Department of Scientific and Industrial Research
Ministry of Science and Technology
Government of India

ANNUAL REPORT

2022 - 23

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DSIR
ANNUAL REPORT

2022-23

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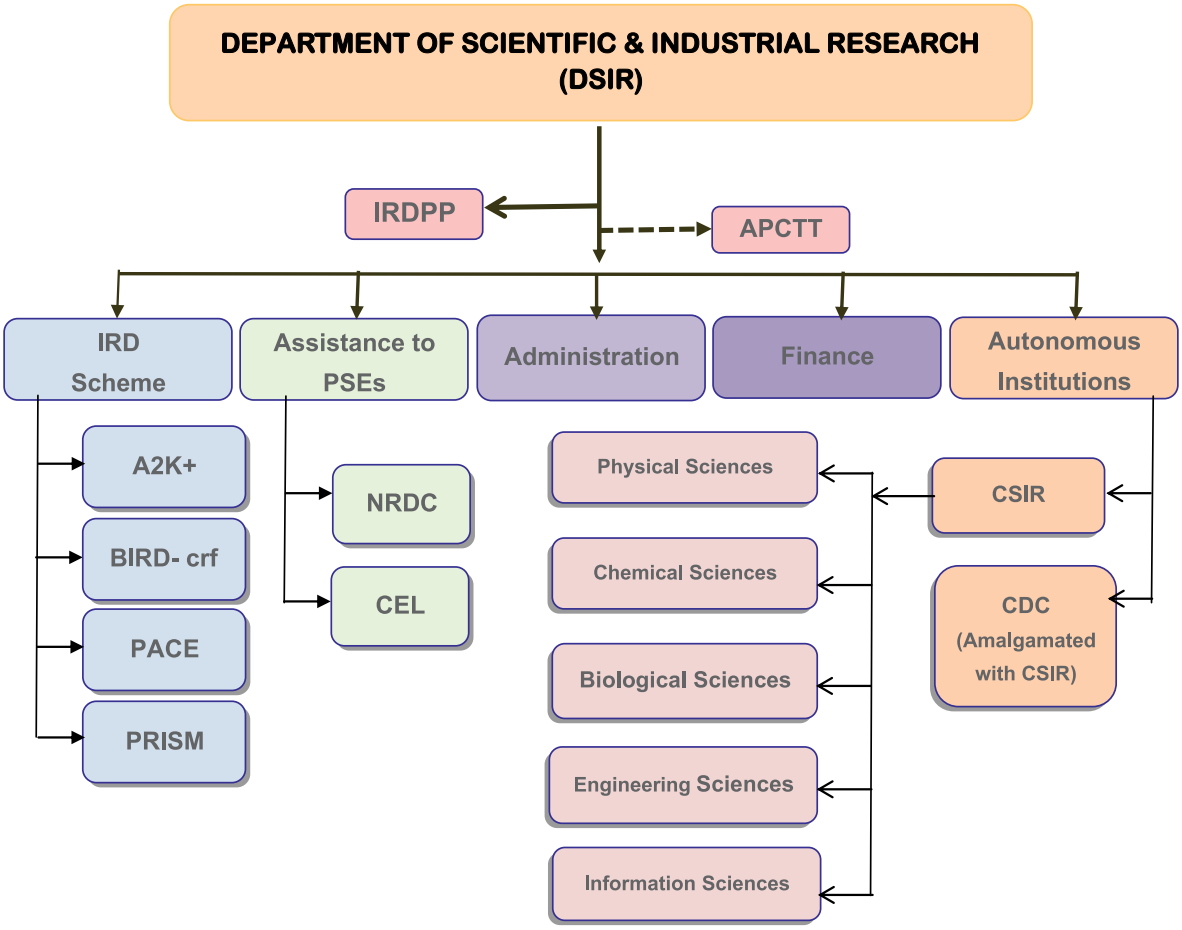
FUNCTIONAL STRUCTURE



A2K+	**Access To Knowledge For Technology Development And Dissemination**
IRD Scheme	**Industrial Research & Development Schemes**
BIRD -crf	**Building Industrial Research & Development and Common Research Facility**
PACE	**Patent Acquisition and Collaborative Research and Technology Development**
PRISM	**Promoting Innovation in Individual, Start -ups and MSMEs**
PSEs	**Public Sector Enterprises**
NRDC	**National Research Development Corporation**
CEL	**Central Electronics Limited**
CSIR	**Council of Scientific and Industrial Research**
CDC	**Consultancy Development Centre (Amalgamated with CSIR)**
APCTT	**Asian Pacific Centre for Transfer of Technology**
IRDPP	**Industrial Research and Development Promotion Programme**

HIGHLIGHTS OF ANNUAL REPORT 2022-23

(i) DSIR is the nodal Department for granting recognition/ registration certificates to the In-house R&D centres established by industry. During the period under report, there were altogether 2397 In-house R&D centres of industry with DSIR recognition.

(ii) 116 In-house R&D centres were accorded fresh recognition and renewal of recognition was accorded to 658 R&D centres of industry.

(iii) Of the total 658 company's granted renewal of recognition during the year, 42 companies incurred an annual R&D expenditure of over Rs. 5000.0 lakhs each, 149 companies incurred an annual R&D expenditure in the range of Rs. 500.0 lakhs to Rs. 5000.0 lakhs and 115 companies incurred an annual R&D expenditure in the range of Rs. 200.0 lakhs to Rs. 500.0 lakhs.

(iv) During the period under report, 87 SIROs were accorded fresh recognition. These include 37 cases in the Natural and Applied Sciences, 01 cases in the area of Agricultural Sciences and 04 cases in the area of Social Sciences and 45 cases in the area of Medical Sciences.

(v) DSIR is the nodal Department for registration of public funded research institutions (PFRI), Universities, IITs, IISc and NITs for availing concessional custom duty exemption on import of equipment, spares, accessories and consumables for research purposes. During the period under report, 06 institutions were newly registered with DSIR and 149 institutions were granted renewal of registration.

(vi) Fresh approvals to 09 companies were accorded u/s 35(2AB) of the IT Act, 1961, wherein the companies become eligible to claim weighted tax deduction @100%. Reports valued at Rs. 14,396.91 crores have been forwarded to Chief Commissioner of Income Tax (Exemption) CCIT (E) in Form 3CL, as required under the IT Act, 1961.

(vii) Financial support was extended to 31 (thirty one) new innovative projects of individual innovators during the period under report for PRISM scheme. The department rendered financial support to 12 (twelve) on-going projects and 17 (seventeen) PRISM projects have been successfully completed during the tenure.

(viii) Two CRTDH at Indian Institute of Technology Bhilai and National Institute of Pharmaceutical Education and Research (NIPER-SAS Nagar) have been set up during 2022-23 in New Materials/ Chemical Process sector.

(ix) A two days "DSIR-CRTDH Conclave–2022 jointly with Common Research and Technology Development Hub (CRTDH) at CSIR - Indian Institute of Toxicology Research, Lucknow was held on 17th & 18th November, 2022. The conclave witnessed signing of MoUs with different industries and CRTDHs. Achievements made by various CRTDH were showcased in the exhibition during the conclave. A compendium on CRTDH scheme was also released containing comprehensive details of all the CRTDHs set up in various institutes in India with the financial support from DSIR along with success stories of MSMEs/Startups which benefited from the DSIR-CRTDH scheme.

(x) A study report "Social & Economic contributions of Women in Manipur" was released by Secretary, DSIR on International's Women's Day (8th March, 2022). The study report is an attempt to share an insight into the gap, constraints

and scope for inspiring, supporting and creating opportunities for women in Manipur to earn their living and empower them as individuals to participate in the development of the North Eastern Region.

(xi) The Department of Scientific and Industrial Research (DSIR) is the national focal Department in India for matters related to APCTT (Asian and Pacific Centre for Transfer of Technology), a regional institution of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). In 2022, APCTT conducted various joint activities with Department of Scientific and Industrial Researchviz: (i) Brainstorming Session between STI Agencies of India and APCTT for Promoting Regional Technology Co-operation held in New Delhi on 19th April 2022, (ii) Industry-Academia-Government consultative meeting to address the challenges of energy sector (conventional & non-conventional) and energy devices, held on 17th October 2022. (iii) International knowledge-sharing workshop on cross-border innovation, acceleration, and challenges in international technology transfer held on 14-15th November 2022 at New Delhi.

(xii) Department has successfully implemented e-Office developed by National Informatics Centre (NIC) under Information Technology e Governance activity.

(xiii) DSIR received 94 RTI Applications during 01/01/2022 to 31/12/2022, 89 RTI requests were disposed off and 5 are under process on RTI Request & Appeal Management Information System.

(xiv) During the year 2022, DSIR organized events like Hindi Pakhwada, Vigilance Awareness Week, Yoga Day, Constitution Day. Special Campaign 2.O from 2nd October, 2022 to 31st October, 2022 was also conducted and reviewed with nodal officers from CSIR, NRDC and CEL at regular intervals.

(xv) HANSA-NG, 2 seater flying trainer Aircraft, design & developed by CSIR-NAL, successfully completed in-flight engine relight test at DRDO's Aeronautical Test Range (ATR) facility, Challakere on 17 May, 2022. Flight test was carried out at an altitude of 7000-8000 feet with the speed range of 60 to 70 knots by Test Pilots from Aircraft and Systems Testing Establishment (ASTE), Indian Air force (IAF).

(xvi) India's first truly indigenously developed Hydrogen Fuel Cell Bus developed by KPIT-CSIR in Pune was launched on 21 August 2022. The Hydrogen Fuel Cells utilize Hydrogen and Air to generate electricity to power the bus and the only effluent from the bus is water, therefore, making it possibly the most environmentally friendly mode of transportation.

(xvii) CSIR won 'The golden Peacock Eco-Innovation Award' for the year 2022 for 'Environmental Surveillance for SARS-CoV-2 Virus in Wastewater for Effective Management. The compressive and extensive work done by CSIR labs IICT, CCMB, NCL and NEERI in surveillance during COVID regime was recognized.

(xviii) CSIR-CSMCRI has undertaken initiative for sustainable development of clean energy and developed a new porous material which may efficiently extract Uranium from seawater.

(xix) CSIR has filed 163 patents abroad and 229 patents in India during the year 2022 and it has been granted 158 patents abroad and 202 patents in India. CSIR has also filed 61 Copyright applications during the period under report.

(xx) CDC got amalgamated with the Council of Scientific and Industrial Research (CSIR), an autonomous body under the Department

of Scientific and Industrial Research (DSIR), along with its manpower, moveable assets and liabilities vide Ministry of Science and Technology (Department of Scientific and Industrial Research) Notification AB-CDC018/1/2021-PSE-DSIR dated 11th May 2022 (published in the Gazette of India on Thursday, May 12, 2022).

(xxi) National Research Development Corporation, PSE with DSIR signed 42 MoU's with new organizations, assigned 42 technologies and Licensed 70 innovative technologies to start-ups / entrepreneurs.

(xxii) Central Electronics Limited, PSE with DSIR incurred the highest ever net worth of Rs.122.34 Cr. as on 31.03.2022.

(xxiii) CEL signed two MoUs with Indian Institute of Kanpur (IIT-K) to work on common areas of interest for the development of technology and signed a technology transfer agreement with Naval Materials Research Laboratory (NMRL DRDO) for production of special grade ferrite based radar absorption material for stealth application.

(xxiv) New website for DSIR with integration of Content Management Framework (CMF) developed by NIC, CMF Team has been launched and available at http://164.100.166.67.

(xxv) 09 study proposals and 11 events were supported under the Access to Knowledge for Technology Development and Dissemination (A2K+) scheme.

(xxvi) Technology Development and Utilization Programme for Women (TDUPW) promotes adoption of new technologies by women/ SHGs/entrepreneurs for greater operational efficiency, product value addition, enhanced/alternate sources of income and reduction of drudgery. 2139 women were trained for technological capacity building under the various ongoing projects of TDUPW scheme.

(xxvii) Skill Satellite Centre with support of Technology Development and utilization programme for women scheme has been facilitated at PSGR Krishnammal College for Women, Peelamedu, Coimbatore.

(xxviii) Rs. 4,966.93 crore was the Actual Expenditure incurred by DSIR (including autonomous organization and PSEs) upto 31.12.2022.

An Overview

An Overview

1.0 INTRODUCTION

The Department of Scientific and Industrial Research (DSIR), under the aegis of the Ministry of Science and Technology,GoI was set up through a Presidential Notification, dated 4th January, 1985 (74/2/1/8 Cab).The mandate of DSIR is to promote industrial research for indigenous technology development, promotion, utilization and transfer.

The Allocation of Business for the Department is as follows:

i. All matters concerning the Council of Scientific and Industrial Research (CSIR).

ii. All matters relating to National Research Development Corporation (NRDC).

iii. All matters relating to Central Electronics Limited (CEL).

iv. Registration and Recognition of R&D Units.

v. Technical matters relating to UNCTAD and WIPO.

vi. National register for foreign collaborations.

vii. Matters relating to creation of a pool for temporary placement of Indian Scientists and Technologists.

DSIR undertakes programmes to facilitate R&D in the industry, supports industrial units develop state-of-the-art competitive technologies, provides an enabling framework for commercialization of laboratory-scale R&D, augments technology transfer capabilities, enhances the share of technology intensive exports in overall exports of the country, strengthen industrial consultancy and establishes a user-friendly information network to facilitate scientific and industrial research in the industry, science research foundations and public funded organizations/ institutes. DSIR has two public sector enterprises, National Research Development Corporation (NRDC) and Central Electronics Ltd (CEL) and two autonomous organizations, Council for Scientific and Industrial Research (CSIR) and Consultancy Development Centre (CDC). The Department also provides host facilities and assistance to a regional institution of the United Nations Economic and Social Commission for Asia and Pacific (UN-ESCAP), Asian and Pacific Centre for Transfer of Technology (APCTT).

2.0 DSIR PROGRAMMES

The Department of Scientific & Industrial Research (DSIR) operates Central Sector Umbrella Scheme – "Industrial Research & Development" which comprises of the following four sub - schemes:

(i) Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM) – focuses on supporting individual innovators, start-ups and MSMEs for converting innovative ideas into demonstrable working models / prototypes / processes and assist them to become techno-preneurs;

(ii) Patent Acquisition and Collaborative Research & Technology Development (PACE) – This is a scheme which focusses on technology acquisition and its development, demonstration for commercialization.

(iii) Building Industrial Research & Development and Common Research Facility (BIRD-crf) –focuses on creation of common research and technology development hubs (CRTDHs) for micro, small and medium enterprises. The other components of BIRD-crf sub-schemewere "Industrial Research & Development Promotion Program", "Information Technology and e-Governance"and"Asian and Pacific Centre for Transfer of Technology(APCTT)" which

operated during the 12th Plan. All these three components of the BIRD-crf scheme, Industrial Research & Development Promotion Program", "Information Technology and e-Governance" and "Asian and Pacific Centre for Transfer of Technology (APCTT)" have been de-linked beyond 31.03.2017, effective from the FY 2017-18 and now operates outside this sub-scheme.

(iv) Access to Knowledge for Technology Development and Dissemination (A2K+)

This sub-scheme has three components viz: 'Technology Development and Utilization Programme for Women' (TDUPW) which promotes adoption of new technologies by women for greater operational efficiency and reduction of drudgery; 'Support to Studies' which undertakes studies related to analysis of latest developments in the emerging technology areas including those related to preparation of status reports on technologies from public funded institutions ready for commercialization and documents the findings, leanings and outcomes for wider dissemination and 'Support to Events' (seminars, workshops, conferences, exhibitions, Hackathons, virtual events etc.) which provides a platform for exchange of views leading to useful insights and policies on issues relating to industrial research and technological innovation, besides recommending collaborative projects between industry, institutions and academia.

The scheme subsumed the 11th Plan component of scheme on Technology Development and Utilization Programme for Women (TDUPW) and DSIR Building and Infrastructure. Besides, the scheme also supports the approved 11th Plan projects related to Technology Development and Demonstration Programme (TDDP) spilling over from the 11th five year plan.

These sub schemes have been continued beyond 31st March, 2020, for a further period of 5 years till the end of fifteenth finance commission, i.e. 31st March, 2025 (now the Fifteenth Finance Commission duration is 2021-2026).

2.1 MAJOR ACHIEVEMENTS

The major achievements of the various programmes of the Department during the period under report are as under:

2.1.1 Industrial R&D Promotion Programme.

DSIR is the nodal Department for granting recognition/ registration to the In-house Research and Development (R&D) centres established by Industry in the country. There are currently 2397 including 116 fresh recognized In-house R&D centres in the country with DSIR recognition (30th December, 2022). Of the total 658 company's granted renewal of recognition during the year, 42 companies incurred an annual R&D expenditure of over Rs. 5000 lakhs each, 149 companies incurred an annual R&D expenditure in the range of Rs. 500 lakhs to Rs. 5000 lakhs and 115 companies incurred an annual R&D expenditure in the range of Rs. 200 lakhs to Rs. 500 lakhs.

Scientific research foundations in the areas of medical, agriculture, natural and applied sciences and social sciences seek DSIR recognition and registration as Scientific and Industrial Research Organisations (SIROs). The recognized and registered SIROs are eligible for availing Customs Duty exemption on imports required for R&D activities. With SIRO recognition, they also become eligible for extramural funding from many government agencies. The exemption under the concessional GST notifications has been rescinded through the notification no. 11/2022-integrated tax (rate) dated 13.07.2022 with effect from 18.07.2022. As present, there are 827 SIROs duly recognized by DSIR. During the period under report 87 SIROs have been accorded fresh recognition. These include 37 cases in the Natural and Applied Sciences, 01 cases in the area of Agricultural Sciences and 04 cases in the area of Social Sciences and 45 cases in the area of Medical Sciences.

PFRI

DSIR is the nodal Department for registration

of public funded research institutions (PFRI), Universities, IITs, IISc and NITs, for availing concessional custom duty exemption, vide Notification No. 43/2017-Customs dt. 30.06.2017 and corrigendum dated 22.07.2017-Custom Notification no. 43/2017 dt 30.06.2017 amending the main notification No. 51/96- Customs dt.23.07.1996 and amendments thereof. During the period under report, 06 institutions were newly registered with DSIR and 52 institutions were granted renewal of registration for the period beyond 31.08.2022. Also 97 cases for renewal of registration were processed and completed based on the receipt of applications in the Department that were due for the period ending 31.08.2021.

Secretary, DSIR is designated as Prescribed Authority under section 35 (2AB) of Income Tax Act, 1961. During the period, the Department accorded fresh approvals in Form 3CM to 9 companies and extension of approvals in Form 3CM to 136 companies under Section 35(2AB) of Income Tax Act, 1961. Agreements of co-operation for R&D were signed with these companies. The R&D expenditure of the approved companies was examined and the Department reported R&D expenditure of Rs. 14396.91 crores for 269 approved companies in Form to Chief Commissioner of Income Tax (Exemption) in Form 3CL, as required under the IT Act.

2.1.2 Information Technology and e-Governance (ITeG)

Information Technology and e-Governance (IT-eG) group was formed during mid of the 10th Plan period in order to create an IT enabled work environment in the Department through accelerated usage of various Information Technology opportunities. Primary aim of ITeG was to convert the existing procedures and processes into citizen centered. IT-eG division implements e-Governance in the Department progressively that needs be in conformance to the National eGovernance Action Plan. IT-eG Division operates on a separate IT Budget Head under Secretariat Economic Services during FY 2022-2023 for the implementation of activities carried out by the division.

Department has successfully implemented e-Office developed by National Informatics Centre (NIC). e-Office is one of the key IT projects of National Informatics Centre (NIC) aimed at improving internal efficiencies in an organization through electronic administration leading to informed and quicker decision making which in turn results in better public service delivery.

The DSIR Website (Bilingual) has been made compliant to the Guidelines for Indian Government of Websites (GIGW). The website has been regularly updated and has been visited more than 4.69 Lakhs times since 6 August 2018.

The new website for DSIR with integration of Content Management Framework (CMF) developed by NIC, CMF Team. The Website development and Content Migration has been completed and is available at http://164.100.166.67.

2.1.3 Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)

PRISM (Promoting Innovations in Individuals, Start-ups and MSMEs) scheme aims at to support individual innovators which will enable to achieve the agenda of inclusive development – one of the thrust areas of 12th Five Year Plan (2012-17). The scheme is continuing with its objectives of supporting innovation for inclusive development. It would also provide support to autonomous institutions or organizations or to society registered under the Societies Registration Act, 1860 or Indian Trusts Act, 1882 or other statues leading to development of state-of-art new technology solutions aimed at helping MSME cluster units. The scheme has been extended till 31.03.2026 as a component scheme of Industrial Research and Development (IRD) Programme of DSIR.

The Proposals shall preferably be considered in the following focus sectors: Green technology, Clean energy, Industrially utilizable smart materials, Waste to Wealth, Affordable Healthcare, Water & Sewage Management and any other technology or knowledge intensive area.

The financial assistance under the programme may vary from Rs. 2.00 lakh to Rs. 50.00 lakh.

The department has successfully completed 17 (seventeen) PRISM projects supported during the period under report i.e. from 01.12.2021-31.12.2022. Some of the successfully completed projects are A Radio frequency device for detection, imaging and mapping of underground utilities, Development of Inflated Solar Dryer and Destalking Machine for Chilli, Elimination of viruses such as SARS-CoV-2 in condition re-circulated air using electrostatics, Design, Development, Fabrication, Testing and Validation of a 1000-Watt Calibration Grade Solid State Power Source with multiple unit synchronizing / IoT capabilities, Multipurpose Innovative Sprayer for Farmers, Microfluidic Enzymatic Biofuel Cell for Energy Harvesting and Blood Parameters Monitoring, Manually Operated Machine for Cutting of Wheat and Paddy Crops, Development of Bael Fruit Pulp Extractor, Affordable Hardened Plastic Based Bamboo Splinting Machine for Productivity Enhancement, Power Assisted Cement Bag Loader, Versatile Hydraulic jack for rapid tyre change and maintenance, Development of UAV Avionics for Drone Delivery - BVLOS Operation, Design and Development of Ultrasonic Impact Test Unit for enhancing the Fatigue Performance of HSLA Steels, Development of portable micro-friction stir welding machine as a green technology, Energy Efficient Smart Transformer, Flexcrutch: Flexure and kinetic shape based crutches for enhanced mobility and reduced energy consumption and so on.

The financial support was extended to 31 (thirty one) new innovative projects of individual innovators during the period 01.12.2021-31.12.2022. The department also rendered financial support to 12 (twelve) ongoing projects during the period from 01.12.2021 to 31.12.2022.

2.1.4 Common Research and Technology Development H ubs (CRTDH)

DSIR operates BIRD-crf scheme as a sub-scheme under the Umbrella Scheme – 'Industrial Research & Development'. This scheme focuses on creation of Common Research facilities for micro and small enterprises i.e. CRTDH (Common Research and Technology Development Hubs) with an aim to enhance translational research and foster industry institution interaction targeted towards innovative product development. DSIR extends grants to institutions for setting up of these hubs/ centres, which include R&D facilities/infrastructure, analytical test facilities, design centres, pilot plant production facility, demonstration units, product display and centre information etc. The facilities at CRTDHs are used by the Micro, Small and Medium Enterprises (MSMEs), Innovators and start-ups. The CRTDHs evolve a business model for self-sustainability. CRTDH program started during the year 2014-15.

Three hubs at CSIR- Centre for Cellular and Molecular Biology (CCMB), Hyderabad, CSIR - Institute of Himalayan Bio resource Technology (IHBT), Palampur and CSIR - National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram were set up in first phase (2014-15) ; the first two are in the area of affordable healthcare and the third one is in the area of environmental interventions. These hubs have identified the needs of the enterprises through seminars and workshops as well as through interaction with the MSME Development Institutes (MSME-DI), Directorate of Industries (DIC), S&T Councils and other state government bodies. Technological development involving MSMEs and host institutions in project mode has begun and several agreements have been signed with enterprises as well as state government agencies for the benefit of the MSMEs and start-ups.

During 2016-17, the second phase, the Department approved setting up of four new hubs at Central Mechanical Engineering Research Institute (CMERI), Durgapur; Central Electronics Engineering Research Institute (CEERI), Pilani; Indian Institute of Technology, Roorkee and Indian Institute of Technology, Gandhinagar in sectors of Low cost machining, Electronics/ Renewable Energy and New Materials/ Chemical Process respectively. These hubs are currently engaged in activities like procurement of equipment, and setting up of infrastructure and essential facilities for R&D. The hubs have started identifying

needs of the enterprises through seminars and workshops as well as through interaction with the MSME-DIs, DICs, S&T Councils, industry representatives and associations and other state government agencies. CRTDH at Indian Institute of Technology, Kharagpur (in Affordable Health), CRTDH at CSIR - Indian Institute of Toxicology Research IITR Lucknow (in Environmental Interventions), CRTDH at CSIR - Central Drug Research Institute (CDRI), Lucknow (in Affordable Health) and CRTDH at CSIR-Central Scientific Instruments Organization, Chennai Centre (CSIO), CSIR Madras Complex Taramani, Chennai (in Electronics/Renewable Energy) and CRTDH at CSIR- Institute of Minerals & Materials Technology (IMMT), Bhubaneshwar (in New Materials/ Chemical Processes) were set up in the third phase (2018-19). These hubs are currently engaged in activities like procurement of equipment, setting up infrastructure and essential facilities for R&D. The hubs have started identifying needs of the enterprises through seminars and workshops as well as through interaction with the MSME-DIs, DICs, S&T Councils, industry representatives and associations and other state government agencies. In the fourth phase, during 2021- 2022, CRTDH Advisory & Screening Committee (CASC) for CRTDH scheme recommended six proposals. Out of these six proposals, four new CRTDH have been sanctioned during 2021-22 each at Delhi Pharmaceutical Science and Research University, Delhi in affordable health sector; National Institute of Technology, Andhra Pradesh in the sector electronic and renewable energy, CSIR-National Chemical Laboratory, Pune in New Materials/ Chemical Process and Indian Institute of Technology Guwahati in New Materials/ Chemical Process sector. Subsequently, two more CRTDHs at Indian Institute of Technology Bhilai and National Institute of Pharmaceutical Education and Research (NIPER-SAS Nagar) have been set up during 2022-23 in New Materials/ Chemical Process sector.

A two days "DSIR-CRTDH Conclave–2022 jointly with Common Research and Technology Development Hub (CRTDH) at CSIR - Indian Institute of Toxicology Research, Lucknow was held on 17th & 18th November, 2022. It brought together co-ordinators and the MSME beneficiaries of these centres. The Conclave focused on the achievements of the CRTDHs and also on the expectations of the MSMEs from these CRTDHs showcasing the technological insight of varied supported sector by the public funded research institutes. CSIR-Indian Institute of Toxicology Research (IITR), Lucknow hosted the DSIR-CRTDH conclave. The conclave highlighted the achievements made and benefits drawn by MSMEs & other stakeholders and the continued commitment of DSIR for MSMEs. The conclave witnessed signing of MoUs with different industries and CRTDHs. Achievements made by various CRTDH were also showcased in exhibition during the conclave. DSIR also released a compendium on CRTDH scheme that has comprehensive details of all the CRTDHs set up along with success stories of MSMEs/ Startups which benefited from the DSIR-CRTDHs.

2.1.5 Patent Acquisition and Collaborative Research and Technology Development (PACE)

DSIR through the PACE scheme provides catalytic support to industries and institutions for development and demonstration of innovative product and process technologies, traversing the journey from proof of concept or laboratory stage to pilot stage, so that they can be launched for commercialization. The scheme supports ingenious work and assists in development of new technologies or creative/innovative application of the existing technologies to solve unmet needs of industry. The scheme also strengthens the interface between industry, R&D establishments and academic institutions by supporting collaborative proposals. During the period under report, the following two ongoing technology development and demonstration projects namely were monitored for assessing the technical and financial progress in the projects:

(i) "Development of Controller Release [CR] Formulation of Natural HighlyPurified Human Chorionic Gonadotropin [hCG]" by M/s Sanzyme Ltd. Hyderabad & ICT Mumbai and

(ii) "Development and standardization of manufacturing processes for large scale production of valuable secondary metabolites from callus-derived cells of vascular cambial explants of selected woody plant species" by M/s Sami-Sabinsa Group Limited (formerly Sami Labs Limited), Bangalore.

During the period under report, the project (i) is completed in the FY 2022-23 with key deliverables:

- Development of a delivery system to enclose the active drug;
- Stable and compatible excipients for the formulation;
- Predictable Pharmacokinetic and Pharmacodynamics profiles, both in-vivo and in-vitro for the 15 day and 30 day formulations;
- Safety profile.

Whereas, under the project (ii), the team was able to produce Arjunolic acid metabolite from Terminaliaarjuna, Salacinol from Salaciasp and oroxylin -A from Oroxylumindicum from 20L bioreactor. The standardization for remaining explants is underway.

2.1.6 Access to Knowledge for Technology Development and Dissemination (A2K+)

A2K+ Studies program aims to support studies in emerging areas of technology and document the findings for wider dissemination and preparation of status reports. Four A2K+ studies projects were completed during the period under report. 9 new study proposals were initiated under new theme areas advertised based on the recommendations of line- ministries and 6 new study proposals were initiated under the theme "Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry"for scouting of TRL level 6 and above technologies in six identified sectors for creating a database of technologies at TRL level 6 & above and enhancing the scope for commercialization of technology developed by public funded Institutions and startups.

TDUPW program promotes adoption of new technologies by women/women SHGs/ entrepreneurs for greater operational efficiency, Product value addition, enhanced/alternate sources of income and reduction of drudgery. The Department supported and initiated five new projects towards women empowerment through technological capacity building under the TDUPW program. 2139 women were trained for technological capacity building under various ongoing projects and one project was successfully completed during the period under report under TDUPW program. Outreach webinars and stakeholder interaction meets were organized under scheme for program awareness, popularization & promotion.

TDUPW Program division celebrated International Women's Day on 8th March 2022 under the theme announced by the United Nations"Gender equality today for a sustainable tomorrow" inviting women speakers to share their journeys towards success in multiple walks of life. Also a desk study report "Social & Economic contributions of Women in Manipur" was released by Secretary, DSIR on International's Women's Day (8th March, 2022). The study report is an attempt to share an insight into the gap, constraints and scope for inspiring, supporting and creating opportunities which can enable women of Manipur to earn their living and also empower them as individuals to participate in the development of the North Eastern Region.

A2K+Events programme provides a platform for exchange of views among industry, consultancy organizations, academic and research institutions that would lead to useful insights on issues relating to industrial research and technological innovation and help in evolving tools and techniques to remain competitive in today's business climate. The objective of A2K+ Events program is to support the organization of workshops, interactions, training programmes, exhibitions and other events for identification of collaborative projects between academia,

institutions and industry participating in the events. Total 11 events were successfully organized by different organizations during the reported period. Each event has fruitful outcomes which are beneficial to the organizers as well as participants. One of the events i.e. National workshop on "Low-Cost Bio-Coal Production and Its Potential Impact on Steel Industries" organized by Indian Institute of Technology (ISM) Dhanbad was attended by more than 100 participants in two days from industries. It led to several collaborations on project of similar interest, for example, academicians from IIT ISM Dhanbad and scientists from National Agri-Food Biotechnology Institute (NABI) are collaborating for joint projects and development of technologies. SAIL Bokaro also showed interest in signing an MoU with IIT ISM Dhanbad during Panel Discussion of Workshop to pursue research in this area.

As a result, MoU has been signed and three projects has been initially agreed to be executed by IIT ISM Dhanbad and SAIL Bokaro. Similar, interest has been shown by TATA Steel and a proposal for opening TATA centre of excellence at IIT ISM Dhanbad is in discussion.

3.0 ASIAN PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT)

The Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology (MoST), Government of India has been the national focal point of Asian and Pacific Centre for Transfer of Technology (APCTT) for India since its inception in 1977. Matters pertaining to APCTT and UNESCAP are dealt with in co-operation with the Ministry of Commerce and Industry and the Ministry of External Affairs, Government of India. DSIR also plays an active role in APCTT's functioning, particularly relating to its policies and programmes. India being the host country has been providing institutional support to APCTT since its inception. APCTT receives annual institutional support of US$ 200,000 in Indian Rupees (to meet the local costs) from DSIR in addition to funding for building repairs, renovation work, and municipal taxes.

In 2022, APCTT had fruitful joint activities with the Government of India, Department of Scientific and Industrial Research (DSIR) of Ministry of Science and Technology to facilitate technology co-operation and capacity building among member States in the region viz: (i) Brainstorming Session between STI Agencies of India and APCTT for Promoting Regional Technology Co-operation held on 19 April 2022 at New Delhi, India.. (ii) Industry-Academia-Government consultative meeting to address the challenges of energy sector (conventional & non-conventional) and energy devices, held on 17th October 2022. (iii) International knowledge-sharing workshop on cross-border innovation, acceleration, and challenges in international technology transfer, organized on 14-15 November 2022 at Ghaziabad, India in physical and virtual mode.

4.0 RTI ACT 2005

The Right to Information Act 2005, enacted on 15th June 2005, has been implemented successfully in the Department. As per the provisions of the Act, Nodal Officer, Appellate Authority, Transparency Officer, Central Public Information Officer and Central Assistant Public Information Officer are designated.

The proactive disclosures under Section 4 (1) (b) of the RTI Act 2005 enacted on June 15, 2005 are regularly updated [Last Updated on 27/12/2022] and available on the DSIR Website at http://www.dsir.gov.in. DSIR has complied with the directives received from Central Information Commission. RTI Requests and First Appeals received and their responses are available on DSIR Website.DSIR has received 94 Applications during 01/01/2022 to 31/12/2022 and all the Applications were registered and out of them, 89 were disposed off and 5 are under process on RTI Request & Appeal Management Information System at https://rtinonline.gov.in/RTIMIS. During 01/01/2022 to 31/12/2022, 02 applications were registered and disposed off as first appeal.

5.0 AUTONOMOUS INSTITUTIONS

5.1 Council of Scientific and Industrial Research (CSIR)

I. The Council of Scientific& Industrial Research (CSIR), was established as an autonomous body in September 1942 to address the needs of industrial research in the country. Further, evolving the scope and range of activities in several domains, CSIR is today known for its excellence in research and development (R&D) and science and technology (S&T) innovations. CSIR has a Pan India presence through its network of 37 national Laboratories which undertakes focused basic and applied research in diverse fields of S&T. CSIR has also 39 outreach centres, one innovation complex and three units. CSIR's R&D expertise and experience is embodied in about 3521 active scientists supported by about 4162 technical and support personnel.

II. CSIR has been playing a significant role in mentoring the scientific and technological advancement in the country. CSIR addresses national needs through its innovative research, strong fundamental science, industry partnerships, entrepreneurship, translation research, capacity building, and policy making. Through its technological interventions, CSIR has provided solutions and innovations for the industry and has also proved to be a catalyst in improving the quality of life of millions of people across the country.

III. Various S&T domains in which CSIR has focused its R&D activities over the years include oceanography, earth sciences, geophysics, chemicals, drugs, genomics, biotechnology and nanotechnology to mining, aeronautics, instrumentation, environmental engineering and information technology. It provides significant technological intervention in many areas with regard to societal efforts which include environment, health, drinking water, food, housing, energy, leather, farm and non-farm sectors.

IV. CSIR is the Nation's custodian for Measurement Standards of Mass, Distance, Time, Temperature, Current etc. CSIR has created and is the custodian of Traditional Knowledge Digital Library (TKDL) which is a powerful weapon against unethical commercial exploitation of Indian Traditional Knowledge. CSIR maintains Microbial Type Culture Collection (MTCC) and Gene Bank.

V. Pioneer of India's intellectual property movement, CSIR today is strengthening its patent portfolio to carve out global niches for the country in select technology domains. CSIR has pursued cutting edge science and advanced knowledge frontiers.

VI. CSIR through its various constituent Laboratories is also placing major focus upon creating incubation facilities for spin off and Start-ups. CSIR hand holds these companies so as to create a new segment of knowledge enterprises.

VII. CSIR has been focusing in a significant manner on the development of S&T Human Resource and has been providing yeoman service through various fellowships. It has been imparting skills in diverse S&T areas so as to empower youth for better career and employment opportunities. CSIR has forged linkage with Ministry of Skill Development and Entrepreneurship to enhance and widen its contributions for Skill Development in the country.

VIII. As the Nation celebrates its 75th year of Independence through Azadi Ka Amrit Mahotsav, CSIR celebrated its 80th Foundation Day on 26th September 2021. The entire CSIR family got united to celebrate both landmark journeys with

profound enthusiasm.

5.1.1 Significant Events

(i) Hon'ble PM Chaired the CSIR Society Meeting

Hon'ble Prime Minister and President, CSIR, Shri Narendra Modi, chaired the meeting of CSIR Society on 15 October 2022.

Hon'ble Minister of State (Independent Charge) Science & Technology, Dr Jitendra Singh, who is the Vice President of CSIR and Hon'ble Minister of Commerce & Industry, Shri Piyush Goyal were present in the meeting along with other CSIR Society members who include eminent scientists, industrialists and Secretaries of scientific and other ministries in the government. DG-CSIR, Dr N Kalaiselvi made a presentation on the recent achievements and contribution of CSIR. She also presented the road map of CSIR Vision 2030 which is aligned to national ambitions and Vision@2047.

Prime Minister appreciated the efforts of CSIR in the past 80 years and urged to develop vision for 2042 when CSIR turns 100 years old. He also highlighted the significance of documenting the journey of the past 80 years, which can help take a review of progress achieved and identify areas of lacunae which can be addressed.

(ii) Inauguration of scaled-up plant for production of Hydrazine Hydrate

Hon'ble Prime Minister, Shri Narendra Modi inaugurated the scaled-up plant for production of Hydrazine Hydrate (HH) developed in collaboration of CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad and Gujarat Alkalies and Chemicals Ltd (GACL), Gujarat on October 10, 2022, as an initiate towards 'Atmanirbhar Bharat'.

The plant developed is based on CSIR-IICT's and GACL's jointly patented technology for production of 10,000 tons per year of Hydrazine Hydrate. The collaboration of CSIR-IICT and GACL led the process development from laboratory scale to pilot scale, and then to a commercial scale. The scale up ratio from pilot scale to commercial scale has been upto 100 times.

(iii) Inauguration of CSIR-IIIM's BioNEST-Bioincubation Centre in Jammu

CSIR-IIIM Jammu's BioNEST-Bioincubator was inaugurated by Hon'ble Minister of State (Independent Charge) Science & Technology, Dr Jitendra Singh on 23 April 2022. The objectives of this incubator are to ignite the entrepreneurship mindset and to nurture start-up culture among youth, local farmers and entrepreneurs of Jammu & Kashmir.

Bio-NEST incubation centre has been financially supported by DBT-BIRAC to foster the biotech innovation ecosystem in the country. Bio-NEST program provides support to establish bio-incubators either as a standalone entity or as a part of academia. 64 Start-Ups have already registered with CSIR-IIIM Jammu and a fresh impetus has been given to promote Start-Up as an alternative source of livelihood, with financial, technical and logistic support being provided by the Union Ministry of Science & Technology through its different agencies and departments. Out of the 64 StartUps, 14 have developed products and 4 have already reached the market.

(iv) Iconic 75 Industry Connect ('i' Connect) inaugurated at CSIR-NEIST, Jorhat

Hon'ble Minister of State (I/C) for S&T & ES, Dr. Jitendra Singh, inaugurated the event of "Iconic 75 Industry Connect ('i' Connect)" at CSIR-NEIST, Jorhat, Assam. In the inaugural event held on 12 May 2022, Dr. Jitendra Singh said, the innovative Start-ups by the young entrepreneurs have to shoulder responsibility for the next 25 years of glorious journey, when we celebrate 100 years of India's Independence as a frontline nation in the world.

The iconic 75 Industry Connect ('i'-connect) events were aimed at forging partnership with industry in 10 thematic /focus areas. The 'i'-connect events were the consolidate efforts of DSIR/CSIR, DBT, DST, MoES and other scientific departments of the Government of India to reach out to industry.

Shri Keshab Mahanta, Hon'ble Minister for Health and Family Welfare, Science and Technology and IT, Assam Government and Dr V. K. Saraswat, Member NITI Aayog were other dignitaries present during the inaugural function. On the occasion, Dr Jitendra Singh also released CSIR Compendium of Technologies for Entrepreneurship of Relevance in North East India.

(v) **Third edition of "TechBharat" inaugurated at CSIR-CFTRI in Mysuru**

The third edition of "TechBharat" on the theme "Transforming India's FoodTech, AgriTech & Agronomic Landscape" was held at CSIR-CFTRI Mysuru and was inaugurated by Hon'ble Minister of State (I/C) for S&T & ES, Dr. Jitendra Singh on 20 May 2022. Addressing the Conclave-cum-Exhibition on Agri-Tech and Food-Tech at CSIR-CFTRI in Mysuru, Dr. Jitendra Singh said, a new wave of Agri-tech Startups has come up in India in the last few years due to enabling policy environment provided by Modi government to address the problems of Indian agriculture such as supply chain management, use of outdated equipment, improper infrastructure, and inability of farmers to access a wider range of markets with ease.

Dr. G.R. Chintala, Chairman, National Bank for Agriculture and Rural Development (NABARD), Dr. Sridevi Annapurna Singh; Director, CSIR-CFTRI, Shri Mahesh Shenoy, President, Laghu Udyog Bharati- Mysuru Vibhag, Shri Rajappa, Secretary, Laghu Udyog Bharati- MysuruVibhag and many senior officials, delegates and invitees joined the programme at CSIR-CFTRI Campus, Mysuru.

(vi) **CSIR-CLRI celebrated its Platinum Jubilee Celebration**

Hon'ble Minister of State (I/C) for S&T& ES, Dr. Jitendra Singh, inaugurated the Platinum Jubilee celebrations of CSIR-CLRI in Chennai on 19 May 2022. Addressing the Platinum Jubilee celebrations of CSIR-CLRI, Dr. Jitendra Singh said, the carbon footprint of leather processing activity needs to approach zero levels and the bio-economy of animal skin-derived products is the new mantra of the time. He said, the carrying capacity requirements of the leather sector in locations like Tamil Nadu demand the implementation of Zero Liquid Discharge as the enforced environmental norm, which is under discussion.

Tracing the evolution of CLRI, Chennai from 1948, Dr. Jitendra Singh said that in the first 25 years, the institute focused on reaching technologies to the unreached and facilitating the planned development of the sector. In the next 25 years, Indian leather research and industry seemed to have focused on modernization and enhancing environmental preparedness and the last 25 years have led to the enhancement of unit value realization from leather in the global market. The new vision for leather research and industry for the next 25 years should be to carve a new niche in world market through innovation and brand building.

(vii) **75th Foundation Day Celebration of CSIR-CECRI**

CSIR-CECRI celebrated its 75th Foundation Day on 25 July, 2022. Dr. N. Kalaiselvi, Director, CSIR-CECRI, in her presidential address, mentioned the co-incidence of the 100th Birthday of Prof. John Bannister Good enough, Nobel Laureate known for his development of lithium-ion batteries. She recalled the remarkable contributions to Electrochemical Science & Technology made by all visionary leaders of CSIR-CECRI starting from Dr. A. Jogarao in 1949 with reverence and the realistic impacts it created in the Industrial & Societal sectors. Padma Vibhushan Dr. R. Chidambaram, DAE-HomiBhabha Professor in BARC, Former Chairman, Atomic Energy Commission of India and Former Principal Scientific Adviser to the GoI, virtually inaugurated the CECRI@75 Celebrations as the Chief Guest of the Event. Shri. U.K. Bhattacharya, Director (Projects), NTPC, New Delhi and Prof. K.I. Vasu, Former Director, CSIR-CECRI & Founder President, Vijnana Bharati graced the occasion as the Guests of Honour. Dr. K.J. Sreeram, Director, CSIR-CLRI and Dr. N. Anandavalli, Director, CSIR-SERC offered felicitations and called for more combined efforts in common R&D and institutional activities. Subsequently, a demonstration of

battery-supercapacitor hybrid e-rickshaw was carried out. As part of the event, the carbon capture demo plant was also inaugurated.

(viii) **HANSA-NG Aircraft of CSIR-NAL successfully completed Engine Relight test in Air**

HANSA-NG, 2 seater flying trainer Aircraft, design & developed by CSIR-NAL, successfully completed in-flight engine relight test at DRDO's Aeronautical Test Range (ATR) facility, Challakere on 17 May, 2022. Flight test was carried out at an altitude of 7000-8000 feet with the speed range of 60 to 70 knots by Wg Cdr K V Prakash and Wg Cdr NDS Reddy,Test Pilots from Aircraft and Systems Testing Establishment (ASTE), Indian Air force (IAF).

In-flight engine relight capability of the aircraft was demonstrated with wind milling propeller and starter assisted start. The aircraft handling characteristics & flight parameters were found to be normal during these test flights. The in-flight engine relight test is most critical and important milestone towards certification of the aircraft by DGCA.The aircraft was ferried to ATR, Challakere on 16 May 2022, after obtaining necessary approvals from DGCA.

(ix) **Inauguration and launch of CSIR "Patch Fill Machine for Pothole Repair & Mobile Cold Mixer cum Paver Machine"**

Programme to dedicate to the public two equipment of CSIR-CRRI, Patch Fill Machine for Pothole Repair & Mobile Cold Mixer cum Paver Machine, for latest value addition in road construction and highways was organized on 9 May 2022 at CSIR-CRRI, New Delhi. Dr. Jitendra Singh, Hon'ble Minister of State (I/C) for S&T & ES; Shri Nitin Gadkari, Hon'ble Union Minister of Road Transport & Highways; and General (Dr) Vijay Kumar Singh, Hon'ble Minister of State for Road Transport & Highways and Civil Aviation participated in the formal launching of 'Mobile Cold Mixer Cum Paver' for constructing black top layer using bitumen emulsion and 'Patch Fill Machine' for Pothole repair along the road.

(x) **Hon'ble Minister of State (I/C) for S&T & ES, Dr Jitendra Singh unveiled India's first truly indigenously developed Hydrogen Fuel Cell Bus developed by KPIT-CSIR in Pune**

Hon'ble Minister of State (I/C) for S&T & ES, Dr Jitendra Singh launched India's first truly indigenously developed Hydrogen Fuel Cell Bus developed by KPIT-CSIR in Pune on 21 August 2022. The Hydrogen Fuel Cells utilize Hydrogen and Air to generate electricity to power the bus and the only effluent from the bus is water, therefore making it possibly the most environmentally friendly mode of transportation. Addressing the gathering, Dr. Jitendra Singh told that PM Modi's Hydrogen Vision is important for India to ensure AtmaNirbhar means of affordable and accessible clean energy, meeting climate change goals, and creating new entrepreneurs and jobs. He said, Green hydrogen is an excellent clean energy vector that enables deep decarbonization of difficult-to-abate emissions from the refining industry, fertiliser industry, steel industry, cement industry and also from the heavy commercial transportation sector. He lauded the joint development efforts of KPIT and CSIR-NCL and pointed out that the technology prowess of Indian scientists and engineers is no less than the best in the world and also at much lower costs.Dr Jitendra Singh also inaugurated the Bisphenol-A pilot plant in CSIR-NCL

(xi) **Inauguration of New Institutional Building of CSIR-URDIP located in NCL Campus**

The New Institutional Building of CSIR-URDIP located in CSIR-NCL Campus in Pune was inaugurated by the Hon'ble Union Minister of State (I/C) for S&T & ES, Dr. Jitendra Singh on 20 August 2022.

As a specialized services unit of CSIR, catering to the niche knowledge–based services sector, CSIR–URDIP is into its 22nd year of existence, dedicated to continuous Analytics and Informatics services activities supporting pre–research and pre–development phases of regular, Mission–mode and Theme–based CSIR R&D projects, besides support services to research institutions, start–ups, SMEs, Indian corporates and also multinational corporations.

The inauguration was marked by a mini exhibition with selected 30 Start-Up founders working on themes of health, energy, environment, digitalization and automation.

(xii) **Cabinet approved widening access of the TKDL database to users, besides patent offices**

The Cabinet chaired by Hon'ble Prime Minister, Shri Narendra Modi approved the Widening access of the Traditional Knowledge Digital Library (TKDL) database to users, besides patent offices on 17 August 2022. The opening up of the TKDL database to users is an ambitious and forward-looking action by the Government of India. This will be a new dawn for Indian traditional knowledge, as the TKDL will drive research & development, and innovation based on India's valued heritage across diverse fields. The opening up of the TKDL is also envisaged to inculcate thought and knowledge leadership through BharatiyaGnanaParampara, under the New Education Policy 2020.

(xiii) **DG, CSIR, N. Kalaiselvi and Hon'ble Minister of State (I/C) for S&T & ES, Dr. Jitendra Singh discussed the status of ongoing research projects in cutting edge and futuristic technologies**

After taking charge as the newly appointed DG, CSIR, Dr N. Kalaiselvi discussed the status of ongoing research projects in cutting edge and futuristic technologies with Hon'ble Minister of State (I/C) for S&T& ES, Dr. Jitendra Singh on 08 August 2022.

Dr Jitendra Singh congratulated Dr Kalaiselvi for being the first woman DG of CSIR in its rich history and legacy of over 80 years.

Dr. Kalaiselvi apprised Dr Jitendra Singh about her research experience spanning over two decades in areas like electrochemical power systems, energy storage devices, lithium technologies and electric mobility.

Their discussion focused on emerging innovations in areas like Hydrogen in the energy transition, Carbon capture and storage, Accessible solar power, Plastic recycling and Cheap energy storage. Various highlighted recent and novel CSIR technologies were discussed such as CSIR-NAL's High Altitude Performance (HAP) Vehicle and Drone technology; Aroma Mission of CSIR and The Purple Revolution; State-of-the-art Heli-borne survey technology of CSIR for groundwater management on a wider scale with cooperation and coordination from Jal Shakti Ministry fulfilling Hon'ble Prime Minister Narendra Modi's Vision and Mission of "HarGharNal Se Jal".

(xiv) **Inauguration of first-of-its-kind Start-ups Expo in Jammu**

Hon'ble Minister of State (I/C) for S&T & ES, Dr. Jitendra Singh inaugurated the first of its kind Start-ups Expo organized in Jammu by CSIR-IIIM on 30 Sept 2022. During the inaugural event the Hon'ble Minister said, the government job mind-set is proving an impediment to Start-Up culture, mainly in North India.

Dr. Jitendra Singh gave full credit to the futuristic vision of Prime Minister Narendra Modi who had given a call for "Start-Up India Stand Up India" from the ramparts of Red Fort in his Independence Day address of 2015 that initiated a mass interest, as a result of which the number of Start-Ups in India has increased from mere 350 in 2014 to over 77,000 in 2022 with more than 100 unicorns, while

India under Modi has achieved 3rd ranking in the world in the Start-Up ecosystem.

Inaugurating the Expo that covered areas of Agriculture, Aroma, Dairy, Pharma, IT, Computer & Communications, Dr Jitendra Singh said that Start-Up culture is yet to fully catch up the imagination of the youth and entrepreneurs in some of the North Indian States, as comparison to some of the South Indian States, which have taken a magnificent lead, engaging also a chain of globally recognised Start-Ups.

(xv) **CSIR Leadership Meet addressed by Hon'ble Minister of S&T, Dr Jitendra Singh**

The first-ever CSIR Leadership Meet was held on 26 Sept 2022 and was attended by the Directors and Head of Departments of all the 37 CSIR labs across the country.

Addressing the Leadership Meet, Hon'ble Minister of State (I/C) for S&T & ES, Dr. Jitendra Singh said, the legacy of CSIR is built on the cumulative contribution of its several national laboratories and institutes. He said, each laboratory of CSIR is unique and specialising in as diverse areas as genomics to geology, material technology to microbial technology and food to fuel. He also announced "One Week One Lab" theme-based campaign to showcase the technological breakthroughs and innovations in each of the 37 CSIR laboratories/institutes spread across the country.

DG, CSIR, Dr N. Kalaiselvi addressed the leaders of CSIR and said that 21st century is going to be the century of India and for India and the Science & Technology fraternity must rise to the occasion and work hard to make India a respected name in the global arena.

(xvi) **Royal Society of Chemistry (RSC) and CSIR worked together to support chemistry in schools across India**

The Royal Society of Chemistry and CSIR have partnered to support an outreach programme designed to promote the chemical sciences in schools and universities. The two organizations signed MoU on 22 September 2022, committing to work together on the CSIR's Jigyasa programme. The MoU will be a non-financial one and will be time-bound for at least three years with an option of renewal.

As part of the event, the collaboration organized a Global Experiment including all the CSIR's laboratories. At least 2,000 school children, 150 teachers, and 350 volunteers took part in the 'RSC's Global Coin experiment organised across over 30 CSIR laboratories, in which participants are asked to compare batteries made from different types of coins.

(xvii) **Cooperation between the Institut National de la PropriétéIndustrielle, France and CSIR on access to TKDL**

The Institut National de la PropriétéIndustrielle (INPI; the National Industrial Property Institute), France, and CSIR entered into a cooperation on the Traditional Knowledge Digital Library (TKDL) access through an Agreement in the gracious presence of Dr. N. Kalaiselvi, DG, CSIR and Secretary, DSIR on 16 Sept 2022. The Agreement was exchanged by Mr. Sebastien Connan, Regional IP Counselor for India and Dr. Viswajanani J Sattigeri, Scientist-H and Head, CSIR-TKDL Unit. The signing of the TKDL Access Agreement with the INPI, France marked the beginning of a new partnership and mutual cooperation in the domains of Intellectual Property Rights as well as traditional knowledge between France and India.

(xviii) **73rd Annual Meeting and Symposium of the International Committee for Coal & Organic Petrology (ICCP-2022) held at New Delhi, India.**

The 73rd Annual Meeting and Symposium of the International Committee for Coal and Organic Petrology (ICCP) was organized by CSIR-CIMFR in New Delhi from 18-25 September, 2022. The inauguration was held in the gracious presence of DG, CSIR, Dr N Kalaiselvi. The Commission Meetings and presentations by the technical

working groups were held for four days from 19-22 September, 2022, preceding the symposium on 23rd September, 2022. It was represented by globally renowned experts from academics, R&D and industry, presented their research findings in the respective Council and Commission Meetings. The meeting was followed by two days' technical tour at NTPC Dadri thermal power plant in Uttar Pradesh.

(xix) **CSIR and iCreate signed MoU to harness India's tech strength**

With the objective to foster rapid economic development and help create world-class start-ups, CSIR signed an MoU with the Government of Gujarat's flagship technology incubator - iCreate (International Centre for Entrepreneurship and Technology) on 25 April 2022. The MoUsiging was presided over by The Chief Minister of Gujarat, Shri Bhupendra Patel. Under the MoU, CSIR and iCreate intend to establish a collaborative support system for promising tech start-ups by making combined resources available for entrepreneurs and innovators in the country. The partnership will also catalyse scientific innovation and the marketability of high-tech start-ups. Further, iCreate will help set up new incubators at identified CSIR labs. Such start-ups will access CSIR's equipment, facilities, and scientific manpower. CSIR will provide intellectual property support and explore methods of financially supporting innovative start-ups from India to boost emerging entrepreneurs.

(xx) **Golden Peacock Eco-Innovation Award – 2022**

CSIR won 'The golden Peacock Eco-Innovation Award' for the year 2022 for 'Environmental Surveillance for SARS-CoV-2 Virus in Wastewater for Effective Management. The compressive and extensive work done by CSIR labs IICT, CCMB, NCL and NEERI in surveillance during COVID regime was recognized.

(xxi) **National Intellectual Property Awards 2021 & 2022**

CSIR bagged the National IP Award for the year 2021 & 2022 under the category "Top R&D institution/organization for Patents Filing, Grant & Commercialization". The award was conferred by Hon'ble Minister of Commerce & Industry Shri Piyush Goyal.

(xxii) **Tata Innovista 2022 Award**

TataInnovista 2022 Award in the category of "Most Innovative Partner" was awarded to CSIR-NML, Jamshedpur as a partner of Tata Steel for the work on "Intelligent Billet Caster: Improve Quality & Productivity.

(xxiii) **CSIR Directors' Conference at CSIR-IHBT**

CSIR Directors' Conference was held at CSIR-IHBT, Palampur during October 28-29, 2022, chaired by Dr. N. Kalaiselvi, Secretary DSIR and DG CSIR. Directors and Heads of all CSIR laboratories, Units and Directorates of CSIR Headquarters attended the conference and discussed the Vision 2030 & Action Taken Reports of labs.

(xxiv) **Swachh Sagar Surakshit Sagar Campaign**

The "Swachh Sagar, Surakshit Sagar/Clean Coast Safe Sea" campaign, a 75-day citizen-led campaign for improving ocean health through collective action started on July 5, 2022 with strategic underlying goals that target transformation and environmental conservation through behavior change. CSIR and its laboratories SERC, CLRI, NIIST, NIO and IICB participated in the campaign and observed coastal clean-up drives at various parts of the country.

5.1.2 Significant S&T Achievements

(i) **Technology of Nucleic Acid Staining Dye GreenR™**

The dye GreenR™ has been developed by CSIR-CDRI in joint collaboration with industry partner Biotech Desk Pvt. Ltd (BDPL), Hyderabad. The product GreenR™ provides an economical alternative to commercially available dyes that are used to stain DNA/RNA, which are currently

imported. It binds to all nucleic acids including genomic DNA, PCR products, plasmids and RNA and fluoresces under blue light or UV exposure. This dye has varied applications in molecular diagnostics and life sciences research. The chemical synthesis of GreenR™ was standardized by CDRI team and the BDPL team has studied its biological applications in real-time PCR and DNA binding. CSIR-CDRI has transferred the technology of the nucleic acid staining dye GreenR™ to GenetoProtein Pvt. Ltd (GPPL), a start-up company registered in Uttar Pradesh, and the company has already started sampling this product amongst researchers both in academia and industry. The development of this indigenous dye will offer the Indian researcher an alternative to expensive imported dyes and take India a step closer to *'Atmanirbhar Bharat'.*

(ii) **CO_2 Capture Technology**

CSIR-CECRI has ventured in search of a viable solution to capture the polluting Carbon-di-oxide (CO_2) from thermal power plant flue gas and emerged successfully with a technology matching with the Department of Energy (DoE), USA targets.

