 new products were added to the GRIHA Product Catalogue, bolstering sustainable building practices nationwide.

The achievements of the Sustainable Infrastructure Programme have been remarkable, including the installation of 599 MWp of renewable energy, saving 29,700 GWh of energy annually, preventing 8,400 gigatonnes of CO2 emissions, and conserving 104 gigalitres of water. Additionally, nearly 295,000 trees were planted or preserved. TERI was recognized as the National Center of Excellence in Green Ports and Shipping, collaborating with Indian Railways on carbon capture initiatives. Key urban and building projects included climate resilience bylaws, support for the Energy Conservation Building Code (ECBC), and electric mobility pilots with India Post, further establishing TERI as a leader in driving sustainable infrastructure across various sectors.

Our Regional Centres are essential conduits for disseminating TERI's initiatives across the country, establishing a solid foundation for grassroots activities and projects. Located in Bengaluru, Mukteshwar, Mumbai, Assam, and Goa, these centres function as vital hubs for research, education, and the implementation of sustainable practices, significantly enhancing our knowledge repository and expanding the organization's impact.

The Western Regional Centre in Mumbai has made notable achievements in environmental monitoring, waste management, and livelihood enhancement. It successfully expanded into ESG, CSR, and sustainability initiatives by forming strategic partnerships with corporate entities, effectively leveraging expertise from the head office for implementation.

In Goa, TERI has successfully implemented Riverbank Filtration (RBF) systems along the Sal River, demonstrating the viability of RBF treatment in Southern India. Through the GEF Small Grants Programme, TERI is building local capacities for conservation and sustainable development, and empowering fishing communities through workshops,

training, and livelihood initiatives. The USAID-backed expansion and the Department of Science and Technology pilot project have created sustainable education models that empower rural local bodies, fishing communities, self-help groups, and farmers across various regions.

The North-Eastern Regional Centre (NERC) has achieved significant milestones in agriculture, waste management, water quality, livelihood enhancement, and traditional knowledge preservation. Key accomplishments include the successful bioremediation of Pond Jamuna, impactful climate resilience programmes promoting biofertilizers in Assam, documentation of indigenous knowledge, and the establishment of a zero-waste campus at Raj Bhavan, Assam. Collectively, these centres play a crucial role in shaping sustainable practices and driving positive change towards a resilient future.

TERI's Social Transformation and CSR Division has significantly improved rural living conditions by addressing energy access challenges and promoting sustainability while lowering CO2 emissions. Today, the Division boasts a record of over 200 projects executed nationwide. In the reporting year, 25 projects encompassed research, modelling, policy advocacy, demonstrations, consultancy, and CSR activities, benefiting farmers, entrepreneurs, fishermen, students, women-led SHGs, and coastal and tribal communities. Reducing the carbon footprint has been central to these initiatives, which have tackled power outages, minimized sound and indoor pollution, and lowered electricity costs. These efforts ensured sustainable livelihoods and education, fostering green jobs and enhancing entrepreneurial opportunities in rural communities.

Children and youth are the future of a country and the world at large. We at TERI, work closely with the younger generation to reverse the planetary environmental crisis, by means of activities oriented towards improvement in their knowledge, attitude, and behaviour.

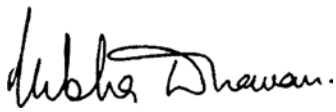
TERI recognizes the role that corporates can play in the endeavour towards sustainable development and environmental stewardship. Keeping in line with this vision, the TERI Council for Business Sustainability (CBS) continues to bridge the gap between TERI's research and the corporate sector. This initiative emphasizes how businesses can lead in sustainability and contribute to achieving India's energy ambitions. In 2023–24, TERI CBS expanded its national and international outreach, providing thought leadership at key industry fora.

A standout achievement is the Industry Charter on Commitment to Near Zero Emissions Ambition by 2050, launched during New York Climate Week 2020 with six signatory CEOs, which has now grown to 92 Indian CEOs as of March 2024. This collaboration underscores the collective commitment of Indian businesses to reach net zero targets, reinforcing the importance of teamwork in addressing climate challenges. Through these efforts, TERI CBS is effectively guiding industries towards sustainable practices, shaping a brighter future for both the environment and the next generation.

One of our key accomplishments is the World Sustainable Development Summit (WSDS), which gathered over 1,200 global leaders from 25 organizations in February 2024. The Centre for Sustainable Development, Research, and Leadership (CSDRL) is instrumental in promoting systemic change for green growth and sustainable development goals, amplifying the Global South's voice through research and sustained dialogue. A notable initiative is the Green Budgeting project in Puducherry and Bihar where sustainability was integrated into fiscal policies. Through such initiatives, CSDRL aligns with TERI's vision of fostering inclusive sustainability.

As we reflect on the achievements of the past year, it is evident that our collective efforts at TERI are paving the way for a sustainable future. Our commitment to innovation, collaboration, and responsible stewardship has yielded significant advancements across diverse sectors, from renewable energy to sustainable agriculture and environmental governance. The partnerships we've forged, both nationally and internationally, have strengthened our capacity to address pressing global challenges and foster positive change. With a clear vision and unwavering resolve, we continue to advocate for inclusive solutions that benefit both people and the planet. As we move forward, I am inspired by TERI's learning curve and remain optimistic that, together, we can overcome the challenges ahead. Let us keep striving towards a resilient and sustainable world, ensuring that our actions today lay a solid foundation for tomorrow.

Thank you for being an integral part of our journey and for sharing our vision for a brighter, more sustainable future. Your support and engagement inspire us more to walk the path we have charted for meaningful change.



Vibha Dhawan
Director-General, TERI

WHO'S WHO AT TERI

TERI'S GOVERNING COUNCIL

Mr Nitin Desai
Chairman

Mr Vijai Sharma
(till 29/10/23)

Mr Nawshir H Mirza
(till 27/01/2024)

Mr R Mukundan

Mr Mahendra Singhi

Mr M S Unnikrishnan

Dr Vibha Dhawan

Ms Ireena Vittal

Mr Siddharth Sharma
(from 04/03/2024)

THE MANAGEMENT TEAM

Dr Vibha Dhawan
Director General, TERI

Dr Banwari Lal
Industrial Biotechnology

Mr Girish Sethi
Energy

Mr Sanjay Seth
Sustainable Infrastructure

Dr Jitendra Vir Sharma
Waste, Water, and
Natural Resources

Dr Dipankar Saharia
Social Transformation & Strategic
Alliance and Administrative Services &
Regional Centres

Mr R R Rashmi
Green Shipping

Ms Suruchi Bhadwal
Climate Change
and Air Quality

TERI'S DISTINGUISHED FELLOWS

Dr Prodipto Ghosh
Distinguished Fellow, Earth Science and Climate Change

Mr K Ramanathan
Distinguished Fellow, Electricity and Fuels Division

Mr Shri Prakash
Distinguished Fellow, Transport and Urban Governance

Mr Ajai Malhotra
Distinguished Fellow and Senior Advisor (Climate Change), Director General's Office

Mr R R Rashmi
Distinguished Fellow and Programme Director, Resource Efficiency and Governance

Mr Ajay Shankar
Distinguished Fellow, Director General's Office

Dr Arvind Kapur
Distinguished Fellow, Sustainable Agriculture (from 21/08/2023)

Mr S Vijay Kumar
Distinguished Fellow and Lead, Food and Land Use Coalition, India

Mr Dipak Dasgupta
Distinguished Fellow, Earth Science and Climate Change

Mr Sanjay Mitra
Distinguished Fellow, Transport and Urban Governance

Dr Syamal Kumar Sarkar
Distinguished Fellow, Water Resources

Mr Manjeev Singh Puri
Distinguished Fellow, Earth Science and Climate Change

Mr I V Rao
Distinguished Fellow, Transport & Urban Governance

Dr Asha Ram Sihag
Distinguished Fellow, Resource Efficiency & Governance

Mr Jiwesh Nandan
Distinguished Fellow, Industrial Energy Efficiency (from 01/09/2023)

Mr Mahendra Singhi
Honorary Distinguished Fellow, Director General's Office (from 06/02/2024)

Mr Venkittu Sundaram
Distinguished Fellow, Director General's Office (from 01/01/2024)

RESEARCH PROGRAMMES

- Energy
- Green Shipping
- Climate Change and Air Quality
- Waste, Water, and Natural Resources
- Sustainable Infrastructure
- Industrial Biotechnology
- Sustainable Agriculture
- Social Transformation and CSR Division

ENERGY PROGRAMME

The Energy Programme promotes energy efficient and renewable energy-based technological solutions to enable India and other developing economies realize sustainable and resilient future through low-carbon pathways.

Themes and Commitments

The Energy Programme dedicates itself towards the energy transition space, addressing key issues such as energy efficiency, cleaner technology options, renewable energy as well as conducting modelling and assessment exercises. We develop and promote clean energy solutions across India and globally by conducting in-depth analysis, field testing, demonstrations and offering customized, need-based solutions to meet the challenges.

Initiatives across the following thematic domains help achieve the key motto of 'promoting energy efficient and low-carbon solutions':

- Industrial energy efficiency
- Electricity and renewables
- Energy assessment and modelling

Industrial Energy Efficiency

- Conducting energy audits and identifying options for energy conservation measures for implementation by the industries to reduce their energy consumption levels.
- Developing evidence-based roadmaps for decarbonization of Indian industry, notably, hard-to-abate sectors such as iron and steel, cement, amongst others.
- Undertaking technology assessment studies for different industry sectors with regard to energy and environment.
- Supporting energy-intensive MSME sub-sectors through energy sector studies, technology development, demonstration and creating enabling environment for large-scale adoption of energy efficient technological options.

Electricity and Renewables

- Facilitating energy transition by promoting low-carbon pathways through:
  - » Integrated demand–supply studies at national and state levels
  - » Storage solutions including pumped storage hydro, concentrated solar thermal with storage, battery energy storage, hydrogen, etc.
  - » Smart distribution with storage
  - » Electric mobility
- Promoting demand-side management and smart grids
- Promoting solar PV, solar thermal, and other applications through research, development, testing, third party inspection, and deployment
- Research and development in the field of smart grid, DSM & EE, etc.
- Conducting policy and regulatory analyses

Energy Assessment and Modelling

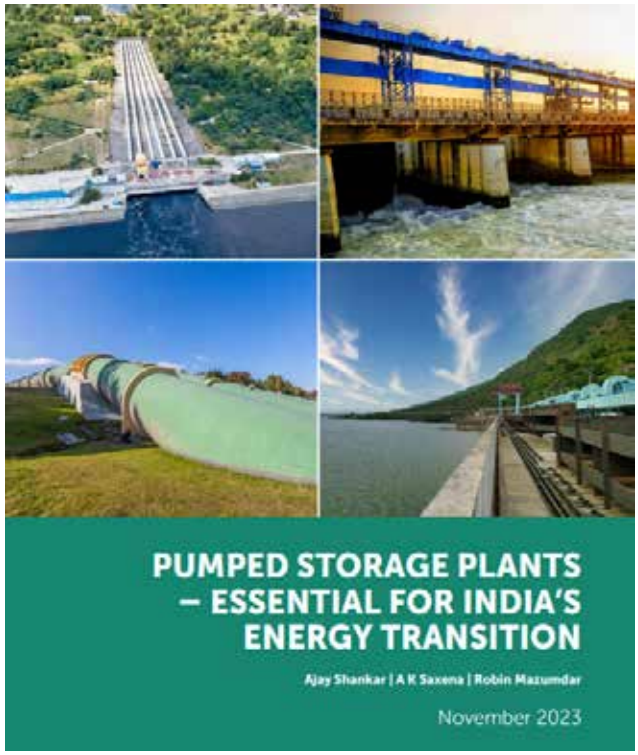
- End-use demand estimation and forecasting for major energy-consuming sectors such as industry, transport, agriculture, residential, and commercial.
- Estimate alternative pathways for decarbonization at the national level using energy model to realize the following mandates:
  - » Estimation of optimal energy-mix at various alternative scenarios
  - » Estimation of total and sectoral emissions (CO_2 equivalent)
  - » Estimation of investment requirement to facilitate decarbonization
- Socio-economic impact assessment for decarbonization
- Studying cross-country energy trade and its implications

Release of "India's Electricity Transition Pathways to 2050" Report

> The success of any energy planning exercise lies in how far it meets the aspirations of the people while meeting at the same time, the national goals of energy security and environmental sustainability.
>
> K Ramanathan, Distinguished Fellow
> Electricity and Renewables Division, TERI

Larger Goals and Context

The Energy Programme endeavours to primarily address SDG 7 focusing on affordable and clean energy. The varied activities under this programme also touch upon SDGs 8, 9, 11, 12, 13, and 17. It envisions overall socio-economic development of India being driven by clean energy along a low-carbon pathway. The Programme focusses on supporting the transformation of the nation's energy landscape by ensuring adequate, reliable, affordable and easily accessible supplies of clean and renewable energy, as well as by developing and promoting energy-efficient technological solutions/ measures for end-users in diverse sectors of the economy.



Approach and Innovation

The Energy Programme promotes low-carbon solutions and clean energy pathways through its in-depth field research and demonstrations, simulations, and modelling. Industry-centric need and opportunity mapping, data gathering and analysis and co-designing sustainable solutions define our journey. We also facilitate multi-stakeholder dialogue around Just Energy Transition and disseminate proven ideas for large-scale adoption and mainstreaming of efficient and cleaner technologies.

Our Accomplishments

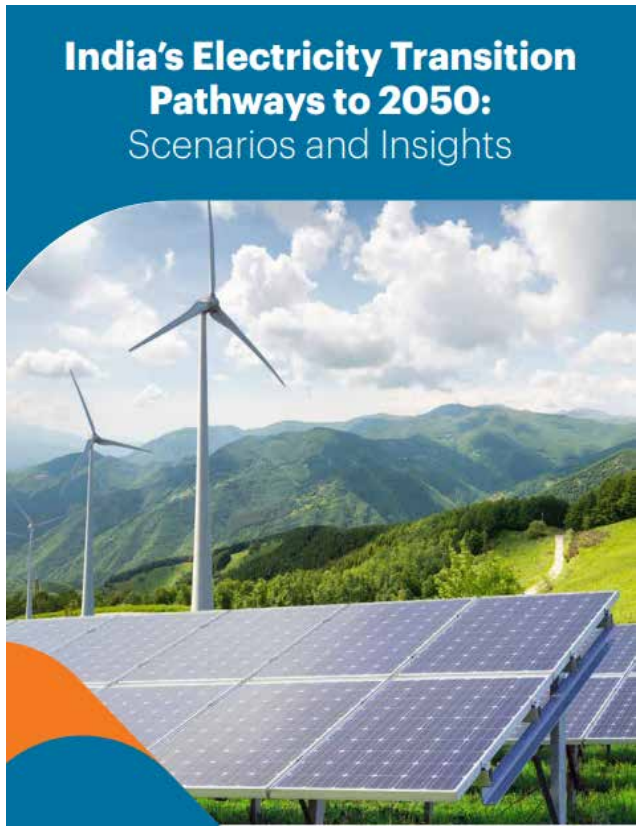
In the bygone year, numerous projects, pertaining to the relevant topics such as low-carbon pathways, energy efficiency, promotion of renewable technologies and studies, just transition, battery energy storage, e-mobility, RE integration, and capacity building were carried out on both national and international levels. Some of the notable examples are as follows:

1. TERI holds prominence in carrying out energy audits for industry and commercial buildings in India. As a lead energy auditing firm, the Institute also supports the effective implementation of the Perform, Achieve, and Trade (PAT) scheme of the Bureau of Energy Efficiency (BEE) via mandatory energy audits and verification audits. Our work has covered various sectors such as cement, iron and steel, pharmaceuticals, laminates, chemicals, airports, etc.

Solar Home Energy (SHE) systems being distributed in Guyana

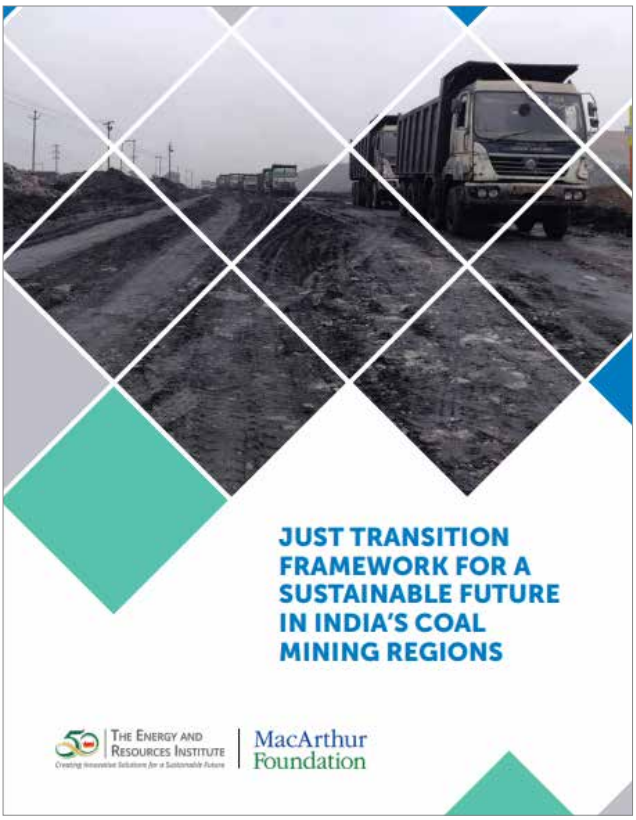
During 2023/24, detailed energy audits were conducted in Grasim Industries, Rain Carbon, Cipla, IVL Dhunseri, Greenlam, Stylam, APAR Industries, Chemplast as well as airports in New Delhi and Hyderabad.

2. On the international front, energy efficiency services were rendered to Maamba Power Plant, Zambia, Indorama Ventures, Thailand, and water utilities in a few Central Asian countries.
3. Considering India's commitment to becoming a net-zero economy, a core area of TERI's research focuses on decarbonization of hard-to-abate industry sectors like steel and cement. Technology roadmaps examining different facets of decarbonization such as energy and resource efficiency, material circularity, renewable energy, green hydrogen, carbon capture and storage were prepared. The research studies on decarbonization were supported by the organizations of relevance including the World Bank, SED Fund, SSEF, GCCA India, World Bank, Pellet and Manufacturers Association of India.
4. TERI undertook several techno-economic feasibility studies related to application of new technologies like environmentally friendly construction blocks, green hydrogen, electrification (fuel switch), energy efficient compressed air and steam systems under different projects. Case studies and other knowledge products were prepared and disseminated. The activities were undertaken for several national (DCM Shriram, Tata Steel) and international (IGES, Japan and SoHHytec, Switzerland) organizations.
5. Preparatory phase work started on a new project focussing on identifying applications and implementation of Battery Energy Storage System (BESS) at distribution level as well as capacity building. It is a joint collaboration between the Ministry of New and Renewable Energy (MNRE), Government of India and the Federal Ministry for Economic Affairs and Climate Action (BMWK), Germany. The other consortia partners are GIZ, IIT-Bombay, WRI, and Fraunhofer-IEE.
6. TERI along with EU and UNDP developed 'Mainstreaming Low-emission Energy Technologies' (MLEET) to build Guyana's Green Economy using renewable energy sources across water treatment plants in Guyana.
7. Under the Central Asia Water and Energy Program (CAWEP) energy efficiency studies were performed across six selected utilities in Kazakhstan, Kyrgyzstan, and Tajikistan. Water utility staff capacity-building programmes were also organized, based on the theme of 'energy management'.
8. The Switch Asia project that was aimed at 'Resource Efficiency in Agri-food Production and Processing (REAP)' was executed in over 100 SMEs in Central Asian countries such as Uzbekistan and Tajikistan.
9. The work on US-India collAborative for smart diStribution System wIth Storage (UI-ASSIST), a project under the Joint Clean Energy Research & Development Centre (JCERDC) of the IUSSTF, funded by DST, GoI, and USDoE that focuses on collaborative research on smart grid technologies and energy storage for power distribution systems continued. Post completion of load data analysis,



application identification, sizing/siting and control logic development for BESS pilots in BRPL licence area, pilot implementation at three locations is under progress.

10. Review of bid documents; technical and financial evaluation and bid process management for design, supply, testing, installation, commissioning, O&M of 20 MW/40 MWh BESS, under tariff-based competitive bidding for BSES Rajdhani Limited, Delhi was done.
11. Evaluation of rooftop solar PV potential for the buildings inside the TATA Steel, Jamshedpur plant boundary was carried out. This research study involved a comprehensive identification of buildings and used an innovative approach to capture building dimensions from 3D modelling using drones. The results from this exercise were correlated with discussions/observations from site visits.
12. A joint project for the application of a cloud-based digital twin technology to the electrical distribution network was undertaken in collaboration with Panitek Power AG Switzerland, Venios GmbH Germany, and BRPL India. The digital-twin technology replicating the operational characteristics of the utility (BRPL) assets, aims to assist the utilities in planning, monitoring, and management of distribution assets through research, analysis, and on-ground implementation.



Energy audit at Maamba Collieries project, Zambia

13. The Energy Programme in conjunction with the Sustainable Habitat Programme is working on a project on zero-emission trucks and is analysing the shift from ICEVs to EVs—specifically trucks—from the point of view of impact on jobs and skill gaps that would arise.
14. As part of the Responsible Energy Initiative (REI) that focuses on advancing RE with an environment- and people-centric approach, TERI is carrying out multi-dimensional research on the multi-land use for energy and food security through AgriPV. The aim is to identify key challenges and opportunities and contribute to policy measures for the establishment and upscaling of the technology in the country.

Success Stories

1. TERI is leading in Task Force 1 (Net Zero Roadmap) of India Climate Energy Modelling Forum (ICEMF), a modelling platform established by NITI Aayog for comparison of net-zero pathways coming from different models across research organizations and is responsible for developing its MARKAL model to identify India's net zero pathways and compile findings from partner organizations.
2. TERI successfully completed a detailed energy audit study of IGI Airport Terminal 3, New Delhi, on behalf of Delhi International Airport Limited (DIAL). The study was concentrated on electrical systems, centralized air conditioning system, baggage handling system, lifts, escalators, travellators, and so on.
3. TERI is supporting the Ministry of Steel (MoS), Government of India, in preparing their VISION 2047 and Green Steel Mission documents. TERI also provided extensive knowledge inputs to the MoS in seven of the fourteen Task Forces it established to draw-up strategies and action plans for low carbon transition of the steel sector.
4. A pilot initiative—SheUdyami—was commenced in the coal affected villages of Giridih, Jharkhand, to financially empower women through imparting a skill that can be monetized. During the year, four villages were covered in the Giridih open cast and

Kabribad coal mines and 238 household surveys were conducted. Based on business idea generation training, 4–6 focus areas have been selected and need-based skilling is being provided.

Promotion of Sustainable Solutions

1. Tata Steel entrusted TERI to conduct an environmental impact assessment of 'TiscoBuild green construction blocks' an eco-friendly alternative to red clay bricks. The green construction block is manufactured using sustainable raw materials like slag and fly ash which are by-products from the steel industry. It was found that switch-over from red clay bricks to TiscoBuild green construction blocks reduced carbon footprint by about 80%, reduces water usage by about 76% and prevents land degradation since no topsoil is consumed.
2. The TERI research team developed and successfully tested a first-of-its-kind Solar Biomass Hybrid Dryer integrated with thermal energy storage and controller. The dryer system has a loading capacity of maximum 50 kg fresh produce per batch, and particularly designed to empower rural tribal communities, women, and differently-abled persons. The integrated system features a seamlessly integrated Thermal Energy Storage (TES) device and a Biomass-based Heat Exchange (B-HE) system to provide backup drying, both working in conjunction with a solar dryer developed by Society for Energy, Environment and Development (SEED). This enables continuous operation and efficient utilization of the hybrid system in food drying, increasing its capacity utilization factor and the quality of the dried product with an electrical energy requirement of less than half a unit (for a 10-hour operation). The entire system is mounted on a mobile base structure.

The solar biomass hybrid dryer model

Impact We Created

- TERI conducted a study on renewable energy transition in South Asia and its role in regional energy cooperation and concluded that there is energy demand and supply complementarity among these countries which can augment cross-border electricity trade among these countries. Electricity trade in RE is an effective alternative of adding energy storage in energy system and it provides economic benefits to promote economic development and decarbonization in the region, through energy trade and cooperation.
- The project—Solar Home Energy (SHE) systems in Guyana—was initiated as a complementary solution to grid electrification and has proven to be the most viable off-grid electrification to date. It has benefited over 245 hinterland and 24 riverine communities, covering a total population of 135,366 people and the estimated greenhouse emission reduction was equivalent to the mitigation of 45,000 tonnes of carbon dioxide over its service life. The project was also designed and monitored using an online portal <https://hinterlandenergy.com/>.
- TERI undertook a multi-disciplinary study, jointly with researchers from Carleton University, Ottawa, Cananda on the potential to achieve low-carbon industrial clusters through a place-based approach. The study examined the opportunities for low-carbon industrial growth, being attentive to the socio-economic implications on the workforce.

Knowledge Building and Dissemination

1. A state-level study on decarbonization pathways for the power sector of Madhya Pradesh was completed. A report—'Low Carbon Pathways for Madhya Pradesh'—evaluated the future capacity and generation portfolio in the short and medium term—2025 and 2030—to meet the projected hourly demand profile of the state.
2. The report titled 'Just Transition Framework for a Sustainable Future in India's Coal Mining Regions', released by the Secretary, Ministry of Coal during the World Sustainable Development Summit 2024, aims to facilitate a structural as well as functional transformation to address concerns in regions affected by closure of coal mines.

3. A discussion paper, 'Establishing Women as Critical Stakeholders in India's Just Energy Transition: Evidences from Odisha, Jharkhand and Chhattisgarh' was brought into the public domain. The paper highlights the gender perspective of the present vulnerability in coal-producing geographies of India.
4. A seminar on 'Just Transition: Future of coal and Pathways to Low carbon footprint' in collaboration with IIT (Indian School of Mines), Dhanbad was organized in Kolkata with participation from Coal India Limited and its subsidiaries and other stakeholders.
5. A discussion paper, 'Concentrating Solar Power plants (CSP) with storage: Deployment essential now', was released which focussed on the actions required for developing concentrated solar plants with storage to achieve India's 2030 power sector decarbonization targets.
6. A discussion paper, 'Pumped Storage Plants (PSP): Essential for India's Energy Transition', was released that details ways of creating large-scale capacity of PSP plants and recommends development of on-river and off-river pumped storage plants, as well as bidding for competitively bid PSPs to accelerate their development.
7. A study was completed and a report, 'Accelerating Net Zero Transition of Public Transportation in Kolkata' was released with the support of West Bengal Transport Corporation. The study analyses the energy demand, power requirement and site suitability of charging station infrastructure for e-2W and e-4W, as well as battery swapping stations for e-3W. The potential of solar rooftops for the generation of electricity was assessed, along with the recommendations for EV charger locations and a public fleet decarbonization strategy for Kolkata till 2050.
8. 'India's Electricity Transition Pathways to 2050: Scenarios and Insights', a report was released during the proceedings of the World Sustainable Development Summit 2024. The report estimates that the electricity demand would increase fourfold by 2050 and the least cost option to meet the same across the year would be through higher RE integration where energy storage would be crucial.
9. A white paper on DSOs titled 'Transforming the Indian Power Sector Distribution System Operators (DSOs): Need, Frameworks, and Regulatory Considerations' was developed by a team of researchers from IIT Delhi, IIT Kanpur, and TERI under the UI-ASSIST project funded and supported by DST and IUSSTF. The paper presents the technical and regulatory requirements, institutional frameworks and proposes pathways to establish DSOs in India.
10. Two editions of the bi-annual Just Transition newsletter 'Vichaar-Vimarsh' were released on the themes of stakeholder engagement and repurposing coal assets.
11. A five-days' training programme on E3ME modelling was organized which is a 'risk opportunity' framework model developed by Cambridge Econometrics using the concept of 'complexity economics'. It is based on 'disequilibrium' state of economies rather than conventional 'equilibrium' models. Colleagues from TERI, WRI-India (country partner), and NITI-Aayog joined this in-person training.
12. As part of the final deliverable for Economics of Energy Innovation and System Transition (EEIST) study, India Country Report and Final Synthesis Report were launched. While the final report focussed on overall findings and cross-country experience, India report focussed on India-specific findings with comparison between conventional equilibrium model, simulation model and newly developed disequilibrium models.
13. TERI prepared detailed situation analysis reports for three secondary steel clusters—Raipur cluster in Chhattisgarh, Durgapur cluster in West Bengal, and Sundergarh cluster in Odisha.
14. Four SAMEEEKSHA newsletters were published.
15. An 'India-Japan Workshop on Hydrogen' was organized in December 2023 by TERI and Institute of Energy Economics Japan (IEEJ) with the support of Ministry of Economy, Trade, and Industry (METI), Japan.

Energy audit at Indorama Ventures, Thailand

16. TERI in partnership with Thomson Reuters Foundation convened a multi-stakeholder workshop on Just transition which saw participation from varied stakeholders such as researchers, policymakers, media, students, etc.

Partnerships and Networks

1. Narrative about nature of partnerships - Multiple projects in energy space could be carried out with generous support from varied donors such as UNEP, GIZ, MacArthur Foundation, DST, BEE, Bloomberg Philanthropies, CIFF, ABT associates, IFC, CTCN, SED, etc. Consultancy projects were executed for many domestic corporate players as well as international players such as Government of Guyana, World Bank, etc., in the field of energy efficiency in countries such as Guyana, Uzbekistan, Tajikistan, etc.
2. TERI received support from ERIN/ERIA to conduct research studies in context of decarbonization initiatives in South Asia through cooperation.
3. TERI also received support from Shakti Foundation to conduct studies on various themes including India's net zero roadmap, steel sector, and MSMEs.

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

[1] https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

[2] https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

GREEN SHIPPING

The Green Shipping programme demonstrates TERI's research capabilities in supporting sustainable utilization of resources across key sectors including ports, shipping, and waterways. The programme hosts the National Centre of Excellence in Green Ports and Shipping (NCoEGPS) that was set up to support the Ministry of Ports, Shipping and Waterways (MoPSW) and key stakeholders in fostering carbon neutrality and circular economy in India's maritime sector in line with changing global and national regulatory landscape. The programme actively engages in industry advisory services on various Environmental, Social and Governance (ESG) dimensions. It undertakes cutting-edge scientific and policy research in promoting commercially viable and sustainable solutions derived from bio-based routes, anchored on the principles of circularity, towards greening India's maritime sector and beyond.

Advanced Biofuels Division
Microbial Biofuels and Biochemical Area

Themes and Commitments

Thematic Focus

With in-depth research explorations, Microbial Biofuel and Biochemical research group at TERI paved the way for development and demonstration bioprocesses for production of biofuels and biochemical and biocommodities from 1st generation as well as from low-cost 2nd and 3rd generation feedstock. With an aim to make these processes environment friendly and cost economical, end-to-end low-cost technologies were developed, in a biorefinery approach. This strategy helped to establish collaboration with industries for demonstration of technologies at higher Technology Readiness Level (TRL) scale, which is the key for commercialization.

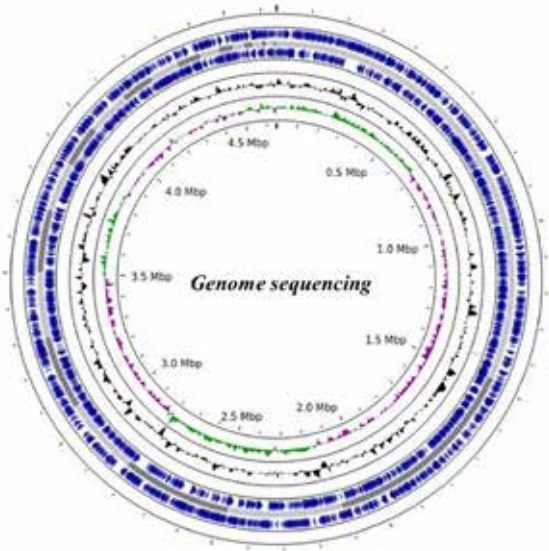
Centre for Biofuels

Research and development of this Area is primarily focused on microbial (using bacteria, yeast, algae as host) bioprocess development and demonstration for production of: (i) liquid biofuels, bioethanol, biobutanol, biojet fuel precursor, marine algae production for application in advanced biodiesel production, biofuels for adoption in shipping sector; (ii) gaseous biofuels; biohydrogen, biomethane. With an aim to overproduce these biomolecules using the select high product yielding microbial strains, research domain of these areas also spans synthetic biology approach using whole genome analysis as a tool for biosynthetic pathway elucidation for construction of recombinant hosts (GM strain).

Centre for Biochemicals

Pilot-scale demonstration of pilot-scale downstream recovery of liquid biofuel molecule(s) at TERI

Marine algal cultivation in 100,000 litres (220 sq. m) production system (based on sunlight distribution and 6000 litres raceway pond inoculum system) for improvement and production of 3rd generation feedstock (to use as platform feed for biodiesel, bioethanol, biohydrogen, aquafeed, and animal feed) production.



Whole genome sequencing of select high product yielding microbial strains for pathway elucidation and construction of GM strain

Thematic research under this Area deals with technology development and demonstration for production of high value industry platform biochemicals (2,3 butane diol, 1,3 propane diol, lactic acid, acetoin, acetic acid, butyric acid, farnasene, beta carotene, gamma linolenic acid, and value-added bio-commodities, aqua feed, animal feed, using low-cost feed including agriculture residues and algal biomass as feed.

Beta-carotene producing algal cultivation in the Mumbai coast using 1000 litres raceway pond (the alga has changed colour from green to orange when beta-carotene production shift happened)

High-value carotenoid production from organic acid rich spent effluent by photosynthetic bacteria

Pilot-scale process demonstrated for downstream recovery of value-added biomolecules

2,3 butanediol and ethanol production from 1st and next generation feed

Tata Chemicals Ltd. -TERI Centre of Excellence

Based on the TERI research leads developed for biochemical production from different low-cost feed, TERI team is exploring for demonstration of the aforementioned technologies at large scale (Higher TRL scale) though employment of novel, end-to-end technologies. These milestones are executed using the dedicated state-of-the-art upstream fermentation integrated with downstream recovery laboratory facility, established under this Centre at TERI GRAM.

Larger Goals and the Context

MBB's research endeavours cover 4 SDGs: SDG 7, SDG 9, SDG 14, and SDG 17.

Sustainable Solutions Promoted

Marine algal production used as feed for high value biomolecule production

- Marine algae cultivation in the coastal site in a 100,000-litre scale for lipid production
- Bioprocess development for extraction of sugar from lipid-extracted algae biomass
- Marine algae production in 1000-litre scale for high-value beta carotene production
- Process development of onsite harvesting and beta carotene extraction from algae biomass.

High value industry platform chemical production

- Pilot-scale production of high-value biochemical, 2,3 butane diol production from 1st and 2nd generation (biomass) feed
- Demonstration of pilot-scale downstream recovery process for recovery of 2,3 butane diol from fermentation broth
- Bioprocess development for biomass treatment for sugar recovery
- Bioprocess developed for 1,3 propane diol production from glycerol
- Lactic acid production from low-cost sugar and biomass
- Lutein and beta carotene extraction from Chlorella and Spirulina biomass.

Microbial biofuel production

- Bioethanol production from algae biomass
- Adoption of biofuel in shipping sector
- Butanol production from low-cost feed
- Algal; biodiesel production.

Our Accomplishments

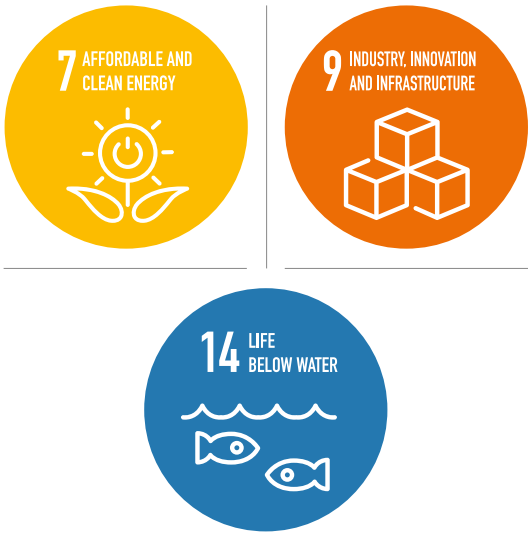
» Tata Chemicals Ltd. – TERI Centre of Excellence on platform biochemical production
» Individual research projects
» Execution of projects under National Centre of Excellence on Green Ports Shipping and Waterways.

Pyrolytic Biofuel, Biochar and Green Chemicals (PBGC) Area

Thematic Focus

The Pyrolytic Biofuels, Biochar, and Green Chemicals (PBGC) Area focuses on advancing research, technology development, policy, and consultancy in sustainable low-carbon biofuels, green fuels, bioenergy, and bioplastics. Its core research emphasizes thermochemical and catalytic conversion of agro-industrial biomass, waste residues, algae, waste/scrap plastics, and used cooking oil (UCO) into advanced biofuels such as sustainable aviation fuels (SAF)/biojet fuels, biodiesel, and refinery-grade pyrolytic bio-crude. Additionally, the Area emphasizes producing valuable by-products like biochar and high-porosity activated carbons, contributing to a

circular economy while addressing the challenges of sustainable energy transition. The PBGC Area aligns closely with three Sustainable Development Goals (SDGs): SDG7 (Affordable and Clean Energy), by promoting the development of sustainable low-carbon biofuels and green energy solutions; SDG9 (Industry, Innovation, and Infrastructure), through advancing cutting-edge technologies for thermochemical and catalytic conversion processes; and SDG14 (Life Below Water), by addressing plastic waste management and reducing marine pollution through innovative recycling and conversion methods. This integrated approach contributes to building a sustainable, resilient, and environmentally responsible future.



Expertise and Thrust Areas


Thermochemical and Catalytic Conversion


Green fuels Development


Biochar and Carbon Materials


Process Design and Optimization


Waste Valorization


Policy and Advisory

- **Advanced Pyrolysis Technologies**: Innovating in pyrolysis for efficient energy recovery and by-product utilization.
- **Sustainable Aviation Fuel (SAF)**: Developing renewable jet fuels to support decarbonization of the aviation sector.
- **Bio-based Chemicals and Plastics**: Creating eco-friendly alternatives to petroleum-based products.
- **Circular Economy Solutions**: Enhancing plastic and waste recycling into fuels and high-value chemicals.
- **Carbon Management**: Utilizing biochar for soil enhancement, carbon sequestration, and industrial uses.
- **Industrial Applications**: Supporting the refinery sector with renewable feedstock solutions like refinery-grade bio-crude.
- **Collaboration and Capacity Building**: Engaging with industries and policymakers to foster technology transfer and implementation.

Our Accomplishments

TERI maintains a Thermochemical Conversion Lab that conducts research in pyrolysis technology for production of biofuel (sustainable aviation fuel, biodiesel, green methanol), biochar and activated carbon, and pyrolysis oil to refinery grade oil. This Area also works on bioplastic research and biofuel and bio-commodity policy domain.

To its credit, TERI has a few patented technologies in this field, and is currently engaged with development of some others. These include:

Pyrolysis Research (Patented Technology Developed)

TERI Pyrolysis Technology: Gas Fired Augur

- Heating dual mode: internal gas fired and external electrical
- Augur moving bed 10–20 kg /h, T up to 800^{o}C, continuous operation
- Intermediate and fast
- Downstream catalytic bio-oil upgradation unit (both liquid and gas phase) integrated

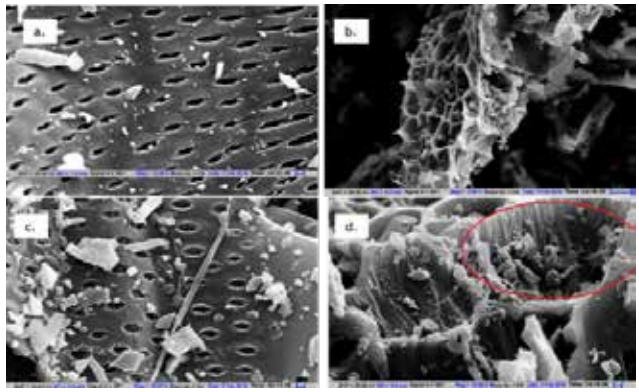
TERI pilot pyrolyser (patented)

Bio oil catalytic upgradation unit

- Using TERI's patented pyrolysis technology, different biomass feedstocks/agro-industrial residues such as tea wastes, coffee wastes, mustard residues, paddy straw, cashew nut shell, cotton stalk, sugarcane bagasse, scrap bamboo, plastics, industrial spent biomass (L'OREAL) have been converted to pyrolytic biofuel and biochar.
- PBGC area has performed intense research aimed at downstream catalytic upgradation of pyrolytic oil produced in pilot pyrolyser to further superior quality bio-oil for refinery integration.
- Indigenous catalysts have been developed for downstream catalytic upgradation of pyrolytic bio-oil to refinery grade bio-oil, aviation fuel components, specialty chemicals and aromatics.

Biochar, Activated Carbon and Green pellets

TERI's pyrolytic char derived green pellets



TERI's biochar derived activated carbon

TERI has been continuing developing technology for making high-grade carbon products from pyrolytic biochar and its applications.

- High micro-porosity (BET surface area 500–2400 m^2/g) activated carbon (green carbon) is successfully made from agro-residues and de-oiled marine algal biomass-based pyrolytic biochar through indigenously developed downstream activation process. The activation is accomplished using environmentally benign physical and chemical processes.
- TERI also has good research leads in biochar soil fertility improvement in the pot experiment so far under controlled in-house condition. TERI's pyrolytic biochar made from mustard and rice stalk at different pyrolytic conditions is used for soil fertility experiments and growth of medicinal plants of *Centalla asiatica* under a research exchange programme by Global Challenges Research Fund (GCRF), UKRI, United Kingdom.
- Under a sponsored research project, the PBGC area has developed indigenous process for making green pellets using pyrolytic biomass-based biochar. The Comparative Analysis of Emission of Air Pollutants from Biochar Pellets against conventional Biomass Briquettes shows 61–93% reduction of particulate matters ($PM_{2.5}$ and PM_{10}) and VOC, respectively.

TERI's Technology has entered a stage where bio-oil and biochar could be recognized as the building block for thermal bio-refinery for co-production of fuels and chemicals.

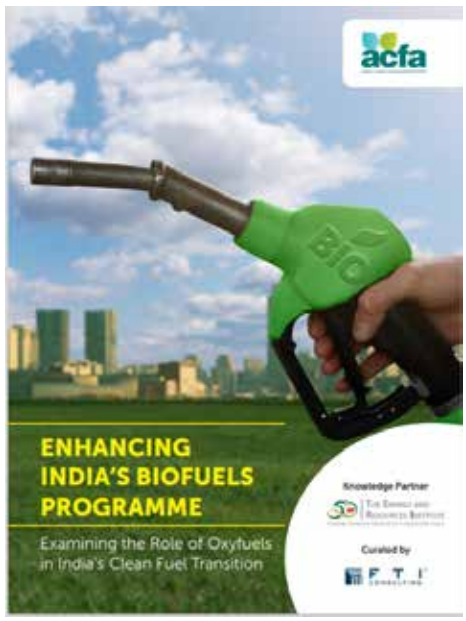
SAF from Biomass Agro Residues and Marine Algal Lipid

- TERI has initiated work in converting both biomass pyrolysis oil and marine algal lipid to SAF. The pyrolytic bio-crude oil has been downstream upgraded through catalytic intervention to bio-jet fuel range products including diesel fraction from a variety of agro residues as well as from de-oiled marine algal biomass.
- Upscaling of these processes and demonstration at minimum sustainable scale will lead to jet fuel range products from 2nd generation low-cost feedstocks and 3G marine algal feedstock available in abundance in India.

Publications

1. Report, titled 'Enhancing India's Biofuels Programme: Examining the Role of Oxyfuels in India's Clean Fuel Transition'

The Energy and Resources Institute (TERI), supported by the Asian Clean Fuels Association (ACFA), launched its report, titled "Enhancing India's Biofuels Programme: Examining the Role of Oxyfuels in India's Clean Fuel Transition," that highlights complimentary strategies that India could deploy to reduce reliance on imported fossil fuels by adopting fuel ethers as part of the national fuel strategy.



2. 'Roadmap for EU-India Cooperation on Sustainable Biofuels from Biomass for Aviation and Maritime Transport: An EU-India Action Plan'

'Roadmap for EU-India Cooperation on Sustainable Biofuels from Biomass for Aviation and Maritime Transport' focuses mainly on the work that needs to be done to eliminate barriers that are currently blocking progress on G2 biofuel production, to create an environment in which the private sector investors and technology providers can more effectively contribute to the decarbonization of the global aviation and maritime sectors, enabled by the social transformation of rural and urban communities.

Projects

The PBGC Area is one of the most dynamic teams in TERI working across diverse disciplines. The Area currently has the following keys projects to its credit:

1. **Adoption of Green Fuels in Indian Maritime sector**

The overall objective of this project is to develop green fuel adoption roadmap for maritime sector in India. The key component of this project includes assessment of feasibility of establishing supply chain logistics for alternative green fuels, assessment of different engines, fuel cell and hybrid ship design options for alternative green fuel transition in ships, assessment of technical feasibility of establishing alternative green fuel storage, bunkering and transport facilities at selected ports in India and developing relevant policies and standards, etc., for accelerating green fuel transition in India.

2. **Workshop on Progress and Adoption of Alternate Engines and Future Fuels for Sustainable Maritime Transport and Shaping the Future – the Path towards Net-zero**

TERI brought together experts and key stakeholders, including ministries (MoPSW, MoPNG, MNRE), BIS, oil refineries, OEMs, and developers, to discuss green fuel production, alternate engine development, and related policies and standards. The event aimed to provide critical inputs for developing a roadmap to guide the transition to sustainable marine fuels and engines.

Workshop on Progress and Adoption of Alternate Engines and Future Fuels for Sustainable Maritime Transport and Shaping the Future - the Path towards Net-zero

3. **Panel Discussion at PPAC Foundation Day: Exploring Feedstocks for Biofuels**

On April 3, 2024, at the Foundation Day celebrations of Petroleum Planning & Analysis Cell (PPAC) under the Ministry of Petroleum and Natural Gas, an engaging panel discussion was held, featuring distinguished speakers from the energy sector. The session focused on biofuels and the diverse feedstocks required for scaling up India's clean energy transition. India, with its agricultural economy, vast population, and significant municipal waste generation, offers immense potential for feedstocks like agricultural products, agri-waste, municipal waste, and CO_2-based synthetic fuels. The panel highlighted the need to expand feedstock options to match the scale of India's energy market.

Panel Discussion at PPAC Foundation Day: Exploring Feedstocks for Biofuels

Approach and Innovation

The PBGC Area is working towards developing strategic collaborative research partnership with Institutes/ and Industry of National and International importance especially in technology upscaling of green fuels production, bioplastics/biodegradable polymers and biochar-based products. TERI's PBGC Area has strength in green technologies (including biofuels), biochar and bioplastic area which could be leveraged for the genesis of full-fledged dedicated centres with industrial partnership.

Impact We Created

- Developing a green fuel adoption roadmap for maritime sector in India on "Advanced Green fuels for Maritime Application (mono fuel, dual fuel/hybrid, co-blending)."
- Fuel ethers such as methyl tert-butyl ether (MTBE) are being produced domestically, this could be easier for India to ramp up production of ethers (MTBE as well as ETBE) and reduce import dependency. Ethyl tert-butyl ether (ETBE) is also colloquially referred to as 'easy to blend ethanol.'

- Pyrolytic bio-oil and biochar-based products for reducing GHG emission (by 60–95%) associated with stubble burning.
- Agro-residue biomass to sustainable aviation fuel production pathway was established, which could be employed for wider biomass feedstocks like Municipal Solid Waste (MSW) and algal biomass.
- Conventional petroleum feedstock replaced by renewable feedstock (glycerol) for making green acrylic acid production through allyl alcohol pathway.
- Solar integrated ionic liquid catalysed biodiesel conversion led to low water and carbon footprint.

Future Endeavours

TERI is exploring several promising areas in sustainable energy and materials development. These include the use of carbon nanomaterials for hydrogen storage, converting pyrolysis oil into sustainable aviation fuel (SAF) and marine fuel, producing green methanol and DME, and transforming CO_2 into polymers and CO_2-adsorbing materials. The scaling up of pyrolysis technology from TRL 5 to TRL 9 is a key focus, aiming for industrial-grade products such as biochar for soil amending, biochar pellets for combustion, and activated and nano-carbon for various applications. Other areas under exploration include biomass-based chemicals like furfural and phenol, as well as industry-relevant biodegradable plastics and polymers. The 10-year goals are categorized into short-term, medium-term, and long-term objectives. Short-term goals include advancing biochar-based products, pyrolysis oil applications, and biodegradable plastics. Medium-term goals focus on developing hydrogen storage systems and carbon capture, utilization, and storage (CCUS) technologies. Long-term objectives include establishing thermochemical bio-refineries and commercializing pyrolysis technologies for broader industrial use.

Resource Efficiency and Governance Division

Thematic Focus

The Resource Efficiency and Governance (REG) Division leads TERI's work around sustainable consumption and production (SDG12) supporting public policy actors and businesses, to drive sustainable use of natural resources along product and service life cycles.

Using evidence-based decision tools and state-of-the-art life cycle assessment frameworks, the Division provides comprehensive understanding of resource efficient solutions in key sectors that support India's achievement of Mission LiFE and SDG12.

Many of these key findings are leveraged by leading Indian and global brands for their sustainability reporting initiatives while supporting ESG compliance. The Division actively engages with relevant ministries, businesses, think tanks, consumers and other stakeholders advocating strategic approach to critical mineral resource security and use of secondary material use for achieving successful policy change.

Expertise and Thrust Areas

The Division's expertise includes Life Cycle Assessment, Agriculture Policy, Blue Economy, Natural Resources Management, Critical Minerals and End of Life Management, and Ecosystem Evaluation.

Life Cycle Assessment (LCA)

Material Flow Analysis (MFA)

Agriculture Policy

Blue Economy

Natural Resource Management

Economic and Policy Analysis

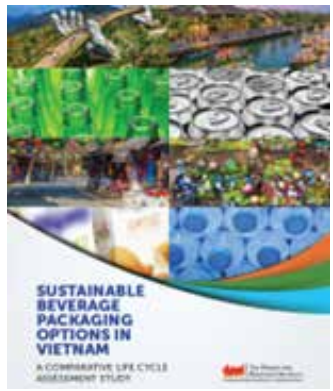
Green Energy

Ecosystem Evaluation

Our Accomplishments

The Division delivers customizable analytical tools that can be used by organizations and brands in assessing environmental impacts and footprints across product and service life cycles. The Division has also completed several innovative research works on ecological footprints of products and processes in selected sectors including benchmarking—thereby, providing meaningful insights to consumers, brands and government for strategic and policy decisions. These include:

- Economic Benefit Assessment of Ujala Scheme in India
- Comprehensive Environmental and Social Sustainability Assessment of Compressed Biogas as a Vehicular Fuel in India
- National Circular Economy Roadmap for Reducing Plastic Waste in India
- Sustainable Beverage Packaging Options in Vietnam: A Comparative Life Cycle Assessment Study
- Quarterly Newsletters for IKI – Partnership Programme



Aggregate Numbers

The Resource Efficiency and Governance is one of the most dynamic teams in TERI working across diverse disciplines. The Division currently has the following keys projects to its credit:

1. **Sustainable Beverage Packaging Options in Vietnam: A Comparative Life Cycle Assessment Study**: The Team leads a first-of-its-kind work for Vietnam and Thailand on comprehensive sustainability assessment of various beverage packaging substrates, highlighting the importance of adoption of sustainable packaging materials that can promote Sustainable Consumption and Production in developing countries.

Delegates at G20 Meeting on ECSWG where CREG supported MoEFCC on Circular Bio-economy

2. **Comprehensive Environmental and Social Sustainability Assessment of Compressed Biogas as a Vehicular Fuel in India:**
TERI undertook a comparative well-to-wheel lifecycle analysis of various fuel and powertrain components of EVs and ICEVs (petrol, diesel, CNG, and Bio-CNG) in India. It was found that Bio-CNG as a potential multi-purpose game-changer capable of aiding India in supporting circular bioeconomy, greenhouse gas mitigation, waste management, de-carbonization of the transport sector, while providing affordable mobility solutions in rural India.

Release of the report on 'Comprehensive Environmental and Social Sustainability Assessment of Compressed Biogas as a Vehicular Fuel in India', by CMD NDDB, DG TERI, Director MSIL and other delegates

3. **4th IKI India Workshop**: The 4th International Climate Initiative (IKI) India Networking Workshop, held in New Delhi on March 6–7, 2024, brought together 28 IKI India projects and about 70 participants from India and Germany. Organized jointly by the IKI India Interface Project and TERI, the workshop focused on enhancing synergies among IKI India projects and sharing outcomes. High-level representatives from the German Ministries—Federal Ministry for Economic Affairs and Climate Action (BMWK), the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), the Federal Foreign Office (AA), as well as from the German Embassy to India contributed to lively and fruitful discussions.

Presentation of LCA study IKI India Workshop jointly hosted by GIZ and TERI

Presentation by Ms Vani Pandey at IKI India Networking Workshop

4. **India–Australia research and industrial collaboration in reducing plastic waste (IACP)**: Three organizations from India (TERI, DA, and CSIR- NEERI) and three from Australia (UNSW, ISF-UTS, and CSIRO) have come together for a comprehensive study on plastic economy of India across its entire value chain. The report was released by the Hon'ble Minister of Science and Technology, Government of India, Dr Jitendra Singh at a function organized by NEERI in association with CSIR.

Offical release of the report on 'India–Australia research and industrial collaboration in reducing plastic waste' by the Honorable Minister of Science and Technology, Government of India

5. **Crop Diversification Pathways for Punjab**: TERI and the Food & Land Use Coalition (FOLU India), in partnership with Bharat Krishak Samaj and the Indian School of Business (ISB), organized a workshop at ISB, Mohali Campus, Punjab on 'Crop Diversification Pathways for Punjab' on June 8, 2023 to deliberate on the key enabling factors that can help fast-track the adoption of crop diversification practices in the state of Punjab. The key stakeholders, including farmers from across the state, scientists from Punjab Agricultural University, policymakers, civil society organizations and industry experts, deliberated on the diversity and drivers of crop diversification pathways along with associated policy decisions that can be developed to help diversify the state's agricultural landscape.

Stakeholder Consultation Workshop on 'Crop Diversification Pathways for Punjab: A Circular Bioeconomy Approach' at ISB Campus in Mohali

Approach and Innovation

The approach of REG is not to limit itself to a few particular specializations but to consistently strive to expand the portfolio of sectors in which we undertake projects. The REG team is dynamic and multidisciplinary, with expertise in resource economics, environmental sciences, agricultural sciences, environmental impact assessment, public policy, and material sciences.

Partnerships and Networks

- Knowledge and technical partner with the MoEFCC for circular economy segment for G20 India.
- Knowledge partner to the Ministry of Mines for developing and implementing National Critical Mineral Mission.
- Knowledge and technical partner with NITI Aayog for circular economy in five key economic sectors.
- Worked closely with CSIRO Australia, CSIR-NEERI, UNSW, UTS and DA on plastics circular economy of India. A long-term partnership has been formed with these research institutes for continuous knowledge exchange through the upcoming work.
- Several private industry partnerships including Ball Corporation, Meta Materials Circular Markets Private Limited, Maruti Suzuki India Ltd, Zen Technologies, FICCI, Indian Sugar Mills Association, LOHUM, Attero, etc.

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

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CLIMATE CHANGE AND AIR QUALITY

The Climate Change and Air Quality Programme has been actively researching global and local environmental and sustainability issues for over three decades. Employing an interdisciplinary approach, it conducts groundbreaking studies related to climate change and air quality in both national and international platforms. By utilizing a combination of research methods, including instrumentation, model-based assessments, and stakeholder consultations, the programme aims to bridge the gap between scientific knowledge, policy formulation, and practical implementation. Its primary focus lies in providing evidence-based recommendations for climate change mitigation, adaptation strategies, and enhancements to air quality and public health.

Themes and Commitments

Thematic Focus

The Earth Science and Climate Change initiatives are centred on the following areas:

- Impacts, vulnerability and adaptation research for climate-sensitive sectors
- Climate risk and disaster management research
- Climate change and health challenges
- Climate mitigation, technology, and policy research
- Climate finance and market
- Return levels of climate extremes
- Regional down scale of climate models using dynamical and statistical methods
- Studies on ocean and atmospheric dynamics
- Climate modelling and monsoon research
- Air quality monitoring and emissions monitoring
- Air pollution and health effects
- Emission inventorization and air quality modelling
- Linking air pollution with climate change
- Developing air quality management plans for urban and regional scales
- Urban indoor air quality assessment
- In-situ and ex-situ management of post-harvest crop residue
- Training and capacity building on various climate and environmental issues

Key Areas of Research

- **Climate change and resilience**: 1) Conducts research on impacts, vulnerability, and adaptation in sectors affected by climate change; 2) Provides actionable recommendations to enhance resilience.
- **Risk management and disaster preparedness**: 1) Investigates climate risk and disaster management strategies; 2) Provides solutions for preparedness and response mechanisms.
- **Mitigation strategies and effective policies**: 1) Offers science-based insights for climate mitigation and technology adoption; 2) Supports sustainable practices through policy recommendations.
- **Climate finance and informed decision-making**: 1) Analyses climate finance dynamics, market mechanism, and trends; 2) Facilitates informed decision-making for climate-related investments.
- **Climate modelling and regional climate outlooks**: 1) Conducts climate modelling at global, regional, and local scales and research related to monsoons; 2) Recognizes regional climate patterns and variability to aid comprehension.
- **Air quality monitoring and pollution linkages**: 1) Assesses air quality (both indoor and ambient) and emissions; 2) Links air pollution monitoring with climate change implications.
- **Urban solutions for cleaner environments**: 1) Develops tailored air quality management plans for cities and regions; 2) Promotes cleaner urban environments through innovative approaches.
- **Health challenges due to climate change and air pollution effects**: 1) Addresses climate change impact on health; 2) Assesses the effects of air pollution on public health.
- **Innovative approaches for Sustainability**: 1) Develops solutions pertaining to mitigate air pollution; 2) Focuses on sustainable practices, including managing post-harvest crop residue.
- **Capacity building and knowledge exchange**: 1) Empowers communities through climate and environmental training; 2) Fosters knowledge sharing and collaboration.

Our Accomplishments

- **Policy support and climate action plans**: Developed research-informed evidence for policy-making and aided government bodies in formulating national and

CII EcoMed Summit - Advancing Sustainable Healthcare

Pollution source monitoring and hotspot identification through installation of camera

sub-national climate action plans related to climate change, heat stress and health, agriculture, and water sectors.

- **Climate solutions and disaster preparedness**: Provided tools for climate and disaster evaluation, including the flood warning and early warning system and the TERI Climate Tool. Additionally, developed emergency action plans for dam safety for nationally important dams such as the Ranjit Sagar Dam and Shahpurkandi Dam.
- **Environmental reports and mitigation measures**: Supported state of environment reports and environmental policies. Contributed to GHG inventory development and mitigation strategies at city and regional scales. Assisted in creating heat action plans, flood risk assessments, and disaster management interventions. Participated in the recent adoption of climate risk information in various state government policies.
- **Sustainable cooling research and national policies**: TERI's research on sustainable cooling has influenced national policies. The work has contributed significantly in India's Cooling Action Plan.
- **COP participation and climate governance**: Maintained a strong presence at the United Nations Framework Convention on Climate Change's (UNFCCC) Conference of the Parties (COP) events. Involved in COP28 events addressing transparency, climate finance, adaptation, decarbonization, technological change, and climate governance.
- **River inflow, power generation forecasting system, and hydro-meteorological network framework**: Assisting the Government of Bhutan (DGPC) by developing a system for the Chhukha Dam to improve river inflow prediction and optimize power generation. Furthermore, we are designing and developing a framework to strengthen Bhutan's hydro-meteorological data collection, enhancing monitoring of weather and water-related phenomena.
- **Dam safety measures**: Revised dam design flood for dam safety, prepared emergency action plans for potential dam failure incidents, and conducted training for dam authorities on effective safety planning and response.
- **State-level policy recommendations**: Conducted source apportionment studies and guided state-level regulatory authorities in developing local action plans to control air pollution and mitigate its impacts.
- **Strengthening airshed management in Uttar Pradesh**: A new project, supported by the Clean Air Fund and Bloomberg Philanthropies, aims to enhance airshed management. TERI established the Strategic and Policy Advisory Unit within the Department of Environment, Government of Uttar Pradesh, providing strategic guidance and technical assistance for effective utilization of funds and delivery of results under the Uttar Pradesh Clean Air Action Plan (UP-CAMP).
- **SLCP concentration estimation and impact assessment**: Building on past knowledge, estimated the present concentration of short-lived climate pollutants (SLCPs) across India, aiding the government in prioritizing policies for maximum co-benefits. Additionally, TERI is developing a coupled model approach to quantify the impact of air pollutants on climate, a unique capability in the country.
- **Real-time source apportionment study and 'supersite'**: In collaboration with Delhi Pollution Control Committee, IIT-Delhi, and IIT-Kanpur, TERI launched a real-time source apportionment 'supersite' sharing hourly pollution source details and air pollutant forecasts. This initiative helps

A stakeholder consultation under progress

policymakers identify pollution hotspots and implement targeted interventions. The website <raasman.com> provides real-time data on air pollution sources in the city.

- **Climate change and health assessments**: Specific work initiated with a focus on the Indo-Pacific region to understand the climate and health linkages and priorities of nearly 12 countries in the regions including India, Bangladesh, Fiji , Thailand, the Philippines, and Vietnam.

Financing Just Transition Side Event in Bonn

Projects

The ESCC has been executing various projects under diverse themes. All in all, more than 50 projects were completed during the last financial year. Some of the notable projects are tabulated here.

S. No.	Area	Project	PI	Sponsors
1	CCCR	ECSWG during G20 India Presidency	Ms Suruchi Bhadwal	The Boston Consulting Group (India) Private Limited
2	CCCR	Developing an Emergency Action Plan (EAP) and Design Flood Review for RSD and Shahpurkandi Dam	Mr Prasoon Singh	Department of Water Resources, Government of Punjab
3	CCCR	Developing Climate Change Resilience Plan	Ms Neha Bharti	Tandon Urban Solutions Private Limited
4	CCCR	Risk Assessment and Accounting for the ecosystem services	Mr Prasoon Singh	WWF-India
5	CCCR	Decarbonization of Ecommerce	Mr K Umamaheswaran	Amazon.com, Aakhya Media Services Private Limited
6	CCCR	Development of a Transition Risk Management	Mr Amlan Mishra	American Friends of EdelGive Foundation
7	CCCR	Green Public Procurement Framework	Mr K Umamaheswaran	Government e Marketplace (GeM)
8	CCCR	Sub-Project for Accelerating Net Zero Transition of Public Transportation	Mr K Umamaheswaran	New Venture Fund
9	CCCR	Climate Change and Health Review of Evid	Ms Smita Chakravarty	Foreign, Commonwealth and Development Office
10	CCCR	ICAT-Phase 2	Ms Suruchi Bhadwal	United Nations Office for Project Services (UNOPS)
11	CCCR	Eco-region Specific Climate Impact Assessment	Ms Suruchi Bhadwal	The Norwegian Ministry of Foreign Affairs
12	CCCR	Determination of Scope 3 Greenhouse Gas	Mr K Umamaheswaran	ITC Limited
13	CCCR	Activities for Dissemination of Findings on HFC-use and Phasedown	Mr Shaurya Anand	Natural Resources Defense Council
14	CCCR	Preparation of Revision Document of Jammu and Kashmir	Dr Manish Kumar Shrivastava	Government of Jammu and Kashmir
15	CCCR	Due Diligence Service for CIP in Bihar	Mr Gaurav Yadav	Climate Impact
16	CCCR	GHG Estimation, Carbon Credit Calculation	Ms Chempakassery P Veena	Kerala Development and Innovation Strategic Council
17	CCCR	Due Diligence Service for CIP in Satpura	Mr Gaurav Yadav	Climate Impact

18	CCCR	Due Diligence Service for CIP in Panna	Mr Gaurav Yadav	Climate Impact
19	CCCR	IGSD Event	Ms Suruchi Bhadwal	Institute for Governance and Sustainable Development
20	CCCR	Site Visit to TERI's R and D Centre, TERI Gram	Ms Suruchi Bhadwal	Observer Research Foundation
22	CAQR	Source Apportionment Study of Kaniha OCP	Mr R Suresh	Mahanadi Coalfields Limited
24	CAQR	Air Pollution Source Apportionment study for Kolkata and Howrah	Dr Arindam Datta	West Bengal Pollution Control Board
25	CAQR	Study on Hyperlocal Air Quality Assessment	Mr R Suresh	Bihar State Pollution Control Board, Patna Municipal Corporation
27	CAQR	Carrying Out Indoor and Ambient Air Quality of Accenture	Mr Prabhat Sharma	Accenture Solutions Private Limited
28	CAQR	Achieving Net Zero with Development and Other Co-Benefits	Mr Nimish Singh	Vasudha Foundation USA
29	CAQR	Support to the Government of Uttar Pradesh for Establishment of Strategic and Policy Advisory Unit for Uttar Pradesh Clean Air Management Programme (UP CAMP)	Dr Anju Goel	Clean Air Fund (CAF)
30	CAQR	Scope and Role of Natural Gas in Mitigating Industrial Air Pollution	Mr R Suresh	FIPI
31	CAQR	Emission inventory and SA study for Kashipur and Rishikesh	Mr R Suresh	Uttarakhand Pollution Control Board
32	CAQR	Emission inventory and SA Study for Vadodara	Mr R Suresh	Vadodara Municipal Corporation
33	CAQR	Emission Inventory and SA Study for Faridabad	Mr R Suresh	Municipal Corporation of Faridabad
34	CAQR	Air Pollutants Emission Inventory Around Monuments in India	Mr R Suresh	Environmental Defense Fund
35	CAQR	Develop an Air Quality Progress Report (AQPR) for India	Mr Nimish Singh	UNEP
36	CAQR	Developing Strategies for Control of Air Pollution in India and Its Cities	Dr Anju Goel	Bloomberg Philanthropies
37	CAQR	Clean Air Project in India (CAP India) -Phase I	Dr Anju Goel	SDC
38	CAQR	Real-Time Source Apportionment and Forecasting for Advance Air Pollution Management in Delhi	Mr R Suresh	IIT Kanpur
39	CAQR	Pilot Study on Preliminary Assessment of Potential Carbon Benefits by Shifting to Improved Cook Stove in Rural Households of West Bengal	Dr Arindam Datta	West Bengal Pollution Control Board
40	CAQR	Development of the Net Zero Emissions Pathways Report (NZEP Report)	Mr Nimish Singh	Institute for Governance and Sustainable Development (IGSD)
41	CCM	Climate Adaptation and Financing	Mr Santosh Kumar Muriki	Deutsche Gesellschaft Fur Internationale Zusammenarbeit (GIZ) GmbH
42	CCM	Risk Assessment and Accounting for the Ecosystem Services for the Identified High-altitude Wetlands in Uttarakhand and Ladakh	Mr K Venkatramana	WWF-India
43	CCM	Sub-project for Eco-region Specific Climate Impact Assessment and Sustainable Agricultural Practices	Mr K Venkatramana	The Norwegian Ministry of Foreign Affairs

44	CCM	Developing Climate Change Resilience Plan and Upgrading City Infrastructure to Mitigate the Effects of Climate Change in Urban Systems	Mr K Venkatramana	Tandon Urban Solutions Private Limited
45	CCM	Water Availability Study	Mr K Venkatramana	MEA
46	CCM	COP Compass and SDG Charter under Act4Ea	Ashwini Pai Panandiker	Multi-clients
47	CCM	ECSWG during G20 India Presidency	Ashwini Pai Panandiker	The Boston Consulting Group (India) Private Limited
48	CCM	Goa Pilot	Ashwini Pai Panandiker	Deutsche Gesellschaft Fur Internationale Zusammenarbeit (GIZ) GmbH
49	CCM	Sub-Project for India-Australia Industry and Research	Ashwini Pai Panandiker	CSIRO
50	EHA	Air Quality and health linkages for UAE	Dr Richa Sharma	VITO
51	EHA	Heat stress and health impacts for UAE under a changing climate	Dr Richa Sharma	VITO

Innovation

- **Tool for flood early warning system (FEWS)**: We pioneered FEWS to deliver precise inundation forecasts, enhancing disaster preparedness.
- **River inflow and hydropower generation forecasting**: Developed a system to optimize hydropower plant operations by forecasting river inflows and power generation.
- **TERI Climate Tool (TCT)**: Designed to simplify the integration of climate modelling results, making complex data more accessible.
- **AI/ML climate risk assessment**: Via leveraging artificial intelligence and machine learning, we evaluate climate risks across various sectors with unparalleled precision.

Capacity Building Programme Targeting School Children on Climate Change, Health and Hygiene reached out to 162 schools in 11 Districts of Uttar Pradesh, with support from UNOPS

- **Source apportionment studies**: Through advanced modelling techniques, we have established our institute as a national leader in source apportionment studies. This distinction includes being listed as an Institute of Repute by the Ministry of Environment, Forest, and Climate Change (MoEFCC) for reviewing emission inventories and source apportionment and carrying capacity studies.
- **Innovative emission estimation**: By utilizing TERI-developed indigenous emission factors, distinct from conventional methods, we have significantly enhanced the value of our emissions estimation findings.
- **National emission inventory development**: TERI's unique capability to develop a comprehensive national emission inventory sets us apart, an achievement only a few institutes have accomplished.
- **Air pollutant forecasting**: Our validated research in air pollutant forecasting is ready for implementation across different regions, promising widespread environmental benefits.
- **Real-time source apportionment**: Participation in real-time source apportionment studies has enabled us to assess the effectiveness of air quality interventions promptly, earning global recognition for our innovative contributions

Inspirational Evidences

Demonstrations

- **Pollution source monitoring in Lucknow**: Cameras, 32 in number, have been installed at various locations in Lucknow—16 by TERI and 16 by APAG. Seven of these cameras are now connected to

MRS audit integration with Smart City Portal in Lucknow

the Integrated Command and Control Centre, operationalizing at ITMS Smart City.