The novelty of CSIR-CECRI's invention lies on the synthesis process to produce an adsorbent capable of adsorbing more than 3 millimoles per gram of CO_2 at flue gas conditions. The process know-how has been transferred to M/s. Summits Hygronics Pvt Ltd, Coimbatore. The technology find application in multiple areas like thermal power plants, submarines, biogas enrichment, automotive sector and direct air capturing in highly polluted cities thereby minimizing CO_2 concentration towards reducing global warming. The captured CO_2 can also be converted into value added industrially important chemicals like methanol, formic acid, adipic acid, etc. leading to a circular economy.

The developed technology is in alignment with one of the United Nation's "Sustainable Development Goals on Climate Action" (SDG 13) and Government of India's mission on "Carbon Capture, Utilization and Storage (CCUS)". Transfer of this technology paves way for a joint working of research institute with industry to address one of the global mandate by fulfilling India's commitment in realizing "net-zero" emission by 2070. The high merit of this technology could reach global arena on CO_2 capture.

(iii) **Steel Slag Road: Steel Slag Valorization Technology for Conversion of Steel Slag as Road Making Aggregates**

INDIA being the world's second largest steel producer also generates around 19 million tons of solid steel slag waste annually. CSIR-CRRI under a major research study sponsored by Ministry of Steel and four major steel industries in India, namely, JSW Steel, AMNS India, TATA Steel and Rashtriya Ispat Nigam Limited has developed the steel slag valorization technology to convert waste steel slag as road making aggregates. Processed steel slag aggregates as developed through waste steel slag has been successfully utilized in the construction of India's First Steel Slag Road at Hazira, Surat. Around one lakh ton processed steel slag aggregates were utilized as

100 % substitute of natural aggregate in steel slag road construction. For its unique design features Steel Slag Road built through CRRI technology has been inducted in INDIA BOOK of Records and ASIA BOOK OF RECORDS as First Steel Slag Road.

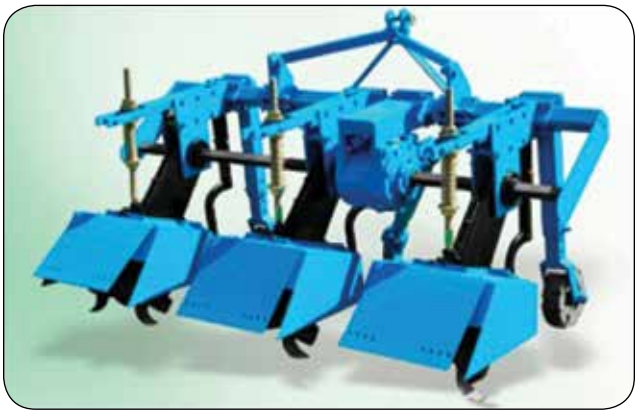
Hon.Minister of Steel, Shri R.C.P Singh inaugurated, Steel slag road at Hazira Surat on 15th June 2022. Technology has been widely appreciated on National and International platforms. An MoU has been signed with different steel industries such as JSW Steel, AMNS India, and Rashtriya Ispat Nigam Limited for Technology Transfer.

(iv) **Bio Ceramic application**

CSIR-CGCRI successfully demonstrated in vitro differentiation capability of the human mesenchymal stem cells (hBMSCs) towards cartilage tissues under normoxic conditions with and without supplement under a CSIR FIRST project. Further, a series of borosilicate bioactive glasses with given specifications were designed with increasing the substitution of B_2O_3 for SiO_2. These have potential applications as a scaffold material in bone tissue engineering. Significant progress has taken place towards development of bioactive glasses and glass composites.

(v) **Development of Inter-row Rotary Cultivator**

The Inter-row Rotary Cultivator has been developed by CSIR-CMERI for Precision Agriculture facilitating Agri-machinery Manufacturers (MSME Sectors). The cultivator is used to perform intercultural operations in wide row crops like cotton, soybean, peas, pulses, maize etc. The developed inter-row rotary cultivator has features such as adjustable working width, high ground clearance, adjustable row spacing, suitable for Indian conditions, reduced fertilizer consumption, increase of yield and vitality of plants. The technology has been transferred to M/s DAJI Industries Pvt. Ltd., Sangli, Maharashtra.



(vi) **Novel Piezo based Multipurpose Non Destructive Evaluation Vibro-integrity Sensing Device (VInSD)**

The various embodiments of the CSIR-CRRI developed piezoelectric based sensor especially for NDT of concrete and steel structures provide a system and method for sensing the dynamic response and the integrity of a concrete structure (such as a bridge) through the measurement of the vibration response of a piezoelectric based sensor. This is a very light weight, battery operated and portable sensor which can be either used as a standalone sensor or as an attachment for the Unarmed Aerial Vehicles (commonly called drones) for inspection of concrete and steel structures. This is designed in a way that it can generate waves in the concrete structure by producing an impact force and then measure the velocity of these waves travelling inside the concrete. Further, this sensor can estimate the depth of the defects (in form of cracks etc.) by studying the dynamic response of the concrete structure.

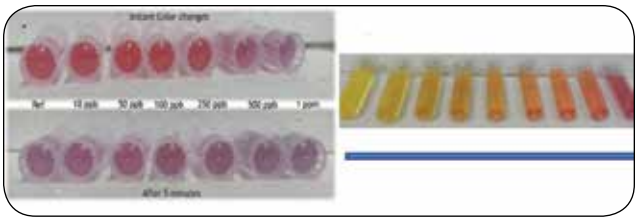
(vii) **Multi-sourced edible vegetable oil with an ideal ratio of SFA: USFA (omega3 and omega6)**

Fats and oils are important dietary components in our diet. Diet provides mixtures of three types of fatty acids saturated (SFA), monounsaturated (MUFA, w-6), and polyunsaturated (PUFA, w-3).

Each fatty acid has unique metabolic facts and potentially independent physiological functions. Hence it should be consumed in a balanced manner to avoid the adverse effect. Accordingly, FSSAI revised the regulation of vegetable oil blending and introduced a new term called "Multi-Source Edible Oil (MSEO; blending of three oils) to ensure the w-3 fatty acids intake and the other w-6 and saturated fatty acids in the recommended ratio in our diet. Hence, Multi-Source Edible Oil (MSEO) has been developed at CSIR-CFTRI with a balanced fatty acid ratio by both enzymatic and non-enzymatic processes as per FSSAI guidelines.

(viii) **Indigenous Colorimetric test kits and device for water quality testing**

In Indian scenario, several states have been affected with high level contamination of heavy metals including arsenic, selenium, chromium, cadmium, etc., in water. It is therefore required to have end-to-end detection platform for their detection before water consumption as well as utilization in agriculture in affected regions. The work initiated at CSIR-CSIO integrates successfully accepted colorimetric approach for heavy metals detection in water with mobile phone-based image processing to quantify the contamination level using affordable paper/membrane based disposable sensor strip. The developed mobile app ensures elimination of subjectivity of the colometric sensor, which limits their application to true extent by users in resource limited regions especially rural sector.

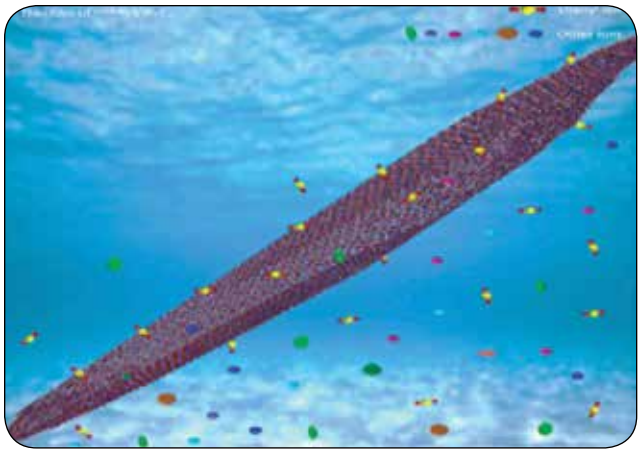


(ix) **Genome-editing of Nicotiana tabacum for introducing mutation in FucT and XylT genes**

CSIR-IIIM developed transgenic N. tabcaum lines having Crispr/Cas components for introducing mutations in the four FucT and two XylT genes. One primary transformant was found to have mutations in all the six genes. This mutant plant is expected to be devoid of plant specific glycan residues.

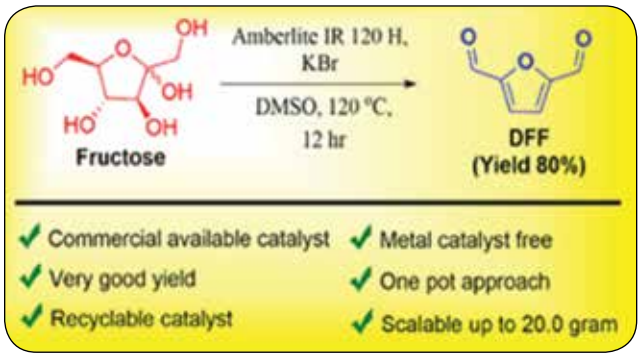
(x) **Uranium Extraction from Seawater**

Uranium extraction from seawater is an emerging paradigm of the Blue economy towards harnessing the ocean resources for sustainable development of clean energy. The large area thin films of permanently porous Hydrogen-bonded Organic Frameworks (HOFs) have been prepared at CSIR-CSMCRI for efficient Uranium Extraction from Seawater (UES). Work highlighted as New porous material efficiently extracts Uranium from seawater.



(xi) **A solid acid catalysed one-pot selective approach for 2,5-diformylfuran synthesis from fructose/carbohydrate feedstocks**

A metal catalyst free synthesis of 2,5-diformylfuran (DFF) from fructose has been established at CSIR-IHBT using a one-pot greener approach. A user-friendly solid acid (Amberlite IR 120 H) was explored for the transformation of fructose into DFF to achieve the highest yield. High chemo-selectivity, recyclability of the solid acid up to seven cycles, and scalable and environmentally benign approaches are some remarkable advantages of the present process. In addition, the devised process was used to obtain DFF from a variety of low-cost feedstocks including fructose, sugar, sugarcane molasses, and jaggery, in an acceptable yield.



(xii) **Food grade xylitol from biomass**

A process for production of crystalline xylitol from biomass has been established at CSIR-IIP with corncob and sugarcane bagasse as the feedstock. The xylan fraction of the biomass was hydrolyzed with dilute acid and steam treatment and the resulting xylose rich fraction was converted into xylitol with high yield by a mesiophilic yeast. The final product after recovery has a purity of ~97.5%, shows no traces of heavy metals or pesticides and has a shelf life of >3 months. Also, the product has been found to have no adverse effect on animal cell lines at a dosage of >10000 mg/kg of the product.

(xiii) **CSIR-NAL's Octa-Copter**

CSIR-NAL has developed a medium-class BVLOS (Beyond Visual Line of Sight) multi-copter UAV. The UAV is made out of a lightweight carbon fiber foldable structure for ease of transportation and has unique features like autonomous guidance through dual redundant MEMS-based digital Autopilot with advanced flight instrumentation systems. DGCA, Ministry of Civil Aviation, Govt. of India has granted conditional permission to CSIR-NAL for conducting BVLOS flight trials. Subsequently, the NAL drone has completed about 50 hrs of flying to verify the performance parameters and the report is being submitted to MoCA for type approval.

NAL's Octa-copter Drone is capable of carrying payload of 20 kg for a duration of 20 minutes. However, for longer duration applications, the payload is reduced suitably. It can fly at an operational altitude of 500 m AGL and a maximum flying speed of 36 kmph. Its regulatory compliance includes DGCA-NPNT, Geo-fencing, and digital sky with 360 degrees Collison avoidance making it one of the best UAVs in its class. The uniqueness of this UAV is its higher payload and higher endurance which is perfect for last-mile delivery, floriculture mapping, geo exploration, precision agriculture pesticide spraying and medical transport at remote places. These drones have been configured to suit multiple applications for societal needs. The three applications envisaged are (a) Emergency

Medical/ Vaccine Delivery (b) Agricultural Spraying and (c) for Geophysical Survey applications. Model based design of the autopilot control laws lead to the robust controller has been achieved. This has enabled the Octa-copter to be suited for these varying applications. Figure show the all three Octa-copters with the three different payloads. The technology has been transferred to 4 MSMEs during the Wings India 2022.

NAL Octa-copters configuration (a) Octa-Med. (b) Octa-Agri and © Octa-Geo formation flying at Wings India 2022

(xiv) **Design & development of a vertical slurry transport system for lifting of minerals/ores in heterogeneous regime**

Limestone samples were collected from Lanjiverna mines, Dalmia Cement, Rajgangpur (Sundergarh), Odisha. Characterization studies comprising of particle size analysis, material density, settling characteristics of the limestone samples were carried out at CSIR-IMMT. In order to transport the limestone samples in vertically upward direction, the settling velocities of lime stone particles in size ranges of 4-6 mm, 8-10 mm, 12-15 mm & 18-20 mm were evaluated experimentally through visual observations at the transparent sections (Perspex tube) using the vertical test loop facility. A 2-4 ton/hr capacity rotary feeding system has been designed, developed & successfully installed by CSIR-IMMT with the vertical lifting system. Experiments have been conducted with a maximum mixture slurry concentration of 12.52% & the pressure drops were evaluated using the vertical slurry test setup. A 4-10 ton/hr capacity feeding system to handle 4-20 mm size particles has been designed to increase the slurry concentration. A mechanical pulsar mechanism has been designed and installed with the system to induce pulsation in a variable frequency.

(xv) **Process Development for VOC and Odour Emissions Control**

Large amounts of organic solvents are used in automotive painting booths. On an average, more than 6 kg of volatile organic compounds (VOCs) are used as paint solvents per vehicle in typical automotive plants with solvent-based coatings. The paints used contain organic polymers and solvents. These compounds can be photo-chemically reactive and negatively affect local air quality. Automobile spray painting units causes VOC and odour emission in several parts of the state. Biological waste air treatment is best for this as it is cost effective as well as environment friendly in comparison with conventional techniques such as chemical or thermal. Therefore, a hybrid bio-physico-chemical process termed as "Gas Bio-trickling filter" has been developed at CSIR-NIIST through R&D project financially supported by Central Pollution Control Board (CPCB) and Kerala State Pollution Control Board (KSPCB). The biological treatment utilizes microbial consortia to treat contaminant emitted in the air. The system is equipped with the continuous recirculation of the aqueous phase containing the essential inorganic nutrients. A counter current gas liquid flow distribution has been designed for efficient treatment and subsequent removal of VOC form polluted air stream. The trickling liquid is circulated from the top of the filter bed by a pump and is homogenously distributed on the top surface of the porous bed by head spray system. The liquid medium is trickled on the filter

bed from the top of the bed at a certain fixed rate and VOC enriched gaseous stream is entering from the bottom of the reactor. Physicochemical and biological phenomena occur simultaneously during the pollutants degradation in biotrickling filtration system. Biotransformation occurs along with adsorption, absorption and diffusion to remove contaminants from the gaseous stream. In the presence of microbial consortia in packed media biofilm will aerobically degrade the VOCs (targeted pollutants).

Modular VOC Emission Control Unit- Gas Bio-trickling

Air sampling from a spray-painting unit along with KSPCB authority and subsequent odour & VOC

(xvi) **Study on the Nature and Formation of Ramsetu and its Surrounding Environment**

Potential sites with hard substrates were identified by CSIR-NIO through bathymetry survey on the southern part of Ramsetu and those sites were further investigated in-situ by SCUBA diving. The sites were characterized by the hard calcareous substrates covered with a thick layer of sediment. The benthic substratum at two of the sites ware characterized by hard calcareous formation (3-4 feet wide and 1 – 1.5 feet in height) elevated from the substrate. No paleo corals could be found at the dive sites due to poor visibility and a thick layer of sediment.

(xvii) **Laboratory scale facility creation of 3D printing (3DP)**

Extrusion-based research scale 3D concrete printer installed in at CSIR-SERC was used for development of 3D printable concrete mixes. About 30 trial mixes were prepared to arrive at a successful 3D printable mix which satisfies flowability, buildability, and open time. Various mixes were developed using different industrial by-products (fly ash, silica fume, GGBS) and different types of fine aggregates such as standard sand, river sand and copper slag. Flowability of these mixes were determined by conducting slump test and flow table tests in accordance with ASTM C 1437. Further, extrudability of 3D printable mixes were evaluated by visual inspection method; extruding filaments without clogging, breaking segregating or bleeding. For the determination of buildability, cylindrical/ rectangular specimens for height up to 500 mm (maximum printable height using the printer) is printed; the total number of printed layers were counted and by measuring the vertical strain the buildability was checked. Structural build up behaviour was evaluated using penetration test. Initial setting time and final setting time of printed sample was less compared to companion cast-in-place samples. Grade of the concrete was achieved as M30.

(xviii) **Development of repair methodologies for structures exposed to chloride/ carbonation/ chemical environments**

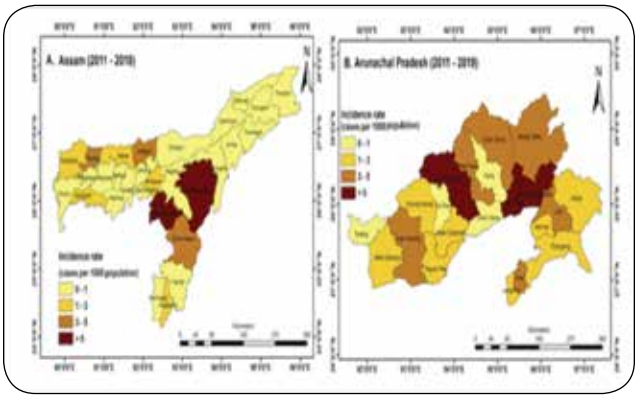
Condition assessment of hydro power project including barrage, intake and desilting structures were carried out by CSIR-SERC. Some portions of the main structures such as bridge deck, radial gates, breast wall etc., were washed away during the unprecedented flash foods. During the in-situ testing, it was noticed that most of the dowel bars provided in the structure got damaged and scrambled. A comprehensive repair methodology is suggested for the repair of damaged breast wall. A conventional repair procedure such as removal of loose concrete, provision of additional rebars, cutting of buckled rebars with a length provision of 40 times the diameter of bar (development length), drilling holes to insert new bars, concrete quality improvement by means of grouting, etc. is suggested. Solvent based bond coat is suggested to ensure bond between the old concrete substrate and new concrete to be poured in the breast wall. Also, condition assessment of ring beam of a nuclear power plant structure was carried out. 0.30 to 0.35mm cracks were noticed in the Corbel

beams. Low viscous epoxy resin grouting was suggested to fill the cracks. After repair, concrete integrity/performance was ensured by UPV testing.

Damage on Barrage Pier and Intake structure

(xix) **Weather integrated malaria prediction system using Bayesian structural time series model for northeast states of India**

Malaria is an endemic disease in India and targeted to be eliminated by the year 2030.The work of CSIR-4PI is aimed at understanding the epidemiological patterns of malaria transmission dynamics in Assam and Arunachal Pradesh followed by the development of a malaria prediction model using monthly climate factors. A total of 144,055 cases in Assam during 2011–2018 and 42,970 cases in Arunachal Pradesh were reported during the 2011–2019 period observed, and Plasmodium falciparum (74.5%) was the most predominant parasite in Assam, whereas Plasmodium vivax (66%) in Arunachal Pradesh. Malaria transmission showed a strong seasonal variation where most of the cases were reported during the monsoon period (Assam, 51.9%, and Arunachal Pradesh, 53.6%). Similarly, the malaria incidence was highest in the male population in both states (Asam, 55.75%, and Arunachal Pradesh, 51.43%), and the disease risk is also higher among the > 15 years age group (Assam, 61.7%, and Arunachal Pradesh, 67.9%). To predict the malaria incidence, Bayesian structural time series (BSTS) and Seasonal Auto-Regressive Integrated Moving Average with eXogenous factors (SARIMAX) models were implemented. A statistically significant association between malaria cases and climate variables were observed. The most influencing climate factors were found to be maximum and mean temperature with a 6-month lag, and it showed a negative association with malaria incidence. The BSTS model has shown superior performance on the optimal auto-correlated dataset (OAD) which contains auto-correlated malaria cases, cross-correlated climate variables besides malaria cases in both Assam (RMSE, 0.106; MAE, 0.089; and SMAPE, 19.2%) and Arunachal Pradesh (RMSE, 0.128; MAE, 0.122; and SMAPE, 22.6%) than the SARIMAX model. The findings suggest that the predictive performance of the BSTS model is outperformed, and it may be helpful for ongoing intervention strategies by Governmental and non-Governmental agencies in the northeast region to combat the disease effectively.



Spatial distribution of District-wise average annual parasite incidence (API) for A. Assam (2011-2018) and B. Arunachal Pradesh (2011-2019) states of NE region of India

(xx) **Ancient DNA research**

DNA and radioisotope analyses by scientists

from CSIR-CCMB, BHU, BirbalSahni Institute of Paleosciences and Punjab University have traced the origin of human skeletons found in a well in Ajnala, Punjab to East of India in 2014. Their findings suggest the skeletons match people of Eastern India. Historical records corroborate this to the British killing of Indian soldiers from the 26th Native Bengal Infantry Battalion during the freedom struggle of 1857 at Ajnala.

5.1.3 Scientific Excellence

CSIR has published 5769 research papers during the period under report in SCI journals of repute. The new knowledge generated from CSIR laboratories is reflected in terms of high average Impact Factor (5.401).

5.1.4 Excellence in Intellectual Property

CSIR has filed 163 patents abroad and 229 patents in India during the period, and it has been granted 158 patents abroad and 202 patents in India. CSIR has filed 61 Copyright applications. The Copyright applications filed by CSIR subsist in different categories such as literary work, software and artistic work.

5.1.5 Value Generation through External Cash Flow (ECF)

CSIR has generated External Cash Flow of Rs. 1639.67 Crore during 2021-22, by working with various Govt./ non-Govt. Indian and foreign organisations.

ECF (Rs in crore)	
Government	619.89
PSU	626.58
Private	368.60
Foreign	24.60
Total	1639.67

5.2 Consultancy Development Centre (CDC) (Amalgamated with CSIR)

Consultancy Development Centre (CDC) was set up in January 1986 in the form of a registered society supported by the Department of Scientific and Industrial Research (DSIR) as its Administrative Ministry, to promote, develop and strengthen consultancy capabilities in the country. CDC was approved as an Autonomous Institution of DSIR by the Government of India in 2004. The Centre is managed by a Governing Council consisting of members drawn inter alia from Government Departments, Research organizations, Academic institutions and Consultancy companies.

CDC amalgamated with the Council of Scientific and Industrial Research (CSIR), an Autonomous Body under the Department of Scientific and Industrial Research (DSIR), along with its manpower, moveable assets and liabilities vide Ministry of Science and Technology (Department of Scientific and Industrial Research) Notification AB-CDC018/1/2021-PSE-DSIR dated 11th May 2022 (published in the Gazette of India on Thursday, May 12, 2022)

6.0 PUBLIC SECTOR ENTERPRISES

6.1 National Research Development Corporation (NRDC)

National Research Development Corporation (NRDC) is a Government of India enterprise, under the administrative control of Department of Scientific & Industrial Research (DSIR), established in 1953 under section 25 now section 8, of the companies act. The main objective is to promote, develop and commercialize technologies/ know how/ inventions/ patents/ processes emanating from various national R&D institutions. The Corporation offers its services through-out the country in improving the Nation's manufacturing base with innovative technologies specially suitable for our entrepreneurs and conditions. It acts as an effective Interface for translating R&D results into marketable products. Over the last more than six decades of its existence, the Corporation has forged strong links with various R&D organizations both within the country and abroad and pursued bringing inventions and innovations to commercial fruition. The Corporation is recognized as a repository of a wide range of technologies and has licensed

technologies to over 5000 entrepreneurs spread over almost all areas of industry and has provided assistance for filing of more than 2000 IP's.

During the financial year 2021-22 Revenue from operations was recorded at ₹1144.66 lakhs compared to ₹ 777.46 Lakhs during the previous financial year in 2020-21. Surplus Before Tax and extraordinary expenses was recorded at ₹20.00 lakhs in 2021-22 compared to ₹33.01 Lakhs during the previous financial year in 2020-21 and Surplus After Tax and Extraordinary Expenses was recorded at ₹ 4.94 lakhs compared to ₹ 18.53 lakhs during the previous financial year.

During the year the Corporation signed 42 MoU's with new organizations, assigned 42 technologies and Licensed 70 innovative technologies to start-ups / entrepreneurs. During the year the corporation assisted start-up mission and evaluated 1379 number of applications received from start-ups for availing tax benefits. NRDC has also partnered with IOCL to mentor, handhold, incubate, implement, monitor and review the progress of the Start-ups supported by IOCL.

During the Year the Corporation also initiated a new activity, TDVC, for supporting technology development as well as operationalized its incubation center set-up at Headquarters and also entered into agreement with CSIR-NAL and CSIR-IMMT for managing their incubation centers. The Corporation in its pursuit of protection of inventions and technologies developed by scientists and researchers, etc. provided financial/ technical assistance for filing of 66 IP applications received from various universities, R&D institutes, etc.

NRDC is increasing its footprints pan India by establishing Outreach Centres in various cities viz. Pune, Guwahati, etc and strengthening its activities in Vishakhapatnam at its MoMSME- IPFC office. Further, an MoU with North East Centre for Technology Application and Reach (NECTAR) has been executed which already has its presence in north-east India. Apart from improving NRDC's operations pan India, foreign collaboration efforts are also being made and in this process MoUs have been executed with United States Patent & Trademark Office (USPTO) and African-Asian Rural Development Organization (AARDO).

6.2 Central Electronics Limited (CEL)

Central Electronics Limited (CEL) is a profit making public sector enterprise under the Department of Scientific and Industrial Research (DSIR), Ministry of Science & Technology, Government of India. It was established in 1974 with an objective to commercially exploit indigenous technologies developed by National Laboratories and R & D Institutions in the country. CEL is one of the companies that utilized home grown technologies during all these years of its existence. The company is primarily engaged in production of strategic components for defence applications of national importance, equipment for railway safety and solar photovoltaic modules and systems. The company has developed a number of products for the first time in thecountry through its own R & D efforts and in close association with the premier National & International Laboratories including Defence Laboratories. The organization had the highest ever net worth of Rs.122.34 Cr. as on 31.03.2022 with positive reserves. CEL signed two MoUs with Indian Institute of Kanpur (IIT-K) to work on common areas of interest for the development of technology and various indigenous products and signed a technology transfer agreement with Naval Materials Research Laboratory (NMRL DRDO) for production of special grade ferrite based radar absorption material for stealth application.

CHAPTER 1 INDUSTRIAL R&D PROMOTION PROGRAMME (IRDPP)

INDUSTRIAL R&D PROMOTION PROGRAMME (IRDPP)

DSIR through its flagship program i.e. "Industrial Research & Development Promotion Program (IRDPP)" has vision to promote Industrial Research in the country through Industry and Institution centric motivational measures and incentives creating an enabling environment for development & utilization of novel technologies and innovations.

1.0 Objectives

The broad objectives of the Industrial Research and Development Promotion Programme (IRDPP) are to:

I. Bring in-house R&D into sharper focus;

II. Strengthen R&D infrastructure in industry and Scientific and Industrial Research Organisations (SIROs);

III. Promote R&D initiatives of the industry and SIROs;

IV. Ensure that the contributions made by the in-house R&D centres and SIROs dovetail adequately in the overall context of technological and industrial development.

1.1 Areas of Coverage

The specific areas covered under the component scheme are:

I. In-house R&D in Industry.

II. Scientific and Industrial Research Organisations (SIROs) and

III. Fiscal Incentives for Scientific Research.

Activities and achievements in each of above areas are presented below:

1.2 In-House R&D in Industry

1.2.1 Recognition of In-house R&D Centers

A strong S&T infrastructure has been created in the country. This covers a chain of national laboratories, specialized R&D centers, various academic institutions and training centers, which continuously provide expertise, technically trained manpower and technological support to the industry. Various policy measures have been introduced from time to time, to meet the changing industrial and technological requirements of the industry. The Government has been giving special attention to promotion and support to industrial research in industry. Several financial benefits have also been provided which encourage and make it financially attractive for industrial units to establish their own in-house R&D units.

A scheme for granting recognition to in-house R&D center of the industry is operated by the DSIR. A number of incentives and support measures are made available to in-house R&D units of industry to strengthen the technological base. Ministry of Finance issued notifications amending the basic notifications under Customs and Goods & Service Tax (GST). As per the amendments, DSIR recognized & registered in-house R&D units other than hospitals can avail customs duty exemption and concessional GST on their procurements for research. However, Government of India, Ministry of Finance (Department of Revenue) has rescinded notifications related to Goods & Service Tax (GST) w.e.f. 18th July 2022.

The in-house R&D center qualifying for recognition are expected to be engaged in research and development activities related to the line of business of the firm such as development of new technologies, design and engineering, process/ product/design improvements, developing new methods of analysis and testing; research for increased efficiency in use of resources such as capital equipment, materials and energy; pollution control, effluent treatment and recycling of waste products.

The R&D activities are expected to be separate

from routine activities of the firm, such as production and quality control. The in-house R&D units should have staff exclusively engaged in R&D and headed by a full-time R&D manager who would have direct access to the chief executive or to the board of directors depending upon the size of the unit. The in-house R&D centers are also expected to maintain separate identifiable infrastructure and R&D accounts.

Number of in-house R&D centers recognized by DSIR increased steadily from around 100 in 1973 to around 275 by 1975, to over 700 by 1980, around 925 by 1985, over 1100 in 1990, over 1200 in 1995 and thereafter hovering between 1200 to 1250; 1361 in March 2010; 1618 in December 2011, 1767 in December 2012, 1797 in December 2013, 1762 in December 2014, 1800 in December 2015, 1900 in November 2016, 1997 in November 2017, 2052 in November 2018, 2238 in December 2019, 2340 in November 2020 and 2481 in December 2021, 2397 in December 2022. Of these nearly 1960 are in the private sector and the remaining units are in public/joint sector. The last 'Directory of Recognized in-house R&D Units' till 31.03.2021 was brought out and next updated directory will be brought out in 2023. Directory lists recognized in-house R&D units, giving registration number, name and mailing address of the company, location of the in-house R&D unit(s) and validity of DSIR recognition.

To promote entrepreneurship in biotechnology sector, the conditional three-year existence of the company was relaxed with effect from July 2015 for according short term fresh recognition to Biotech Start-ups established in the Incubation Centre or Technology Parks. DSIR refers the applications received from start-up companies in the biotechnology sector to the Department of Biotechnology (DBT), being the nodal Department for promoting biotechnology in the country for their views and comments. Based on recommendations received from DBT and keeping the guideline relaxation in view, the application is considered for recognition. The relaxation of three years of existence of the companies for other sectors has been proposed for consideration.

A detailed guidelines for the Recognition of In-house R&D centre are available on Department's website. The applications received are scrutinized for their completeness in the department and are then circulated for comments to various other departments/agencies, concerned administrative ministries such as MSME, MNRE, CSIR, ICAR, ICMR, MoEF, CCRAS, AYUSH, DBT, DST, SERB, TDB, TIFAC, DC&PC, MeitY, DoP and NRDC. The applicant industries seeking recognition are pre-screened by the departmental officers and invited for online / physical presentation and discussion in DSIR and may be visited by a team of experts and DSIR representatives. The applications along with comments from outside nodal departments/ organizations, visit reports, and the Department's own evaluation are considered by an Inter-Departmental Screening Committee constituted by the Secretary, DSIR. The Committee meeting is scheduled every month / bimonthly to consider the applications and makes recommendations for recognition & registration to the Secretary, DSIR.

During the period under report, the Screening Committee met 8 times and 228 applications received for recognition. The screening committee considered 223 applications including new application and deferred cases and cumulative disposal was 222 applications, of which 106 applications having 116 R&D units were granted fresh recognition based on their satisfactory R&D infrastructure, qualified manpower and programmes. 95 new companies and 11 already recognized companies with endorsement were recognized, 1 (one) application was deferred and 116 applications were closed in its present form due to either withdrawal by the company or not eligible for consideration under existing guideline of IRDPP scheme. A statement giving month-wise receipt, disposal and pendency of applications for recognition of in-house R&D units is given at **Annexure-1.**

During the period under report, more than 225 discussions/meetings were held with heads/ representatives of in-house R&D centers. Also, a number of visits of In-house R&D centers were organized along with domain experts through

VC/Skype/MS-Teams.

1.2.2 Renewal of Recognition

DSIR recognition to the in-house R&D centres of the industry is granted for a period ranging from 2 to 5 years. The companies having the R&D units recognized by the Department are advised to apply for renewal of recognition well in advance (3 months prior to the date of expiry of the recognition). The applications are examined in DSIR by the Research and Review Group (RRG) comprising of representatives from CSIR, NRDC, DSIR and DST constituted by the Secretary DSIR. The RRG takes into account recommendation for renewal of recognition based on satisfactory R&D performance of the R&D centres of industry from the last recognition based on the research indicators like the R&D expenditure, R&D assets, R&D manpower, R&D achievements (new products and processes developed, technologies commercialized, patents filed, research papers published etc.) and the ongoing and future R&D programmes. Sometimes, the RRG may seek clarification/suggestions from the industry for strengthening their R&D activities. After obtaining the necessary information from the industries, the cases which have been accorded DSIR recognition are considered for renewal of recognition.

As of 1st April 2022, in-house R&D units of 829 companies were due for renewal of recognition beyond 31.03.2022. A total of 683 applications were received till 31st December, 2022 which included 652 applications pertaining to renewal beyond 31.03.2022 and 31 applications pertaining to renewal beyond 31.03.2021. During the period under report, the Research Review group (RRG) met ten times. Based on the evaluation of the performance of the R&D units, renewal of recognition was granted to 653 company's having recognized R&D units. Total of 146 companies could not be renewed so far because of the reason that their application was not received in the department so far. 05 companies could not be renewed beyond 31.03.2022 because of the reason that the R&D performance was not satisfactory. A total of 25 applications are being processed currently in the department. A statement showing month-wise receipt, disposal and pendency of the cases of renewal of recognition of the R&D units is given in Annexure 2

1.2.3 R&D Expenditure

The R&D expenditure incurred by in-house R&D units in industry has steadily increased. During 1980-81, it was of the order of Rs. 300.00 crores. In 1985-86, it was of the order of Rs. 500.00 crores. It is estimated that the present R&D expenditure of the 2397 recognized in-house R&D units is of the order of about Rs. 44030.00 crores per annum. The share of public and joint sector is about 20 per cent and that of private sector about 80 per cent. The representative list of Companies spending over Rs. 5000 lakhs per annum on R&D, Rs. 500 lakhs to Rs. 5000 lakhs per annum on R&D and between Rs. 200 lakhs to Rs. 500 lakhs each per annum on R&D is given in Annexure 3, 4 and 5 respectively.

1.2.4 R&D Infrastructure

The in-house R&D centers have created State of art design & simulation facilities, Prototyping, Validation & Testing facilities meeting regulatory requirements and compliance with National/ International Laboratory certifications. The laboratories of In-House R&D centers are equipped with sophisticated analytical equipment, design software's, predictive testing and advanced raw material characterization facilities for carrying out their research activities.

The major equipment include : Monocular microscope, Radar Interface, Welding Machine, Spectrum Analyzer, Flow Meter-0 to 1500 LPM, Test Bed, Testing Cooler Skid, Air Cooled Heat Exchanger for Seal Plans, Large-scale Shell-tube Gas coolers, AWS cloud-based development, Machine learning with data analytics on IoT edge platform and cloud integration, Electrophoresis Protein Equipment, Shaker-Biologic Outflow Pathfinder System, HPLC-Preparative Chromatography System, Incubator Shaker, Freezer 80 Degree, Freeze Dryer, Laminar Air Flow, Incubator Bacteriological, Hot Air Oven Model, Electronic Weighing Scale, Refrigerator, Binocular Microscope, Table Top

Portable Autoclave, Poly House, Glass House, Cultivation Equipment, Germinator, Tractor and its Accessories, PCR Machines, Automatic absorption Spectrometer, Gene gun, Refrigerated Centrifuge, FTIR With ATR and standard Accessories, Muffle Furnace with digital Controller, Osmometer, Viscometer, 160 KVA Diesel Generator, Eddy Current Dynamometers, Engine Test Controller, Orbit-E Test Automation System, Tablet multi punching machine, Digital Polarimeter, DigiRefractometer IR with accessories, High Speed Ref Centrifuge, Tablet coating machine, Microhardness tester with software, Fluorescence microscope, Fermenter, 5 LTR capacity SSF system, Sterilizers, HPLC with PDA and RI detector, LC-MS.MS TQ-XS with UPLC H class, MASS SPECTROMETER, Lcms / MS System, Gas Chromatography, Auto-titrator, Rotavapor, Vacuum Pump with Gauge, Balance, DSC, Atomic absorption chromatography, Turbid meter, Karl fisher, Potentiometer, pH meter. Mini Atomizer with accessories, Atomic absorption spectrophotometer, Optical metallurgical microscope, Scanning electron microscope, HPLC system, RotavaporVaccum pump, Spectrophotometers, Agilent 6890 GC System, Spectrometer NMR, Hardness Tester, Die Punch Cutter, Viscometer, Chiller, Oil vacuum pump, Autoclave, High Performance Liquid Chromatography, Electro spinning machine, Freeze dryer, Upright Metallurgical Microscope & Camera, Universal Testing Machine, Abrasive cut off Machine, Milling Machine, Oil fired Furnace, Xilinx FPGA Software Development Board, Power supplies : Var Tech System 3005B-3, G-suite, Picoscopes: Pico Tech 6404D and 2408B, RT-PCR, PCR, ELISA analyzer, microcentrifuge, Deep freezer, NGS servers, Adiabatic Reaction Calorimeter Y 2020, Mass Spectrometer, Coulometric moisture analyzer, Fluorescence microscope, Hot embossing machine, Nano Photometer / Spectrometer, Freezer, Humidification chamber, Eddy Current Dynamometers, Engine Test Controller, Orbit-E Test Automation System, Tablet multi punching machine, Blender, Continuous inkjet printer, Tablet coating machine, Rheometer, Mooney viscometer, twist tester, Texture tester, Fatigue Testing Machine-INSTRON, Fatigue testing M/C-RUMUL, Fatigue testing M/C-CRIMS, Chain test rig with D.C Motor system, Automotive drive chain test rig, Microprocessor kit, Digital Multimeter, Digital Clamp meter, Digital LCR meter, Digital storage oscilloscope, Laminar Air flow unit, CO_2 Incubator, -20 Freezers, Nano coating machine, High temperature Pin-on-disc machine, Fully automatic Rockwell hardness testing machine, Microhardness tester with software, Portable microscope with software, High-Throughput submarine Electrophoresis systems, Gel Doc XR+molecular imager system-bio-rad, Semi Auto pipe bending machine, Swaging machine with tool sets, Fiber laser Cutting machine, AVIII 600 MHz Spectrometer – Ascend ULH magnet exchange, Falling Ball Viscometer, Brookfield Viscometer, High Voltage Tester, Bench scale wall mounted glass herbal extractor, Horizontal autoclave, Cultivation Equipment, Germinator, Pressure reactor 1L, Cryogenic Bath (-70*C), etc.

1.2.5 R&D Manpower

There has been a steady increase in R&D manpower employed by the in-house R&D units. By 1975-76, about 12,000 R&D personnel were employed by the recognized in- house units and by 1981-82, the figure was over 30,000. The estimated manpower for the 2397 in-house R&D units is over 1,67,000.

1.2.6 Achievements of In-house R&D Units

Agricultural Sciences:

i. Development of new products/varieties ofCotton, Pearl Millet, Tomato Hybrid, veer Bio Kiran, Brinjal Hybrids, Mustard, Hot Pepper Hybrids, Okra Hybrid, Bottle Gourd Hybrids, Bitter Gourd hybrids.

ii. Development ofHybrid Bhindi, Hybrid Cabbage-Early Champion, Hybrid Cauliflower-Ananya White, Hybrid Capsicum-Eskimo, Hybrid Radish-Moonwhite.

iii. Development of new products such as various Paddy Hybrids

iv. Development of New genes for insect

resistance, development of resistance for BLB, blast and BVH in rice varieties through molecular markers.

v. Development of new products as Strawberry, Papaya & Bamboo micro-propagation process, Hy. Sorghum, Hy. Pearl Millet, Hy. Maize.

vi. Development of new improved varieties of Hybrids: Castor, Pearl Millet, Improved Varieties of Cumin, Wheat, Gram, Madhur Grass and Fodder.

vii. Development of new products such as Black Tea Liquid Concentrate, Decaffeinated Green Tea Extract Sweetened Liquid, Rosemary Extract 10% Carnosic acid decolorized de-flavored antioxidant for shelf-life extension of Food, Personal Care Products – Quercetagetin, Chlorogenic acid > 80%, Black Cumin Extract >2% Thymoquinone, Skin tone formulations, Hair care formulations, Rice Protein Concentrate &Hydrolysate.

viii. Development of Microencapsulated flavours for Beverages, Liquid Seasonings – Garam Masala, Tandoori Spice, Ginger Root Extract high Gingerols, FenuBoost – combination of protein, soluble fibreand Insoluble fibre, Fenugreek Saponins.

ix. Development of Lemon Balm, Polyherbal Extract, Cardamom Oleoresin for Tea Flavouring, Antioxidant Formulations for shelf-life extension of Meat and Meat products, Black garlic Extract, Antibiotic replacers & Growth promoters for Animal health.

x. Development of Beverage, Personal care Products, Herbal Extracts as Adoptogen– Extracts of Ashwagandha, Holybasil, Chamomile, EncapsulatedOreganum oil, Lemongrass Extract, Yellow Pigment, red Pigment.

xi. Development of Pod planting system with OCP (Optimised Coconut Plantation).

xii. Development of Rhinoceros beetle control by naphthalene ball in Coconut crops.

xiii. Development of Integrated Farming Model in Coconut Plantation.

xiv. Development of coconut Tissue Culture plantlets from inflorescence explants using Micro-propagation technique.

xv. Development of CMS lines in Cauliflower and Radish for heterosis, Breeding, Developed and Characterised tomato Lines.

xvi. Organic NPK granules to provide alternative to synthetic NPK Fertilizers for sustainable agriculture.

xvii. Development of Microtrace formulation for trace elements as Conventional micronutrients are basically salts. Nano technology based micro trace elements employs reduction based chemical technology. When compared to the Mineral Ions the bioavailability of microencapsulated trace elements is high. The microencapsulated trace elements are absorbed easily in plant system either by foliar spray drip irrigation.

xviii. Organic insecticide for sucking pest to provide alternative to synthetic insecticides for sustainable agriculture.

xix. Formulation for organic herbicide for controlling weed population.

xx. Development of medium maturity and high nutrients bioavailability of Maize hybrids for mall nutrition.

xxi. Development of new products such as Developed hybrids in major vegetable crops.

xxii. Development of extracts of few very promising & potential cultivars; Bt Cotton, Soyabean, Paddy, Tamato, Okra.

xxiii. Development of early and medium maturity Bajra hybrids, purpose of Tolerant to abiotic stress (heat & drought), and Downey mildew and Lodging Resistance.

xxiv. Development of high density suitable cotton hybrids with high yield, big boll and sucking pest tolerance.

xxv. Development of High Yielding Varieties/ hybrids with big bolls &extra long staples & tolerant to pest & diseases as well as drought.

xxvi. Development of New Products/varieties such as pearl millet, maize, single-cut sorghum, sunflower, cotton.

xxvii. Development of hybrids of papaya.

Biological / Biomedical Sciences/ Pharmaceuticals:

i. Development of new products such asOnium (Phosphonium and ammonium/ uranium) salts of hydrobenzotriazole derivatives that are compatible with current industrial requirements; process modifications to reduce racemization and avoidthe formation of other derivatives; development ofGanirelix, Tetracosactide, Thymosin Alpha-1, Octreotide, Lanreotideetc.

ii. Development of new products such as Rabiesvaccine, Quadrivalent Flu vaccine, anti-VEGF protein, anti-TNF MAb for treatment of autoimmune disorders, anti-CTLA-4 protein, recombinant Human Albumin as New Biological Entity, anti-TNF fusion protein for treatment of autoimmune disorders.

iii. Development of Gliclazide Modified Release Tablets, Metformin Sustained Release Tablets, Caralluma Capsules, Loprazolam Tablets, Brotizolam Tablets, Acetazolamide tablets, Zolpidem Extended-Release Tablets, Alprazolam Tablets, Clobazam Tablets, Hypromellose Eye Drops, Clonazepam Tablets, Hypromelloseand Sodium HyaluronateEye Drops, Diperoxochloric Acid Concentrate, Betahistine, Sodium Hyaluronate Eye Drops.

iv. Development of Air Handling Units, Raw material dispensing booth for Sampling of Excipients / Active Sampling, Automatic Capsule Filling Machine for commercial batches, First in First Out system for dispensing of Raw Material, Escitalopram Oxalate and Clonazepam Tab, Risperidone and Trihexyphenidyl Hydrochloride.

v. Development of L1 protein in the form of Virus Like Particles (VLP's) against Human Papilloma Virus that causes cervical cancer in women; Growth, production and purification of S1 Spike protein used in preparation of vaccine against SARS-COVID-19.

vi. Development of (5)7-A V C A, 3-OH Compound, Cefpodoxime Acid, Cefixime, Ceftibuten Hydrate, Citicoline sodium, Pregabalin, Levetiracetam, Montelukast sodium, TelmisartanVildagliptin, Favipiravir.

vii. Development of Production of microbe immune, user-friendly bio-sampler for Corona virus collection & smooth hygienic transport.

viii. Development of Intracellular Delivery of Genome editing tools for Cancer Therapy.

ix. Development of Intracellular Drug delivery system to make cancer therapy safe, affordable & Painless.

x. Development of method for Genetic analysis of products of conception and fetal tissues using QF-PCR/MLPA/ARRAY CGH.

xi. Development of novel FDC for diabetic neuropathy pain relief consisting of Pregabalin, Mecobalamin and Pregabalin for sustained action.

xii. Development of anti allergic combination for treatment of allergic rhinitis and asthma for pediatrics.

xiii. Development of hypoglycemic combination containing DPPIV inhibitor and thiazolidinedione for effective diabetes control.

xiv. Development of new products such as Oseltamivir D3 acid, Tauro obeticholic acid, 15 epi travoprost, Ezetimibe Benzyl Diol Impurity, Lapatinib D4, Orlistat impurity A, Abemaciclib impurity 27, Ivacaftro D4.

xv. Development of multiplex detection assay for Hepatitis B DNA and Hepatitis C RNA.

xvi. Development of ImatinibMesylate for use in treatment of blood cancer.

xvii. Development of new products such as LBC self sample collection kit, HPV DNA RT PCR kit, TB-RT-PCR Kit, HLA B27 RT-PCR kit, Covid VTM kit, Nucleic Acid Extraction kit.

xviii. Follicle Stimulating Hormone Injection (Human Recombinant) in Prefilled Pen.

xix. Development of Anti-Scorpion Venom Antiserum.

xx. Process improvement of 2,7Dichloro α(Dibutylamino)-Methyl-9H-Fluorene 4 Methanol(DBA).

xxi. Development process for the synthesis of nanocomposites of conjugated polymers for corrosion protection in Marine Environment.

xxii. Development of diagnostic test for Thyroid function Test (T3, T4 abd TSH) on the ACIX100 platform, Development of ELISA test for detecting antibodies against COVID19.

Chemical Sciences:

i. Development of new products such as Bio fiber enzyme cocktail fiber enzyme, Bioethanol enzyme cocktail, palm oil enzyme cocktail for enhancing oil recovery from palm fruit, Bioplastic from Microorganism, clarification of fruit juice (Sparkle enzyme), Pyrazinamide.

ii. Development of new products such as brake fluids, gear oils, flushing oils, shock absorber fluids, engine oils, clay grease, crankcase oils, preservation oils, metal stamping & drawings oils, insulating oils, aluminum drawing oils, copper wire drawing oils, technology of fluidized bed heat treating, development of an austempering plant with 100 % salt recovery and quench rate control, process development for 100 % reclamation of spent foundry shell moulding, development of a new type of fluidized bed with gas flow rates that exceed circulating fluidized beds, plant design for bulk quenching in continuous austempering plant.

iii. Development of process for Metformin HCl SR granules, Metformin HCl SR granules.

iv. Development of Flourinefree foam, film forming flouroprotein alcohol resistant N,N'-Dicyclohexylcarbodiimide (DCC), Tertiary butyl hydroquinone (TBHQ), Para benzoquinone (PBQ).

v. Development of process synthesizing Lithium Carbonate and Triflic Acid, Lithium Hydroxide and Triflyl Fluoride gas

vi. Development of Silicone based Coating formulations for replacing Polyethylene coating used on stiffener for soap packaging application as the silicone functionality helps is better water repellency and allows complete recyclability, water saving technology for laundry application.

vii. Development of weak acid cation resin for potable water, strong base anion resin for removal of impurities, sulfate form resin for fertilizer industry, strong base anion resin for organic removal, improved catalyst for

alkylation and esterification.

viii. Process improvement for development of 2,7Dichloro α(Dibutylamino)-Methyl-9H-Fluorene 4 Methanol(DBA).

ix. Process improvement for development of 2-(2,7 Dichloro 9h Fluorene-4yl) Oxirane (Epoxide).

x. Process improvement for development of 2,7Dichloro 9H fluorine.

xi. In situ process development from L-Valine to Benzyl ester of Valsartan, N-1 Intermediate, which is subjected to debenzylated under Hydrogenation conditions.

xii. Development of process for finer grade Magnesium Powders in different mesh sizes by introducing a special type of grinding system and also with PLC controlled semi-automation process, which on formulation with oxidizers and donors act as a capable energy source in pyro fireworks industries for developing a spectrum of colors, glittering effect & sparkling effect in sparklers, stars, twinklers, regular color-effect aerial shots etc.

xiii. Thermally Conductive Adhesive & Greases for EV Segment.

xiv. Urethane Acrylate Development.

xv. Process for conversion of Rice Husk into Silica (SiO2) by chemical treatment followed by heat treatment under controlled temperature and atmosphere.

xvi. Removal of Crude-oil from Marine environment using magnetic-nanocomposite materials:.

xvii. Treatment of fly ash for converting it into effective inorganic filler.

xviii. Novel route development of Roxadustat.

xix. Herbal Antihypertensive Formulation - for the management & Treatment of Hypertension.

xx. Modification of Isoniazid Plant process, from 4-Cyanopyridine to Isonicotinic acid amide (INAA), so that formation of by-product, Isonicotinic acid is suppressed, resulting in improvement in INAA yield.

Engineering / Information Technology:

i. Development of new products such as online SPC 7" graphic Display Unit, hand held contact type mandrels, smart probe interface box, SPV pneumatic converter, semi-automatic pneumatic measuring system for connecting rod to measure all parameters, PC based automatic measuring and marketing machine for connecting rod, fully automatic multi gauging system for crankshaft.

ii. Development of telematics, traction motor, traction motor controller, 10A DCDC, 20A DCDC, K17 Instrument Cluster, K17 Instrument Cluster with Connectivity, regulator rectifier, magneto, starter motor, head lamps (LED), tail lamp, TFT Cluster, switches.

iii. Development of VMC machine centre, achieving 10 um accuracy and good surface finish and bore centre distance, conventional lathe machine, drilling machine, milling machines for machining fixture parts.

iv. Development of new products for the special grade Alumina and alumina hydrate from aluminium dross residues, aluminiumsulphate and poly-aluminium chloride from aluminium dross residues, tin metal and alloys from tin bearing sludge and residues and low grade ores, tin oxide, tin chlorides, stannate from tin sludge and tin ore, nickel sulphate and nickel hydroxide from waste nickel bearing sludge, water treatment system for COVID wastewater treatment, an electrochemical

Hypochlorite generator for disinfectant and water treatment, pure chrome alum from waste/low grade ferrochrome.

v. Development of bins, Disposable Injector Pen, All Star C Rapid Injector Pen for drug delivery, 3 dose Injector pen, Teriparatide Pen (Injector Pen), Semaglutide Pen injector.

vi. Development of new products for the telematics unit, traction motor and controller, DC-DC converter, Axial flux Magento, Shunt Regulator rectifier.

vii. Development of new products for the multiple variants of high-resolution cameras (5MP with fixed lens, manual varifocal lens and motorized varifocal lens) with built-in analytics features, AI based license number plate detection solution for access control applications, AI based integrated face recognition device with built-in fake face detection algorithms, integration of thermal sensor devices with access control solutions to prevent entry of employees with high fever etc.

viii. Development of failure indication cum brake application,inter vehicular coupler, key multiplier, earthingswitch, connectors, DI/DU relays, MCR relays, pantograph for EMUs/MEMUs, pantograph for passenger, locomotive, electrical panels for rolling stocks.

ix. Development of centrifugal pumps along with its accessories.

x. Development of new products for the KBVCT 400/cooling tower gearbox, agitator/mixer gearbox, scoop coupling.

xi. Development of Armored vehicles for main battle tank such as T-90 and T-72 and Infantry fighting vehicles such as BMP I and BMP II.

xii. Development of SPX Universal Diamond blade (300mm) for cordless tool DSH600-22 battery cut-off saw.

xiii. Development of Free sintering process for laser welded diamond cutting inserts.

xiv. Development of Hemo Dialysis Machine.

xv. Development of new products such as 105m 24 knots Offshore Patrol Vessel, 105m Advance Offshore Patrol Vessel for Export, 115m Survey vessel platform, 50m Coastal Patrol Vessel.

xvi. Development of tubular heater of Diameter 8, 9.5 and 10 mm for industrial use.

xvii. Development of Semi-Automatic sand filling machine for Cartridge heater.

xviii. Development and Productionisation of combat vehicles like IPMV, Paramilitary, WhAP etc.

xix. Development of new products such as 12mm Gen 2 Condenser Internal, Heat Exchanger – IHX, High corrosion durabillty-Customer, TAF 38/50, Radiator 22mm, 16mm Gen 2 Condenser, Cold plate for Electic Vehicles, Battery cooling system for electric vehicles.

xx. Development of LVPS and HVPS for HUD of Su 30 Aircrafts

xxi. Development and Productionisation of QRFV and CMVR certification of the same.

xxii. Development of Multi-Axle vehicles like 4X4,6X6 8x8, 10x10 &12x12 for various DRDO defence programs, Indian Defence sector, paramilitary forces and IB market.

xxiii. Development of Special Purpose Troop Carriers, Water Tanker, Ambulance, UAV Carriers for defence& paramilitary forces. These are designed, developed & CMVR Certified

xxiv. Development of induction heating controller design for pre and post weld heat treatment (PWHT) of welding joints.

xxv. Indigenization of 02 type of Liquid Crystal Display Assembly Module (LAM1 & LAM2) of Multi-Function Display (MFD) for SU-30 MKI aircraft

xxvi. Development of multi-loop parallelly-connected power converters for high-current sub-merged arc welding applications.

xxvii. Development of DC current controller for feeding hot wire to weld pool in TIG application.

1.2.7 Imports Made by In-house R&D Units

The recognized in-house R&D units have imported a variety of equipment, raw material and reference standards for their R&D activities. These include: Biological Safety Cabinet, CO_2 Incubators, Conductivity IC 1.0 Kit, PH KIT, PT – 100 Temperature Kit, White Box Labs tentacle shelter, Spectral Radio Meter, Mooney Viscometer, PCR Unit, Centrifuge, Cartridge Sterile Filter, UTM Machine, Profile Measuring Instrument, PLC Controller, Micro Balance, Deep Freezer, Electronic Balance, Multi-Mode Reader, Liquid handling Pod, HPLC System etc.

1.3 SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATIONS

1.3.1 Recognition of Scientific and Industrial Research Organizations (SIROs)

The DSIR had launched a scheme of granting recognition to SIROs in 1988. The SIROs recognized by DSIR are eligible for customs duty exemption under notification no. 51/96-customs dated 23.07.1996; notification no. 24/2007-customs dated 01.03.2007; notification no.43/2017-customs dated 30.06.2017; notification no.42/2022-customs dated 13.07.2022; as applicable and all notification, as amended from time to time. The exemption under the concessional GST notifications has been rescinded through the notification no. 11/2022-integrated tax (rate) dated 13.07.2022 with effect from 18.07.2022.

The DSIR has brought out Guidelines for Recognition of SIROs, which gives procedural details and application proforma for seeking recognition under the SIRO Scheme. Functional SIROs having broad based governing council, research advisory committee, research personnel, infrastructural facilities for research, well defined, time bound research programmes and clearly stated objectives of undertaking scientific research, are considered eligible for recognition by DSIR. The investments of surplus funds not needed for immediate research should be in accordance with the Income-tax Act, 1961.

Applications for seeking recognition under the SIRO scheme are considered in DSIR by a common Inter-departmental Screening Committee constituted for both In-house R&D Units (RDI) of Industries and Scientific and Industrial Research Organizations (SIROs) schemes with members from Council of Scientific and Industrial Research (CSIR), Indian Council of Medical Research (ICMR), Indian Council of Agricultural Research (ICAR), Indian Council of Social Sciences Research (ICSSR) and Department of Biotechnology (DBT), National Research and Development Corporation (NRDC), Ministry of Environment, Forest & Climate Change, Department of Chemicals and Petrochemicals (DCPC), Ministry of AYUSH, Department of Pharmaceuticals (DOP), Ministry of Electronics & Information Technology (MeiTY), Ministry of New and Renewable Energy (MNRE), Ministry of Micro, Small and Medium Enterprises (MSME) and Technology Development Board (TDB). The recommendations of the Screening Committee are put up for approval of Secretary, DSIR. The recognition is effective from the date of the Screening Committee meeting.

During the period December 2021 to November 2022, the Screening Committee met 9 times and recommended 87 cases for recognition as SIROs. These include 37 cases in the Natural and Applied Sciences, 1 cases in the area of Agricultural Sciences and 4 cases in the area of Social Sciences and 45 cases in the area of Medical Sciences. The sector-wise list of these SIROs is furnished at Annexure - 6.Out of the 87 recognized SIROs,

46 SIROs were issued registration certificates for obtaining customs duty exemptions and GST waiver (GST concession has been rescinded with effect from 18.07.2022).