- **Inflow forecasting system in Bhutan**: An inflow forecasting system and RTDAS network have been installed in the Chhukha Basin, Bhutan, under the SAREP-USAID Programme.
- **Dam-break analysis**: Dam-break analysis was conducted for the inundation mapping downstream and identification of flood vulnerable areas for the development of emergency action plan for various dams in the country using combination and hydrologic and spatial modelling tools
- **Model construction site establishment**: A construction manual detailing dust mitigation measures has been prepared. One construction site in Lucknow and two in Kanpur were visited for stakeholder consultations based on the manual's recommendations.
- **Retrofitting IC 2-wheelers to electric vehicles in Pune**: The methodology for retrofitting internal combustion 2-wheelers to electric vehicles has been finalized. Vehicles have been retrofitted with batteries, and calibration is underway. Battery-calibrated vehicles have been dispatched to Dominos for field trials.
- **MRS audit integration with Smart City Portal in Lucknow**: The MRS App module has been developed and integrated into the Smart City 311 app. Training sessions for LMC staff have been conducted while the trial runs for drivers and supervisors are ongoing.

Policy and Capacity Building

- **Research-informed policymaking**: TERI has played a crucial role in developing evidence-based research to aid government bodies in formulating state of environment reports and environmental policies, particularly in air quality management.
- **State-level policy recommendations**: Through various source apportionment studies, TERI has provided state-level policy recommendations that have helped regulatory authorities develop local action plans to control air pollution and its impacts.
- **Capacity building and training programmes**: TERI has conducted programmes to enhance the awareness and policymaking capacity of personnel involved in climate science and risk management, air pollution management, climate change issues and health.

Capacity Building Programme Targeting School Children on Climate Change, Health and Hygiene reached out to 162 schools in 11 Districts of Uttar Pradesh, with support from UNOPS

- **Strategic and policy advisory unit**: TERI established a unit within the Department of Environment, Government of Uttar Pradesh, to provide strategic guidance and technical assistance for effective utilization of funds and results delivery under UP-CAMP.

Impact We Created

Global Contribution

- **IPCC contributions**: Played a significant role in contributing to the Intergovernmental Panel on Climate Change (IPCC) special reports and the Sixth Assessment Report (AR6). Our involvement included providing expert analysis, data,

and insights that informed the comprehensive assessments.

- **ICAO Technical Advisory Board**: Served on the board, offering research and advisory services for the implementation of CORSIA, a global market mechanism for reducing emissions in international aviation.
- **UNFCCC COP**: Maintains a robust annual presence at the COP under the UNFCCC. Each year, we actively engage in discussions, present our latest research, and collaborate with international stakeholders to influence global climate policies. Our participation includes organizing side events, contributing to policy dialogues, and networking with other key players to drive collective action towards addressing climate change.
- **Bonn Climate Change Conference**: Actively participated in and facilitated discussions on climate change issues during the Bonn Climate Change Conference in June 2023. Our engagement focused on fostering dialogue among key stakeholders, presenting research findings, and contributing to the development of actionable strategies for addressing global climate challenges.
- **Multi-country Cooling Platform**: Partnered with the Embassy of France in India to facilitate cross-country knowledge exchange for sustainable habitat, energy efficiency, and thermal comfort for all.

National Policy

- **India's Cooling Action Plan**: Actively contributed to the development of India's Cooling Action Plan, providing key insights and strategies to enhance cooling efficiency and sustainability across the country.
- **National State of Environment Report (NSoER)**: Played a pivotal role in preparing the NSoER, ensuring comprehensive analysis and accurate reporting of environmental conditions and trends.
- **Host institute for environmental studies**: Served as a national host for conducting crucial studies on source apportionment, emission inventory, and carrying capacity, providing essential data and recommendations.
- **Institute of repute**: Designated by the Central Pollution Control Board (CPCB) as an 'institute of repute' to offer technical inputs and guidance for emissions inventory, source apportionment, and carrying capacity reports for cities with populations over a million and non-attainment cities.
- **Air quality management**: Delivered policy-relevant scientific research to inform policymakers, contributing to the enhancement of air quality standards and making high-level policy submissions to the government.
- **Air quality progress report**: Prepared an air quality progress report for India, enabling the policymakers to inform changes in the air environment in a timely manner.
- **Training and capacity building**: Implemented training programmes to improve the skills and knowledge of officials from state pollution boards and Central Pollution Control Board, effectively

Capacity building

bridging gaps and building expertise in pollution management.

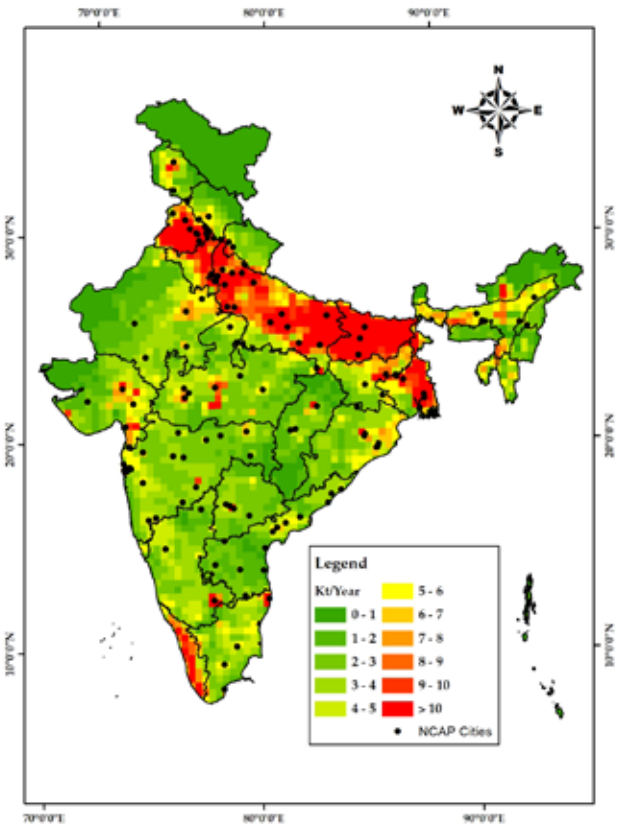
- **Health vulnerability assessment and climate change monitoring**: TERI developed the Framework for Monitoring and Evaluation of the National Action Plan for Climate Change and Human Health (NAPCCHH) and conducted a national-level health vulnerability assessment for climate change.

Sub-national Policy

- **State Action plans on climate change (SAPCCs)**: Prepared and revised SAPCCs for states/UTs including Uttarakhand, Puducherry, Chandigarh, and Jammu and Kashmir.
- **State of environment reports (SoER)**: Prepared reports for Punjab and Chandigarh.
- **Sectoral GHG inventory and abatement**: Developed inventories and abatement options for various sectors.
- **Local action plans for air pollution control**: Guided state regulatory authorities through source apportionment studies, helping prioritize actions to achieve NCAP's interim target of a 20–30% reduction in air pollutant concentrations by 2024 for non-attainment cities.
- **SLCP concentration mapping**: Leveraging past project knowledge, TERI is mapping current SLCP concentrations and aiding the government in policy prioritization. We are also developing a coupled model approach to quantify the impact of air pollutants on climate, making TERI one of the few organizations in the country with this capability.

Corporate Actions

- **Carbon pricing handbook**: Developed a comprehensive handbook for corporates on carbon pricing.
- **Climate risk and disaster profiling**: Conducted profiling to ensure risk-free and sustainable business operations. Conducted climate change impact and vulnerability assessments for various industrial sectors and units.
- **Custom climate products**: Produced granular-scale climate products tailored for various stakeholders.
- **Strategies for net-zero and energy transition**: Developed emission inventories and outlined pathways for achieving net-zero and green energy transitions across various industries, with a particular focus on hard-to-abate sectors such as steel and cement.



National level emission inventory - Spatial distribution of PM2.5 emissions

Major Events Organized

S. No.	Programme	Venue	City	Mode	Area
1	Operationalizing the Loss and Damage Fund with Equity and Efficacy	COP28	Dubai	Physical	CCCR
2	Global Collaboration for Innovation and Sustainable Cooling: Solutions for Market Transformation	COP28	Dubai	Physical	CCCR
3	COP28 Debriefing: Contextualizing COP28 Outcome and Way Forward for COP29	TERI, IHC	Delhi	Physical	CCCR
4	TERI Side Event at Thirty-Fifth Meeting of the Parties (MoP) to the Montreal Protocol	MOP35	Nairobi	Physical	CCCR

5	Just Transitions for Land-based Climate Action in India	Jacaranda Hall, IHC	Delhi	Physical	CCCR
6	Mobilizing Finance for Low-Carbon Transition in India: Role of Green Bonds and Partnerships	TERI, IHC	Delhi	Physical	CCCR
7	Sustainable Agriculture for Food Security: Exploring Climate Action and SDG Synergies	Mapple, IHC	Delhi	Physical	CCCR
8	National Conference on Disaster Resilience-2024 Uniting Disaster Mitigation Stakeholders	Tamarind, IHC	Delhi	Physical	CCCR
9	Capacity Building Workshop for Financial Institutions on Technologies for Decarbonization Jointly organized by TERI and IBA, Supported by SED	TERI, IHC	Delhi	Hybrid	CCCR
10	Mobilizing Finance for Low-carbon Transition in India: Role of Green Bonds and Partnerships	TERI, IHC	Delhi	Physical	CCCR
11	Webinar Launch of Report on Financing the Decarbonization of Indian Secondary Steel Sector: Towards an Enabling Environment	TERI, IHC	Delhi	Physical	CCCR
12	Consultation Workshop on Decarbonization of Indian Secondary Steel Sector: Role of International Climate Finance, Jointly Organized with DIW, Berlin	Seminar Hall 2, IIC	Delhi	Physical	CCCR
13	Making Well-informed Decisions About Solar Radiation Modification A Session at Science Summit of UNGA, Jointly Organized with C2G, UNESCO, and The Degrees Initiative	Madison Hub, Convene, 101 Park Avenue	New York	Hybrid	CCCR
14	Taking Stock of India's Implementation Readiness, Jointly Organized with Climate Transparency and the Berlin Governance Platform	TERI, IHC	Delhi	Virtual	CCCR
15	How to Evaluate Implementation? Results from Piloting the Climate Transparency Implementation Check, Jointly organized with the Berlin Governance Platform	The Climate Week	Delhi	Virtual	CCCR
16	Combating the Silent Threat: Health Camp in Kanpur, Lucknow, Pune and Nashik Addresses Air Pollution Impact	Different locations in four cities	Lucknow, Kanpur, Pune, and Nashik	Physical	CAQR
17	Capacity-building Training Programme for the Officials of West Bengal Pollution Control Board on 'Emission Inventory, Source Apportionment and Carrying-capacity Study	WBPCB, Kolkata	Kolkata	Physical	CAQR
18	Training Programme on the MRS-based Audit System	Taj Hotel, Lucknow	Lucknow	Offline	CAQR
19	Capacity Building Workshops for School students	Pune and Nashik	Pune and Nashik	Physical	CAQR
20	Celebration of 'Clean Air for Blue Sky' Day. Themed on Samanvaya: Living in Harmony with Nature	Different locations in Pune, Kanpur, and Lucknow	Pune, Kanpur, and Lucknow	Physical	CAQR
21	Samanvaya, Every Step for Environmental Conservation	Different locations	Pune and Nashik	Physical	CAQR
22	National Conference on 'Strengthening Actions involving Communities for Cleaner Air and Better Future'	SS Jain Subodh PG College	Jaipur	Offline	CAQR
23	Stakeholders' Consultation Meetings on Conversion of Coal-based Tandoors to Gas-based Tandoors.	Directorate of Environment	Lucknow	Offline	CAQR
24	Panel Discussion on 'Best Practices for Air Pollution Management and Mitigation'	Juniper, IHC	New Delhi	Physical	CAQR

Ambient air quality monitoring

Partnerships and Networks

Government

Government of Punjab, Haryana, Uttar Pradesh, Jammu and Kashmir, Puducherry, Uttarakhand, National Disaster management Authority (NDMA), Ministry of Earth Sciences (MoES), National Institute of Disaster Management (NIDM), DGPC Government of Bhutan, municipal corporations, state pollution control boards, Central Pollution Control Board (CPCB), Delhi Pollution Control Committee (DPCC), MoEFCC, Department of Environment, CSIR NEERI, Punjab Council for Science and Technology (PSCST), Environmental Management and Policy Research Institute (EMPRI), Mahanadi Coal Fields, RITES.

Land based climate action, WSDS Thematic Track, February 2024

Non-governmental and Academic

Automotive Research Association of India (ARAI), Federation of Indian Petroleum Industry (FIPI), IIT Delhi, IIT Kanpur, Accenture, Calcutta University, Sky Gate, IIT Roorkee, KPMG, BCG, ITC

International

The World Bank, USAID, IGSD, SED, Royal Norwegian Embassy, IKI Foundation, McArthur Foundation, Swiss Agency for Development and Cooperation (SDC), Bloomberg Philanthropies, Environmental Defence Fund (EDF), UNEP, VITO Belgium, GIZ, RICARDO, Clean Air Fund (CAF), Vasudha Foundation, University of Aberdeen, EPFL, IIASA, PSI, University of Bern, Pure Earth, European Commission

Sustainable Agriculture for Food Security-Exploring Climate Action and SDG Synergies, WSDS Thematic Track, February 2024

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WASTE, WATER, AND **NATURAL RESOURCES**

The Waste, Water, and Natural Resources Programme's mission is to spearhead transformative solutions for sustainable resource management. We are setting a new standard for environmental stewardship by generation of carbon credits through nature-based solutions, unlocking nature's potential by valuing ecosystem services, and rehabilitating degraded lands. Using Sustainable Development Goals (SDGs) as way-posts, we develop innovative strategies for biodiversity conservation to strive for a harmonious coexistence between progress and nature. As both pioneers and providers of cutting-edge technologies, we are at the forefront of revolutionizing waste management, circular economy practices, wastewater reuse, and resource efficiency.

Themes and Commitments

The Waste, Water, and Natural Resources Programme (WWNR) is dedicated to addressing the issues related to management of natural resources, waste, and wastewater management through a multifaceted approach. The Programme holistically addresses the sustainability of natural resources by developing policy solutions and project-based interventions such as developing agroforestry-based carbon finance, reclamation of mined areas, community-based biodiversity conservation, application of technologies like remote sensing and GIS in resource assessment, circular economy, solid waste and wastewater management issues, and solutions for holistic waste management and resource optimization.

Programme Structure

The WWNR Programme divides its responsibilities amongst two divisions:

1. The Land Resources Division (LR)
2. Circular Economy and Waste Management Division (CEWM)

The Land Resources Division focuses on promoting sustainable forest and biodiversity management, providing solutions towards generating finance through carbon mechanisms for forests, and supporting the livelihood of forest-dependent communities. The Division operates through six areas.

Centre for Biodiversity and Ecosystem Services (CBES)

Primarily focuses on assessment, monitoring, and evaluation of management of forest ecosystem and biodiversity conservation, valuation and payment of ecosystem services. We develop effective strategies for environmental restoration and community development through REDD+ and ARR-based carbon finance projects. We work to address the intricate web of policies, social, and economic factors that underlie the most critical challenges associated with biodiversity loss and climate change.

Centre for Sustainable Land Management (CSLM)

Focuses to address the issues related to unsustainable land management practices, land degradation, rehabilitation and resettlement, mine reclamation. Organize training and capacity building on climate change, forestry, and provide policy support.

Centre for Forest Management and Governance (CFMG)

Focuses on research and implementation in the areas of forest management, governance, and policy. The Area is involved in monitoring, evaluation, training, and capacity building in natural resource management and implementing ARR (afforestation, reforestation, and revegetation)-based carbon finance projects.

Centre for Geospatial Technology Application (CGTA)

CGTA is working with the objective to play a key role in the management of natural resources and man-made environment with the blending of remote sensing (optical/thermal/microwave), GIS, artificial intelligence, machine learning and deep learning-based techniques.

Nutritional Security (NS)

Involves in implementing health and nutrition, environmental monitoring and reporting, waste management, and resource mapping-related projects. Along with these, the team is also engaged in conducting awareness and outreach.

Sustainable Services Management (SSM)

Deals with applied research on land-use change and ecosystem services, biomass assessment, nature-based technology interventions in securing water quality and quantity, applications of renewable energy in NRM, monitoring, evaluation, and impact studies of development programmes and watershed development project.

Circular Economy and Waste Management Division works towards application of research on policies, regulation, governance, technology deployment and capacity building on solid waste and wastewater management issues, assessment of resource-efficient cleaner production (RECP) potential in micro, small, and medium-scale industries (MSMEs) and solutions for holistic waste management and resource optimization. The Division operates through four areas.

Centre for Waste Management (CWM)

This Area is creating technologies (bio-methanation) and solutions to minimize waste generation and convert waste into energy/useful products

Resource Efficient Technologies (RET)

This Area provides resource efficiency, circular economy and sustainable consumption and production (SCP) consulting and implementation support in central and south Asia for small and medium enterprises (SMEs).

Bio-waste Technologies (BWT)

This Area evaluates diverse bio-waste samples collected from MSW, agricultural residue, industrial waste, and energy crops, to test the bio-methane yield and identify the best suitable feedstock for biogas plants.

NMCG-TERI Centre of Excellence on Water Reuse (NTCoE)

Jointly established by National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti (MoJS), GoI and TERI that has an objective to create platform for supporting targeted research and innovation to develop clean, green, cost and resource effective wastewater treatment technologies for reuse of treated water.

Our projects within the Waste, Water, and Natural Resources Programme significantly contribute to achieving twelve Sustainable Development Goals. Additionally, our efforts support the NDC target of creating an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent by 2030 through the expansion of forest and tree cover.

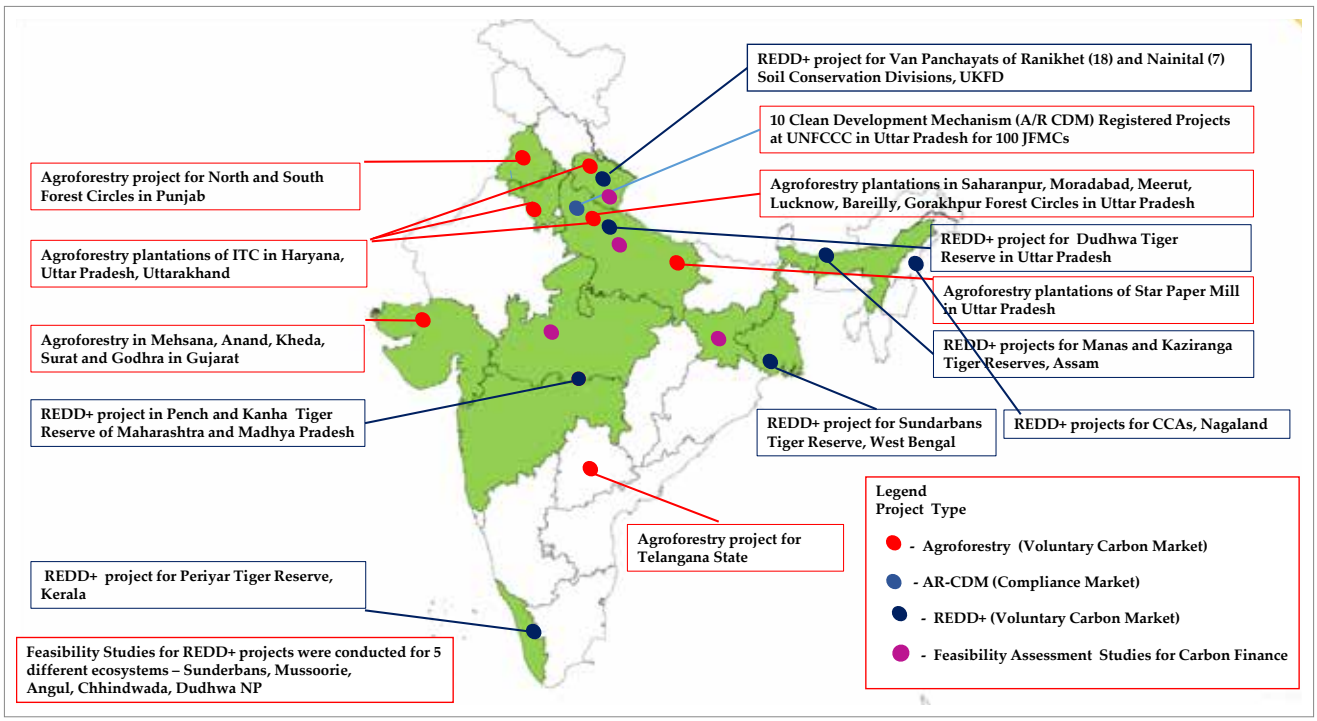
Our Accomplishments

In the last fiscal year, 64 projects were implemented under the WWNR Programme. These projects encompass afforestation, reforestation, and revegetation (ARR) and reducing emission from deforestation and forest degradation (REDD+) carbon finance projects in the agriculture, forestry, and other land use (AFOLU) sector, biodiversity assessment and ecosystem service valuation, waste management solutions, and circular economy strategies.

- We have provided livelihood support to over 2 lakh farmers and forest-dependent communities through carbon finance projects. Recently, in two of our ARR-based carbon finance projects in Punjab which are registered on VERRA platform, 684,620 carbon credits have been issued for the first monitoring cycle. These initiatives would provide livelihood support worth approximately INR 350,000,000 to about 3,686 farmers.
- During the previous fiscal year, we have focused particularly on the northeastern region of India, launching multiple carbon finance projects aimed at addressing the impacts of climate change on ecosystem services and improving the socio-economic conditions of the local communities. Key initiatives include a carbon finance project for community-conserved areas in Nagaland; developing climate change mitigation and adaptation strategies for forests and biodiversity in Assam; conducting a scoping study and feasibility assessment for carbon finance projects in Sikkim; implementing a project for agroforestry plantation and regenerative agriculture in Assam.
- We have been regularly organizing training workshops for officers of the Indian Forest Services (IFS). About 50 training workshops, sponsored by the Ministry of Environment, Forest, and Climate Change and participated by about 1500 IFS officers have been organized since 1991. In the last year, four training programmes were organized.
- TERI and Ion Exchange (India) have formed a strategic partnership by signing a TADOX® Technology and Trademark Licence Agreement (TTLA). This collaboration focuses on commercializing TERI's patented TADOX® wastewater treatment technology for industrial applications.
- Under the European Union Phase II Initiative, we have developed a reporting framework for the textile sector to promote circularity in textiles and apparel industries in India.
- We have collaborated with Rocky Mountain Institute for providing technical, analytical, and capacity-building support to promote methane mitigation activities to reduce methane emissions from India's municipal solid waste (MSW) sector.
- Our work has led to savings of energy, water, and materials along with minimized waste in SMEs from various sectors, leading to development of low-cost products from waste contributing to circular economy.
- We are working on techno-economic analysis (TEA) of compressed biogas (CBG) under the SATAT and GOBARDhan scheme.

Aggregate Numbers

- The Land Resources Division is currently implementing approximately 40 projects in the fields of ARR and REDD+ carbon finance within the AFOLU sector, biodiversity assessment, and ecosystem service valuation. These projects promote biodiversity conservation and empower local communities to sustainably utilize natural resources. Key initiatives include ARR projects for agroforestry plantations in selected districts of Gujarat, Uttar Pradesh, Punjab, Haryana, and Uttarakhand; REDD+ projects in Van Panchayats of Ranikhet and Nainital; REDD+ projects in Tiger Reserves such as Dudhwa, Periyar, Pench (Maharashtra), Pench (Madhya Pradesh), Sundarbans, Manas, Kaziranga, Kanha; Projects in Community Conserved Areas of Nagaland and Assam.
- The Circular Economy and Waste Management Division has been executing about 24 projects related to waste management solutions; study froth and micro plastic problem in Yamuna River; integration plan of TADOX® technology in 1.55 MLD CETP of textile cluster in Kanpur, GHG emission from wastewater in India; treatment and management of landfill leachates; bioenergy and related technologies, including feasibility studies for bio-CNG plants, assessment of Napier grass for CBG generation, and degradation studies of paddy straw; investigations into CBG/BMP potential in sugarcane trash and press mud; consultancy support for installing a cattle dung-based CBG plant in Jharkhand.
- Presently, the team is working on an assignment that is aimed at developing the natural wealth accounting system for Bangladesh and identifying payment for environment services (PES) schemes for conservation and preservation of natural resources.
- We are working on a project with HINDALCO for restoration of red mud dump sites by converting the alkaline inhospitable red mud deposits to a substrate which allows vegetative growth to develop green cover.



Projects under WWNR Programme for the fiscal year 2023/24

Approach and Innovation

Our initiatives focus on improving the sustainable management of biodiversity and ecosystem services through forestry and agroforestry-based carbon finance projects under REDD+ and ARR. The REDD+ projects in India are local projects being implemented in collaboration with forest department, EDCs, and local communities. The project addresses issues such as income generation, biodiversity conservation, and alternate sustainable livelihoods. We have also provided technologies and solutions to minimize waste generation and convert waste into useful products. TERI's patented technology, TADOX® (TERI's Advanced Oxidation Technology) treats municipal and highly polluted industrial wastewater having issues of high colour, high COD, BOD and dissolved organics.

Inspirational Evidences

- Our voluntary carbon market projects in tiger reserves of India are enhancing carbon sequestration, forest cover, and generate additional income to the dwellers of forest fringe villages.
- Our voluntary carbon market projects for agroforestry plantations in Uttarakhand, Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, and Gujarat are generating additional income to the farmers and restoring agrarian ecosystem.
- We have conducted study on estimation of carbon stocks in biodiversity conservation plots promoted under ITC's Mission Sunehra Kal Programme.
- Under India-Norway cooperation we have worked on building knowledge and capacity to tackle plastic and chemical pollution from important sources within key industries, public sector, and civil society.
- We have had developed research-informed evidence for policymaking, aiding government bodies for the formulation of state of environment reports and environmental policies.
- We offer extensive expertise in waste-to-energy technologies like incineration, gasification, and anaerobic digestion. This enables us to assess the environmental and social consequences of these technologies and suggest sustainable solutions that mitigate adverse effects while promoting energy recovery.
- We are deeply involved in understanding material flow analysis and life cycle assessment methodologies in waste management systems and our proficiency lies in evaluating the environmental effects of various waste treatment options and identifying avenues for integrating circular economy principles, where waste is repurposed as a valuable resource.
- A 10-KLD TADOX® based wastewater treatment plant that was commissioned in August 2020 has been working efficiently for treating mixed sewage

consisting of effluents from research laboratories, soil lab, canteen, hostel, and toilets in the TERI Gurugram campus. TADOX has received certification for compliance for Wastewater Management in Green Buildings norms, also included as a suitable product in GRIHA Catalogue.

Impact We Created

- Carbon finance projects are benefiting over 35,000 farmers across five states in India by generating an additional income of approximately INR 115 crore.
- REDD+ projects are benefiting around 700 EDCs/forest-dependent villages, generating an incentive of around INR 29.5 crore.
- The mine reclamation work is converting the red mud dump sites into usable form.
- Waste management studies, supported by GIZ, contribute to reduce, reuse and recycle (R3) concept of an integrated circular economy waste management system in the solid waste sector in cities such as Panjim and Varanasi.
- Our projects at CWM are addressing critical environmental and sustainability challenges across various sectors, ranging from combating plastic pollution in marine ecosystems and enhancing resource efficiency to assessing the state of the environment and accelerating industrial decarburization. Donors, including organizations like GIZ, CSIRO, and the Children's Investment Fund Foundation, provide crucial support for these endeavours.
- We are working closely with National Mission for Clean Ganga (NMCG) on pilot demonstration of TADOX® technology in textile CETP cluster, Rooma Kanpur. We are also working on a World Bank project with Bangalore Water Supply and Sewerage Board (BWSSB) to assess advanced treatment options, recovery and utilization of biogas, bio-solids and reusable water in the expanded Bengaluru area.
- RET Area is targeting 300 agri food SMEs in Uzbekistan and Tajikistan, 100 enterprises in tourism sector in Kerala, 100 enterprises from plastic value chain in Sri Lanka, 17 Business Development Service providers through Circular Economy Enterprise Incubation Training of Trainers (ToT), and 18 participants in Circular Economy Catalyst replicator workshop.

Knowledge Building and Dissemination

- Under the WWNR Programme, continuous efforts are made to consolidate learnings from various projects, build capacity of stakeholders, and disseminate achievements and key insights.
- In the previous fiscal year, four training workshops were organized for capacity building of over 160 frontline staff of forest departments and 14 stakeholder consultations under ARR and REDD+ projects were conducted where over 1000 participants were sensitized for natural resource conservation.
- We conducted 'Waste Clinic' in Lucknow for urban local bodies from Uttar Pradesh to diagnose waste management challenges in India, resulting in methane emissions and identify appropriate treatments or solutions (e.g., technical support, enhanced institutional capability and financial readiness). We also provide training on available tools and resources to improve waste management and reduce emissions. We also assist selected cities in building capacity and document these activities for replication thereby increasing impact.

TADOX® Technology and Trademark License Agreement signing

Farmers felicitated during stakeholder consultation in Vadodara

Group photo with participants of the IFS training workshop

- We conducted a workshop at Gwal Pahari, TERI, for urban local bodies from various parts of the country. The workshop aimed to lay the groundwork for waste management strategies that align with Swachh Bharat objectives, prioritize public health protection, minimize environmental impacts, and address the challenges posed by climate change (https://www.teriin.org/event/wastemap-workshop-key-strategies-organic-waste-management).
- Coinciding with TERI's 50th Year anniversary celebrations, the first Annual Meet and International Conference on advancing Circular Economy and Water Reuse was conducted under the aegis of the NTCOE together in collaboration of NMCG and FICCI. The event highlighted the importance of circular economy principles in water management, emphasizing the need for reducing, reusing, and recycling water resources.
- Within the framework of WSDS, the NTCoE organized a Thematic Track entitled Net Zero Possibility in Textile Sector. The event aimed at delivering key insights and outcomes of the successful pilot demonstration of TADOX® technology and released a policy brief based on this project (https://www.nmcgtericoe-wr.in/).
- Conducted international training on 'Risk Analysis Checklist and Anaerobic Digestion Screening Tool for Biogas Projects', supported by ABT Associates, USEPA and the MNRE.

Partnerships and Networks

The WWNR Programme maintains a close and collaborative partnership with the state departments across India, as well as with key ministries within the Central Government, including the Ministry of Environment, Forest, and Climate Change (MoEFCC), the Ministry of Tribal Affairs (MoTA), the Ministry of Rural Development (MoRD), the Ministry of Water Resources (MoWR), the Ministry of Urban Development (MoUD), and others. This extensive network actively engages in shaping national-level policymaking. Additionally, the Programme collaborates with numerous corporate entities, academic institutions, community-based organizations, multilateral and bilateral organizations on both national and international scales.

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

1 https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

2 https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

SUSTAINABLE INFRASTRUCTURE PROGRAMME

With extensive and rapid urbanization, the need for sustainable infrastructure has become much more pronounced than ever. In this regard, the Sustainable Infrastructure Programme dedicates itself towards reducing urban carbon footprints through utilization of the principles of sustainability in the built environment.

Themes and Commitments

Sustainable Infrastructure Programme (SIP) promotes sustainability in urban development by addressing the challenges of rapid urbanization and integrating sustainable practices in:

- Buildings
- Mobility
- Planning
- Governance

The SIP aims at creating innovative solutions for low-carbon resilient cities and infrastructure. It comprises three divisions:

Sustainable Buildings Division (SBD): The SBD provides innovative, integrated, and cost-effective solutions to mainstream the principles of sustainability in the buildings sector to stimulate low-carbon development pathways, leading to increased resilience and mitigation potential

Transport and Urban Governance Division (TUGD): Accelerating urbanization and rising resource consumption in India present opportunities to integrate resource efficiency and low-carbon pathways into urban sectors. Cities, while hubs for innovation, face complex challenges. Focusing on transport systems and governance can help address these issues, fostering sustainable development, economic growth, and inclusivity. The TUGD assists policymakers in urban management and transport, offering technical support for smart city planning, mobility policies, and innovative approaches like urban living labs. Our multidisciplinary team conducts research on energy, environment, and climate change impacts on urban growth and resilience.

GRIHA Council: The Council endeavours to advance the development of sustainable habitats, fostering sustainable and resilient built environment. It promotes and administers GRIHA rating tool, acknowledged as the national rating system for green buildings in India by the Ministry of New and Renewable Energy, Government of India. It holistically evaluates the environmental performance of built environment, thereby providing a definitive standard for sustainable habitats.

Sustainable Development Goals Addressed

Aligning with global commitments, the SIP addresses SDG 3, SDG 6, SDG 7, SDG 9, SDG 11, SDG 12, SDG 13, SDG 15, and SDG 17.

Regional Centres and Pan-India Operations

The SIP has regional centres in Bengaluru and Mumbai to strengthen outreach, implementation, and communication with the clientele for seamless project execution. The centres significantly contribute to the development of a strong network of stakeholders and collaborations including but not limited to government agencies, corporates, and bilateral organizations.

Our Accomplishments

In 2023/24, the SBD executed 26 projects across India, belonging to the given-below genres:

- Environmental design consultancy projects for green buildings (14)
- Research projects (8)
- Project management cells created for implementation of energy efficiency in buildings (2)
- Resource efficiency audits (2)

In 2023/24, the TUGD worked on 12 projects across India, pertaining to the following categories:

- Research projects (5)
- Training and capacity-building projects (3)
- Energy and environment analysis (4)

In the bygone year, the GRIHA Council was involved in an extensive number of projects, some of the worth-quoting examples are listed here:

- 808 projects were registered with GRIHA Council under diverse GRIHA variants.
- 830 projects were rated in the last financial year.
- 19 capacity-building programmes were conducted with diverse stakeholder groups.

- 1088 participants were trained in the capacity-building programmes.
- 3 Green Building Tours were conducted that were attended by more than 100 participants.
- 1240 new products were enlisted on GRIHA Product Catalogue.

Approach and Innovation

Sustainable Buildings Division: The Division addresses a wide range of sustainable building topics, including comfort, passive design, innovative materials, and energy efficiency. Implementation projects focus on local expertise to adapt energy conservation building codes and technologies to specific state needs.

Transport and Urban Governance Division: This Division emphasizes a holistic approach to decarbonization, sustainability, innovation, stakeholder engagement, and resilience. By integrating these elements, it fosters efficient, well-governed transportation and governance systems that enhance quality of life and promote sustainable development.

GRIHA Council recently launched the following:

- **GRIHA for Interior Spaces** for building interiors
- **GRIHA for Existing Schools Manual V3,** an extension to GRIHA for Existing Schools rating variant
- **GRIHA 50 Stories: Case Studies**, a book, that showcases top-rated, newly constructed projects of GRIHA, SVAGRIHA, Affordable Housing and Large Development ratings across diverse climatic zones of India

- GRIHA Council introduced GRIHA Green Building Tours for professionals, completing three tours in FY 2023/24: IIT Hyderabad, Bangalore International Centre, and Bestech House, Gurugram.