1.3.2. Renewal of Recognition of SIROs

Recognition granted to SIROs is for duration ranging from 1 to 3 years. The SIROs are advised to apply for renewal of recognition well in advance (3 months prior to the date of expiry of recognition). Such applications received for renewal of recognition are examined by Research Review Group (RRG) by involving representatives from DST, ICAR, ICMR, CSIR, ICSSR, NRDC and UGC depending on the area of research. Based on the evaluation made by the RRG, renewal of recognition is granted to SIROs. During the period December 2021 to December 2022, RRG met 6 times and recommended 269 SIROs for renewal of recognition beyond 31.03.2021 and 31.03.2022. Out of the 269 recognized SIROs, 167 SIROs were issued registration certificates for obtaining customs duty exemptions and concessional GST (GST concession has been rescinded with effect from 18.07.2022).

As present, there are 827 SIROs duly recognized by DSIR; of these, 400 are in the area of natural and applied sciences, 322 are in the area of medical sciences, 42 are in the area of agricultural sciences and 63 are in the area of social sciences.

The SIROs have employed qualified scientists and researchers and have also established good infrastructural facilities for research. They have developed new processes, procedures, techniques and technologies and also filed several patents. They have also organized seminars/ symposiums/ workshops and published research papers / reports / books.

1.4 FISCAL INCENTIVES FOR SCIENTIFIC RESEARCH

Government has evolved, from time to time, fiscal incentives and support measures to encourage R&D in industry and increased utilization of locally available R&D options for industrial development. New incentives to encourage investments in R&D by industry are announced in the Union Budget. Fiscal incentives and support measures presently available include:

I. Income-tax relief on R&D expenditure (capital & revenue);

II. Weighted tax deduction U/s 35(2AA) of IT Act 1961 for sponsored research programs in approved national laboratories, universities and IITs;

III. Weighted tax deduction u/s 35(2AB) of IT Act, 1961 on In-house R&D expenditure for any company engaged in the business of biotechnology or in any business of manufacture or production of any article or thing not being an article or thing specified in the list of the eleventh schedule of IT Act, having R&D facility approved by Secretary, DSIR.

IV. Customs Duty exemption on capital equipment, spares, accessories and consumables imported for R&D by approved institutions/SIROs;

V. Customs Duty exemption on specified goods (comprising of analytical and specialty equipment) for use in pharmaceutical and biotechnology sector;

VI. Accelerated depreciation allowance on plant and machinery set-up based on indigenous technology;

VII. Customs Duty exemption on imports for R&D projects supported by Government.

Information on some of these fiscal incentives implemented by DSIR is given in the following paragraph.

1.4.1 Depreciation Allowance on Plant and Machinery Setup Based on Indigenous Technology

Secretary, DSIR, Ministry of Science and Technology, is the Prescribed Authority to certify

expenditures where higher rate of depreciation is to be allowed for the plant and machinery installed for the manufacturing of products using indigenous know-how as per provisions of rule 5(2) of IT Rules. Guidelines have been issued for making application for obtaining the aforesaid certificate. All such applications received are examined in the department, and discussions and visits by experts to verify the claim are made to the plants by expert teams. Based on a detailed examination, certificates in deserving cases are issued for eligible expenditure.

1.4.2 Reference on expenditure on scientific research under Section 35 (3) of Income Tax Act, 1961.

Section 35(3) of Income-tax Act, 1961 provides that if a question arises as to whether and, if so, to what extent any activity constitutes or constituted or any asset is or was being used for scientific research, the Central Board of Direct Taxes would refer the question to the Prescribed Authority. Chief Commissioner Income-tax in concurrence with Secretary, DSIR is the Prescribed Authority for deciding such cases.

1.4.3 Approval of In-house R&D Centers under Section 35(2AB) of I.T. Act 1961

In order to encourage R&D initiatives of industry, the finance bill 1997 introduced a sub section (2AB) in section 35 of the IT Act, 1961. The provision introduced initially was for select sectors of industry i.e. drugs, pharmaceuticals, electronic equipment, computers, telecommunication equipment, chemicals and provided weighted deduction of 125 per cent on expenditure on in-house research and development facility as approved by the prescribed authority i.e. Secretary, DSIR. Subsequently, a number of other sectors were added to the list of eligible sectors. From the year 2009 the benefits have been extended to all sectors of industry with a select list of non-priority items. Rate of weighted tax deduction was raised from 125 per cent to 150 per cent subsequent to the year ending March, 2000. The rate of weighted tax deduction was further enhanced to 200% from 1st April 2010. Initially the provision was introduced up to 31st March, 2000. The provision was extended from time to time initially till 31st March, 2005 and then up to 31st March, 2007, further up to 31st March 2012. In the Union Budget 2012, the provision was extended up to 31st March 2017. In the Union Budget 2016, the provision has been further extended up to 31st March 2020. The rate of weighted tax deduction was lowered from 200% to 150% from 1st April 2017 to 31.03.2020. Further the rate of weighted tax deduction has been lowered from 150 % to 100% from 1st April 2020.

During the period from January 2022 to December 2022, the Department accorded fresh approvals in Form 3CM to 9 companies and extension of approvals in Form 3CM to 136 companies under Section 35(2AB) of Income Tax Act, 1961. Further, the Department reported R&D expenditure of **Rs. 14396.91** Crores for 269 approved companies in Form to Chief Commissioner of Income Tax (Exemption) in Form 3CL, as required under the IT Act.

1.4.4 Customs Duty Exemption to Recognized & Registered SIROs

All SIROs recognized and registered by DSIR (other than hospitals) are eligible for customs duty exemption on import of equipment/instruments and their spares and consumables; under notification No. 51/96-Customs dated 23.07.1996, No. 24/2007- Customs dated 01.03.2007 & No. 43/2017-Customs dated 30.06.2017, notification no. 42/2022-customs dated 13.07.2022 as amended from time to time. The department was issuing essentiality certificates to SIROs for obtaining customs duty exemption. As per notification No. 24/2007-Customs dated 01.03.2007, the Director or Head of the Institute/ organization is empowered to sign the essentiality certificate.

1.4.5 Concessional GST to Recognized & Registered SIROs

The SIROs recognized & registered by DSIR (other

than hospitals) were eligible for concessional GST on purchase of equipment/instruments including computers, apparatus, accessories and their spares and consumables; computer software, CD-ROM, recorded tapes, microfilms, microfiches, under notification nos. 45/2017-central tax (rate) & 47/2017-integrated tax (rate) dated 14.11.2017; Notification No. 9/2018-central tax (rate), Notification No. 09/2018-union territory tax (rate) & Notification No. 10/2018-integrated tax (rate) dated 25.01.2018; and state tax (rate) as applicable and all notification, as amended from time to time. As per the notification no. 45/2017-central tax (rate) dated 14.11.2017, the Director or Head of the Institute/organization is empowered to sign the essentiality certificate. The GST concession has been rescinded with effect from 18.07.2022 through the notification no. 11/2022-integrated tax (rate) dated 13.07.2022 with effect from 18.07.2022.

1.4.6 Online Application submission of Fresh SIRO recognition and Renewal of recognition of existing SIROs.

The application for Fresh SIRO recognition and Renewal of recognition of existing SIROs has now be made for online submission through DSIR website. The applicant is taken to the ServicePlus Portal developed by National Informatics Center (NIC), Government of India, which is a unified service delivery platform to provide services to the client citizen by the Central and State Governments. ServicePlus is a meta-data based e-Service delivery framework which is built on LowCode–NoCode (LCNC) architecture for delivering electronic-services to citizens. After submission, the applicant can track their application status online at all times. This provides complete transparency to the client citizen, for the action being taken on their application till the delivery of service.

1.4.7 Customs Duty Exemption and concessional GST benefits to Recognized & registered in-house R&D units

Department of Scientific & Industrial Research (DSIR) is issuing "Certificate of Registration" to i) Research Institutions, other than a Hospital viz. In-house R&D Units of Industry and Scientific and Industrial Research Organizations (SIROs); ii) Public Funded Research Institution (PFRI) or a University of an Indian Institute of Technology or Indian Institute of Science, Bangalore or a Regional Engineering College, other than a Hospital; and iii) Regional Cancer Centres (Cancers Institute) in terms of General exemptions No. 136. The Certificate of Registrationis issued by DSIR to the Research Institution, other than a Hospital, for the purpose of availing Customs duty exemption in terms of Government Notifications No. 51/96 - Customs dated 23.07.1996; No. 24/2007 Customs dated 1.03.2007; No. 43/2017 - Customs dated 30.06.2017; No. 45/2017-Central Tax (Rate) & 47/2017-Integrated Tax (Rate) dated 14.11,2017; No. 9/2018 - Central Tax (Rate), No. 09/2018 Union Territory Tax (Rate) & No.l0/2018-Integrated Tax (Rate) dated 25.01.2018; and State Tax (Rate) as applicable and all notification as amended from time to time".

In view of recent notification(s) of Ministry of Finance, Government of India, specially rescinding Notification No. 47/2017-Integrated Tax (Rate) dated 14.11.2017 and 45/2017-Central Tax (Rate) dated 14.11.2017, now DSIR is registering "Research Institution, other than a Hospital, for the purpose of availing Customs duty exemption in terms of Government Notifications No. 51/96 - Customs dated 23.07.1996; No. 24/2007 Customs dated 1.03.2007; No. 43/2017 - Customs dated 30.06.2017; No. 42/2022 - Customs dated 13.07.2022 as applicable and all notification as amended from time to time"

1.4.8 Other Benefits Availed by the Recognized R&D Units

The Department provides assistance to recognized in-house R&D units in a number of ways, such as cases of industrial R&D units requiring allotment of special controlled materials for R&D, permission to export of specialized products reserved for small scale industries by medium scale industries for

test marketing in other countries and disposal of imported R&D equipment/instruments and pilot plant produce are examined for making suitable recommendations to concerned agencies.

1.4.9 Registration of Public Funded Research Institutions, Universities etc.

Public funded research institutions, universities, IITs, IISc., Bangalore; Regional Engineering Colleges (other than a hospital) are eligible for availing concessional customs duty exemption on import of equipment, spares, accessories and consumables for research purposes through registration with the DSIR. The heads of the public funded research institutions / organizations duly registered with DSIR can certify the R&D goods for customs duty exemption vide Notification No. 43/2017-Customs dt. 30.06.2017, corrigendum dated 22.07.2017-Custom Notification no. 43/2017 dt 30.06.2017. Ministry of Finance amended the main notification No.51/96-Customs dt.23.07.1996 from time to time.

Coinciding with the presentation of Union Budget for the year 2004, Ministry of Finance amended the notification No. 51/96-customs vide notification No. 28/2003-Customs dt.1.3.2003. As per the amendment, departments & laboratories of central government and state governments (other than a hospital) are not required to register with DSIR for availing the concessional customs duty exemption. They can clear the consignments by producing a certificate from the Head of the institution certifying that the said goods are required for research purposes only. Another significant change in the notification was that Regional Cancer Centers have been included in the list of institutions eligible for DSIR registration for importing goods for research purposes at a concessional rate of customs duty.

The Union Government of India enacted 'The Constitution (101st Amendment) Act, 2016 w.e.f. 16th September 2016, as introduction of Goods and Services Tax to concurrently empower the Centre and States to levy and collect Goods and Services Tax (GST). Central Government vide Notification No. 03/2017-Central Tax, dt. 19-06-2017 has notified Central Goods and Services Tax Rules, 2017 w.e.f. 22nd June 2017. The introduction of Central Goods and Services Tax Act, 2017 (No. 12 of 2017) on 1st July, 2017 was a very significant step in the field of Indirect Tax Reforms in India. After introduction of CGST Act, 2017 (No.12 of 2017) from 1st July, 2017, import of goods was treated as inter-state supplies and was subject to integrated tax (IGST) in addition to the applicable customs duties. Updates can be viewed at http://www.cbec.gov.in/htdocs-cbec/gst/index.

Central Government vide Notification 47/2017-Integrated Tax (Rate) dt. 14.11.2017 and Notification No. 45/2017- Central Tax (Rate) dt. 14.11.2017, Notification No. 45/2017- Union Territory Tax (Rate) dt. 14.11.2017, as amended from time to time granted concessional GST benefits to Public funded research institutions, universities, IITs, IISc., Bangalore; Regional Engineering Colleges (other than a hospital). During the year 2022-23, Central Govt. vide Notification No. 42/2022-Customs dated 13.07.2022 had issued amendments in main Notification No. 51/96 -Customs dated 23rd July 1996, so as to withdraw the exemption of the Integrated Goods and Service Tax (IGST) . Central Govt. vide Notification No.11/2022-Central Tax (Rate) dated 13.07.2022 rescinds the Notification No. 45/2017- Central Tax (Rate) dt. 14.11.2017; vide Notification No.11/2022- Union Territory Tax (Rate) dated 13.07.2022 rescinds the Notification No. 45/2017- Union Territory(Rate) dt. 14.11.2017 and vide Notification No.11/2022-Integrtaed Tax (Rate) dated 13.07.2022 rescinds the Notification No. 47/2017- Integrated Tax (Rate) dt.14.11.2017.)

Application for registration / renewal of registration of Public Funded Research Institutions (PFRIs) and details about the schemes are available on Department website (www.dsir.gov.in). The complete applications are considered by an Inter-Departmental Screening Committee constituted by the Department for considering the requests from various institutions. Presently the committee is chaired by a former Director, CSIR –NPL.

The Screening Committee met once during the period under report and considered 25 applications received from various public funded research institutions. 06 fresh registration certificates were issued to such public funded research institutions for availing Customs Duty exemption on import of scientific equipment, spares, accessories and consumable items meant for scientific research and purpose. There are about 619 PFRIs registered with DSIR. The registration to public funded research and other institutions is granted for a maximum period of five years. The registered institutions are advised to apply for renewal of registration well in advance before the date of expiry of their registration.

During the period under report, 104 institutions were due for renewal of registration. The department received 60 renewal applications. These were processed on individual files and approval of Competent Authority was obtained and 52 renewal certificates were issued. Also 97 cases for renewal of registration were processed and completed based on the receipt of applications in the Department that were due for the period ending 31.08.2021.

CHAPTER 2: PROMOTING INNOVATIONS IN INDIVIDUALS START-UPs AND MSMEs (PRISM)

PROMOTING INNOVATIONS IN INDIVIDUALS START-UPS AND MSMEs (PRISM)

1.0 PREAMBLE

Department of Scientific and Industrial Research (DSIR) launched a programme on Promoting Innovations in Individuals, Start-UPs and MSMEs (PRISM) during the 12th Five Year Plan. The Scheme is now extended till 30.03.2026. The programme aims to support individual innovators having original ideas to convert them into working models, prototype etc. It also aims at supporting autonomous institutions or organizations or registered society for developing state-of-art new technology solutions aimed at helping MSME units in industrial clusters. PRISM Scheme is a component scheme of Industrial Research and Development (IRD) Scheme of DSIR. The Department has supported 31 (Thirty one) new projects during the period under report i.e. from 01.12.2021 to 31.12.2022. The department rendered financial support to 12 (twelve) ongoing projects. The details of the new projects and ongoing projects supported under PRISM are given in Annexure-7. The Department has also successfully completed 17 (seventeen) PRISM projects during the period under report and the details are given in Annexure-8.

2.0 HIGHLIGHTS OF THE COMPLETED PROJECTS

2.1 A Radio Frequency Device for Detection, Imaging and Mapping of Underground Utilities

The PRISM project "A Radio Frequency Device for Detection, Imaging and Mapping of Underground Utilities" is executed by the innovator Shri Pragyan Prasu Patnaik, through the TOCIC, University of Madras Chennai. The innovator has designed and developed a non-destructive solution which detects, locates, maps and inspects the buried utilities. The collected data is processed and stored in cloud which is accessible to the customers. With this critical information available at the design stage, construction downtime and cost of the project is reduced. The developed prototype is called RUDI (Radar for Utility Detection and Inspection). It works on the Radar principle, where electromagnetic (EM) waves are generated and transmitted through pair of antennas. The echo from the targets is collected, processed and analyzed to extract features like depth, leakages etc. With GPS tagging of data, the utility can be mapped into any mapping software. A data collection and data post processing software were also developed along with the hardware. Currently RUDI depth range is close to 2 meters under the ground. RUDI was customized for defense application to detect buried tunnels along the Indo-Pak border which are being used for infiltration. Testing was done with RUDI to detect tunnels in Samba district of Jammu region. The project has been successfully completed.

Fig 1: Radio Frequency Device for Detection, Imaging and Mapping of Underground Utilities

2.2 Inflated Solar Dryer and Destalking Machine for Dry Chilli

The PRISM project "Inflated Solar Dryer and Destalking Machine for Dry Chilli" is executed by the innovator, Dr. Srinivas. G, through the TOCIC, College of Technology and Engineering, MPUAT, Udaipur, Rajasthan. The innovator designed and developed Inflated Solar Dryer for fresh ripe red

Chilli and destalking machine for dry red Chilli. Inflated Solar Dryer (ISD) for chilli with 0.5 tonne capacity in the drying area of 20 m^2 is sufficient to handle the yield of small farmer with a land holding upto 2 acres, yielding about 7-8 quintal/ acre/harvest. This new technique saves the drying time up to 60% with perfect accuracy. Inflated Solar Dryers minimizes the losses and maximizes quality due to proper drying, thereby improves the farmer income by 20-25%. After drying of chilli, destalking of dried chilli is a costly labour oriented task where farmer has to pay significant amount to the labour. Moreover, labour experiences allergies and rashes while working with chilli with bare hands. Machine for destalking of dry chilli with a capacity of 80-100 kg/h was designed and developed, under the project. It is designed in such a way that the output obtained from Inflated solar dryer (ISD) can be destalked in 3 to 4 days keeping the drying and destalking operations under continuous process. The mechanization of destalking process helps to improve the income of chilli growing farmers by 10-15%. The project has been successfully completed.

(a) Destalking Machine for Dry Chilli

Fig: 2 (b) Inflated Solar Dryer

2.3 *Design, Development, Fabrication, Testing and Validation of a 1000-Watt Calibration Grade Solid State Power Source with multiple unit synchronizing / IoT capabilities*

The proposal was scouted and mentored by TOCIC, GSBTM, Gandhinagar and DSIR. The innovation aimed at designing a solid-state electronic device which replaces existing electrical-mechanical power sources used for calibration with an efficient, economical, solid-state, single-phase source which will benefit Indian manufacturers of transformers, relays, energy meters and other electrical equipment in terms of improved speed of process, ease of use and accuracy at an affordable price. The work involved development of enclosure/mechanical design, PCB design and fabrication, component assembly and integration, GUI Memory management & power stage functionality, internal stage testing, and external testing. The prototype was demonstrated with different settings with respect to voltage, current, frequency, phase and their output, generation of stable signals, load and line regulation, stability and achievement of distortion targets. The device implemented IoT features such as communication with PC and inter device communication. The testing of device by an external agency as well as In-house testing and power stage fine tuning to achieve the product specifications was conducted.

Fig: 3 Prototype of 1000 Watt Calibration Grade Solid State Power Source

The prototype generated signal meeting targeted value and accuracy and the settable phase angle (shift) as targeted. The device was tested by a NABL accredited external agency and detailed report of the same meeting target specifications was shown by the Innovator. The project activities have been successfully completed with the primary objective of design and implementation of a calibration grade power stage achieved.

2.4 *Multipurpose Innovative Sprayer for Farmers*

Spraying liquid fertilizer, insecticide, etc., in local farms in the State of Assam is a difficult task as

the machinery used is heavy and requires a lot of manual effort. Agriculture in Assam suffers due to scarcity of good quality fertilizers along with proper equipment for adding it to fields. The sprayers found in the market are very common with the capacity of up to 30-35 liters. The farmer has to carry the tank on his/her back for a long time. The sprayer has to be pumped by one hand while simultaneously rotating the nozzle with the other hand. This sprayer requires immense physical effort and many times do not suit women farmers who find it difficult to carry the sprayer for long duration. Due to the mentioned disadvantages, an innovative sprayer was developed which required minimum human effort. The developed innovative sprayer machine is useful for spraying liquid fertilizer, insecticide, water into agricultural field, orchard, garden or for any other agro related activities in field. The users need not to carry the tank on their back as the tank is placed in the machine frame itself and it does not require hand pumping for spraying.

Fig:4

2.5 Microfluidic Enzymatic Biofuel Cell for Energy Harvesting and Blood Parameters Monitoring"

The primary technological hurdle in implantable devices for healthcare is the limitations pertaining to power sources. Be it insulin pumps, transcutaneous electrical nerve stimulators or wearable glucose monitors – the limitation of a restricted battery life and the successive need for replacement, hampers their carefree use. The work carried out as a part of this project aims to address a part of this problem by identifying electrodes for implantable fuel cells which theoretically could cater to the perpetual energy needs of these implantable and wearable devices. The energy solution identified is on the principle of Enzymatic Biofuel Cell (EBFC), a bio electrochemical micro device that efficiently converts the chemical energy stored in the organic compounds into electrical energy using electrochemical redox reaction. EBFC consists of bioanode and biocathode where the fuel (glucose) is oxidized via glucose oxidase (GOx) enzyme and oxidant (oxygen) is reduced via laccase enzyme. The vision with this approach is enabling the disease (diabetes), where excessive glucose is present in the body to act as the fuel for the EBFC to drive insulin pumps – disease drives the solution.

To achieve this vision, a part of solution was developed in this project. The critical parameter of inexpensive bioelectrode development was concentrated as the first objective where different inexpensive materials were evaluated as bioelectrode such as carbon paper, carbon thread, laser ablated graphene, 3D printed electrodes, screen printed electrodes and pencil graphite-based electrodes. The laser induced graphene (LIG) with carbon nanotubes showed extraordinary electrical and structural properties that can be used for efficient electrode development and the integrated microfluidic device generated 4.7 $\mu W/cm^2$ power density, which was not enough for low power devices. Different commercially available 3D printing filaments with different configurations were also tested for its performance as bioelectrode. Later, utilizing flexible substrate of carbon cloth was considered for the bioelectrode development. The woven structure of the carbon cloth helps in increasing the electro active surface area for catalysis which delivered a decent power of 24.8 $\mu W/cm^2$. As a next step, the thread from these electrodes were taken and tested for its capacity as bio electrode. A Direct Electron Transfer (DET) based glucose biofuel cell integrated with gold electrodeposited carbon-paste electrodes printed using a desktop PCB inkjet printer harvested power of 3.1 $\mu W/cm^2$ and 8.8 $\mu W/cm^2$ in tears and physiological

serum respectively. The development of these bio electrodes by this simple method was key to the realization of various micro-devices in a flexible manner and paves way for mass production at a very low-cost.

As an addition to the project work, the work was further extended by introducing the carbon thread-based electrodes inside a living rat and observed for its power performance changes over period of 15 days. The implanted device was capable of delivering a high power of 200 $\mu W/cm^2$. The rat was left in free movement throughout the experimentations and data was collected using a portable potentiostat for 15 days. This validation established the capability of the developed bio electrodes to be used in implantable fuels cells as energy devices

(a)

(b)

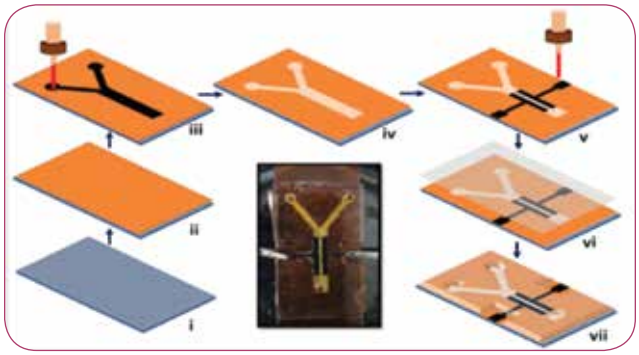


Fig: 5 (c)

2.6 *Manually Operated Machine for Cutting of Wheat and Paddy Crops*

The manual harvester developed by innovator facilitates the harvesting process of wheat and paddy crops in an efficient way as opposed to the manual work of marginal farmers. The harvester helps marginal farmers who harvest paddy and wheat crops using sickle. There are harvester machines which cost more than ₹1lakh making it difficult for the marginal farmers to use for harvesting and such machines still throw husk. Hence, there was a requirement of low-cost harvester that does not produces husk. The manual harvester machine developed with the support of PRISM scheme can perform the harvesting process in single cut. It can catch the plant from stem in an area of 36 inches wide and 20 inches long at once. It can cut the plant from just above the ground, collect the cut crop in left and right side on ground and then collect the harvest and bind in a bale. These functions of the harvester eliminate the need of manual crop cutting by farmers. The machine involves mechanical system of gears and levers for cutting stems of crop at near ground level and putting them down in a neat line. The harvester has different heads for cutting crops. It is useful for efficient and mass cutting of wheat and paddy crops during harvesting season and for tall and hard plants. The small size of machine makes it convenient for use in small fields and makes storage convenient. The machine can be fabricated and serviced in simple mechanical workshop. The harvester has a utility for marginal farmers where one unit of the manual harvester machine will cost up to Rs. fifteen thousand making it a viable option for small marginal farmers where on the other hand machines available in the market cost around ₹1.0 lakh.

Fig 6 (a) & (b)

2.7 Development of Bael Fruit Pulp Extractor

Bael is the underutilized fruit and is a rich source of carbohydrates, fibres, vitamins, proteins etc. with high content of riboflavin. The small or medium scale food processing industries and farmers may adopt and use Bael Fruit Pulp Extractor for revenue and employment generation. This innovation is useful for farmers of Bael fruit crop which is very hardy plant and requires low amount of water for its cultivation/irrigation. The proposed technology has a wide scope of popularizing the bael fruit processing. This will add new avenues for doubling the farmer income and it will also be a step forward towards AtmaNirbhar Bharat Abhiyan of GoI. Peeling is not possible for this hard shell fruit for extracting pulp. The hand cutting of bael fruit into exact two halves is very difficult and therefore, the cutting unit for bael fruit was designed to operate by foot, as one man can exert nearly 800 N by foot when compared to that of 400 N by hand. The cutting force requirement of bael fruit was 490 N, so foot (pedal) operated cutter was developed. The bael fruit cutter is capable to cut the bael fruits of 150 mm diameters. The extraction of bael pulp by a spoon or knife is also a tedious process in traditional method. Therefore, a scooping unit was also developed to extract the mucilaginous pulp. The pulper section is developed based on abrasive action of beater or bars against the semi cylindrical mesh or sieve provided in cylinder so that the pulp was able to pass through the mesh, conveyed to pulper tray and the gummy fibre, seed was separated through the waste outlet. This cutting, scooping, pulping unit can effectively cut the fruit and separate the hard shell from the pulp so that the ripen pulp can be processed separately for value added products

Fig: 7 Bael Fruit Pulp Extractor Equipment

2.8 Affordable Hardened Plastic Based Bamboo Splinting Machine for Productivity Enhancement

Bamboo can be used for making of splints for Agarbatti (Incense Sticks) and bamboo mat boards. However, the prevalent practice of manual splitting of bamboo is a tedious process which only workers with expertise can perform. The innovator has developed a low cost hardened plastic based slicing and splitting machine, which gives final product output as multiple precise incense sticks, not requiring much operator skill. The technology holds the promise of being exploited at different scales, particularly by small industries (MSME units), Khadi Gram Udyog (KVIC), DICs, NSIC, NGOs, etc.

Fig 8

2.9 Power Assisted Cement Bag Loader

Efficient movement of materials is a very important activity for improving the productivity of operations in Industries, factories, hospitals, office complex or campus, agricultural farms, botanical gardens, poultry farms, airports, railway stations, etc. The Power Assisted Loader is a versatile machine capable of carrying materials upto 800 Kgs in one trip. At present all such

Fig; (9)

material movement is happening by manual process where it is being done in an unscientific and unergonomic way. This is making the process of material movement un-productive and cumbersome for workers/labours involved in transportation of materials.

The features of Power Assisted Loader:

- Has a steering system to easily maneuver the machine
- Has a dumping system to unload the material at the point of use
- Easily operated without any training/ license
- Improve efficiency and productivity in repetitive operations
- Carry upto 800 Kgs in one trip.
- Capability to work in inclined terrain up to 30 degrees gradient
- A safe and healthy way to carry materials repetitively and efficiently

The prototype was fabricated, assembled and then trials of the machine has been completed with the support from PRISM scheme funding. The machine worked well under load conditions. After the initial trials, innovator has added the standing platform of the machine by which now the operator can stand on the machine or it can also be converted to a seater version for the operator comfort.

2.10 Versatile Hydraulic jack for rapid tyre change and maintenance

Car tyre change is necessitated during both long and short haul travels which is unavoidable due to operational factors including road conditions, tyre wear and driving habits. Conventional type of tyre changing in a conventional mode is a labour intensive and time consuming operation. The proposed innovation transforms a fraction of the engine power available in an Internal Combustion (IC) engine into hydraulic pressure for converting the tyre change process rapid and labour free. Conversion of mechanical form of energy into hydraulic pressure is based on Pascal's law with quasi hydrostatic drive. The IC engines that power cars using gasoline as the fuel are based on the principle of Otto cycle consisting of intake, compression, ignition, expansion and exhaust. In this working cycle an IC engine converts the chemical energy of the fuel in to heat energy and subsequently into rotary power of the crank shaft. The innovator has developed a smart hydraulic module that is powered by crankshaft to pressurise a viscous fluid. The pressurised fluid in turn causes the mechanical movement of the piston leading to the lift-off of the tyre from the ground. The working principle of the hydraulic device is schematically and as it can be readily inferred it consists of 3 important sub systems. The intake fluid from reservoir enters the suction manifold and then flows in to the compression cylinder where it gets compressed by the piston. Reciprocating compressor is a positive displacement compressor and it uses the piston driven by the crank shaft to deliver fluid at high pressure. A control valve is used to control fluid flow by varying the size of the flow passage as directed by a signal from a controller. This enables the direct control of flow rate and the consequential control of process quantities such as fluid pressureand flow rate.

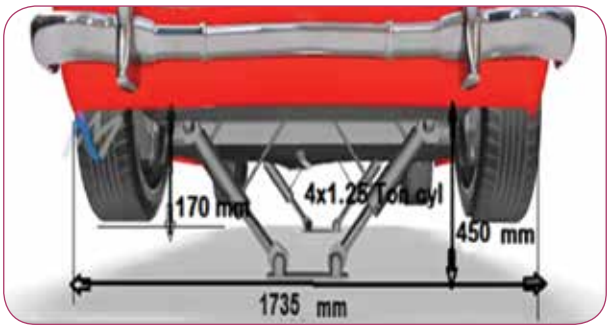


Fig (10)

2.11 Development of UAV Avionics for Drone Delivery - BVLOS Operation

CD Space Robotics is an early-stage startup which builds drones for logistics and is currently incubated at SIIC, IIT Kanpur. The focus of the start-up is to build efficient, reliable and indigenous drone technology.

Innovator has developed unique Vertical Take-off and Landing(VTOL) fixed-wing drones that exhibit superior advantage over existing drone tech making it viable to serve new-age transportation. With cutting edge aerospace design and software intelligence, these drones can solve critical limitations in logistics making it faster, cheaper and autonomous. Below is a photo of drone SPOT45

UAV Avionics suite for BVLOS flights consists of following four critical flight components

Fig 11

1) Autopilot:

- Rugged Inertial sensor with wide temperature range, 3x Redundancy
- All sensors sending data over democratic CAN (control area network) protocol
- EMI resistant
- Multiple failsafe options
- Expected Weight 50gm

2) Telemetry system

- Long range 20+Km
- Power 1W
- Mesh Network to connect multiple system at once
- ISM frequency, High gain antenna
- Expected Weight 20gm

3) Battery Monitoring system

- Voltage range up to 12S(48V)
- Coulomb measurement for accurate capacity
- Failsafe facility (switching to other battery in bad health)
- Expected Weight 20gm

4) ADSB and GSM tracking system

- GSM tracking over app and compatibility over digital sky
- Integration with UTM to track manned and unmanned flights with detect and avoid software capabilities
- Expected Weight 30gm

2.12 Design and Development of Ultrasonic Impact Test Unit for enhancing the Fatigue Performance of HSLA Steels

Normal welding usually leaves defects in the joint part, including excess weld metal, rut, undercut and so on which causes serious stress centralization. Welding also causes residual stress and all these factors harm the fatigue quality. There is dross in the surface of toe zone which accelerates the outburst of fatigue crack. Using UIT equipment to process toe zone after welding, smooth transition can be made to decrease stress centralization by excess weld metal, dispersing defects in the surface of toe zone. At the same time, it may create compression stress thereby compression plastic deformation and adjust residual stress field, enhancing the intensity and hardness of toe zone. Ultrasonic impact treatment equipment gives the high power to the head of the impact gun forcing it to impact the metal surface at a speed of over 30,000 times per second, which makes the surface a great plastic transmogrification. At the same time, the impact changes the stress field, dispersing tension stress while transforming it into beneficial compression stress. Detailed drawings of the entire subsystems have been done after detailed discussions through R & D consultancy based

on functional requirements, identifying all the materials, components, consumables, electrical systems, signal generator and various subsystems involved in product development. After the product drawings were finalized, procurement of materials, electrical and other items was done and fabrication was initiated incorporating all systems and subsystems resulting in complete functional product.

2.13 Development of portable micro-friction stir welding machine as a green technology

FSW tools are used for the current work. The simple cylindrical tool is developed with multiple pin heights. The pin diameter for the tool is ~ 4 mm while the shoulder diameter is ~ 12 mm. The pin height varies between 0.0 mm and 1.0 mm. The advantage of using the simple variant of the FSW tool is the easy design of the welding bed. The bobbin tool requires a specially designed welding bed. This special requirement can make the application of bobbin tool to weld at intricate locations difficult. Moreover, a variant of the FSW. i.e., Friction stir spot welding (FSSW) can be performed using the simple FSW tool, unlike the bobbin tool.

The two different types of bobbin tools are used for experimental purposes. Due to the presence of two shoulders, the bobbin tool can help improve the heat generation in the plates. A threaded pin is used to hold the bottom shoulder. The threaded pin primarily has two benefits, i.e., it holds both the shoulder in location and helps in the material mixing. Moreover, small height adjustments can be easily performed due to the nut and bolt type mechanism between the pin and the tool body. A secondary pin in the bobbin tool. This secondary pin helps to maintain the minimum gap between the two shoulders. Thus, it prevents the sticking of the shoulders that may occur.

The circuit used to program and control the movement of the welding bed is switched mode power supply (SMPS) converts the AC to DC form and feeds it to the DC motor as a power source. The power supply is connected to the DC motor through a stepper driver. The stepper driver is connected to the microcontroller. The microcontroller and the IDE allow for any code to be written with the help of a computer and feed to the circuit. This accurate regulation over the welding bed movement increases the versatility of the developed setup while performing different types and configurations of welding.

Fig. 12

2.14 Energy Efficient Smart Transformer

The innovator has designed, developed and tested the distribution transformer to replace the existing technology based transformer with enhanced efficiency and spike buster of 500 KVA, 11KV/433V. The innovation of the project work was to focus on design of special type core and divide it in two sections on which winding of primary circuit is in series while the winding in secondary coil is in parallel. The effect of innovative winding as claimed by the innovator and vetted by experts are

i. No residual Magnetism in core

ii. No inrush current during switching on/ off - with transient less switching

iii. Energy saving due to zero retentively

iv. No leakage of flux as the secondary coil current are opposing each other

Fig. 13

CHAPTER 3: PATENT ACQUISITION AND COLLABORATIVE RESEARCH AND TECHNOLOGY DEVELOPMENT

PATENT ACQUISITION AND COLLABORATIVE RESEARCH AND TECHNOLOGY DEVELOPMENT (PACE)

1.0 PREAMBLE

The Department of Scientific and Industrial Research (DSIR) through its Patent Acquisition and Collaborative Research and Technology Development (PACE) scheme provides catalytic support to industries and institutions for development and demonstration of innovative product and process technologies, traversing the journey from proof of concept or laboratory stage to pilot stage so that they can be launched for commercialization. The scheme supports ingenious work and assists in development of new technologies or creative/innovative application of the existing technologies to solve unmet needs of industry. The scheme also strengthens the interface between industry, R&D establishments and academic institutions by supporting collaborative proposals. The scheme also jointly supported initiatives of other Ministries / Departments aimed at technology development and demonstration, e.g. IMPRINT initiative of Ministry of Human Resource Development/DST, wherein institutions of higher learning were supported for development and demonstration of technologies. Now duringthe phase 2021-2026, the IMPRINT component is dropped. However, on-going IMPRINT projects will be supported till they are completed. Support is provided for proposals which give clear evidence of existence of proof-of-concept and aim at developing an innovative content for fulfilling an unmet need. Development and demonstration of technologies can be undertaken by industries alone (such as in-house R&D centers of the industry recognized by DSIR) or in collaboration with Universities, Public Funded Research Institutions or academic institutions. The technology development projects supported under the scheme aim at development of a new product or a process with attractive market potential which will result in significant benefits to the industry concerned in terms of raising its technological level, turnover, energy and material savings/recovery, export sales etc.

2.0 OBJECTIVES

The objectives of the scheme are:

i. To support development and demonstration of indigenous product / process technologies, either by industry or by R&D organizations/ academic institutions/ universities aimed at commercialization of new products and processes;

ii. To support collaborative research between Indian Industry and R&D organizations/ academic institutions/ universities for development and demonstration of lab scale technologies, aimed at commercialization of new products and processes;

3.0 ONGOING TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS DURING 2022-23

3.1 Development of Controlled Release [CR] Formulation of Natural Highly-Purified Human Chorionic Gonadotropin [HCG] – M/s Sanzyme Ltd. Hyderabad & ICT Mumbai

A project entitled "Development of Controlled Release (CR) Formulation of Natural Highly - Purified Human Chorionic Gonadotropin (HCG)" has been supported to M/s Sanzyme Ltd., Hyderabad in collaboration with Department of Pharmaceutical Sciences & Technology, Institute of Chemical Technology, Mumbai under PACE-TDD scheme.

Natural highly purified HCG (99%) is used as a surrogate for LH (Luteinizing Hormone)

for triggering ovulation and maintenance of pregnancy.However,theroleofHCGisnotrestricted to infertility in women alone but has wider applications in the field of metabolic disorders such as Diabetes and other clinical conditions where HCG is being used for a process known as angiogenesis in the fields of vascular surgery and CNS surgery. HCG is available in two variants either as highly purified form or the recombinant version of HCG. Despite recombinant being available, only a single dosage form is available for clinical use. The natural, highly purified version, is available in a number of strengths ranging from 500 IU to 10000 IU. Despite the availability of recombinant HCG, only a single dosage form for multiple injections is available for clinical use. Moreover, clinical studies conducted and published in journals of repute, have shown no great advantage of natural vs recombinant, the latter being more expensive as compared to natural form of HCG. In view of the above, M/s Sanzyme Ltd explored to improve patient compliance and reduce the frequency of injections to make the treatment more affordable and available to masses by developing CR-release HCG formulation using Nano technology with release rates of either 15 or 30 days.

Project involved formulation development of microspheres at lab scale batches of around 0.5 g - 1 g size, scale up to 0.5-4g and 4 g to 10 g size. The microspheres formulation was prepared by double emulsion solvent evaporation method. The process was successfully automated using peristaltic pumps to control the flow of primary emulsion injection and stabilizer solution injection to In-line homogenizer to prevent any manual errors. The release profile of HCG was optimized using the different grades of PLGA polymer and Resomer RG 503H grades polymer showed the desired in-vitro release profile for 15 days. Hence, Resomer RG 503 H polymer was selected for the further scale up of HCG PLGA microspheres. Increase in batch size from 0.5 g to 4 g of HCG microspheres did not show a significant change in particle size, entrapment efficiency, and in-vitro release. However, an increase in batch size (4 g) showed an increase in % yield (63 %) of microspheres as compared to 0.5 g batch (yield of 38 %). Further scale up from 4 g to 10 g was optimized using the larger size homogenizer probe (18 G), which showed the similar globule size of primary emulsion and the in-vitro release profile (based on similarity factor, f2 value) as of the 4 g batch prepared with smaller size homogenizer probe (10 G). M/s Sanzyme Ltd and ICT Mumbai also identified the effect of scale up batches on HCG loaded PLGA microspheres characteristics such as encapsulation efficiency, and in-vitro release and no significant difference was noted in particle size and encapsulation efficiency of microspheres produced in 4g-10g batches. Also, the residual solvent content and residual surfactant content were found within the limit as batch size increased. Stability studies did not show significant change in appearance, particle size, entrapment efficiency, and in-vitro release of HCG from microspheres (503 B-31) at long term storage conditions (5°C ± 3°C) after six months. However, higher initial burst release was observed at accelerated storage conditions (25°C ± 2°C / 60% RH ± 5% RH) after six months.

Preclinical study results were recorded as (i) Bioassay study: HCG loaded PLGA microspheres (performed by Sanzyme team) in the animal model showed the bioactive nature of HCG. (ii)Pharmacokinetic study:It was observed that microspheres prepared with Resomer RG 503 H polymer showed higher serum concentration of HCG from 3rd day to 13th day when compared with marketed formulation [HCG concentration was detected till 7 days (conventional injection given 2 times in a week)] in Wistar rats. (iii) Acute toxicity study:HCG-PLGA was tolerable and not causing any mortality at 190000 IU/kg b.wt. by single administration. (iv) Repeated dose toxicity study: In repeated toxicity study, following 28 consequent days dosing of "HCG-PLGA" up to 190000 IU/kg b.wt./day in Wistar rats did not induce any toxicity and abnormal changes in body weights, feed consumption, clinical signs, ophthalmic examination, clinical pathology and histopathology. Hence, it was concluded that the NOAEL of the HCG-PLGA Injection is 95000 IU/kg b.wt./day.

The project was supported by DSIR with a soft loan of Rs. 52.50 Lakhs to M/s. Sanzyme Ltd., Hyderabad and a grant of Rs. 52.24 lakhs to ICT, Mumbai out of a total project cost of Rs. 159.55 Lakhs. As per the company's requirement, DSIR supported Rs. 32.50 lakhs to M/s. Sanzyme Ltd., Hyderabad as loan and Rs. 32.50 lakhs to ICT, Mumbai as grant-in-aid. The Project was completed in the FY 2022-23 with key deliverables:

- Development of a delivery system to enclose the active drug;
- Stable and compatible excipients for the formulation;
- Predictable Pharmacokinetic and Pharmacodynamics profiles, both in-vivo and in-vitro for the 15 day and 30 day formulations;
- Safety profile.

3.2 Development and standardization of manufacturing processes for large scale production of valuable secondary metabolites from callus-derived cells of vascular cambial explants of selected woody plant species - Ms. Sami Sabinsa Group Limited (formerly Sami Labs Limited), Bangalore.

M/s Sami Labs Limited, Bangalore has undertaken to develop and standardize the manufacturing processes for large scale production of valuable secondary metabolites from callus-derived cells of vascular cambial explants of six selected woody plant species and established a 20 litres suspension culture pilot plant facility. The company is currently manufacturing the targeted secondary metabolites by direct extraction methods and the current project has developed a new route of continuous perfusion of in vitro cambial tissue cultivation for commercial production of secondary metabolites from cambial explants of six medicinal plants. The new technique has led to cost reduction, reduction in energy consumption /emissions and would have positive impact on environment by sparing the medicinal plants from destruction.

It was demonstrated that extracted cambium layer was able to grow in varied solid medium and proliferates and produces secondary metabolites upon induction. The team was able to extract secondary metabolites via solvent extraction method and performed standard analytical test to confirm the metabolite. During the period under report, project team was able to produce Arjunolic acid metabolite from *Terminalia arjuna,* Salacinol from *Salacia sp* and *oroxylin -A from Oroxylum indicumfrom* 20L bioreactor. The standardization for remaining explants is underway. **The project has been supported by DSIR with revised loan amount of Rs.90.00 lakh out of a total project cost of Rs. 197.80 lakh. The Project is under progress and is scheduled to finish in the current financial year.**

4.0 TECHNOLOGY DEVELOPMENT PROJECTS UNDER IMPRINT INITIATIVE

Impacting Research Innovation and Technology (IMPRINT), the first-of-its-kind Pan-IIT and IISc joint initiative, is a Ministry of Education (MoE) and DST initiative to address major engineering challenges that the country must address and champion to enable, empower and embolden the nation for inclusive growth and self-reliance. Department of Scientific and Industrial Research has partnered with MoE in implementing this program. In order to pursue the mandates of IMPRINT, ten technology domains as grand engineering challenges have been thought of. DSIR is contributing in two sectors, viz, Manufacturing Technology and Water Resources. Five IMPRINT proposals of IITs/IISc/NITs in the two identified sectors for DSIR (Manufacturing Technologies and Water Resources) have been supported. DSIR grant support is matched by MoE. The details of IMPRINT projects supported under PACE scheme are as follows:

4.1 Development of an Innovative process to fabricate ultra-fine grained bimetallic thin sheets for Micro-Forming applications - IIT Madras

The current project is aimed to establish an innovative manufacturing process to fabricate high strength ultrafine grained Al-Cu bimetallic thin sheets with good formability. The proposed novel hybrid manufacturing route contains cryorolling, controlled annealing of the cryorolled material, cold and warm roll bonding, and asymmetric rolling. The developed sheets are specifically designed for micro-forming and macro-forming applications. The proposed manufacturing process is proven (through this project) to have high productions yield, better product quality, reduction in material loss, lower energy usage, and mass production capability.

Under the project, UFG Al-Cu bimetallic thin sheets have been successfully developed by adopting a novel hybrid manufacturing process comprising of cryorolling, accumulative roll bonding and asymmetric rolling. The UFG Al-Cu bimetallic sheet has superior bond strength compared to the coarse-grained bimetallic sheet as observed by peel test of the material. The UFG Al-Cu bimetals shows a much thicker and richer interface due to effective protrusion of the Nano-metric grains resulting a stronger mechanical bond. Due to its unique Nano-grained structure, the UFG Al-Cu bimetal shows significantly improved formability compared to the conventional coarse-grained Al-Cu bimetals. project has successfully established a manufacturing route to develop ultrafine grained (UFG) Al/Cu sheets. The developed UFG Al/Cu sheets showed excellent static strength, bond strength compared to the coarse-grained bimetallic sheet as observed by peel test of the material. The UFG Al-Cu bimetals shows a much thicker and richer interface due to effective protrusion of the Nano-metric grains resulting a stronger mechanical bond. Due to its unique Nano-grained structure, the UFG Al-Cu bimetal shows significantly improved formability compared to the conventional coarse-grained Al-Cu bimetals.

As an additional activity, a new manufacturing route to manufacture conventional Al/Cu Bimetallic sheets with a key objective to achieve excellent interfacial bonding has also been successfully explored and patent filing for the same is in the process. A modular tool for micro deep drawing of metallic thin sheets with integrated localized heating capability has also been developed under the project and this study is in final stage of Patent filing.

03 research papers have been published under the project, and 2 patents have been filed. Some key results of this work are shown below:

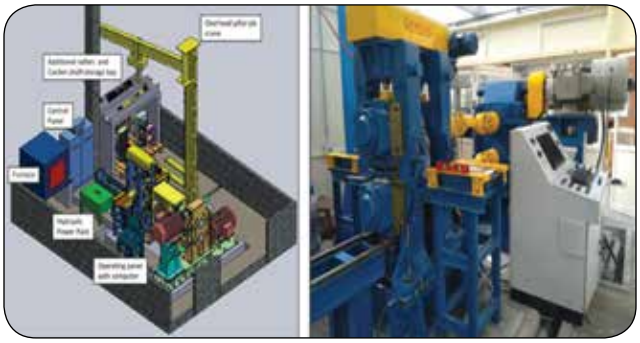


Fig.1. Custom Designed and Developed Roll Bonding Set up (Designed at IIT Madras, Developed at Industry and housed at IIT Madras)

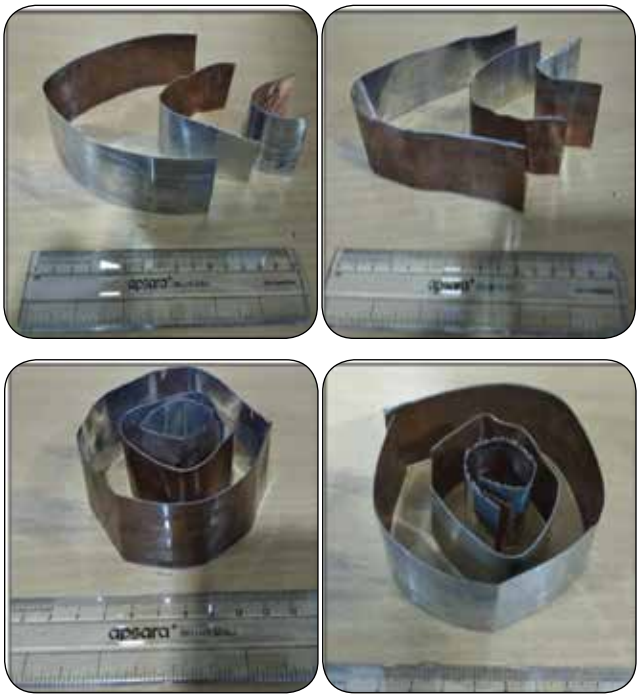


Fig.2. Micro-components developed from the UFG bimetals shows much sharper bent angle and lower undesirable curvature indicating their superior formability compared to the conventional CG bimetallic sheets

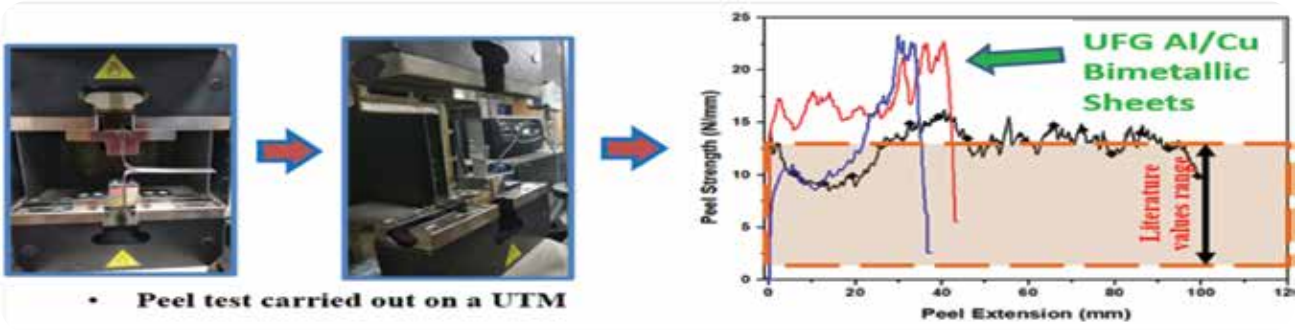


Fig.3. Interfacial bond strength of presently developed UFG Al/Cu bimetal sheets in comparison of Al/Cu bimetal sheets developed by other processes from literature

The project has been supported by DSIR with a grant of Rs. 83.46 Lakhs out of a total project cost of Rs. 166.92 Lakhs. The objectives laid under the project have been successfully achieved and data analysis is ongoing for publications.

4.2 Fabrication and evaluation of atomic force microscope probes with detachable and re-usable tips - Indian Institute of Science, Bangalore

The project aims to batch fabricate array of detachable probe-tips at significantly greater densities than in batch-fabricated conventional AFM probes, batch fabricate tip-less AFM probes capable of picking up the probe-tips with precise control of their position and orientation by employing a liquid-meniscus micro-gripper and evaluate AFM tip pick-up, gripping and re-use while performing high-resolution AFM imaging in contact-mode and dynamic-mode AFM of Nano-materials using detachable tips and demonstrate automatic detection of tip wear and replacement of worn-out tips during AFM imaging.

Achievements:

(a) Batch fabricate array of detachable probe-tips at significantly greater densities than in batch-fabricated conventional AFM probes: Batch fabrication of detachable probes has been completed. Batch fabrication of probe tips on substrates and on probes has also been completed. Achieving high densities, i.e., densities greater than that of AFM probes is in progress. The recipe has been developed.

(b) Batch fabricate tip-less AFM probes capable of picking up the probe-tips with precise control of their position and orientation by employing a liquid-meniscus micro-gripper: Fabrication of tip-less AFM probes has been successfully achieved both by using dry etching and wet etching. Precise control over the position and orientation has also been demonstrated. The results have been presented in a journal publication.

(c) Evaluation of AFM tip pick-up, gripping and re-use: Manual and automated pick, gripping and reuse of AFM probes has been experimentally demonstrated. The results are reported in a journal publication.

(d) Perform high-resolution AFM imaging in contact-mode and dynamic-mode AFM of Nano-materials using detachable tips: High resolution imaging of samples with nanometerscale features has been performed both in contact mode and dynamic mode imaging. The results show that the image quality remains unaffected by tip replacement process.

(e) Demonstrate automatic detection of tip wear and replacement of worn-out tips during AFM imaging. A single rough sample was scanned multiple times and shown that the progressive degradation of its image can help with detection of tip wear. An automated system for replacement of worn-out tips during AFM imaging has

been developed. It was also shown that this system enables in-situ tip replacement even in the event of tip-fracture.

The automated tip-exchange module has also been successfully demonstrated to replace tips during Nano-indentation experiments (Fig. 2).

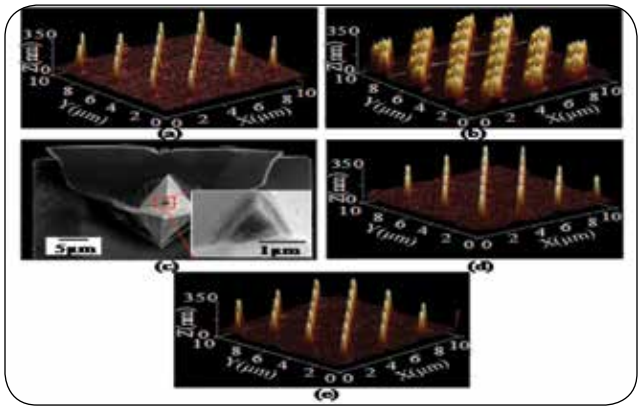


Fig. 4. AFM image of the standard sample: (a) using the sharp tip, (b) using the fractured tip. (c) SEM image of the tip after performing indentation, (d) AFM image of the standard sample with the replaced tip in contact mode, where the normal force was regulated at 26 nN and the tip was raster scanned at 0.756 Hz, and (e) AFM image of the standard sample with the replaced tip in tapping mode where the excitation was at 19.26 kHz while the oscillation amplitude was regulated at 34 nm and the tip was raster scanned at 0.730 Hz. The AFM images were acquired using Dimension Icon AFM (Bruker).

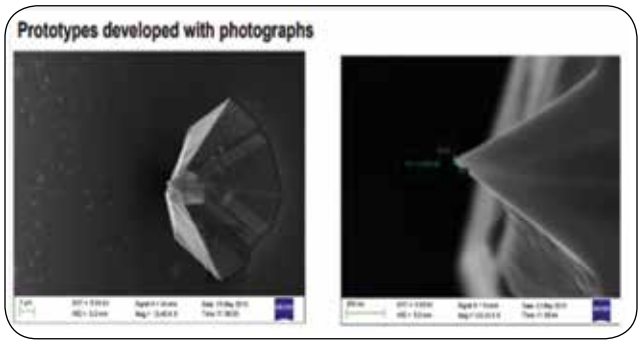


Fig. 5: Micrographs of the tip on a silicon substrate obtained by using wet etching

An automated tip replacement station capable of simultaneous in-situ tip-replacement and AFM imaging has been developed. The photograph is shown below at Fig. 6

The project has been supported by DSIR with a grant of Rs. 72.69 Lakhs out of a total project cost of Rs. 145.38 Lakhs. The objectives laid under the project have been successfully achieved.

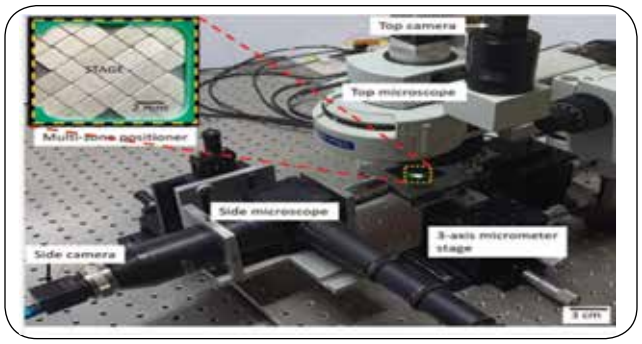


Fig. 6

4.3 Low-cost Additive Manufacturing Technique for Fabricating Through - Substrate Vias based Three-dimensional Microstructures used in MEMS Applications – IIT Bombay

This research project aims to develop and demonstrate a cost-effective manufacturing technique to make miniaturized components in non-conductive substrates like fused silica, alumina, borosilicate glass, applicable in radio-frequency Micro-electromechanical systems (MEMS) applications. At present, the formation of various features such as blind/through-holes in these hard and brittle materials is carried out either by plasma etching or by laser ablation. Both of these techniques require expensive infrastructures and, thus, are not easily accessible to the academic and research community.

A cost-effective electrochemical discharge (ECDM) technique is used for the first time to create multiple through-holes at the predefined locations on a fused silica wafer simultaneously. ECDM is a hybrid process that combines the principles of electrochemical machining (ECM) and electro-discharge machining (EDM). During the ECDM process, discharges are generated between the tool electrode (cathode) and the electrolyte when a potential difference is applied between a tool electrode and a counter electrode (anode). The material removal occurs by melting and vaporization of the workpiece due to the discharges and high-temperature chemical etching by the electrolyte. Although the ECDM has been earlier reported for glass machining,

only a single tool electrode has been used so far, which results in a single hole formation at a time. In applications where a large number of through-holes are required, this serial approach not only increases the overall process time but also results in alignment error. A novel multi-tip array tool electrode is used for the first time to overcome the existing issues.