Inspirational Evidence

GRIHA Council

- **The flagship event '15th GRIHA Summit' Theme: Empowering Sustainable and Resilient Communities**

The event was held on November 23-24, 2023 and was graced by eminent personalities—Smt. Leena Nandan, Secretary, Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India; H. E. Mr Freddy Svane, Ambassador, Royal Danish Embassy, New Delhi, India; Shri Pramod Kumar Tiwari, Director General, Bureau of Indian Standards (BIS), Ministry of Consumer Affairs, Food and Public Distribution, Government of India; Dr Ajay Mathur, Director General, International Solar Alliance (ISA); Mr Sameer Pandey, IRS, Joint Commissioner [Admin], Navodaya Vidyalaya Samiti, Ministry of Education, Government of India, and other eminent dignitaries. More details on the Summit could be accessed via the URL https://www.grihaindia.org/grihasummit/.

Glimpses of 15th GRIHA Summit

'VIKALP' Exhibition: The 'VIKALP' exhibition at the 15th GRIHA Summit showcased real-scale models of bamboo and mud houses alongside light gauge steel frame structures, emphasizing informed decision making in selecting materials for green building construction

Exhibition 'VIKALP' organized during the 15th GRIHA Summit

- **Prelude events of the 15th GRIHA Summit**

GRIHA Council hosted a 'Sustainability Fair' on November 3, 2023, featuring workshops and competitions, engaging over 400 students from schools nationwide under the Paryavaran Rakshak Programme 2.0.

Sustainability Fair conducted for school children under the GRIHA Council's flagship initiative 'Earth ko Anarth Se Bachaye'

Technical workshop on Re-defining Thermal Comfort—the way forward was organized for diverse building industry professionals to educate and disseminate knowledge on indoor thermal comfort requirements.

Technical workshop on 'Re-defining Thermal Comfort: the way forward' conducted as a part of the Prelude events of the 15th GRIHA Summit

Transport and Urban Governance

Stakeholder workshop on 'Preparing Roadmap for Fleet Electrification of Department of Posts'

TUGD, TERI in collaboration with the Department of Posts, India, and Shakti Sustainable Energy Foundation, successfully organized a stakeholder workshop—'Preparing Roadmap for Fleet Electrification of Department of Posts, India'—on January 9, 2024. The workshop convened stakeholders to discuss key findings, technical terms of reference for electric vehicle (EV) procurement, and the draft EV roadmap. This initiative is a significant step towards electrifying the existing mail motor service (MMS) fleet in the India Postal Service.

TUGD, TERI collaborated with the Department of Science and Technology under Mission Innovation 2.0 for Advancing Clean Energy with Data

TUGD moderated a discussion on the status of data related to research, development, and demonstration (RD&D) in Clean Energy on March 21, 2024. TERI is actively engaged in Mission Innovation 2.0, collaborating with the Department of Science and Technology to harness the power of data for clean energy development. The session saw participation from key stakeholders including ministries, departments, public sector undertakings (PSUs), and Government of India-supported institutions. With the development of standardized frameworks for data collection and reporting on RD&D expenditures at the Central Government level, the aim is to foster transparency and coherence in documenting formal expenditures directed towards RD&D initiatives, ultimately fortifying the foundation for innovation and sustainable development in the clean energy sector.

TUGD, TERI supported DMRC for the CarbonLite Metro Travel initiative

TUGD, TERI supported the Delhi Metro Rail Corporation (DMRC) in conducting an awareness-building initiative to educate passengers about the carbon emission

reductions achievable by choosing the metro over motorized road transport in Delhi. TERI has estimated the per passenger kilometre emission from the metro and five motorized modes of road transport and provided DMRC with detailed CO_2 emissions, saving impact of Delhi Metro visa vie motorized modes of road transport. The DMRC on August 9, 2023, rolled out the

Metro tickets showing the amount of CO_2 emissions saved

project with due credit to TERI. This initiative has greatly received media attention, highlighting its positive impact.

TUGD, TERI hosted 14th Clean Energy Ministerial/ 8th Mission Innovation 'Technology and Cultural Showcase' and 'Zero Emission Truck and Bus Showcase' in Goa

TUGD, TERI hosted the Technology and Cultural Showcase at CEM14/MI8 in Goa from July 19 to 22, 2023. The event highlighted zero-emission vehicles, hydrogen fuel cells, EV-charging infrastructure, battery swapping, and clean tech start-ups. It was inaugurated by Goa's Chief Minister, Dr Pramod Sawant, and attended by key officials including Dr Jitender Singh. Curated by TERI and Shakti Energy Foundation, the 'Zero Emission Truck and Bus Showcase' demonstrated innovations for India's decarbonization and attracted over 4,000 students from 100+ schools and colleges.

Technology and Cultural Showcase, Goa

TUGD, TERI signed a memorandum of understanding (MoU) with Urban and Training Institute and Directorate of Urban Local Bodies, Government of Uttar Pradesh

TUGD, TERI signed an MoU with Urban and Training Institute and Urban Local Bodies, Government of Uttar Pradesh on July 28, 2023 to collaborate on several sustainable urban development domains. The MoU was signed between Dr Nitin Bansal, Director, Urban Training and Research Institute and Urban Local Bodies, and Mr Sanjay Seth, Senior Director, Sustainable Infrastructure Programme, TERI. As an outcome of the signing of the MoU, TERI will actively engage with the State Government of Uttar Pradesh in providing technical and handholding assistance, knowledge generation and dissemination, policy alignment, and capacity-building support.

Sustainable Buildings

- **Roundtable discussion on 'Towards the Development of a National Guiding Framework on Sustainable Cooling and Thermal Comfort'**

The Sustainable Buildings Division of TERI organized a roundtable on 'Developing a National Guiding Framework on Sustainable Cooling and Thermal Comfort' on June 8, 2023 at India Habitat Centre, New Delhi. Experts from government, academia, industry, and the World Bank discussed strategies to accelerate the adoption of efficient cooling solutions and enhance urban resilience.

- **Roundtable Consultation on 'Developing a National Guiding Framework for Accelerating the Implementation Of India's Cooling Action Plan (ICAP)'**

On September 27, 2023, TERI's Sustainable Buildings Division hosted a national roundtable at the India Habitat Centre, focusing on strategies to accelerate ICAP. Key experts from government, academia, industry, and the World Bank discussed innovative cooling solutions and urban resilience. Chaired by Mr Kuldip Narayan (MoHUA) and Mrs Rajasree Ray (MoEFCC), the event strengthened collaboration between TERI, the World Bank, and stakeholders to advance ICAP's objectives.

- **Roundtable Discussion on Reducing Carbon Footprint and Developing Climate-resilient Infrastructure**

TERI along with Deakin University, Australia organized a roundtable discussion, Reducing Carbon Footprint and Developing Climate-resilient Infrastructure, on March 5,

2024, at TERI, New Delhi. This session brought together a select group of experts to craft strategies, discuss challenges, opportunities, and on-going work in low-carbon pathways and climate-resilient infrastructure, aiming to forge collaboration between TERI and Deakin University, Australia.

- **Stakeholder consultation between DSIR AND TERI for transformative stakeholder consultation event**

TERI and DSIR held a stakeholder consultation on advancing construction and wastewater treatment, aligning A2K+ studies with smart cities and net-zero goals, focusing on energy-efficient materials and wastewater systems.

- **SBD, TERI organized an open house session on affordable housing and thermal comfort**

TERI's SBD hosted an open house on aligning affordable housing with thermal comfort, energy, and resource efficiency, bringing together experts from government, academia, industry, and non-governmental organizations (NGOs).

Technology and Cultural Showcase, Goa

Impact We Created

- GRIHA Council was honoured to receive a message from the Hon'ble Prime Minister Shri Narendra Modi for the 15th GRIHA Summit, published in the 10th edition of the GRIHA magazine, *Shashwat*.
- With over 4,100 projects registered, covering 1 billion sq. ft., GRIHA-rated projects have installed 599 MWp of renewable energy, saved 29,700 GWh of energy, prevented 8,400 gigatonnes of CO_2 emissions annually, and contributed to water savings of 104 gigalitres/year. Additionally, 2,66,923 new trees have been planted and 28,000 preserved.
- GRIHA Council received the 'Best National Brand of the Year' award at the Global Smart Build Summit 2023 and became a member of the Climate Technology Centre Network (CTCN).
- In 2023/24, 808 new projects were registered, 82 were rated, and 360 were certified under JAN GRIHA. The cumulative impact of rated projects includes 19.65 kL/year water savings, 679.83 MWh/year energy savings, and 696.29 tonnes CO_2 reduction.
- Key projects included the Water Positive Certification for ABB India Limited and DS Group, evaluation of 376 Jawahar Navodaya Vidyalayas.
- An 8-day online workshop was organized on Corporate Sustainability and ESG Reporting wherein 25 corporate professionals attended the training programme. GRIHA conducted 16 professional exams.
- We also hosted the Fifth Consultant Meet, announcing the 1st GRIHA Valuable Contributor Awards for Consultants.
- Water sustainability Awards: Initiated in the year 2022, these awards aim to encourage the achievement of the Sustainable Development Goal on Water by way of reducing water footprint among various stakeholders through the adoption of the 'water neutrality' approach. The Awards are spread over multiple categories and domains within the water sector and hence recognize multiple stakeholders' role.
- The Water Sustainability Awards evaluate excellence in all kinds of new ideas, approaches, processes, products, services, technologies, and other types of innovations in the water sector which can tangibly address the SDGs.
- Government officials trained under NJJM Har Ghar Jal Capacity Building training programmes: Senior and middle management-level officials were trained as part of capacity building programme under Har Ghar Jal, National Jal Jeevan Mission (NJJM) scheme launched by the Government of India in the year 2019. The participants under these capacity building programmes are senior and middle-level management officials across different districts, states and UTs of the country.

Transport and Urban Governance

- TUGD is supporting India Post in developing a comprehensive roadmap for electrification and initiating pilot projects in six cities, paving the way for a greener postal network.
- The Ministry of Heavy Industry has assigned TERI's TUGD to spearhead the task force addressing skill gaps and workforce development in the emerging green technology sectors.
- TUGD, TERI is partnering with the Indian Railways to introduce Rail Green Points aimed at carbon capture, and to develop a comprehensive dashboard for monitoring and reporting progress.
- TUGD is facilitating the implementation of emission estimation protocols for large shippers in India, integrating these efforts with the Carbon Credit Trading Scheme (CCTS) to incentivize reductions.
- TERI has been recognized as the National Centre of Excellence in Green Ports and Shipping, focusing on innovative practices such as the just-in-time arrival of ships to enhance efficiency and sustainability.
- TUGD is championing the creation of a sustainable and resilient urban environment through climate

- action initiatives, including the establishment of a Climate Cell in Uttar Pradesh to drive local climate strategies.
- TUGD has successfully engaged city authorities and stakeholders in participatory governance through innovative approaches like urban living labs, implemented in cities such as Visakhapatnam, Panaji, Coimbatore, and Shimla, fostering inclusive and sustainable urban development.

Sustainable Buildings

- TERI supported the implementation of the Energy Conservation Building Code (ECBC) and Eco-Niwas Samhita (ENS) in Ladakh and Odisha, and facilitated the inclusion of climate resilience in byelaws of five states—Madhya Pradesh, Chhattisgarh, Maharashtra, Andhra Pradesh, and Goa.
- The Mahindra–TERI Centre of Excellence (MTCoE) launched the Daylight Plug-in tool, enabling precise daylight simulations tailored to India's tropical climate, optimizing building design for energy efficiency.
- MTCoE's building material-testing services are aiding industry and academia in evaluating thermal performance, promoting energy-efficient construction. Additionally, a UV-Vis-NIR Spectrophotometer was installed at MTCoE Lab to measure solar thermal properties of reflective materials and coatings, enhancing building performance.

Panellists of 'A Roadmap for Mainstreaming Inclusive Climate Action Planning in Urban Landscapes' at the World Sustainable Development Summit (WSDS)

Participants of the panel discussion on 'Decarbonizing Freight in India: Turning Ambition to Action'

Water Resources Division

- **Water Resources Division (WD), TERI organized an outreach workshop under National Water Mission (NWM)on December 18, 2023**

The WRD organized a workshop on 'Benchmarking Industrial Water Use to assist policy for enhancing Industrial Water Use Efficiency in India'. Various experts and stakeholders from government organizations, industries, businesses, and academia attended the workshop. The objective of the workshop was to disseminate the outcomes of the study, including a review of the current water use scenario in thermal power plants, textile industries, pulp & paper industries, and iron & steel plants.

- **Final Conference under Pavitra Ganga Project was organized on January 24, 2024**

TERI and VITO, in collaboration with Indian and European Partners, organized a conference on 'Wastewater Treatment and Reuse: Challenges and Solutions in India' at India Habitat Centre, on January 24, 2024. The conference witnessed participants from diverse backgrounds, along with the 14 project partners including: VITO, IHE Delft, TU Delft, Bochum University, Fachhochschule Nordwestschweiz, Consiglio Nazionale delle Ricerche, Akvo, Aquafin, and AQUA-Q from Europe as well as TERI, IIT Delhi, IIT Kanpur, IRAP, and Ion Exchange from India.

- **Release of policy brief in WSDS**

The policy brief titled 'Benchmarking Industrial Water Use Efficiency in India: Opportunities for Water-Intensive Industries' was launched at WSDS 2024 by Dr Vibha Dhawan (Director General, TERI), Mr Anshuman (Director, Water Resources, TERI) and Mr Mannu Ji Upadhyay (Director, Bureau of Water Use Efficiency, National Water Mission, Ministry of Jal Shakti, Government of India). Shri Gajendra Singh Shekhawat (Hon'ble Union Minister, Ministry of Jal Shakti, Government of India), in his video message, expressed appreciation for the work done by TERI and looked forward to future collaboration.

- **Residential training programme for senior management and middle management officers under National Jal Jeevan Mission (NJJM), Ministry of Jal Shakti (MoJS), Government of India**

A capacity-building training programme on the theme: Utility Reforms for Rural Water Supply was organized for senior management officials between 1 and 2 November 2024. The training programme was attended

by Additional Mission Directors, Chief Engineers, Executive Engineers and Superintending Engineers from Puducherry, Tamil Nadu, Maharashtra, Kerala, Bihar, Goa, Uttar Pradesh, Haryana, Rajasthan and Andaman and Nicobar states/UTs.

- **Launch Event: Water Sustainability Campaign: Forging a Water Smart Delhi**

A campaign titled 'Water Sustainability Campaign: Forging a Water Smart Delhi' was launched by Shri Durgesh Pathak, MLA Rajendra Nagar Assembly, in Delhi to sensitize its residents about the value and preciousness of water in October 2023. Initiated by TERI with support from JWIL Infra Limited, the campaign aimed to raise awareness in all levels of society about the importance of saving water.

- **Nukkad Nataks organized as part of Water Sustainability Campaign**

An initiative within the 'Water Sustainability Campaign' was initiated on October 28, 2023, in Naraina Vihar. TERI, in collaboration with JWIL Infra Limited, coordinated a sequence of street plays (*Nukkad Nataks*) continuously for 2 months, across different parts of Delhi which included Anand Parbat, Daya Basti, East Patel Nagar, Gulabi Bagh, Inderpuri, Naraina Vihar, Prasad Nagar, Sarai Rohilla, Shadipur, and Shastri Nagar.

- **RWA meeting organized under 'Water Sustainability Campaign' by TERI in Prasad Nagar, New Delhi**

As part of the 'Water Sustainability Campaign', TERI had organized a stakeholder consultation meeting with the residents of DDA MIG Flats, Prasad Nagar, New Delhi on January 31, 2024. Mr Sumit Bajaj, the RWA President of Prasad Nagar, played a pivotal role in disseminating information about the event to ensure local participation and benefit from the discussions.

- **Residential Training Programme for Middle Management Level Officers (Level 2) Under National Jal Jeevan Mission (NJJM), Ministry of Jal Shakti (MoJS), Government of India**

The capacity-building training programme on theme: Impact of Climate change on Water Supply in Cold Regions and its Management Mitigation Measures was organized during 5–7 March 2024 at Dehradun. The three-day programme was attended by the AEs, AAEs, JEs, etc,. from different districts of Himachal Pradesh, Uttarakhand and Ladakh across Himalayan states/UT. Dr S. K. Sarkar (IAS Retd) gave the opening remarks and Ms Neelima Garg, shared the keynote address. On the third day of the field trip to the Water Learning Centre at Himmotthan Pariyojana in Chureddhar village, Chamba, Uttarakhand, the group was led by Mr Nikhil Pant, an expert geologist from the Himmotthan Society.

- **Third Water Sustainability Awards 2023–24**

The prestigious third edition of Water Sustainability Awards (WSA) was organized by TERI on the eve of World Water Day 2024. The event was an occasion to recognize the efforts of the people who had made significant contributions towards advancing the water sustainability initiatives under the umbrella of Sustainable Development Goals, by the United Nations, on the theme, 'Leveraging Water for Peace'. The tone for the main event of the day was set with the inaugural address by the Chief Guest, Mr Bharat Lal, Secretary General, CEO of the Commission National Human Rights Commission (NHRC). The Water Champion awards were given to Dr Sonam Wangchuk in individual capacity, while Paani Foundation was awarded the Water Champion at the institution level.

Knowledge Building and Dissemination

The SIP brought out more than 60 knowledge and information dissemination publications under the following heads:

- Green booklets: 1
- Manuals: 2
- Magazines: 1
- Research Papers: 6
- Articles and Op-ed: 33
- Policy Briefs: 7
- Newsletters: 20

Sustainable Buildings, TERI organized two thematic tracks during the World Sustainable Development Summit 2024.

Thematic Track 1: Sustainable Skylines: Enabling Tomorrow's Architecture with a Web-based Knowledge Hub on Advanced Building Materials and Energy-efficient Design

Thematic Track 2: Advancing Sustainable Building Practices: Role of Laboratories and State-of-the-art Infrastructure to Enhance Energy and Thermal Comfort

Thematic session: 'A Roadmap for Mainstreaming Inclusive Climate Action Planning in Urban Landscapes' during the World Sustainable Development Summit (WSDS)

TUGD, TERI conducted a panel discussion on 'Decarbonizing Freight in India: Turning Ambition to Action' at the World Sustainable Development Summit (WSDS)

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

[1] https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

[2] https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

INDUSTRIAL BIOTECHNOLOGY (IB) PROGRAMME

The goal of the Industrial Biotechnology (IB) Programme is to protect the environment while developing long-term solutions that may be widely applied in India's quickly developing economy.

Thematic Focus

Through continuous research and innovation, the Industrial Biotechnology Programme has significantly aided in the development of bio-based products, the bioremediation of oil-contaminated land, oil spills, and oily sludge, as well as the creation of sustainable energy over the past 30 years.

An extensive research programme led to the development and commercialization of indigenous technologies, including PDB (paraffin degrading bacteria), which prevents paraffin deposition in oil well tubing, and "Oilzapper," a globally recognized microbial consortium for bioremediation of oil spill sites and treatment of oily sludge generated by oil refineries. Another indigenous technology is "MEOR," or Microbial Enhanced Oil Recovery from matured oil wells. ONGC TERI Biotech Ltd (OTBL) was the joint venture incorporated to market these innovations. (www.otbl.co.in)

Microbial Biotechnology (MB)

Microbial biotechnology area deals with using bacteria to provide long-term, economically viable solutions. The successful demonstration of increased methane output from coalbed methane (CBM) wells is one such instance. Various microbial strains have been selected to restore pesticide and many other persistent organic pollutants (POPs) contaminated areas, such as polychlorinated biphenyls (PCBs). In addition, the development of value-added products from industrial waste through biological processes has been significant. Notable achievements include the production of precipitated calcium carbonate (PCC) from industry waste containing calcium oxide and the fermentation of CO_2 gas to produce succinic acid.

Bioremediation Technology (BT)

The current work in the bioremediation domain entails large-scale application of microbial product, primarily focuses on bioremediation of oil spill sites in oilfields, as well as sites contaminated by pesticides and other organic pollutants contaminated sites. We also perform evaluations of the soil, water, and vegetation for environmental quality.

Before bioremediation of oil contaminated land

After bioremediation of oil contaminated land

Bioremediation of oil contaminated site at farmer's field with the application of Oilzapper

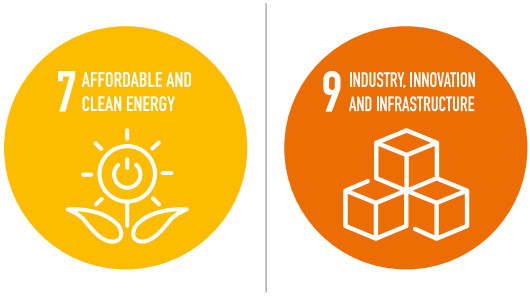
Fermentation Technology Research Centre

TERI conducts extensive research on fermentation technology and has built a cutting-edge state-of-art bioreactor facility, the Fermentation Technology Research Centre (FTRC), at TERI Gram, Gurugram. The Centre is equipped with bioreactors that hold 1, 3.2, 15, 30, 100, 200, 1500, and 15,000 litres capacities. Additionally, the facility is used to develop bio-based technologies and products including carboxymethyl hydroxypropyl guar (CMHPG) and XC polymer (xanthangum), which are utilized in the hydro-fracturing of oil reservoir rocks and drilling of oil wells, respectively. These hold great potential for use in industrial settings including food production and oil well drilling.

Fermentation Technology Research Centre (FTRC), TERI Gram, Gurugram

Larger Goals and the Context

- Six SDGs are covered by EIB research projects: SDGs 7, 9, 12, 13, 15, and 17.



The programme's focus is on collaborating with the public and private sectors to identify sustainable solutions for issues related to environment and industry.

Approach and Innovation

The IB Programme focuses on basic and applied research, additionally investigating environmentally friendly options and encouraging technical innovation for the oil and gas industry.

Our Accomplishments

The Department of Biotechnology (DBT), the Department of Science and Technology (DST), the Department of Scientific and Industrial Research (DSIR), the Defence Research and Development Organization (DRDO), the Oil and Natural Gas Corporation (ONGC) Ltd, Institute of Reservoir Studies, ONGC, Ahmedabad, Oil India Ltd (OIL), Chennai Petroleum Corporation Ltd (CPCL), and a few other notable private entities, including Essar Oil & Gas Exploration & Production Ltd (EOGEPL), Vedanta Ltd (Cairn Oil and Gas), Reliance Industries Ltd, and Indian Synthetic Rubber Private Limited, funded 14 projects for the fiscal year 2023–2024. The Programme has used the state-of-the-art bioreactor facility to successfully manufacture inventions on a big scale.

Other key accomplishments include the following:

- Hiring of services for in-situ and ex-situ bioremediation of oily sludge/oil contaminated soil/water of various production installations, fields and water bodies in Assam and Arunachal Pradesh fields for a period of 3 years extendable by another 1 year.

- Bioremediation work of oily sludge, oil contaminated soil at various production installations, fields and water bodies in Assam and Arunachal Pradesh fields of Oil India Limited (OIL), Duliajan, Assam were undertaken by TERI, New Delhi. The scope of work includes 30,000 m^3 of in-situ bioremediation and 15,000 m^3 of ex-situ bioremediation for oily sludge/oil-contaminated soil. TERI has successfully completed in-situ bioremediation of a total volume 20,671 m^3 oily sludge and oil-contaminated soil. Currently, 11,825 m^3 of oily sludge and oil-contaminated soil is undergoing bioremediation. After bioremediation, less than 5,000 mg/kg total petroleum hydrocarbon (TPH) or oil concentration was achieved in oil-contaminated soil/oily sludge in 4–6 months.

Bioremediation site before and after oil contamination bioremediation 513, Digboi, Assam

Bioremediation site before and after oil contamination NHK-207, OCS-8, Sasoni, Assam

- **Assessment of environmental quality of oil spill contaminated sites at Chennai Petroleum Corporation Ltd (CPCL) due to Cyclone Michaung**

  Due to the recent landfall of Cyclone Michaung between Buckingham Canal and Ennore Creek, major rivers in Chennai overflowed, wreaking havoc in low-lying communities along their banks, including the Coovum, Buckingham Canal, and Adyar River. After clean-up drive in Ennore creek, CPCL invited TERI to assess the environmental damage of the impacted area. TERI conducted environmental assessments and sampling activities on December 28–29, 2023. Samples of water, sediment, vegetation, and fish were gathered from the Buckingham Canal to Ennore Creek, which included the Kosasthalaiyar River's backwaters.

Assessment team collecting sample in sea

Sludge sample collection

- **Bioremediation of oily sludge waste generated in Chennai Petroleum Corporation Ltd. (CPCL) Tamil Nadu**

  Recently, TERI was given the go-ahead to bioremediate the waste oily sludge produced by CPCL utilizing oilzapper technology through an open tender process. Approximately, 500 metric tonnes of oily sludge were being treated using bioremediation. Starting in June 2024, the effective bioremediation procedure aims to reduce total petroleum hydrocarbons (TPH) to below 0.5% in order to meet bioremediation targets.

Application of Oilzapper at CPCL

- **Feasibility and demonstration of biodegradation of polymer lumps (PAM/HPAM) used in oil operations and their application**

  Partially hydrolyzed polyacrylamide (HPAM) is widely used in oil fields to enhance or improve the recovery of crude oil from the reservoirs. This project aims to offer a sustainable solution for in-situ polymer degradation via microbial action. Successful development of selected HPAM-degrading microbial strain has been achieved in the laboratory for degradation of polymer used in Barmer oil fields, Rajasthan provided by Cairn Oil and Gas, Vedanta Limited. In-situ field demonstration of the developed process shall be performed in the oil wells for efficient and environmentally friendly removal of polymer lumps.

- **Microbial corrosion study and sulphate reducing bacteria (SRB) monitoring in MBA field**

  Funded by Cairn Oil and Gas, Vedanta, this project deals with the study of corrosion caused by sulphate reducing bacteria (SRB) in the pipeline network of the Mangala-Bhagyam-Aishwarya oil fields. The study confirms and estimates the presence of SRB and other microbes that support SRB activities directly or indirectly and contribute to microbial induced corrosion (MIC). The main objective of this study is to control the MIC through microbial intervention. The study is pivotal for the investigation of the root cause of corrosion and identification of remedial and/or preventative actions.

- **Development and demonstration of bioconversion of carbon dioxide to methane using hydrogenotrophic methanogens in coal seams**

- **Feasibility and demonstration of in-situ stimulation for biological methane generation/enhancement from marginal/non-producer CBM wells of Bokaro Asset**

  TERI in collaboration with ONGC Energy Centre developed a process to stimulate methane generation in the marginal and non-producing wells by providing the indigenous microbes with specific nutrients which supports the growth of microbes involved in methane generation. At the lab scale, the study demonstrated significant increase in biological methane production. The study has been

implemented on field and currently the coal bed methane wells are under monitoring stage.

- **Demonstration for re-validation of in-situ bio-stimulation and bio-augmentation for enhancement of methane in three (03) marginal CBM wells of Bokaro/Jharia**

  TERI in collaboration with ONGC Energy Centre developed a biostimulation and bioaugmentation process which resulted in 4–5 folds of biogenic methane generation and resulted in significant profit to ONGC. In this project, revalidation of the previous biostimulation process in different CBM wells located in Jharia region has been performed. Design of specific nutrient recipe in consideration with the indigenous microbes resulted in significant enhancement in the biogenic methane generation.

- **Resident microbial enhanced production pilot in the onshore oil fields of Gujarat**

  TERI, in collaboration with the Institute of Reservoir Studies (IRS), developed a stimulation process targeting the indigenous microbial diversity present in the reservoirs. This approach facilitated the production of various bio-metabolites, including gases, acids, and biosurfactants, which play a crucial role in enhancing oil recovery. This initiative not only addresses the challenges associated with declining oil recovery rates but also promotes sustainable practices in oil extraction through the innovative use of microbial technology. The findings have significant implications for improving oil recovery efficiency while minimizing environmental impact.

Application of coal bed methane (CBM) technology in CBM wells

- **Bioremediation of oil-contaminated site using 'Oilzapper' technology**

  In 2023/24 around 618 tonnes of Oilzapper and 20 tonnes of other products were produced at the FTRC and supplied to user industry and utilized for the treatment of oil spills/contaminated soils, primarily in oil fields owned by oil firms.

- **Lab demonstration for CO_2 utilization and production of precipitated calcium carbonate (PCC) using bypass dust and carbon dioxide in a reactor**

  The possibilities for reducing carbon dioxide (CO_2) emission from the cement industry by production of precipitated calcium carbonation (PCC) were demonstrated. In our lab-scale set-up, we demonstrated the production of pure PCC using CO_2 and chlorine bypass waste generated by the cement industry. For every 1 kg of purified PCC produced, approximately 1.2 kg of bypass waste from the cement plant is required. In this process, we have captured around 440 grams of CO_2 utilized to produce 1 kg of calcium carbonate.

- **Development of controlled release P-fertilizer (CRPF) and its evaluation with plant growth-promoting rhizobacteria (PGPR) on soybean productivity and soil microbial health**

  There is a huge demand for development of a sustainable management of phosphatic fertilizers through control release along with maintenance of the moisture conditions in soil. This project focuses on the mitigation of the low efficiency of phosphatic fertilizers with enhanced P-use efficiency and development of a nanofiller-based natural product for control release of P fertilizers.

- **Degradation of polychlorinated biphenyls (PCBs) by microorganism**

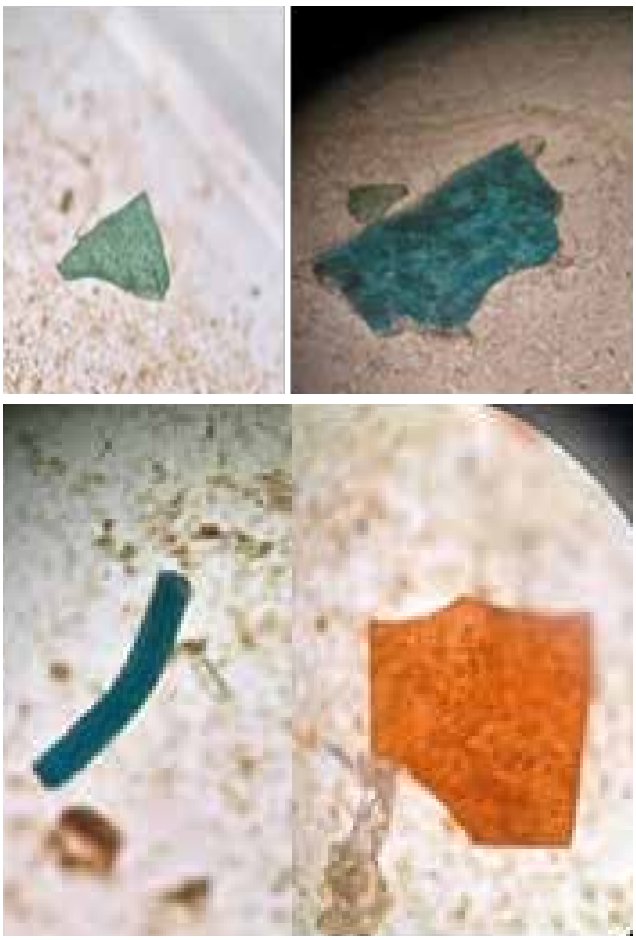
  Polychlorinated biphenyls (PCBs) are aromatic compounds that are either oily liquids or solids ranging from colourless to light yellow widely used for a variety of industrial and commercial applications. Our findings highlight the potential synergistic effects of co-culturing different microbial strains, wherein their combined metabolic activities contributed in enhanced PCB degradation. Understanding and harnessing these synergies hold significant implications for the development of effective bioremediation strategies targeting PCB contamination. By leveraging the complementary abilities of diverse microbial species, it becomes possible to optimize degradation processes, potentially leading to more efficient and sustainable remediation approaches. These results underscore the importance of exploring microbial interactions and employing consortia-based approaches in environmental biotechnology for addressing complex pollutant challenges such as higher chlorinated PCBs.

Inspirational Evidences

Abatement of microplastics and associated pollution by using biodegradation and nano-materials

Microplastics (MPs) pollution has emerged as a major environmental concern globally in recent years, as it impacts both aquatic life and mankind. MPs are plastic particles that are less than 5 mm in size and because of their minute size, bioaccumulation capacity, biological toxicity, and biomagnification potential; they have been recognized as 'emergent water pollutants'.

TERI is working on the project on abatement of microplastics and associated pollution by using bio-degradation and nano-materials funded by the Department of Biotechnology, Ministry of Science and Technology. The main aim of this project is to understand the occurrence, fate, and removal of MPs, including their recent detection status and advanced sustainable removal technologies in wastewater treatment plants. As part of this project, microplastics were quantified in wastewater collected from various treatment plants in New Delhi. We are also collaborating with the Indian Institute of Technology, New Delhi, to explore biodegradation and nanomaterial-based bioremediation of microplastics.



Microscopic images of microfibres, films, and fragments of MPs

Enhanced production of xanthan gum using novel *Xanthomonas campestris* teri007 for the oil well drilling application

Oil industries use xanthan gum (XC Polymer) as a viscosifier agent to increase the mud's viscosity during oil well drilling. As more than 90% of xanthan gum is imported by Indian oil companies for the oil well drilling, TERI initiated indigenous xanthan gum research in the year 2014. TERI has achieved up-scale production of xanthan gum polymer followed by its application in oil well drilling field trials funded by the Department of Biotechnology (DBT) under ATGC scheme in the year 2022. Due to the superior quality of the developed xanthan gum, TERI successfully demonstrated the xanthan gum in drilling of three oil wells and achieved Technology Readiness Level (TRL level 8). Further to commercialize the developed product, ONGC TERI Biotech Ltd (OTBL) has come up with a Detailed Feasibility Report (DFR) for the 10 tonnes/day xanthan gum production facility. The xanthan gum production process was filed for the patent.

Testing of xanthan gum (XC) in the drilling of oil wells in Gujarat oilfields

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

[1] https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

[2] https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

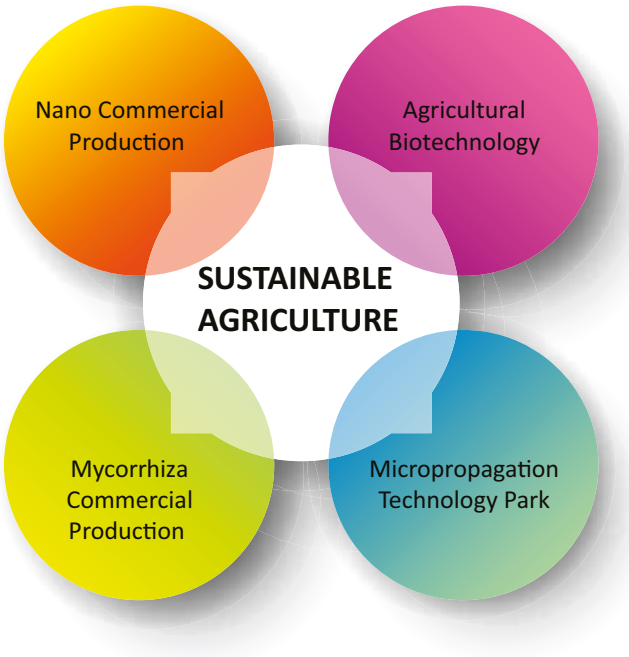
SUSTAINABLE AGRICULTURE PROGRAMME

The Sustainable Agriculture Programme (SAP) dedicates itself towards creating innovative solutions and developing new opportunities for profitable farming and livelihoods while conserving natural resources. Our vision is "More with Less" that means achieving more productivity with less input resources.