Achievements:

1. A 3 axis ECDM setup was designed build up and tested
2. The project established ECDM process which is capable of creating microfeatures not only in the Z axis (Drilling) but also in the X-Y plane (embedded redistribution lines)
3. The novelty of the work lies in the formation of several through holes simultaneously by using a tool electrode having multiple array tips.
4. Detailed investigation of process parameters like machining voltage, pulse frequency, duty ratio, electrolyte type for ECDM based drilling was carried out under the project.
5. A new parameter tool work-piece gap was investigated and reported for the first time. This gap was extremely critical.
6. Successful application of the originally proposed ECDM based methodology was demonstrated by fabricating prototypes: The in house developed electrochemical discharge machining setup and through substrate vias based 3D interconnects.

Based on this project work, 19 journal articles were published in high impact factor reputable journals. The research work has also been presented in prestigious 11 international conferences like 46th/47th/48th NAMRC, USA, 70th IEEE ECTC, USA, and 21st IEEE EPTC, Singapore.

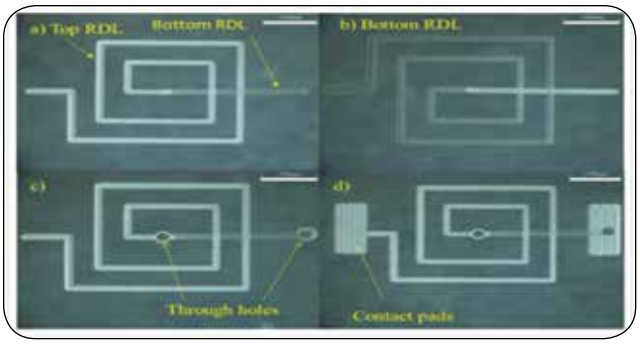


Fig 7: Optical image showing the step by step formation of the embedded RDLs of spiral inductors made in fused silicaa

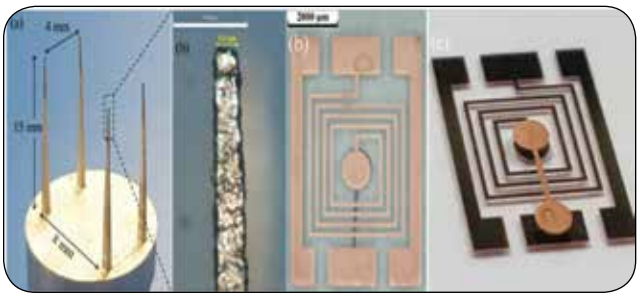


Fig 8: Optical images showing tool electrode having 2x2 tips (left), which was used to create through-holes in fused silica. Fabricated spiral inductors are also shown.

The project has been supported by DSIR with a grant of Rs. 72.69 Lakhs out of a total project cost of Rs. 145.38 Lakhs. The objectives laid under the project have been successfully achieved

4.4 Designing and fabrication of an aerodynamic lens for nanoparticles of variable size – IIT Hyderabad

The main objective of the project is to design and fabricate an instrument (aerodynamic lens) to tightly collimate beams of Nano/microparticles and fabricate a high-resolution mass and imaging spectrometer for real-time analysis of the chemical composition of aerosols with designed mass resolutions of m/Δm of ~ 700, up to a mass of 800 amu., with fast response rates up to 10 Hz or better. The project also aims to develop a large through put method to fabricate microstructures with resolutions of better than 0.5 mm using the aerodynamic lens system.

Achievements: Designed and developed aerodynamic lenses b) Beamline to characterize the beam width of Nano/microparticles c)

Designed and fabricated one of its own kind, a high-resolution compact mass spectrometer. d) Signal decoupler electronics and data acquisition code developed in house.e) Built and characterized the mass spectrometer and tested for air content and Xenon Isotope analysis

The project resulted in designing and fabrication of a low cost, compact, high resolution mass spectrometer for the first time in India. 10 research articles have been published under the project.

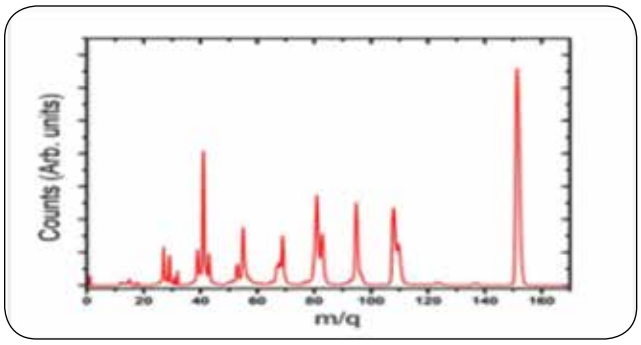


Fig. 9a. An aerosol mass spectrometer and mass spectrum
The project has been supported by DSIR with a grant of Rs. 25.60 Lakhs out of a total project cost of Rs. 51.20 Lakhs.

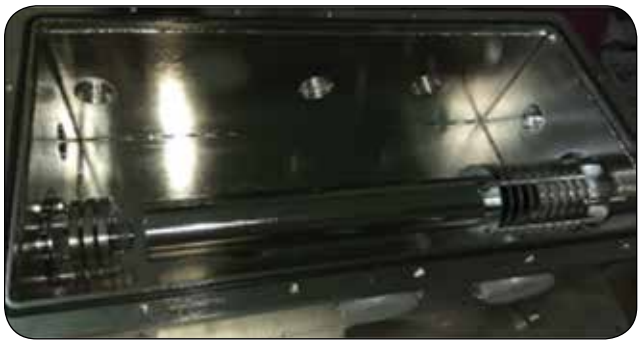


Fig. 9b

4.5 Continuous discharge measurement in small open channels by using ultrasonic tomography – IIT Kanpur

The project aims to develop a continuous real-time discharge monitoring system for small open channels (width 1 to 50 m) by tomographic reconstruction of ultrasonic transit-time measurements. The system will be designed to be accurate, cost-effective, field deployable, easy to calibrate and capable of unattended real-time data transmission. The developed system will be tested under laboratory and field conditions and determine its range of measurement errors under different channel geometry and flow conditions. The developed system will be a user-friendly commercial product.

Small rivers and channels dominate Indian rural and urban landscape. Monitoring discharge in them has direct utility in managing water-resource distribution issues prevalent in India today. The infrastructure for discharge data collection in small rivers is either absent or greatly limited by manual methods that use current-meters, floats, and gauges. The continuous discharge monitoring instruments that are readily available in the market like **Acoustic Doppler Current Profiler (ADCP) and Laser Doppler Anemometer (LDA)** are too expensive for multiple deployments. The motivation is to fill this gap by developing a discharge measurement system that is inexpensive, easy to deploy, operate and maintain, and requires minimum calibration. The scope of this project is to develop and test an ultrasonic transit-time discharge measurement system for small channels (width 1 to 50 m). The configuration of the ultrasonic transducers will be designed to get a cost-effective flowmeter with measurement error of less than 5%.

Achievements:

1. Ultrasonic transit-time Flow Meters (UFM) for pipes and open channels are developed and tested in experimental facilities developed as part of this project.

2. UFM for pipes received ISO certification and are now commercially manufactured by our industry partner, Kritsnam Technologies Pvt. Ltd.

3. Prototypes for open channel UFM can reliably capture the shape of velocity profiles; however, the magnitude of velocity and discharge estimated by them show a systematic bias. Extensive experiments at different scales and flow

rates are required for calibrating the open channel flowmeters and removing the bias.

The ultrasonic transit-time flowmeters developed in this study are relatively less expensive, non-intrusive, easy to install & operate and can provide real-time continuous discharge data at remote sites. Nevertheless, many avenues can be explored to improve their performance. Foremost among them is to increase the number of ultrasonic transducers along the depth and in the diagonal direction to measure velocity along large number of ultrasonic flow paths. Tomographic econstruction techniques can then be applied and tested for improving the accuracy of discharge estimated by UFMs. The project has been supported by DSIR with a grant of Rs. 57.84 Lakhs out of a total project cost of Rs. 115.68 Lakhs. The objectives laid under the project have been successfully achieved.

CHAPTER 4: COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUBS (CRTDH)

Building Industrial Research & Development and Common Research Facilities (BIRD-CRF)

This scheme focuses on the creation of Common Research facilities for micro and small enterprises i.e. CRTDH (Common Research and Technology Development Hubs) with an aim to enhance translational research and foster industry institution interaction targeted towards innovative product development.

1.0 Preamble

Micro, Small and Medium Enterprises (MSMEs) play a pivotal role in the overall economy by promoting equitable development in India. They need to be sensitized towards the translation of public funded R&D into products and processes. Their higher involvement, especially in application-oriented R&D is expected to enhance the private sector's share in national R&D expenditure. Common Research and Technology Development Hubs (CRTDHs) aim to enhance translational research and foster industry institution interaction targeted towards innovative product development. DSIR extends grants to institutions for setting up of these hubs/centers, which include R&D facilities/infrastructure, analytical test facilities, design centers, pilot plant production facility, design engineering and prototype development, demonstration units, product display center etc. The facilities at CRTDHs are used by Micro, Small and Medium Enterprises (MSMEs), Innovators and startups. The CRTDHs evolve a business model for self-sustainability and operate on a cost-plusnoncommercial basis.

1.1 Aims and Objectives

The CRTDH programme is aimed at the creation of common research facilities equipped with analytical equipment and pilot plant facilities to facilitate and encourage innovators, startups and micro, small and medium enterprises for R&D and technology development. These hubs are currently engaged in activities like procurement of equipment, setting up infrastructure and essential facilities for R&D. The hubs have started identifying the needs of the enterprises through seminars and workshops as well as through interaction with the MSME Development Institutes (MSME-DI), Directorate of Industries (DIs), S&T Councils and other state government bodies. Technological development involving MSMEs and host institutions in project mode has begun and several agreements have been signed with enterprises as well as state government agencies for the benefit of the MSMEs and start-ups.

1.2 Achievements

The highlights of achievements of the ongoing CRTDHs are summarized below:

1.2.1 CRTDH at CSIR - Central Mechanical Engineering Research Institute (CMERI), Durgapur

CRTDH was set up at CMERI, Durgapur in the sector Low Cost Machining with the objectives to meet the R&D requirements of MSMEs regarding improvements in product design & manufacturing involving sizing & shaping, patterns & finishing, special purpose machines, CAM for ensuring product conformity and automation. Approximately 2160 sq. feet area on the ground floor is dedicated to installations of machines and around 2017sq.feet area has been allocated at the first floor area for conducting CAD training and lecture sessions.

This CRTHD has identified and interacted with various target clusters such as Makhana cluster in North Bengal, Bargachia Cluster of Metal Product Manufacturers, Howrah; Surgical Instruments Industry Cluster, Baruipur, 24-Parganas; Shuttlecock Manufacturing Cluster, Uluberia, Howrah; Fan Manufacturers Cluster

Foundation of Bansdroni, Kolkata; Metal Casting Foundry Cluster, Howrah; Zari Embroidery Cluster, Sankrail, Howrah; Gems and Jewellery Cluster and Imitation Ornaments Cluster, Domjur, Howrah; Brass Cluster of Goghat; Oil expelling cluster of Dinajpur, etc. The center proposes to adopt a cluster approach for improving the manufacturing competence of these enterprises and is striving towards establishing itself as a manufacturing hub by providing state of the art facility such as debinding furnace, drying ovens, sand testing equipment, sigma blade mixer, Brinell hardness,Vicker'shardness tester, compressor, vacuum sintering furnace, double column all geared radiral drilling machine, manual surface grinder, universal tool & cutter grinding machine, micro feed hydraulic surface grinder, measuring instruments, hydraulic press brake with NC system, injection moulding machine, universal cylindrical grinder, dewaxer, heat treatment furnace, CAD and CAM and R&D support and services to MSMEs.

Under the CRTDH, several projects were completed and ongoing such as design and development of a special slitting machine for the reduction of production cycle time for anchor bolts, a machine shop facility and near-net-shape manufacturing facility for Metal Injection Moulding (MIM), surgical tools such as Artery Forceps and Needle holders, etc. Various technological solutions developed under CRTDH includes (i) technological intervention to improve the existing manufacturing techniques for anchor bolt and copper nozzle to enhance productivity; (ii) technological intervention to replace the age old manual manufacturing techniques for surgical tools to enhance product quality; (iii) technological intervention to replace the age old manual processing techniques for semi-automated slotting of makhana seeds to enhance productivity; (iv) technological intervention to replace the age-old manual manufacturing techniques for slitting operation to enhance product quality; (v) technological intervention for different designs of moulds for ornaments manufacturing and machines for productivity improvement; (vi) technological intervention to mechanize sorting process and different designs of moulds for ornaments; (vii) casting design using solidification simulation, sand quality assessment, quality consistency of cast product and training on foundry practice.

CMERI has undertaken several training/skill development Programs on Computer aided Drawings (CAD) and showcased the facility to stakeholders. Major events organized by CMERI-CRTDH had the participation of stakeholders from MSMEs, academia, etc.

The CRTDH at CMERI has been completed in June 2022 and is continuing to support Startups & MSMEs in Design and Manufacturing. Major services offered at CRTDH-CMERI include the following:

i. All kinds of supportat the initial stages of product development.

ii. Entrepreneur trainings and workshops, skill development programs, leadership programs, R&D facilities, etc.

iii. Enable the entrepreneurs to be ready with an 'innovative technology' in the form of a marketable product.

iv. New start-ups can avail the organization and activity structures of CRTDH.

v. Competitive facility utilization charges and fast approval procedure.

1.2.2 CRTDH at CSIR - Central Electronics Engineering Research Institute (CEERI), Pilani

The CRTDH at CSIR- CEERI, Pilani is dedicated to MSMEs/Startups to help them conduct their research and development activities including testing of innovative products and technologies in Advanced Electronic Systems, Power electronics and Renewable energy. The CRTDH facility may enable to meet the unmet R&D and technology development needs of MSME clusters like the non-availability of infrastructure, workspace, state-of-the-art R&D equipment, technologies and

design solutions in the electronics and renewable energy sector.

To support the solar inverter and renewable energy industries in Rajasthan, a solar grid test facility was setup for supporting industries developing grid connected inverter and also to

certify the products developed. Solar grid tied inverter testing facility is 10th in India and has been granted NABL accreditation ISO 17025:2017.

The centre has developed the technology of dust

precipitator system for stone carving artisans and multiple prototypes of the technology were fabricated at the facility.

Centre has also developed a system for the detection of adulteration in milk and the technology of the system was transferred to three industries. A new version of milk adulteration has been developed and its multiple prototypes have been fabricated at the facility.

Product design & fabrication facility has been created to address PCB designing, 3D printing & prototyping. Centre has also developed analytical testing facilities for dairy products, water testing and general spectral characterization for MSME. Other facilities include design engineering facility, intervolved incubation unit and centre of eminence for skill development.

Six startups were incubated and MSMEs regularly use the facilities at CRTDH. The centre regularly organises workshops & training programmes to sensitize industries, NGOs, Start-ups, professional teachers, students and innovators under the various specialized themes.

Centre has been successful in transferring the developed technologies to the industries and these technologies are Milk Adulteration Detection System, Supply Chain Monitoring System, Mercury Free UV Lamp, Smart Solar Tree. The CRTDH centre was instrumental in carrying out technology transfer agreements to M/s REIL Pv, Jaipur; M/s QboidsIOtechPvt Ltd, Gurugram; M/s. Parappadi Technologies Pvt. Ltd, Trivandrum; M/s Raytrig Innovation Pvt. Ltd., Jaipur.The project is in progress and is expected to be completed in the current financial year.

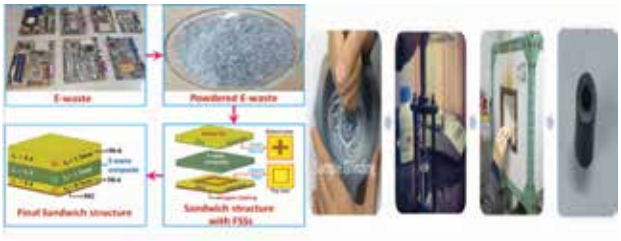
1.2.3 CRTDH at Indian Institute of Technology, Roorkee (IIT Roorkee), Roorkee, Uttarakhand

The seamless integration of high speed digital communication systems and the ever increasing usage of the mobile phones demand the shielding of harmful electromagnetic radiation which has an adverse effect on the human body. The objective of the CRTDH at IIT Roorkee is to work towards development of microwave absorbing materials and its characterization for social, stealth and electronics applications. With the creation of such facilities under CRTDH, the institute is expected to meet growing challenges of enterprises regarding testing of microwave

absorbing materials that have potential for various applications in the commercial as well as defiance space. Material testing and characterization proposed in this CRTDH requires isolated space for each instrument / set up. The following facilities have been established: i) **Free Space Measurement for Transmission and reflection loss of EM wave in microwave region; ii) Radar Cross Section (RCS) measurement; iii) EM radiation level from different communication devices; iv) Thermal absorption of camouflage network and Radar Imaging; v) Vector Network Analyzer Measurement of complex-Coaxial Waveguide, Coaxial Probe Liquids & Rectangular Waveguide; vi) Camouflage Net Testing – Reflection Loss & Transmission Loss; vii) Antenna Characterization – Radiation Pattern, Gain Measurement & Return Loss and viii) Material Characterization for their electrical properties.**

The facilities for material Testing, Measurement of complex permittivity and permeability from 2-18 GHz (i.e. Coaxial wave guide-powder sample in pellet form, Rectangular wave guide- powder sample in pellet form and Coaxial probe-liquids); Camouflage Net Testing (i.e. Reflection loss and Transmission loss); Antenna Characterization (i.e. Radiation Pattern, Gain measurement, Return loss (5kHz-26.5 GHz)) have been created at the CRTDH Center. The project activities undertaken at the center are i) E-waste based Composite Microwave Absorbing Material and ii) Role of MoS_2 and Graphite Composite Thickness Variation on Wideband Microwave Absorption. The CRTDH hub at IITRoorkee has successfully established a large database of advanced radar absorbing materials. The characterization and performance evaluation facility are also available with the hub. Indian Institute of Technology Roorkee organized a two day "Awareness Generation Programme" on the facilities available at the Common Research and Technology Development Hub (CRTDH) for New Materials/Stealth Applications, on 28th to 29th January, 2022. The sixth edition of National Symposium on Microwave Absorbing Materials as a part of the CRTDH center programs was held on 24th and 25th August, 2022 at NIT Patna and around 48 participants attended from different institutions.

Measurement setup (a) sample preparation



Characterization results of the developed E-waste based MAM (a) E-waste Material, (b) powdered material, (c) design, and (d) final structure

CRTDH Center at IITR Compact RCS Measurement Material Characterization for Electrical Properties

1.2.4 CRTDH at Indian Institute of Technology, Gandhinagar, Gujarat

Dyes and dye intermediates are one of the core chemical industries in India and are mostly located in Gujarat. The waste generated from this sector is highly toxic/hazardous, difficult to treat and very large in quantum. The objective of the CRTDH at IIT Gandhinagar is development and customization of R&D requirements of different dye industries for both waste minimization and waste treatment. With the creation of facilities under CRTDH, IITGandhinagar has endeavored to engage dye industries in nearby clusters and cater to their technical and R&D needs for management of dye effluent including testing requirements.

The centre is working on water treatment technologies and lab facility can greatly help MSMEs to test the water and wastewater through a NABL accredited Lab. The centre has received NABL accreditation of ISO/IEC 17025:2017 in the discipline of Chemical Testing in the water and wastewater group.The accredited lab will facilitate water and wastewater testing in Gujarat. It is expected to help hundreds of MSMEs to achieve proper water quality in their facility. The facility is also being used by other research organizations and academic institutes, including non-chemical industries.

The centre has performed 200L & 400L trail run on sewage water from STP of three municipalities

and from IIT-Gn itself using aluminium hydroxide chloride (AHC). Upon successful run in the pilot scale plant, process was tested in Nadiad 0.38 MLD batch and the product was found to reduce the TSS, TOC, COD and increase the DO of STP water.

The CRTDH is working to recover valuable metals from used batteries, as the use of Li-ion batteries has spiked in recent years and end-of-life use of the used batteries is a major environmental problem. The CRTDH proposed an idea of developing and optimizing the combined metal separation technology that includes Liquid-liquid extraction (LLE), Ion exchange, Electroplating and precipitation to minimize the acid, alkaline and organic waste.The CRTDH has developed the protocol for discharging, dismantling, and separating cathode and anode from used batteries. A proof of concept for metal separation by LLE to separate active metal oxide from binder resulted in recovery of about 70% of metals (Co, Li, Ni) from cathode.

CRTDH facility is regularly used by several industry members and Universities for testing and to characterize their products, raw materials. While industries are utilizing the CRTDH facility through the project mode. The centre has helped four startups and has arranged workshops & cluster meetings. CRTDH also worked with the industry members for developing the Li-ion battery anode materials using carbon nano-tube and that the performance was found to be significantly increased after incorporating the carbon nano-tube. The centre is helping industry members manufacture toxic-free products and become better competitors in the international market. The project is in progress and is expected to be completed in the current financial year.

1.2.5 CRTDH at Indian Institute of Technology, Kharagpur

CRTDH-IIT Kharagpur, in the sector affordable healthcare is based at the second floor of Life Science Building at Diamond Jubilee Complex, IIT Kharagpur. It has earmarked space of more than 4000 sqft area and dedicated pilot plant facility for diagnostic kit manufacturing, Bio-safety units and other laboratory units for R&D on diagnostic technologies. The objectives of the CRTDH are (i) to strengthen the collaborative research between academia and industries; (ii) to facilitate the MSMEs/Startups with newer technologies, infrastructure support, knowledge transfer; (iii) to 'democratize' disease management by bringing high-end procedures to the ambit of the bottom of the community pyramid in the green field with no differential treatment of the rich and the poor; (iv) to generate local small scale enterprises, stimulating localized economy of small scale jobs across spectrum of skills.The hub aims to develop novel portable devices that can be deployed at rural healthcare centres, for affordable quick

and reliable diagnosis; taking the products from bench to bedside (rural health kiosks); and provide training and consultancy to the MSMEs for skill development and augmenting technical knowledge. Thus CRTDH facility will be used to support entrepreneurs, startups and MSMEs to conduct their research and development activities.

The CRTDH has extended state of the art manufacturing facilities and R&D support to budding enterprises and MSMEs. State of the art facilities includes – Pilot plant for manufacturing fpaper- based diagnostic kits,Molecular diagnostic device manufacturing unit, Data Science R&D unit, Blood test readout device prototype fabrication unit, Lateral flow strip manufacturing unit, Bio-Safety labs (L2), Rapid prototyping unit, Microfluidic cell culture and analysis unit and PCB printing and assembly work bench. Thus, the CRTDH offers a bouquet of services to the MSMEs, Start-ups, rural entrepreneurs and frontline workers engaged in the healthcare delivery space. Other supports include: enterprise incubation, technology-centric mentoring and training, technology transfer and facilitation towards lab-to-market translation.

Under the CRTDH, following technologies have been developed for societal needs that could be offered to MSMEs for technology transfer -

i. Paper-based diagnostic device for detecting multiple blood parameters (glucose, haemoglobin, creatinine concentration)

ii. Primary healthcare clinical decision support system software and algorithm

iii. Electronic Health Record system based telemedicine software

iv. Portable spinning disc for complete blood count and other haematological examination

v. Nucleic Acid Based Rapid Diagnostic Device platform technology for infectious disease detection.

vi. Portable hand-held device for early screening of oral cancer and pre-cancer

vii. Paper-based device for antibiotic drug resistance evaluation

viii. Tumour on a chip for cancer cell analysis

ix. COVICUBE – a all in one solution for temperature and pulse oximetry based screening

x. Lateral Flow device technology – design and fabrication

xi. Electricity generation technology from wet textile

CRTDH has organized several offline and hands-on sessions with MSMEs and frontline health workers to provide training and consultancy for skill development and augmenting technical knowledge. Under the ambit of CRTDH, a number of economically and socially-challenged rural entrepreneurs have also been trained with the knowhow of manufacturing frugal-medical devices and kits developed by the research team. The human resource development programs are targeted towards innovating and infusing affordable diagnostic technologies for underserved community healthcare, having an inherent integrability with the digital healthcare mission of the Government. Till date, 18 MSMEs/enterprises and more than 140 rural entrepreneurs have been trained on different technologies at CRTDH.

1.2.6 CRTDH at CSIR - Indian Institute of Toxicology Research (IITR), Lucknow

CRTDH in the sector Environmental Intervention and Monitoring was set up at IITR, Lucknow and is fully functional to promote and mentor R&D startups/MSEs as well as develop trained human resource with the following objectives:

a) Drinking water disinfection and water quality assessment technologies

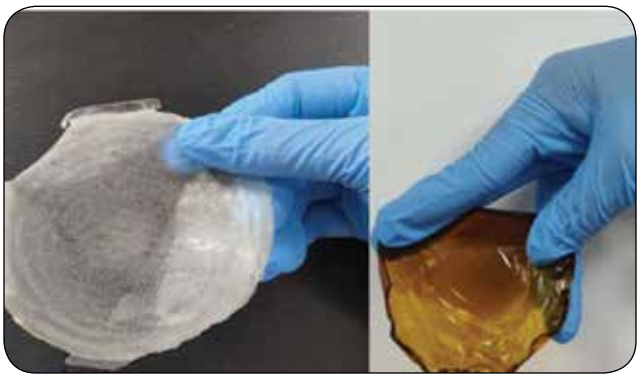
b) Technologies for treatment of industrial effluent from Pulp & Paper industries

c) Build predictive models including source apportionment for air quality as well as pollution abatement.

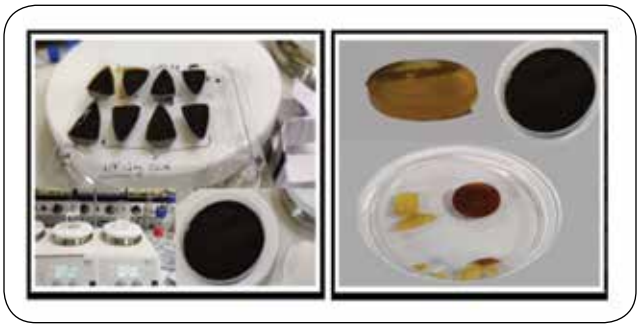
d) Develop customized training programs / workshops for specific cluster to generate trained human resource

Under CRTDH, IITR has procured various capital equipment as per the project plan. Important facility established under CRTDH includes Anaerobic workstation, 3D Printing Portable Fine Dust Aerosol Spectrometer (FIDAS), Cirrus Sound Level Meter (model:CK-152B) etc.for the utilization of MSMEs. Primary activities are initiated at the institute in three areas such as (i) Water treatment and monitoring (ii) Effluent treatment and (iii) Air pollution abatement to serve the industries and public awareness along with skill development and training.

Achievements recorded under the CRTDH at IITR, Lucknow includes: (A **Water Treatment Sector:i**) Commercial models of water disinfectant technology developed by the institute is available for non-exclusive licensing; ii) Developed prototype of hydrophilic hydrogel membrane derived from biomass for the removal of heavy metal ion from present in natural water resources. (B) **Effluent Treatment Sector:i**) Pilot Scale 2000L Bioreactor plant deployed at M/s YashPakka Limited, Ayodhya for pulp and paper mill effluent treatment. A Non-disclosure agreement was signed between M/s YashPakka Limited, Ayodhya and CSIR-IITR, Lucknow; ii) The Lignin-based bioadsorbent gel (Patent App. No. 202211033284) has been developed for water treatment from industry waste; iii) Biocharfrom sewage and paper mill sludge waste is tested and treatment of textile effluent at the lab scale; iv) Textile industry (Unnao) waste water treatment process is established at lab level. (C) **Prototype of natural polymer-based packaging material: i**) development of bio-polymer based packaging material. (D) **Gelponic:** development of gels for use in hydroponics and the agricultural industry to reduce water consumption and decrease application of pesticide. (E) **Air Pollution Abatement:i**)Device and technique for air quality monitoring & management (Patent Filled App. No –202011048084, Date of filing 3/11/2020).



Sample antimicrobial sheet synthesis process using graft polymerization



(i)The process developed for bioadsorbent gels synthesis& (ii) Synthesized Lignin-PVA/PAA bioadsorbent gels

CRTDH has conducted 14 seminars/workshops and 3 international conferences to create awareness about the CRTDH facilityand promoted the activities to MSMEs. Through various workshops/trainings CRTDH has trained more than 370 persons. CRTDH has served 33 Industry/ Startups/MSME through various technology andservicessupport.

1.2.7 CRTDH at CSIR - Central Drug Research Institute (CDRI), Lucknow

CRTDH set up at CSIR-CDRI Lucknow in the area affordable health was inaugurated by the then Union Minister of Health and Science & Technology in presence of Secretary, DSIR. This CRTDH focuses on developing and operating a Pharmaceutical Formulation Development and National Clinical Trial Batch Production Facility (via Quality by Design (QbD)) to support industrially-

scalable process-cum-product technology packages for different dosage forms (oral, topical and sterile products) and manufacture batches of drug products and corresponding placebos for Phase I and Phase II clinical trials under Form 29 license from State Licensing Authority of UP. The hub also aims to establish and operate a Unit for GLP-compliant Pre-clinical and Clinical Bioanalysis (PK, BA, BE) and Drug Testing Laboratory (DTL) that will undertake activities pertaining to generation of chemical and pharmaceutical information on API and formulations; quality assurance, monograph and final/batch release specifications including Stability Studies; in-vitro pharmacokinetics and metabolism; preclinical pharmacokinetics, absorption, distribution, metabolism and excretion; and bioanalysis for clinical pharmacokinetics, including bioavailability and bioequivalence.

Micro-scale, GMP-compliant (per Schedule M) manufacturing equipment for tablets, capsules, liquid orals, topical preparations (gels, ointments, creams) and dry powder inhalations were procured to establish testing and GMP compliant pharmaceutical manufacturing facility. Although facility creation under CRTDH is ongoing, it is ready to support MSMEs for activities such as formulation, pilot scale process, product characterization, pharmacokinetics, on-site troubleshooting, consulting and training and regulatory filing support. An application in Form 36 for the grant of approval in Form 37 License to function as a Drug Testing Laboratory for MSME under the D&C Act was made to the drug regulatory authorities. A joint inspection of the CRTDH by the Central Drugs Control Standard Organization (CDSCO) and Uttar Pradesh Food Safety and Drug Administration (UPFSDA) was carried out on 19 May 2022. The Inspection Team suggested procurement of additional equipment before the required License could be granted. Further process in this regard in ongoing.

Technological solutions developed by CRTDH includes – i) Tablets and syrup formulations of umifenovir (Medizest, Goa), dry powder inhalation of favipiravir (Windlas, Dehradun) for COVID-19, ii) Dry powder inhalation for anti-tuberculosis medicines (Camus, Jaipur), iii) Tablets of CDRI's anti-platelet New Chemical Entity S007-867 (Marc, Lucknow) iv) Valorization of poultry industry waste for use as excipient in drug products (Helixion, Hyderabad), v) Technology Feasibility Assessment, Detailed Project Reports, Regulatory Filings in India and Europe– Consultancy Services etc.

CRTDH at CDRI is actively interacting with MSMEs and few prospective clients such as M/s. Neurochem, G Praxen, Marc Laboratories, Helixion (Biotech Park); and Mediclin, (Lucknow); M/s. Modern Laboratories, (Indore); M/s. Windlas Biotech, (Dehradun), M/s. Medicine Complex, (Agra) were visited at their site.

Awareness regarding capabilities and activities was spread through the good offices of the Uttar Pradesh Drug Manufacturers Association (UPDMA) and various other workshops/seminars. These programs were attended cumulatively by

Rapid Mixer Granulator with 3Kg bowl in use to prepare 1 Kg granules for tablet compression

Tablet press and control system in use to prepare tablet batch of size 1 Kg

Tablet ejected from die, turret working with only two stations occupied

~300 participants from MSME, large firms and academia. A 10-minute video clip has been also prepared, describing the CRTDH. This was seen by >500 students and MSME visitors who visited CSIR-CDRI under various outreach programs and Open Day. As a result of this, 27 MSMEs have been served by the CRTDH. This CRTDH facility will continue to support MSMEs by creating awareness through awareness programs, hands-on training and workshops, site visits and webinars scheduled.

1.2.8 CRTDH at CSIR-Central Scientific Instruments Organization Chennai Centre (CSIO), CSIR Madras Complex Taramani, Chennai

The objective of the CRTDH at CSIR-CSIO, Chennai is to provide technical support, infrastructure and sophisticated analytical as well as advanced research equipment facilities to the MSMEs for carrying out technological research with a view to translate new idea into marketable products as well as to scale-up already developed technologies available with CSIR-CSIO for taking them to market. The Center has proposed to create the facilities for testing of Solar Inverters & Solar Panels and similar electronic systems including Maximum power point tracking (MPPT), UPS, Charge controllers etc. The Center has created a Brochure/Pamphlet for CRTDH and Website for CRTDH: https://crtdh.csio.res.in/. CRTDH has recently installed a testing service facility for 30 kVA solar inverter manufacturers in India. The laboratory can test solar PV inverters with a rating of up to 30 kVA with an integrated setup comprising of solar array simulator, grid simulator, RLC load and power meters.

The CRTDH is capable of conducting test through the established infrastructure:

i) Testing of Power Efficiency of Solar Inverter (as per IEC 61683 :1999) ;

ii) Testing of Static MPPT Efficiency of Solar Inverter (as per EN 50530 :2010);

iii) Testing of Dynamic MPPT Efficiency of Solar Inverter (as per EN 50530 :2010) and

iv) Testing for Characteristic Interface of Solar Inverter (as per IEC 61727 :2004).

CRTDH is in the process of setting up solar PV testing laboratory whose function is to evaluate solar panels for its performance, which could help solar project owners and operators to capitalize on the production. Apart, from the inverter test facility, the CRTDH team is in the process of setting up a solar PV testing laboratory whose function is to evaluate solar panels for their performance, which could help solar project owners and operators to capitalize on the production. CRTDH along with Caliber Interconnect, Coimbatore and Frontier Ltd., Vellore had initiated feasibility testing and handholding of their 12-kVA solar inverter and EV accessories during March to August 2022 at CRTDH Chennai. The interaction has successfully resulted in the commencement of testing and handholding of their inverter development in project mode.

CRTDH conducted series of Technologist – Industrialist Meet & Expos (TIME), the latest being

TIME 2022 organized on September and October 2022 which sensitized around 100 industrial participants from different parts of India in the areas of Energy and Energy Infrastructure Instrumentation. This also facilitated the opportunity for industries & users to know about the technologies & facilities of CRTDH. CRTDH had implemented an optical sensor setup and dark room setup for measuring the irradiance, dose, temporal stability and leakage of the UVGI systems at various planes and heights according to the type of the systems and developed SOPs for testing & validating the same.

1.2.9 CRTDH at CSIR- Institute of Minerals & Materials Technology (IMMT), Bhubaneswar

The CRTDH centre was established in the area of "New materials & Chemical Processes" to address concerns of large number of MSEs working on processing of metal, alloy & materials, chemical processes that require R&D inputs/ interventions to meet the emerging market needs and for their own sustenance. The areas of innovation driven intervention being developed by CSIR-IMMT are Mineral Processing, Industrial Waste Utilization, Coatings & Surface Engineering, Chemical Processes, Metallurgical Processes, New Materials, Testing& Quality Assurance Services.

The Industrial shed for providing incubation facilities to Start-ups measuring around 7000 sqft has been inaugurated by the Honorable Union Minister for Science and Technology Dr. Jitendra Singh on 4th December 2021. Mobilization of MSMEs under different categories along with necessary R&D support is under progress. The centre has been actively engaged in sensitizing MSMEs/entrepreneurs/start-ups.

While working with the MSME, a number of technologies have been developed that includes Automated Chemical Dosing System, Wireless Temp Sensing and Recording, Nutrient enriched biochar, Development of Selective Bio/Chemical Additives for Drag Reduction During Slurry Transportation, conducting coating on the phosphor bronze pin for signaling application.

Several start-up have also been associated for R&D interventions in the area of new materials that includes M/s Innocule, Bhubaneswar, M/s Jigsan Mercantile Pvt. Ltd., Bhubaneswar, and K-First Biotech Pvt Ltd, Bhubaneswar. The prototype developed for Automated Chemical Dosing System & Wireless Temp Sensing and Recording and has been transferred for field trial to M/s Innocule, Bhubaneswar. Licensing agreement signed towards technology transfer on 'Nutrient enriched biochar for organic based fertilizer' and demonstrated to M/s Indian Plant Feeds, Cuttack and M/s Jaydev Banana Farmers and Artisans Association. The M/s Jaydev Banana Farmers and Artisans Association has already brought the product in market based on this technology. A process on 'production of SiC from rice husk' has been established and an industry has shown interest to take it up for scaling.

A number of workshops and training programs have been organized. Nearly 30 nos of artisans were demonstrated and trained on improved brass melting furnace that has been constructed in the metal craft centre of the CRTDH. Farmers (30nos) and UtkalikaSamiti-an NGO, Jajpur, Odisha were trained on the biochar processing. During various metal craft related workshop and exhibition, more than 70 artisans were sensitized for various processes involved in metal craft industry and more than 50 entrepreneurs were sensitized on coatings, Waste to Wealth and IP.

Centre has sensitized 37 industries/ innovators. Centre was able to conduct 10 awareness programmes related to CRTDH. Additionally, 10 know-hows on sanitizer, disinfecting device, hospital assistive device, personnel protective device have been transferred to 14 MSMEs, while progress on further scale-up and /or commercialization is underway.

The project currently in progress and is expected to finish as per timeline.

1.2.10 CRTDH at Delhi Pharmaceutical Sciences and Research University (DPSRU), New Delhi

DSIR-DPSRU-CRTDH hub will offer a broad range of services, including the development, GMP manufacturing, analysis and extensive evaluation of advanced formulation technologies including but not limited to liposomes, solid lipid nanoparticles, lipid nanocarriers, polymeric nanoparticles, inorganic nanoparticles, multi-particulates, nano-emulsions, nanosuspensions, nanocrystals, as solid, liquid or semisolid products for oral, ocular, transdermal, intranasal, pulmonary, parenteral, rectal and targeted delivery. The focus of centre is to provide the safe and efficient translation of new therapeutic agents from bench to bedside with the goal of improving human health. Further, the application is not only on pharmaceuticals but also to assist development of advanced formulations for biopharmaceuticals, herbal drugs, ayurvedic extracts, cosmetics ingredients, and nutraceuticals as well, precisely fulfil the need of MSME culture and lead to accelerated development of innovative and advanced products in field of healthcare.

The main objectives of the CRTDH at DPSRU, New Delhi are:

I. To accelerate research and development of advance and innovative healthcare solutions through integration of nanotechnology, molecular, preclinical and clinical testing, thus making interventions more affordable, safe and effective.

II. To set up core translational facilities and infrastructure for advanced product development (IPR, market research, preformulation, formulation optimization, dosage form development, characterization, testing, analysis, preclinical and clinical research) accessible for MSME clusture, startups, research institutes/ universities and individuals

III. To support and cater the research, development and testing needs of Healthcare MSME clusture, startups, research institutes/ universities and individual and to provide them unique platform to validate their proof of concepts to scale-ups and ultimately commercially viable sustainable solutions

IV. To develop state-of-art preclinical animal imaging facility which will assist in understanding in vivo molecular interaction and fate of advanced formulations (1st year).

V. To develop one-stop solution for translation (bench to bed side) of advance healthcare formulation and products.

VI. To train people in the advanced formulation development technology to serve the needs of development in these areas and to develop affordable healthcare products through novel processes and technologies.

The major achievements of the CRTDH at DPSRU, New Delhi are:

i. More than 23 MSMEs/Industries were invited in the campus and the areas of collaborative formulation development were identified. Revenue generation is in process

ii. Start of art facility (for solid, liquid and semisolid formulations) is in development process.

iii. In- vivo Animal Imaging System funded by DSIR is ordered. Further the equipments including LCMS-MS, Raman Spectroscopy will be purchased.

iv. More than 20workshops/ seminars were conducted with industry for awareness about the centre.

v. MoUs are signed with 5 industries.

vi. More than 10 publications in journals of repute.

vii. 1 technology transfer is done for the developed product.

viii. 6 products including Detox Water,

Immunity Tea, Galactagogue Milk powder, Dispersion for platelet enhancement, Non medicated and medicated Nano-Gels, Medicated Jellies are under development from the centre.

ix. The project is under progress and has been reviewed once.

1.2.11 CRTDH at National Institute of Technology, Andhra Pradesh (NIT-AP)

A new CRTDH has been set up at NIT, AP based on the identified unmet R & D & Technology development needs of the clusters in AP region. This CRTDH is focused to support MSEs research pursuits towards ideation, evaluation, design, development and testing of innovative products/process in the sector electronic and renewableenergy with following objectives -

i. To help in expanding/ starting of new MSEs/startups in developing products/ software in renewable energy sector.

ii. To help MSEs in adapting Internet of Things (IoT), edge computing, artificial intelligence (AI) driven for increase in productivity or better service or improved security or enhanced reliability or reduced cost in smart integration of renewable systems.

iii. To improve skill sets of MSEs towards knowledge/application of best technology in product manufacturing process/ product/ service by conducting workshops, certification course/ short term programs.

iv. To facilitate on-demand learning facilities to institutes/researchers interested to work in Electronics/Renewable energy sector and encouraging collaborative

v. To develop/design power converter topologies of renewable power generation.

The CRTDH is currently procuring equipment and setting up the facility. The current state of the art facility at this CRTDH includes - Micro Grid setup consisting of solar, wind and energy storage technologies, Power stacks for developing energy converter configurations, FPGA based hardware in loop real time digital controllers for rapid prototyping, Solar and Wind energy emulators, Programmable high precision AC/DC power sources, Programmable AC/DC electronic loads / Bus, Three phase power quality analyzer and insulation testing equipment, Computed aided design tools for simulation of renewable energy, Electric Vehicle Charging setup etc. and following services will be offered to MSMEs -

i. Delivery of first hand R&D technological solutions to the MSEs in Renewable Energy sector including testing services.

ii. Development of data driven simulation and design tools for assessment of renewable resource potential, cost estimation, operation & maintenance planning and asset management through testing and characterizing of renewable resources.

iii. Design and development of solutions to the decentralized power generation and to increase the penetration of renewable energies to the grid.

iv. Development of optimal sizing and power control strategies for hybrid renewable systems consisting of photovoltaic, wind, hydro, fuel cells including battery management.

v. Analyzing the power converters efficiency and reliability by developing loss models and mission profile parameters taken at MSEs location towards selection of suitable power converters in renewable systems.

vi. Support to MSEs in technological solutions towards Power quality enhancement in off-grid and on-grid renewable energy systems.

vii. Skill development of manpower of MSEs through training and capacity building programs.

viii. Repository of knowledge sheets in renewable energy sector and made available for quick adaption of recent technologies Incubation of Startups/MSEs in the renewable sector.

Expected outcome of this CRTDH is to cater 100 number of MSE's, organising 15 number of capacity building programmes and raising 05 start-ups.

1.2.12 CRTDH at CSIR- National Chemical Laboratory (NCL), Pune

The CRTDH centre was established in September, 2021 in the area of "New materials & Chemical Processes" to address the unmet needs of MSE in the areas of polymer synthesis and the methods of synthesizing functionalized nanoparticles at a large scale through the unique flow processes developed at CSIR-NCL. CRTDH is focused on MSME clusters located at MIDC areas in Pune, Ahmednagar, Satara, Solapur, Mahad (Raigad), Thane and GIDC areas like Vatva, Vapi, Bharuch etc. for pigments and polymeric films. The centre is undertaking research in both fundamental and applied nature so as to meet the industrial requirements for synthesis of functional materials, their composites and processes for polymer scale-up & polymerization. Objectives further includes rheological characterization of the new materials and printed objects for various applications. Additional objectives include organizing training sessions, review meetings with MSME industry and annual conclave to showcase developed technologies. Centre has sensitized 150 MSMEs during the period and has developed one technology.

1.2.13 CRTDH at Indian Institute of Technology Guwahati

CRTDH at IIT Guwahati is dedicated to disseminate biodegradable plastics research and related technologies to MSMEs for industrial commercialization of sustainable packaging &healthcare products & to create required infrastructure / incubate innovative entrepreneurs and collaborate to build ecosystem, create impact to promote sustainable materials and eco-friendly processes for MSMEs.

The mandate of the CRTDH at Indian Institute of Technology Guwahati are :

i. One state of the art CRTDH in New Material/ Chemical process will be established for MSEs in biodegradable polymer manufacturing, processing industry and product manufacturing industries.

ii. Hub will provide R&D benefits to 100 MSEs industries

iii. Hub will empower trained manpower for MSE's (~ 300).

iv. Scale-up facility for polymerization in the scale of 50 liters.

v. Create at least 20 Start-up on Biodegradable Plastics from proposed Hub

vi. Fifty new technologies from this HUB will be targeted

vii. Hub will develop NABL accredited composting certification/Testing facility to the industries.

viii. Biodegradable polymer processing Center for MSE's (catering to over 50 industries).

ix. Blending of polymers to reduce necking in films (training to over 50 industries).

x. 150- 200 start-up/ micro and small entrepreneur to get benefitted in 5 years period.

xi. 3-5 innovative products/process will be brought into market during entire tenure.

xii. Customized R&D activities as per local needs and dissemination of Know-how developed.

xiii. Research outcome by means of patents and publications.

xiv. Training of Industrial houses for the production of polymer resins, products

and composting of such products after service life

Some of the activities undertaken by the CRTDH at Indian Institute of Technology Guwahati, Guwahati are:

1. Showcasing the CRTDH at IITG during Northeast Research Conclave: During the Northeast Research Conclave 2022, May 20-22, (NERC-2022), there was a meet and discussion with the various industries partners at IIT Guwahati for the "Common Research and Technology Development Hub (CRTDH) for the support for MSMEs in the Northeast region". More than 300 large scale and small scale industries participated which includedcompanies like Indian Oil, ONGC, Oil India Limited, Numaligarh Refinery Limited, Industry Federation, FINER, DSIR, DBT, Coal India, CIPET, ADEDA, NERAMAC, India Accelerator, NRDC, BIRAC, IJBC, ElmackEngg Services, Anton Paar, Molbiogen, Iclean, Mayuri, IGGL, Engineers India Limited.

2. Industry Interaction with CRTDH at IIT Guwahati: Indian Institute of Technology Guwahati (IITG), Assam, India, National Science & Technology Council (NSTC) and Taiwan Chamber of Commerce in Delhi, India (TCCD) jointly organized the Taiwan-India 2022 Exchange Workshop and Symposium on Intensifying the Connection of Sustainable Technology (TIEWS-2022) during September 04-06, 2022. During the program one "Brainstorming Session and Panel Discussion on Sustainable Manufacturing (Role of IITG-CRTDH for Industries)" was organised. There were more than 50 industries participated from the northeast region. All the industry delegates and participants discussed about the role of government to improve the state of industries, during panel discussions. Several new startups participated and got information about the government schemes and programs.

3. MoUs signed with MSMEs with an intent to work with CRTDH at IIT Guwahati on Biodegradable Plastics, during held during November 17-18, 2022:The following seven Industries with different portfolio signed MOUs with IITG-CRTDH during DSIR - CRTDH Conclave, 2022:

   1. Deep Polymers Limited, Ahmadabad, Gujarat
   2. Pilon Engineering Pvt. Ltd,Pune Maharashtra
   3. Biojagat Private Limited, Uttar Pradesh
   4. DECCO WW, a subsidiary of UPL Limited from Vapi, Gujarat
   5. Baracudda Technologies, Gurgaon
   6. TechnoClean engineers Pvt. Ltd., New Delhi
   7. Life Essentials Personal Care Private Limited, Mumbai

1.2.14 CRTDH at Indian Institute of Technology Bhilai

The dominance of industrial regions in and around Chhattisgarh shows economic prosperity of the region. However, absence of a state-of the-art material characterization facility always remains a concern and it is preventing the growth of the industry. The raw materials used in the industry such as pharmaceuticals, pigments, textile, dye and dye intermediates, metal and mineral require to be characterized well to determine their key physico-chemical and mechanical properties before using them in large scale production. In a major initiative to work with MSMEs and to help them in improving their processes through efficient material characterization, IIT Bhilai has established a Common Research & Technology Development Hub, supported by Department of Scientific and Industrial Research (DSIR) on New Materials/Chemical Process sector.

Focus Area and Objectives: The focus is on the development of a state-of-the-art material

characterization facility for minerals and metals, pharmaceuticals, pigments, dye and textile industries. The objective of the CRTDH is to engage MSMEs and other industries to enhance their capabilities in technology know-how on process improvement, research on new products and testing (products/raw materials) etc.

Specialization of work at CRTDH: New Material/ Chemical process development for MSMEs involved in the production of polymers, pharmaceuticals, pigments, textiles, dye and dye intermediates, metals, and minerals.

State-of-the-art Facility and R&D support and services to MSME: Mass Spectrometer for characterization of molecules/compounds used in pharmaceuticals, pigments and textile industries; Optical emission spectrometer for characterization materials used in metal/mineral industries; Inert gas workstation for processing/ sample preparation of air sensitive materials.

Targeted MSME clusters: Pharmaceuticals, pigments, textile, dye and dye intermediates, metal and mineral sectors.

Services to be offered to MSMEs: The facilities at DSIR-IIT BHILAI-CRTDH and the knowledge base of IIT Bhilai along with the other facilities at IIT Bhilai shall serve as one-stop solution for MSMEs and industries in the state of Chhattisgarh.

The project started in October 2022.

1.2.15 CRTDH at National Institute of Pharmaceutical Education and Research (NIPER-SAS Nagar)

A new CRTDH in the sector New Materials/ Chemical Process has been set up at NIPER – SAS Nagar, Mohali based on the identified unmet R&D Technology development needs of the clusters in nearby region such as Una (GoI –Bulk Drug Park), Baddi-Brotiwala-Nalagarh, Derabassi-Lalru, Chandigarh-Mohali-Panchkula, Ludhiana-Amritsar, Parwanoo, Kalaamb-Paonta Sahib, Delhi-Noida-Gurugram-Rewari and Jammu etc. This CRTDH is focused to support MSE's research pursuits with following objectives –

i. Build in facilities for pharmaceutical companies of India and abroad for pilot trials (GMP), Kilogram scale and research & development

ii. Development of sustainable, cost effective, industry feasible processes for APIs/ KSM/Intermediates (PLI scheme/import molecules/off patented molecules-Annexure VII) and extraction & isolation process of high value herbals.

iii. Creation of Natural Product Standards Library for use by herbal and nutraceutical Industry.

iv. Development of new bioactive materials (High protein affinity).

v. Validation and Contract Research Services to industry.

vi. Technology transfer to industry.

vii. Skill development trainings for MSMEs/ Chemical startups and refresher courses for other industry employees.

CRTDH at NIPER, SAS Nagar is expected to lead to setting up of State-of-the-art facility for MSMEs in the sector New Materials/ Chemical Process besides catering to unmet needs of enterprises. The project is expected to achieve following outcomes/deliverables in 05 years' duration:

i. 01 GMP certified Pilot Plant under CRTDH for APIs

ii. 01 Kilogram/R&D laboratory

iii. >100 Industry projects/ Industry Engagements- Contractual Research and Consultancy projects

iv. >10 Cost effective industry feasible synthesis of APIs/KSM/Intermediates

v. >20 New bioactive materials

vi. Creation of Natural Product Standards

Library for use by herbal and nutraceutical Industry

vii. 5-6 Transfer - Ready Technology

viii. Approx. 11 Publications and approx. 9 Patents under CRTDH

ix. Approx. 350 MSMEs/startup staff training under CRTDH

1.3 DSIR - CRTDH Conclave

To bring the successes and learning from journey traversed by DSIR-CRTDH Centres, DSIR organized two days' "DSIR-CRTDH Conclave – 2022 jointly with Common Research and Technology Development Hub (CRTDH) at CSIR - Indian Institute of Toxicology Research, Lucknow (CSIR-IITR, Lucknow) at IITR, Lucknow on 17th &18th November, 2022. It brought together coordinators of the CRTDHs established by DSIR and the MSME beneficiaries of these centres. The Conclave focused on the achievements of the CRTDHs and also on the expectations of the MSMEs from these CRTDHs showcasing the technological insight of varied supported sector by the public funded research institutes. CSIR-Indian Institute of Toxicology Research (IITR), Lucknow hosted the DSIR-CRTDH conclave. The conclave highlighted the achievements made and benefits drawn by MSME & other stakeholders and the continued commitment of DSIR for MSMEs. The conclave was inaugurated by Dr N Kalaiselvi, Secretary, DSIR & DG, CSIR and was attended by eminent scientists, industry representatives and MSMEs along with representatives from different CRTDHs. The conclave witnessed IIT - Guwahati and CSIR- IITR Lucknow signing of MoUs with various industries and achievement made by various CRTDH were showcased in a exhibition during the conclave. DSIR also released a compendium on CRTDH scheme that has comprehensive details of all the CRTDHs set up along with success stories of MSMEs/Startups which benefited from the DSIR-CRTDHs. The conclave not only gave opportunity to the all CRTDHs to showcase their achievements but also motivate new CRTDHs and MSMEs/start-ups to get associated with the DSIR-CRTDHs.

CHAPTER 5: ACCESS TO KNOWLEDGE FOR TECHNOLOGY DEVELOPMENT AND DISSEMINATION (A2K+)

ACCESS TO KNOWLEDGE FOR TECHNOLOGY DEVELOPMENT AND DISSEMINATION (A2K+)

Access to Knowledge for Technology Development and Dissemination (A2K+) scheme has three components (i) Technology Development and Utilization Programme for Women - promotes adoption of new technologies by women for greater operational efficiency and reduction of drudgery; (ii) Support to Studies – undertakes study and analysis of developments in the emerging technology areas and documents the findings, leanings and outcomes for wider dissemination including preparation of status reports on technologies from public funded institutions, (iii) Support to Events like seminars, workshops, conferences, exhibitions etc. - provides a platform for exchange of views leading to useful insights on issues relating to industrial research.

1.0 Technology Development and Utilization Programme for Women (TDUPW)

The program is aimed to meet the specific needs of women and to enhance their technological capabilities. The objectives of the programme are:

- Promoting the adoption of new technologies by women.
- Awareness creation and training of women on technology related issues with regard to women related occupations.
- Promoting Technology up gradation (through technologies developed by scientific establishments) of micro, small and medium enterprises run by women Self Help Groups (SHGs) / entrepreneurs.
- Showcasing of appropriate technologies developed by scientific establishments and organizing demonstration programmes for the benefit of women.
- Design and development of products, processes (e.g. by utilizing waste) beneficial to women.
- Deployment of technologies developed by scientific establishments for reduction of drudgery and empowerment of women.

The department has supported five (5) new projects and four (4) are under consideration during the year 2022-23 (Annexure 9). The department has successfully completed the project, "Skill up-gradation of women potters in fabricating fine terracotta Pottery products in Tirunelveli Distt., Tamil Nadu undertaken by Centre for Social Development, Kanyakumari.

1.1 Ongoing projects under TDUPW Programme:

1.1.1. Empowerment of women through silk and cocoon based handicrafts (Wealth from Sericulture Waste) undertaken by Department of Biosciences and Sericulture, Sri Padmavati Mahila Visvavidyalayam (Women's University), Tirupati.

The main objectives of the project are to impart training to women in preparation of handicrafts with silk waste and cocoons and to promote the skills of trained women and empower them by facilitating the marketing of the end products to promote the women to become entrepreneurs to enhance their economic standards. The venue for training programs was identified based on the number of trainees concentrated in the area, facility available to reach the venue and where necessary local resources were available to conduct the training programmes. A total of Ten training programs were conducted, at various places of Chittoor district and trained 274 women

@ around 25-30 women per programme. The ten locations i.e. i) Govinda Nagar, Tirupati, Chittoor Dist.; ii) Sathyasai Nagar, V. Kota, ChittoorDist; iii) NTR Colony Penumuru, Chittoor Dist.; iv) Industrial Estate, Madanapalle, ChittoorDist; v) Sericulture Complex,Bangalore Road,Palamaner, ChittoorDist; vi) Sri Padmavati Mahila Visvavidyalayam, Tirupati, ChittoorDist; vii).S.D.K Nagar, Srikalahasti, ChittoorDist; viii). Patrapalli, V. Kota, Chittoor Dist.; ix) Santhipuram, Chittoor Dist; x) Mandal Office, Ramchandrapuram, Chittoor Dist. of Andhra Pradesh were selected to conduct the training programmes. The selected women were trained on preparation of cocoon-based handicrafts. Duration of each training program was 15 days. As part of training program exposure visits were arranged to Cocoon Handicraft preparation centers. Trainees were motivated to take up the seri-craft as an enterprise. After completion of the training program, the trainees were monitored as part of the follow–up programme, for helping them to solve their practical problems in taking up the activity. With the training programs conducted at different places women at large were enlightened with entrepreneurial skills and developed dignity of labor rewarded with handful of income source. Trainees were enlightened on entrepreneurship development, various ways of marketing (including digital marketing) of the handicrafts. Various consumer sale points were established at exhibitions conducted at different places on various occasions and trainees were guided to exhibit and market their products. Documentation in the form of Hand book on Seri-crafts in local language and Audio-visual documentation on preparation of Cocoon based Handcrafts in the form of video cassettes are brought out, as ready to reference to the trainees.