Themes and Commitments

At TERI's Sustainable Agriculture Programme, our innovations are focused on increasing productivity, enhancing resource-use efficiency, and strengthening sustainability in agriculture. We create innovative solutions for profitable farming through substantial improvement in plant and soil health, while economizing natural resources and making our soil live again. Our focus is on sustainable agriculture, environment, improving crop productivity and production, and reducing carbon footprint. Our research spans key areas to enhance plant and soil health and climate resilience, revolutionizing farming practices.

Thematic Focus and Key Areas



Agricultural Biotechnology (ABT)

- Understanding soil microbiome engineering and developing microbial products applied in the soils to enhance crop yield and minimize farming's carbon footprint.
- Converting agricultural waste into valuable products for agriculture and non-agriculture purposes.
- Innovative solutions are developed for improving food, feed production, nutraceutical and functional food supplements for animal and human health.
- Producing natural pigments for textile dying from microbes such as bacteria, algae, fungi and lichens to reduce water, soil, and air pollution.

Nano Commercial Production (NCP)

- Nanomaterials, such as nano fertilizers, nano pesticides/insecticides, and nano carriers for Agri-inputs and pharmaceutically important bio-actives are continuously getting developed for commercial use.
- Significantly higher efficiency and lower dosage of nano products directly translates to reduction in GHG emissions from production and transport sections.

Mycorrhiza Commercial Production (MCP)

- Mycorrhizae-based biofertilizers are developed to enhance nutrient absorption in plants, increasing the organic matter and improving the soil's structure.
- Developing microbiome in the soils to create a strong symbiosis in rhizosphere. This will not only provide better nutrition for the plants but also create more carbon in the soils with higher water retention.
- Our facilities at TERI supported the use of in vitro mass production techniques to generate high-quality, genetically pure, and healthy mycorrhizal propagules for use in agricultural applications.

Micropropagation Technology Park (MTP)

- Innovative tissue culture is used for mass propagation of economically important crops including fruit crops, ornamental foliage, medicinal plants, cash crops, aromatic, and forest plants.
- This is also linked to creating livelihoods through diversification of crops with better horticultural planting material, market linkages, and better profitability to farmers.

Larger Goals and the Context

Our work on sustainable agriculture aligns with the major United Nations Sustainable Development Goals (UNSDGs). We are actively developing interdisciplinary tools and technologies to ensure sustainability in agricultural practices by improving soil quality and health while enriching soil biodiversity, using a rich microbial germplasm bank to develop biofertilizers and nano-Agri inputs. Our team is also working with multiple microbial systems to develop natural products, pigments, and alternative sources of energy and food supplements. Active efforts are also being made to study the effects of carbon sequestration in soil and life cycle assessment of Agri inputs being developed by our team. Our work focusses on UNSDGs—2, 12, 9, 13, 15, 17 and 1.

Sustainable Solutions Promoted

- **TERI's unique nano-fertilizers for climate smart agriculture**: The Indian government through the PM-PRANAM scheme is promoting development of alternative fertilizers, particularly the nano-fertilizers, to sustainably enhance the yield benefits for farmer communities and simultaneously reduce greenhouse gas emission emanating from agriculture. TERI is in the forefront in introducing these changes through the development of nano-fertilizers. Nano-fertilizers are extremely efficient fertilizers that provide nutrients such as nitrogen and phosphorous to crops through fine granules. A substitute to conventional fertilizers, nano-fertilizers can reduce the requirement of conventional nitrogen and phosphorous fertilizers by 25–50% in agricultural fields. These fertilizers are quickly absorbed by plant surfaces and therefore nutrient use efficiency (NUE) is 90–100% against 20–40% of conventional nitrogen and phosphorus fertilizers. With unique optical and electrical properties, nano-fertilizers can also enhance photosynthesis. The nano-fertilizers produced by TERI are synthesized using a biological process and not chemical synthesis process, that makes them highly efficient and safe in comparison to the other nano products
- **Microbial bioformulations for plant and soil health**: SA programme's microbial biofertilizer bioformulations are in pre-commercial stages and working closely with industries and is at an advanced stage of testing bio-stimulant and bio-fungicidal formulations in the field to improve plant health, soil quality, and carbon sequestration. With the huge success in new mycorrhizal biofertilizer product "Uttam Superrhiza" to our credit and multiple other products being supplied to industries across India and the Middle East Asia, we have a robust product pipeline being tested for their impact in field on multiple crops.

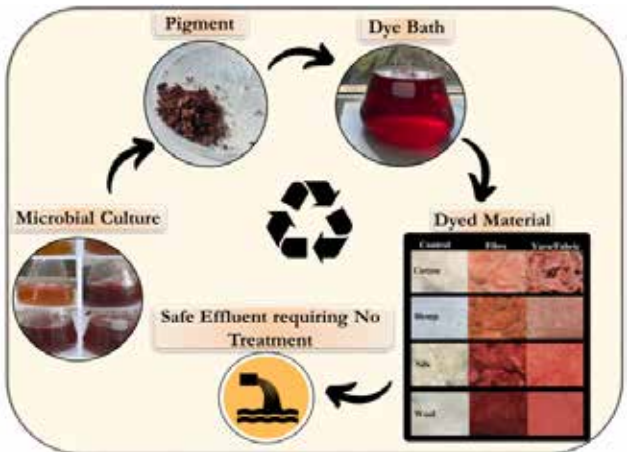
- **Regulatory molecules of mycorrhizal microbiome that impact beneficial traits**: Arbuscular mycorrhizal fungi (AMF) and beneficial bacteria are found naturally associated with most terrestrial plant roots. We investigated the impact of inoculation with AMF-associated bacteria (AABs) of AMF by in vitro recreation assays. AABs differentially influenced the growth of the AMF and their functional capability demonstrated by analysis of phosphate solubilization, nitrogen fixation, and biofilm formation. The transcriptome analysis of an AAB under carbon enriched and deprived conditions was performed using next-generation Illumina sequencing. The characterization, de novo assembly and annotation revealed a total of 701 differentially expressed genes which are being investigated further. 168 non-coding RNAs were identified from the RNA sequencing data of *Priestia filamentosa*, which are currently being validated.
- **Metabolite analysis of the mycorrhizal microbiome bacteria**: Knowledge of the metabolites that underpin symbiotic relationships is currently limited but there is a high degree of translation both within and between the organisms involved. We undertook liquid chromatography-high-resolution mass spectrometry analysis of AMF colonized root cultures, and its associated microbiomes were used for metabolite characterization. Major metabolites identified were amino acids, carboxylic acids, esters, organic compounds, hydrocarbons, sulphonamides, fatty acids, alcohols, imidazoles, carbohydrates, furans, pyrrolidinium, nitrogenated compounds, diazonium, and amidase.
- **Regulatory RNAs in bacteria**: *Azospirillum baldaniorum* Sp245 is a well-studied plant growth-promoting bacterium and we have recently unravelled ~468 small, non-coding RNAs (sRNA) in this organism, many of which exhibited differential expression under nutrient stress conditions. We have reported the functional characterization of the sRNA, sSp_p4, from *A. baldaniorum* Sp245 and confirmed its differential expression under different nutrient stress conditions. Expression analysis of sSp_p4 confirmed that it influences and regulates PGP traits, particularly polyhydroxybutyrate synthesis, indole acetic acid production, and biofilm formation. sSp_p4 is likely involved in the regulation of essential bacterial biological networks in this agriculturally relevant bacterial strain and may impact plant growth. We are currently working on optimized retrieval of polyhydroxybutyrate (PHB) from engineered *A. baldaniorum* and its use as a functional alternative to conventional plastic.
- **Microalgal bio-stimulants for agricultural**

application: The Sustainable Agriculture Division is working towards development of microalgal bio-stimulants for improving the carbon content and photosynthetic efficiency in the crops. TERI has a unique state-of-the-art facility for large-scale microalgae cultivation and germplasm collection with a wide diversity of strains from natural habitats. The bio-stimulants produced in TERI are made with a number of consortia of algal species depending on the individual needs providing essential nutrients for crop development. We have conducted the initial bio-efficacy test at TERI's trialing station and found interesting results on wheat crop.

Field evaluation of TERI algal bio-stimulants on the wheat crop at TERI trialing station during Kharif 2023

Bigger panicle with grain filling till top of spikelet

- **Omega-3 production from microalgae**: The Sustainable Agriculture Division developed a process for producing omega-3 fatty acids, specifically eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), from both autotrophic and heterotrophic microalgae. These fatty acids are vital for preventing lifestyle-related diseases.
- **Agricultural biomass derived products**: Phenyl was derived from biomass which has applications as disinfectant, floor cleaner, and insecticide. A promising insecticidal and nematocidal product proven against *Tribolium castaneum*, the stored grain pest and *Caenorhabditis elegans*. Rice straw-derived cellulose nanofibres are used as successful Smart Delivery System for nitrogen fertilizer. A Bio-Hydrogel (TERRAGEL) is made from rice straw which has a capacity to hold ~1000 times water of its original weight. This hydrogel has a wide range of applications, including soil conditioning, seed priming, smart carriers, wound healing, and diapers.
- **Microbial products**: Successful establishment of microbial pigments isolated from medicinal plants as sustainable sources of colourants for several industries. The pigments achieved exceptional dyeing on protein-based fibres with superior colour fastness, a high dye utilization rate, and zero waste discharge. The pigments have been improvised for enhanced yields and possess multi-functional properties, including antimicrobial, anti-inflammatory, and sun-protective effects, making them ideal for futuristic technical textiles.



In-house developed microbial dye production and textile dyeing process with cellulosic and proteinaceous fibres along with safe effluent discharge without any chemical treatment

Our Accomplishments

Number and Nature of Projects

Research and development, consultancy, technology transfer, product development, implementation, skill development and research networking are the key focus areas of our ongoing projects. Our funding is sourced from government, industry, corporate social responsibility, and bilateral projects.

Role in reducing GHG emissions: It is achieved through development of next-generation mycorrhizal biofertilizers and nano-fertilizers using biological approach leading to minimal generation of

chemical waste. This also supports the reduction of indiscriminate/overuse of chemical fertilizers. Research and field-scale programmes in these efforts were launched with the support of Shell India Markets.

New formulations of mycorrhizal biofertilizer: Harnessing the mycorrhizal–microbiome and isolating many synergistic, agriculturally relevant bacteria is a vital component of the programme. Three new formulations were developed, tested in-house and are now being tested on a large scale by industries and large farm holders, not only in India but in other parts of the globe including the Middle East and the USA. The initial results have shown that apart from reduction in chemical fertilizer input, irrigation water consumption can also be decreased significantly while showing positive impacts on plant development.

TERI Deakin University collaboration: TERI, TERI School of Advanced Studies (TERI-SAS) and Deakin University entered into a tripartite agreement for launching the TERI Deakin Centre for Excellence in Agriculture and Environment as TERI entered the 4th Phase of its Collaborative Relationship with Deakin University, Australia beginning in 2023.

Approach and Innovation

- **Mycorrhiza germplasm collection**: We are the only R&D unit utilizing the entire microbiome in the bioformulation products. This is powered by TERI's Germplasm Bank, which is the largest bank for Mycorrhiza and associated microbes in Asia.
- **A TERI-SHELL Initiative**: Under the umbrella of SHELL (financial support from SHELL PLC, a British Multinational Oil and Gas Company, London, UK), TERI has been successful in creating one-of-its-kind facilities for detailed composition analysis and characterization of biomass samples across the globe. It is an initiative to generate a 'Database of Lignocellulosic Biomass Feedstocks from Various Geographical Regions of the World' at Sustainable Agriculture Division, TERI Gram, Gurugram.
- **Machine learning assisted pest management in microalgae farming**: Maintaining long-term, stable, and productive algal biomass production is the key barrier in algal products commercialization. Much like terrestrial crops, algal cultures are invaded by weeds, pests, and pathogens, making crop protection a major challenge to algal pond sustainability. On several occasions, algal pond crashes were reported within 2–5 days after detection of pests. Whereas the detection threshold is the main barrier to managing algal crops, quantifying the response in algae because of the invasion of pests in the cultivation system rather than looking for pests could offer a solution. Indeed, our research demonstrated that algal photosynthetic parameters could serve as markers for pest attacks. We developed a predictive machine learning model to assess algal health and manage pests in an environmentally sustainable manner.

Inspirational Evidences

- **Advanced bioformulations of microbiome-enriched and mycorrhizal biofertilizers**: Harnessing the potential of the mycorrhizal microbiome towards impacting plant and soil health is a vital component of the programme. Uttam Superrhiza marketed by Chambal Fertilizers and Chemicals Limited and Bio+ Mycorrhiza Biofertilizer marketed by PKC Tecknix in the UAE are successful examples. Superrhiza launched in July 2022 had a market share of ~ 3725 tonnes in 2023. Extensive trials on new microbial consortia, bio-stimulant and bio-fungicidal products are ongoing in consultation with industries.

- **Role in reducing GHG emissions**: Nitrous oxide and carbon dioxide emissions from agriculture, resulting from the application of nitrogen and phosphatic fertilizers, are significant contributors to total greenhouse gas (GHG) emissions across all industries and are adversely impacting agriculture. Nano-fertilizers are required in miniscule amounts as compared to the traditional fertilizers. Reduction in dosage cuts emissions otherwise generated

from production and transport of traditional fertilizers. Also, the farmers can reduce the dose of conventional fertilizers and yet attain higher yield benefits along with improvement in soil structure and soil microflora that support plant growth promotion activities. They are beneficial to crops, help in soil structure improvement, soil rejuvenation, and reduce the impact of climate change.

Success stories

- In the FY 2023–2024, after securing the approval from the Department of Agriculture, Government of India, TERI's nano Urea (under the brand name Nano Shakti Nano Urea) and nano DAP (under the brand name Nano Shakti Nano DAP) products got launched by the commercial partner, Zuari Farm-Hub Limited; and nano Phosphorous (under the brand name Uttam Pranam) by Chambal Fertilizers and Chemicals Limited. It is also approved and marketed as Nano Shakti, Nano Urea, Nano DAP, and Uttam Pranam Nano Phosphorus.

- *They are cost effective, too. For an acre, nano urea is available at INR 250/bottle (in comparison to INR 500/subsidized bag of urea), nano DAP at INR 650/bottle (in comparison to INR 1350/ subsidized bag of DAP), nano phosphorous at INR 350/bottle.*

- TERI's Uttam Superrhiza has recently been recognized as "International Product of the Year" developed using field performance—enhancing green microbial technology by Applied Microbiology International, UK. This recognizes TERI's microbial technology supporting achievement of UN SDGs.
- Dr Mandira Kochar was recognized as 'Outstanding Woman Researcher' in Agriculture at the 9th Annual Women's Meet organized by VIWA in March 2024.
- Dr Ruchi Agrawal Awarded with prestigious 'Fulbright-Kalam Climate Fellowships for Academic and Professional Excellence – 2024' by United States-India Educational Foundation (USIEF).
- A PhD student received the prestigious 'Rex Williamson Prize-2023' under the TERI-Deakin Collaboration

Impact We Created

- TERI, in partnership with Hindustan Rasayan Private limited (HRPL), launched the one-of-its-kind production facility for biogenic nanofertilizers at Bathinda. Since the production process is chemical-free and utilizes microbial bio-factories, the carbon footprint of nanofertilizer production is minimal.

- Our microbial biofertilizers have helped farmers across India increase farm productivity by 10–18%, with a more robust root system, increased grain filling, and better responses in fluctuating environments like drought and extreme weathers. We are committed to providing innovative bioproducts for managing Agri bio resources, soil quality, and better food production.


Farmer impacts

- Superrhiza was developed to enhance the quality of mycorrhiza products existing in the market. Additionally, it uses the natural soil microbiome and microbial biodiversity to improve crop productivity but also the soil quality in the long run.
- The Micropropagation Technology Park (MTP) has supplied micro-propagated, high-yielding, good-quality, and disease-free planting material of Grand Naine (G-9) banana, potato, strawberry, and various high-value ornamental foliage to thousands of farmers and large growers/nurseries annually. This technology has a significant socio-economic impact, generating a total revenue of 9,000 million rupees for farmers to date. MTP has also created approximately 124,000 man-days of employment for skilled manpower.

Partnerships and Networks

Support from public and private sectors

Nano-agri inputs to enhance nutrient-use efficiency and reduce greenhouse gas emissions

- TERI's claims for the three nano-fertilizers are supported by extensive field efficacy tests carried out by renowned ICAR institutes and state agriculture universities, including Punjab agriculture university (PAU), Haryana Agriculture University (CCS HAU), University of Agriculture Science-Bangalore (UAS Bangalore), UAS Dharwad, ICAR-Indian Institute of Rice Research Hyderabad (IIRR), Indian Institute of Pulse Research Kanpur (IIPR Kanpur), Indian Institute of Oil Research (IIOR Hyderabad), Indian Institute of Wheat and Barley Research Karnal (IIWBR Karnal), ICAR – Indian Institute of Seed Science Regional Station, GKVK Campus, Bengaluru, and trials at many Krishi Vigyan Kendra (KVKs) and farmers' fields across several states of India.
- In 2023, DCM Shriram collaborated with TERI for nano NPK nano-fertilizer development and technology transfer, which is in progress at present.
- "Elucidation of RNA-RNA Interaction Networks in Plant-Associated Bacteria towards Enhancing Food Security" has been jointly selected for funding to TERI, India and The Hebrew University of Jerusalem, Israel, under DST's India-Israel Joint Research Program (IIJRC) – 2023.
- An MoA was signed between TERI and the Ministry of Petroleum & Natural Gas (MoPNG), Govt. of India on January 12, 2024, where TERI has proposed to contribute by providing a novel and sustainable solution for the high-volume applications of the biorefinery waste in the agriculture sector.

MoA Signing at The Oil Industry Development Board (OIDB) Bhavan, Noida

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

[1] https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

[2] https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

SOCIAL TRANSFORMATION AND CSR DIVISION

The genesis of Social Transformation and CSR Division's activities lies in its firm belief that sustainable use of natural resources, efficient utilization of energy, large-scale adoption of renewable energy technologies, and reduction of all forms of waste would move the process of development towards the goal of sustainability.

Themes and Commitments

Thematic Focus

In Social Transformation and CSR (ST&CSR) space, TERI addresses a wide spectrum of techno-social dimensions such as the following:

- Clean energy technology design and customization
- Skilling and employment
- Action research
- Business model development for livelihood opportunities
- Renewable and solar-PV based solutions for quality and reliable power for energy access and livelihoods
- Livelihoods, health, and education

Interweaving elements of gender and social inclusion at every stage of design and implementation of all its interventions have been the cornerstone of TERI's endeavours. With its focus on clean and rational use of energy, TERI continues to strive for a climate-resilient and 'Atmanirbhar' rural India.

Larger Goals and the Context

Social transformation and CSR initiatives, which include clean energy solutions and sustainable capacity building, aim to help India achieve its net zero targets by 2070. In the process, it addresses 10 out of 17 Sustainable Development Goals (SDGs).

In this context, some of the key projects undertaken include development of clean and reliable solar-based power infrastructures to improve the operational reliability of power.

Sustainable Solutions Promoted

Developing green skills of rural India is a key intangible sustainable solution actively advocated by TERI. On the

Empowering women SHGs through trainings in livelihood generating activities

other hand, some of the tangible sustainable solutions promoted are as follows:

- Clean energy solutions in MSMEs
- Solar-based solutions—irrigation pumps, home lighting system, LED street lights and DC fan, portable solar-powered cold storage and boats, sewing machine, solar water pumps for drinking water supply, etc.
- Hybrid solar charging units for power looms
- Improved biomass cookstoves
- Large-scale village adoption programmes for community development

Our Accomplishments

Number and Nature of Projects

Till date, 200+ projects have been executed across India and with the objective of "social transformation," several grassroots initiatives are still ongoing. In the reporting year, 25 projects have been executed. These projects involve research, modelling, policy advocacy, demonstration, consultancy, CSR activity, etc. The projects touch lives of a diverse range of communities such as farmers, micro and small entrepreneurs, fishermen, school students, women led SHGs, coastal and tribal communities, etc.

Role in Reducing Carbon Footprint

- A special focus on CO_2 emissions' mitigation is placed in all the projects undertaken by ST & CSR.
- 424 units of hybrid solar charging units (HSCU) for power looms—installed in Varanasi, Burahanpur—helped reduce emission of 1534 metric tonnes of CO_2 per year.
- 300 kW of clean energy systems installed in MSMEs of Uttar Pradesh abates 245 metric tonnes of CO_2 annually.
- Around 50,000 clean cookstoves promoted in rural areas that reduce approximately 1 lakh metric tonnes of CO_2 per year.

Approach and Innovation

Sustainable and customer-centred ST & CSR initiatives helped develop clean energy technologies that are shared through open source platforms. Implementation methodologies are being adapted to changing context to increase process efficiencies and to reinforce best practices through policy advocacy and capacity building.

Relentless efforts made in creating sustainable market led value chains that align commercial and social objectives of stakeholders. This has led to developing customized technology options, responsive service mechanisms, localized and inclusive entrepreneurial business models, generating awareness and livelihood opportunities at the grassroots level.

Inspirational Evidences

Demonstrations

Various holistic village and school development programmes with CSR funding on the theme of Natural Resource Management have been implemented majorly in Haryana, Jharkhand, and other parts of India. The on-ground factors that manifest positive changes, transformation, greater adoption of clean energy practices and behavioural changes in the rural communities have been captured through some audio-visuals listed here.

Films & Videos		
S. No.	**Film / Video**	**YouTube link**
1.	Weaving In The Sunshine: A film on hybrid solar charging unit for power loom	https://youtu.be/2oQEHmjIMdU
2.	Solar Flow in Mandakini: A film on battery powered boat	https://youtu.be/bJ2N50_S5jA
3.	Anjora: The Light	https://www.youtube.com/watch?v=WNTk-Qx6Nmc
4.	Solar Flow in Mandakini : A film on battery powered boat	https://www.youtube.com/watch?v=bJ2N50_S5jA
5.	New bloom on the loom (Short film on solar loom)	https://www.youtube.com/watch?v=aw30zHEujkg
6.	A Journey towards Sustainability: Empowering Lives, Preserving Nature	https://youtu.be/pLpwAWnVaFk?si=8MqY9qKeUzpFd5Pq

7.	My Village Is My Home: A CSR initiative of Coal India Limited and TERI	https://youtu.be/DtkxmicRa50
8.	The Apple Trails: A CSR initiative of CONCOR and TERI	https://www.youtube.com/watch?v=k8c2vxwQxck
9.	Solar Karawan: Solar Electrification & Clean Energy Technologies	https://youtu.be/Vhk0zkP5rqM?si=lDqJTgTzHiq723bA
10.	Lighting a Billion Lives - Bringing Solar Light to Rural India	https://youtu.be/Ft99NJK-YSQ?si=SpT5Len1g-mqhDBa
11.	Powering MSMEs, Empowering Lives: Sattata Jeevika Vardhanam	https://youtu.be/DtkxmicRa50

Success Stories

We took lead in providing infrastructure for reliable energy in remote schools to ensure quality education for the children. The initiative integrated renewable energy with quality learning and local economy imaginatively. More than 380 students were imparted training in solar energy-related skills by leveraging 'Green Skill Development Programme' of the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. About 50% have been placed in different industry and few of them have started their career in green entrepreneurship.

Impact We Created

- **Owing to prevailing problems of energy access, reliability of energy supply, poor operation and maintenance there was wastage of 3–4 working hours due to power cut, sound pollution and CO_2 emission due to diesel generators, disruption of household chores and livelihood activities, etc. Interventions targeting these issues have benefited the rural population by ensuring regular power supply, reducing electricity bills, minimizing disruptions to livelihood activities, saving time, lowering CO_2 emissions, and reduced sound pollution and indoor air pollution.**
- **The initiative on ensuring reliability energy supply to remote schools helped promote green jobs, enhanced career and entrepreneurial opportunities.**

Technical trainings on clean energy to ensure just transition

Community development and skill enhancement for MSMEs

Customized clean energy solutions

Implementation of solar-based projects

Water conservation through pond rejuvenation as a CSR initiative

As a part of CSR initiative of CCL, TERI disseminated 200 solar hybrid solutions for powering sewing machines in Ramgarh sewing cluster of Jharkhand. A series of participatory processes were followed that included technology design, pilot, replication, and then scale up. The users adopted as well as co-funded the project.

Knowledge Building and Dissemination

The consolidation of learning from diverse projects focused on sustainable energy promotion and social and gender inclusion has enabled TERI to share

Best overall Excellence in CSR Award by ET Ascent

innovative and proven ideas, ground insights, and policy perspectives at various local (village and state), national, and international forums through participation in knowledge exchange events.

Contribution in Knowledge Building

Various publications on the basis of action research and other innovations helped in reaching out to researchers, practitioners, policymakers, and other actors.

- 80 publications
- 100+ articles
- 1 patent and 4 other patents have been filed

Partnerships and Networks

TERI constantly strives to draw synergies with national and state level government programmes to integrate the scope of energy access into other related sectors such as livelihoods, health, education, and women's empowerment. Working in conjunction with government schemes, programmes and a range of rural development initiatives TERI has successfully reached the remotest of areas in providing energy poor communities the access to clean technologies for basic and productive use. To create a cadre of socially conscious youth, contributing towards a better and brighter future and facilitate progress towards the achievement of the SDGs, TERI incorporates students and young professionals in the rural energy access framework. A list of all our esteemed partners is attached separately.

Awards and Recognition

- Mahatma Award for best CSR project in Environment category for Coal India Project
- Best CSR project in Rural Development category for Coal India Project

- Indo–French Award for CONCOR CSR Project
- MCA Award for PFC CSR Project
- Best CSR Initiative by IIT and DPE
- Award for best Swachhta Project
- Woodpecker Award for CONCOR CSR Project
- National Best overall Excellence in CSR under the Organizational Award by ET Ascent
- Dedication Excellence Award in Sustainability Programme Development-South Asia by Acquisition International

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REGIONAL CENTRES

Serving as bridges to propogate the organization's work throughout the nation, Regional Centres help establish a strong base for TERI's activites and projects at the grassroots level. They help in further diversifying and broadening the knowledge repository as well as the scope of the organization's operations.

TERI Southern Regional Centre, Bengaluru

The Southern Regional Centre (SRC) undertakes applied research to promote rational use of energy across the priority sectors. Under the net-zero regime, energy efficiency will play a key role across all sectors, from transport and buildings to industry. It is a firm belief that energy-use optimization is a first step before integrating renewables. Best sustainable industrial practices and adaptation include energy efficiency and conservation that can be easily incorporated into daily operations, as well as solutions that can reach beyond greenhouse gas (GHG) reduction and lead to operating cost reductions. Renewable energy projects are viable alternatives to fossil fuel energy sources and they provide a way to lower GHG emissions along with lowering direct energy costs. The SRC's focus is mainly to support corporate and governments, accelerate energy efficiency and more effective uptake of renewables to slash emission cuts.

The Industrial Energy Group (IEG) is helping prominent clients to achieve their sustainability, climate, and equity goals. The group amplifies ideas and innovations to design new pathways towards the future. Perform, Achieve, and Trade (PAT) scheme is a flagship initiative of the Bureau of Energy Efficiency (BEE) and the Ministry of Power (MoP). The group extends its services to designated consumers in implementing the PAT scheme during the previous financial year, mainly thermal power plants, cement, and iron & steel industries. Energy efficiency studies were also conducted across chemical, pharmaceutical, FMCG and commercial buildings (airports) this year. Benchmarking studies were carried out for pulp and paper sector plants, covering units across north, west, and southern Indian States.

The IEG provides technical assistance to the Government of the Republic of Guyana in the implementation of a Low Carbon Development Strategy (LCDS), particularly in the agriculture and energy sectors. Energy efficiency studies were performed across six selected utilities in Kazakhstan, Kyrgyzstan Republic, and Tajikistan under Central Asia Water and Energy Program (CAWEP). A comprehensive energy assessment was performed at a large coal-based power plant in Zambia. A petrochemical plant energy optimization study was carried out in Thailand.

The SRC supported various solar rooftop photovoltaic (PV) projects, in the preparation of project feasibility

Energy audit at pharmaceutical industry

EKOenergy project - Solar power cold storage

Environmental Lab - SRC

and tender documents, inviting tenders, identifying and allotting work to developers, and supervising system installation, commissioning, and handover. Through EKOenergy ecolabel, Finland funds solar-based cooling solutions for horticulture produce to improve the income of small and marginal farmers in Karnataka state.

The SRC is mainly concerned about dealing with the environmental pollution caused due to the improver or unconventional disposal of plastic waste. Based on the group expertise, GIZ, India has engaged in the development of a national strategy for the mitigation of urban plastic waste generation from sanitary waste streams. Research studies on high-performance compatibilized composites from recycled commingled plastic waste reinforced with halogen-free nano-sized are underway.

TERI has been engaged by the Watershed Development Department (WDD), Government of Karnataka, Bengaluru, as a 'Process Monitoring Agency (PMA) for Rejuvenating Watersheds for Agricultural Resilience through Innovative Development (REWARD)'. The project comprises 21 districts of Karnataka state, which is being developed under the Watershed project, covering an area of about 19 lakh hectares.

Northern Regional Centre – Mukteshwar

About TRISHA

TRISHA (TERI's Research Initiative at Supi for Himalayan Advancement) came into being in 2003 at Supi village, Mukteshwar in Nainital district of Uttarakhand. Since agriculture is the principal occupation of the hill inhabitants, research and extension have been largely undertaken to uplift the livelihoods of the local farmers who are largely marginalized. As a viable approach, the aim was to develop crop value chains for providing financial security to the marginal farmers of the Himalayan villages.

The following list gives a glimpse of the thrust areas of the Himalayan agriculture:

- Fragmented and marginal land holding
- Rainfed agriculture
- Infestation of wild animals
- Unsustainable farming practices
- Less marketing facilities

Available Facilities

TRISHA, situated at height of 7,500 feet, is a distinct venture towards sustainable development. The centre houses a number of state-of-the-heart facilities. Some of the facilities of significance include Supi bio farm's vermicomposting units, polyhouses, glasshouses, solar greenhouses, oil distillation unit, solar dryers, mechanical dryers, grinders, pulverizers, ovens, herbal garden of medicinal and aromatic crops, rainwater harvesting models, knowledge-cum-training centre, and a resource centre of various value-added products.

TERI-TRISHA Approach

Realization of enhancement of land and crop productivity through utilization of sustainable and organic biotechnological approaches and harmonizing modern technologies and traditional knowledge are amongst

our core areas. Our initiatives have benefitted the local farmers, especially to look beyond their conventional farming system and bring about successful diversification of crops through organic inputs. The farmers of the area have been able to overcome the adverse impact of climate change by adopting cultivation of medicinal and aromatic herbs that require minimal amount of water and thereby have an assured source of income round the year. It has also strengthened their village-based micro-enterprise capability, leading to improvement in their economic condition. With its initiatives, TERI has touched lives of more than 5,000 households spread across many villages of the country. With the approach aimed at improving the socio-economic status of the farming community, TERI has not only provided farmers with high-quality planting material but has also entered into buyback arrangement for ensuring to provide them with assured market and better returns. Our efforts have successfully created an enduring platform for facilitating assuring economic returns by eliminating intermediaries and thus created a win-win situation for both farmers and clients.

TERI DeraGreen—Himalayan Centre

TERI DeraGreen is nestled in Mukteshwar, a secluded hill station located 350 km from Delhi and 46 km from Nainital. Mukteshwar is situated about 7,500 feet above sea level. The weather here ranges from pleasant to cold, which makes it an ideal year-round destination. It's a self-sustainable retreat that runs on solar energy and a rainwater harvesting system—perfect structure to save resources and nurture Mother Nature. The nearest railway station is at Kathgodam, 56 km from Mukteshwar.

TERI Eco-Tourism Programme is inclusive of two camps:

TERI Leadership Camp

TERI presents a dynamic and one-of-its-kind leadership camp that significantly interests young minds, looking forward to assume leadership roles in near future and contributing towards the common good. Through these camps, we not just offer a chance to get close to the wilderness and nature at our Himalayan Centre, but also facilitate comprehension of sustainability on the participants' end, effectively strengthening their leadership skills through various action-oriented activities and sessions.

TERI's Eco-Adventure Camp: a cool way to learn and care for the Mother Earth

TERI DeraGreen (Himalayan Centre) at Mukteshwar offers its visitors an adventure-filled holiday in the lap of nature—right from watching butterflies to witnessing kingfishers flit. If one cares for the Mother Nature, Eco-Tourism will prove as the perfect destination. At DeraGreen, we encourage close connectedness with the

nature and village lifestyle. A stay at DeraGreen is aimed at instilling a sense of preserving nature's bounties for the future.

Highlights of the Eco-Tourism Programme

- Learning without textbooks; thereby linking the activities to the curriculum.
- Visit to TERI's bio-farm, Trisha, where one can see and learn about a variety of plants and herbs, rainwater harvesting and solar energy.
- Visiting Kumaon Vani radio station.
- A day in village: learning village lifestyle and other issues of the daily lives of villagers.
- Adventure sports at Chauli ki Jali, rock climbing, rappelling, flying fox, archery, trekking.

Kumaon Vani 90.4 FM

- Kumaon Vani is Uttarakhand's first community radio station located in Supi village. It was established in 2010 by TERI. Kumaon Vani radio aims towards bringing together communities across several villages in the Kumaon region. It was established to use radio as a tool to promote sustainable development amongst the local farming community. It broadcasts content that is relevant to the people of the area and is often overlooked by the commercial media. The radio station is run by youth from the local community, under TERI's supervision.

Western Regional Centre – Mumbai

Thematic focus

The work of TERI Western Regional Centre (WRC), Mumbai focuses broadly on environmental monitoring and assessment, environmental reporting, nutrition and livelihoods, and waste management. Over the years, through the implementation of projects related to these domains, the WRC has managed to create a strong network of stakeholders along with collaborations with several government agencies, corporates, and bilateral organizations. The Centre aims to continue these efforts and venture into the areas of environmental social and governance (ESG), corporate social responsibility (CSR) and sustainability in close coordination and under the able guidance of the expertise of the Delhi office.

Key Projects

1. **Innovative Interventions in Mokhada Block of Palghar district to address malnutrition and enhance the livelihood of scheduled tribe (ST) Communities**

Sponsored by the Department of Science and Technology (DST) for a period of three years (2023–26), the project focuses on addressing malnutrition and generating livelihood opportunities for tribal stakeholders by developing capacity building of the tribal farmers, youth and self-help group (SHG) women to cultivate mushroom, azolla, and aromatic plants for the production of aromatic oil. A dedicated Science, Technology and Innovation (STI) hub is planned to be developed in the Loknete Ramsheth Thakur College of Arts, Science and Commerce (Mokhada College) campus to create demonstration units which would act as training and knowledge-sharing platforms for these tribal stakeholders. A memorandum of understanding (MoU) was signed between the involved parties on January 25, 2024.