Hand on training on Handicraft preparation

1.1.2. Dissemination of Bio-energy Technology through Bio-coal Preparation from Waste Green Coconut Shell as an Energy Rich and Smokeless Cooking Fuel among Rural Women in Puri District of Odisha undertaken by Socio Cultural Development Centre, Jagatsinghpur, Odisha

The project has been taken up with a view to derive useful energy from the most underutilized and neglected biomass i.e. green coconut shells available abundantly in the coconut growing regions. The main objective of this project is to build the capacity of women in Konark block of Puri dist. of Odisha in the preparation of Biocoal from green coconut shell. The project also envisages to enhance the entrepreneurial skills of the women as a source of livelihood. The briquetted char (bio-coal) from green coconut shell through the evolved technology in this project would become an effective substitute for fossil coal for its various applications in domestic and industrial sector. The area chosen for this project is Puri District in the state of Odisha where coconut is the major horticultural crop. 13 skills oriented training cum demonstration programmes have been conducted for training of 423 women identified from 08 SHGs (149 Women) and 274 women identified from 25 Villages of Eight (08) Grampanchayats of Konark Block, Puri District to prepare biocoal from green coconut shell. The training is creating awareness among the coconut growers and vendors regarding the effective utilization of used and discarded green coconut shell; popularization of solar greenhouse dryer among the women of identified beneficiaries not only for quick and safe drying of green coconut shell but also for other perishable agricultural produces available in the proposed area; developing skills among the women beneficiaries regarding the use of a low cost charring drum for carbonization of biomass and optimization of burning time and charring time for effective and better recovery of char from the biomass. The beneficiaries participated

in the programme have been convinced to earn by preparing biocoal (briquetted char) from waste green coconut shell through hand press method with the technology, using a 30 kg capacity charring drum. The activities have initiated to establish the linkage with (i) MahilaSamities, (ii) Pollution Control Board of the state, (iii) Coconut Development Board of the state and (iv) Local KrishiVigyan Kendra for wide dissemination of technology. The training to the other women identified is in under process.

1.1.3. Promoting Opportunities for Women Empowerment Rejoicing through Traditional Arts/Crafts for Women in Varanasi District, U.P. undertaken by Sai Institute of Rural Development, Varanasi, U.P.

The objective of the project is to enhance the skills, productivity & livelihood of the identified women artisans of Varanasi through capacity building & training in traditional arts/ crafts, embroidery, design making. The project will promote adoption of new technologies in the given field. The three locations i.e. i) Badagaon Block, ii) Pindra Block and iii) KashiVidhyapeeth Block were selected based on the number of trainee calculated in the area and interest of the women conduct the training. 31 training programs have been conducted for 962 identified women from 3 blocks i.e. Baragoan, Pindra and KashiVidyapeeth of Varanasi District and Imparted training to 261 women beneficiaries on Handicraft; 165 women beneficiaries on Embroidery and Textile and 184 Women Beneficiaries on Kabad se Jugad. The various products prepared during the training under Handicraft, Embroidery and textile and Kabad se Jugad (i.e. Dress like Kurti and Tops, Ear rings & Bangles, Necklace, Bouquets, Garlands, Flowers, Wall Hangings etc.). Three EDP programs have been conducted for 134 selected beneficiaries. The products made by the trained women is being marketed by Hunar-a-Banaras. The imparting training to other identified women and market survey for absorption of end products in the markets and develop a market linkage to help the women beneficiaries in selling the product is under process.

Skill training on Handicraft, EmbroideryCAD Tool Training and Textile and Kabad se Jugad

1.1.4. Socio-Economic Development of Women Weavers Community in Dakshina Kannada and Udupi districts of Karnataka undertaken by Dept. of Business Administration, Sahyadri College of Engineering & Management, Mangaluru, Karnataka.

The project has been taken up with a view to train women on power-looms to increase efficiency & productivity, to upgrade the skills of women leading to entrepreneurship and to provide awareness on marketing. The main objective of this project is to train 150 women in power looms, upgrade the skills of women as entrepreneurs and create marketing assistance for women weavers to market handloom products. A total of four batches (45 days each) of Power Loom Training cum demonstration programmes have been conducted for training 51 women identified from Udupi and Dakshina Kannada Districts to develop self-employment ability on production using Power loom. Under the training, women were trained on use of efficient looms for manufacturing handlooms. The introduction of women weavers to efficient handlooms would benefit in reduction of physical stress on their legs and hands in addition to improvement in quantity and quality. The training is creating awareness and providing opportunities for self-employability. It is also giving guidance to the women beneficiaries on procuring financial assistance and marketing strategies to scale up the business. The power loom trainees were also involved in the manufacture of Indian National Flag on the occasion of

AzadiKaAmritMahotsav and weaved 500 different sizes of Indian National Flags using power looms.

1.1.5. Training of Progressive Technologies and Capacity Building for Himalayan Community" undertaken by Himalayan Environmental Studies and Conservation Organization (HESCO) Dehradun, Uttatakhand.

The project has been taken up with a view to train rural Himalayan women of Uttarakhand mainly in two regions i.e. Chakrata&Bandal valley of Dehradun District. This project is to build the capacity of women in Dehradun district of Uttarakahand to be self-reliant by learning technological advancement with local resources. The project also envisages to enhance the entrepreneurial skills of the women as a source of livelihood. The Major technologies under which women were trained are: (i) Herbal incense sticks (Dhoop and Agarbatti); (ii) Herbal Gulal; (iii) Turmeric Capsules; (iv) Dehydration of flowers and foliage to develop products; (v) Distillation Technology; The area chosen for this project is Dehradun District (Chakrata&Bandal Valley) in the state of Uttarakhand where turmeric, flower from temples, waste wood is the abandoned source of raw material for processing of herbal incense sticks, herbal gulal and turmeric capsules. Till date 27 skills oriented training cum demonstration programmes have been conducted in the villages and HESCO campus and trained a total of 567 women, 49 master trainer identified from both valleys of 10 Villages. The beneficiaries participated in the programme have been convinced to earn by preparing these products like Dhoop&Agarbatti, Turmeric Capsules and Herbal Gulal. The activities have initiate to establish the linkage with the local market and some online marketing startup of the region to ensure continues selling of produced products. The training to the other women identified is in under process.

Herbal GulalTrainingDhoop-Agarbatti Training

1.1.6. Training of Rajasthan rural women on use of biofertilizer for crop productivity enhancement undertaken jointly by Amity Institute of Microbial Technology, Amity University, Noida and Arid Forest Research Institute (AFRI), Jodhpur, Rajasthan

The main objective of this project is to train Rajasthan rural women farmers on benefits of biofertilizers based on the endophyte Piriformospora indica for crop productivity enhancement. To select the trainees, the details of the training program was publicized through local newspapers and the same was intimated to Central and State Departments and Women groups, seeking their help in identifying women with entrepreneurial zeal. The three locations: i) 4 Villages of Tiwari Tehsil, (MathaniaBlock), (i.e. Ramsagar, Kachan, Pipalki, Mathania); ii) 4 Villages of Falodi Tehsil: (i.e. Amla, Bapini, Batiyali, Jaloda) and iii) 4 Villages of Bilara (i.e. Harsh, Deval, Karmavas and Bilara) of Jodhpur Dist., Rajasthan were selected to conduct the training programmes. The biofertlizer preparation process was standardized and optimized. 80Kg of biofertilizer was prepared for imparting the training at identified block of Jodhpur Dist. The skill up-gradation training about the applications of bio-fertilizer which increase the yield crops and impart value addition to plants, dose of application and the methods of application, beneficial effect of biofertilizer etc. was provided to 72 Nos of women

farmers.Pamphlet and brochures incorporating the information about the bio-fertilizers and its applications were prepared in Hindi language. The printed copies were distributed to the women beneficiaries for dissemination of the technology. Three technical sessions were conducted to train the identified women. During the session, the women farmers were briefed about the applications of bio-inoculants which enhanced the yield of the economically important crops and improved value addition to plants. The dose of application and the methods of application were explained to them and along with mass multiplication of these biofertilizers. The training to the other women identified is in under process

1.1.7. Building Capacity of Tribal Women Farmers in Production of a Farm Based Nutritious Food Product for Tackling Malnutrition, Drudgery Reduction and Income Generation through Enterprise undertaken by Deepak Foundation Vadodara.

The main objectives of the project was to build capacity of tribal women farmers so that they can earn a better livelihood through food processing. Cluster of 20 Villages in Naswadi block of ChhotaUdepur District of Gujarat were selected based on the survey conducted in the project area. Total 756 nos of women were trained by skilled and experienced trainers on various aspects. Imparted trainings on dal mill operation to 23 women; 20 women were trained on processing unit operation; 60 women on marketing & account management; 491 women on FPG management; 44 women on FPG leadership & enterprise development for leaders; 10 women on FPC Board of Directors on compliances; 18 women on flour mill operation; 18 women on masala mill operation; 18 women on processing of custard apple; 18 women on processing of tomato; 18 women on grading, sorting and cutting of vegetables for vegetable selling business and 18 women on packaging within stipulated time period. The women beneficiaries marketed their products at platforms like 'One Station One Product situated at Railway Station (Vadodara and Bharuch), at Vadodara Airport, and during fair organized by Mission Mangalam at ChhotaUdepur. The trained women continued activities like training of spices through 'ApniDukan' at village level, selling of vegetables, milling and trading of pulses, flours; earned through labour work for packaging food relief kits, spices, flours, khichdi, ketchup and pulses. Apart from income generation activities women were

Processes before milling grains

One station one Product Stall at railwaystation

also engaged newer product development like 'Jelly' and 'Hand Grounded Spices'.

1.1.8. Dehydrated Flowers and Foliages for Women Empowerment undertaken by CSIR-National Botanical Research Institute, Lucknow.

Dry flower industry is growing very rapidly, and at present, contributes about 70% of the earnings of the total floriculture produce.Fresh flowers,though quite attractive, are short lived and available only in particular season. Their freshness and beauty are lost due to various biochemical changes and microbial activities. Dried flower products are long lasting and retain their aesthetic value, irrespective of the season. The main objectives of the project are skilling women for self-employment, income

generation and competency, using dehydrated floral crafts (DFC) as enterprise and to establish women Self Help Groups (SHGs) as model DFC entrepreneurs. The area chosen for this project is CSIR-NBRI, Lucknow, Uttar Pradesh which has a Botanical Garden, rich in floral diversity. Seven skill oriented training cum demonstration programmes have been conducted for training of 189 women beneficiaries since start of project. Conducted three months training programme in collaboration with an NGO "Ehsaas"andtraining kits were given to each trainee after which presentation session was organised based on the preparation of different artifacts along with its precautions. The trainees were trained for collection of plant material, their drying and preservation, making bookmarks, cards, land scope and 3D containers round, cylindrical (small and large) etc. The trainees were also given exposure to making resin-based arte facts, incorporating dehydrated flowers and foliages. In these training programmes, five master trainers were identified who are popularizing the technique. The training to the other women identified is in under process.

1.1.9. "Promotion of Stevia- A gift of Nature "0"calorie bio sweetener- for Income Generation of Female Farmers in Chandrapur District, a backward District of Maharashtra and sugar alternative to diabetic population of India" undertaken by AFORD, Bramhapuri, Dist. Chandrapur , Maharashtra

The main objectives of the project was to form Women Stevia Growers Group (WSGG) and empower them through adaptation of stevia crop for better income opportunities, towards doubling the farm income; to impart training on the stevia cultivation and management, to establish complete value chain from cultivation to marketing of the produce, by providing training and guidance during cultivation and buyback option for the produce. A nursery for Stevia cultivation has been established. 100 Nos of women farmers were trained on land preparation, preparation of raised beds, planting of sapling, plantation management covering irrigation, understanding of growth, disease if any and weeding, Harvesting. 100 nos of women in five groups have been provided hands-on training on plastic mulching, harvesting in 10 groups at 5 locations. Training on drying and packaging: how to dry, remove leaves and pack of the stevia leaves was also imparted to the participants on farm. 20 master trainers trained for provided training. Initiated the activities for networking with various

framers, farmer producer organizations and state government organizations for promotion of the stevia crop.

1.1.10. Empowering women through appropriate technology intervention in weaving sector for productivity enhancement and drudgery reduction of artisans undertaken by IIT Guwahati.

The project has been taken up with a view to train women through appropriate technology intervention in weaving sector for productivity enhancement and drudgery reduction of artisans. The main objectives of the project wasto impart the training on various techniques like Hank to Bobbin Machine, Pirn Winding Machine, Sectional Warping Machine and Semi Automated Handloom. Two locations i.e. i) Village- Nisalamari, Dhamdhama Development Block and ii) Village - Amingao, Bezera Block, Dist. Kamrup, Assam were selected to conduct the training programmes. Total 11 villages (i.e, Ghoramara, Kadamtola, Thalkuchi, Khagrabari, Garbhitar, Gowalbil, Harharia, Jartaluk, Chamridwar, Madaltana and Nisalamari under Dhamdhama Development Block) in BaksaDist, Assam were selected and identified the women beneficiaries on the basis of the primary data collected through focused group

discussions, interaction meetings with SHGs and block heads with NGO, GramyaVikash Mancha and willingness of a participant to undertake the training. 300 beneficiaries identified according to criteria decided by IIT Guwahati and the GVM. Total 60 women in 5 batches have been trained. The topics covered while conducting the training to the women beneficiaries are: i). Awareness on importance of uniform quality of products; ii): Hands on training on Hank to Bobbin winding Machining; Module; iii): Hands on training on Pirn Winding Machining; iv). Hands on training on Sectional Warping Machining; v) Hands on training on fabric production in Semi-Automated Loom and vi) Maintenance of machineries.The training to the other women identified and creating a market linkage to help the women beneficiaries in selling the product (i.e. Link with SHGs, KhadiGramodyog outlets in Fairs / exhibitions, Set-up shop in market etc.) is in under process.

1.1.11. Enhancing the livelihoods of tribal and rural women through technological intervention of trainings on postharvest handling and value addition of custard apple and ber fruits under taken by IARI, New Delhi

The aim behind to take up this important project was to utilize custard apple and ber fruits abundantly available in saurashtra region of the Gujarat state for livelihood creation to rural women. This region experiences scanty rainfall with arid climatic conditions, predominated by tribal communities. The women constitute about 80% of work force of agricultural and allied activities. The project envisages to enhance the skills of the women on custard apple pulp extraction, preservation hygienic packaging, and marketing through various state agencies. The custard apple pulp is in high demand in ice-cream making units. Besides, custard apple, ber is another important fruit which has very high lively hood potential for rural women in Saurashtra region. The specific area chosen for this project is Junagadh Dist. in the state of Gujarat where custard apple and ber are naturally grown without much expenditure on crop cultivation. In this project, conducted 05 custard apple processing skills oriented training cum demonstration programmes in which 278 women from Dhanfulia, Luvasar, Bhatiya and Banthali of BanthaliTaluka of Junagadh district were identified

Training of women on handling and processing of custard apple fruits

and trained on pulp extraction, preservation and packaging of custard apple. The awareness among the women was also created on complete utilization of processed waste (seed, peel) of custard apple. The interactive sessions of the trainees were also conducted with Junagadh University Extension Director, State Agriculture Department officials for their easy access to trainees for future continuity of the project. The activities have initiate to establish the linkage with (i) Local KrishiVigyan Kendra (ii) State Agriculture Department for wide dissemination of technology. The training to the other identified women is in under process.

1.1.12. Mechanized system for making hawaijar-A traditional fermented food of North-East India by ICAR-Central Institute of Post-Harvest Engineering and technology, Ludhiana, Punjab.

This project aims to develop a mechanized system for making hawaijar(Local name of the product in Manipur) which is a traditional fermented soybean product of North-East India. This product is entirely made and sold by the women folk of the region. The objectives of this work are (a) Fabrication & validation of mechanized system for preparation of hawaijar (b) Awareness & Capacity building of women entrepreneurs/SHGs of North-East India

Fig: (a) Hawaijar maker (b) Fermenting Unit (c) Soaking and Cooking Unit

on this technology and (c) Entrepreneurship development training of women beneficiary on the technology developed. A prototype has been developed and optimization of the process parameters are in progress. The system has an integrated unit of soaking, cooking and fermenting which are the important unit operations in producing hawaijar. It has also controlled unit of temperature and pressure during the processes using Programmable Logic Controller (PLC). For microbial study, hawaijar has been prepared by traditional method (wrapping in banana leaves) using local soybean of North-East. In similar way, soybean has been prepared in steel container and glass container to see how the packing material affects the biodiversity of the microorganisms that will grow during fermentation. The microflora presents in naturally fermented soybean samples were examined by spread plate method using different media like nutrient agar and potato dextrose agar are used. For identification, the Bacillus Subtilis (MTCC) has been used as a standard culture. Study on the cell morphology and biochemical identification confirmed that bacterial cultures isolated from natural fermented Hawaijar belong to Bacillus spp.

Three days awareness training program for women SHGs/Entrepreneur/FPOs was also conducted twice at various locations of Manipur. Viz. Khurkhul Village, Imphal West District; Kakching, Kakching District; College of Food Technology (CoFT), CAU, Imphal, Ahallup, ThongjuPheijaleitong and Lamlai of Imphal East District and KVK Thoubal of Thoubal. The benefits of hawaijar and its different value-added products along its commercial potential both in the region as well as international market were highlighted. Additionally, they were made aware of the continuing automated system project as well as the scientific processes and hygienic procedures used in hawaijar production. Design and operation of the mechanized system were also explained to the participants. The women participants were emphasized on the ventures which can be taken up as a means for enhancing income and start their own enterprise. A total number of 327 women participants from different locations of Manipur attended the awareness training programme.

1.1.13. Skill Development Program on processing, preservation and value addition of Food & Agro based products for commercial use in Eight Aspirational Districts of Uttar Pradesh with special emphasis on development of women

entrepreneurs undertaken by CSIR-CFTRI (Regional Centre), Lucknow.

The main objectives of the project is to (i) To utilize the Agro/food based raw materials available in abundance in the region for making various value added products. Thereby benefiting the growers of the region, and upliftment of status of common masses by generating self-employment and income; (ii) To generate considerable employment for the skilled as well as unskilled population especially the women entrepreneur by means of setting up tiny/cottage/small scale food industries based on simple technologies developed by CFTRI; (iii) To empower women entrepreneurs through training in generating self-employment opportunities and also to provide the basic nutritional requirements to the common masses for maintaining better health standards; (iv) To catalyze the establishment of full-fledged food processing units in the region. Upgrading the existing traditional methods with adaptation of newer technologies.

They have already imparted training bilingually by creating a bilingual training manual both in English & Hindi regarding Geography, production of fruits and vegetables, cereals and pulses, and other agro crops grown in the region. They have included preparation, preservation and management of the Food and Agro based value added products as proposed in the project. The training manual were, distributed among women trainees selected in Balrampur, Bahraich, Shravasti and Siddharthanagar districts of Uttar Pradesh. Further they have carried out the survey in the above districts for finalizing Food and Agro based raw materials availability and training schedules. They met concern State Government official who is working in developmental scheme and women empowerment in the Government of Uttar Pradesh in these aspirational districts. They have selected prospected women entrepreneur with the help of leading NGOs as well as through state government officials for imparting of training – cum-demonstration programs.

They have conducted 05 days of traiing-cum- demonstration programs to 163 women beneficiaries in Sidddharthnagar, Balrampur, Bahraich and Shravasti districts of Uttar Pradesh from May 2022 to October, 2022. They have imparted training-cum-demonstration towards preparation, preservation and management of the Food and Agro based value added products as proposed in the project. The training manual were, distributed among women trainees selected in Balrampur, Bahraich, Shravasti and Siddharthanagar districts of Uttar Pradesh.

1.1.14. Women Empowerment through Silkworm Culture in Tribal Dominated Mayurbhanj District of Odisha undertaken by Mayurbhanj Biological Research (MBR), Odisha.

The specific objectives of the project is to (i) To undertake capacity building programmes by organizing training courses on latest technologies for silkworm rearing to increase silk production, reduce silkworm diseases, pest control, and larva care systems for retention of improved silkworm races; (ii) To expand employment and livelihood opportunities through development of skills of women on cluster-scale mulberry cocoon production, and its demonstration; (iii) To ensure marketing opportunities for sericulture produce; (iv) To identify socio-economic and technical indicators for expansion of area under sustainable sericulture.

They have already started imparting training-cum-demonstration programs to 62 Women Beneficiaries/ Women Farmers in Four Villages of Mayurbhanj District i.e., Alubani, Jhilirbani, Mudrajodi, Kitadihi. Further they have taken Technology support from Central Silk Research & Training Institute (CSRTI), Berhampur, WB. They have conducted 2-day initial training and awareness program in Mulberry Plant Cultivation & Silk Worm Culture in Alubani, Jhilirbani, Mudrajodi, Kitadihi villages with approximately 12-18 Women Beneficiaries in each village. The organization has created a bilingual training manual (English &Odiya) were, distributed among women trainees selected from Alubani, Jhilirbani, Mudrajodi,

Kitadihi villages of Mayurbhanj district 62 Women Beneficiaries and training schedules. They have selected prospected women farmers with the help of state government officials for imparting of training –cum-demonstration programs.

They have conducted 02 days of training-cum-demonstration programs to 62 women beneficiaries in Alubani, Jhilirbani, Mudrajodi, Kitadihi villages from April, 2022 to October, 2022. They have imparted training-cum-demonstration towards Mulberry Plant Cultivation & Silk Worm Culture, Land Preparation towards Mulberry Plantation, Mulberry Stem Cutting & Planting with Weed Management, Application of Biofertilizers to Mulberry Plantation, Training and Demonstration on Mulberry Rise-Bed Development Technology, Mulberry Plantation Management, Pest & Disease

Mulberry Cultivation Program photos

Control on Mulberry Plantation (Tukura Disease Control on Mulberry Leaf) as proposed in the project. The training manual were, distributed among women trainees selected from Alubani, Jhilirbani, Mudrajodi, Kitadihi villages of Mayurbhanj district of Odisha.

1.2 Women's Day Celebration:

Program division celebrated International Women's Day on 8th March 2022 under the theme announced by the United Nations "Gender equality today for a sustainable tomorrow". Dr SujataChaklanobis gave the welcome address and while talking about the status of women at national and international level, shared the vision and objectives of TDUPW program of DSIR towards women empowerment by creating economic opportunities through technology intervention. Dr. Shekhar C. Mande, Secretary, DSIR & DG-CSIR in his keynote address spoke about the role of women in society and science and how a society with empowered women leads to an empowered nation.

Second session of the program had talks from four incredible women speakers of high accomplishments and great success in different fields of life namely, DrVasudhaKamat, who is Chairperson, Governing Board, at CEC (Consortium of Educational Communication) and former Vice Chancellor of SNDT Women's University, Mumbai; Padmashri Ms. SantoshYadav who is first women in the world to climb Mount Everest twice; DrGagandeep Kang, a leading Virologist, microbiologist and Epidemiologist and DrAnuradhaAcharya a young entrepreneur, and Founder & CEO of Mapmygenome and OcimumBiosolutions (2000 TO 2013). The speakers enthralled the audience by sharing their struggles and bottlenecks faced in reaching their current milestones of life and enriched the participants with their thoughts on women empowerment.

As a part of celebration a desk study report "Social & Economic contributions of Women in Manipur" was released. The report was catalyzed and prepared under a TDUPW program supported project. It is a way to celebrate the social, economic, cultural and political achievements of women of Manipur. The study is an attempt to share an insight into the gap, constraints and scope for inspiring, supporting and creating opportunities which can enable women of Manipur to earn their living and also empower them as individuals to participate in the development of the North Eastern Region.

2.0 ACCESS TO KNOWLEDGE FOR TECHNOLOGY DEVELOPMENT AND DISSEMINATION (A2K+) – STUDIES

2.1 PREAMBLE

The objectives of A2K+ Studies program is to support studies in current and emerging areas of technology aimed at providing useful information and knowledge base to industry, industry associations, academia, research institutions,

consultants, entrepreneurs, research students and policy makers for doing any further work in these areas; to study and analyze the developments in the emerging technology areas and document the findings, learning's and outcomes for wider dissemination and preparation of status reports on technologies from public funded institutions that are ready for commercialization with a view to catalyze the translation of research output from institutions to market.

2.2 Study Theme Areas

(i) To enhance the scope and outcome of the studies conducted under A2K+ Studies scheme, the Department communicated with 65 Ministries/ Departments, seeking inputs on the specific technological requirements of allied industry and their stakeholders. Based on the themes suggested by Line Ministries and areas of mutual interest, Department is supporting 13 new studies which are expected to be beneficial for academic and scientific community in India and guide Line Ministries in developing future technology roadmap & policy formulation in their strategic sectors.

(ii) Understanding the need for scouting of market ready technologies and assessing the Technology Readiness Level (TRL) of technologies available in research institutions, academia and startups, a call for fresh proposals was issued on theme- "Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry". Department has supported six studies under six technology

S. No	Proposal Title & Organization	Recommended Sector
1	Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry Applicant Organisation: Foundation for Innovation and Technology Transfer, Dean's complex. Main Building, IIT Delhi, HauzKhas, New Delhi-110016	Energy & Transportation
2	Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry Applicant Organisation: Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi	Medical Sciences and Healthcare & Pharmaceutical and Chemicals
3	Access to Knowledge for Technology Development & Dissemination (A2K+) Studies Applicant Organisation: Indian Institute of Technology (ISM) Dhanbad	Food Processing and Agriculture Technologies
4	Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry Applicant Organisation: Indian Institute of Technology Roorkee, Haridwar -District Uttarakhand	Manufacturing & Electronics and Telecommunication
5	Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry Applicant Organisation: Indian Institute of Technology Jammu, Jagti, PO Nagrota, Jammu	Material and Manufacturing
6	To study and analyse the developments in the emerging technology areas of drinking water purification systems and document the findings, learnings, and outcomes for wider dissemination; and preparation of status reports on technologies from public funded institutions, that are ready for commercialization with a view to catalyze the translation of research output from institutions to market Applicant Organisation: International Centre for Clean Water (ICCW), IIT Madras Research Park, Chennai	

domains. These studies are expected to provide a database of technologies at TRL level 6 & above in six identified sectors and enhance the scope for commercialization of technology developed by public funded Institutions and startups. The six technology domains under which the six studies have been supported are :

(iii) Department advertised a fresh call for proposals on six themes of mutual interest aligned with Line Ministries and Departments. 10 proposals have been recommended by the TAC for financial support on the following themes:

1. A study report on development of new building materials using agro-industrial waste like PVC Waste, Municipal Waste, Construction & Demolition waste, hospital waste, e-waste etc
2. A study report on research on indigenous development of membranes for sewage treatment to promote it's recycle and reuse.
3. Report on advanced building materials and building design towards energy efficient building
4. A report on ICT tools catering to a wide range of learners, including Children with Special Needs
5. Study report on development of cost effective technology/ instrumentation in waste management systems such as Sensor based bins, Sensor based automatic waste collection system through garbage chutes in residential buildings

2.3 Studies completed during the period 2022-23

2.3.1 Technologies Strategies and Branding Manifestations for better firm performance – A comprehensive study from the year 2000 to 2019, after phases of liberalization of the Indian Economy by Symbiosis School of Media and Communication, Bangalore

The study entitled "Technologies Strategies and Branding Manifestations for better firm performance - A comprehensive study from the year 2000 to 2019, after phases of liberalization of the Indian Economy" was supported to Symbiosis School of Media and Communication, Bangalore. The objectives of the study were – (i) to study the impact of technology strategies on branding and marketing outcomes of durable companies in India; (ii) to study the effect of technology based branding on market and financial performance of Indian and foreign firms; (iii) to study the impact of technology policy variables of GoI on branding strategies and performance outcomes of these firms. This study has provided information on the (i) drivers of good performance of the Indian companies and how are they different from the MNCs approaches; and (ii) best technology and branding strategies to improve the performance of consumer durable companies in India.

2.3.2 Speeding up the Lab to Market Journey: Repurposing Drugs for COVID-19 by Entrepreneurship Development Center (EDC), Pune

A project entitled "Speeding up the Lab to Market Journey: Repurposing Drugs for COVID-19" was supported to Entrepreneurship Development Center with the objectives to (i) track and collect information on technology development efforts on repurposing of drugs in India and abroad ; (ii) create an advisory group that reviews the data, helps prioritize the leads, identifies barriers and provides a learned opinion of the same when asked; (iii) create a virtual network of technology development, translation and commercialization stakeholders so as to help increase speed to market (to engage with academia, research organizations, industry, regulators etc. as needed & to "connect dots" and identify useful collaborations) ; (iv) leverage the office of PSA to facilitate the journey to market and use by doctors; (v) contribute to getting practical solutions in use for COVID-19. The study constituted an interdisciplinary advisory group of 20 experts from diverse background such

as clinicians, scientist, regulatory and clinical trial experts, IP experts etc. Under the study, a website has been developed to showcase the data related to study (https://nclinnovations.org/covid19/).

The project has been completed and the key outcomes of this study include detailed and carefully curated information on drug candidates, assessment and ranking frameworks that can be used for any suggested molecule, comparative charts assessing different drug molecules, a virtual translation network to support drug developers. All this was done in consultation with an Advisory Group. Although this study was performed during the period of COVID-19 pandemic, the outcomes and structure of this study could be helpful in guiding National strategy on repurposing drugs in the early stages of the pandemic.

2.3.3 An assessment study of the commercialization of already developed technologies of the Public Funded Research Institutes established in Madhya Pradesh and to evaluate their relevance in synchrony to the technical requirement of the local industries by Rabindranath Tagore University, Raisen, MP

This study was supported to Rabindranath Tagore University, Raisen, MP with the objectives to (i) study and assess the status of the technologies developed at the public funded institutes with respect to their commercialization; (ii) study the relevance of the developed technology in relation to local specific problems; (iii) analyze the gap between the existing industrial requirements and ongoing researches in these regional institutes; (iv) map local industry based on their requirement to relevant government funded R & D institute of MP.

It has been observed that PFRIs like CSIR/ICAR have been successful in generating extra budgetary resources apart from their allocated government budget. It was found that about 24 % industries used technologies developed by PFRIs. In spite of several pro-active measures, large number of technologies developed in the Indian publicly funded R&D laboratories have remained either unexploited, or the desired impact has not been made by the transferred technologies, although a beginning has been made. Public Funded Research Institutes may give the main attention on the development of commercially viable technologies suitable for local industries as was targeted by CIAE and AMPRI. Technologies commercially viable and relevant of the local industries should be considered for the development. Coordination mechanism of these institutes with local industries is better. Institutes are to be actively involved in exploration of the industries to carry out Technology Transfer and commercialization activities. Study found that presently, universities have restructured their research capabilities to be more responsive to local industry—for example, setting up specialized research units, joint cooperative ventures or interdisciplinary projects that are more receptive to industrial needs. In order to make the technology transfer and technology commercialization more relevant the study has provided few recommendations. The study has been completed and provided a comprehensive report on the technology transfer and commercialization from the public funded research institutes in MP.

2.3.4 Studies on Technology & Innovation Management by CSIR-Institute of Himalayan Bio Resource Technology (IHBT), Palampur

The project entitled "studies on technology and innovation management" was supported to IHBT, Palampur with the objectives to (i) study the extent of linkages (collaborative, sponsored, consultancy, transfer of technology, incubation etc.) amongst academia, R&D and Industry; (ii) study the innovation policies of various academia, R&D institutes and industry of the region and its mechanism for industrial research, IPRs and transfer of technology; & (iii) study the R&D needs of Industry and the extent of in-house R&D and technology out sourcing. The study presented two case studies (success/ failure) for linkages amongst academia, R&D and Industry.

The study revealed that there is poor collaboration

and knowledge transfer between industry and university/R&D institutes/colleges. Among the barriers against effective collaboration and knowledge transfer, the study noted few including the lack of research orientation, industry experience and commercial mindset of the academicians, different motivations of academia and industry for collaborations. The study addresses concerns from the perspectives of the two key stakeholders, academia/R&D institutes and industry. Outcomes of this study includes - recommendations for strengthening the linkages of industry with Academia and R&D Institutes, sharing of Good practices, new avenues for collaboration and support in policy framing.

2.4 Ongoing studies during the period 2022-23

2.4.1 Readiness and Interest of Organizations for Adopting Emerging Technologies Like AI and ML: A Research Study Proposal by All India Management Association (AIMA), Delhi

The study entitled "Readiness and Interest of Organizations for Adopting Emerging Technologies like AI and ML: A Research Study Proposal" has been supported to All India Management Association (AIMA). The objectives of the study are - (i) study technology readiness for AI and ML implementation (identify major AI technologies available in India). (ii) Identify key factors impacting the adoption of AI in organizations (iii) design and validate the framework over a set of organizations to identify factors which impact AI adoption (iv) Examine key challenges being faced by the organizations in implementing the technology/ies and recommendations to minimize the challenges (v) identify key sector, sub sector for AI implementations in India and suggest relevant AI technologies (vi) Develop an AI-readiness framework like a capability maturity model at firm level and sector level (road map for AI implementation sector wise, Firm wise) (vii) suggest key organization task/ processes where AI implementation is easy, cost effective and does not disturb the current organization structure.

Currently the study is ongoing. Expected specific outcomes of the study are to: (i) the emergence of AI in society has presented several challenges, particularly at organization level (ii) on the theoretical side; this study will contribute to the body of knowledge through exploration of the innovation of technology adoption theory and by identifying factors affecting an organization's readiness for AI (iii) On the practical side, this study will provide insight into AI adoption by helping organizations to be prepared and successful in implementing this emerging technology (iv) Research provided a thorough conceptualization of organizational AI readiness. Since AI's nature as a General-Purpose Technology, the context- and purposes specifics, and the mutually reinforcing interplay of AI readiness and AI adoption.

2.4.2 Readiness and interest of organizations for adopting emerging technologies like AI and ML by Indian Institute of Technology Indore

The study entitled "Readiness and interest of organizations for adopting emerging technologies like AI and ML." has been supported to Indian Institute of Technology Indore. The objectives of the study are to: (i) conduct an in-depth study of the existing events encountered by the power systems. Additionally, examine the effect of increasing renewable penetration on the dynamics of the events (ii) Investigate the different AI and ML methods for the detection of both transient and oscillatory events for the Indian power system (iii) develop a scalable and real-time solution for event detection, localization, and classification (iv) develop data analytics techniques to convert the big data from the phasor measurement units (PMUs) into actionable information for increased situational awareness for the power system in real-time. Currently the study is ongoing. Expected specific outcomes of the study are (i) the project would be an AI/ML based solution to predict and identify the different types of events encountered by the power system. (ii) Proposed method will be able to detect the time at which the fault

occurred, and it will detect the location of the fault along with identification of the type of event. (iii) Architecture will be developed to deploy the AI/ML solutions in real-time (iv) Proposed solution will be immune to bad data, noises in the system, and network delays. (v) Algorithm developed under the study will be tested using standard IEEE test system. Moreover, the facility of Real Time Digital Simulator (RTDS) at IIT Indore would be pivotal in the testing of the developed solutions in real-time.

2.4.3 Machine Learning in Mechanics: Current Status and Future Prospects submitted by Indian Institute of Technology, Tirupati

The study entitled "Machine Learning in Mechanics: Current Status and Future Prospects" has been supported to Indian Institute of Technology, Tirupati. The objectives of the study are (i) Significance of existing computational strategies in mechanics and their relation to ML. (ii) Explore the class of problems amenable for solutions within the ML framework. (iii) Integrate ML tools within the computational mechanic's framework to aid informed decision making. (iv) Identify specific engineering problems where newer ML tools need to be developed. Currently the study is ongoing. Expected specific outcomes of the study are (i) highlight the state of knowledge in applying ML tools to various problems in mechanics, which will serve as a useful guide for academia and industry. (ii) Study will help stakeholders appreciate the relevance of ML tools for a specific application and accordingly make informed choices. (iii) The findings of the study will help organizations understand the requirements of ML tools, recognize their preparedness, and equip themselves in adopting these tools to develop solutions to mainstream applications.

2.4.4 Readiness and interest of Indian refineries for adopting AI/ML technology for operations submitted by Rajiv Gandhi Institute of Petroleum Technology (RGIPT), UP

The study entitled "Readiness and interest of Indian refineries for adopting AI/ML technology for operations" has been supported to Rajiv Gandhi Institute of Petroleum Technology (RGIPT), UP. The objectives of the study are to (i) Creating awareness among Indian refineries regarding the applications and benefits of AI/ML. (ii) Understanding the readiness of Indian refineries for the implementation of AI/ML technology. (iii) Generating a patron database, to help Indian refineries develop prospective solutions for related problems employing AI/ML technologies. Expected specific outcomes of the study are: (i) plan to utilize the vast stores of process-data collected over several years and stored by refineries, and use them to develop intelligent industrial setups. (ii) Integrative IoT webs to enhance overall visibility and efficiency; AI-powered optimization insights to improve refinery operations; Predictive analytics for proactive maintenance of critical and super-critical assets; automated spares-inventory management; and development of automated process-control Operator Training Simulators. (iii) Transition in industrial setups would deliver several benefits: maximize operational and managerial efficiencies, and drive down functional costs significantly. (iv) Conduct multiple industry visits which will help us to gain first-hand insights into existing refinery processes, the current challenges they face, and the most suitable aspects for disruptive AI/ML intervention. (v) we will also be delivering documentation for the various methodologies, our research outcomes, and the use-case specific findings for the proposed solution.

2.4.5 Artificial intelligence based loaded forecasting models for load dispatch centers in India submitted by Symbiosis Institute of Digital Telecom Management, Pune

The study entitled "Artificial intelligence based loaded forecasting models for load dispatch centers in India" has been supported to Symbiosis institute of digital telecom management, Pune. The objectives of the study are to (i) develop a graphical user interface (GUI) based load forecasting models. (ii) To load forecasting for long term for load

dispatch center (LDCs)in India. (iii) to improve the accuracy of the load forecasting using different AI techniques. Expected specific outcomes of the study are: (i) Development of AI based stable and reliable power distribution system with: (a) comprehensive/extensive domain expertise. (b) Capability to adapt to new circumstances. (c) Capability to deal with ill-conditioning and cohesion problems. (d) higher accuracy of load requirement prediction/load forecasting. (ii) Development of a module which will be integrated to LDC, WRLDC to automatically fetch the data and feed to the algorithm for continuous monitoring. (iii) Development of a module which will be integrated to LDC, WRLDC to automatically fetch the data and feed to the algorithm for continuous monitoring. (iv) Research papers in reputed journals and patenting the part of the research work. (v) Development of State-of-the Art research facilities at the institute. (vi) the state load dispatch centers to make the grid management more efficient and thereby optimizing the costs.AI relies heavily on good problem description and extensive domain knowledge. The information-based system, Expert Systems (ES), suffered from an expertise deficiency due to its inability to learn or adapt to new circumstances. Information-based systems can boost a power system's capabilities, while ANN can gain knowledge through integrated learning and generalization. The outcome of the work will be disseminated through publication in reputed SCI indexed journals like IET generation, transmission and distribution, IET SMT, IEEE transaction on Power delivery, Power system, smart grid, EPSR, IJEPES, etc.

2.4.6 Studies on air ventilation in central Air-conditioning units in post-COVID-19 scenario guided by machine learning and artificial intelligence techniques by IIT Delhi

Ventilation plays a critical role in alleviating airborne diseases by reducing droplets and aerosols in the air and subsequent airborne transmission. Filtration is capable of conditioning air by replacing the contaminant air with fresh air from the ambient conditions. One of the critical issues with the existing air and recirculating systems is that they are not typically capable of handling true high-efficiency particulate air (HEPA) filtration primarily due to the high-pressure drop and size constraints. Therefore, this project aims to provide a long-term solution for air ventilation in central air-conditioning units in post-COVID-19 scenarios using machine learning and artificial intelligence techniques. The entire project is divided into seven specific objectives to solve the problem, particularly focusing on the requirements of the Indian market and its users. To date, five of the seven objectives have been met. In general, the national and international status is critically analyzed, followed by a literature review and case studies. A targeted questionnaire is being sent to 64 companies to achieve the goal. In addition, samples from industrial firms like Elofic Industries Limited and AFI India have been collected and tested according to the ISO 16890 standard for general ventilation. In addition, the data from internationally published articles according to the Minimum efficiency reporting values 16 (MERV) have been collected, which sets the stage for creating a database using MySQL workbench. Collected data is used to train and develop a machine learning-based model which can aid in healthy air ventilation/ air conditioning/ air filtration/HVAC systems in the post-Covid-19 scenario according to the Indian situation. To date, India is lacking in developing the standards for HVAC systems installation and testing HEPA filters. However, there are few Indian policies available by the Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) and the Indian Society of Critical Care Medicine (ISCCM) on HVAC installation and general air ventilation, primarily governed by International and European standards. The study is under progress, one review meeting was conducted to assess the progress made and that the study is scheduled to be completed in the current financial year.

2.4.7 Study of specific areas registering high failure rate of distribution transformers to analyze the cause of failure and suggest a solution to overcome this

problem by applying IT technology and integrating it with metering solutions by PDPM Indian Institute of Information Technology, Design and Manufacturing Jabalpur, Jabalpur MP

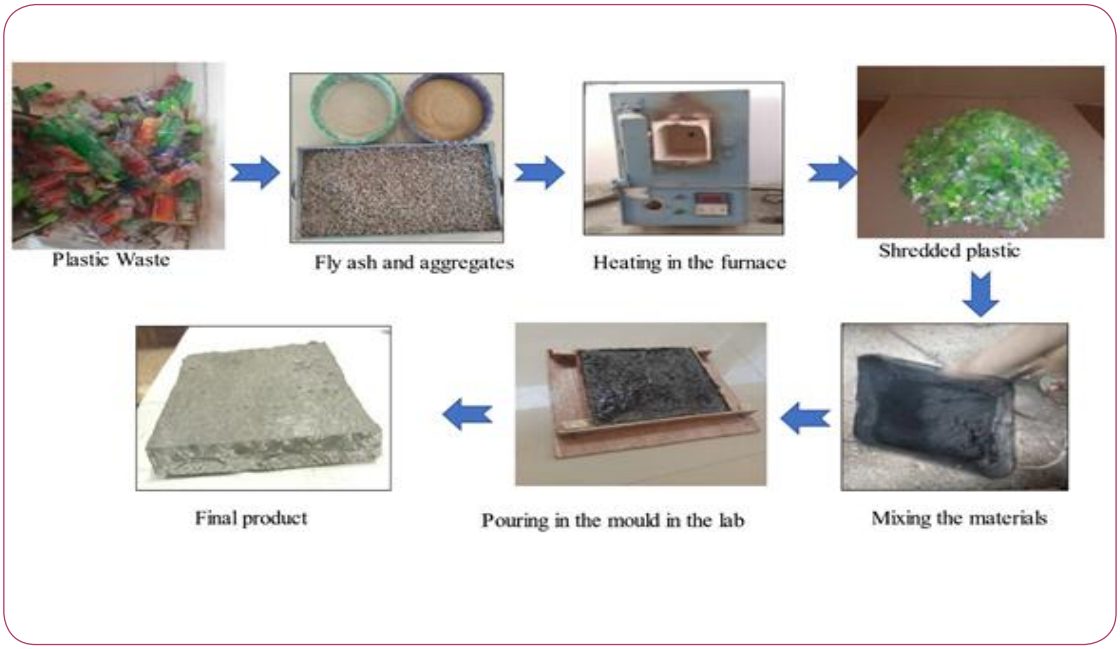
The study has been supported to PDPM Indian Institute of Information Technology, Design and Manufacturing Jabalpur (IIITD&M). Most of the DISCOMs are having revenue losses consistently. Distribution transformers failure is one of the most serious concerns of the DISCOMs that attributes to the loss of revenue. Distribution transformer failure can be attributed to many technical and operational reasons.

The study aims to provide an artificial intelligence based solution for analysis and prediction of distribution transformers with metered data. It is expected that outcome of this project will help in finding out the root causes of the transformers failures in specific areas and minimizing the rate of failure of transformers. Study intend to address the following objectives (i)Data collection related to transformer failure within a distribution area (DISCOM), (ii) Data analysis & interpretation to find out the vital causes of transformer failure, (iii) Identification of key parameters for possible remedial solution, (iv) Development of an information technology-based solution for minimizing the transformer failure rate.

The study is in progress, one review meeting was conducted to assess the progress made and that the study is scheduled to be completed in the current financial year.

2.4.8 **Smart waste management – development of cost-effective technology -study on development of high strength and durable material which can be used as construction material by recycling the waste plastic by Rajiv Gandhi University of Knowledge Technologies (RGUKT) Basar, Nirmal Dist., Telangana**

The study has been granted to Rajiv Gandhi University of Knowledge Technologies (RGUKT) Basar with the objectives i) to study to prepare the study report of about 20-30 available technologies/procedures that convert plastic waste into construction related materials and ii) to develop methodology to attain high strength and durable material which can be used as



Steps for producing construction material by recycling the waste plastic

construction material with reusing of waste plastic under different compositions and variety of base plastics. Methodologies for developing the high strength and durable materials using various compositions of the different materials and plastic waste (in various ratios) has been formulated. Two compositions have shown higher compressive strength in comparison to available reported data. Comparison of the developed composition with the existing technology material and its use as a construction material for roads is under process.

2.4.9 *Developing a framework for assessing innovation readiness, research intensity and technology resilience of firms by ABV-Indian Institute of Information Technology and Management, Gwalior.*

The study has been supported with the following objectives :

i. To analyse current state of innovation readiness in the Indian firms operating across manufacturing sector for adoption of Industry 4.0,

ii. To examine the role of research intensity in enhancing innovation capability of the Indian firms operating across manufacturing sector for adoption of Industry 4.0),

iii. To evaluate the role of technology resilience in managing emerging risks and the development of resilient innovation system in the Indian firms operating across manufacturing sector for adoption of Industry 4.0 and

iv. To develop an integrative framework representing structural relationship between constructs of innovation readiness, research intensity and technology resilience.

In this study, statistical validity of developed scales as well as fitness of the structural model will be assessed using data collected from various industrial contexts in India. Multivariate data analysis method, namely, structural equation modeling will be used for data analysis. Findings are expected to provide evidence-led strategic roadmap for operationalization of Industry 4.0 and developing competitiveness in the Indian manufacturing organizations. Collecting the information has been initiated and in progress.

2.4.10 *Forecast Model to Predict Leather Footwear Trade data for the year 2030 using Artificial Intelligence Approach by CSIR-CLRI, Chennai.*

The Study entitled "Forecast Model to Predict Leather Footwear Trade data for the year 2030 using Artificial Intelligence Approach" has been granted to CSIR-Central Leather Research Institute, Chennai. The objective of the study is to have the insight into the trade data on India`s export of leather footwear and prediction of leather footwear trade for the year 2030.

The project team has compiled 18 years of Leather Footwear data from 2003-04 to 2020-21 collected from secondary source comprising of 57 commodities. In addition to the secondary data collection, a questionnaire is designed to collect primary data under various categories such as i) Demographic, ii) Factors influencing Leather Footwear Demand & Supply, iii) Impact of COVID-19, iv) Particulars of Unit and v) Others. A stakeholders meeting was organized under the study on 9th June 2022 with active participation by representatives from Leather Industry and allied government agencies discussing issues related to footwear trade (national & international), data mining mechanism and market sentiment post COVID-19.

Based on the inputs provided during stakeholders' meeting, a detailed questionnaire is formulated and two pilot surveys conducted on 19th and 25th July 2022. Further, the project team visited "Meet at Agra", Trade Fair organized by Agra Footwear Manufacturers & Exporters Chamber and interacted with various Leather Footwear manufacturer's during 6th-8th October 2022. They had a meeting on 27th Oct 2022 with Director of

M/s. Mohib India Shoes Pvt. Ltd. and discussed about Leather footwear trade.

Data Analysis based on 18 years of data has been streamlined by taking care of null values and outliers. The performance of imputation methods such as Mean/Median has been implemented using ANN model. The model was trained with different number of hidden layers, optimizers, activation function, and epochs (using Early Stopping). The ANN based model has been validated with Live Stock Population Dataset and results confirm the progress of the project is in line with the objectives Proposed. The project is on-going and the key outcomes of this study may guide and enlighten thereon on trade data on country`s export of Leather Footwear and Prediction of Leather Footwear Trade for the year 2030.

2.4.11 Performance Evaluation of Advanced Dielectric Materials in Transformers" by NIT, Srinagar.

A study entitled "Performance Evaluation of Advanced Dielectric Materials in Transformers" has been granted to "National Institute of Technology, Srinagar". The objectives of the study are: (i) To study the dielectric behavior of various transformers installed in Kashmir region; (ii) To examine the influence of several working stresses on operating performance of transformers; (iii) To investigate the advancements in solid & liquid dielectrics of transformers; (iv) To study the recent advanced technologies to determine the health status as well as faults present in transformers; (v) To develop a new & generalized algorithm for transformers health assessment based on the collected Primary & Secondary Data.

Field inspection/field Surveys of around 35 Transformers in 15 Sub-stations have been carried out in various districts of Jammu & Kashmir Valley & Himachal Pradesh. The Data towards performance of Transformers collected during these visits is being used effectively towards framing questionnaire. Two Stakeholder meetings & Pilot Surveys has been undertaken. The focus of the study is to prioritize Problem-solving by providing regional specific solutions for proper functioning of Transformers of the region.

Further several working stresses/conditions on operating performance of transformers in Jammu & Kashmir Valley, Himachal Pradesh are being studied. The focus is on addressing various problems/issues in the working of transformers like moisture stress, internal fault, cold stress issue, overloading issues, oil winding & ambient temperatures etc. Testing of transformers health has been undertaken by Flame Test, Water Content Test, UV-Vis Spectroscopy Test, Solid Dielectric break-down Test, Dissolved Gas Analysis Test. Advantages of Natural Esters fluids in Transformer Technology are measured by significant improvement in fire safety, environmental performance and sustainability. As the project is on-going, the key outcome of this study is expected to come out with guidelines strengthening the performance evaluation of Advanced Dielectrics Materials in Transformers.

2.4.12 "Integrating AI, AR and VR in learning models and their impact" to be conducted by Indian Institute of Technology Hyderabad

The objective of this study is to assess the effectiveness of technologies like Virtual Reality, Augmented Reality and Mixed Reality in building learning models for school Education in India. This empirical study will explore the useful VR application on the school syllabus and find out the learning concerning the skill, understanding of the concept, and perception development. The study is intended to develop AR/VR -based content for school curriculum, a detailed design procedure and criteria for VR based lesson making. The other major aspect of this study is also to assess the preparedness of the schools in implementing the VR based pedagogy. In the end, the content will be experiment/tested the effectiveness of the method for STEM education. This study also focuses on the preparedness of the school infrastructure in facilitating such initiatives from the government or other organizations. It is

also planned to look at the emerging XR (Extended Reality) technologies that how can they bridge the gap of achieving the goals as envisioned by the government.

As per the objective of the project, IIT Hyderabad has already finalised the course curriculum

VR Platform Conceived

for 5th standard school student that includes a multidisciplinary approach and centralising with STEM program. Secondly, IIT Hyderabad has done the ideation for VR immersive environment. In this part of ideation the work-flow for VR creation is finalised. They have also developed the structured pattern for information architecture (for VR interaction such as annotations/ enhancement/ animation) and design parameter (for VR scene). The VR environment tested within the co-researchers and peer and it provided positive outcome. Currently, IIT Hyderabad is planning for end user test with large number of participants.

2.4.13 *Studies on the implementation of stainless steel fabricated by additive manufacturing and computational forecasting technique for high temperature applications by Indian Institute of Technology Jammu, Jammu*

The study supported to Indian Institute of Technology Jammu, Jammu was under the theme area 'Technology Foresight studies on Advanced manufacturing technologies for sustainable future'. The study has its relevance to the fact that world is moving towards green manufacturing by reducing the maximum percentage of waste materials, additive manufacturing serves the purpose very effectively. Additive manufacturing technology can fabricate structures of complex geometry with high precision, tailor their composition & with high mobility and is very much needed in Indian manufacturing sector.

Additive manufacturing is already deployed for powder based manufacturing of stainless steel structures and is widely used in oil and natural gas agency. Thus, study is needed to explore the possibilities of additive manufacturing of fabricating other grades of stainless steel and super alloys like Inconel &stellite for various sectors of Indian manufacturing.

The study is relevant on the pretext that, global market additive manufacturing has already its presence and that additive manufacturing is making inroads into Indian Market.

The study aims to provide a comprehensive report on additive manufacturing in Indian context and way forward with respective policies, forecasting and its wide applications.

Study intends to address the following objectives (i) Deploy additive manufacturing technique to fabricate stainless steel structures for various applications, (ii) Fabricate complex three dimensional structures/ product and study its various application. (iii) The life cycle analyses of the products in various types of applications, (iv) To study the fabrication efficiency of stainless steel structures to improve the manufacturing and machinability of products made out of stainless steel, which are widely used in Indian market, (v) To analyse the conventionally manufactured stainless steel structures their performance and machinability with the additive manufactured stainless steel structures, (vi) To study the additive manufactured stainless steel structure's behavior in high temperature applications using computational fluid dynamics software, (vii) To propose policies for effectively fabricating the stainless steel structures and their reliability report on high temperatures applications especially very

similar to Indian conditions.

The study is in progress, one review meeting was conducted to assess the progress made and the the study is scheduled to be completed in the current financial year.

2.5 Studies on theme Techno-commercial assessment of TRL-6 and above technologies developed in India in Academia, Research labs and industry

2.5.1 Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industryunder Energy & Transportation sector by Foundation for Innovation and Technology Transfer (FIIT), IIT Delhi, New Delhi.

The study has been supported to Foundation for Innovation and Technology Transfer (FIIT), IIT Delhi, New Delhi (FIIT, New Delhi) under the theme area 'Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry'. The study has its relevance to the fact that there are many technologies available with the organizations, but there is no structures approach used for its evaluation or commercialization. Evaluation of technology serves many purposes and is usually the starting point for any negotiation/ strategy development. Evaluation enables making decisions related to commercialization, further development of a technology, investment, audit etc. It is a detailed process and requires appropriate expertise to conduct it.

The study aims to address the technology evaluation and policy framework to enhance the commercialization rate of these technologies. Study would identify & tracking TRL-6 and above technologies with technology commercialization potential. Status of identified technologies in India and globally in terms of Assessment of Technology Readiness Level vs Market / Commercial Readiness Level and Challenges in commercialization. The study intend to put forth a multifaceted approach to increase technology-commercialization and also recommendations for policy makers (Government), technology developers (academia/ labs/industry) and commercializing agency (industry).

Study intend to address the following objectives (i) Mapping and identifying of technologies available with various R&D organizations, (ii) Evaluation of the technologies to shortlist commercially viable technologies, (iii) Identification of major hurdles faced while either transferring the technologies or on its commercialization, (iv) Suggesting models to facilitate the commercialization.

The study is under progress, one review meeting was conducted to assess the progress made and that the study is scheduled to be completed in the current financial year.

2.5.2 Techno-commercial assessment of TRL-6 and above technologies developed in India by academia, research labs and industry by Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi

The study broadly aims at (i) evaluation of the technology readiness level of the technologies in the domains of Chemicals and Pharmaceuticals, Medical Sciences and Health care (ii) analyzing the issues, barriers and challenges in technology transfer/licensing for commercialization.

As a part of the study, a questionnaire has been designed and circulated towards scouting of technologies developed by the research labs, academia and startups. Three workshops have been conducted at CSIR-IICT Hyderabad where 11 technologies, CSIR-IICB Kolkata where 12 technologies and NIPER Guwahati where 15 technologies were presented by PIs and discussed. Assessment of the technologies is under process. Issues, barriers and challenges being faced by labs and academia for transfer/licensing of technologies towards commercialization were discussed among panelists during the workshops to capture optimal and sustainable solutions. The study targets at compiling information on

approximately 100 technologies at TRL6 and above in the identified domains in the form of a compendium towards necessary policy interventions by the Government.

2.5.3 Accessing the Techno Commercial Status of TRL-6 and above technologies in the field of Food Processing and Agriculture by Indian Institute of Technology (ISM) Dhanbad.

The study has been granted to Indian Institute of Technology (ISM) Dhanbad with the objectives (i) to access the techno-commercial status of at least 100 or more TRL6 & above technologies are developed in academic institutes, research labs and MSME sector in India, (ii) to prepare the status report on the techno-commercial status of at least 100 or more identified TRL6 & above technologies. (iii)To identify the challenges faced by academic institutes, research labs and industry in the commercialization of technologie, (iv) to prepare/create the road-map for policy makers, technology developers and commercializing agencies for translation of research output from institutions to the market. Currently, the study is going on, two stakeholders meeting and Brain Storming sessions were conducted on 26th September 2022 at IIT(ISM) Dhanbad and 10th October 2022 at IIIF IIT(ISM) Centre New Delhi, respectively on TRL and its application in Food Processing and Agriculture Technologies. Delegates from CSIR, IITs, ICAR, State Agricultural Universities, Incubation Centers, Start-ups and MSMEs working in agriculture sectors participated in the brainstorming session.The seminar brought together experts in a common place to discuss the issues and challenges of technology innovation in these sectors. It created awareness regarding the need for assessing the techno-commercial status of TRL-6 and above technology in these sectors. Experts from participating institutions discussed the barriers they are facing in commercialization of these technologies. For study, questionnaire have been developed to identify the barriers in commercialization and to access the TRL level of the technology available in research institutes, Academia, State Agriculture Universities and MSMEs. 85 technologies developed in the field of Food processing and Agriculture have been collected from various institutes and research labs.

2.5.4 Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry" by Indian Institute of Technology, Roorkee

The study entitled "Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry" has been supported to Indian Institute of Technology Roorkee. The objectives of the study are to (i) identify already existing successful epitome of TRL6 level or above technologies at least 100 in number) in Indian Institutes, Universities, startups and Industries. (ii) identify types of obstruction and their nature in already existing TRL6 or above level technologies in academic and industrial environments. (iii) develop a database of technologies developed by academia, research labs using Government funding's and mapping them on the TRL scale. (iv) study the challenges in the commercialization of technologies developed in academia and research labs. (v) conduct the case studies on success stories of the technologies(projects) which are in the TRL-6 and above in academia, research labs. (vi) develop the clusters of technologies based on the potential of commercialization and accordingly proposing the strategies for different clusters. To provide recommendations for policymakers. Currently the study is ongoing. Expected specific outcomes of the study are to:(i) develop a cloud-based database Management System. (ii) propose strategies to increase the possibilities of commercialization of technologies based on important challenges and relationships. (iii) identify the challenges in the commercialization of technologies developed in academia, research labs and industry. (iv) identify the factors making TRL6 or above level technologies a success or failure. (v) identify barriers impeding the higher performance.