MoU signing with project partner at Mokhada, Palghar

Awareness session conducted for tribal stakeholders at a village in Mokhada block, Palghar

At the start, in order to gauge the actual ground-level scenario about the problem statement, focussed group discussions (FGDs) and a baseline assessment survey of about 266 tribal respondents were conducted by the survey team in Marathi with the help of local stakeholders; for which orientation sessions were conducted at Mokhada College. This analysis would help to understand the weakest linkages in

The movement of plastic waste in a water body recorded using satellite tracker

predominant livelihoods, livelihood strengths, and map the indigenous–traditional knowledge of the tribals. The further stage would involve the development of demonstration units for the proposed interventions and the mobilization of tribal stakeholders, especially farmers and SHG women for the implementation of interventions on their farmland/ backyard gardens.

2. Conducting research on watershed locations draining to focus areas in the MMR with respect to the estimation of plastic waste

Being implemented jointly under the research collaboration with The Ocean Cleanup (TOC), the Netherlands-based not-for-profit organization, the project aims at identifying plastic leakage hotspots in the MMR, particularly in Thane and Mumbai regions. This is an extension of the research activities being carried out in Navi Mumbai and Panvel areas. A field-based survey was conducted jointly by TERI and TOC wherein potential locations for mounting solar-powered cameras were identified to understand the seasonal extent of plastic waste pollution. Satellite-based trackers were dropped in some of these waterbodies to gauge the transport pattern of plastic waste due to the tidal flow. Based on these data, solar-powered cameras shall be mounted at selected locations to estimate the plastic pollution.

3. Environment reporting

The Centre has annually prepared Environmental Status Report 2022–23 (ESR) for the Navi Mumbai Municipal Corporation (NMMC) and Air and Water Quality Status Report 2022–23 for the state of Maharashtra, sponsored by the Maharashtra Pollution Control Board (MPCB). These annual reports help maintain the database of the status of locally available natural resources and monitor the level of pollutants. They also aid decision-makers/ policymakers to take timely implementation/mitigative measures to address issues potentially detrimental to human health and the environment.

Important Links

- Nutrition security webpage: https://www.teriin.org/projects/nutrition-security/
- Rethink plastic project webpage: https://www.teriin.org/project/rethink-plastic-unep-teri-joint-initiative-mumbai-region

Partnerships and Networks

- A grant secured from DST to implement a 3-year project on implementing innovative interventions to address malnutrition and generate alternate livelihood for tribal stakeholders in Mokhada block, Palghar, Maharashtra. An MoU was signed between TERI and Loknete Rmasheth Thakur College of Arts, Science and Commerce College – Mokhada, Palghar on January 25, 2024 to jointly implement project activities.
- Signed an MoU with the Department of Environment and Climate Change, Government of Maharashtra to prepare the State of Environment Report of Maharashtra 2021.
- Signed a research agreement with TOC, to jointly implement long-term research to monitor and assess the extent of plastic waste in waterbodies located in MMR.
- Long-term association with government organizations such as MPCB and NMMC for projects related to environmental reporting.

Way Forward

As a next step, the Centre is working towards developing a strategic plan to collaborate with corporate/industrial players in the state, especially located in the MMR to implement projects related to the CSR, ESG and sustainability reporting domains. With the set framework and expertise available at the Delhi office, it holds tremendous potential to expand into these sectors in the near future.

North-Eastern Regional Centre – Assam

Thematic Focus

TERI North-Eastern Regional Centre (NERC) dedicates towards several areas including but not limited to agriculture, medicinal plants, sericulture, solid and liquid waste management, water quality improvement, wastewater treatment, livelihood enhancement, watershed management, preparation of detailed project report and village development plan, production of quality planting materials, water and food testing, preservation, and protection of traditional knowledge through documentation initiative, capacity building and rural extension. The multidimensional efforts of the Centre are aimed at improving the production base, livelihood generation, cleaner and better environment, and capacity building and competency development of various stakeholders.

Rejuvenation of Jamuna Drinking Water Supply Storage Pond through Bioremediation at Golaghat

TERI has been involved in planning, designing, implementation, management and operation, and maintenance of the bioremediation treatment infrastructure and biological system commissioned and operationalized at the Jamuna water tank. The goal of Jamuna drinking water supply storage pond bioremediation project is to remove or reduce harmful compounds through biological restoration process to improve water quality of the pond.

Objective and Risks Faced/ dealt within Achieving the Objective

The main objective of Jamuna drinking water supply storage pond bioremediation project is to remove or reduce harmful compounds to rejuvenate the water body and improve the water quality. The risks associated with the initiative of rejuvenation of the drinking water supply storage pond are to treat the pond water through biological process by adopting a variety of treatment processes, such as, bioremediation of pond water, installation of floating island, oxygenation process and development of sub-surface horizontal constructed wetland (reed bed) at contaminated site, etc.

Preservation and Protection of Traditional Knowledge—documentation initiative in the North-East region

The field-based documentation project was carried out in collaboration with Bio-Resources Development Centre (BRDC), Shillong focusing on documentation, preservation, promotion of traditional knowledge that existed and is practised at the community level. Under the project, field surveys were carried out in Ri-Bhoi and West Garo Hills districts of Meghalaya with the aim to document various forms of traditional knowledge from the knowledge holders of the districts.

Scientific cultivation of vegetable-Biotech Kisan project

Raj Bhavan Zero waste campus project

Consultative stakeholders workshop on traditional knowledge were organized for teacher and awareness workshop for students in Shillong and Tura, respectively. Ten video and twenty-six audio documentations were done to capture various traditional knowledge, followed by the knowledge holders. A course curriculum on Meghalaya traditional knowledge (supporting document for course curriculum in schools) was also developed as a part of the project.

Farmers' Training Programme On Awareness Generation and Capacity Building For Utilization of Biofertilizer in Crop Production

Three farmers training programmes supported by Assam Science and Technology and Environmental Council (ASTEC), Government of Assam were conducted by TERI in collaboration with ASTEC under the project 'Capacity Building Programme on Climate Resilience Through Promotion of Biofertilizers' in Darrang and Kamrup districts of Assam. The aim of conducting the training programmes was to educate farmers on the benefits of biofertilizers and their role in improving the crop productivity, promoting sustainable agricultural practices, and reducing reliance on harmful chemical fertilizers.

PRA photo for vision plan preparation project

Preparation of Vision Plan on Community Development Activities nearby Dalmia Cement Bharat Limited (DCBL) Plant Locations in North-East India

Preparation of context appropriate vision plan for the villages in and around the units of Dalmia Cement (Bharat) Limited in Jagiroad, Lanka, and Umrangshu in Assam and Thangskai in Meghalaya was undertaken through a participatory approach. As a part of the project work, stakeholder consultative workshop was organized by TERI NERC where 85 participants from 31 villages including village headman, President and Secretary of Village Development Council (VDC), women self-help groups (SHGs), progressive farmers, key persons from the villages, and representative from Umrangso Town Committee participated in the workshop and shared their views on the vision plan and also suggested to incorporate a few requirements in the final vision plan apart from the assessed one.

Biotech-Krishi Innovation Science Application Network (Biotech-KISAN)

Department of Biotechnology sponsored Biotech-Krishi Innovation Science Application Network (Biotech-KISAN) project was undertaken in four districts of Assam, covering 13 villages for promotion of scientific cultivation of vegetables for livelihood enhancement. Under this project, the farmers were provided with technical know-how on scientific cultivation of vegetable crops through on-field demonstration along with crop management practices in four districts of Assam—Kamrup (M), Kamrup (R), Darrang, and Dhubri, covering 50 direct beneficiaries and 15.53 acres of lands were brought under vegetable cultivation. Capacity-building programmes were organized that included 141 participants from the 13 villages of Kamrup (M), Kamrup (R), Darrang and Dhubri districts of Assam. The farmers have been cultivating vegetable for 2–3 times during the vegetable cultivation period due to project intervention and technical know-how provided to them.

PRA photo for vision plan preparation project

TERI Food Testing Laboratory at NERC

The Food Testing Laboratory (FTL) of TERI at NERC, Guwahati, Assam, partially funded by the Ministry of Food Processing Industries (MoFPI) has been developed for testing of packaged drinking water, food, and beverages for determining chemical, microbial, and elemental parameters.

The FTL is one of the few NABL-accredited food testing laboratories in Guwahati, Assam, or North-East India as a whole. The Lab had been able to successfully achieve and maintain its NABL accreditation from the past two years. The Lab has renewed its NABL accreditation after successful completion of its assessment by Quality Council of India (QCI) with scope addition for 30 parameters.

Our Accomplishments

Research and development, consultancy, project implementation, capacity building and research networking are the key focus areas of the Centre. Funding sourced from government, corporate social responsibility, etc., is utilized to implement the project activities.

Rejuvenation of Jamuna drinking water supply storage pond through bioremediation

The project focused on removal or reduction of harmful compounds to rejuvenate the water body and improve the water quality of the pond through bioremediation process. Designing, installation, and commissioning of different infrastructures like floating islands and site-specific sub-surface horizontal constructed wetland with bio filter for water quality improvement have been done under the project.

Preservation and protection of traditional knowledge-documentation initiative in the North-East region

This is a collaborative project of Bio-Resources Development Centre (BRDC) and The Energy and Resources Institute (TERI) funded by the North-Eastern Council (NEC), Government of India in the state of Meghalaya. The project focused on identifying, documenting, preserving, promoting various forms of traditional knowledge that existed and are practised at the community level. It also focused on exploring the possibilities to integrate traditional knowledge in school curriculum through sensitization of traditional knowledge amongst youths, teachers/students fraternity and to bring about a change of system in the traditional health care practices amongst the people at the community and village levels. Assessment and documentation of traditional knowledge relating to traditional medicinal system and other major sectors such as, agriculture, fisheries, handicraft, handlooms, bee keeping, and veterinary were carried out under the project.

Capacity-building programme on climate resilience through promotion of biofertilizers

The capacity-building programme focused on climate resilience through promotion of biofertilizers in Darrang and Kamrup districts of Assam. The aim of conducting the training programmes was to educate farmers on the benefits of biofertilizers and their role in improving the crop productivity, promoting sustainable agricultural practices, and reducing reliance on harmful chemical fertilizers.

Preparation of vision plan on community development activities

The project focused on preparation of the context-appropriate plan for the villages in and around the Dalmia Cement (Bharat) Limited units in Jagiroad, Lanka, and Umrangshu in Assam and Thangskai in Meghalaya through a participatory approach. Stakeholder consultative workshop was organized where 85 participants from 31 villages participated and shared their views and suggestion on the vision plan.

Biotech-Krishi Innovation Science Application Network (Biotech-KISAN)

This project was undertaken for the promotion of scientific cultivation of vegetables for livelihood enhancement. Capacity-building programmes and demonstration of vegetable crops and management practices were carried out in four districts of Assam—Kamrup (M), Kamrup (R), Darrang, and Dhubri. The project covered 50 beneficiaries who were involved in vegetable cultivation in a scientific way. Under the project, 15.53 acres of land were brought under vegetable cultivation.

Zero-waste campus in Raj Bhavan, Assam

The Centre has been implementing the project Raj Bhavan Assam—a zero-waste

Handicraft under Documentation of TK project

campus in partnership with TERI, NERC. The project focused on formulation and implementation of standard waste management procedure for achieving a zero-waste campus at Raj Bhavan, Assam campus. Under the project, day-to-day collection, segregation, and processing of decomposable waste at material recovery facility (MRF) for production of compost, treatment of black and grey water through developed reed beds systems are being done.

TERI Food Testing Laboratory at NERC

The Laboratory has commenced testing of tea which is a major commodity being sold out of Assam. The Laboratory has initiated testing of spices especially turmeric, which is again a major agricultural produce in the spices category being grown and sold out of the north-eastern region. The laboratory has also included testing of packaged natural mineral water and drinking water in its testing domain.

- The Lab has added 30 parameters in its sample testing scope.
- Development of testing capability for 30–35 parameters in different commodities, for instance, tea, turmeric, packaged drinking water, packaged natural mineral water and drinking water.
- The scope of the laboratory enhanced from 6 to 30 accredited parameters across different food matrices and has been working for further scope addition in other food matrices.

Approach and Innovation

The research and development initiatives of TERI, NERC focus on offering scientific solutions for water quality improvement, wastewater treatment, waste management, crop productivity enhancement and natural resource management. The projects of the Centre address issues such as income generation, environment, and water quality improvement. We have also provided solutions to waste reduction, recycling, and conversion of waste into useful products.

- We facilitate scientific cultivation of crops with hand-holding on-field technical support for productivity and income enhancement.
- Our R&D work focuses on exploration of processes and solutions for sectoral problems and to create uniqueness of works with visible impact.
- The food testing laboratory of the Centre is taking initiatives for testing of drinking water, tea, spices, cooking oil, and other food products.

Impact We Created

Zero-waste campus at Raj Bhavan, Assam	
Tangible	**Intangible**
• More than 81,476 solid waste processed at the Raj Bhavan, Assam campus. • The project achieved the treatment efficiency of constructed wetlands for biochemical oxygen demand or BOD (73%), ammonia removal efficiency (90%), total hardness (84%), chemical oxygen demand or COD (64%), total dissolved solids or TDS (88%), total suspended solids or TSS (47%), total volatile solids (72%), and faecal coliform (70%) for treatment of black and grey water.	• The project helps in minimizing the population of harmful microbes resulting in a healthy environment for human beings due to regular collection, segregation and processing of waste generated within the campus and treatment of grey and black water.

Water quality improvement of Dighalipukhuri, Guwahati	
Tangible	**Intangible**
Restoration works in the polluted water body to eliminate toxic cyanobacterial blooms for improvement of water quality in terms of dissolved oxygen (DO), reduction in BOD, COD, odour, and colour were done through application of scientifically-designed formulation and designing and installation of reed bed systems, Artificial floating islands (AFIs) and hypolymnetic water withdrawal system. This initiative resulted in corrections in pH of the water body (8.0), odour (odourless), DO (7.0 mg/l), COD (20.0 mg/l), total alkalinity (60.0 mg/l) and reduction of values of sulphate, nitrate, ammonia than the Central Pollution Control Board (CPCB) standard range and BIS 10500. A total of 13.157 kg biomass harvested from floating islands and floatables during the project period.	Improvement in flora and fauna of the pond ecosystem on account of improvement in water quality of the pond due to application of bio-formulation and more developed root system of Canna plants planted in the floating islands which exhibited better total nutrient removal capacity along with removal of deoxygenated water from the bottom layer of the water body through Hypolimnetic water withdrawal system.
Rejuvenation of Jamuna drinking water supply storage pond through bioremediation	
Tangible	**Intangible**
After application of scientific formulation and operationalization of floating islands, continuous water quality improvement has been observed from the analysed data. The pH value changed from 8.0 to 7.0, the turbidity of water has changed from 10 mg/L to 6 mg/L, the TDS reduced from 406 mg/L to 184 mg/L, total hardness as $CaCO_3$ continuously showing a reduction trend from 131 mg/L to 110 mg/L, total alkalinity as $CaCO_3$ reduced from 60 mg/L to 40 mg/L. Similarly, the nitrate content of Jamuna water pond also reduced from 15.9 mg/L to 0.7 mg/L. Other microelements like chloride, calcium, magnesium, sulphate, sodium, etc, have also proportionately reduced with the treatment duration.	We have introduced continuous improvement in the water quality of Jamuna drinking water supply storage pond, as a result of the initiatives taken towards bioremediation of pond water, nutrient removal through floating island plants, removal of aquatic plants, oxygenation process, and reed bed system commissioned at the strategic location.

Inspirational Evidences

- Information from 120 traditional healers and 65 patients were collected and documented. One-hundred ninety medicinal plants used for health care system were also documented under the project 'Preservation and Protection of Traditional Knowledge' documentation initiative in the North-East region.
- Seventy-five different types of diseases or ailments treated by the traditional healers were documented.
- Forty-four traditional agricultural practices of traditional knowledge holders pertaining to livestock practices, fisheries, bee-keeping, agricultural calendar, natural farming, jhum cultivation, pest management, seed germination and seed storage, handloom and handicrafts were documented.
- Ten videos on different aspects of traditional knowledges and 15 audios of traditional knowledge holders were documented.
- Adequate testing capability has been developed for 30 physical, organoleptic, proximate, and chemical parameters in different commodities. Examples include tea, turmeric, packaged drinking water, packaged natural mineral water, and drinking water.

Dighalipukhuri water quality improvement project

Dighalipukhuri water quality improvement project

Knowledge Building and Dissemination

- TERI has initiated the facilitation of natural remedial process for solid and liquid waste management. We have also developed strategy to enhance oxygenation and nutrient remedial from polluted water body by designing, installation, and operationalization of sub-surface horizontal constructed wetland, artificial floating island and hypolimnetic water withdrawal system for water quality improvement. The application of scientifically designed formulation for bioaugmentation also supports the growth of beneficial microorganisms to facilitate bioremediation process.
- In order to document traditional knowledge, TERI prepared 11 documentary films on traditional vegetable dye, agriculture, bee keeping, herbal medicine, and handicraft and 15 audios from four districts of Meghalaya, covering Khasi, Jaintia, and Garo tribes and the same has been uploaded in the Meghalaya Traditional Knowledge Portal (MTKP).
- The Food Testing Laboratory of TERI along with its testing services in the food sector is focusing to cater to the requirements of academic and research communities by offering a platform to test their research samples of different novel food products, ingredients, etc. The Laboratory has also worked on its plan to carry out R&D in the fields of food safety, shelf-life studies, food spoilage, nutrient profiling, food processing, etc.

Publications

- Nath P and Goswami N. K. 2023. Indigenous knowledge in muga culture and terminologies used by muga rearers of lower Assam, Assam. Indian Journal of Applied Research, 13 (8):69–72
- A book titled Meghalaya Traditional Knowledge—Supporting Document for Course Curriculum in Schools was developed for Meghalaya Board of School Education.
- Prepared project brochure covering all the outcomes of the project on traditional knowledge was brought to the public domain.

Partnerships and Networks

TERI-NE collaborated with different government departments, Krishi Vikash Kendras (KVKs), Assam Agricultural University, Assam Science Technology and Environment Council (ASTEC), Govt of Assam, Department of Indigenous and Tribal Faith and Culture, Govt. of Assam, ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand; M S University of Baroda; North-Eastern Hill University, Tura, Meghalaya; Bio-Resources Development Centre (BRDC), Government of Meghalaya, etc., for implementation of projects and collaborative proposal development.

Short, Medium, and Long-term Partnership

The partnership with BRDC for project activities was a medium-term in nature. TERI-NE has made a long-term partnership with Assam Science Technology and Environment Council (ASTEC), Assam Energy Development Agency (AEDA), Guwahati Biotech Park, Science and Technology Department, Government of Assam for collaborative works through an MoU. Long-term partnership with Assam Agriculture University, Jorhat has been established for joint implementation of the various projects.

Western Regional Centre – Goa

The Coastal Ecology and Marine Resources Centre (CEMRC) area works towards strengthening the institutional support required for managing coastal and marine resources. Conserving coastal ecosystems through best management practices and community-based approaches have always been a core expertise of this Centre. The Centre is engaged in carrying out research that focuses on sectors such as marine ecology, aquaculture activities, and impact and vulnerability assessment of coastal resources to climate change. Through capacity-building programmes for climate-resilient fish farming, the Centre aims to address key challenges on declining fish stocks and climate adaptations for smallholder fishers across freshwater ecosystems. The Centre is also actively involved in examining and analysing objectives under SDG 14 that are critical to address sustainable development of the Indian Ocean both domestically and internationally. With regards to imparting training, TERI has established the Coastal Educational Hub which brings attention to our priceless coastal habitats and resources for student education, entrepreneurship training and development, woman empowerment, and creating awareness among the public.

- **Water resource management and water technologies**

Apart from Coastal Resource Management we also address issues pertaining to water resource management with a focus on water remediation technologies and watershed development projects. Primarily, we provide sustainable and cost-efficient solutions aligned with the needs of the stakeholders, based on measurements, in-depth analysis, field testing, and demonstrations with their collaborations. Our focus is to provide affordable and clean water supply solutions to the community. The varied activities under this programme also touch upon SDG 6 and SDG 15.

Being driven by the broad intent of promoting cost-efficient and sustainable solutions, the water technology encompasses the following thematic domains:

- River bank filtration (RBF) technology
- Watershed management
- Groundwater exploration studies
- Hydrogeological investigations

- **Rural development and environment**

Rural development and environmental conservation through sustainable practices is another focus area of the CEMRC. The projects emphasize capacity building, sustainable resource use, and the diversification of income streams, contributing to economic resilience and ecological sustainability in rural regions.

Our Accomplishments

- TERI successfully implemented RBF installations along several major rivers, including the Kali, Krishna, and Tungabhadra rivers in Karnataka and the Sal River in Goa, prove feasibility of the RBF-treatment approach in Southern India. Our RBF rural systems are designed for rural communities of about 2,000 to 5,000 people, but larger systems are feasible.
- Under the watershed project (2022) TERI has prepared a detailed project report for implementation of various soil and moisture-

Riverbank Filtration Well at Kapila River in Mysuru implemented for meeting drinking water supply

UNDP project

Mechanization of farming-labour intensive practices such as tilling the land

conservation activities and conducted various participatory rural appraisal (PRA) exercises across selected villages, covering 900 households to gather essential baseline data on social, economic, and natural resources as part of preparatory phase.

- TERI through the Science Technology and Innovation Hub aims to uplift rural communities, particularly the scheduled tribes by promoting sustainable agriculture and entrepreneurship.
- Several demonstrations and trainings have been completed focussing on vermicomposting, organic farming, mechanization of labour-intensive farming tasks, and the use of solar-powered food dryers.
- Initiative undertaken by TERI aims to improve agricultural productivity, increase farmers' incomes, and diversify economic opportunities in the village fostering a self-sustaining rural economy.
- TERI is implementing Seventh Operational Phase of GEF Small Grants Programme in India (SGP-OP7) in Indian Coastal Region funded by the Ministry of Environment, Forest and Climate Change (MoEFCC), in collaboration with the United Nations Development Programme (UNDP). The project aims to build capacities of local communities to take collective action for conservation and sustainable development, thereby generating global environmental benefits.
- TERI also emphasizes capacity building by conducting workshops and training programmes to raise awareness and equip local fishing communities with necessary skills.

Aggregate Numbers

SDG 14 Project Map: The governance framework specifically in the context of the Goals that are critical to address sustainable development of the Indian Ocean both domestically and internationally, would be examined and analysed. The project would provide a comprehensive analysis of SDG 14 apart from the key data and scrutiny that can aid in drafting the next Voluntary National Review and provide input to the SDGs NIF progress report. Institutional mapping would provide the framework to address gaps and challenges in governance and policy pathways to achieve the SDG. Assessment of 10 targets of SGD14 in the context of India's progress and country-level evaluation for the fisheries sector, marine pollution, biodiversity conservation and protection, climate change impacts, economic measures and marine governance will be carried out. This would serve as a vital component to build the SDG index for Goal 14 in India. A final report would be produced and an outreach workshop would be conducted to disseminate its results.

Another on-going ADB project (2024) on capacity building for climate-resilient fish farming will addresses key challenges such as declining fish stocks, climate change impacts, and limited access to resources for smallholder farmers. By promoting sustainable practices and enhancing financial literacy, the project will create new economic opportunities, especially for marginalized and vulnerable communities.

Under water technology domain for RBF, overall nine projects were executed across India, out of these seven were RBF implementation projects to provide clean and sustainable water supply for meeting drinking, domestic and irrigation needs for the community. In one pan-India project on the Indo–German Competence Centre

Participatory Rural Appraisal (PRA) activity to raise awareness and mobilize the local community

Demonstration on rainwater harvesting through pond construction

for Riverbank Filtration, 14 partners from EU and India participated. Currently, the Centre is working with the US. Agency for International Development's (USAID) DIV programme on sensor-controlled irrigation system in Karnataka and Goa. Ensuring a clean and adequate water supply for agriculture and domestic needs is a primary challenge for the sustainable development of the rural India as it requires unique, country-specific solutions to address water problems. RBF-based sensor controlled irrigation systems can supply high-quality irrigation water to rural farmers and generate business opportunities for system operators. This project will demonstrate how a combination of RBF and sensor technology can reduce the pressure on groundwater resources by converting polluted surface water into high-quality irrigation water.

The Watershed project funded by the Department of Agriculture, Government of Goa, under PMKSY WDC 2.0, focuses on promoting integrated cultivation techniques and sustainable water and soil management in 4200 hectares (Ha) area across selected villages, covering 900 households in Dharbandora, South Goa. The key objectives of the project include improving the productivity of rainfed and degraded land, increasing water availability, conservation of fertile topsoil and empowering community-based institutions such as self-help groups and user groups by conducting workshops and training programmes focusing on women empowerment (SDG 5).

The Science Technology and Innovation Hub in Gaondongrem Village is a project funded by DST-SEED that aims to uplift rural communities, particularly the scheduled tribes by promoting sustainable agriculture and entrepreneurship, fostering a self-sustaining rural economy. Benefiting 800 individuals, the project integrates organic farming, mechanization, and sustainable water management practices such as rainwater harvesting. Several demonstrations and trainings have been conducted, focusing on organic farming, mechanization of labour-intensive farming tasks, and value-addition of agri-products.

We work with a diverse range of organizations, including nodal ministries/departments, public sector undertakings (PSUs), corporates, academia and international development agencies.

Approach and Innovation

- Uniqueness
- Value addition

Coastal Educational Hub

The TERI Coastal Education Hub has made significant strides in disseminating education regarding Goa's coastal habitats and traditional coastal occupations among students and the general public. The Hub is dedicated to fostering entrepreneurship development and livelihood diversification opportunities, thereby contributing to sustainable coastal development.

Riverbank Filtration Systems

Our approach is distinctive, for instance, combining RBF with other water-treatment alternatives results in energy saving and water-use efficiency systems that can be used to a variety of applications across all disciplines.

Science Technology and Innovation Hub

The Science Technology and Innovation (STI) Hub project in Gaondongrem is designed to facilitate knowledge transfer and enhancement of traditional/ local knowledge. Mechanization of the labour-intensive agricultural work reduces drudgery and processing of locally available natural produce or resources supplements the income of schedule tribes' community in the project area.

USAID project

Coastal and hub

Inspirational Evidences

TERI successfully completed setting up a fully functional RBF demonstration site(s) in Thoremavu village of Mysuru district to quantify its pollutant-treatment efficiency and the amount of water that can be made available for domestic use.

Success Stories and Sustainable Solutions from TERI's 50th Year Celebration Event in Goa: On the occasion of the 50th celebration, the event focused on 'Pioneering Sustainable Solutions: Goa's Journey towards the 2030 SDGs,' emphasizing partnerships to foster sustainability and resilience. Major highlights are provided below:

- Chief Minister's Address: Dr Pramod Sawant emphasized Goa's progress in waste management, including:
  - E-waste plant proposal by the Goa Waste Management Corporation (GWMC)
  - Functional biowaste plant in Kundaim
  - Plans for a 'construction and demolition' debris plant
  - Wealth from waste: The Goa Government is focusing on creating wealth through effective waste management.
- Goa State Action Plan for Climate Change: Shri Aleixo Sequeira mentioned the final stages of the State Climate Action Plan 2023–2033 and the State Biodiversity Strategy.
- Global and Local Challenges: Discussions led by Shri Suresh Prabhu highlighted both global and local sustainability challenges. He urged Goa Government to assess the carrying capacity of the state of Goa to determine how much load Goa can handle to maintain its fisheries agriculture, sustainable tourism and good practices and suggested that TERI can be approached for this initiative.
- A memorandum of understanding (MoU) between TERI and Goa Chamber of Commerce & Industry (GCCI) Collaboration to equip policymakers, businesses, and communities to make informed sustainable decisions.

Impact We Created

We have been involved in initiatives that demonstrate a sustainable model for the education of rural local bodies, fishing communities, SHGs, and farming communities.

With regards to RBF technology projects, we collaborated with partners to implement sensor-based irrigation system controlled via web/mobile application. A recent initiative of USAID has expanded the systems to reach a greater number of farmers in various geographic domains, leveraging the expertise of the DST India pilot project.

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

[1] https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

[2] https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

SUSTAINABLE DEVELOPMENT AND OUTREACH

Shri R K Singh, Hon'ble Union Minister of Power, New & Renewable Energy, Government of India, delivered his address in a spotlight session during WSDS 2024

Sustainable Development and Outreach is dedicated to driving systemic change to enhance green growth and achieve sustainable development goals. By engaging in policy research and innovative practices such as green budgeting and environment-friendly public procurement, we aim to incorporate sustainability into a wide range of issues.

Centre for Sustainable Development Research and Leadership (CSDRL)

The Centre for Sustainable Development Research and Leadership (CSDRL) focuses on promoting systemic change to accelerate green growth and sustainable development goals. Through policy research and innovation like green budgeting and green public procurement, we integrate sustainability across various issues. Our work aims to enhance the voice of the Global South through research and dialogues. The analytical lens of political economy and network analysis enables us to critically examine the interface between sustainable development goals and various initiatives.

As the Secretariat for TERI's flagship initiative, the World Sustainable Development Summit (WSDS), we facilitate leadership and knowledge-based dialogues. Our Act4Earth initiative, comprising the SDG Charter and COP Compass, conducts research to strengthen synergies between sustainable development and climate action, particularly to enhance global governance mechanisms.

One of our key initiatives is the promotion of green growth through policy innovations of green budgeting and green public procurement. Green budgeting involves planning, tagging, and mapping budget allocations to environmental and sustainable development goals (SDGs), thematic areas, and activities, along with unique budget codes. Similarly, green public procurement prioritizes sustainable practices by incorporating environmental goals into procurement processes, thereby promoting accountability and transparency in sustainability measures. The SDG Blueprint project delves into interlinkages between SDGs and critical issue areas like sustainable agriculture. By understanding synergies and trade-offs, we can develop more holistic and effective strategies to address complex sustainability challenges and enhancement of policies.

The World Sustainable Development Summit (WSDS) serves as a crucial global forum for exchanging knowledge, ideas, and best practices. By bringing together stakeholders from around the world, WSDS facilitates collaboration and cooperation, ultimately advancing leadership and contributing to the achievement of SDGs and the goals outlined in Agenda 2030 and the Paris Agreement. Act4Earth, another flagship initiative, plays a pivotal role in driving global leadership and fostering dialogue among diverse stakeholders. Through platforms like the SDG Charter and COP Compass, we not only initiate conversations but also research to strengthen the narratives underpinning climate action and sustainable development. This not only raises awareness but also empowers decision-makers with the knowledge needed to drive meaningful change.

For initiatives such as green budgeting, we have technically engaged with the state governments of Bihar, Puducherry, and Assam. Similarly, our efforts in green public procurement (GPP) involved conducting a comprehensive stocktaking study encompassing all

> World Sustainable Development Summit (WSDS) brings together the North and the South for cooperative action for sustainable development. Kudos to TERI for championing the global South in this imperative of our times.
>
> Ambassador Manjeev Singh Puri, Distinguished Fellow, Earth Science and Climate Change Division, TERI

> The Sustainable Development division has emerged as one of the most dynamic and innovative divisions in TERI. In the past year, it has successfully completed two landmark projects: SDG Blueprint for Sustainable Agriculture and Green Budgeting.
>
> Dr Prodipto Ghosh, Distinguished Fellow, TERI

36 states and Union Territories of India to evaluate their GPP readiness. Two states, namely Punjab and Assam, are actively planning to strengthen green public procurement policies and practices. TERI is actively engaged with state governments, particularly finance and environment departments along with corporations, to solicit their insights and address challenges related to green public procurement. Additionally, our SDG Blueprint project involved assessing national policies with inputs gathered from experts from across the country. The flagship event of WSDS draws stakeholders from across India and the world.

Our Accomplishments

Major Projects

- World Sustainable Development Summit 2024
- Act4Earth – SDG Charter and COP 28 Compass
- Technical Support to the UT of Puducherry for Strengthening Green Budgeting
- South–South Cooperation in BIMSTEC, SAARC, and select African Countries
- Stocktaking Study on Green Public Procurement in India
- Mission Efficiency Stakeholder Engagement
- SDG Blueprint on Sustainable Agriculture

Aggregate numbers

In the financial year 2023–2024:

Green budgeting: TERI engaged in technical engagement on green budgeting for the Union Territory of Puducherry and the state of Bihar. In FY 2023–24, UT's green budget increased by 153% as compared to the baseline year of FY 2022–23.

153%	Increase in green budget allocation for the UT of Puducherry for FY 2023–24 as compared to the baseline year.

Green Public Procurement: A comprehensive stocktaking study covered all 28 states and 8 Union Territories, evaluating the presence of green procurement policies, practices, and market readiness. The team engaged in consultations of over 100 stakeholders including the Ministry of Finance, Government e-Marketplace, state governments, and industry leaders.

36	States and union territories covered in the stocktaking exercise on green public procurement.

SDG Blueprint: The study examined synergies and trade-offs of sustainable agriculture for 169 targets across 17 SDGs. The study involved consultations and gathered inputs from 123 experts.

169	SDG targets mapped for synergies and trade-offs

South–South Cooperation in BIMSTEC, SAARC, and select African Countries: The study comprehensively mapped 258 policies in Asian countries and 55 policies of African countries to arrive at a framework for South–South cooperation for sustainable agriculture.

258	Policies studied across Asia for identifying areas for South–South cooperation for BIMSTEC and SAARC countries

Approach and Innovation

- The Centre uses the theory of change rooted in constructivism and stakeholder engagement for advancing the cause of integrating and mainstreaming sustainable development across various sectors. From community engagement to engaging with global leaders, CSDRL prides itself in integrating policy research and outreach to foster innovative change and policy making.
- The team's expertise lies in green policy innovations of green budgeting and green public procurement, a pivotal component in promoting sustainability in the intersections of finance and environment policies.
- We aim to map both synergies and trade-offs of various issue areas with SDGs to promote holistic and system-wide approaches.
- Emerging areas of work include South–South cooperation, political economy and international organization frameworks to critically examine and strengthen international cooperation.

Inspirational Evidence

G20 Engagement

The team's engagement with India's G20 Presidency was a key focus area in the last financial year, with various working groups and ministries, especially with the T20 engagement group and Sherpa Track. TERI worked with the Ministry of External Affairs to

organize the Development Working Group's side event, 'Towards a Green Economy: Through Lifestyles for Environment (LiFE) and Just Green Transitions' in April 2023 in Kumarakom. Alongside the Energy Transitions Working Group, TERI organized an event of the Clean Energy Ministerial on "An Economy-wide Quantified Goal on Energy Efficiency in India" in July 2023 in Goa. Furthermore, as the Knowledge Partner for the Environment, Climate, and Sustainability Working Group, we played a pivotal role in drafting the G20 ECSWG Presidency Outcome Document on Circular Bio-economy. For the Think20 Engagement Group, Dr Shailly Kedia, our team lead who is a Senior Fellow and Associate Director, served as the Co-chair of "TF-3: LiFE, Resilience, and Values for Wellbeing".
Dr Vibha Dhawan, Director General, TERI and Programme Director, CSDRL, served as the Chair of the Think 20 engagement group within the G20. In her capacity as Chair of Task Force 4, she led efforts focused on "Refueling Growth: Clean Energy and Green Transitions."