2.5.5 Materials and Manufacturing:

Technology Commercial Assessment of TRL6 and above Technologies Developed in India (Academia, Research Labs and Industry)

The study awarded to IIT Jammu, proposes to identify the critical aspects encountered in conventional manufacturing of composites based on industrial association versus Technology readiness level; Deliver and document the importance to the fabrication of 3D composites and incorporating to address the complications encountered in TRL6 level technologies on different sectors. It also intends to congregate the technology critical aspects encountered in industries after deliberations with industrial experts and it finally aims to demonstrate the pathway of technology development of 3D composites to TRL level 6 and beyond among stakeholders.

Following are the key activities and progress in the project to scout technologies in various parts of India:

A. Organized workshop on Advances in a composite product, process and systems-Technology Readiness in Indian Context 1st and 2nd September 2022 at IIT Jammu in collaboration with IIM Jammu

Successfully conducted the first workshop with the theme of technology readiness in the Indian Context, where all stakeholders from IITs, CSIR, and industries were present. Our main objective from the workshop was to share MoU with all the stakeholders to coordinate in collecting data, assessment, findings and recommendations. Through this workshop, significant awareness of TRL was created.

B. Organizing workshop on Industry 4.0 implementation and practices-Technology Readiness in Indian Context 28th and 29th November 2022 at IIT Madras in collaboration with IIM Jammu

The second workshop is planned to be organized with the theme of Industry 4.0 implementation and practices Technology readiness in the Indian Context, where stakeholders invited from IITs and industries will be present. The workshop venue is at IIT Madras Campus, is focused on deliberations with industry professional's to bridge gaps between academia and industry.

24 technologies in materials and manufacturing sector are scouted and 45 stakeholders identified for detailed assessment of TRL6 and above technologies in the given sector. This has been achieved through various workshops, meetings and detailed questionnaire prepared in collaboration with DSIR and CSIR-NISCAIR. Overall, 75 technologies are recognized for materials sector across academia, industry and research labs. The study is under progress, one review meeting was conducted to assess the progress made and that the study is scheduled to be completed in the current financial year.

2.5.6 Water Technology: "Techno-commercial Assessment of TRL-6 & above Technologies developed in India in Academia, Research Lab & Industry" by ICCW, Chennai.

The Study entitled "Techno-commercial Assessment of TRL-6 & above Technologies developed in India in Academia, Research Lab & Industry" has been granted to ICCW, Chennai aiming to scout TRL6 and above level technologies in the sector and identifying various challenges and gaps in commercialization & prescribe solution to government Technology Developer & commercial entities.

Objectives of the study are: (i) Identification of gaps in implementation of emerging water purification technologies above TRL 6 Level for eliminating contamination of drinking water due to fluoride, arsenic, nitrate, iron, coliform bacteria and reduction of total dissolved solids or salinity, (ii) Develop action plans for minimizing gaps to ensure effective implementation.A visit to various

hotspots in West Bengal, Punjab and other parts of country wherein the content of Arsenic, Nitrate, Flouride, Chloride dissolved solids in drinking water were planned high and further plan to identify & map technologies specific to each containment & geographical location.

As it is an on-going project they plan to conduct 3-4 stakeholders meetings for technology Scouting & assessment to understand the challenges barriers being faced for commercialization of water purification technologies at TRL-6 & above levels. The objective of the meetings is to identify the various issues, challenges, and opportunities of drinking water purification technologies on its technology readiness levels. This meeting would be utilized to achieve the following: (i) Scout for a list of technologies, (ii) Identify the issues, gaps, challenges and recommendations for improvements in the existing commercial technologies. Understand perspectives from technology/service providers,experts,consultants, start-ups, investors, donors, community, NGO, Panchayat, Municipal administration, and Government. The Validation of Technologies is: (i) The selected technologies would be visited to understand the ground realities of its operational efficiency using Assured matrix, (ii) Identify opportunities for improvement and gaps in maturity levels required.

2.6 Outreach and Stakeholder engagement:

Program Division organied an "Interaction meet on A2K+ Studies program: Introduction and awareness" on April 05, 2022. The webinar focussed on funding opportunities under Access to Knowledge for Technology Development & Dissemination (A2K+) Studies program of DSIR. The interaction meet witnessed participation of faculty and researchers from various academic and management Institutes and national research laboratories. The insightful talk during the event and interactive question-answer session made participants aware of the vision of the programme and expected outcomes and output of the studies supported under the program. It guided participants in bringing out well conceptualized and well written proposals for availing funding support under latest call for proposals in A2K+ Studies program.

A Brainstorming meeting of DSIR and CSIR-NIScPR to jointly develop TRL Awareness towards technology commercialization among stakeholders from academia, R&D, Institutions and Industry was organized on 27th May, 2022.

3.0 A2K+ Events:

The Access to knowledge for Technology Development and Dissemination (A2K+) Events programme of DSIR provides a platform for

Events approved for support under A2K+ Events :

S. No.	Title of Event	Name of Agency
1.	Applications of Machine Learning & AI Techniques	Balaji Institute of Technology & Science, Warangal
2.	International conference on recent and future Trends in Smart Electronics System Designs and Manufacturing	Symbiosis Institute of Technology, Pune
3.	Technologists – Industrialists Meet & Expo (TIME-2022 MEGA)	CSIR-Central Scientific Instruments Organisation, Chennai
4.	Low-Cost Bio Coal Production and Its Potential Impact on Steel Industries	Indian Institute of Technology (Indian School of Mines) Dhanbad
5.	Hydrogen Energy and Fuel Cells: A vision for our future MSMEs	Anand Engineering College, Keetham, Agra, Department of Electronics and Communication Engineering, Keetham Agra

S. No.	Title of Event	Name of Agency
6.	North East Research Conclave	Indian Institute of Technology Guwahati,
7.	Workshop on Technology Readiness Level and its applications for Technology Assessment	CSIR-National Institute of Science Communication and Policy Research (CSIR- NIScPR), Delhi
8.	Conference on Industry 4.0 – An Enabler For Make in India	PHD Chamber of Commerce and Industry, Skill and Entrepreneurship Committee, New Delhi
9.	12th Indian Fisheries and Aquaculture Forum (IFAF)- Fish for Nutritional Security and Economic Sustainability	Tamil Nadu Dr. J. Jayalalithaa Fisheries University, State University (Department of Fisheries, Tamil Nadu), Vettar River View Campus, Nagapattinum
10.	8th International Congress on Computational Mechanics and Simulation (ICCMS 2022)	Indian Institute of Technology Indore
11.	International Conference on Biotechnology, Sustainable Bio- resources and Bio economy	Indian Institute of Technology Guwahati (IITG)
12.	Conference: One health and Translation Research in Neuroscience Workshop: Clinical and Translational Research in Neurological Disorders	Dr. G.M. Taori Central India Institute of Medical sciences (CIIMS)
13.	National Conference on Business Sustainability and SDG's	PHD Chamber of Commerce and Industry, Delhi
14.	III International Conference on Advancements in Automation, Robotics & Sensing (ICAARS-2022)	PSG College of Technology, Peelamedu, Coimbatore, TN
15.	Opportunities for Technology Upgradation for MSMEs in the Engineering Sector.	EEPC India (formerly Engineering Export Promotion Council)
16.	International Conference on Emerging Materials for Sustainable Development (EMSD)	CSIR-CSIO, Chandigarh
17.	International conference on Artificial Intelligence of Things	National Institute of Technical Teachers Training & Research, NITTTR, Chandigarh
18.	Net-zero Emission Technologies for Sustainable Development: Challenges and Opportunities (N0ET – 2022)	Indian Institute of Technology (Indian School of Mines) Dhanbad
19.	5th International Conference on Nutraceuticals& Chronic Diseases (INCD-2022) on the topic "Pharmaceuticals &Nutraceuticals for Cancer & other Chronic Diseases"	Department of Zoology, University of Delhi, Delhi.
20.	International Conference on "Sustainable Energy & Environmental Challenges"	Indian Institute of Technology, BHU, Varanasi.

exchange of views among industry, consultancy organizations, academic and research institutions that would lead to useful insights on issues relating to industrial research and technological innovation and help in evolving tools and techniques to remain competitive in today's business climate.

The objective of A2K+ Events program is to support the organization of workshops, interactions, training programmes, exhibitions and other events for identification of collaborative projects between academia, institutions and industry participating in the events.

The following events were organized during the period under report from 2022-23 :

1. Decrypting the Future Course of Competitive Technologies for MSMEs and

New Ventures: An Initiative for An Atmanirbhar BharatbyOP Jindal University, Haryana

An event was supported to OP Jindal Global University, Haryana (Institute of Eminence Deemed to be University) to conduct first virtual international conference on "Decrypting the Future Course of Competitive Technologies for MSMEs and New Ventures: An Initiative for an Atmanirbhar Bharat". The conference aimed to promote research and outreach programs through scientific deliberations such as plenary talks, panel discussions, and presentations. The objective of the virtual conference was to address and debate competitive technologies for micro, small, and medium-sized enterprises (MSMEs) and new ventures. Participants included researchers, students, and other industry professionals. Both the conference and the workshop are intended to accomplish the following goals:

(i). To assist the micro, small, and medium-sized enterprises (MSMEs) while also expanding their understanding of the low-cost technologies that are useful for their everyday operations and growth.

(ii). To assist start-up companies while simultaneously adopting a competitive technology and a good match for the Business environment that may be exploited for the creation of new products and the manufacturing of services.

(iii). To forecast the future direction of technology to devise a plan for the investment of technology by a large number of small firms experiencing falling sales. The 25th and 26th of February 2022 saw the organization of this conference in a digital format and across digital media. Approximately 240 people from India and other countries took part in this seminar. The conference was divided up into nine separate sessions, each focused on a particular topic and attempted to cover every angle of that topic.

The conference was split up into nine separate sessions, each focused on a particular topic and attempted to cover every angle of that topic such as - i) The Spreading and Shaking Up of New Technologies; ii) The Long-Term Repercussions of Making Inappropriate Investments in Technology; iii) A Strategic Approach to Competitive Technology for New and Emerging Businesses; iv) A Strategic Approach to Competitive Technology for Faltering Businesses; v) Technology Spotting, Management of Acquired Knowledge, and the Sharing of Acquired Knowledge; vi) The Effect That Rapid Technological Advancement Has On The System of Industrial Production; vii) • Mapping Patents of Competing Technologies and Identifying the Directions of Technological Trends; viii) Mapping a Strategic Technology Roadmap for Micro, Small, and Medium-Sized Enterprises and New Ventures. There were six presenters for the sessions that were arranged, and there were two professionals that led the workshop. Both the diffusion and disruption of technology was discussed.

2. National Seminar on Ayush Healthcare Sector- Opportunity And Challenges by Jaipuria Institute of Management, Lucknow

Jaipuria Institute of Management, Lucknow conducted a two days' National Seminar under on the topic of Ayush Healthcare Sector-Opportunity And Challenges on 26th & 27th March, 2022. The seminar comprised of Ayush Exhibition, Hackathon and Exposition. The objective was to create awareness about the scope of Ayush healthcare sector and spread information, education and communication to promote quality Ayush healthcare products and services and to come up with solutions for burning problems in the health sector in the country.

3. "Tech-O-Thon: TechnasiaTheHackathon" conducted by MNIT, Jaipur

An event titled "Tech-O-Thon: Technasia The Hackathon" from 28-30 April, 2022was organized at MNIT, Jaipur with aims to support "Make in India"

and "AtmaNirbhar Bharat" campaign through maximum participation of young entrepreneurs for developing indigenous engineering and technology. This hackathon provided real time competitions in which participants developed their novel ideas and implemented the same in day-to-day technical problems within a stipulated time. The hackathon had three themes i.e., EV infrastructure, Agriculture based solutions and Healthcare. The basic approach of the event was to promote the out-of-the-box thinking in young minds, especially science and engineering students from across India. 60 teams participated into the Hackathon event and total 16 teams were shortlisted to participate in the second round of hackathon out of 60 entries. 2 innovations from each theme were shortlisted and those participated in the final round of Tech-O-Thon and three best solutions were awarded by the organizers.

4. National workshop on "Low-Cost Bio-Coal Production and Its Potential Impact on Steel Industries" by Indian Institute of Technology Dhanbad (IIT Dhanbad), Dhanbad, Jharkhand

IIT Dhanbad conducted a National workshop on "Low-Cost Bio-Coal Production and Its Potential Impact on Steel Industries" at IIT Dhanbad, on 14 & 15th May, 2022. The workshop addressed the objective on (i) Bio-coal production technologies, (ii) Challenges associated with Bio-coal blending with coal, (iii) Effect of bio-coal blending on GHG emissions from Steel industries, (iv) Government initiatives, schemes and way forward for bio-coal technologies implementation at larger scale.

The event was attended by more than 100 participants in two days from industries such as TATA Steel Limited, SAIL Bokaro, BCCL Dhanbad, JSPL Orissa and academia such as IIT ISM Dhanbad, BIT Sindri and BBMKU, Dhanbad. More than 50% participants were from industry who applauded the usefulness of this DSIR supported workshop. Since several academicians, industry personnel and scientists attended and interacted with each other, it led to several collaborations on project of similar interest. For example, academicians from IIT ISM Dhanbad and scientists from National Agri-Food Biotechnology Institute (NABI) are collaborating for joint projects and development of technologies. SAIL Bokaro also showed interest in signing an MoU with IIT ISM Dhanbad during Panel Discussion of Workshop to pursue research in this area. As results, MoU has been signed and three projects has been initially agreed to be executed by IIT ISM Dhanbad and SAIL Bokaro. One project is particularly on application of Bio-Coal in Steel Industries. Similar, interest has been shown by TATA Steel and a proposal for opening TATA centre of excellence at IIT ISM Dhanbad is in discussion.

5. National Level Workshop on "Applications on Machine Learning and Artificial Intelligence Techniques" by Balaji Institute of Technology & Science, Warangal, Telangana

A two days' National level Workshop on "Applications on Machine Learning and Artificial Intelligence Techniques" was organized by Department of Electrical Engineering "Balaji Institute of Technology & Science" Narsampet, Warangal, Telangana during 20-21 May, 2022 in Narsampet, Warangal, Telangana.

The main objective of FDP workshop on "AI & Machine learning" was to connect prestigious academic institutions & industry professionals with educational institutes to provide a platform/ forum for learning latest tools in Artificial Intelligence & Machine learning to all the engineering faculty, who will in turn educate student community & also to facilitate research program using the advanced software tools in the field of machine learning. There were 4 technical sessions in Two-Day Workshop. Academicians, researchers, students, faculty members, industry representatives participated and deliberated upon.

The Outcome of the Program was that the delegates/participants acquired skills about Artificial Intelligence & Machine learning to

produce promising outcomes in the teaching & learning practices. The faculty members, Researchers gained knowledge about various aspects of Artificial & Machine learning which will help them to design curriculum for Artificial Intelligence & Machine learning Courses.

6. North East Research Conclave – IIT, Guwahati

An event was supported to Indian Institute of Technology, Guwahati for organizing North East Research Conclave from 20-22 May 2022 at Indian Institute of Technology, Guwahati. The conclave aimed to -

- attract potential partners across the ecosystem to invest/consider Assam for Biotech activities.
- increase industry linkage to create business and partnering opportunities for its stakeholders.
- put forward the facilities offered by Guwahati Biotech Park and Bio-Nest IIT Guwahati wherein prospective Biotech ventures may avail incentives/subsidies etc. through the provisions laid under the Biotechnology Policy for the State of Assam.
- create an industry-academic interface bringing all stakeholders together to spread fundamental knowledge and technological developments in Biotechnology. Through such interactions, advances in applications and the future directions of Biotechnology can be discussed in order to explore and create new products, technologies and services to increase market ventures in North East India.
- enhance investment opportunities for product development and scale-ups.

The event has been successfully organized by IIT, Guwahati. DSIR officials attended the event and a scientific session on CRTDH was conducted during the event to cater north east region of the nation.

7. Workshop on Technology Readiness Level and its applications for Technology Assessment by CSIR- National Institute of Science Communication and Policy Research (CSIR-NIScPR), New Delhi

An event titled "Workshop on Technology Readiness Level and its applications for Technology Assessment" was held from 22nd June, 2022 at CSIR-NIScPR, New Delhi with aim to support "Make in India" and "AtmaNirbhar Bharat" (self-reliant India) campaign through maximum participation of experts, scientists, technology developers with the objective to i) assess the stage of technology development from the technology developers' perspective and ii) develop TRL sectoral framework suitable to the technology being assessed. 50 participants comprising of scientists, industry experts, scholars attended the workshop. The event focused on areas like to check the maturity level & a generic framework for TRL assessment, integration of various technologies being developed in different R&D Setups (both public and private) and their mapping to critical user requirements and national missions and development of sectoral framework through stakeholders interactions (including representatives of technology developers, industry experts, experts form R&D institutions etc.) of each sector. During the workshop, the methodology and action plan were shared by 6 PIs carrying out their studies on "Techno-commercial assessment of TRL-6 and above technologies developed in India in academia, research labs and industry" supported by DSIR under its A2K+Stidies scheme. A brainstorming session was also held on approaches towards scouting and assessment of TRL6 and above technologies.

8. National conference on Industry 4.0 – An enabler for make in India" by PHD Chamber of Commerce & Industry (PHDCCI), New Delhi

A one day "National conference on Industry 4.0 – An enabler for make in India" was organized by

PHD Chamber of Commerce & Industry (PHDCCI), New Delhi on 16th September 2022 at PHD House, New Delhi.

The conference on Industry 4.0 focussed on integration of traditional manufacturing with IOT technologies and it was all about cyber physical systems, wherein communication is through machines. Further, this conference was crafted towards creating learning experience for Indian manufacturing companies, scouting for technologies & trends in the Smart Manufacturing domain. The main objective of the conference was to bring influencers and domain experts of breakthrough technologies & innovations to discuss on new approaches of manufacturing. Also many stakeholders like Researchers, Academicians, Industry Representations, Government officials R&D participated & deliberated on best Practices of Industry 4.0.

Significant Outcome:

The seminar aimed at keeping abreast of the current development in Industry 4.0 sector and provided an opportunity to listen to the Industry experts, where they share their experience on how to leverage Industry 4.0

The summit brought together experts in Industry 4.0 Manufacturing & Solution Providers, Researchers Skill Industry, Business and Government Officials and Consultants. The conference discussed the following issues, challenges and solutions for the Industry 4.0:

- Brought together influencers and domain experts of breakthrough technologies & innovations to discuss new approaches of manufacturing.
- It created learning experience for Indian manufacturing companies, who are looking for technologies and trends in the Smart Manufacturing domain.
- Also, it brought together senior officials from Industry, Government, R&D fraternity and Academia to network and deliberate on best practices for Industry 4.0.
- The seminar deliberated on Factories of the Future Roadmap, Accelerating Industrial Performance, Connected Enterprises, Insights on Latest Manufacturing Trends and New Technologies Driven Business Model.

9. Fifth International Conference on Nutraceuticals & Chronic Diseases INCD 2022 on "Pharmaceuticals & Nutraceuticals for cancer & other Chronic Diseases" by University of Delhi, Delhi

Fifth International Conference on Nutraceuticals & Chronic Diseases INCD 2022 on "Pharmaceuticals & Nutraceuticals for cancer & other Chronic Diseases" was organized by Department of Zoology, University of Delhi, Delhi in University of Delhi (North Campus) from 7th October, 2022 – 9th October, 2022.

The International conference was organized by Department of Zoology, University of Delhi as a part of University's Centenary and Departments 75th year celebrations. The entire event was designed to explore the scientific basis and experimental approaches for the use of Pharmaceuticals & Nutraceuticals for treating cancer & other chronic diseases. Conference provided a much needed platform to enable discussion & exchange ideas to enhance the understanding of complex regulatory processes leading to the development of extra disciplinary research collaborations. The technical sessions mainly focused on 10 different thematic areas like (i) Thematic potential of Nutraceuticals in Stress and Cancer, (ii) Nutraceuticals in Neurological & Neuromuscular Disorders, (iii) Molecular Targets & Drug delivery, (iv) Cancer Genomics, (v) Metabolic disorders & Personalized medicines, (vi) Emerging Anti-cancer PhytoNutraceuticals, (vii) Emerging Infection Diseases, (viii) Chronic Infection Diseases, (ix) Non-infection Diseases, (x) Ayus Therapies for chronic Diseases & Inflammatory Disorders. Total 78 National & International Speakers from India and other Parts of the World gathered and

delivered in this global event. The conference had harbored around 300 – 350 Participants with 34 Oral Presentations & 64 Poster Presentations.

Significant Outcome:-

The significant leads that emerged out the 3-day deliberations were on development of reliable strategies for the characterization of Nutraceuticals to facilitate translation of lead into the clinic, promotion of indigenized multi-targeted pharmaceuticals & nutraceuticals over monotargeted agents, motivation of pharma companies to support Nutraceuticals clinical trials and spreading awareness on potential of leading Nutraceuticals in disease prevention & management globally and also convincing regulatory bodies such as USFDA and Indian FDA (FSSCI) for the approval of Nutraceuticals use in clinic. The event helped in bridging the gap between basic research & clinical research by increasing the interaction and translation of Pre-clinical studies on Nutraceuticals to clinical practice.

10. International Conference on "Emerging Materials for Sustainable Development (EMSD)" by CSIR- Central Scientific and Instruments Organization (CSIO), Chandigarh

CSIO, Chandigarh conducted an International Conference on "Emerging Materials for Sustainable Development (EMSD)" at CSIR-CSIO, Chandigarh on 9th – 11th October, 2022. The conference addressed the issue on (i) creating awareness among young researchers about emerging materials role in sustainable development goals (SDGs), (ii) importance of networking amongst researchers for interdisciplinary research in materials for SDGs, (iii) necessity to understand and deliberate on materials scaling challenges for translation in reference to SDGs goals.

11. International Conference titled: One health and Translational Research in Neurosciences and Workshop on clinical and Translational Research in Neurological Disorder by Dr. G. M Taori Central India Institute of Medical Sciences (CIIMS), Nagpur

An event was supported to Dr. G. M Taori Central India Institute of Medical Sciences (CIIMS) for organizing (i) an International Conference titled: One health and Translational Research in Neurosciences and (ii) Workshop on clinical and Translational Research in Neurological Disorder at Nagpur during 7th November 2022 to 12th November 2022.

The conference aims at following objectives:

- To impact and build skilled human resources in the field of Neurosciences.
- To promote and develop strong interdisciplinary linkage with researchers for promoting translational research.
- To promote hands on experience leading and young scientist on cutting edge immunological and genomics tools in Neurological research.
- Participating Community: The national community comprise of leading scientist, young scientist. PhD Scholars, technicians, academies, associate delegates, Faculty, and stake holders.

CHAPTER 6: ASIAN PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT)

ASIAN PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT)

1.0 PREAMBLE

The Asian and Pacific Centre for Transfer of Technology (APCTT) is a regional institution of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) servicing the Asia-Pacific region. APCTT promotes an enabling environment for innovation, transfer and commercialization of technologies in 53 member states and 9 associate members of ESCAP. All the member states and associate members of the United Nations ESCAP are de facto members of APCTT.

The Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India has been the national focal Department on behalf of India, for APCTT. Matters pertaining to APCTT and ESCAP are dealt in co-operation with the Ministry of Commerce and Industry and the Ministry of External Affairs, Government of India. DSIR plays an active role in APCTT's functioning, particularly relating to its work programmes and initiatives. India, being the host country for APCTT has been providing institutional support to the APCTT since its inception in 1977.

In 2022, APCTT had fruitful joint activities with the Government of India, Department of Scientific and Industrial Research (DSIR) of Ministry of Science and Technology to facilitate technology co-operation and capacity building amongst the member States in the region. The joint activities are listed below and illustrated in details in further sections.

- Brainstorming Session between STI Agencies of India and APCTT for Promoting Regional Technology Co-operation held on 19th April 2022 at New Delhi, India.
- Industry-Academia-Government consultative meeting to address the challenges of energy sector (conventional & non-conventional) and energy devices, held on 17th October 2022.
- International knowledge-sharing workshop on cross-border innovation, acceleration, and challenges in international technology transfer organized on 14-15th November 2022 at New Delhi, India in physical and virtual mode.

These joint activities of India and APCTT resulted in impressive outcomes in terms of understanding country needs, availability of resources, and opportunities for collaboration; identifying priorities and actions,increasing knowledge and capabilities of target stakeholders in enabling policies, strategies and good practices to address the challenges and formulating policy recommendations for strengthening regional technology cooperation. Indian experts from key technology domains also actively participated in and contributed to other regional technology cooperation and capacity building activities of APCTT. These activities were useful for them to learn from regional experiences and good practices, exchange knowledge, and explore opportunities for cross-border collaboration.

2.0 INTRODUCTION

1. APCTT assists member States to strengthen their capabilities to develop and manage national innovation systems, develop, transfer, adapt and commercialize technologies; improve the terms of transfer of technologies and identify and promote the development and transfer of technologies relevant to the region.

2. APCTT has been fostering inclusive partnerships between governments, research and development institutions,

academia, international organizations, private sector and civil society for transfer, dissemination and diffusion of environmentally sound technologies between countries in the Asia-Pacific Region.

3. APCTT supports development of partnerships and creation of enabling environment for innovation and technology transfer. The activities of the APCTT contribute towards the Sustainable Development Goal 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation) and Sustainable Development Goal 17 (Strengthen the means of implementation and revitalize the global partnership for sustainable development). The activities also support other Sustainable Development Goals related to the APCTT's programme of including: Goal 3 (Good health and well-being), Goal 7 (Affordable and clean energy), Goal 11 (Sustainable cities and communities), and Goal 13 (Climate action).

3.0 SUMMARY OF ACTIVITIES IN 2022

4. During 2022, APCTT's primary focus areas were to: (a)Strengthening regional technology co-operation, transfer and strategic partnerships; (b) Capacity building and enhanced knowledge on technology and innovation policy; and (c) Enhancing technology intelligence through production and dissemination of knowledge products.

5. During the reporting period, they delivered and actively contributed to 16 demand-driven activities in virtual and/or hybrid mode (hosted by China, India, Thailand and Uzbekistan) in close collaboration with 81 partner institutions. The activities included regional consultation meetings, expert group meetings, international conferences, capacity building workshops, national stakeholder consultations, and knowledge products. The list of partner institutions which worked with the APCTT in delivering the activities is given at (Annexure 10).

6. APCTT reached out to over 1,100 target participants comprising representatives from governments, technology promotion agencies, technology transfer intermediaries, academia, research and development institutions, industrial enterprises, technology-based start-ups and financial institutions.

7. The functioning of APCTT was benefited from participation of experts from 28 UN Member States, namely Azerbaijan, Bangladesh, Bhutan, Cambodia, China, Denmark, India, Indonesia, the Islamic Republic of Iran, Japan, Jordan, Kazakhstan, Lebanon, Maldives, Malaysia, Mongolia, Nepal, Nigeria, Norway, Pakistan, the Philippines, the Republic of Korea, Singapore, Sri Lanka, Thailand, Trinidad and Tobago, Türkiye, and Uzbekistan. The experts shared their knowledge, experiences, and best practices with the target participants.

8. Through developing and disseminating knowledge products, APCTT enhanced technology intelligence of stakeholders from member States on key issues and good practices in intellectual property management, diffusion of fourth industrial revolution technologies, inclusive innovations and technologies, air pollution control technologies, regional cooperation for innovation and technology transfer and affordable and sustainable clean energy technologies(Annexure 11).

9. As recommended by the seventeenth session of Governing Council held in December 2021, APCTT developed a draft strategic plan (2023-2027) during this reporting period. The Council had

recommended APCTT to develop a strategic plan and redesign the work programme to bring it into alignment with the current priorities and needs of the member States for consideration by the Council at its eighteenth session". The draft strategic plan was presented to the eighteenth session of Governing Council for consideration and adoption.

10. During the reporting period, APCTT contributed to strengthening the capabilities of stakeholders from countries with special needs such as Bangladesh, Bhutan, and Nepal.

4.0 Details of Activities Carried out by APCTT During January To December 2022

A. Regional technology co-operation strengthened

11. APCTT facilitated four consultative meetings to strengthen technology cooperation among member States in healthcare biotechnology and biomedical technologies, emerging energy technologies for climate change mitigation, and industry-academia-government collaboration. These activities contributed to the following:

a) Identified country needs, availability of resources, and opportunities of collaboration for strengthening healthcare biotechnology research and testing facilities, and energy sector;

b) Identified priorities and actions required through Industry-Academia-Government collaboration to accelerate transfer and adoption of emerging energy technologies;

c) Explored strategies and modalities to share their resources, expertise and experiences among member States in the focused areas;

d) Enhanced knowledge and understanding of 206 target stakeholders from 17 countries in enabling policies, strategies and good practices to address the challenges; and

e) Provided policy recommendations for strengthening regional technology cooperation.

12. Following are the key technology cooperation activities carried out and/or contributed by APCTT:

(a) **Expert group meeting on strengthening regional cooperation in healthcare biotechnology and biomedical sector, 22 March 2022 (Virtual):** The expert group meeting brought together 36 participants from ten ESCAP member States, namely Bangladesh, India, Indonesia, Kazakhstan, Malaysia, Nepal, Pakistan, the Republic of Korea, Sri Lanka, and Thailand. The participants included national focal points of the APCTT, biomedical experts on research and development strategy and management from member States. The policymakers and experts shared knowledge, experience and good practices, discussed country needs and availability of resources for strengthening healthcare biotechnology research and testing facilities, identified opportunities of collaboration, and explored modalities to share their resources, expertise and experiences.

Key recommendations: developing affordable, and state-of-the art healthcare biotech products, drugs and vaccines through collaborative efforts; identifying gaps in the vaccine ecosystems in countries and develop

targeted interventions; identifying common research problems and collaborative research strategies to bring down the costs of developing drugs and vaccines; establishing common facilities for collaborative research; implementing co-funded projects by multiple partners across the region for cost reduction; and building capacity of researchers, among others.

(b) **Brainstorming session between STI agencies of India and APCTT for promoting regional technology cooperation, 19 April 2022, New Delhi, India:** Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India organized a brainstorming session jointly with APCTT. The participants included 12 senior policymakers and experts representing six key ministries, departments and national agencies of the Government of India. Shared priorities for regional technology cooperation, identified potential areas of collaboration with APCTT, and explored strategies for regional cooperation using APCTT's platform.

Key recommendations: conducting mapping of relevant actors and stakeholders in India as per the Sustainable Development Goals; listing of technologies from India for transfer; conducting technology demand survey in member States; identifying innovative technology solutions to address specific challenges; preparing good case studies of specific technology solutions; identifying specific problems and digital technology-based solutions; training, capacity building and developing tailor-made courses to enhance research capacity and promote good clinical practices; and cross-learning of good practices in renewable energy.

(c) **Strategic priorities for adoption of emerging technologies in the energy sector for climate change mitigation (side event of seventy-eighth session of the Commission), 24 May 2022 (Virtual):** APCTT organized this regional consultation meeting as a side event of the seventy-eighth session of the Commission. The event was jointly organized by Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India and APCTT. The meeting brought together 72 participants from 14 countries (namely Bangladesh, Denmark, India, Indonesia, the Islamic Republic of Iran, Kazakhstan, Lebanon, Malaysia, Norway, Pakistan, the Philippines, the Republic of Korea, Thailand and Uzbekistan) comprising of policymakers, experts and practitioners from the member States. The experts shared experience and good practices on strategies to facilitate transfer and adoption of emerging technologies in the energy sector for climate change mitigation.

Key recommendations: building capacity of maintenance and servicing professionals and local entrepreneurs of renewable energy equipment; conducting matchmaking events to connect innovators and inventors with investors; identifying and scaling up renewable energy technologies for commercialization; conducting technology feasibility studies, and technology piloting; and developing standards for renewable energy products.

(d) **Industry-Academia-Government**

consultative meeting to address the challenges of energy sector (conventional & non-conventional) and energy devices, 17 October 2022 (Virtual): Department of Scientific and Industrial Research and Council of Scientific and Industrial Research, Ministry of Science and Technology of Government of India jointly organized this consultative meeting with APCTT. The meeting deliberated on strategies for addressing the challenges of energy sector (both conventional and non-conventional) and energy devices. The meeting was attended by 86 participants from six ESCAP member States, namely China, India, Nepal, Pakistan, Sri Lanka and Thailand, national focal points of APCTT, representatives from Government, academia, industries and related agencies and institutions; and experts from energy associations and relevant stakeholders from the region.

Key recommendations: increasing investments for moving towards emission reduction; upscaling affordable and economically viable technologies; establishing a common electrical grid for the region; integrating international research collaboration efforts into formal decision-making processes; and creating digital platforms to share research findings among member States.

B. Innovation and technology transfer capacity enhanced

13. During the reporting period, APCTT organized the 6 demand-driven capacity building activities in areas such as innovation, transfer and diffusion of fourth industrial revolution technologies, energy resilience through decentralized power plants and smart grid integration, mechanisms for technical cooperation on green innovation, innovation and challenges in international technology transfer, and innovation, technology transfer and cooperation for addressing climate change.These activities contributed to the following:

a) Enhanced knowledge and capabilities of over 800 target stakeholders from 26 countriesin challenges, opportunities, enabling policies, strategies, good practices;

b) Explored potential collaboration opportunities for cross-border technology transfer; and

c) Provided recommendations on enabling strategies for innovation, technology transfer and regional technology cooperation.

14. APCTT organized the following capacity building activities:

(a) International conference on innovation, transfer and diffusion of fourth industrial revolution technologies, 30 June 2022, Guangzhou, China (Hybrid): APCTT organized this conference jointly with the Department of International Cooperation, Ministry of Science and Technology, People's Republic of China, and hosted by the Asia-Pacific Regional Innovation Knowledge Network for 4th Industrial Revolution Technologies and Secretariat Office at Guangzhou University, People's Republic of China. International and national experts deliberated on the challenges, mechanisms and good practices of innovation, transfer and diffusion of fourth industrial revolution technologies. The conference brought together 132 participants from 16 UN Member

States, namely Azerbaijan, Bhutan, China, India, Indonesia, the Islamic Republic of Iran, Japan, Malaysia, Nepal, Pakistan, the Philippines, the Republic of Korea, Singapore, Thailand, Trinidad and Tobago and Uzbekistan. Included policymakers and government officials from the member States in Asia and the Pacific, representatives from the academia, national laboratories, research and development institutions, and industrial and research organizations engaged in development and deployment of fourth industrial revolution technologies.

Key recommendations: digital skilling and capacity building in the domain of fourth industrial revolution technologies; implementing joint research and innovation programmes; facilitating cross-border sharing of talent; incubation funding to research institutes to upscale and commercialize fourth industrial revolution technologies; and strengthening inter-institutional linkages between research and development institutes, academia and industry.

(b) Regional conference on energy resilience through decentralized power plants and smart grid integration, 15 September 2022, Bangkok, Thailand (Hybrid): APCTT organized this conference jointly with the Ministry of Higher Education, Science, Research and Innovation, Government of Thailand, and Thailand Institute of Scientific and Technological Research. It was held in conjunction with ASEAN Sustainable Energy Week 2022, 14-16 September 2022. Key international and national experts shared experiences, success stories and challenges of decentralized energy generation and smart grid systems. Deliberated on the opportunities and challenges of decentralized power plants integration with smart grids and discussed enabling strategies for facilitating investment and commercialization of smart grids. The conference brought together 126 experts and participants from 10 ESCAP member States (namely Bangladesh, India, Indonesia, Japan, Malaysia, Nepal, Pakistan, Philippines, Singapore and Thailand). Included policy makers, representatives from international organizations, research and development institutions and private sector representatives involved in electricity regulation, generation and consumption.

Key recommendations: linking decentralized energy solutions with livelihoods; developing regulations for operation of smart grids and data security; scaling up and replication of decentralized renewable energy systems for wider and largescale use; establishing larger scale demonstration plants for smart grids and smart microgrids for increased adoption; and developing standards for the implementation of smart grid projects.

(c) Regional workshop on mechanisms for technical cooperation on green innovation, 19 October 2022, Tashkent, Uzbekistan (Hybrid): APCTT organized this workshop jointly with the Ministry of Innovative Development, Republic of Uzbekistan. It was held as part of International Week of Innovative Ideas 2022 (InnoWeek 2022) from 17-21 October 2022 in Tashkent, Uzbekistan on the theme of 'Green Innovations for Sustainable Development' (https://innoweek.uz/).

Key international and national experts shared experiences, and perspectives on enabling mechanisms for technical cooperation to foster green innovation. Deliberated on strategies to adopt new and emerging mechanisms for technical cooperation on green innovation. The workshop brought together 137 experts and participants from 15 UN Member States (namely Cambodia, China, India, Kazakhstan, Malaysia, Maldives, Mongolia, Nepal, Nigeria, Pakistan, the Philippines, Sri Lanka, Thailand, Türkiyeand Uzbekistan. Included policymakers, Government officials, representatives from technology and innovation centers, universities, educational institutions, research and development institutions, innovators, business entities and private sector.

Key recommendations: strengthening collaborations, networks and partnerships to increase awareness of policymakers and to promote low cost, inclusive green innovation; scaling-up financing to achieve green innovation; promoting enabling policies including intellectual property protection to accelerate green innovation; and enhanced private sector engagement approaches to promote technology innovations but also a business model for green innovation by understanding the market demands.

(d) International knowledge-sharing workshop on cross-border innovation, acceleration, and challenges in international technology transfer, 14-15 November 2022, New Delhi, India (Hybrid): The knowledge-sharing workshop was jointly organized with the Council of Scientific and Industrial Research and the Department of Scientific and Industrial Research, Ministry of Science and Technology of Government of India along with APCTT, and coordinated by Human Resource Development Centre of the Council of Scientific and Industrial Research and the Department of Scientific and Industrial Research of India. The workshop provided a platform to deliberate on the challenges and share knowledge, experience and good practices on innovation and cross-border transfer of technologies in the Asia-Pacific region. The workshop enhanced the knowledge and capacity of innovators and promoted regional cooperation between innovators from India and other member States through cross-learning from experience and good practices, identifying potential collaboration opportunities and strategies for cross-border technology transfer. The workshop was attended by around 350 participants comprising policymakers, innovators and relevant stakeholders from 16 UN Member States (namely Bangladesh, Cambodia, the Islamic Republic of Iran, India, Indonesia, Jordan, Lebanon, Malaysia, Nepal, Pakistan, the Philippines, the Republic of Korea, Sri Lanka, Thailand, Trinidad and Tobago, and Uzbekistan) engaged in development of policies, innovation, development or deployment of technologies to support Sustainable Development Goals.

Key recommendations: addressing information asymmetry between licensee and licensor during the technology transfer process; testing and demonstration of new technologies thoroughly before public acceptance; addressing system barriers through developing infrastructure, market and public

incentives; and focusing on commercially viable research; identifying mechanisms to collaborate with industry among others.

(e) International conference on innovation, technology transfer and cooperation for addressing climate change, 6 December 2022, Bangkok, Thailand (Hybrid):The international conference was organized to facilitate sharing of technical and institutional experiences on the complex policy and technology issues around urban climate resilience and sustainability in the Asia-Pacific region and explore possible strategies and pathways to overcome the challenges. It provided a platform to foster collaboration among policymakers and Government officials from member States, representatives of international organizations, research and development institutions and relevant stakeholders involved in urban governance and climate resilience technologies. The conference discussed opportunities and challenges related to climate technologies, innovative applications of climate technologies, case studies and good practices, mechanisms to accelerate technology adoption and diffusion for climate resilient urban development and strengthening regional cooperation for adoption of innovative technologies for climate resilient cities. It highlighted the need for partnerships and collective actions by governments including municipalities, civil society, and research organizations to overcome the challenges being faced by cities due to climate change. Over 170 participants including senior Government officials and experts from the member States including Bangladesh, China, India, Indonesia, the Islamic Republic of Iran, Malaysia,Nepal, the Philippines, the Republic of Korea, Switzerland, Thailand, Uzbekistan, Viet Nam and others from the Asia-Pacific region participated in the conference.

Key Recommendations: facilitating cooperation between the member countries to freely access the available climate technologies; developing proposals for support by the funding agencies, and forge cross-border technology collaboration for enhancing climate resilience of cities; strengthening capacity of countries to promote start-ups and industries and scale-up climate technologies through creating pro-start-upenabling environment; funding to facilitate commercialization initiatives of the start-ups; and capacity building of start-ups for adoption of technologies.

(f) Regional workshop on development of enabling strategies for transfer of inclusive innovations and technologies, 8 December 2022, Bangkok, Thailand (hybrid): The regional workshop was organized as part of an ESCAP project titled "Evidence-based innovation policy for effective implementation of 2030 Agenda for Sustainable Development in the Asia-Pacific region". Under the project the Asian and Pacific Centre for Transfer of Technology assisted policymakers and other stakeholders in member States to develop and adopt enabling strategies for enhancing access to inclusive innovation sand technologies. The workshop provided a platform for sharing the project findings and leanings with policy makers and stakeholders from ESCAP member

States which would be beneficial for them to adopting similar strategies for promoting inclusive innovations and technologies. Representatives from 7 member States including Bangladesh, India, Nepal, the Republic of Korea, Thailand, Uzbekistan, as well as from Climate Technology Centre and Network (CTCN attended the workshop.

15. During the reporting period, APCTT provided substantive contributions to the capacity building activities organized by external partner institutions.

(a) Workshop on opportunity for low-emission transportation in South Asia, Pacific & African regions, 20-23 June 2022, New Delhi, India: APCTT contributed to this workshop through a keynote presentation on opportunities, challenges and cost-effective strategies and pathways for reducing greenhouse gas emissions from the transportation sector in the Asia-Pacific region. The workshop was jointly organized by Climate Technology Centre and Network, The Energy and Resources Institute, and Green Technology Centre, the Republic of Korea.

(b) International conference: Systems analysis for enabling integrated policy making, 10-12 August 2022, New Delhi, India: APCTT delivered a technical presentation titled "Technology innovations for achieving SDGs in the Asia-Pacific - challenges, opportunities and regional cooperation" at this conference which was jointly organized by the Technology Information, Forecasting and Assessment Council, Government of India and the International Institute for Applied Systems Analysis. APCTT shared key perspectives on the global challenges, SDG progress in the Asia-Pacific, enabling innovation ecosystems to achieve SDGs, and regional technology cooperation.

(c) East Asia Summit New Energy Forum 2022, 20 October 2022 (Virtual): APCTT delivered a presentation on "Fourth industrial revolution technologies and regional cooperation to promote clean energy" at this forum. It was hosted by the Department of International Cooperation, Ministry of Science and Technology, China and organized by the Yunnan Academy of Scientific and Technical Information. APCTT shared perspectives on significance of fourth industrial revolution technologies and role of regional cooperation for transfer, adoption and dissemination of such technologies for climate change mitigation and clean energy transition.

C. Project-based activities

16. During the reporting period, APCTT organized three capacity building activities under ongoing projects. The projects are: 'Evidence-based innovation policy for effective implementation of 2030 Agenda for Sustainable Development in the Asia-Pacific region', and 'Enhanced capabilities to adopt innovative technologies for city air pollution control in select countries of the Asia-Pacific'.

17. Two capacity building activities were organized under the project 'Evidence-based innovation policy for effective implementation of 2030 Agenda for Sustainable Development in the Asia-Pacific region'. The activities supported enhancing knowledge of stakeholders of inclusive innovations and technologies vis-à-vis Sustainable Development Goals, criteria for selecting inclusive innovations

and technologies, and roadmap for developing database of inclusive innovations and technologies. The events were:

(a) National consultation: Bangladesh - Development of enabling strategies for transfer of inclusive innovations and technologies, 15 February 2022 (Virtual): This consultation workshop was organized to discuss the national study report prepared by APCTT with relevant stakeholders from Bangladesh. The meeting was attended by 12 participants comprising Government officials and stakeholders from Bangladesh, officials from APCTT and the international experts engaged in the analytical study. The deliberations provided recommendations for finalization of the report which would help provide direction for promotion of inclusive innovations and technologies at the regional level. Key recommendations: focus on criteria for the technologies selected, and how these would be beneficial at the national level; include affordability costs and intellectual property aspects of the technologies; elaborate the roadmap for developing database of inclusive innovations and technologies; and include homegrown technologies developed by indigenous institutions.

(b) National consultation: Nepal - Development of enabling strategies for transfer of inclusive innovations and technologies, 24 February 2022 (Virtual): This consultation workshop was organized to discuss the national study reports prepared by APCTT with relevant stakeholders from Nepal. The meeting was attended by 28 participants comprising of Government officials and stakeholders from Nepal, officials from APCTT and the international experts engaged in the analytical study. The consultation provided recommendations to finalize the Nepal study report which would help provide direction for promotion of inclusive innovations and technologies. Key recommendations: inclusion of the latest Science, Technology and Innovation policy of Nepal (2019); addition of financial resource requirements for promotion of inclusive innovations and technologies; cover aspects of Industry-Academia collaboration and intellectual property; inclusion of technologies for smart cities and e-governance; and focus on mobile technologies related to cashless payments; among others.

(c) Inception meeting for the project 'Enhanced capabilities to adopt innovative technologies for city air pollution control in select countries of the Asia-Pacific', 23 September 2022 (Virtual): In the Inception meeting, APCTT introduced the project, discussed implementation modalities and explored cooperation and support from project implementing partners, key stakeholders and knowledge partners. The meeting was attended by twelve participants including representatives from project target countries (namely Bangladesh and India), United Nations Resident Coordinator in Bangladesh; Environment and Development Division of ESCAP; and Subregional Office for South and South-West Asia of ESCAP. Key outcomes/suggestions: commitment and ownership of the project from Bangladesh and India; identifying of city-level nodal agencies for implementing project activities; facilitating agreements between APCTT and the target cities; organizing multi-stakeholder consultations in Dhaka in partnership with United Nations Resident Coordinator in Bangladesh; and initiating the development of technology compendium and city-level assessment studies.

D. Technology intelligence enhanced through knowledge products

18. APCTT enhanced technology intelligence of stakeholders from member states through developing and disseminating knowledge products including periodicals, study report and publications. The list of the APCTT's periodicals and publications during the reporting period is provided as Annexure 11.

19. APCTT developed and disseminated four issues of its online periodical Asia-Pacific Tech Monitor(https://www.apctt.org/techmonitor). The Tech Monitor issues focussed on special themes such as: Technology transfer for sustainable development in the Asia-Pacific (Jan-Mar 2022), Innovative technologies for air pollution control (Apr- Jun 2022), Regional cooperation for innovation and technology transfer – emerging strategies, models and collaborative networks (Jul-Sep 2022), and Affordable and sustainable clean energy technologies (Oct-Dec 2022). The articles provided information on latest technology trends and developments, technology policies, technology market, innovation management, technology transfer and innovative technologies. The special issues featured 8 special articles contributed by 20 authors and experts from India, Indonesia, Italy, Japan, the Republic of Korea, and Thailand. The articles presented data and analysis on critical issues related to the respective special themes and included case studies and best practices from the region and outside. The periodical also disseminated short articles on- useful guides; best practices for start-ups and small and medium enterprises; and technology networks and databases from the region.

20. APCTT shared its online periodicals with readers from the member countries and outside the region as well. During the reporting period, the web-version of the Tech Monitor was distributed to 1941 stakeholders and e-subscribers from the member States. APCTT also disseminated the e-periodicals through social media platforms such as Twitter and Facebook.

21. APCTT produced and disseminated the publication titled Intellectual Property Management and Technology Licensing - Guide for Policymakers and Managers of Research and Development Institutes, 2022, among national focal points and relevant stakeholders in member States. The target users of the publication and the training manual are policymakers, managers of technology licensing and transfer offices of research and development institutes, and the private sector enterprises.

22. APCTT finalized and disseminated three thematic papers related to innovation, transfer and diffusion of fourth industrial revolution technologies for sustainable development, healthcare, and climate change mitigation, among stakeholders of member States.

23. APCTT developed a study report on 'Development of enabling strategy for the transfer of inclusive innovations and technologies' for policymakers to develop and adopt enabling strategies for enhancing access to inclusive innovations and technologies. A major outcome of the report is the strategic roadmap for an online database of inclusive innovations and technologies. The report covers analysis of three countries from South Asia and includes mapping of policy landscape vis-à-vis Sustainable Development Goals, technology needs assessment, and methodology for identification and selection of inclusive innovations and technologies.

E. Support to inter-governmental meetings of ESCAP

24. Seventy-eighth session of the Commission

23-27 May 2022, Bangkok, Thailand:APCTT provided substantive support and submitted the report on the seventeenth session of its Governing Council, held in New Delhi, India. The following are the outcomes of the session regarding APCTT's work programme:

(a) The Commission endorsed the report of the Governing Council of the Asian and Pacific Centre for Transfer of Technology on its seventeenth session (ESCAP/78/18). (Decision 78/5)

(b) The Commission took note of the overview of partnerships, extra-budgetary contributions and capacity development(ESCAP/78/29) and expressed its appreciation for the following contributions pledged by members and associate members for 2022. Bangladesh - $7,000, India - $870,000, People's Republic of China - RMB 180,900, and Republic of Korea - $26,548. (Decision 78/11)

25. Committee on Information and Communication Technology, and Science, Technology, and Innovation, fourth session, 31st August – 2nd September 2022, Bangkok, Thailand: APCTT provided substantive support, and presented a study report on 'Fourth industrial revolution technologies for sustainable development' under agenda item 4 of the session (ESCAP/CICTSTI/2022/3). The following are the outcomes of the deliberations of agenda item 4.

(a) The Committee strongly supports the promotion of fourth industrial revolution technologies for the sustainable development of the region and recommends that the secretariat further strengthen its support to members and associate members through demand-driven programmes and activities including policy and advisory support, research and analytical support, strategy and road map development, training and capacity-building. The secretariat could provide support for facilitating strategic stakeholder collaborations and networking, managing intellectual property, establishing technology banks and facilitating regional cooperation. The secretariat could also provide support to coastal and small island developing States to accelerate the adoption of fourth industrial revolution technologies for sustainable development. (Recommendation 5)

(b) In line with the priorities of members and associate members, the Committee recommends that the secretariat develop programmes for example through the Asian and Pacific Centre for Transfer of Technology to support youth engagement in developing innovative technology solutions in support of sustainable development. (Recommendation 9)

(c) Recognizing the vital importance of the fourth industrial revolution technologies to achieving the Sustainable Development Goals, the Committee decides to support the efforts of the secretariat as implemented by its regional institution, the Asian and Pacific Centre for Transfer of Technology, to strengthen the capacity of members and associate members to accelerate the transfer, adoption and diffusion of these technologies in the region, particularly focusing on climate change mitigation and adaptation. (Decision 6)

26. Eighteenth session of the Governing Council of Asian and Pacific Centre for

Transfer of Technology, 7-8 December 2022, Bangkok, Thailand (hybrid): APCTT organized and serviced the eighteenth session of its Governing Council held in hybrid mode on 7-8 December 2022. The session was attended by the representatives from ten member States of the Governing Council: Bangladesh, People's Republic of China, India, Islamic Republic of Iran, Nepal, Pakistan, Republic of Korea, Thailand, and the Republic of Uzbekistan. In addition, the representatives of Japan, Philippines, Malaysia, Viet Nam and the Climate Technology Centre & Network attended as observers. The following are the key outcomes of the Governing Council session:

(a) The Governing Council requested APCTT to continue providing demand-driven policy advice, analytical and capacity building support for strengthening national innovation systems, technology innovations, transfer, adoption and diffusion, and promotion of regional technology cooperation for the achievement of sustainable development goals.

(b) The Council requested APCTT to continue providing demand-driven policy advice, analytical and capacity building support for strengthening national innovation systems, technology innovations and transfer, and promotion of regional technology cooperation for the achievement of Sustainable Development Goals.

(c) The Council adopted the draft strategic plan of APCTT (2023-2027) for implementation in co-operation with member States as per advice of members and discussions that took place during the 18th session of Governing Council.

(d) The Council adopted the proposed programme of work of APCTT for 2023.

(e) The Council requested APCTT to include concrete proposals on the areas of co-operation with APCTT presented by the member States as well as observers into the Governing Council report.

(f) The Council adopted the report of its eighteenth session on 8th December 2022.

F. Development of strategic plan of the APCTT

27. As recommended by the seventeenth session of the Governing Council, held in December 2021 (Decision 7), APCTT developed a draft strategic plan (2023-2027). The strategic plan aims at redesigning the work programme of APCTT to bring it into alignment with the current priorities and needs of the member States. The draft strategic plan will be presented to the eighteenth session of Governing Council for consideration and adoption.

G. Co-operation with international organizations and other partners

28. During this reporting period, APCTT jointly delivered activities/ worked closely with international organizations including Asia-Pacific Economic Cooperation, Asian Development Bank, Climate Technology Centre & Network, Economic Research Institute for ASEAN and East Asia, Gavi the Vaccine Alliance, Global Antibiotic Research and Development Partnership, International Energy Agency, International Renewable Energy Agency, International Solar Alliance, International Vaccine Institute, South Centre, and World Economic Forumwhile implementing regional consultation meetings, capacity-building activities and developing

knowledge products including periodicals and reports.

H. Digital outreach

29. APCTT continued to extend its outreach to stakeholders, policy makers and institutions through digital tools (e.g., website, technology databases), and social media including Facebook (facebook.com/UNAPCTT) and Twitter (@UN-APCTT) / Twitter). APCTT co-ordinated with the Communications and Knowledge Management Section of ESCAP to disseminate information about its activities and outputs through ESCAP website, newsletters and Twitter updates.

CHAPTER 7: INFORMATION TECHNOLOGY AND e-GOVERNANCE (ITeG)

INFORMATION TECHNOLOGY AND e-GOVERNANCE (ITeG)

1.0 Introduction

Information Technology and e-Governance (IT-eG) group was formed during mid of the 10th Plan period in order to create an IT enabled work environment in the Department through accelerated usage of various Information Technology opportunities. Primary aim of ITeG was to convert the existing procedures and processes into citizen centric procedures. IT-eG division implements e-Governance in the Department progressively that needs be in conformance to the National eGovernance Action Plan. IT-eG Division operated on a separate IT Budget Head under Secretariat Economic Services during the FY 2022-2023 for the implementation of activities carried out by the division.

2.0 IT Action Plan

For IT and e-Governance activities a comprehensive IT-Action Plan in the department as formulated in line with the Government directions issued from time to time.

- Infrastructure Development: Provide and maintain Personal Computers (PCs) and other essential IT- equipment and software to all the functionaries.
- Networking: Upgradation, extension and maintenance of Local Area Network (LAN).
- Office Automation: Implement various applications software that not only maintain records of receipt, issue of letters and movement of files but also offer enhancement in accountability, responsiveness and transparency in governance.
- IT Training: Provide relevant training courses to the officers/ staff that enable them to work on computers by using application software developed.
- e-Reports: Convert the Acts, Rules, Circulars and other published materials of interest or relevance to the public in the electronic form.
- DBT Mission: Online integration of schemes of DSIR with DBT Mission portal
- Website: Enrich the contents of the DSIR website by including downloadable forms and guidelines relevant to various citizen services that Department provides.

3.0 Implementation of e-Office in the DSIR

Department has successfully implemented e-Office developed by National Informatics Centre (NIC) at https://dsir.eoffice.gov.in. e-Office is one of the key IT projects of National Informatics Centre (NIC) aimed at improving internal efficiencies in an organization through electronic administration leading to informed and quicker decision making which in turn results in better public service delivery. It is a complete digital

work place solution for Government offices and is based on Central Secretariat Manual of e-Office Procedures (CSMeOP) formulated by Department of Administrative Reforms & Public Grievances (DAR&PG) e-Office provides a convenient way for officials to access information related to every aspect of their working and knowledge sharing by presenting a single gateway to information and services.

4.0 DSIR Website

The DSIR Website (Bilingual) has been made compliant to the Guidelines for Indian Government of Websites (GIGW). The website has been regularly updated and has been visited more than 4.69 Lakhs times since 6 August 2018.

The new website for DSIR with integration of Content Management Framework (CMF) developed by NIC, CMF Team. The Website development and Content Migration has been completed and is available at http://164.100.166.67.

CHAPTER 8: IMPLEMENTATION OF RTI ACT 2005

IMPLEMENTATION OF RTI ACT 2005

The Right to Information Act 2005, enacted on 15th June 2005, has been implemented successfully in the department. As per the provisions of the RTI Act 2005, following officers are designated:

Appellate Authority	Ms Kamini Mishra, Scientist 'F' Department of Scientific and Industrial Research Room No 19C, S&T Block 1, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26529753, 26590656 Fax: 26960629 ksm[at]nic[dot]in
Transparency Officer	Dr Prabhat Kumar Dutta, Scientist 'G' Department of Scientific and Industrial Research Room No. 524, 5th Floor, S&T Block 2, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26534823, 26590658 Fax: 26960629 pkdutta[at]nic[dot]in
Nodal Officer and Central Public Information Officer	Shri Shailendra Tripathi, Under Secretary Department of Scientific and Industrial Research, Room No 533, 5th Floor, S&T Block 2, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26590509 shailendra[dot]tripathi[at]nic[dot]in

The proactive disclosures under Section 4 (1) (b) of the RTI Act 2005 enacted on June 15, 2005 are regularly updated [Last Updated on 14/12/2022] and available on the DSIR Website at http://www.dsir.gov.in. DSIR has complied with the directives received from Central Information Commission. RTI Requests and First Appeals received and their responses are available on DSIR Website.

https://dsir.gov.in/#files/rti-dsir.html

https://www.dsir.gov.in/dsirhindi/#files/rti-dsir.html

DSIR has received 94 Applications during 01/01/2022 to 31/12/2022 and all the Applications were registered and out of them, 89 were disposed off and 5 are under process on RTI Request & Appeal Management Information System at https://rtinonline.gov.in/RTIMIS. During 01/01/2022 to 31/12/2022, 2 applications were registered and disposed off as first appeal.