Second DWG Meeting was organized in April 2023 at Kumarakom on Just Green Transitions

T20 Summit – Launch T20 Statement in Mysore

The team's work also in the form of T20 policy briefs on promoting sustainable lifestyles and circular bioeconomy aligned with the SDGs. These engagements reflect our commitment to providing knowledge inputs and fostering dialogues towards a more sustainable and resilient future on the global stage.

SDG Blueprint Tool

Within the framework of the SDG Blueprint for Sustainable Agriculture project, we have developed a valuable resource known as the SDG Blueprint Tool. This tool serves as an open-access knowledge repository, offering insights into the national policy

SDG Blueprint Tool for Sustainable Agriculture

The SDG Blueprint Tool is an open-access knowledge tool which provides the national policy interface between sustainable development goals (SDGs) and sustainable agriculture. The tool is a ready reckoner which can be used by policymakers, researchers, and civil society to inform policy and praxis on the issue of sustainable agriculture in India.

Impact We Created

Green Budgeting

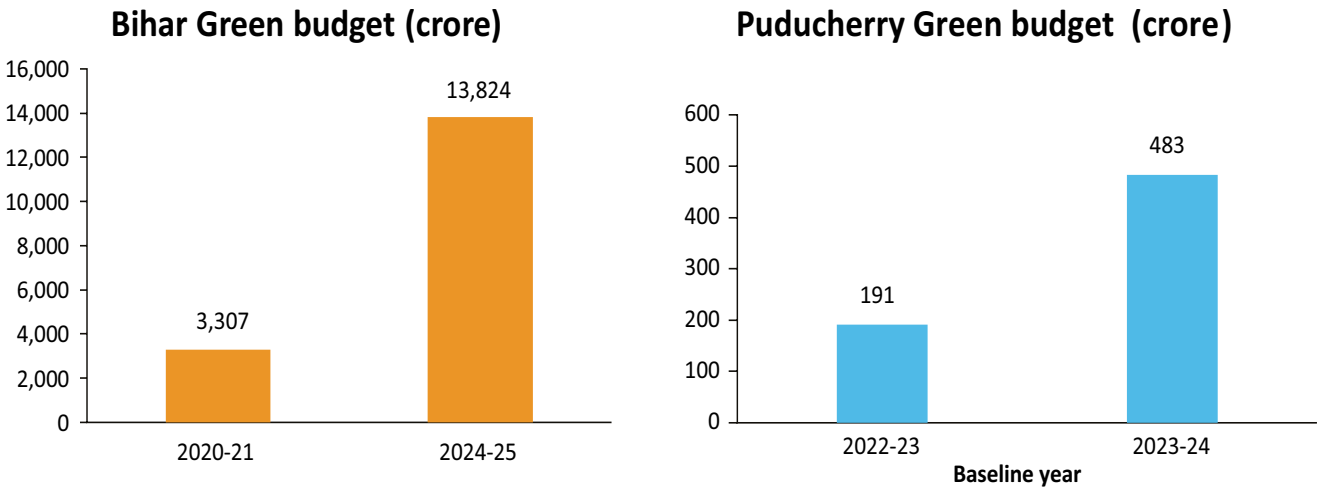
The Green Budgeting project supports Indian states, with a notable impact in the Union Territory of Puducherry and Bihar. In FY 2023–24, UT's green budget increased by 153%, with a 16.42% share in identified schemes. Regarding budget heads, the baseline year includes 120 heads, while for FY 2023–24, 134 budget heads were identified. Bihar's schemes rose from 103 to 281, with the budget soaring from INR 5,694 crore to INR 13,824 crore from FY 2020–2021 to FY 2024–2025. TERI recently also conducted a second capacity-building workshop in Puducherry for their next cycle. Over 150 stakeholders attended the workshop.

Second Capacity Building Workshop on Green Budgeting organized in Puducherry in January 2024

Second Capacity Building Workshop on Green Budgeting organized in Puducherry in January 2024

alignment between sustainable development goals (SDGs) and sustainable agriculture. It functions as a readily accessible guide for policymakers, researchers, and civil society stakeholders, empowering them to make informed decisions and take action in the realm of sustainable agriculture in India.

The knowledge resource portal established by TERI further enhanced awareness and understanding of green budgeting practices; it can be accessed from https://greenbudgeting.teriin.org/index.php. The initiative's success in Bihar and Puducherry underscores the potential for systemic change, with the knowledge resource portal serving as a valuable tool for wider adoption and understanding. In Bihar's green budget, the FY 2020–2021 includes actual expenditure, whereas 2024–2025 includes budget estimates. Similarly, in the case of Puducherry, FY 2022–2023 was the baseline year and was reported on the actuals.



Graphs representing the increased green budget in Bihar and Puducherry

WSDS 2024

The 23rd edition of WSDS was held on February 7–9, 2024, at India Habitat Centre, New Delhi. The Summit deliberations focused on the umbrella theme: 'Leadership for Sustainable Development and Climate Justice.' Considering the multiple crises and the need for polycentric leadership, the deliberations at the 2024 edition of the Summit focused on topics, such as climate solutions, integrating sustainable development, addressing the energy trilemma, driving green growth, lifestyles, and nature and ecosystems.

The participation of 2 heads of state/government and 11 ministerial speakers shows the continued political traction towards sustainability. The Summit saw 800+ in-person delegates. Additionally, 23 organizations partnered for the Summit. The Summit also saw engagement with Lifestyle for Environment (LiFE) as a special initiative. The media coverage for the Summit was 1,500+, social media reach was 700,000+, and the Summit page views were more than 85,000. The myriad segments included 17 plenary sessions, 31 thematic tracks, 3 special sessions, and 15 exhibition booths and were driven by 97 plenary speakers, and 272 thematic track speakers.

- *WSDS 2024 was inaugurated by esteemed dignitaries including Shri Jagdeep Dhankhar, Vice President of India; H.E. Brigadier (Retd) Mark Phillips, Prime Minister of Guyana; and Shri Bhupender Yadav, Minister of Environment, Forest, and Climate Change, Government of India*

Knowledge Building & Dissemination

1.	Policy Brief on Just Energy Transition Partnerships, Climate Action, and Minilateralism	Read Here
2.	Policy Brief on Road to Dubai and The Global Goal on Adaptation	Read Here
3.	Policy Brief on Advancing Environmental and Climate Goals Through a Multidimensional Model of Green Budgeting	Read Here
4.	Policy Brief on Internationalizing Lifestyles for Sustainable Development	Read Here
5.	SDG Blueprint for Sustainable Agriculture	Read Here
6.	WSDS 2024 Summit Overview Document	Read Here
7.	An Economy-Wide Quantified Goal on Energy Efficiency in India	Read Here
9	Promoting Sustainable Lifestyles: Metrics, Instruments, and Proposals for G20	Read Here
10	Circular Bioeconomy and SDGs: Proposals for the G20	Read Here

Partnerships and Networks

CSDRL was able to successfully mobilize partnership and support from various national and international agencies. Our partners include: Ministry of Environment, Forest and Climate Change; Ministry of External Affairs; Royal Norwegian Embassy; Bloomberg Philanthropies; Bill & Melinda Gates Foundation; The Rockefeller Foundation; The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection & International Climate Initiative (Germany); The World Bank; Tata Capital; Johnson Controls; TERI School of Advanced Studies; Asian Development Bank; International Energy Agency; Natural Resources Defense Council; Tata Power; National Bank for Agriculture and Rural Development; POP Movement; Kaizzen; Outlook Group; Climate Trends; The Foreign Correspondents Club; Press Club of India; IFAT India; Sustainability Karma; Sustainable Energy for All; Research and Information System for Developing Countries (RIS); Asia Society; Centre for International Climate and Environmental Research (CICERO); and Shakti Sustainable Energy Foundation.

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

[1] https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

[2] https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

Environment Education and Awareness

Working with Gen Z to reverse planetary environmental crisis, the Environment Education and Awareness (EEA) division's activities are oriented towards improvement in knowledge, attitude, and behaviour of children and youth. The division's work is implemented through two operational areas—Education for Youth Empowerment (EYE) and Strategic Communication for Sustainability (SCS) with members spread across Delhi, Guwahati, and Bengaluru centres of TERI. Projects cover schools, Higher Education Institutions (HEIs) and communities on issues related to environment and sustainable development.

Thematic Focus

- Adoption of best sustainability practices involving schools, colleges and universities to inculcate environmentally responsible behaviour (ERB) amongst students and youth
- Work on principles of Education for Sustainable Development (ESD) and contribute towards sustainable environment, healthy communities, and social cohesion

Felicitation Ceremony of GO4Youth 2023–24

Larger Goal

Projects and activities are designed around SDG 4.7, those that will lead to sustainability in thought and practice. For more details, visit: https://www.teriin.org/environment-education

Impact We Created

- **The Green School project** (supported by Tata Steel Foundation), reached out to 23,000 students, 371 teachers, and related community members in 47 targeted schools in Odisha and Jharkhand through campaigns and actionable community projects.
- **GREEN Olympiad**, India's premier environment quiz for school students and endorsed by the Ministry of Education (MoE) and the Ministry of Environment, Forest and Climate Change (MoEFCC) impacted 149,955 students from 2355 schools in India and abroad.
- **GREEN Olympiad for Youth** endorsed by the University Grants Commission (UGC), MoEFCC, MoE, Government of India had a participation of 10,225 students enrolled in Higher Education Institutions (HEIs) in India.
- **Urja Arpan project**, in collaboration with Tata Power DDL, developed a learning module aimed at increasing awareness about energy conservation and fostering a shift towards sustainable practices.
- **#75ReelsforCelebratingIndia**, a youth engagement programme to celebrate positivity and patriotism to promote culture in

partnership with the Ministry of Culture, under the umbrella of *Azadi Ka Amrit Mahotsav* (AKAM), brought forward innovative ideas by youth.

- **Cities Combatting Plastic Entering Marine Environment (CCPME) Project** in collaboration with GIZ, developed a wide range of communication and knowledge products to support clean-up drives, awareness events, stakeholder engagement sessions, slum beautification initiatives, and installation of Fischer Boom Barriers across Kochi, Port Blair, and Kanpur.
- **Ocean Matters (Safeguarding our Oceans Promoting Evidence Based Awareness and Education)**, a prestigious initiative supported by US Consulate office, Chennai reached out to 200 schools, 200 educators and 2000 students, parents and coastal communities from coastal cities of Mumbai, Mangalore, Mormugao, Kochi, Chennai and Puducherry, aims to promote a cadre of students and teachers to track and monitor environmental health using GLOBE and MMPT protocol.
- **Project LAMP** (Local Air Management Plan) supported by the Environment Defense Fund (EDF) included activities like surveys, gap analysis, stakeholder engagement to foster pro-environmental behaviour to combat air pollution's health implications and its effects on monuments in Patna, Indore, and Dewas.
- **Capacity Building Programme Targeting School Children on Climate Change, Health and Hygiene** reached out to 162 schools in 11 Districts of Uttar Pradesh, India with support from UNOPS.
- **Energy Wise and Energy Rise** programme with support from BSES Rajdhani Power Limited (BRPL) reached out to 30,000 students from 100 government schools in Delhi, with the aim to sensitize them towards pollution, energy conservation, renewable energy, and energy audits.
- **Comprehensive Assessment of Job Impacts and Skill Gaps of Transitioning from ICE to Electric Trucks** project, sponsored by Shakti Foundation included a system based study to identify job impacts and development of recommendations for training programmes and skilling initiatives.
- **CAP-India** sponsored by the Swiss Agency for Development and Cooperation (SDC) reached out to 21 schools from Kanpur, Lucknow, Pune, and Nashik with direct beneficiaries including 16,852 students, 9100 parents and 1328 other members of the community.
- **OTBL Campus Impact Challenge** focusses on learnings about Sustainable Development Goals (SDGs).
- **Youth Sustainability Vote**, a partnership programme with UNITAR provides a unique opportunity to map country's inclusive green economy transition by engaging youth views on the future that they want.
- **LEAD (Leadership for Environment, Awareness and Development) Programme** enabled school students to gain knowledge, acquire skillsets and obtain access to resources to strengthen their competencies on issues related to environment and sustainable development.
- **School-specific curated programmes** conducted at TERI SRC.

Highlights

- Nominated as member of Curricular Area Group on Environment Education constituted by NCERT to develop new syllabi and teaching-learning materials including school textbooks/guidebooks (Dec 15, 2023).
- MoU signed with IUCN India Country Office to advance environmentally responsible behaviour through sustainability education and communication activities, including promotion of ecotourism at Mukteshwar amongst children and youth (September 15, 2023).
- MoU signed with Bharat Soka Gakkai (BSG) to advance Goal 17 of the United Nations (Partnerships for Goals), including creating collaborative research materials, exhibitions, educational initiatives and others (July 28, 2023).

Youth participation at YCC 4th edition

High Impact Events

S. No.	Title	Date	About the event
1.	Leading Collective Action for Greener Future: Green Skippers and Experts leading the prospect	February 8, 2024	The Green School initiative showcased at TERI's annual flagship event, World Sustainable Development Summit (WSDS)
2.	Knowledge session on combating the global plastic waste crisis	January 30, 2024	The event, drew active participation from 70 attendees across GAIL locations
3.	Rivers in Spring programme on the occasion of World Water Day	March 22, 2024	In collaboration with GLOBE Italia, engaged communities at an on-ground interface of creating awareness about our oceanic wealth
4.	Education Summit- GSV Emeritus India (Gurgaon)	February, 13, 2024	Presentation on Education, the Workforce and Sustainability
5.	GREEN Olympiad	January 30, 2024	GREEN Olympiad presented at 12th World Environment Education Congress in Abu Dhabi
6.	Integrating Climate Change and Sustainability in Higher Education	January 9–10, 2024	Organized by ATREE, APU and Massachusetts University, Boston
7.	Innovative Curricula and Pedagogical Approaches to advance Climate Change Education	December 18–20, 2023	First ESD-NET Global Meeting organized by UNESCO and the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT), and co-hosted by the United Nations University (UNU)
8.	'Accelerating Climate Action Through Citizen Science: Role of COP28 and Beyond'	December 2, 2023	Project Ocean Matters showcased at "Greening Education Pavilion: LEGACY – from the Land of Zayed" hosted by the UAE Ministry of Education in partnership with the Greening Education Partnership with its secretariat at UNESCO organized by UNESCO and Ministry of Education, UAE at COP28 in UAE
9.	YCC Bootcamp	December 1, 2023	Provide a learning environment for the youth to further hone their skills on issues related to climate change and also act as goodwill ambassadors and peer leaders to spearhead the movement
10.	ASEF Policy Dialogue with Youth' and the ASEAN Youth Conference 2023	November 2–5, 2023	ASEF Policy Dialogue with Youth on 'Higher Education Working Towards the SDGs in Asia and Europe' was organized by Asia-Europe Foundation (ASEF), along with the side event of ASEAN Youth Conference 2023

11.	Demonstration of citizen science experiments to monitor oceanic health using the GLOBE protocol	July 27, 2023	Project Ocean Matters was demonstrated to the visiting administrator of US Environment Protection Agency, Mr Michael Regan. Students demonstrate the temperature and salinity experiments under the GLOBE protocol and interacted with the administrator and completed a short walk with him to understand the impact of climate change on oceans and beach ecosystems
12.	Generation Green: Promoting Sustainable Lifestyles for Youth as part of EU alliances	July 26, 2023	Youth outreach event in the presence of HE Mr Virginijus Sinkevičius, Commissioner, Environment, Oceans and Fisheries of the European Green Deal
13.	Principals' Forum	May 5, 2023	Organized in partnership with TERI School of Advanced Studies (T-SAS) to deliberate about sustainability education regime in India, schemes like Mission LiFE and how schools can embed environment education within their curricula
14.	Mainstreaming Biodiversity in Coastal/Marine Tourism Sector of Goa	September 29, 2023	Organized by Wildlife Conservation Society, India, Department of Forest, and Department of Tourism, Government of Goa
15.	Climate Change, Oceans and role of Education was presented at Waves of Change: Understanding Climate Change's Influence on Water Systems and Oceanic Health	September 11, 2023	Emirates Policy Centre, Abu Dhabi
16.	Special invite to Roadmap for engaging NGOs in Karnataka State Action Plan on Climate Change: Water and Agriculture sectors	September 2023	Organized by CEE and HSS in Bengaluru
17.	Moving towards Sustainable Development through Mission LiFE (Lifestyle for Environment)	September 2023	Thematic track was organized in 5th International Conference on Sustainability Education (ICSE). The event focussed on role youth can play in initiatives related to Mission LiFE. The session saw participation of experts from education, environment, spirituality, government institutions; winners of Mission LiFE, etc., to discuss and share their experiences and to illuminate the way forward.

Launch of GO4Youth 2023–24 at UGC

Students sharing Youth Priorities to finalize the Youth Pledge as part of Youth Climate Conclave 4th Edition

Approach and Innovation

- Interdisciplinary learning environment by including systems thinking approaches for enhancing futuristic planning and design thinking approaches for youth.
- An out-of-the-box thinking and innovative, cutting-edge sustainable practices that students can adopt within their campuses and communities.
- Imparts knowledge on the triple bottom line (people, planet, profit) of business, thereby developing a sense of business sustainability and leadership qualities.
- Create value-based learning and citizen science programmes for creating environmentally responsible citizenry and self-reliance in communities.
- Cutting-edge research on Education for Sustainable Development (ESD), and publishing case studies in national and international publications and journals.

Knowledge Building and Dissemination

- Cover publication in Education Challenge on "Beating Plastic Pollution: Role of Education" by Ms Saltanat M Kazi, Fellow, EYE, TERI
- Article on "Youth Climate Conclave (YCC): Youth's Commitment to Promote 'Sustainable Lifestyle" as part of Special edition CEESP IUCN Newsletter: International Youth Day contributed by Ms Monmi Barua, Associate Fellow, EYE, TERI; Dr Livleen K Kahlon, Senior Fellow & Associate Director, Environment Education & Awareness (EEA), TERI; and Ms Taru Mehta, Fellow and Area Convener, EYE, TERI
- An article on "Youth personify hope" as part of International Climate Initiative contributed by Dr Livleen K Kahlon, Senior Fellow & Associate Director, Environment Education & Awareness (EEA), TERI
- Mobilizing Youth Potential to Facilitate Innovative Activities around Climate Action a, IRB Review/ http://www.trdresearch.in/peerreviewed-refereed-research-journal.html contributed by Ms Monmi Barua, Associate Fellow, EYE, TERI; Dr Livleen K Kahlon, Senior Fellow & Associate Director, Environment Education & Awareness (EEA), TERI; and Ms Taru Mehta, Fellow and Area Convener, EYE, TERI
- Building Competencies Amongst Youth to Mainstream Knowledge and Soft Skills to Enable a Transformative Impact on the Society as part of *International Journal of Applied Sciences & Development*, vol. 2, pp. 147–152, 2023 contributed by Ms Taru Mehta, Fellow and Area Convener, EYE, TERI; Dr Livleen K Kahlon, Senior Fellow & Associate Director, Environment Education & Awareness (EEA), TERI; and Ms Monmi Barua, Associate Fellow, EYE, TERI
- Innovation Showcase in *TerraGreen*, Creating Futuristic Mindsets Amongst Youth Through Climate Change Education in February 2024 Issue contributed by Ms Taru Mehta, Fellow and Area Convener, EYE, TERI; Ms Monmi Barua, Associate Fellow, EYE, TERI; and Dr Livleen K Kahlon, Senior Fellow & Associate Director, Environment Education & Awareness (EEA), TERI
- Neha et al., 2023, Step towards Achieving Sustainable Development Goals through Eco club by State Council Educational Research & Training
- Neha and Abhas Mukherjee, 2023, Hamari Prithvi, Hamara Paryavaran, Hamara Jeevan, Book developed for BSES Rajdhani Power Limited (BRPL) and published by TERI in December 2023

- Learning Module on Students and teachers, The Green School - Tata Steel Foundation and TERI Initiative, 2023
- A handbook for schools on Audit (Energy, waste, water) and biodiversity mapping, The Green School - Tata Steel Foundation and TERI Initiative, 2023
- Moving towards a greener Life, Planetcast Media and TERI Publication, 2023
- Neha and Arun Kansal, 2023. What adolescents know and believe about reclaimed water and water scarcity: A survey of School Children in National Capital Region. *Indian J Environmental Protection*, Vol. 43 No. 03 pp 270-276, March 2023 (ISSN:0253-7141)
- Neha et al., 2023, Standard Operating Procedure for Cleanup Drive, Published by MoHUA and GIZ for National level

Partnerships and Networks

- University Grants Commission
- Ministry of Environment, Forest and Climate Change, Government of India
- Ministry of Education, Government of India
- Ministry of Culture, Government of India
- United Nations Institute for Training and Research (UNITAR), Geneva
- United Nations Environment Programme (UNEP), New Delhi
- United Nations Educational, Scientific and Cultural Organization (UNESCO), New Delhi
- US Consulate General Chennai
- European Union Delegation to India
- Central Board of Secondary Education
- Kendriya Vidyalaya Sangathan
- Navodaya Vidyalaya Samiti
- State Council of Educational Research and Training, Goa
- Council on Energy, Environment and Water (CEEW)
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), India
- United Nations Children's Fund (UNICEF)
- International Union for Conservation of Nature (IUCN)
- Bharat Soka Gakkai (BSG)
- Tata Steel Foundation
- BSES Rajdhani Power Limited (BRPL)
- Tata Power Ltd
- United Nations Office for Project Services (UNOPS)

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Communications & Publications

Communications and Stakeholder Engagement (CSE) Area

The Communications and Stakeholder Engagement (CSE) Area conceptualizes and implements the outreach activities of TERI's diverse knowledge and amplifies them to key stakeholders. The Area contributes to TERI's outreach through a well outlined communication strategy.

Effective communications and outreach are crucial for a research organization to make a societal impact. Cutting edge research at TERI strives to bring about change—small and big—through stakeholder engagement and uptake. To maximize the impact of research, it is imperative it reaches beyond the selective realm of science and theory to public at large. The communication team plays a critical role in doing that.

Work We Do

Mainstream Media Engagement

Media—print, broadcast and online—continues to be the most popular and effective mode of outreach for TERI's knowledge outputs. Engagement with the media ranges from facilitating in-depth opinion pieces, experts' inputs, and interviews. Project milestones such as publication of reports and findings, workshops, and conferences are amplified through classic outreach tools of press releases, press conferences, and special stories.

Social Media

Social media has established itself as an indispensable tool in reaching out to a larger audience base, building brand awareness and fostering growth.

TERI is active across all popular social media platforms—Twitter, Facebook, LinkedIn and Instagram, as well as YouTube. The Institute has a growing and dynamic following on all social media platforms and content shared on them ranges from announcements and project milestones to audio-visual products.

The communication team leverages the potential of social media platforms to take TERI's innovative research to a cross-section of followers. Project specific and platform specific social media strategies are also curated by the CSE team.

Project-based Films and Audio

The CSE team produces audio-visual content such as micro and short films to augment the reach of TERI's vast body of work in sustainability domain.

Additionally, the CSE team brings out 'TAKE-3', a monthly short video, where in-house experts answer three questions on relevant subjects.

Kumaon Vani

Broadcasting at 90.4 MHz FM, the station serves as a vital communication hub for the predominantly agricultural community in and around Nainital. Its reach extends to nearly 3,50,000 people within a 20-km radius, providing a platform to address local concerns and share valuable information. Over the past financial year, the station curated and aired several impactful community-oriented programmes. These included campaigns like International Yoga Day, promoting health and wellness; Har Ghar Tiranga, celebrating national pride and unity; and Meri Mati Mera Desh, fostering a connection to the land and honouring cultural heritage. Through these initiatives, the station continues to strengthen its role as a voice for the community.

Kumaon Vani also broadcasted information on environment, education, disaster and social welfare schemes. Link: http://bit.ly/KumaonVaniYouTube

Kumaon Vani community radio station activities

Social Media Performance of TERI FY 2023–24

Platform	01-Apr-23	31-Mar-24	Increase
LinkedIn	73,153	88,852	15,699
Twitter	24,070	25,109	1,039
Instagram	3,291	3,755	464
Facebook	37,297	37,586	289
YouTube	80,482	84,246	3,764

Media Analytics FY 2023–24

Activity	Total
Interviews	435
News Stories	1701
Op-eds	150
Press Releases	193

Films/Videos and Podcasts

Several film and videos were produced in FY 2023–24.

Several webinars and events were also livestreamed on the YouTube channel - https://www.youtube.com/teri

Films and Videos

Films & Videos	
Film / Video	**YouTube link**
TAKE 3: Just Green Transitions	https://youtu.be/c37iiKi0vxQ
Indian industries support key messages of TERI at COP27	https://youtu.be/oxP1p9xBMX4
TADOX: TERI Advanced Oxidation Technology for Wastewater Treatment and Reuse	https://youtu.be/tCt5rxC7eik
TERRANOVA - Official Mascot of TERI	https://youtu.be/hBLEoRNZl1s
Ocean Matters: Safeguarding Our Oceans	https://youtu.be/cBQ3hHpbsdE
About TERI Council for Business Sustainability	https://youtu.be/soJ6Jlro-kQ
New Bloom On The Loom: A film on hybrid solar charging unit for power looms	https://youtu.be/aw30zHEujkg
CEM-14/MI-8 – Technology and Cultural Showcase: Advancing Clean Energy Together	https://youtu.be/buAWBiW1AVg
A Journey towards Sustainability: Empowering Lives, Preserving Nature	https://youtu.be/pLpwAWnVaFk
Through the Bioscope of Time: 50 Years of Shaping Tomorrow	https://youtu.be/x53bsUmwK-I
GREEN Olympiad: Nurturing Environment Stewardship since 25 Years	https://youtu.be/TUbkJFr3xJw
TAKE 3: Water Crisis	https://youtu.be/E2vRdBLj6DI

Podcasts – The Earth Pod

TERI engages with multiple facets of sustainable development from science and technology to policy. The Earth Pod steers conversations with experts on issues related to climate change, energy transitions, and environment-friendly growth.

Podcasts	
Podcast	**Spotify link**
Episode-5 — On Blue Economy: An Ocean of opportunities	https://open.spotify.com/episode/270ywe8g-pRyyOz4IC4FFfw
Episode-2 — All Things Plastic: The Good, the Bad, and the Necessary	https://open.spotify.com/episode/08fBm4nIfJemE-5abl9irTK
Episode-3 — Water Scarcity in India	https://open.spotify.com/episode/6NmQhnH9npXtY-cIJYKZ0nI
Episode-4 — Land Restoration, Desertification and Drought Resilience	https://open.spotify.com/episode/4nur43IKujz7sN-8FlBRBni

TERI Publications

TERI Publishing Solutions area, the publishing arm of TERI, is one of India's prominent publishers in the areas of environment, energy, and sustainable development. The Publications division publishes books, journals, and magazines on these topics at all levels.

TERI Publications, in its endeavour to bring greater ecological awareness, has an extensive range of print publications; widely accessible e-books; and sophisticated, interactive e-learning products that cater to every type of reader and knowledge requirement on diverse areas of the environment.

We work with academics across the globe to produce quality content and materials and contribute significantly towards enhancing learning outcomes of the students.

Our Accomplishments

Number and nature of projects

With close to 400 published titles over the years, TERI Publications has been a valuable source for filling the learning gap on environment and sustainability.

We also provide support and assistance to all programmes for their various publication needs on a wide range of projects.

TERI Publications division also conceptualizes customized knowledge resources, based on the needs and assessments of the target group. This includes undertaking environment-related projects to encourage an active social connect with the environment.

With every carefully chosen and published title, quality has been the single major idea that drives TERI Publications.

TERI Publications books and learning resources create a lasting impression and aim to make a positive difference.

TerraGreen

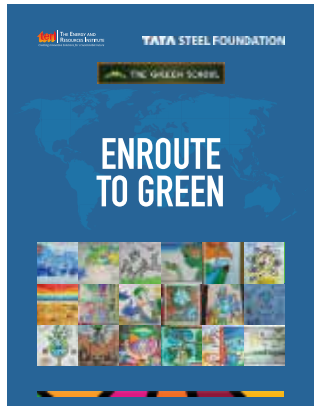
TERI's flagship digital magazine that deals with issues related to sustainable development, environment, and energy.

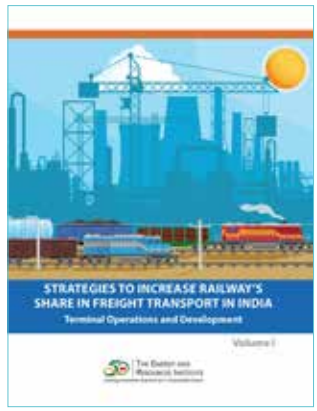
Energy Future

It aims to educate and inform you about the wide world of energy: its history, its future, how the energy industry works, how it has affected the world and how is continues to affect you and me.

World Digital Libraries (WDL)

WDL is an international peer-reviewed biannual journal, that seeks quality research papers that present original theoretical approaches.





Electronic Newsletter on Renewable Energy and Environment (eNREE)

Beneficial for policymakers, researchers, consultants, academicians, and students engaged in the area of renewable energy and environment.

Journal of Resources, Energy, and Development (JREaD)

It provides a forum for comprehensive investigation, analysis, and review of subjects in the fields of energy, environment, and natural resource management that confront decision-makers, planners, consultants, politicians, and researchers.

TERI Energy & Environment Data Diary and Yearbook (TEDDY)

It is the only comprehensive energy and environment yearbook in India that provides updated information on the energy supply sectors (coal and lignite, petroleum and natural gas, power, and renewable energy sources), energy demand sectors (agriculture, industry, transport, household, buildings), and environment (local and global).

TERI COUNCIL FOR
BUSINESS SUSTAINABILITY

TERI Council for Business Sustainability (CBS) serves as the interface for TERI's research work to be connected to the corporate world. The Council is a network of Indian business leaders working on a shared commitment to mainstream sustainability in business strategies and practices. Set up in 2001, member companies of the Council include public and private sector, including MNCs—representing various industry sectors, sizes and geographies. Activities of the Council are governed by an executive committee from amongst member companies.

Themes and Commitments

Thematic Focus

TERI CBS engages with the core issue of what businesses must do to shape and lead in sustainability. The Council co-creates business solutions with member companies to address national sustainability challenges; curates common interest forums of member companies with the participation of board members and Chief Sustainability Officers; undertakes policy advocacy through Thought Leadership reports and industry dialogues; and builds capacity through trainings, learning visits, webinars, conferences, etc. With individual member companies, the Council provides a range of tailor-made advisory services. These comprise sustainability strategy development, performance assessment and improvements, capacity building and facilitates showcasing best practices in national and international forums.

The fiscal year 2023–24 proved pivotal for a variety of reasons. India successfully hosted its first G20 presidency. The year emerged as a crucial midpoint—marking 7 years since the Paris Agreement was agreed upon in 2015; with the next 7 years in hand to reach the goalpost for realizing the 2030 Agenda for Sustainable Development. At the UN annual climate summit COP28, hosted by the UAE, the first Global Stocktake (GST) provided a comprehensive assessment of progress since adopting the Paris Agreement. This helped align the efforts on climate action, including measures that need to be put in place to bridge the gaps in progress. Given India's development priorities and progress so far on its NDCs, international cooperation, finance and technology will be critical.

This past year, we witnessed enthused participation from our national and global partners as well as diverse government stakeholders at the state and central levels, alongside global partners. Engagements with the businesses and member companies of our Council ranged from diverse webinar and hybrid sessions, sustainability assessments and in-person workshops to high-level convenings at major global events. We indeed are thankful to the support from all our partners and the companies in the Council's network, who helped build a system that provides policymakers with reliable, relevant and real-world evidence from businesses to support the translation of NDCs and sustainability goals into effective policies and regulations.

Larger Goals and the Context

The inclusion of—Sustainable Solutions for Climate Change and Sustainable Energy Transition; Inclusive Global Value Chains; Employment generation, social

Dr Vibha Dhawan, Director General, TERI at the thought leadership session 'MegaWhat: Making Energy Limitless, Affordable and Secure, organized by Hitachi Energy and CNBC

Prof. Jim Skea, IPCC Chair; Dr Vibha Dhawan, Director General, TERI; Mr Mahendra Singhi, Director and Strategic Advisor, Dalmia Cement Bharat Limited, Governing Council Member, TERI; and Indian Business Leaders at a panel session at COP28

protection and skilling—in the G20 New Delhi Leaders Declaration brought to centrestage the solutions that will shape future development pathways. All these have been integral components of our 2023–24 engagements with Council member companies and C-suite dialogues. The G20 reconfirmed one of the major messages from the G7 Hiroshima Summit, stressing that there should be "various pathways" for our energy transitions. Such message recognizes the needs, the vulnerabilities, the priorities as well as the different national circumstances of the developing countries. This message about various pathways is crucial and has been evident in our study's findings and recommendations.

India has massive ambitions. It wants to become a $5 trillion economy in the next few years. By 2025, it wants to add over 30,000 km of highways, 400 Vande Bharat trains, over 200 airports and double our port capacity. By 2030, it plans to leapfrog Japan and Germany to become the third-largest economy in the world. However, to get there, the government will need to invest massive sums of money across the board. Governments, firms, institutions, civil society groups and citizens across the world need to act with the utmost sense of urgency on climate now. Carbon emissions must be brought down to zero at the earliest. This means we need a strategy, sector by sector, for a rapid reduction in carbon emissions. Leadership initiatives of our Council members and signatory companies of the Industry Charter for Near-Zero Emissions Ambition by 2050, https://teriindustrycharter.in instituted by TERI, clearly depict that these strategies need to be evolved by each country and should ideally combine a top down as well as a bottom-up approach.

TERI CBS: business-policy-research interface on environmental sustainability

Working towards achieving India's energy ambitions would require an unprecedented scale of transformation along a pathway never followed by other countries of rapidly increasing energy consumption and decarbonizing energy at the same time. The Council observes that forward-thinking Indian businesses will have a critical impact on India's success. We are delighted that during 2023–24 continued support and regular participation of the Council members have enabled us to host several high level convenings—both part of the Sherpa tracks as well as official engagement platforms, e.g., Think Tank 20 (T20). The G20 International Seminar on Sharing global policies and best practices to decarbonize "Hard to Abate" sectors held as part of the G20 Sherpa track on Energy Transitions ensured that key messages from India are reaching the global leaders. Jointly developed with Shell, the T20 Summit in Mysuru, Karnataka, embraced the recommendations of our report titled "India Transforming to a Net-Zero Emissions Energy System – A call to action to 2030". Our scenarios examined how clean energy will look like in the decades to come. This becomes important to the central theme of T20's Task Force on "Refueling Growth in the context of energy transitions". The trilemma of energy security, energy equitability and energy sustainability are

Dr Vibha Dhawan, Director General, TERI at the India Net Zero Forum organized by The Economic Times

mainstream like never before, particularly in the context of very near-term 2030 commitments. This report and our joint efforts exhibit that India can be a global leader, as well as source of global inspiration to the Global South. Our joint efforts with the World Economic Forum (WEF) and the Leadership Group for Industry Transitions (LeadIT), informed the G20 Energy Ministers meet the significant levels of risk-tolerant international capital and ambitious domestic policy measures are needed to decarbonize India's hardest-to-abate industrial sectors.