The Division provided technical support by way of lectures and online demonstrations covering Overview of RTI Act 2005, Proactive Disclosures, Exemptions under RTI Act, RTI Online Portal, CIC Portal, Transparency Audit etc during:

- Programme on RTI and Transparency Audit organized by Council of Scientific and Industrial Research-Human Resource Development Centre (CSIR-HRDC), Ghaziabad during 23-24 May 2022 through MS Teams
- Workshop on RTI organized by Council of Scientific and Industrial Research-Central Road Research Institute (CSIR-CRRI), New Delhi during 25 May 2022 at New Delhi
- Induction Programme for Newly Recruited Scientists organized by Council of Scientific and Industrial Research-Human Resource Development Centre (CSIR-HRDC), Ghaziabad during 11-16 July 2022 at Kolkata through MS Teams
- Induction Programme for Newly Recruited Scientists organized by Council of Scientific and Industrial Research-Human Resource Development Centre (CSIR-HRDC), Ghaziabad during 18-23 July 2022 at Lucknow through MS Teams

DSIR has been effectively using various IT applications like RTI Request & Appeal Management Information System at http://rtionline.gov.in/RTIMIS, RTI Annual Return Information System at https://dsscic.nic.in/users/pn-login wherein quarterly returns were uploaded regularly.

CHAPTER 9: AUTONOMOUS BODIES

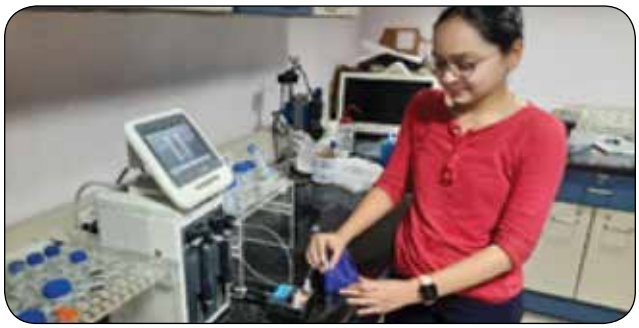
AUTONOMOUS BODIES

1.0 Council of Scientific and Industrial Research (CSIR)

1.1 Major Covid-19 Contributions

(i) mRNAVaccine Development Platform

CSIR-CCMB has set-up a working platform to develop mRNA vaccines, starting with identifying a candidate for the COVID-19 vaccine. The mRNA vaccines are modular. In principle, the mRNA can be inserted to make a protein of a pathogen of concern in human cells. This can be used to train the recipient's immune system to evade the real pathogen, if it infects.



(ii) Tablets and syrup of Umifenovir for Clinical Trials

Tablets of Umifenovir, an inhibitor of virus entry into host cells, have been developed at CSIR-CDRI for clinical trials. A syrup formulation was also developed for administration to children. The technologies have been transferred to M/s. Medizest, Goa for production of the dosage forms employing Good Manufacturing Practices. Currently, M/s. Medizest is carrying out large-scale Phase III clinical trial as COVID-19 therapeutic at multiple locations in India.

(iii) Dry powder inhalation of Favipiravir

A powder containing Favipiravir (a directly-acting antiviral), intended for inhalation through the mouth, without using any propellant or spraying valve, has been developed at CSIR-CDRI. This technique supplies medicine directly to the throat, airways and lungs. The technology has been transferred to M/s. Windlas Biotech, Dehradun.

(iv) Phenome India - CSIR Health Cohort Knowledgebase (PI-CHeCK)

One of the holy grails of preventive precision medicine is to predict the health trajectories of individuals to allow early intervention and prevent onset or complications of the disease. Such prediction of health outcomes has traditionally been accomplished by the development of risk scores based on limited data from prospective cohort studies. The advent of multi-omics data and artificial intelligence-based big-data analytical tools has opened an unprecedented opportunity for developing novel personalized risk matrix to predict health outcomes.

This was evident during the recent pandemic of COVID-19 when CSIR in its more than forty constituent laboratories and centres spread all over the country, representing a wide range of ethnicity subclasses, geo-social habitats and occupational exposures, initiated a longitudinal cohort study (Phenome-India Cohort) to estimate the burden of COVID-19 and to assess antibody stability. In a first-of-its-kind study from India,

this cohort enabled us to ascertain the sero-positivity across the country and identify variable susceptible associations for contacting infection. The longitudinal design enabled us to follow up sero-positive individuals and provide insights on the stability of these antibodies.

This multi-centric program involved longitudinal collection and biobanking of biological samples from about 5,000 CSIR employees, pensioners and their family members with concurrent collection of multi-parametric data and included clinical questionnaire, lifestyle and dietary habits, anthropometric parameters, imaging/scanning, biochemical data, and molecular data including genomics, plasma proteomics, and metabolomics. The data, archived in a central data server, was analyzed to develop robust individual and pathway-based observations which then using artificial intelligence-based tools will help to identify risk factors and develop risk matrix for various communicable (COVID-19) and non-communicable (CVD, Diabetes) that will be applicable to the Indian population. When combined with prospective collection of biological samples and analysis of the phenome using big-data approach, it can yield a wealth of information in establishing causation and development of diagnostic and prognostic biomarkers especially for chronic non-communicable metabolic diseases, which is an emerging health crisis in India.

(v) AC powered Intelligent, Remote Controlled UVC LED Sterilizer Unit

An intelligent, ultra-portable, safe UVC LED based disinfection technology was developed by CSIR-CMERI to sterilize electronic gadgets (mobile phones, remotes, power banks etc.) and personal use items like masks, keys, watches, wallets, currency notes, spectacles, jewellery etc.

It's a Clean technology based high quality, environment friendly, long life LEDs of short wave length (~275nm) for efficient disinfection with standard UVC dosage with no chemicals, no heat, no ozone involved. The system consists of timer, display, buzzer and LED based functionality indicating end of disinfection cycle or low battery level. It is operated through standard 220V AC power supply. The technology has been transferred to one MSME M/s A.R. Infotech, Madhyamgram, West Bengal.

(vi) V-Treat: A wearable pressurized air-breathing and SARS CoV-2 scavenging device

COVID-19 was declared an air borne virus and spreads through aerosols. The frontliners were at high risk working in COVID environment as well as attending thousands of patients in COVID wards, OTs, OPDs, etc. The mask used creates an un-comfort for wearing 24X7 due to negative pressure and CO_2 build up. Also, despite of using mask several doctors got infected with COVID. To overcome this and provide

a more comfortable solution, a wearable pressurized air-breathing and SARS CoV-2 scavenging device called as V-Treat was developed under collaborative project between CSIR-CSIO, Chandigarh and Ideamines Pvt. Ltd., Noida. The device works on three-level deactivation of virus and is tested for UVC safety by CSIR-NPL and SARS-CoV2 viricidal activity by CSIR-IMTECH. The device provides SARS CoV-2 free air while wearing PPE kits in COVID wards/OPDs.

(vii) Benchmarking the ability of novel compounds to inhibit SARS-CoV-2 main protease using steered molecular dynamics simulations

To explore the potential binding mechanisms of 1,2,3-triazole scaffolds in comparison to co-crystallized inhibitors 11a and 11b towards Mpro, CSIR-IHBT utilized molecular dynamics and enhanced sampling simulation studies. All the 1,2,3-triazole scaffolds interacted with catalytic residues (Cys145 and His41) and binding pocket residues of Mpro involving Met165, Glu166, Ser144, Gln189, His163, and Met49. Furthermore, the adequate binding free energy and potential mean force of the topmost compound 3h was comparable to the experimental inhibitors 11a and 11b of Mpro. Overall, the current analysis could be beneficial in developing the SARS-CoV-2 Mpro potential inhibitors.

(viii) Novel process for synthesis of TLR-7/8 Adjuvant molecule for COVAXIN to BBIL

TLR-7/8 technology developed by CSIR-IICT is one of the main components of COVAXIN efficacy against COVID-19 virus. This technology was transferred to Bharat Biotech Industries Ltd (BBIL) and applied in producing COVAXIN. Till August 2022, the production and export of COVAXIN was 3516.5745 lakh units in India and 504.30 lakh units exported. The vaccine has been exported in almost all continents of the globe especially with lower economic stature.

(ix) Portable lightweight foldable module for make-shift hospitals and other needs (Poli-Tal(M))

In the present situation of quickly developing spacious structures for temporary housing/shelters in cases of unforeseen events/natural calamities, even in villages/remote places, it will be required to develop innovative concepts for prefabricated, lightweight and modular structures for rapid installation. Utilizing the expertise of CSIR-SERC on analysis and design of light weight structures and considering the requirements, designs of temporary structures have been made. The designs utilize optimum material (thus light weight), extremely stable and can be executed in fast track construction mode.

Foldable Make-shift Hospital structure - PoliTal(M)

(x) Non-invasive Ultrasensitive Diagnostic Approach for COVID-19 Infection using Salivary Label-free SERS Fingerprinting and Artificial Intelligence

Clinical diagnostics for SARS-CoV-2 infection usually comprises the sampling of throat or nasopharyngeal swabs that are invasive and create patient discomfort. Hence, saliva is attempted as a sample of choice for the management of COVID-19 outbreaks that cripples the global healthcare system. Although limited by

the risk of eliciting false-negative and positive results, tedious test procedures, requirement of specialized laboratories, and expensive reagents, nucleic acid-based tests remain the gold standard for COVID-19 diagnostics. Herein, we have demonstrated the simplest screening modality based on label-free surface enhanced Raman scattering (LF-SERS) for scrutinizing the SARS-CoV-2-mediated molecular-level changes of the saliva samples among healthy, COVID-19 infected and COVID-19 recovered subjects. Moreover, our LF-SERS technique enabled to differentiate the three classes of corona virus spike protein derived from SARS-CoV-2, SARS-CoV and MERS-CoV. Raman spectral data was further decoded, segregated and effectively managed with the aid of machine learning algorithms. The classification models built upon biochemical signature-based discrimination method of the COVID-19 condition from the patient saliva ensured high accuracy, specificity, and sensitivity. The trained support vector machine (SVM) classifier achieved a prediction accuracy of 95% and F1-score of 94.73%, and 95.28% for healthy and COVID-19 infected patients respectively. The current approach not only differentiate SARS-CoV-2 infection with healthy controls but also predicted a distinct fingerprint for different stages of patient recovery. Employing portable hand-held Raman spectrophotometer as the instrument and saliva as the sample of choice will guarantee a rapid and non-invasive diagnostic strategy to warrant or assure patient comfort and large-scale population screening for SARS-CoV-2 infection and monitoring the recovery process.

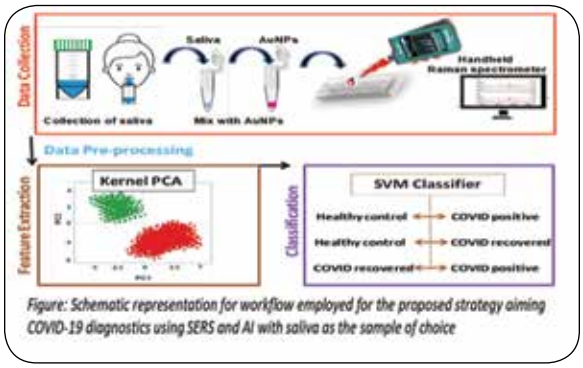


Figure: Schematic representation for workflow employed for the proposed strategy aiming COVID-19 diagnostics using SERS and AI with saliva as the sample of choice

1.2 Area-wise Significant S&T Contributions

1.2.1 Biological Sciences

Fatty acyl-AMP ligase enzyme or DIP2

Bacteria make lipid-based metabolites like antibiotics using a set of enzymes. While tracking the evolutionary path of these enzymes, Scientists at CSIR-CCMB observed that most of them are missing in higher eukaryotes. Except one – an enzyme called fatty acyl-AMP ligase. It is retained in a new avatar with additional domains, and named as DIP2.

The scientists looked for the function of these proteins in lipid metabolism. It was found that DIP2 is present mostly in mitochondria, the power house of the cell, and they are in contact with the membranes of vacuoles, organelles that contain sap, water or even excretory material, in eukaryotic cells. Their studies showed that DIP2 regulates a specific subset of a class of lipids called diacylglycerols (DAGs) in these cells. This regulation helps in controlling the size and number of vacuoles by their fusion and fission, needed for a variety of functions in cells across species to overcome stress. Just as proteins have very specific roles, lipids like DIP-2 make a similar case for lipids too.

ERK protein for culture of stem cells

Pluripotent stem cells can divide in two ways. They either give rise to more stem cells or specialized cell types and tissues of the body. The decision between the two is regulated by a protein named Nanog. Less Nanog in the cells allows stem cells to give rise to specialized cells but more Nanog

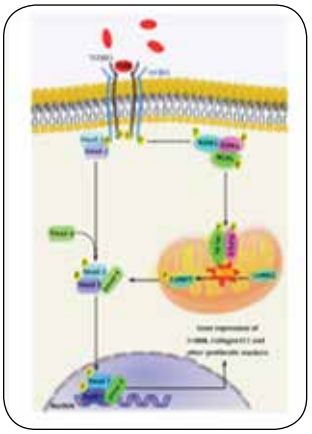
prevents it. Scientists at CSIR-CCMB have discovered that stem cells utilize another protein called ERK to adjust the levels of Nanog in the stem cells. Where there is high Nanog, ERK is low, and vice versa. This knowledge is useful in designing methods to establish large-scale cultures of stem cells and deliberately control their ability to give rise to specific specialized cell types. This is key for regenerative medicine protocols. This finding also propels our understanding of behaviour of cancerous cells since Nanog and ERK are known to be activated in stem cells of many types of cancers.

Dihydroartemesinin and Curcumin Based Self-Microemulsifying Drug Delivery System for Antimalarial Activity

Malaria is a significant global problem which still persists despite the development of various effective antimalarial drugs. It is challenging to treat this disease due to the parasite's complex life cycle and high recrudesce of antimalarial drugs. A new self-micro emulsifying drug delivery system has been developed by CSIR-CDRI to improve the solubility of dihydroartemisinin and curcumin. The prepared formulation contained Dihydroartemesinin, curcumin, Groundnut Oil, Cremephor RH, and Tween 80. Self-micro emulsification time, zeta potential, droplet size, polydispersity index, transmission electron microscopy, drug release, and in-vivo studies were performed for characterization. The globule size was found to be 25.59±0.40 nm and the zeta potential was-5.75±0.18 mV. The globules prepared were spherical in shape. The in-vitro dissolution performance of formulation of dihydroartemisinin and curcumin self-emulsifying drug delivery system showed significantly ($p<0.05$, Origin Pro 8.5) higher release as compared to the pure drugs. The results of the study suggested that the prepared self-emulsifying drug delivery system combination of Dihydroartemesinin and curcumin has a better potential to cure parasitemia as compared to the individual drug.

RIPK3-MLKL signalling activates mitochondrial CaMKII and drives intrarenal extracellular matrix production during CKD

Intrarenal extracellular matrix production or kidney fibrosis is a prevalent feature of all forms of chronic kidney disease (CKD). The transforming growth factor-beta (TGFβ) is believed to be a major driver of extracellular matrix production. Nevertheless, anti-TGFβ therapies have consistently failed to reduce extracellular matrix production in CKD patients indicating the need for novel therapeutic strategies. We have previously shown that necroinflammation contributes to acute kidney injury. Here, we show that chronic/persistent necroinflammation drives intrarenal extracellular matrix production during CKD. We found that renal expression of receptor-interacting protein kinase-1 (RIPK1), RIPK3, and mixed lineage kinase domain-like (MLKL) increases with the production of intrarenal extracellular matrix and declined kidney function in both humans and mice. Furthermore, we found that TGFβ exposure induces the translocation of RIPK3 and MLKL to mitochondria resulting in mitochondrial dysfunction and ROS production.



Mitochondrial ROS activates the serine-threonine kinase calcium/calmodulin-dependent protein kinases-II (CaMKII) that increases phosphorylation of Smad2/3 and subsequent production of alpha-smooth muscle actin (αSMA),

collagen (Col) 1α1, etc. in response to TGFβ during the intrarenal extracellular matrix production. Consistent with this, deficiency or knockdown of RIPK3 or MLKL as well as pharmacological inhibition of RIPK1, RIPK3, and CaMKII prevents the intrarenal extracellular matrix production in oxalate-induced CKD and unilateral ureteral obstruction (UUO). Together, RIPK1, RIPK3, MLKL, CaMKII, and Smad2/3 are molecular targets to inhibit intrarenal extracellular matrix production and preserve kidney function during CKD. The work has been performed at CSIR-CDRI.

Hypocholesterolemic effect of biomolecules from food origin

Proprotein convertase subtilisin/kexin type 9 (PCSK9) has been identified at CSIR-CFTRI as a novel therapeutic target for hypercholesterolemia, prompting the discovery of new therapeutic agents targeting PCSK9 for lowering cholesterol. Molecular mechanisms of the beneficial hypolipidemic effects of saffron and its carotenoid pigments have been found to reduce hypercholesterolemia and inflammation. Molecular docking and simulation studies also endorse that PCSK9 can be therapeutically targeted by natural pigments of saffron for ameliorating hypercholesterolemia.

Preparation of pushti products for target population

CSIR-CFTRI prepared a product suitable for take home ration, named as Pushti, as per the ingredient composition decided by the Women and Child Welfare Department, Karnataka. Four different formulations were prepared. The products were evaluated for their acceptability studies among the children of age group 6-26 months, in collaboration with St. John's Research Institute, Bangalore. The acceptability trails were undertaken in rural areas of the selected districts of Karnataka state. It was observed that, the formulation based on green gram and rice along with ragi was most acceptable.

CSIR-Aroma Mission

Under the second phase of Aroma Mission, CSIR-IHBT consolidated the area under aromatic crops to 1398 ha extending cultivation in twelve states and two union territories. Nineteen lakh rooted plants and three tons of seeds were generated and supplied to the farmers. Eight field distillation units have been installed in the farmers' fields for extraction of essential oils, while four more units are in the process of installation in Dodra Kwar (Himachal Pradesh), Kalimpong (West Bengal), Medina (Haryana) and Nawanshahr (Punjab). CSIR-IHBT has contributed significantly under CSIR-Aroma mission in creating essential oil-based aroma industry in hill regions of India, which has greatly helped Indian industry, farmers, progressive growers and entrepreneurs for in job creation and income-enhancement.

During the year, Himachal Pradesh retained its position as the top producer of Aromatic marigold oil in the country with production of 7.3 tonnes of oil. Overall, 29.25 tonnes of essential oil was produced from cultivation of aromatic crops leading to revenues to the tune of ₹15.66 crores.

Lavender Festival at Bhaderwah Jammu & Kashmir

Hon'ble Minister of S&T, Dr Jitendra Singh inaugurated the Lavender Festival held during 25-26 May 2022 at Bhaderwah Jammu & Kashmir, to celebrate India's Purple Revolution which is in sync with Hon'ble PM's Vision of doubling of farmers income and agri entrepreneurship.

CSIR-Floriculture Mission

CSIR Floriculture Mission program was

launched to boost floriculture industry and make it export oriented. With growing urban area, floriculture industry has become a profitable venture and emerging as a major alternate for crop diversification in the agriculture scenario of the country. Promotion of cut-flower crops for cultivation in the hill regions of the country has multifarious advantages. The strategic location of Himalayan Zone of the country can make significant impact on the floriculture industry in terms of acreage and source of employment through the cultivation of cut-flowers.

Area coverage under CSIR-Floriculture Mission was extended to 350 ha leading to revenue generation of ₹15.68 crores and benefitting 1004 farmers. Thirty training and awareness programs were organized in which 1089 farmers were trained. Fifteen lakh planting material of floriculture crops in form of corms and rooted plants was generated and supplied to the farmers of Himachal Pradesh, Uttarakhand, Punjab and union territories of Jammu & Kashmir and Ladakh which have been covered under the mission.

One of the main attractions of floriculture mission was the first Tulip Garden in Himachal Pradesh at CSIR-IHBT, which was inaugurated by Hon'ble Governor of Himachal Pradesh, Shri Rajendra Vishwanath Arlekar on the occasion of National Science Day 2022 celebrations at CSIR-IHBT campus. Increasing demand of flowers in the domestic market has given impetus to bulb production of flower crops such as tulips and lilium in the country, whereby CSIR-IHBT has provided bulb production technology to farmers of high altitude regions such as Lahaul & Spiti and Ladakh to meet the indigenous demand. Besides floriculture, apiculture is also being promoted under the mission programs and 2100 bee-boxes were supplied to farmer groups to boost generation of additional income by the farmers.

Tulip garden at CSIR-IHBT, Palampur

Under the mission, CSIR-NBRI created more than 70 farmer clusters in nine states of the country, trained more than 2000 individuals, distributed more than 60,000 planting materials to the beneficiaries.

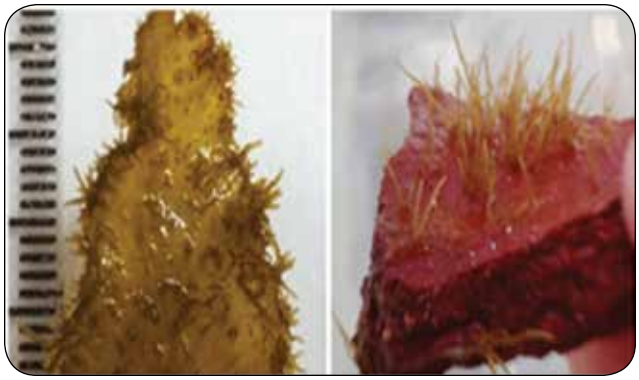
Establishment of decentralized processing units for fruits and vegetable value addition

The technologies developed for the post-harvest value addition of indigenous fruits and vegetables by CSIR-NIIST was transferred to various Government, self-help groups and farmer's consortium in order to prevent the post-harvest loss and to support the local farmer's groups. A turnkey execution of 500 kg per day processing unit for dehydration, preservation and value addition of regional fruits & vegetables was successfully completed for HORTICORP, Govt of Kerala.

Development of plantlets from secondary phyllodes of Sargassum siliquosum

The plantlets developed rhizoids and have shown the ability to get attached to various substrata like clay panels, cotton-mixed nylon threads, sponges etc. these plantlets can be used as seedling sources to cultivate Sargassum during the off-reproductive season. Further, this induction method

is quick and simple and can reduce the three to four months' period of culturing and rearing of recruited germlings in the nursery of conventional cultivation. The work has been performed at CSIR-CSMCRI.



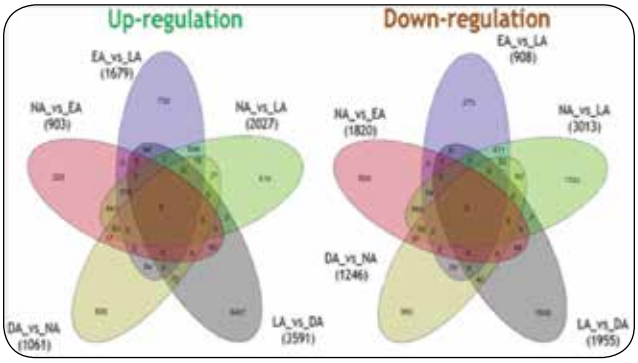
Induction of plantlets from secondary phyllodes of *Sargassum siliquosum* and their recruitment on clay panel

Exogenous indole-3-acetic acid (IAA) modulates growth and internal levels of IAA and zeatin in the green seaweed, Ulva spp.

There is very little knowledge available on the role of phytohormones in the regulation of algae's growth and developmental processes. The effect of exogenous indole-3-acetic acid (IAA) on the growth and internal levels of IAA, and zeatin, was studied in the green seaweed, Ulva. The quantitative estimation of hormones was done by high-performance liquid chromatography (HPLC) analysis. Ulva tissue was treated with 10, 50, 100, 500, and 1000 µg/L exogenous IAA concentrations for varied time durations (15, 30, and 60 minutes). Internal IAA varied from 0.2-16.4 ppm, while zeatin varied from 0.5-4.3 ppm due to various treatments of exogenous IAA. The daily growth rate (DGR) was modulated between 9.2 to 15.8% due to various treatments of exogenous IAA. Both the hormones and DGR were changed significantly by the factor concentration while only internal IAA was significantly modulated by the factor time. The highest level of internal IAA and zeatin were recorded in the treatments where exogenous IAA was applied at a concentration of 100 and 10 µg/L for 60 minutes, respectively. DGR increased up to the treatment of 500 µg/L and decreased after that. Highest DGR (15.8 %) was recorded in the treatment of 500 µg/L IAA for 15 minutes. It was found from the study that exogenous IAA can significantly influenced internal IAA, zeatin levels as well as the DGR of the green seaweed, Ulva. Understanding the hormonal cross-talks in the Ulva help to fill the knowledge gap regarding the factors which plays important role in the stimulation and inhibition of the growth and reproduction process. This knowledge will certainly help to generate sustainable feedstock for commercial cultivation of the algae. The work has been performed at CSIR-CSMCRI.

Seasonal variation in transcriptome and physiological adjustments

Seasonal variation in transcriptome and physiological adjustments occurring across the year at high elevation environments was studied by CSIR-IHBT in *Rhododendron anthopogon*, an evergreen alpine shrub of Himalaya. A considerable amount of variation was observed in the transcriptome in a time-dependent sequential manner, with a total of 9,881 differentially expressed genes. The maximum variation in expression levels of genes occurred during

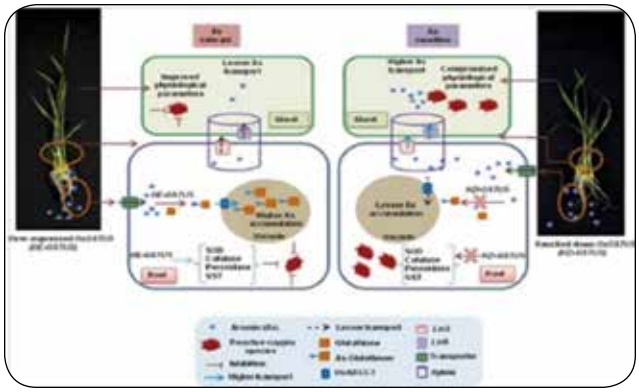


Venn diagram showing the 'common' and 'specific' differentially expressed genes in *Rhododendron anthopogon*.

the transition to de-acclimation, hence was 'transcriptionally' the most active phase, which suggests that molecular functionality is re-initiated after passing through the harsh winter conditions.

A tau class glutathione-S-transferase (OsGSTU5) confers tolerance against arsenic toxicity in rice by accumulating more arsenic in root

Arsenic (As) is considered as one of the hazardous metalloid that hampers various physiological activities in rice. To study the mechanism of As tolerance in rice, one differentially expressed tau class glutathione-S-transferase (OsGSTU5) has been selected and transgenic rice plants with knockdown (KD) and overexpressing (OE) OsGSTU5 were generated. CSIR-NBRI study suggested that KD lines became less tolerant to As stress than WT plants, while OE lines showed enhanced tolerance to As. Under As toxicity, OE and KD lines showed enhanced and reduced antioxidant activities such as, SOD, PRX and catalase, respectively indicating its role in ROS homeostasis. In addition, higher malondialdehyde content, poor photosynthetic parameters and higher reactive oxygen species (ROS) in KD plant, suggests that knockdown of OsGSTU5 renders KD plants more susceptible to oxidative damage. Also, the relative expression profile of various transporters such as OsABCC1 (As sequestration), Lsi2 and Lsi6 (As translocaters) and GSH dependent activity of GSTU5 suggests that GSTU5 might help in chelation of As with GSH and sequester it into the root vacuole using OsABCC1 transporter and thus limits the upward translocation of As towards shoot. This study suggests the importance of GSTU5 as a good target to improve the As tolerance in rice.



Impact of chronic elevated ozone exposure on photosynthetic traits and anti-oxidative defense responses of Leucaena leucocephala (Lam.) de wit tree under field conditions

The impact of long term exposure of elevated ozone (+20 ppb above ambient) on photosynthetic traits and anti-oxidative defense system of Leucaena leucocephala, a tree of great economic importance, was studied in a Free Air Ozone Concentration Enrichment (O_3-FACE) facility at different time intervals (6, 12, 18, and 24 months) by CSIR-NBRI. Results showed that net photosynthesis, photosynthetic pigments and lipid peroxidation were significantly reduced after 6, 12 and 24 months of exposure to elevated ozone (eO_3) whereas stomatal conductance and transpiration rate were significantly decreased after 12 months of exposure to eO_3. Antioxidant enzymatic activities (catalase, ascorbate peroxidase and glutathione reductase) were significantly increased after 12 months of exposure to eO_3. Ascorbate was increased significantly after 6 and 12 months of exposure to eO_3 while reduced glutathione content declined significantly after 6 and 24 months of exposure to eO_3. The study showed that there were several negative long lasting physiological and biochemical responses in *Leucaena*. The results provide evidence that *Leucaena* exhibited greater sensitivity to O_3 during initial exposure (up to 12 months) but showed moderate tolerance by the end of the 2nd year.

Isolation of a novel vicinal diepoxide of alloaureothin from Streptomyces NIIST-D31 strain

Actinomycetes are regarded as prolific producers of antimicrobials, but their vast untapped diversity awaits exploitation. In this regard, a promising area for the discovery of new antibiotics is the isolation of potent microbes from ecologically important niches. The 180,000 km2 stretch of Western Ghats region of India is renowned for its rich flora and fauna, however, the microbial wealth from this area for novel antimicrobials remain underexploited. In the quest for isolation of novel antibiotics from the Malampuzha forest area of Western Ghats region of Kerala, CSIR-NIIST isolated 300 Streptomyces strains from this area, 25 recorded potential in vitro antagonism, which beckon Malampuzha forest area of Western Ghats region of Kerala as the 'promised land' for potent antimicrobial strains and CSIR-NIIST published the isolation of a novel vicinal diepoxide of alloaureothin from Streptomyces NIIST-D31 strain.

NADH-Depletion Triggered Energy Shutting with Cyclometalated Iridium (III) Complex Enabled Bimodal Luminescence-SERS Sensing and Photodynamic Therapy

The nicotinamide adenine dinucleotide-reduced (NADH) function as a hydride (H−) carrier to maintain cellular homeostasis. CSIR-NIIST reported a quinoline appended iridium complex (QAIC) as a molecular probe in fluorescence and surface-enhanced Raman spectroscopy (SERS) modalities to evaluate the endogenous NADH status. NADH-triggered activation of QAIC enabled luminescence (turn-ON) and SERS (turn-OFF) switching phenomenon with a detection limit of 25.6 nM and 15 pM for NADH in luminescence and SERS respectively. Furthermore, N-QAIC is probed as a photosensitizer to source singlet oxygen by blocking the photo-induced electron transfer (PeT) and generate NAD radicals. Interestingly, the generated NAD radicals were capable of reducing intracellular cytochrome c in hepatocellular carcinoma cells (HepG2) as identified by the signature Raman fingerprint at 750 cm-1 Therefore, an efficient light triggered cyclometalated iridium-based molecular probe has been divulged to promote bimodal NADH sensing and multiphase photodynamic therapy.

1.2.2 Chemical Sciences

Battery-Supercapacitor Hybrid

CSIR-CECRI has developed a process for supercapacitor electrode grade carbon as a substitute to carbon import for supercapacitor device. The technology Know-how on (i) Value added high surface area Carbon for the fabrication of Supercapacitors and (ii) Process for the fabrication of 2.7 V, 100 F cylindrical supercapacitors have been transferred to M/s Qmax Ion (P) Ltd, Chennai. CSIR-CECRI team in partnership with M/s Qmax Ion (P) Ltd, Chennai has developed a battery-supercapacitor hybrid device to meet the high power and energy demand by electric vehicles. Generally, the life of the battery is diminished due to the high power demand by electric vehicles during starting-running when overload. The developed supercapacitor-battery hybrid will increase the life time of the battery as the high current demand will be managed by the supercapacitor. As a proof of concept, the battery-supercapacitor hybrid device was demonstrated in a e-rickshaw.

Polymer based Coatings to Improve the Performance of Ballistic Materials

Polymer based Coatings technology

has been developed at CSIR-CECRI to Improve the Performance of Ballistic Materials. The objectives have been to develop improvised ballistic material for light weight bullet resistant jacket/ vest for better energy absorption, energy distribution & to reduce back face signature and to coat cross linked polymer on para aramid woven fabric. Coating of graphene or graphene-based polymer composite on para aramid woven fabric and coating of nano carbon or graphene on ceramic plates have also been performed. In the process, graphene oxide was synthesized by modified Hummers method and was mixed with cross linked polymers and coated on the surface of para aramid woven fabric. The coating process on aramid woven fabric was demonstrated to OCF officials.

Development of Thermal Barrier Coatings for Casing material of Box Furnace

CSIR-CECRI developed a facility for testing the performance of thermal barrier coatings at 1200°C, which demonstrated adequate performance. These coatings can be used in aerospace, oil and gas sectors. The objectives have been to study the root cause analysis on the formation time of openings in thermal insulation test blocks & identification of the nature of the problem and to study the effect of thermal barrier coatings on the hot spot formation rate or time on mild steel box furnace.

Wastewater to Hydrogen Generation

Hydrogen as an element and as a gas (H_2) is colourless, odorless, and tasteless. Hydrogen gas on burning (combustion) with oxygen (air) generates a humongous amount of energy. Wastewater remains the untapped feedstock for green hydrogen generation. CSIR-CSIO is working on non-noble metal free and 2D materials based catalysts electrodes for photoelectrochemical (PEC) and electrochemical green hydrogen generation from wastewater. The team have demonstrated candle soot derived carbon, MXenes and MoS_2 catalysts for the same.

Hydrogenated Soya PC (95%) from Soya Lecithin Powder

A Process for Hydrogenated Soya PC (HSPC, 98%) from Soya Lecithin Powder was developed at CSIR-IICT by Isolating pure PC (≥ 95%) from Soya Lecithin Powder supplied by the client and then optimising the Process. The process was developed at 50 g/ batch and demonstrated to client

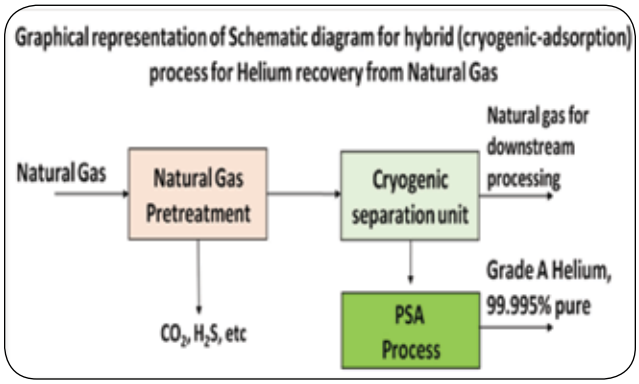
Process know how for ortho-chlorobenzonitrile

A catalytic process for the preparation of o-chlorobenzonitrile by vapour phase ammoxidation of o-chloro toluene was developed by CSIR-IICT at a batch scale of 100 g and provided the design of the reactor. Reaction was demonstrated at 10 g catalyst scale with a minimum of 75% conversion and above 98% selectivity. Active catalyst preparation at 100 g batch with know-how details was demonstrated.

Development of hybrid process for helium recovery from Natural gas

CSIR-IIP is developing a hybrid process for helium recovery from Natural gas in collaboration with ONGC- Energy Centre Trust (OECT). The hybrid process is comprised of a cryogenic section for the production of crude Helium from natural gas and Pressure/Vacuum Swing Adsorption (PVSA) for the crude helium purification for the production of Grade A helium. The natural gas is first pre-treated to remove the moisture, H_2S and CO_2. Energy and the capital-efficient cryogenic process was developed using the process simulation and process integration tools to produce crude Helium with helium purity

in the 50-70% range.The crude Helium from the cryogenic section is processed in the PVSA section. A three-column PSA demo plant has been designed. A technology information package was developed for the Grade A helium production from natural gas using one design case and two check cases to cover the entire range of design variables. ONGC and CSIR-IIP have approached Engineers India Limited (EIL) for further detailed engineering and fabrication of a pilot plant with a feed capacity of 750 NM^3/hr Natural gas.

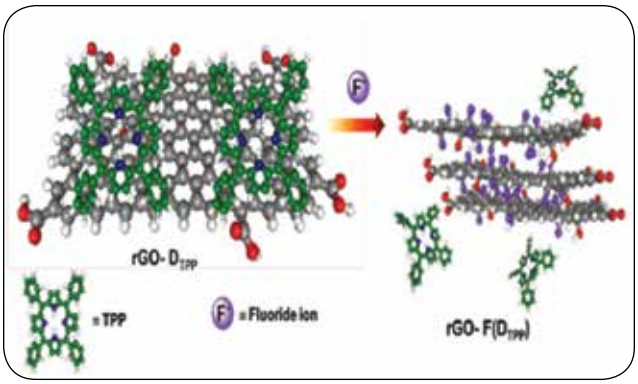


Process for production of pipeline quality bio-methane

CSIR-IIP has developed an efficient Vacuum Swing Adsorption (VSA) based process for the up-gradation of raw biogas to produce pipeline quality bio-methane meeting BIS-16087 specifications and is currently working towards its commercialization. The process had been validated at pilot scale under a Fast Track Translation (FTT) project of CSIR at 500 m^3/day raw biogas processing throughput. The basic design and engineering package for commercial scale up to 5 TPD bio-methane has been recently completed under a Fast Track Commercialization (FTC) project of CSIR.

Reduced graphene oxide–fluorophore anion sensors

The detection and quantification of the fluoride ion, one of the most significant

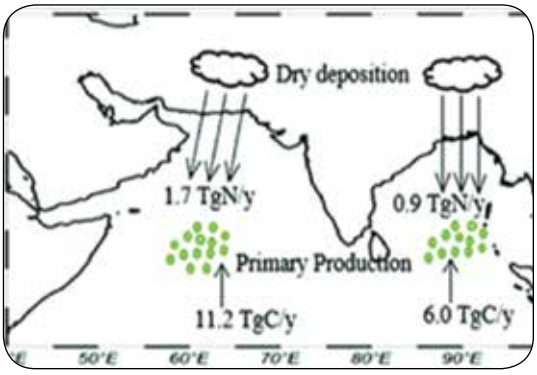


anions, have attracted much research interest because of its striking role in oral/bone health and clinical treatment of osteoporosis. In line with this objective, a set of fluoride ion sensors operating through the fluorescence turn-on response of reduced graphene oxide (rGO)–fluorophorenoncovalent conjugate has been developed at CSIR-NIIST. The sensing systems perform well at neutral pH in aqueous solutions, and the response towards fluoride ions was initiated within seconds. The high specificity for these optical sensors towards fluoride ions, among a set of significant competing anions, was notable. The turn-on fluorescence strategy was extended further to develop solid-state sensor strips for F ion detection at the attomolar level.

Study on Marine aerosols

Aerosols are one of the significant external sources of soluble reactive nitrogen to the surface ocean and their deposition affects the primary productivity. Owing to rapid industrialization over South and Southeast Asia, an increasing trend in atmospheric pollutants was observed over the northern Indian Ocean. To assess the contribution of the aeolian supply of inorganic nitrogen to the northern Indian Ocean, the available compositional data of marine aerosols collected over this basin between 2001 and 2020 were compiled at CSIR-NIO. Based on the observed relationship of mass load,

and particulate nitrate and ammonium concentrations with the corresponding satellite-derived anthropogenic aerosol optical depth the temporal, spatial, and long-term variabilities were derived for the past two decades. In particular, high aerosol mass load, nitrate and ammonium levels were observed in the coastal aerosols of peninsular India during fall and winter and they were low in summer. The atmospheric input of inorganic nitrogen to the Arabian Sea is higher (1.7 TgN per year) compared to that of the Bay of Bengal (0.9 TgN per year) and accounts for 30% of the total external sources of nitrogen to the northern Indian Ocean. The new production, supported by external sources of nitrogen, contributes to 23 and 53% of export production to the oxygen minimum zone in the Arabian Sea and Bay of Bengal respectively. A significant rate of increase in the aerosol mass load (0.05–1.67 mg per m^3 per year), and nitrate (0.003–0.04 mg per m^3 per year) and ammonium (0.006–0.11 mg per m^3 per year) concentrations was observed between 2001 and 2020, likely because of the increased emission of anthropogenic pollutants over South and Southeast Asia and their subsequent long-range atmospheric transport to the northern Indian Ocean. Overall, these results suggest that an enhanced contribution of atmospheric nitrogen may potentially increase (1) the Nitrogen/Phosphorus ratio of the surface ocean that impacts phytoplankton composition, (2) export production to the oxygen minimum zone leads to intensification, and (3) sequestration of atmospheric carbon dioxide. A decrease in primary production due to global warming is reported due to a decrease in vertical nutrient supply; however, the increase in atmospheric deposition of nutrients may compensate for this.

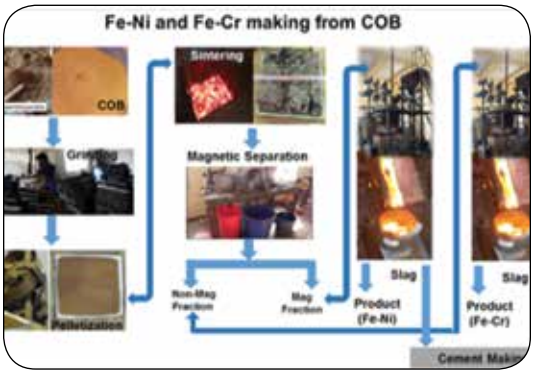


Energy Storage Application of VO2(D)

Graphene Hybrid Material a rare VO2(D) phase plate-like structures. VO2(D) integrated with graphene (rGO/VO2(D)) has been developed by facile hydrothermal route at CSIR-IMMT to explored their activity towards supercapacitor application. The graphene integrated (rGO/VO2(D)) have been validated by the extensive ab-initio simulations using Density Functional Theory (DFT). After successful synthesis, the samples have been characterized by various techniques to know its crystal phase, surface morphology and elemental composition.

Recovery of Nickel, Chromium and Iron from Chromite Overburden (COB)

Chromite overburden (COB) is a waste generated to the tune of 6-8 tons per ton mining of chrome ore. It contains metal values like iron, chromium and nickel along with other non-metallic oxides like silica, alumina etc. These metal values carry huge commercial value. Nickel percentage in COB ranges between 0.3-0.8 and it is also considered as lateritic ore of nickel. So far no commercially viable technology is available to extract these metals from COB.



CSIR-IMMT has been working on recovery of Nickel, Chromium and Iron from COB.

1.2.3 Engineering Sciences

Retractable Roof Polyhouse

In order to overcome the adverse climatic impacts and open-air pest infestations, the CSIR-CMERI developed Retractable Roof Polyhouse is used to manipulate sunlight quantity, quality and duration, water stress, humidity, carbon dioxide levels, and crop and soil temperatures for cultivation of horticultural crops. The Retractable Roof Polyhouse combines the benefit of both the natural outdoor environment and a controlled greenhouse environment to allow growers to extend harvest seasons. It helps in growing organically or chemical-free crops in order to achieve higher revenues and lower production costs. Farmers can cultivate both seasonal and non-seasonal crops throughout the year which can fetch higher value and income. The Retractable Roof Polyhouse increases harvesting period, reduces requirement of pesticide and also reduces cost of crop cultivation. The Technology has been transferred to one MSME, M/s Blue Stallion Equipments (P) Ltd., Ludhiana, Punjab.

Vehicle Mounted Drain Cleaning System

Vehicle Mounted Drain Cleaning developed by CSIR-CMERI is designed for up to 5,000 people density i.e. best suitable up to 300 mm diameter and up to a 100-metre length of the sewer system. The developed system is benchmarked with the market available system in India, and a number of features have been added which makes it first of its kind in India. It is used to handle the blockage caused by plastic and other non-biodegradable domestic thrown-away items, debris, intrusion of tree roots, etc. It is very economical and an important vehicle in the Swach Bharat Mission. In the developed system, the water collected from the drain is recycled to be used for drain/road cleaning. The technology Know-how has been transferred to one (01) Medium Enterprise of MSME M/s KamAvidaEnviro Engineers Pvt. Ltd., Pune, Maharashtra.

CSIR Hydrogen Technology (H_2T) Mission Program

CSIR-CGCRI worked on development of Electrolyser Technologies for Affordable Generation of Hydrogen (DELTAGH): Solid Oxide Electrolyser. Synthesized MIEC based phase pure BSCF air electrodes which reveals a degradation rate of 0.019 mA.h-1 and 0.06 mA.h-1 under the anodic (OER) and cathodic (ORR) over potential respectively and fabricated half cells of dimension up to 10 cmx10cmx1.5mm of configuration NiO-YSZ (fuel electrode)/ YSZ (electrolyte)/ Co-GDC (interlayer) using tapecasting and screen printing techniques.

Indian BIPV Report 2022: Status and Roadmap

The importance of more Decentralised Distributed Generation can be drawn as crucial, as recommended in National Energy Policy by NITI Aayog. In this context, the integration of PV in building construction as Building Adapted Photovoltaic and Building Integrated Photovoltaic (BIPV) has a huge potential for onsite green power generation, with the reduced transmission losses, zero space wastage and improved overall building performance. Even though the importance of BIPV is extensively recognised in the rest of the world, the perception of barriers and constraints, such as low energy production, high costs and long return of investment, quality and technical challenges still exists, which hamper its diffusion in India. In this purview, the "Indian BIPV Report 2022:

Status and Roadmap" was conceived and prepared jointly by CSIR-NIIST and SUPSI-ISAAC, Switzerland (supported by ZHAW-Leading House South with the Indo-Swiss bridging grant "SOLID-PV"). The report provides insights to the stakeholders of the solar value chain by focusing on the integration of PV systems into the built environment. An overview of India's building and solar potentials is presented and discussed to support investors, manufacturers, architects, and the construction value chain stakeholders in making the timeliest decisions. The crucial questions of business models, barriers and boundary conditions are illustrated with real data, and also based on case studies realised in recent years in India. Hence, this first "Indian BIPV Report 2022: Status and Roadmap", is expected to pull Indian BIPV sector by retracing the status, roadmap for future technological and sectoral evolution.

PatchFILL: The Pothole Repair Machine

Potholes are one of the most common types of pavement distress. They are a perennial problem for road maintenance agencies because potholes are geographically spread out and repair work is costly as well as time-consuming. Pothole problem aggravates during rainy season, and their repair becomes more difficult because of inclement weather and wet pavement surfaces. The workmanship has major impact on durability of repair. In India, potholes are generally repaired the manually, due to non-availability of indigenous machine. The imported machines are very huge along with high maintenance and operational cost. To overcome this problem, CSIR-CRRI has indigenously developed a compact and low cost Pothole Repair Machine which uses bitumen emulsion based mix technology. This machine is self-propelled and self-contained, and can carry out cleaning of pothole using compressed air, as well as placing bituminous mix and its compaction to fill up the pothole.

The machine will help in constructing roads in high-altitude Himalayan region where design and construction of roads are more difficult as compared to plain terrain due to the non-availability of skilled labour and lack of space. Compared to cost of other similar equipment available abroad, this equipment is about 70 per cent cheaper. 'Patch fill' equipment contributes towards 'AtmaNirbhar Bharat' and 'Make in India' endeavours. It also represents a step towards 'Clean India' by introducing green technology for maintenance of road pavement, and avoiding use of environmentally polluting hot-mix technology.

Intelligent solutions for Road Safety through Technology and Engineering (iRASTE)

Road crashes involving large vehicles like buses or trucks typically cause more serious injuries toVulnerable Road Users (VRUs) as well as grave damage to public property. The objective of CSIR-CRRI's iRASTEis to improve safety of large vehicle fleets by helping drivers improve safe driving behaviors.

PoC device for HbA1c detection

The maximum number of devices that are available in the market for hemoglobin A1C (HbA1c) detection are bench-type devices and the test which are conducted with them are costlier. In this invention by CSIR-CSIO, a cartridge is develop which will be single-use, disposable, and cost-effective. Cartridge provides a medium for the usage of less amount of blood sample (3-15 µl) for the detection. Cartridge has been developed using 3 different layers having different function. One layer provides

substrate to the embodiment, second layer will form channel for sample movement and the top most layer forms the passage for air which helps in movement of sample into the capillary. The channel width of capillary is optimized according to sample requirement.

Thermal imaging based Knee Osteoarthritis Diagnosis System

CSIR-CSIO designed this application as an aid to the doctors, to predict the grade of Knee Osteoarthritis (Knee OA) using thermography. It is a MATLAB-based application which works on the IRT based thermograms to predict the severity by determining the grade of the knee OA, based on the thermal emission of the human body in the affected area i.e. knee. The Thermogram Acquisition System acquires thermograms of the subject for which evaluation is to be done. The thermogram is acquired after the predefined acclimatization period of 20 min. The thermograms are taken from two angles, called Frontal View (FV) and Lateral View (LV). The FV and FV thermograms are then passed to the developed software tool for further processing, for getting the analysis results of Knee OA severity grade prediction.

In Biomedical Instruments, the current technologies used as gold standard for Knee OA severity prediction are X-ray (Radiography), MRI or CT scan that collects information from the target by emitting some waves, energy or radiation towards it. Sometimes, this approach can be dangerous for the subject if it is exposed for more than a particular time to these radiations or the subject is not suitable for MRI, if there is any implant inside the body. Here thermography is used, a technique which 'captures' infrared thermal emissions from subjects. So, no any harmful radiations or energies are being emitted from the thermography acquisition system. This system can be used as the first step of diagnosis of Knee OA as an adjunctive tool. If the symptoms off Knee OA has been detected, then Radiography / radiology can be preferred, avoiding unnecessary frequent exposure of human body to the X-rays etc.

DRISHTI & Airport Weather Monitoring System

DRISHTI, an airport runway visibility assessor system developed by CSIR-NAL has completed the land mark supply of 105 systems working in 21 civilian international airports and 18 Indian Airforce Airbases (51 systems to Civilian and 54 systems to Defence Airports). Following this success, the Airport Weather Monitoring System (AWMS) developed by the laboratory has been installed at Mangalore International Airport. This airport is the first airport in the country to have indigenously developed AWMS. The system measures Wind Speed, Wind Direction, Humidity, Pressure, Temperature and Dew Point along with Visibility. The KIA international airport, Bengaluru has become the first airport in the country to install six Drishtitransmissometer at both runways and has the unique honor of having 50th Drishti and AWMS technology at both ends of new runway. CSIR-NAL has transferred technology to Central Electronics Ltd., Ghaziabad and Tata Advanced System

NaviMet- IndigenousAWOS

Ltd., (TASL) Hyderabad. TASL is executing the IAF order for installation of 66 systems under MAFI II project and CEL is expected to get installation of Drishti & AWMS for 20 systems from IMD. CSIR-NAL, HAL & CEL has signed a MoU to install Drishti& AWMS at Tumkur Helipad to be inaugurated by the Hon'ble PM as part of AzadiKaAmritMahotsav.

High Altitude Platforms (HAP)

CSIR-NAL has taken up the development of High Altitude Platforms (HAP) for applications like broadband communication, surveillance, earth observation, climate research etc. HAP is a solar powered unmanned aircraft envisaged to operate at the stratosphere regime, i.e. approximately 20 km altitude, and with maximum endurance so that it can emulate a perpetual flight. The objective of the aerodynamics task team is to provide an aircraft configuration with maximum aerodynamic performance along with sufficient stability and control authorities. The final configuration has been achieved in an iterative manner with feedback and suggestion from the different task teams. The subscale model aims to evaluate the Reynold Number

CAD rendering of the aircaft HAP SubScale Ver4.0

effects, flight mechanics, stability and control as well as avionics & autopilot performance. The functional subscale model prototype has been demonstrated at Wings India 2022. HAP will be a game-changer to work as a pseudo satellite for telecommunication applications in the 5G & 6G spectrum with advantages like low data latency, high bandwidth, the flexibility of launch and low cost.

Technology for process improvement in degreasing, brightening & passivation process of cartridge case of 7.62mm(M-80), 7.62mm(A-7), 5.56mm & 12.7mm SA Ammnuntion and process improvement in cleaning and polishing operation of 5.56mm Bullet manufacturing

Ordinance Factory was receiving a number of complaints from customers about the blackening of Cartridge SA 7.62mm Ball M-80/M-62 Sequence belt Ammunition & 12.7 mm API/APIT ammunition. CSIR-NML worked for the process improvement in the brass cartridge case manufacturing line. CSIR-NML developed chemical composition of degreasing, brightening and passivation chemicals that could be used during the brass cartridge case production process. CSIR-NML also provided technology to produce corrosion resistant brass ammunitions. With the chemical developed by CSIR-NML, Ordinance Factory prepared the degreasing, brightening and passivation chemicals for their use. This ensured proper quality control and long-term economic benefit for the sponsor.

Upscaling of Red Mud Containing Geopolymer Paving Block Process

The upscaling (to 10 tons per day) of the 'red mud containing geopolymer paving blocks' process has been developed at CSIR-NML. Red mud and the fly ash required for the process were obtained from Hindalco Industries Ltd., Muri (Ranchi). Red mud from two other sources were also used to study the raw material sensitivity. Studies

with geopolymer samples at small scales with controlled conditions showed that 30% of red mud could be incorporated. However, large-scale optimization studies at atmospheric conditions show that 20% red mud incorporation is safer. About 10 tons of samples prepared (under optimized conditions) were field tested. Field-tested samples developed surface deterioration due to efflorescence. The incorporation of reactive additives in small amounts in the charge was adopted to circumvent this problem. No efflorescence was observed for pavers prepared with reactive additive incorporated charge mix. The durability studies carried out for six months did not show any appreciable deterioration of strength characteristics. LCA studies indicated that the red mud paving blocks have important environmental advantages in most impact categories which could help minimize natural resource depletion and environmental damages. It also helps to promote the sustainable management of waste.

Development of melting-casting facilities and optimization of melting and casting parameters for 3rd generation Al-Li alloys

Al-Li alloys are paramount considerations for designers to replace conventional Al alloys in aerospace industries. The present grade in Al-Li alloy is third generation where, couple of disadvantages of Generation-I and II have been overcome. This lead to make indigenous technology to make AL-Li alloy for aerospace industries. Development of AL-Li alloy for aerospace application requires a very challenging melting and casting methodology. The melting of Al-Li alloys is reported by CSIR-NML using either resistance heating furnace under argon atmosphere with suitable flux cover or vacuum induction melting furnace. The objectives of the present work included development of resistance heating melting and casting facilities under inert atmosphere, selection of crucible and mould materials for Al-Li alloys and explore the possibilities of melting the Al alloys containing lithium in the present project, new bottom pouring melting furnaces for melting of Al and Al alloys under inert gas atmosphere was designed and procured. With the furnace both melting and pouring can be carried out under controlled atmosphere. The furnace was successfully installed. Four number of melting trail of Al alloy containing lithium up to 2 percent was successfully carried out without any melting issues. Significant melt loss was observed in lithium element. Iron pick up in final cast alloys was observed. Minor pick up of Si and Zinc also was observed in final cast alloy.

Electromechanical impedance-based embeddable smart composite for condition-state monitoring

An alternating current (AC) based electro-mechanical impedance (EMI) technique was employed by CSIR-SERC to evaluate the performance of smart cementitious composite-based impedance sensor (SCC-iS) over a frequency range, and then was employed as embeddable sensor for monitoring and assessing the health of concrete structure. For this purpose, a method for developing SCC-iS by reinforcing the carboxylic group (COOH-) multi-walled carbon nanotube (COOH-MWCNT) in the cementitious composite matrix has been described. The optimal CNT concentration in SCC-iS was obtained and its piezoresistive behaviour was examined using an electro-mechanical impedance measurement approach under uniaxial compressive loading. The developed sensor is employed as an embedded sensor for damage monitoring of structures under flexural loading. The developed SCC-iS is the first of its kind and

is found to be very effective and durable for real-time monitoring of structures, especially in the aggressive environment.

A Macro Modelling based FEA Methodology for Realization of Textile Reinforced Concrete Rectangular and Cylindrical Shaped Tanks

Thin-walled constructions for various applications have been realized at CSIR-SERC using textile-reinforced concrete (TRC), mainly due to the non-corrosiveness of the textile reinforcement. By proper selection of matrix and textiles, TRC is able to withstand high compressive and tensile loads in a structure. For the application of TRC in highly stressed structures, it is essential to evaluate the local and global response performance of TRC. Based on this requirement, a macro-modelling methodology for finite element analysis of TRC products is developed. The model has been validated with the experimental response of TRC. The global and local behaviour of TRC tanks modelled implementing the macro-modelling methodology has been analysed. The proposed numerical analysis method further opens up the possibility of adopting the proposed method to various TRC product applications.

161 kV Double circuit suspension tower

161 kV Double circuit suspension tower (SERC Test Report no. 1263A, 2022) is of square configuration with 9.556 m base width reduced to 1.3 m width at waist level and 42.90 m height tested with + 19 m extension. While increasing the loads from 90 to 95% corresponding to the normal condition case, buckling of both the compression leg members L3 was observed, and the entire tower collapsed, as shown in the pic. The FE nonlinear analysis predicts the failure load as 85%. In segment three from ground level, the internal angle between the leg and the primary bracing member is observed to be 17 degrees. Since the bracing member's slope is steep, the bracing member shall not be considered as providing full support. The bracing system is considered insufficiently stiff, and moments can occur in the leg member. Based on CSIR-SERC's nonlinear FE analysis and their recommendations the bracing pattern in the segment- 3 of the tower was changed from 7 m K-braced system into two X – braced segments. The entire tower was re-fabricated and tested successfully.

1.2.4 Physical Sciences

ChloriSense: An IoT Enabled Portable USB colorimeter for Detection of Residual Chlorine in Water

ChlorineSense is a portable USB shaped colorimeter to quantify to color of sensor strips for residual chlorine detection in water, developed by CSIR-CSIO. This is very compact device and is used along with a mobile phone. This device can be used in rural sector for color based quantification of chlorine. The device is battery powered and having Bluetooth for data transfer. The device captures the color of sensor strip and is provided along with a Mobile App ChloriSense for analysis of captured color. It also provides the location of test and data can be stored either locally in device or emailed to the intended user. This device is further extendable to other

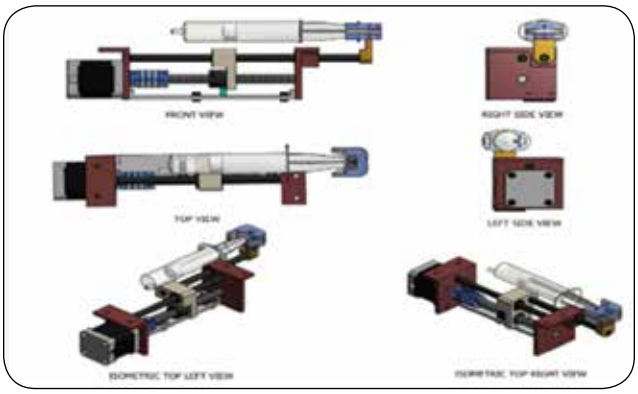
water quality parameters testing utilizing colorimetric paper strips such as pH, nitrate, etc. The device has potential usage in the "National Water Quality Management and Surveillance Program" of GoI, and is a suitable solution for low resource areas especially rural sectors using FTKs for water testing.