The focus on 'Just Transition' as part of energy transitions and in view of achieving the Sustainable Development Goals (SDGs) of 2030 was well recognized in the New Delhi Leaders' Declaration. Enthused participation from the Council members emphasized that companies have a critical role in advancing a just transition by taking concrete actions that address the social impacts of climate change mitigation and adaptation in partnership with other actors such as workers, unions, communities, and suppliers. Given the scale of the climate crisis, our engagements in 2023–24 pointed out that there is an urgent need for the private sector to enhance its ambition, commitments and actions for a just transition to an environmentally sustainable economy that leaves no one behind. Under aegis of the T20 Task Force 4 'Refuelling Growth: Clean Energy and Green Transitions', TERI in partnership with Thomson Reuters Foundation (TRF) organized a day-long convening 'Building a Resilient Future'. https://www.teriin.org/event/building-resilient-future-investing-green-jobs-and-reskilling-women-workers Sessions under the convening discussed key enablers (resources)—finance and green skills—required to ensure just transitions in the society.

The Council recognizes that as key drivers of energy transition in the Indian economy, Indian businesses will be required to mobilize resources, especially financial resources. TERI's 'Expert Group on Financing India's Long Term Low-Carbon Development Strategies (LT-LEDS) has been initiated to evaluate India's financial

TERI along with ERIA and ERIN organized a workshop on Energy Transitions in Asia

High Level Convening of Industry Charter during TERI's WSDS 2024

strategy with respect to its LT-LEDS especially in the context of hard-to-abate industries and the ancillary MSME sectors. Comprising members from the Industry and Financial sector, the Expert Group will analyse policy frameworks and investment markets that favour financing technology transfers and share recommendations that help strengthen existing policy and regulatory frameworks that promote green investments whilst ensuring just transitions.

TERI CBS has consistently engaged with policymakers at the subnational, national and bilateral levels as a knowledge partner and convening multiple stakeholders. The high-level convening of Industry Charter and the interactive session with Indian Chief Sustainability Officers https://www.teriin.org/event/meeting-chief-sustainability-officers held alongside our annual flagship World Sustainable Development Summit 2024, identified key actions needed by CXOs and CSOs to accelerate sustainability across the value chain of businesses. TERI served as a knowledge partner at the Environmental Sustainability Summit https://www.youtube.com/watch?v=j53V7oyUV4k supported by the Environment and Climate Change Department of the Maharashtra Government. To strengthen bilateral relationships with Japan and the United Kingdom, during 2023–24 the Council members shared their know-how and practices to aid and support organization of stakeholder convenings and sessions. The 'India – Japan Deeptech Innovation and Clean Energy Seminar' witnessed discussions across a range of sectors—digital innovation, semiconductors, hydrogen and ammonia, energy efficiency, and clean mobility. With the Foreign, Commonwealth and Development Office (FCDO) of the Government of United Kingdom, TERI CBS hosted a series of stakeholder engagements focussed on renewable energy and energy efficiency, urban transitions, nature-based solutions, and green finance.

Vibrant Network and Strengthened National and International Outreach

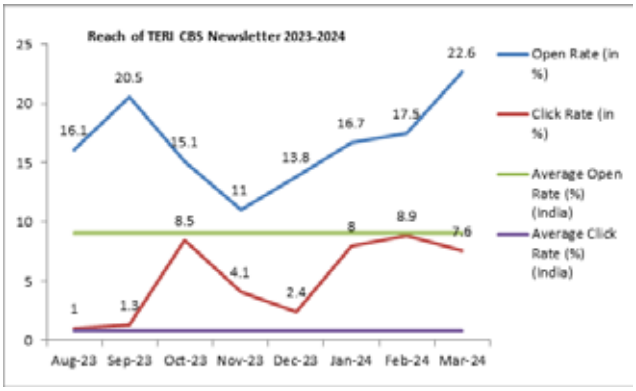


Figure 1: Reach of TERI CBS Newsletter 2023–2024
*Note 1: *Open Rate refers to the % of contacts that opened the email. *Click Rate refers to the % of contacts that clicked on any link embedded in the newsletter*
Note 2: Comparison of TERI CBS Newsletter against average newsletters of other Indian organizations (Average Open Rate 9.05%; Average Click Rate – 0.84%; Source - https://www.benchmarkemail.com/email-marketing-benchmarks)

Our engagements with leading Indian industries have gained consistent traction to advance agenda of industry decarbonization and circular economy.

Our technical proposals on why storage of electricity is necessary for meeting demand round the clock and the details of range of possible mitigation strategies for Net Zero steel sector have witnessed significant uptake by Indian industries, while garnering concurrence from global partners. In 2023–24, at an aggregate level, the Council directly engaged with over 300 Indian companies, while reaching out to over 500 companies in the CBS Network. As an advisory partner to the India Net Zero Alliance, https://netzeroalliance.in/ TERI supported organization of webinars discussing actions that will enable sectors such as buildings, cement & concrete, chemicals and, cement & concrete to become net zero. The year 2023–24 marked strengthened outreach by TERI CBS, through providing thought leadership at various forums for Indian industries (refer Knowledge Contributions section). The monthly-connect Newsletters for CBS Network was well received and recorded consistent readership throughout the financial year 2023–24 (Figure 1).

TERI's outreach on the challenges faced by businesses as they look to decarbonize their operations, and the necessary support required in industry transitions have been undertaken at the highest levels of decision making. At COP28 in Dubai, TERI CBS hosted high-level convenings with business leaders bringing forth the challenges in industry decarbonization, and how these can be overcome. With BCG India, TERI organized a high-level roundtable discussion 'Transformative Climate Leadership for more actions on Finance, Technology and International Cooperation'. Focusing further on the need for multi-stakeholder cooperation, TERI jointly with DNV organized a session 'Accelerating Multistakeholder Cooperation for Climate Actions in the Global South'. Highlighting further some of the specific requirements, especially financial requirements, of the emerging economies as they look to decarbonize their industries was the session on 'Green Market Instruments for Industry Decarbonization – Spotlight on Steel in Emerging Economies'. Jointly organized by TERI, Climate Catalyst and Mission Possible Partnership at the Marrakech Partnership Pavilion, Panellists at the session, representing leading industry players such as Avaada Energy, Tata Steel, Arcelor Mittal/Nippon Steel (AM/NS) shared their perspectives on how a whole-

Environment Sustainability Summit, Mumbai, organized by the Department of Environment, Maharashtra Government

Mr Arupendra Nath Mullick, Vice President, TERI Council for Business Sustainability at the 'Fuels of Future' Conference

Chief Sustainability Officers Forum organized during TERI's WSDS 2024

value chain thinking and development of enabling conditions is crucial for the application and utilization of green market instruments. In addition, TERI also engaged with its other global partners such as the Asia Europe Environment Forum on discussions of how businesses need to integrate sustainable development concerns with their business objectives.

Our Accomplishments

The engagements with industry representatives from steel and cement sectors have increased on building a narrative on importance of technological innovation and low carbon industry transition with steel sector representing 45% of market share and cement sector representing more than 42% of market share. The Marrakesh Partnership Pavilion at COP28, Dubai hosted a high-level convening titled 'Green Market Instruments for Industry Decarbonization – Spotlight on Steel in Emerging Economies' with Indian CXOs and global partners to disseminate a set of recommendations on financing the industry transitions.

- Industry charter on commitment to Near Zero Emissions Ambition by 2050 was launched during New York Climate Week of 2020 with 6 signatory CEOs which increased to 92 Indian CEOs on-board as of March 2024.
- Under the aegis of T20 – the official engagement platform of G20, Indian business leaders come together to exchange experiences to establish new and effective financing mechanisms to enable a 'just transition'; thereby reaffirming their commitment to zero emission and decarbonization targets to build a cleaner and resilient future. TERI's work on energy transitions, skilling and just transitions initiatives alongside initiatives of Council member companies and global partners were showcased at the global platform.

Voluntary actions on climate change by the signatory companies of the Industry Charter were showcased at a High-Level Convening at the annual UN climate Summit COP 28 in Dubai where Prof. Jim Skea, Chairman of the Intergovernmental Panel on Climate Change (IPCC) and Indian CXOs from major Indian industry conglomerates launched the Anniversary Update Report 'Practices and Solutions: Accelerating Indian Industry Decarbonisation'. The Report contains 21 practices and solutions adopted by the Indian industry to decarbonize their operations.

- The Hon'ble Chief Minister of Maharashtra and the Hon'ble Governor of Maharashtra acknowledged the contributions of TERI in advancing environmental sustainability initiatives in the state of Maharashtra and across the country and globe.

> One of the biggest challenges for the decarbonization of air travel is the availability of sustainable aviation fuel. We need to increase collaborations and build the technologies and enhancements into the existing structures and supply chains.
>
> Mr Sourabh Mukherjee, Executive Vice President at Tata Projects, India (at the EU-India Collaboration on Sustainable Biofuels for Aviation and Maritime Transport Roadmap Workshop hosted by TERI in collaboration with the European Union)

> For the first time in history, there is a clear destination of the 2070 net zero goal and while the journey has already started, it will take several generations of people to contribute to it.
>
> Mr Satish Pai, Managing Director, Hindalco Industries (at TERI's 'Panel Discussion with IPCC Chair and Indian Business Leaders' hosted at COP28 in Dubai)

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

1 https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

2 https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

SUPPORT UNITS AND INFRASTRUCTURE FACILITIES

Support Units assist TERI in its efforts on climate resilience, renewable energy technologies, participatory forest management, and knowledge generation. They ensure smooth and timely management of operations throughout TERI, helping it to emerge as a premier think tank. TERI's infrastructure facilities are crucial for facilitating its research work. Equipped with the latest advancements, these facilities enable the various programmes to succeed in their initiatives.

Information Technology and Services Division

TERI Information Technology and Services Division is in charge of giving other divisions cutting-edge IT infrastructure, communication platforms, and smart applications for their efficient operations. The Division is also responsible for creating specialized applications and platforms for researchers. The IT Division has introduced unified communication tools and strengthened communication networks. This has made it possible for TERI's offices and centres to collaborate via instant messaging, web conferencing, and videoconferencing. It has also made it possible for mobile researchers to stay connected and operate remotely. The main goal is to give everyone secure access to IT applications and services from any location, at any time, and on any device. Additionally, it aims to make IT services adaptable enough to alter in accordance with business requirements and needs.

The IT infrastructure team is transitioning towards cloud-based architecture in order to stay current with IT standards. To guarantee the highest possible uptime for our websites and other services, the majority of our websites/applications are hosted in a cloud environment.

With more than 70 network switches, seven firewalls, and 40+ Wi-Fi access points, TERI's centres are connected to one another without interruption and the network security is ensured by Sophos XG series Firewall.

The following is the list of important projects that the IT Division undertook during 2023–24:

- **TERI E-learning**
  Link: https://teriin.org/e-learning/
- **TERI_50Years**
  Link: https://www.teriin.org/TERI_50Years/
- **NMCG-TERI**
  Link: https://nmcgtericoe-wr.in/
- **Meghalaya Traditional Knowledge Portal**
  Link: https://netkp.org/public/index.php
- **Green Budgeting**
  Link: https://greenbudgeting.teriin.org/
- **WSDS**
  Link: https://wsds.teriin.org/2024/
- **Green Olympiad Online Examination**:
  Link: https://www.teriin.org/olympiad/
- **GRIHA Summit**:
  Link: https://www.grihaindia.org/grihasummit/

Knowledge Resource Centre (KRC)

Knowledge Resource Centre's (KRC) vision is to develop technology-enabled knowledge solutions and emerge as a skill development hub to support the transition to sustainability.

KRC has been at the forefront of knowledge creation and dissemination. Our focus lies in establishing robust knowledge management systems, crafting value-added services, and conducting skill development programmes that address sustainability issues nationwide.

Themes and Commitments

Library and Knowledge Management

KRC caters to the knowledge needs of TERI researchers and other stakeholders from government, corporate, bi/multilaterals and academic organizations by disseminating innovative knowledge-based products and services using ICT tools. Knowledge services are provided using physical and e-resources. Besides providing research assistance, the KRC professionals are also engaged in multi-stakeholder research projects, data analysis, developing international and national-level networking, conducting capacity-building programmes for researchers, web content and database development, bringing out peer-reviewed publications and knowledge products. KRC also maintains a state-of-the-art knowledge management system as a research support tool, which captures and disseminates TERI's vast knowledge and research data.

Specialized Information Centres

KRC has set up several specialized information centres for knowledge dissemination on sustainability areas on transport, renewable energy and climate change, sustainable development. These centres create knowledge products, maintain websites and repositories and provide online knowledge services to stakeholders.

Knowledge Sharing and Collaboration

During 2023–24, KRC executed several knowledge-based activities that included development of Digital Repository of S&T publications <http://digitalrepository-nstmis-dst.org> and Digital Library on Green Mobility (DLGM) <https://greenmobility-library.org> under the India component of NDC Transport Initiative for Asia project, supported by GIZ India. Under DLGM, a webinar on "Sustainable Mobility Research, Knowledge Management, and Dissemination: Advancing the Transition to a Low-Carbon Transportation Future" was held on December 21, 2023.

KRC hosts the EIACP (Environmental Information, Awareness, Capacity Building and Livelihood) Resource Partner on Renewable Energy and Climate Change <http://terienvis.nic.in> supported by the Ministry of Environment, Forest and Climate Change, Government of India, which works relentlessly towards knowledge creation and dissemination for education, awareness and inputs to policy-making. The Centre has produced reports, infographics, datasets, case studies and 4 issues of eNREE News.

Supported by the International Solar Alliance, a project was undertaken to collate laws, regulations, policies, guidelines, technical standards, publications, research papers and reports relating to the regulatory environment in ISA's member countries and make them available in the Regulation Resource Repository on Solar Energy. These resources have been meticulously gathered to serve as a comprehensive and valuable knowledge hub, promoting the development and harmonization of solar regulations worldwide.

The Ministry of Earth Sciences (MoES), Government of India has commissioned TERI with the study titled "Analysis of Outcome of Extramural Research Projects, sponsored under the Programmes of MoES, Government of India, during the period 2012–2020".

The objective of the study is to map the significance and outputs of the MoES-sponsored extramural research projects; and analyse the outcomes and impacts the extramural research projects have made during the period 2012–2020.

'Preservation and Protection of Traditional Knowledge – Documentation initiative in the North-East Region, India' is a joint project carried out by the BRDC (Bio-Resources Development Centre) and TERI, with sponsorship from the NEC (North-Eastern Council), Ministry of Development of North Eastern Region, Government of India. The study effectively identified and documented distinct Traditional Knowledge pertaining to agriculture, handicraft, handloom, medicine, fishery, and veterinary science that were present and continue to be practiced within the community. The Meghalaya Traditional Knowledge Portal, available at http://netkp.org/, was developed as a repository for the knowledge materials gathered and captured throughout the current study.

The E-learning Platform https://teriin.org/e-learning/ aims to facilitate capacity building across professionals and communities with the aim to promote efficient use of resource; increase access and uptake of sustainable inputs and practices thereby reducing the impact on environment and climate.

Coordinates_of_GSDP

Mission LiFE awareness programme locations

Training and Skill Development

TERI EIACP organized "Carbon Neutral Ladakh Movement" seminar held on September 24–25, 2023 in collaboration with HIAL at Leh. This seminar was dedicated to introducing Ladakh's youth to sustainable solutions that align with vision of carbon neutral Ladakh.

TERI EIACP RP conducted 16 awareness programmes under Mission LiFE at different parts of India reaching over 45,000 stakeholders. During the reporting period, under the Green Skill Development Programme (GSDP), the Centre imparted 4 residential technical trainings engaging rural youths from different Indian States on solar energy applications and waste management sectors to develop skills and livelihood generation in Dhanbad (Jharkhand), Lucknow (UP), Meghalaya, and Tripura.

TERI, with support from NABARD, conducted specialized skill development training programme on Skill Development Training for Unemployed Youth of Lucknow Region, Uttar Pradesh on solar energy and its technologies with reference to agriculture for the rural youth of Lucknow, Uttar Pradesh. TERI provided classroom-based training programmes that included site visits and imparting practical understanding of the functioning and maintenance of solar power plants,

solar pump, solar dryers, solar cold storage, solar lighting-cooking, and other solar systems.

TERI conducted two online Women Entrepreneurship Development Programme (WEDP) and two online Technology-Based Entrepreneurship Development Programme (TEDP) in 2023. These programmes were sponsored by the National Science & Technology Entrepreneurship Development Board (NSTEDB), Department of Science & Technology, Government of India.

Launch of Meghalaya TK portal

Seminar on Green Livelihood Opportunities for a Carbon Neutral Ladakh- 24-25 September, 2023

TEDP

Knowledge Building and Dissemination

We have been at the forefront of knowledge creation through acquisition, organization, dissemination of knowledge resources, and providing value-added services on energy and environmental topics.

Impact We Created

- Our online knowledge platforms and contents have been used by over 1 lakh diverse stakeholders for conducting research, making decisions, and developing collaborations with others.
- Developed green skills of 180 trainees through a structured programme focused on solar energy technologies and waste management practices.
- Over 60 potential entrepreneurs were selected and trained through a structured 3-week online training programme. Around 80 S&T graduates were selected for 4 weeks Technology-Based Entrepreneurship Development Programmes.
- Under Mission LiFE awareness drive, we have reached over 45,000 stakeholders from different parts of India.
- Over 28 students have been trained under Skill Development Training for Unemployed Youth.

Partnerships and Networks

Most of the funding and support has been received from the government sector comprising the Ministry of Environment, Forest and Climate Change; the Department of Science and Technology; and the Ministry of Earth Sciences, Government of India.

Collaborations with organizations such as Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the International Solar Alliance have led to the creation of a Digital Library on Green Mobility and Regulation Resource Repository on Solar Energy, respectively.

Partnerships developed with multiple academic institutions and NGOs have resulted in the successful conduct of skill development programmes focusing on SDGs across various states in India.

Details on Knowledge Building; Partnerships and Networks can be viewed via the following URLs:

[1] https://www.teriin.org/files/TERI_Annual_Report_Knowledge_Contributions.pdf

[2] https://www.teriin.org/files/TERI_Annual_Report_Partnerships_and_Networks.pdf

Project Management Unit

The Project Management Unit (PMU) is the institute's central hub for all project activities. At any given time, more than 300 projects, ranging from research to implementation, would be underway. The objective of PMU is to efficiently manage the projects—from their inception through to their conclusion. The PMU's key responsibilities include:

- Identifying funding opportunities and areas of dissemination and coordination
- Facilitation for the preparation and submission of bids
- Team and relationship management, including the ongoing communication of duties and responsibilities within the project teams
- Ensuring a timely delivery of all contractual obligations—Interim, mid-term, and project completion reporting
- Contract administration and budget control
- Quality control
- Facilitating effective utilization of resources
- Generation of MIS reports
- Maintenance of knowledge repository

TERI's PMU uses sound project management techniques and customized software tools to facilitate deliverables on time and within strict quality guidelines, thereby ensuring that the desired outcomes of the projects are met. It also ensures that all the projects are well documented and catalogued in TERI's knowledge repository.

Human Resources Division

The Human Resources (HR) Division aims to engage the workforce to ensure a growth enabling, progressive working environment, which facilitates the realization of the vision and mission of TERI. The HR Division has been instrumental in facilitating learning and development initiatives for staff to keep them in sync with the changing business environment and plays a crucial role in promoting and maintaining a positive and productive work environment at TERI.

The Division's primary objectives are as follows:

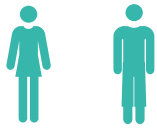
1. **Fostering engagement:** The Division focuses on actively engaging the colleagues, ensuring colleagues are motivated, satisfied, and committed to the TERI's goals and values with the aim to implement various programmes and initiatives to enhance morale and well-being.
2. **Growth enablement:** The HR Division works towards creating an environment that fosters growth and development. This involves talent management, performance evaluations, career planning, and opportunities for skill enhancement.
3. **Progressive working environment:** The HR Division strives to maintain a forward-thinking and innovative workplace. With the aim to implement policies and practices that encourage creativity, collaboration, and adaptability, HR department is able to establish a progressive culture.
4. **Realization of vision and mission:** The Division aligns HR practices with TERI's vision and mission, ensuring that employees are working towards the TERI's overarching goals and objectives.
5. **Learning and development:** The HR Division is responsible for designing and implementing learning and development initiatives. These programmes help employees acquire new skills and stay updated with industry trends and best practices. HR Department aims to establish 'Total People Development Plan'.
6. **Internship and career development:** Our HR department plays a pivotal role in providing internship opportunities to top graduates from leading institutes in the country. These interns work closely with researchers on various projects, ensuring that TERI has access to the best talent available. Furthermore, we are strong proponents of a work-education culture. Through our employee-friendly policies, we create a conducive environment for researchers to pursue PhD programmes at renowned global universities, thus helping them realize their full potential.
7. **Commitment to diversity and inclusion:** Diversity and cultural sensitivity are highly valued within TERI's ecosystem, as they are essential for establishing and maintaining a respectful and engaging workplace environment. We take pride in specializing in providing cross-divisional work and career opportunities, enabling professionals to contribute their expertise in areas beyond their primary research, thereby enhancing our interdisciplinary capabilities and contributions to a sustainable world.
8. **Employee well-being and transparent work culture** The HR places a strong emphasis on its employees' well-being. We provide wellness programmes that include training and guidance to motivate and enable our employees to lead healthy lifestyles, ultimately enhancing their work productivity. Our commitment to transparency and employee engagement is reflected in the work culture fostered by TERI's Administrative Services.

Human Capital and Infrastructure Facilities

The Administrative Services Division also looks after The RETREAT (Resource Efficient TERI RETREAT for Environmental Awareness and Training). The RETREAT Centre is a training and conference facility at TERI Gram. It provides organizations an opportunity to use its facilities for holding training programmes, workshops, and conferences with an objective of linking the process of corporate growth and training with the expression of corporate responsibility towards protecting the environment. The facility provides a unique experience of doing things in an unconventional yet viable way.

TERI's growing reach and visibility make it an integral part of the itineraries of many international dignitaries and delegates, including heads of governments. The professional coordination and conduct of all such visits continues to receive appreciation from the heads of missions in New Delhi.

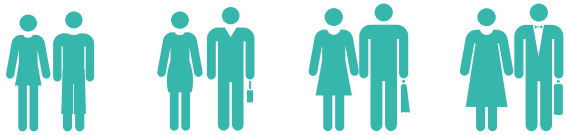
GENDER



31% Female

69% Male

AGE DISTRIBUTION



18% AGE 22-30 YEARS

28% AGE 31-40 YEARS

28% AGE 41-50 YEARS

26% AGE 51 AND ABOVE

QUALIFICATION

19% GRADUATE

46% POSTGRADUATE

14% PhD

OTHERS 21%

SPECIALIZATION

2% SOCIAL SCIENCE & AWARENESS

3% BIOTECH & AGRICULTURE

4% ECONOMICS

4% ENERGY

5% ENGINEERING

3% INFORMATION & TECHNOLOGY

9% ENVIRONMENT

71% OTHERS

Administrative Services

TERI's Administrative Services primarily focus on streamlining activities related to the extensive research conducted by TERI. In essence, our core mission is to reinforce research endeavours. We achieve this by offering administrative and maintenance support services across multiple locations, including TERI Headquarters at India Habitat Centre, regional centres in Bengaluru, Goa, Guwahati, and Mumbai, as well as the campuses at TERI Gram in Gurugram and TERI Himalayan Centre in Mukteshwar, Uttarakhand.

Our responsibilities also extend to managing, maintaining, and operating amenities and utilities in alignment with international standards and norms. Notable examples include our Quality Management System (QMS) certified to ISO 9001:2015 standards, Health and Safety Management System in compliance with ISO 45001:2018, and Environmental Management System adhering to ISO 14001:2015.

One of our core responsibilities is the management of the RETREAT (Resources Efficient TERI RETREAT for Environmental Awareness and Training) located at TERI Gram. This unique facility offers a sustainable and unconventional approach to training and conferences, reflecting TERI's commitment to environmental awareness and practical sustainability.

As TERI's reach and visibility continue to expand, we have become an integral part of the itineraries of many international dignitaries and delegates, including Heads of Governments. This underscores our growing influence and impact on the global stage.

Infrastructural Facilities

TERI requires state-of-the-art, modern, and vital infrastructure facilities, which are instrumental in facilitating research and development on a large scale. TERI has developed a host of infrastructure facilities, across the length and breadth of the country, which have continued to propel the Institute throughout its history.

CMCC Germplasm Bank

The Centre for Mycorrhizal Culture Collection is stepping into its second-generation level with an objective of supplying well-characterized mycorrhizal cultures to researchers and industry. The Bank has three temperature-controlled greenhouses at Gual Pahari which house 2,800 isolates of Arbuscular Mycorrhizal Fungi (AMF) and 285 cultures of Ectomycorrhizal Fungi (EMF) collected from different soil types from India and around the globe. Our molecular biology and biochemical labs are equipped with avant-garde equipment which aid in characterizing each isolate and help in generating an information database which is available on the CMCC website (http://mycorrhizae.org.in/CMCC).

Solar Smart Mini-grid Facility

TERI has established solar hybrid smart mini-grid at its Gual Pahari campus. The mini-grid has inhouse developed controller for load scheduling and load & grid management including prioritizing of solar PV utilization.

Mass Production Technology

In vitro mass production technology produces viable, healthy, genetically pure, and high-quality mycorrhizal propagules without any pathogenic contamination in a sterile environment.

DNA Fingerprinting and Molecular Breeding Lab

The DNA fingerprinting facility is a state-of-the art laboratory for varietal identification, mapping of genetic diversity, and marker assisted breeding. The facility harbours a LICOR 4300 DNA analyser and other molecular biology-related equipment. The facility is being used for providing DNA fingerprinting services to state horticulture departments and genotyping services to plant breeders for their breeding programmes.

Plant Genetic Transformation and Functional Genomics Laboratory

This laboratory has all the basic equipment such as Real Time–PCR, gel electrophoresis systems, and plant culture room. It works on developing genetically modified plants for better quality and productivity under changing environments.

Micropropagation Technology Park

Complete with infrastructural facilities ranging from modern laboratories and greenhouses to nurseries that are required for mass production of tissue-cultured plants, the facility has an annual production capacity of over two million plants.

Herbal Garden at Supi

The herbal garden is home to more than 60 different varieties of fresh and dry exotic vegetables, fruits, and herbs such as all in lower case font.

TERI–Deakin Nanobiotechnology Research Centre

The Centre bridges the gap between industry and academia through research and collaboration of leading international experts to generate effective solutions for a sustainable future. This Centre is working towards a greener and more advanced use of nanotechnology for resolving challenges in agriculture, biofuel production, and biomedical issues through nanoparticles, nano-biosensors, nanocarrier-formulations, nanodelivery of agrochemicals, and seed coating formulations (details available at: http://tdnbc.teriin.org).

Fermentation Technology and Research Centre

The Centre is a state-of-the-art fermentation with a pilot-scale platform to carry out studies. It has a series of fermenters of working volume ranging from 3.5 litres to 13,000 litres. Apart from mass-scale production of indigenously developed oil degrading bacterial cultures, the facility has capacity to carry out research on anaerobic fermentation processes in pilot and large industrial scale.

Microbial Biotechnology Laboratory

The Laboratory is an experimentation facility for the exploration of microbial diversity to provide biotechnological solutions in the field of environmental protection and sustainability, especially in the sector of oil and gas. The facility has state-of-the-art set ups for petrochemicals, petroleum microbiology, petroleum hydrocarbons, and molecular biology with automated facility and real-time PCR systems. Infrastructure for both aerobic and anaerobic microbiology facility is also available. The laboratory is supported by analytical facility that is equipped with Gas Chromatography, High Performance Liquid Chromatography, Gas Chromatography-Mass Spectrometry, GC-headspace systems with other requisite instrumentations.

Supercomputer to Enhance Climate Modelling Capabilities

TERI has a well-equipped climate modelling infrastructure, which consists of a supercomputer with a peak performance of 12TeraFLOPs - to carry out the climate simulations at various spatial and temporal scales with varying global and regional horizontal resolutions. High-end servers are also present for running impact models at ultra-high resolutions. TERI's research in climate science and associated modelling spans a whole range of activities beginning with the understanding of the climate system through the use of state-of-art modelling tools like Global Climate Models, viz., CCSM, CESM and NorESM; Regional Climate Models, viz., PRECIS, WRF and COAWST and impact models, viz., ADCIRC (for storm surges and coastal inundation), MIKE-11 (for inland flooding), SWAT (for water resources), DSSAT (for agriculture), and DIVA (for coastal zones).

TERI Water Laboratory

Recognized and certified under the Environment (Protection) Act of 1986 by the Ministry of Environment and Forest (now, Ministry of Environment, Forest and Climate Change), Government of India, the laboratory is equipped with field sampling, monitoring equipment, and analytical instruments. The laboratory provides multi-disciplinary water quality and quantity monitoring, testing, and related services.

TRISHA

TERI's Himalayan Centre at Latey Bunga, Mukteshwar exemplifies 'ideal' green environment. It is a symbol of optimum use of natural resources such as solar and other forms of renewable energy.

Himalayan Centre at Latey Bunga, Mukteshwar

TERI's Research Facility in Bengaluru

The TERI Southern Regional Centre building is a judicious blend of technology and tradition that promotes energy efficiency and sustainable development. The centre has a state-of-the-art environmental laboratory at Bengaluru office, which includes:

- Sophisticated instrumentation, such as atomic force microscopy and FTIR spectroscopy;
- Polymer-processing equipment such as Dynisco table top twin-screw extruder, Microwave reactor, Brabender plastic order, and compression moulding;
- Testing instruments such as Extensometer, EMI shielding analyser, Delta mode systems, and Specific gravity tester.

Knowledge Resource Centre

TERI library houses a wide array of resources on energy, environment, and sustainable development—from books, journals, and papers to the world's leading academic databases. A book digitization scanner—Bookeye 4—is installed in the Library and Information Centre.

TERI Gram

TERI Gram is located on the outskirts of Delhi. It is a sustainable habitat consisting residential as well as conference facilities, powered by a specially designed renewable energy system to meet its energy requirements.

Test Bed Facility, Gual Pahari

TERI and Somfy India Private Limited had partnered to set up a Test Bed Facility at Gual Pahari in the year 2015/16. The main objective of setting up this facility is to derive the benefits of Somfy Roller Blinds in test building.

TADOX® Wastewater Treatment Plant

TERI Advanced Oxidation Technology (TADOX®) for the treatment of industrial and municipal wastewater is currently being demonstrated at TRL-7 with a wastewater treatment plant of 10 KLD (10,000 L per day) capacity. The USP of this technology is that it can treat in few hours and bypass any kind of biological treatment and directly utilizes Advanced Oxidation Nanotechnology for the treatment of sewage and mixed effluents from the campus.

Mahindra Centre for Excellence

A joint research initiative of Mahindra Lifespace Developers Limited (MLDL) and TERI, the vision of the Mahindra-TERI Centre of Excellence (MTCoE) for Sustainable Habitats is to foster sustainability by developing innovative and resource-efficient solutions tailored to the Indian building sector and climate.

The CoE, a SVAGRIHA 5-star rated facility, has received accreditation from National Accreditation Board for Testing and Calibration Laboratories (NABL) for testing the thermal properties of building materials. It is equipped with a one-of-its-kind 'Guarded Hot Box', that was fabricated under the close guidance of TERI researchers. The facility has a 'Sky Scanner' installed to monitor the sky conditions of Gurugram city. The findings of the study would throw light on the impacts of climate change and provide a fresh perspective on the way we design buildings today. The water sustainability city-level assessment, building-level water audits, and a web-based tool generate awareness among relevant stakeholders, mitigate potential risks, and ensure efficient water management at micro and macro levels. A web-based EcoNiwas Samhita Design aider tool has been developed to ease the implementation of the residential building code at

MTCoE Lab

the design level. To know more about the CoE, please visit the website Mahindra-TERI Centre of Excellence (mahindratericoe.com).

TERI Food Testing Laboratory at NERC

The Food Testing Laboratory partially funded by the Ministry of Food Processing Industries (MoFPI) has been developed for testing of packaged water, food, and beverages for determining chemical, microbial and elemental parameters. The Laboratory has been accredited as NABL testing lab for testing of Packaged Drinking Water (As per IS: 14543) for some chemical parameters. Apart from the scopes for ensuring food safety, in due course of time nutritional profiling and GMO testing will also be included in the scope of services of this lab.

Nano Production Technology

The National Centre of Excellence for Advanced Research in Agricultural Nanotechnology is the first-of-its-kind research platform in India, which endeavours to carry out end-to-end research to innovate green nanoproducts including nano-fertilizer, nano-pesticide and nanocarrier products and technologies. Safe and efficacious nanoproducts will be developed by the Centre in order to meet the global food demand along with protecting environment and human health.

Field evaluation of TERI Nano Urea formulation following drone-based supplemental spray on the paddy crop at Davangere, Karnataka, during Kharif 2022. This resulted in enhanced yield of up to 17.1%.

Centre of Excellence in Agriculture and Environment

We make significant contributions to the development of the research and scholarly capabilities of the future generation in partnership with TERI SAS in India and Deakin University in Australia.

Foliar spray with TERI Nano Urea

Farmer's Practice, 100% Urea

- *Evaluation of TERI Nano urea product under drone application in Chilli*

FINANCIAL SUMMARY 2023/24

INFLOWS (₹ in Lakh)

98.84%
₹22728.92
INCOME FROM PROJECTS

0.12%
₹27.30
INCOME FROM INVESTMENTS

0.18%
₹40.44
SALE OF PUBLICATIONS

0.86%
₹197.92
INCOME FROM OTHERS

TOTAL **100%** (₹ 22994.58)

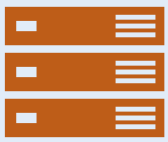
OUTFLOWS (₹ in Lakh)

37.98%
₹6604.10
SALARIES

6.15%
₹1069.67
EQUIPMENT

48.85%
₹8492.00
RESEARCH MATERIAL, TRAVEL

6.32%
₹1099.54
RENTAL,UTILITIES, INFRASTRUCTURE AND MAINTENANCE



0.70%
₹120.78
ADMINISTRATIVE EXPENSES

TOTAL **100%** (₹ 17386.09)

About TERI

A dynamic and flexible organization with a global vision and a local focus, TERI was established in 1974, with initial focus on documentation and information dissemination. Research activities, initiated towards the end of 1982, were rooted in TERI's firm conviction that efficient utilization of energy and sustainable use of natural resources would propel the process of development.

All activities in TERI, the largest developing-country institution working towards sustainability, move from formulating local and national-level strategies to shaping global solutions to critical issues.

Buoyed by more than 43 years of excellence in research and innovation, TERI is now poised for future growth, driven by a global vision and outreach, with a philosophy that assigns primacy to enterprise in government, industry, and individual actions.

THE ENERGY AND RESOURCES INSTITUTE
Creating Innovative Solutions for a Sustainable Future

The Energy and Resources Institute
Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003
Tel. 2468 2100 or 2468 2111, Fax 2468 2144 or 2468 2145
India +91 • Delhi (0)11
Website: www.teriin.org

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