High-precision secondary ion mass spectrometer

CSIR-NIO reported high-precision secondary ion mass spectrometer triple oxygen isotope systematics (95 individual analyses) from 37 micrometeorites collected from South Pole Water Well, Antarctica. The work supported findings from earlier in-situ O-isotope studies, concluding that small micrometeorites overwhelmingly sample material from carbonaceous chondrite parent bodies and that cource grained micrometeorites largely sample chondrules and, to a lesser extent, chondrules and refractory inclusion material. The analysis of cource grained micrometeorites therefore provides insights into the primitive O-isotope reservoirs that were present in the early solar system and how they interacted.

Device for precise infusion of liquids for various types of Industry

The CSIR-CSIO developed device for precise infusion of liquids is an infusion pump which can be used for the infusion of liquids such as drugs, chemicals, etc. for various types of industry at slow rates in the range of 0-10 ml/hr in steps of 0.1 ml/hr. It is an electro-mechanical device working on the leadscrew based mechanism to convert the rotary motion of stepper motor into translational motion of the syringe plunger. In the design, the syringe of variable volume can be filled up with liquid and the position of plunger holder can be adjusted using the electronic switches to fit it. The range of its translational travel is governed by the opto-switches fixed at the two extreme ends parallel to the lead screw. Guided steel rods present in the device adjacent to the lead screw, provide the stability to the system and translate the linear bearing liable for the plunger movement.



Gas migration signatures related to active volcanism

CSIR-NIO collected identified gas flares from the water column images during the multibeam bathymetric mapping performed over the cratered seamount located off the Nicobar Island in the Andaman Sea and interpreted them as gas migration signatures related to active volcanism.

Observation of Deep-sea mooring

The region between the southern tip of the Indian subcontinent and the equator links the Arabian Sea and the Bay of Bengal. A

significant exchange of mass, heat and salt occurs in the region via two major current systems: the monsoon current (dominant annual cycle) and the equatorial current (dominant semi-annual cycle). The work performed at CSIR-NIO observed the deep-sea mooring programmes and described the rationale for maintaining a mooring array along 77.4°E to monitor both current systems. Analysis shows that the semi-annual to annual cycle transition occurs at 2–2.5°N, with the winter monsoon current peaking at 5°N, the summer monsoon current at 3–6°N, and the equatorial current at 0–1°N.

1.2.5 Information Sciences

Seismic hazard potential of Kachchhpaleo-rift basin of Indian craton from seismic and geodetic strain rates

The Kachchhpaleo-rift basin of western India which recently experienced Mw 7.6, 26th January 2001 Bhuj earthquake, is one of the most active and vulnerable intra-cratonic zones in the world categorized as seismic zone V, i.e. having potential to produce earthquakes of intensity IX or higher. CSIR-4PI analysed the geodetic and seismic principal strain rates to reveal the seismic hazard potential of the Kachchhpaleo-rift basin. The geodetic strain rates are calculated from the reported surface motion in the region using a modified least-square inversion scheme that utilizes distance and spatial coverage dependent weight factor on the uncertainty in the plate motion to get a reliable estimate of principal strain rates and their orientations at regular grid nodes. An optimal weighting factor yields a mean rate of compression of ~ – 16 ± 6 nano strain/yr towards north-northeast in the region. The seismic strain rates are estimated based on fault plane solutions of the significant past earthquakes (Mw ≥ 2.5) of the region using the Kostrov formulations. The seismic strain rate and stress inversion estimate indicate that the region released elastic strain at an average rate of ~ – 85 nano strain/yr towards north-south in the past 350 years. A composite analysis of the geodetic and seismic strain rates indicates 900–3000 years of recurrence interval of major (Mw 7.8–8) earthquakes in the region. The analysis indicated a high rate of strain build-up on the reactivated major faults in the region that have the potential to generate devastating (Mw ≥ 6) earthquakes.

Sensor orientation and noise analysis of the Kashmir-Zanskar seismic network: An appraisal from 2014-2020

This work of CSIR-4PI estimated misorientation angles of broadband seismic sensors of the Kashmir-Zanskar network and their effects on anisotropy determinations and great-circle-path deviations. The misorientations were calculated from the difference between backazimuths of Rayleigh waves and those of the great-circle-arcs connecting the source and receiver. Waveforms of global Rayleigh waves extracted from the records of 13 broadband seismographs in the Kashmir-Zanskar region of Northwestern Himalaya, and 3 others around the region, were used to evaluate misorientation errors in each of these sensor installations. Three of the 16 were found to have orientation errors between ± 5 and 10° with respect to the geographic north, 4 between 10 and 16° and the remainder with <5°. These misalignments had resulted in leakage of a substantial amount of energy in the transverse component receiver functions which, after correction, led to sharper amplitudes and polarities. Indeed, the SKS-derived azimuths of the fast component were found to be quite sensitive to instrument misalignment, suffering ~ 16° shift from a ~ 15.5° error in orientation. A notable observation

revealed by misalignment corrections was the substantial, up to 20°, off-great-circle arc deviations even along shorter path arrivals from regional events, offering a qualitative ordination of the region's heterogeneities. The work also presented probability distribution functions of the estimated power spectral density of ambient noise at each station compared with global high and low-noise models and near-source earthquake models. The results provide a first-order assessment of small earthquake detection capability of this network, down to M1.0, also confirmed by some of the smallest events located.

Assessing the impact of modified LULC on extreme hydrological event over a complex terrain: A case study for Kodagu 2018 flood event

The livelihoods and biodiversity in the Kodagu district of Karnataka are greatly altered by the growing urbanization through huge deforestation. The changes in the Land Use and Land Cover (LULC) patterns have important implications on the heavy rainfall activity due to significant alterations in the spatial distribution of existing land-surface properties. Hence, in order to make region (like Kodagu) more climate resilient; it is utmost important to construct a novel coupled framework for hydro-meteorological prediction to assess the impact of changing LULC (degradation of forest cover owing to urban expansion) on extreme rainfall events. Only a well-calibrated, validated, and optimized coupled high-resolution hydrological-atmospheric modelling system can be one of the best tools to study such complex problems. In this work CSIR-4PI enhanced the forecasting capability of the state-of-the-art Weather Research and Forecasting (WRF) model by coupling with a physically based, fully distributed, WRF-Hydro. The evaluation of the proposed model configurations (stand-alone and coupled mode) has been done with respect to two LULC datasets (USGS, 1992: less urbanized scenario and ISRO, 2017: more urbanized scenario) to explore the underlying causes and hydrological responses behind the 2018 Kodagu flood event. The simulations have been contended with both the stand-alone and coupled WRF/WRF-hydro models with different LULC datasets and a comparative evaluation have been carried out. The simulated variables (rainfall, runoff, surface fluxes, and peak stream discharge) are evaluated and compared with observation to assess the impact of changing LULC pattern during the flood event.

Scientifically Validated Societal Traditional Knowledge (SVASTIK)

SVASTIK - Scientifically Validated Societal Traditional Knowledge, is a nationwide initiative launched by CSIR-NIScPR that aims to preserve and perpetuate the practice of the appropriate tradition, instill the scientific temperament of verifying tradition scientifically, and boost public faith in the Nation's traditional knowledge and practices. Initiated with a Steering Committee of distinguished experts, presently, various research organisations, higher education institutions, experts and NGOs have joined hands with SVASTIK to document and disseminate content on scientifically validated Indian traditional knowledge. The SVASTIK campaign using attractive infographics, short audio-visuals, virtual lectures, webinars etc., has been launched on all popular social media platforms through @NIScPR_SVASTIK. So far, eighteen interesting infographic series on Indian traditional knowledge such as Aranmula metal mirror, URO-5, Āryabhaṭa, Yoga, rolu, turmeric, hydrologicial advancements of the Mauryans, Kunapajala etc. have been disseminated.

2.0 CONSULTANCY DEVELOPMENT CENTRE(Amalgamated with CSIR)

Consultancy Development Centre (CDC) was set up in January 1986 in the form of a registered society supported by the Department of Scientific and Industrial Research (DSIR) as its administrative Ministry to promote, develop and strengthen consultancy capabilities in the country. CDC was approved as an autonomous institution of DSIR by the Government of India in 2004. The Centre was managed by a Governing Council consisting of members drawn inter alia from Government Departments, research organizations, academic institutions and consultancy companies.

CDC amalgamated with the Council of Scientific and Industrial Research (CSIR), an autonomous body under the Department of Scientific and Industrial Research (DSIR), along with its manpower,moveable assets and liabilities vide Ministry of Science and Technology (Department of Scientific and Industrial Research) Notification AB-CDC018/1/2021-PSE-DSIR dated 11th May 2022 (published in the Gazette of India on Thursday, May 12, 2022)

During the FY 2022-23, till date of amalgamation CDC Employees (13 No.s) have been providing services to various Divisions of CSIR and CSIR paid service charges against the services of CDC Employees.

CHAPTER 10: ASSISTANCE TO PUBLIC SECTOR ENTERPRISES

ASSISTANCE TO PUBLIC SECTOR ENTERPRISES

1.0 NATIONAL RESEARCH DEVELOPMENT CORPORATION

Introduction

National Research Development Corporation (NRDC) is a Government of India enterprise, under the Administrative control of the Department of Scientific & Industrial Research (DSIR), established in 1953 under section 25 now section 8, of the Companies Act. The main objective is to promote, develop and commercialize technologies/ know how/ inventions/ patents/ processes emanating from various national R&D institutions. The Corporation offers it's services through-out the country in improving the Nation's manufacturing base with innovative technologies especially suitable for our entrepreneurs and conditions. It acts as an effective Interface for translating R&D results into marketable products. Over the last more than six decades of it's existence, the Corporation has forged strong links with various R&D organizations both within the country and abroad and pursued bringing inventions and innovations to commercial fruition. The Corporation is recognized as a repository of a wide range of technologies and has licensed technologies to over 5000 entrepreneurs spread over almost all areas of industry and has provided assistance for filing of more than 2000 IP's.

Financial Results

The highlights of the performance and the financial result for the financial year ended on 31st March 2022 as per the revised accounting policy are given below:

Performance Parameters	2021-22 (₹ in Lakhs)	2020-21 (₹ in Lakhs)
Gross Income	1189.41	816.52
Revenue from operations	1144.66	777.46
Other Income	44.75	39.06
Surplus Before Tax and extraordinary expenses	20.00	33.01
Extraordinary expenses /Prior Period expense	0.31	1.69
Surplus After Tax and Extraordinary Expenses	4.94	18.53
Paid up Share Capital	441.81	441.81
Reserves & Surplus	508.17	503.22
Net Worth	949.98	945.03

*The 75% Royalty share of DSIR i.e. ₹ 7,31,89,360/- has not been shown in Revenue as per Accounting Standards.

1.0 PROCESSES ASSIGNED AND LICENCE AGREEMENTS CONCLUDED

The Corporation continued to lay emphasis on broadening and strengthening the technology resource base by nurturing long-term relationships with R&D institutions as well as Universities, technical organizations, industries and also individual inventors. This endeavour is reflected in the Corporation's signing of **42 MOUs/MOAs/ Agreements with Institutions/Organizations** for intellectual property protection, technology commercialization, technology consultation and other value-added services. Some of the major institutions are as under:

a) Kumaun University, Nainital, Uttarakhand

b) Andhra Pradesh Electronics and IT agency (APEITA), Vijayawada, Andra Pradesh

c) The Maharaja Sayajirao University of Baroda

d) National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, Telangana

e) MIT Centre for Analytical Research & Studies, Aurangabad, Maharashtra

f) All India Institute of Medical Sciences (AIIMS), New Delhi

(I) Process Assigned

During the financial year, 38 new processes/ technologies were received (assigned) to the Corporation for licensing. Some of the commercially important processes assigned to the Corporation from various research institutes, and universities were:

i. Additive Manufacturing of Micro Architected Materials for Energy and Mechanical Applications

ii. Mobile Cold Mixer cum Paver

iii. Bio Mix-1 (A novel formulation of beneficial micro-organisms for soil remediation)

iv. Crop Residue Management for improving Soil health in the Rice Wheat system

v. Bio-surfactant from Marine bacteria for environmental cleanup and waste management

vi. Indigenous Rain Gauge

(II) Major Technologies Licensed

As a result of Value addition, the Corporation managed to sign 70 license agreements with the industry to undertake manufacturing during the year compared to 24 license agreements executed in the previous year. Some of the major processes/ technologies licensed by the Corporation in the financial year were:

i. Seaweed Extract Fertilisers

ii. Navrakshak Ultra PPE suits

iii. Ayush-64 – for treating mild to moderate cases of Covid-19

iv. Vijetha Supplement Powder (Silkworm Bed Disinfectant)

v. Poshan – A Multi-nutrient Formulation for Mulberry

vi. Development and Characterization of silk and silk blended mélange yarn

vii. Ocean drifter with INSAT communication

viii. Bio-surfactant from Marine bacteria for environmental cleanup and waste management

ix. Autonomous underwater profiling drifter for 2,000 Meter of water depth (Argofloats)

x. Met-Ocean Buoy System Type-I

(III) Lumpsum Premia and Royalty

Corporation's consolidated Lumpsum Premia & Royalty income is ₹951.97 lakhs as compared to ₹618.38 lakhs in the previous year. The Royalty received was from both the NRDC licensees and PATSER projects.

2.0 MoU EVALUATION

Corporation's performance has been evaluated on the basis of audited data by the concerned Syndicate Group of the Task Force constituted by the Department of Public Enterprises (DPE). We report that the rating awarded by the DPE as per the Memorandum of Agreement (MoA) signed with the Government of India during the year 2020-21 after the annual evaluation was 'FAIR'.

3.0 PROMOTIONAL ACTIVITIES/ OPERATIONS.

NRDC has been undertaking two promotional programmes of DSIR i.e(i) Programme for Inspiring Inventors and Innovators (PIII) and (ii) Programme for Development of Technologies for Commercialization (PDTC).

3.1 Programme for Inspiring Inventors and Innovators (PIII)

The programme is planned to encourage the innovators/inventors in developing new innovative technologies and products and tap these technologies for Corporation's business activities. To achieve this, Corporation carries out various activities like TDVC, IP Assistance and Incubation Services. The activities carried out under this programme are summarized below.

3.1.1 Implementation of the Technology Development Validation and Commercialisation (TDVC) Program

As per the advice of Technical Advisory Committee, several on-going schemes under theProgramme for Inspiring Inventors and Innovators(PIII) were dropped and NRDC was requested to form new schemes in their place and submit the proposals to DSIR for consideration and support. Accordingly, NRDC submitted the proposal on Technology Development, Validation and Commercialisation (TDVC) to DSIR in October, 2020 to be included as a new scheme under the PIII. In principle approval was granted to NRDC for the implementation of the TDVC program from Financial Year 2021-22 onwards for providing support to Start-ups, MSMEs and incubates in two phases.

NRDC formulated the TDVC implementation guidelines in consultation with the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Govt. of India. Under this program, Rs.3.00 crore has been allocated for providing support which is subject to a maximum of Rs.1.00 crore per TDVC project proposal for development of technologies in bench scale (TRL 2 to 4) to take it upto pilot plant scale (TRL 6 to 8) in the Phase 1. Successfully completed TDVC Projects, will be eligible for availing support in Phase 2 wherein Rs.1.00 crore will be provided to beneficiary against partaking of equity to NRDC.

Subsequently, after the Board approval was given in November 2021, a dedicated online portal was created to receive the TDVC proposals. A total of 53 proposals seeking support under TDVC were received. After the screening of proposals by the internal TDVC committee, 22 proposals were found eligible for support as per the guidelines. These proposals were then assessed by domain experts and along with assessment report of NRDC Technical Officers and NRDC IP Analysts, the proposal were placed before the APEX Committee for final selection of proposals for support under TDVC Program.

APEX Committee was formed during February 2022 for the selection of TDVC beneficiaries. All the 22 eligible proposals were placed before APEX Committee during March 2022. The eligible proposals were requested to present their case online alongwith the justification for availing funding support under TDVC.

After deliberations, the APEX Committee recommended extending support to the following 8 proposals under the TDVC program;

Proposals Recommended by NRDC TDVC Apex Committee		
Sl. No.	**Title of the Proposal**	**Applicant Name**
1.	Multi-Spectral Imaging Device Combining Auto-flourescence and Tissue Oxygeneration for AI based integrative assessment of Diabetic Foot Ulcers and Wounds	Adiuvo Diagnostics Pvt. Ltd., Chennai
2.	Heat Insulating & fire Insulating Materials and Process of their Development	Securefire Safety Industries Pvt. Ltd., New Delhi.

Proposals Recommended by NRDC TDVC Apex Committee		
Sl. No.	**Title of the Proposal**	**Applicant Name**
3.	Preclinical validation of 3D printed silicone breast implants	Prayasta 3D Inventions Private Limited, Bengaluru
4.	Wearable Methanol Fuel Cell Power Pack for Soldiers	Aatral Innovations Private Limited, Chennai
5.	TMSG-DC (Thermoelectric Module Static Generator – DC Power)	Prayogik Technologies Private Limited, Bhopal
6.	Reusable and Adjustable Surgical Osteotomy Guide for Fibula Free Flap Surgery in Mandibular Reconstruction	Precisurg Private Limited, Nagpur
7.	Aum Voice Prosthesis	Innaumation Medical Devices Private Limited, Bengaluru
8.	One Pot Synthesis of Solid and Liquid Bio-Nano (Ag/Cu/Zn) Materials	NSMR Private Limited, Roorkee

The support under TDVC Program extended by DSIR was Rs.3.00 crores during the Financial Year 2021-22. Provision for utilization of the funds has been made by the Corporation for the implementation of the TDVC Program during the subsequent FY as the duration of the TDVC Project is18 months.

3.1.2 INTELLECTUAL PROPERTY PROMOTION & FACILITATION

3.1.2.1 IPR Activities

The objective of the National IPR Policy is to encourage creativity and innovation in the country which helps in the generation of Intellectual Properties and also enables and facilitates the protection of the same by securing Intellectual Property Rights. Instruments of IP Rights are considered to achieve economic, social and technological advancement for a country. The Corporation continued to provide financial/technical and legal support to protect inventions developed by various universities, R&D institutes, etc. by filing patent applications in India and abroad in the year 2021-22.

The various services provided and activities undertaken under the National IP Protection Scheme are:

(a) **IP Protection:** The Corporation in its pursuit of protection of inventions and technologies developed by scientists, researchers, etc.has provided financial technical assistance for the filing of 66 IP applications received from various universities, R&D institutes, etc. The Corporation has provided technical and financial support for filing of 34 Patents, 22 Trademarks, 6 Copyrights and 4 Design registrations in the country. The efforts of the Corporation during the past several years have resulted in the grant of 28 Patents in diverse fields like chemical, mechanical, sericulture, dairy, food, and drugs, etc. During the year, the Corporation has developed the expertise for in-house filing and prosecution of IP applications and has initiated filing of IPs in the country. The corporation also field 13 patent applications under consultancy mode.

(b) **Patent Search Facility:** The Corporation has been catering to the requests received from various Universities, R&D Institutes, individual inventors, etc. for conducting the state of the art searches, the results of which are utilized for submitting research projects at university level. These reports enable the Scientists to submit novel R&D projects for funding from various agencies. It also

helps in submission of the invention disclosures during the time of filing for IP protection. During the year 2021-22, 42 Prior Art Searches have been conducted by the Corporation.

(c) Patent Awareness: Duringtheyear 2021-22, NRDC MoMSME-IPFC& TISC has organized and acted as resource persons for more than 43 webinars for promoting and creating awareness about Innovation, Technologies, Role of IPR and Management in National and International platforms.

3.1.2.2 Managing Incubation Centres

NRDC has taken upseveral initiatives to support and encourage the start-up eco-system in the Country. With this objective, NRDC has established and has started to manage incubation centers to nurture technology driven start-ups for maturation into commercial ventures.

(a) **NRDC Incubation Centre:** The Corporation has created a physical and virtual space for incubating four start-ups each, who are working on novel solutions in the manufacturing industry space. These start-ups will be provided mentoring and hand-holding services, subsidized facilities for testing and fabrication at various networked laboratories, funding against equity, certification of incubation, Office and Conference facilities, etc. The Corporation has followed a due diligence process and selected the following Start-ups for incubation at the NRDC Headquarters:

a. For physical Incubation

I. M/s Soundlear Pvt. Ltd., Dhanbad

b. For virtual Incubation

i. M/s. Muffin Health & Lifestyle Pvt. Ltd., Chandigarh

ii. M/s. Tapah Mechatronics Pvt. Ltd., Bengaluru

iii. M/s. Navshali Innovations Pvt. Ltd., Kamal

(b) **mach33.aero:** mach33.aero is a highly specialized start-up incubation facility created at CSIR-NAL Campus at Bengaluruincollaborationwith CSIR-NAL and Foundation for Innovation and Social Entrepreneurs (FISE), Bengaluru (An initiativesupported by Tata Trust) which was established and inaugurated in December2021 and is managed by Corporation. This incubationfacility encourages the incubation of start-ups in the Aerospace and allied industry sectors.

(c) **Innovative Technology Enabling Centre(InTEC):** InTEC is a start-up incubation facility created at CSRI IMMTCampusatBhubaneshwarwhich isnow managed by the Corporation. This facility is for encouraging the incubation of start-ups working in the area of materials, mining and allied industry sectors.

3.1.2.3 NRDC Intellectual Property Facilitation Centre (IPFC), and WIPO Technology Innovation Support Centre (TICS) Vishakhapatnam

IPFC Visakhapatnam office was established in Visakhapatnam, Andhra Pradesh on January 28, 2017. In due course of time, the 3rd Technology and Innovation Support Centre (TISC) by the World Intellectual property Organization (WIPO) and DPIIT, Govt. of India was established in NRDC-IPFC at Visakhapatnam on February 25, 2018 with an objective to promotetechnological innovation, IP promotion, IP management and technology transfer in the region in view of growingindustrialization and vibrant start-upecosystem evolving in the region. The Centre has developed a wide

network with the scientific and industrial community in South India. During the year, NRDC Visakhapatnam has bagged "National IP Award' from Govt. of India.

The Centre is actively working in the area of technologies licensing, IP awareness, IP facilitation, IP capacity building, etc. and is focused to make itself self sustainable.

During the year, the Centre has provided IPR facilitation & consultancy and technology transfer services to various clients including PSU's, Start-ups, entrepreneurs and MSME's. Some of the notable achievements of the Centre in Financial Year 2021-22 are detailed below:

i. Concluded 14 license agreements with several companies pan India for transfer of technical know hows sourced from public funded laboratories and earned revenue of Rs. 65 lakhs from this activity.

ii. Facilitated in obtaining assignment of 4 indigenous technologies for commercialization.

iii. Facilitated and filed 15 Patent applications. Registered 19 Trademarks, 6 Copyrights and 2 industrial designs.

iv. Conducted and participated in 22 workshops physically and virtually on IPR and transfer of technology for the benefit of various stakeholders and also participated in 43 IP promotional events/ webinars.

v. Organized Innovation Roundtable Conclave on "opportunities for Academia Industries Collaboration in Intellectual Property & Innovation Management holders" on 1st September 2021 in collaboration with the United States Patent Trademark Office (USPTO) and deliberated on industry-academia collaborations to promote innovation and technology transfer mechanisms.

vi. Organized ·Academia - Industry Innovation Conclave Specific to Minerals, Materials Life Sciences Technology" on 16th March 2022 in association with CSIR-IMMT to focus on the advanced research and potential opportunities in transfer of technologies.

vii. NRDC Visakhapatnam received Best TISC (Technology and Innovation Support Centre) National IP Award for the year 2021 from Hon Union Minister of Commerce & Industry, Shri Piyush Goyal for contribution towards strengthening IP ecosystem in the country and for encouraging creativity and innovation

viii. Coordinated signing of MoU with CSIR-IMMT for the management of IMMT-InTec Incubation Centre. The Centre has been launched at CSIR IMMT Bhubaneswar campus to nurture start-ups and is being managed by NRDC IMMT to catalyze, incubate and accelerate start-ups and SMEs for Atmanirbhar Bharat.

ix. The Centre has provided IPR consultancy services to various stakeholders including Ordnance Factories Board (Gun Carriage Factory, Jabalpur and Vehicle Factory, Jabalpur) and Rashtriya Ispat Nigam Limited (RINL)

x. Dr. Bijay Kumar Sahu, Senior Manager & Head NRDC Visakhapatnam Office received Danida Fellowship and visited Copenhagen Business School (CBS), Denmark for undergoing an advanced diploma course on "Fostering Innovation and Commercialisation of IPR" from 6 th to 27 th November, 2021.

3.2.1 TECHNOLOGY VALUE ADDITION

Technology upgradation for taking the Technology from Lab to Land provided 39 technologies by conducting Market Surveys (MS), preparation of Basic

Engineering Design Package (BEDP), Feasibility Reports (FR), Socio Economic Impact Assessment (SEIA), Techno-Commercial Support (TCS) and Priority Projects (PS) to various stake-holders I the country.

3.2.1.1 Basic Engineering Design Package (BEDP)

The preparation of Basic Engineering Design Package carried out by the Corporation is a very important value addition activity for high potential technologies that are assigned for commercialisation. The package provides information on the plant, equipment, raw material, utilities and features of the finished product etc. The data from the BEDP report forms the basis for the preparation of feasibility study report and detailed project report. These reports enable the entrepreneur to prepare a detailed engineering project report for setting up of commercial plant. The reports also help the Corporation in planning for marketing of its technologies.

During the year, BEDP on the following technologies were conducted through professional empanelled consultants:

i. Marine Oil Spill Bioremediation Technology

ii. Mobile Cold Mixer cum Paver

iii. Low cost multi filter element system for ground water recharging by using rain water

iv. Development of High Temperature Self-sustaining Low Energy Nuclear Reactor (LENR)

v. Micronutrient composition of spices: Ginger, turmeric, pepper and cardamom

vi. Bifacial Solar Panels

3.2.1.2 Feasibility Reports

The feasibility report provides information on the investment to be made on plant and equipment, raw materials and the product, etc. which helps the entrepreneurs in decision making as well as implementation of the project according to their investment capacity. It also helps entrepreneurs to get loans from financial institutions by submitting the ibility Reports. With these reports, it becomes easy for the entrepreneurs to carry out detailed engineering for setting up the commercial plant and planning for investment strategy. The reports also help the Corporation in planning for marketing of its technologies.

During the year 2021-22, Feasibility Reports on the following technologies were conducted through professional empaneled consultants:

(a) Intelligent Real Time Fish Biomass Estimation System(I-Biomes)- Drishti

(b) Vacuum chunks for Ultra-Precision Air Bearing spindle

(c) Twin screw gear

(d) Indian Tsunami Buoy System- CHATUR

3.2.1.3 Market Surveys

Market surveys are of considerable significance to the process of technology transfer. It helps ascertain the marketing potential and knowledge on prospective markets for the product manufactured using the technology transferred by the Corporation.

During the year 2021-22, market survey reports on the following technologies were conducted through professional empanelled market consulting firms:

(1) Portable Aerosol Protective Apparatus

for Dental Treatment

(2) Driving Simulators

(3) Utilizing waste heat from cold storage for drying vegetables and storing grains and other product

(4) Utilizing solar heat/Generator heat/ Air conditioning / Refrigeration system heat for controlling room temperature, for drying vegetables, storing grains and other product

(5) A Bi-Directional automatically opening and closing sanitation device for railway carriage toilets

(6) Multipurpose Geothermal tank for Gray water/rain water filtration and room cooling

(7) Method for Automatic disinfection system of Railway track at Railway stations

(8) intelligent realtime fish biomass estimation system (i-biomes)- Drishti

(9) Marine Oil Spill Bioremediation Technology

(10) Sic-surfactant From Marine Bacteria

(11) C-Phycocyanin from Marine Spirulina Technology

(12) Process for the Production of Lutein

(13) Breath Analyzer- A system and kit for non-invasive detection of peptic ulcer diseases, Non-Ulcerous Dyspesis and Helicobacter pylori infection

(14) Mobile Cold Mixer cum Paver

(15) Process for manufacture of Graphene from waste plastic

(16) Continuous process for manufacturing precision silver nanowires

(17) Thermal Error Compensation module

(18) Pressure Endurance Testing

(19) MultiZone Hot bonder

(20) Dual Heat UV Sterilizer

3.2.1.4 Socio Economic Impact Assessment (SEIA) of Technologies Licensed by NRDC

NRDC since its inception has commercialized technologies to various industry clientele pan India. it was felt that the socio economic impact of the technologies/products licensed by NRDC to the industries should be carried out for major technologies. Therefore, the activity has been started from the current financial year 2021-22. The report is prepared based on the information of the Licensee, production data and interaction with the end users of the product, their feedback, etc.

Socio Economic Impact Assessment (SEIA) report was prepared for Recycling of plastic waste to tiles through the empaneled consultant firms of the Corporation.

3.2.1.5 Techno-Commercial Support to Scientists, Innovators and Students for Process Trial and Validation of Technologies

The core mandate of the Corporation is to commercialize technologies developed in the Indian R&D sector and over the years, the Corporation has been acquiring several technologies from R&D institutions and individual innovators for commercialization. Most of the technologies acquired by the Corporation are at laboratory I bench scale with proven concepts and with IP protection. For upscaling of the technologies, the Corporation has been inviting proposals from Research Institutes/Individual Inventors, Universities, etc. for providing financial support through its program on

& quot; Development Projects and Value Addition for Priority Projects (DPVAPPY up to Rs.10.00 lakhs and Techno Commercial Support (TCS) up to Rs.2.00 lakhs which is a component of the PDTC Promotion Program funded by the Govt. of India.

The list of technologies being supported under the Priority Projects and Techno Commercial Support Scheme are asunder:

Priority Projects:

1. Development of High Temperature Self-sustaining Low Energy Nuclear Reactor (LENR) from Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA University), Prashanti Kutiram, Kallubau Post Jigan Hobli, Anekal Taluk, Bengaluru

2. Agro Farming Gardening Machine from India Skillpedia Foundation (Society Reg. with Registrar of Societies) Govt. of Assam Work carried at: M/s. Prenac Tools, Coimbatore, Tamil Nadu

3. Additive manufacturing of micro architected materials for energy and mechanical applications from Central Manufacturing Technology Institute (CMTI), Bengaluru

Techno Commercial Support:

1. Preparation of Arappu (Albizia Amara) Based Herbal Shampoo Fortified With Fruit Pulp Extract of Aegle marmelos and Testing the Efficacy of the Product for Acceptability and Applicability from Kongunadu Arts and Science College (Autonomous), G N Mills Post, Coimbatore, (For further development of the technology).

2. High Precision Optical Standard Glass Scales from Central Manufacturing Technology Institute (CMTI), Bengaluru, (For preparation of Comprehensive Know-how document)

3. High Precision Optical Standard Glass Scales from Central Manufacturing Technology Institute (CMTI), Bengaluru, (For further development of the technology).

4. Production of first indigenous growth promoter 'Mycobactin J' for the growth of Mycobacterium paratuberculosis, a major pathogen infecting livestock; for the growth of Mycobacterium paratuberculosis, a major pathogen infecting livestock and humans from Shri Ganeshi LalAgarwal (GLA) University, Mathura, (For further development of the technology).

5. Production of Anti Corrosive Carbon based paint and coating from the waste Tyre Pyrolysis Char from LN Indtech Services Pvt. Ltd., Odisha, (For further development of the technology)

3.2.2 DISSEMINATION OF INFORMATION ON SCIENCE AND TECHNOLOGY

3.2.2.1 Exhibitions and Publicity

The Corporation participates in various exhibitions for creation of awareness about the technologies available with the Corporation for transfer, explore avanues for technology assignment, etc. with this objective in view, the Corporation participated in 11 exhibitions in India oranised by various agencies in the Financial Year 2021-22.

3.2.2.2 Publication of Magazines in NRDC for dissemination of information on Science and Technology for the Financial Year 2021-2022

NRDC continues to bring out its regular

publications –*Awishkar* (Monthly Hindi S&T magazine) and Invention Intelligence (Bi-Monthly English S&T magazine). The main objectives of the magazines are to disseminate information and create awareness about new technologies, inventions, innovations, IPR issues, etc. amongst the masses and foster the spirit of inventiveness, innovativeness and entrepreneurship in the country.

During the year some of the important articles covered in Awishkar are: Rural Innovation and Entrepreneurship; Biodiversity; Plastic Pollution; Biographies of India's Scientists – Acharya Jagdeesh Chandra Basu, P.C.Ray, C.V. Raman; Scientific institutions and Scientists of Modern India; Malarial Vaccine; Mosquirix; Cryogenic Technology; Hydrogen Fuel; Block Chain Technology; New Technologies in Water Treatment.

During the year some of the important articles/topics covered in Invention Intelligence are: The role of Digital Infrastructure in Socio-economic Development; The issue focused on Scientific Institutions and Scientists of Modern India; Hydrogen Fuel; Deep Ocean Mission; Cryogenic Technology

3.2.3 START-UP INDIA: SEED FUNDING OF MANUFACTURING START-UPS IN INCUBATION CENTRES.

NRDC provides seed funding against equity to eligible technology based start-ups incubated in state/central Govt. incubators. The start-ups have to demonstrate innovative and technology intensive development with strong commercial value.

Through this program, the Corporation selects technology based start-up enterprises and provides a part of the capital required as seed funding which prima facie have the potential to develop into significant technical and commercial venture. The Corporation would subscribe to the equity share capital of such Start ups based on innovative technology intensive processes.

During the year, 43 applications for Seed Funding were received and these were screened by a committee constituted within the Corporation for verifying their eligibility as per the guidelines. The following four start-ups companies were shortlisted from a total of 43 applications based on the recommendations of the Investment and Disinvestment Committee:

Sl. No.	Name of the Start-up company	Proposal
1.	MachPhy Solutions Pvt. Ltd.	Multipurpose crryo-cool boxes for cold chain storage in Agriculture, healthcare and Retail
2.	TIEA Connectors Pvt. Ltd.	Commercialisation of High precision low voltage Miniature connectors and contact solutions
3.	Indigenous Energy Storage Technologies Pvt. Ltd.	Development and Commercialisation of Sodium ion batteries and its components (like Hard carbon) using agricultural waste like rice straw and sodium precursors.
4.	Avay Biosciences Pvt. Ltd.	Manufacturing of PEEK (Poly ether ether ketone) 3D printers for Industrial applications

NRDC will be acquiring the equity in these Start-ups after reviewing the reports on Due Diligence and Valuation.

4.0 START-UP INDIA INITIATIVE

4.1 Assessment of Start-Up-India Applications for Tax-Exemption "Start-up-India" is an initiative of the Department for Promotion of Industry and Internal Trade (DPIIT), Government of India, designed for fostering innovations, create jobs and facilitate investments. Start-up India receives applications from all over

India for getting recognition (as Start-ups) for further availing proposed benefits under this scheme including the three year tax benefits.

DPIIT has given the responsibility to NRDC for technically assessing these applications for recognizing start-ups and recommending the eligible start-ups for tax exemption and other benefits. Till date total 74,466 start-ups have been successfully received the recognition certificate. As notified, for further availing tax benefits, the eligible applications are further reviewed by an Inter-Ministerial Board (1MB) chaired by JS, DPIIT. NRDC evaluates the applications basis of norms given by Start-Up India initiative and submit the reports regarding the same to Inter Ministerial Board (IMB)for final decision. NRDC has evaluated 1379 number of applications in the Financial Year 2021-22. Based on the recommendation of assessment by NRDC the 1MB has approved 39 Start-ups for availing tax benefits in Financial Year 2021-22.

5.0 CONSULTANCY

5.1 Indian Oil Start-Up Scheme: Mentoring & Monitoring Start-Ups

Indian Oil Corporation, India's flagship National oil major, has launched a Start-up Scheme with a funding of ₹ 3.00 Crores to promote promising start-ups and nurture an eco-system conducive for innovations in the domestic hydrocarbons and allied sectors. Driven by Indian Oils Research Development Centre based at Faridabad, the scheme is supporting projects that aim to establish innovative technology and business process re-engineering ideas with significant business potential, social relevance and focused on environment protection. It will help them pursue their promising ideas right up to validated Proof of Concept (POC) by funding the incubation ecosystem and through intellectual mentoring. Indian Oil may further aid in the commercialization of selected validated PoCs through equity participation.

Based on Corporation experience in working with Start-up eco system, IOCL entered into an agreement with NRDC for short listing and fixing of milestone from the proposals received from the start-ups for funding.

During the year corporation provided mentoring and monitoring services to 12 start-ups funded by IOCL to promote the start-up culture in the country.

5.2 Engagement of NRDC as an IPR Consultant:

During the financial year 2021-22, the Corporation has filed more than 35 IPR applications (patents, copyrights, design, trademarks) for various organisations like NTPC, NIFTEM, MIDHANI, IWST, NEHU etc. through our empanelled attorneys on Consultancy basis as compared to 40 Application in 2020-21.

5.3 Establishing Intellectual Property Facilitation Cell (IPFC) for Director General of Quality Assurance, Department of Defence Production, Ministry of Defence for Capacity Building of IPFC under IPR Consultancy scheme of NRDC

To spur creativity and stimulate innovation in defence sector, Ministry of Defence launched 'Mission Raksha Gyan Shakti' (MRGS). This mission aims to institute an enabling framework for creation and management of Intellectual Property (IP) in Indian defence sector. Therefore, an Intellectual Property Facilitation Cell (IPFC) has been set up under the aegis of Director General Quality Assurance (DGQA) to steer all efforts in this direction.

NRDC signed an MoA with IPFC of DGQA, Department of Defence Production, Ministry of Defence on 9 th July 2019. As per the MoA, NRDC shall provide support to DGQA for capacity building of their Intellectual Property Facilitation Cell (IPFC) for a period of two year

The major roles and responsibilities have been to provide a suitable organizational structure of IPFC, formulate IP management policies for DPSUs/ OFBs, formulate requisite Standard Operating Procedures (SOPs), Process Sheets, Forms and Reports, provide structured and hands on training to personnel of IPFC, provide services for filing of IP applications through NRDC empanelled attorneys, provide professional guidance and assistance for empanelment of IP Attorneys, provide professional guidance for procurement of suitable hardware, software and databases, conduct basic and advanced training on IP Management for personnel from DPSUs, OFs, Army / Navy / Air Force and Private Sector and to provide professional guidance and assistance on any other issue pertaining to IPR / IP Management

In the year 2021-22 NRDC carried out the following activities for the IPF Cell DGQA:

1. Assisted in formulating the policy for Creation and Management of Intellectual Property(IP)by Defence Public Sector Units Ordnance Factories.
2. Placed two full time Consultants at IPF cell for providing support and professional guidance to the IPFCell.
3. Assisted in preparation and publication of three editions of e-magazines MRGS Samvaad for dissemination of information on IPR.
4. Assisted in filing of 140+ IP applications including patent, copyright, design and trademark of Indian Army. Navy, AFMC, etc. through NRDC empanelled attorneys.
5. Participated in progress review of MRGS.
6. Indian Navy and NRDC partnered in protecting the IP developed by Innovation Cell of Institute of Naval Medicine and commercialization of NavRakshak PPE Kit. The Manufacturing Know-How of NavRakshak TM has been licensed to two Indian MSME manufacturer.
7. Providing Professional guidance for any other issue pertaining to IP Management.
8. Design and development of MRGS website.

6.0 ASEAN-INDIA INNOVATION PLATFORM (AIIP)

6.1 Technology Database:

During the year 2021-22 the ASEAN Portal was online and efforts were made for the collection of new technologies from National and International R&D Institutes. As a result, the portal has a data bank of 440 Indian Technologies and 187 technologies from other ASEAN countries. In order to fill-up the gaps and full fill the technological needs of the ASEAN member countries, a database of 500 international agencies in the area of technology development was also developed.

7.0 Manpower (Human-Resource)

The real asset of any company is its human resource. The total regular manpower of the Corporation as on 31st March, 2022 was 57 viz. (Group A-29, Group B-6, Group C-19 and Group D-3) along with 7 contractual engagements (viz 3 Technical + 2 Non-technical + 2 Retired persons). The representation of reserved category of regular employees as on 31.3.2022 stood at SCs (26.31 % - (15 employees) ST (Nil % - No employee) OBC (5.26% - 3 employees),

PwD (Nil % - No employee), ESM NIL (No employees) and women representation (19.30% -11 employees) and Minority Community (3.51%-2 employees) respectively.

The Corporation is following all the instructions and Govt. directives relating to reservation of the above categories issued from time to time. In some areas, their representation could not be brought to the prescribed levels due to non-filling of vacant posts and the continuing rationalization of existing manpower. The employee-management relationship was cordial throughout the year.

7.1 Human Resource Development

Training and development of all levels of employees are given due priority by the Corporation to increase effectiveness. Special emphasis is given to organization building and shaping the right attitudes, team building and work culture besides preparing employees to understand the trends in fast changing technology/ switching over to the latest technology for achieving higher results in productivity and profitability. Due to financial constraints, pandemic, and other reasons none of the officials of the Corporation were deputed to training programs this year. However, employees were exposed to in-house training in the subjects related to technology transfer, IP, Discipline Leave regulations, GeM procurement, RTI. Etc. The thrust for better utilisation of Human Resources and improvement in work practice continued during the year.

7.2 Information Status of Complaint Mechanism for Women

NRDC has a 'Women's Cell' consisting of the following members to look after the well-being and welfare of the female employees:

1.	Ms. Mayuree Sengupta	Chairperson
2.	Ms. Sharda	Member (Rep Officers Association)
3.	Ms. Asha Devi	Member (Rep. Staff Union)
4.	Ms. Smita Parashar	Convenor

The Women Cell is provided with requisite facilities. The Cell also shares awareness for all female employees on sexual harassment at the workplace. The Cell also displays posters to show the type of harassment acts at work places. All the circulars pertaining to the welfare/protection of women's rights received from the Government Departments are brought to the notice of female employees for awareness. A meeting of the Committee was held on 8th March, 2022. The Corporation did not receive any complaints during the financial year 2021-22.

The Women Cell members look into the grievances of female employees and complaints of sexual harassment received, if any. There is a cordial atmosphere for male and female employees of the Corporation.

8.0 RIGHT TO INFORMATION

Under the provisions of section 4 of the Right to Information Act, 2005, every Public Authority is required to display necessary information to citizens to secure access to information under the control of public authority in order to promote transparency and accountability in its working and functioning.

NRDC, being a responsible Central Public Sector Enterprise, has displayed essential information on its website under the head RTI. The management has notified APIO, PIO, Transparency Officer and the First Appellate Authority (FAA) in compliance with the requirements of the RTI Act.

Between April 01st, 2021 to March 31st, 2022, a total of 22 applications were received by the Company and all of them were disposed off by providing requisite information as per rules. Apart from RTI applications, the Company also received 02 appeals against the information provided, which too were duly attended to and appropriately disposed off by the First Appellate Authority. It is pertinent to note that Central Information Commission has not passed any adverse order against the Corporation.

9.0 TECHNOLOGY ABSORPTION, ADAPTATION INNOVATION & CONSERVATION OF ENERGY

Being a Section 8 company under Companies Act 2013, while a major objective of the Corporation is the promotion, development and commercialization of indigenous technologies, the Corporation itself does not carry out any R&D. However, it promotes and provides limited finances assistance for R&D on a meritorious need basis to both laboratories and industries.

As the Company's operations do not involve any manufacturing or processing activities, the particulars required under Section 134(3)(m) of the Companies Act, 2013 read with Rule 8(3) of the Companies (Accounts) Rules, 2014 regarding conservation of energy and technology and absorption are not applicable.

10.0 CORPORATE GOVERNANCE

Corporate governance is the system of rules, practices and processes by which a company is directed and controlled. Corporate Governance refers to the way in which companies are governed and to what purpose. It is, in essence, a toolkit that enables management and the board to deal more effectively with the challenges of running a company.

NRDC is fully committed towards good Corporate Governance in letter and spirit. NRDC makes all efforts to achieve the highest level of corporate governance as per the applicable guidelines in this regard.

11.0 IMPLEMENTATION OF OFFICIAL LANGUAGE (2021-22)

The Corporation continued to make efforts to fulfill the targets prescribed by Govt. of India in the Official Language Act and Rules framed therein with regard to increase the use of Hindi Rajbhasha in office during the year 2021-22. Employees were motivated to use their working knowledge of Hindi in day to day official work. All the Standard Forms, Files etc. are bilingual. Significant progress has been made in the field of correspondence, noting and drafting in Hindi. All Hindi letters are being replied in Hindi only. The Annual Report of the Corporation is being published in digital form in both Hindi & English since 1986-87. The Corporation also publishes a popular Science &Technology monthly magazine in Hindi, entitled 'Awishkar'. To popularize the use of Hindi, the Corporation organized a "Rajbhasha Pakhwara" (14 - 30 September 2021). During the Pakhwara Hindi Essay writing competition was organized & cash awards were given to the winner. Cash Awards were also given to employees under "Rajbhasha Incentive Scheme". To enrich Hindi vocabulary of the employees of the Corporation as well as visitors, an English word with its Hindi meaning is written daily on a writing board as 'Today's Word' at the reception of the Corporation.

2.0 CENTRAL ELECTRONICS LIMITED

2.1 I NTRODUCTION

Central Electronics Limited is a Public Sector

Enterprise under Department of Scientific Industrial Research (DSIR), Ministry of Science Technology, Govt. of India. It was established in 1974 with an objective to commercially exploit the indigenous technologies developed by National Laboratories and R&D Institutions in the country. The company has commercialized number of products developed in collaboration with CSIR, DRDO and other institutions. The renewed mandate of CEL includes development and harnessing technology for (i) Solar Energy Systems and Solutions (ii) Strategic Electronic Components and Systems required for defense and other science and technology missions (iii) Signaling and safety in public transport systems and (iv) Security and surveillance in strategic establishments.

CEL has pioneered in Defense components and materials like Phase Control Modules (PCM) and CZT substrates, Solar Photovoltaic, Railway Safety Signaling Equipment, and different types of PZT elements in the country. The company is a leading manufacturer of RDSO approved railway safety and signaling systems with a market share of 60%. These signaling systems are important equipment for public safety during the operation of trains. CEL is involved in commercialization of critical products for strategic applications for defense like Ceramic Radome for Missile radar for Air force, Drishti Transmissometer for visibility measurement in Airports, Development of circulators Isolators for ISRO. CEL is also working on failsafe new generation railway signaling and safety systems.

CEL has established partnerships and linkages with various stake holders and business associates in the areas of railways, power generation and distribution companies, service providers in the energy sector, public funded institutions and even rural communities through the state governments. CEL's programs and operations for production, business operations, distribution and marketing as well as support services are aligned with the programs being implemented by the central government of India.

2.2 Major Developmental Activities during 2022-23

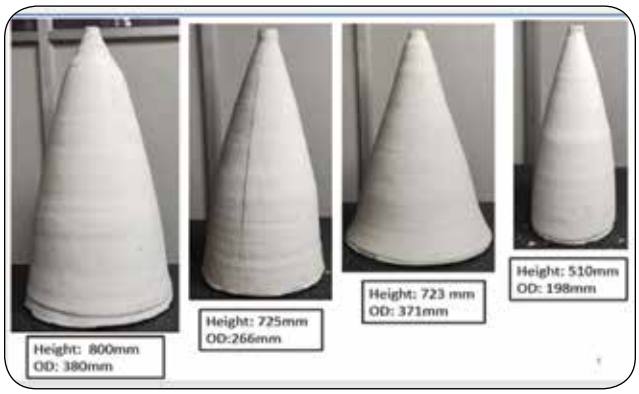
(i) Ceramic Radomes

Radome is a thermo-structural member used in tactical missiles and houses the avionic systems like seeker. It is subjected to severe thermal as well as structural loads during the flight. It is one of the most critical components for the seeker missile having complex manufacturing process. High temperature ceramic materials which are transparent to electromagnetic radiation are chosen as radome materials.

The know-how of the ceramic radome technology was provided by Defence Metallurgical Research Laboratory (DMRL), DRDO and the company has set up the manufacturing and inspection facilities for sintered radome and successfully commercialized the product.

Bottom Loading Furnace Max. Temp.: 1300 °C Chamber Dimension: 1 X 1 X 1 m

CEL is capable of manufacturing sintered radomes up to the diameter of 400 mm and height up to 950 mm.



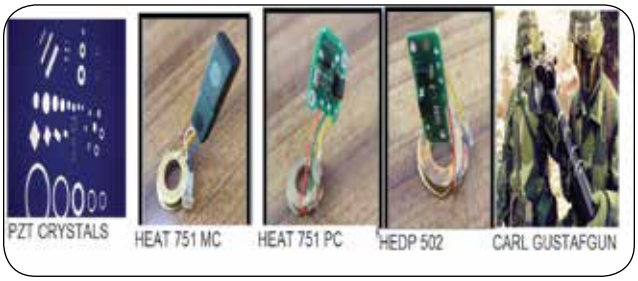
CEL has recently, indigenously developed machining of ceramic radome, successfully.

Outer profile machining in progress Inner profile machining in progress

The company has also received orders of worth Rs.6.5 Cr from defence organizations for supply of ceramic radomes for various missile systems. CEL is working towards providing complete radome solution that shall be ready for integration with RF seeker.

(ii) Electronic Ceramics Components

CEL has developed new designs and now manufacturing Lead Zirconium Titanate (PZT) crystal in the shape of Disc, Ring, Rod etc. CEL has also, Indigenously developed HEAT (High Explosive Anti Tank) Fuze for 84 mm Carl Gustaf Gun.



Piezoelectric Generator - HEAT 551 (Developed)
Main Charge and Precursor Charge - HEAT 751(Under -Development)
High Explosive Dual Program(HEDP) - 502 (Under-Development)
Piezoelectric Body and Detonating Device Body of 125 mm HEAT round ammunition gun for T72 tank (Under development).

(iii) Commercial Production of New Multi Section Digital Axle Counter (newMSDAC)

MSDAC is a multi-section digital axle counter system used for detection of railway tract occupancy primarily in a station.

The current version of MSDAC being manufactured by CEL is a fail-safe, train detection system and caters to maximum of 40 Detection points suitable for larger installations. The new generation MSDAC is planned to come up with smaller configuration system for meeting railways requirement, to be price competitive, to

tackle the component obsolescence in the existing system in compliance to RDSO EMI/EMC specifications.

The sub-modules and engineering model of the system have been developed by the company and the system is approved and included in Part-I. Commercial orders for MSDAC from Railways are in pipeline and CEL is confident of achieving highest ever turnover in Railway section this year.

(iv) Broken Rail Detection / Rail Monitoring System for DMRC

CEL has signed MoU with DMRC for development of Broken Rail Detection / Rail Monitoring System for DMRC to detect rail breakage in Metro Lines installed with Driver less technology. This is an Inhouse smart IoT device developed for Alert / Alarm Generation. Recently it has been deployed and commissioned on Magenta Line of DMRC between Jasola Vihar-Shaheen Bagh Metro Stations on May 29, 2021.

Broken Rail Detection System

Prototype Broken Rail Detection System At ShaeenBagh

This new development has huge Market Potential in DMRC and other regional lines with Driverless train movements.

2.3 Technology Absorption, Adaptation, Innovation:

(i) Drishti Transmissometer

CEL has recently manufactured, supplied and installed Drishti Transmissometer at Tumkur, Karnataka, which is mandatory equipment required for safe landing and take-off operations at the airport. The know-how of the system has been provided by CSIR-National Aerospace Laboratories (NAL). The system measures visibility as low as 4m and as high as 10km and meets standards of International Civil Aviation Organization (ICAO) and World Meteorological Organization (WMO) and suitable for all categories of airports viz CAT I, CAT II, CAT III A & B. CEL also received and executing commercial orders for AMC of DrishtiTransmissometer at Indira Gandhi International Airport, Delhi.

Drishti Transmissometer

2.4 Memorandum of Understanding (MoU)s Signed

i. Memorandum of Understanding (MoU) signed with DMRC for

development and supply of Broken Rail Detection / Rail Monitoring System for DMRC.

ii. Technology transfer agreement has been signed with Naval Materials Research Laboratory (NMRL DRDO) for production of Gel Casting Based Radome.

iii. MoU signed for installation of 500 KWp Solar Power plant at Village Palli, J&K and the plant was successfully installed by CEL in a record time of 18 days. Hon`ble PM Shri Narendra Modi inaugurated the plant at Palli Village on 24.04.2022 to make it a Carbon neutral Panchayat.

2.5 Financial Achievements

i. Highest ever Profit Before Tax and exceptional items of Rs.55.19 Cr.;

ii. Highest ever net worth of Rs.122.34 Cr. as on 31.3.2022 after Dividend payout;

iii. First ever declaration of Dividend by CEL @Rs.100/- per share on Equity Capital as on 31.03.2022.

iv. Debt Free company as on 31.03.2022.

v. Over Rs.145 Lakhs spent under Corporate Social responsibility (CSR) in last 6 years.

vi. Wage Arrear of the year 2007 of Rs.18.99 Cr. distributed on September 20,2022 by Hon'ble DG of DSIR.

Financial details in comparison with previous years supported with Table/figure:

Year	2021-2022	2020-2021
Production	251.53	287.21
Sales	253.34	296.37
Gross Margin	59.03	41.40
Gross Profit	55.15	36.58
Profit Before tax (PBT)	35.18	34.21
Net Profit after Tax (PAT)	23.78	23.26

Wage Arrear Payment 2007

In view of the company's performance for financial year 2021-2022, long term growth strategy and ability to pay, the board approved payment of wage arrears to all board level and below board level executives and non-executives due for the period from 01.01.2007 to 30.09.2010 and accordingly an amount of Rs.18.99 Crore was provided in books and later disbursed to all existing, superannuated and dependent of superannuated employees as under :

Description	No. of Employees	Amount in Cr.
Superannuated Employees	432	12.82
Dependents to expired employees	107	2.57
Left Cases	7	0.21
Remaining Regular Employees	168	3.39
Total	**714**	**18.99**

2.6 Information on PwDs:

The percentage of PwDs (Persons differently abled) employed in the company is 4.36% as on 31/03/2022.

2.7 CSR activity details with financials:

Rs.29.65 Lakhs was spent towards Medical facilities, Ambulance and medical equipment to MMG hospital and contribution to PM Cares Fund. Manner in which amount spent through CEL CSR Trust, during the financial year is detailed below:

1	2	3	4	5	6
Sl No.	**CSR project or activity identified**	**Sector in which the project is covered**	**Project or programs**	**Amount out lay programs wise (Rs. Lakhs)**	**Amount spent on the project or programs(Rs. In Lakhs)**
1	Health	II	Ambulance, wheel chair stretcher trolley etc. given to MMG Hospital, Ghaziabad	29.21	29.21
2.	Other		PM Cares Fund	0.44	0.44

2.8 Manpower details with OBC/SC/ST/PWDs details

The particulars of SC / ST and other categories of employees as on 31 March 2022, are as under

Categories of Employee	**As on 31.03.2022**	
	Executives	**Non Executives**
SC	17	36
ST	-	-
OBC	13	14
PH	5	7
General	99	82

2.9 Implementation of Official language

The Financial Year, 2021-22 had been a year of achievements for your company in the area of official language. On 17.08.2021, the Deputy Director (Official Language) of the Ministry of Science and Technology and other representative inspect the Hindi work in CEL.

The Meeting of official Language Implementation committee were organised in each quarter to review and improve implementation of official language policy. The first meeting of the Official Language Implementation Committee of CEL was held under the chairmanship of the Chairman and Managing Director. In the meeting, detailed discussion was held on the annual program for the year 2021-22 released by the Department of Official Language, Ministry of Home Affairs.

Hindi website of company was updated regularly. During the year, 04 Hindi workshop/training programmes were organised whereas 47 Executives and 51 Non- Executives were trained. Employees were imparted training in usage at Hindi computer applications.

Annual Report of the company was published in Digital platform. A 'Hindi Seminar' was organized on 16.09.2021 that was attended by the President, Former President, General Manager and Member Secretary, High Level Telecom Training Institute Center, Ghaziabad Office and NARAKAS Undertaking (Ghaziabad). About 35 high officials and employees participated in this seminar.

To create a Hindi oriented environment, the company celebrated Hindi day on 14.09.2021 and Hindi Pakhwada was observed from 14.09.2021 to 28.09.2021. During this, various competitions, like Hindi Samanya Gyan Pratiyogita for Non-Hindi and all employees, Poetry and Hindi speech competitions were organised. Employees were encouraged to use Hindi in official correspondence.

A 2-days All India Official Language Conference was organized by the Department of Official Language, Ministry of Home Affairs in November at Trade Center in Varanasi that was attended by two officials of CEL.

International Women's Day was organized in the office on 08.03.2022. On this occasion 'Slogan' and 'Essay Competition' were organized in both Hindi and English language.

The company continues to implement the official Language Policies of the Government through motivation and encouragement.

All these efforts were motivational tools in creating possibilities of better and progressive use of Hindi in the office.

3.0 Technology absorption, adaptation, innovation and conservation of energy

The particulars relating to conservation of energy, technology absorption, foreign exchange earnings and outgo, as required to be disclosed under the Act are as under:

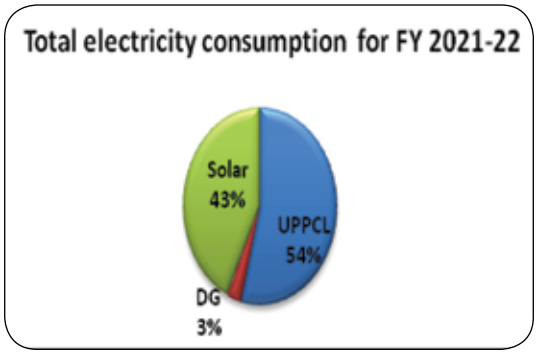
1) Power Factor Improvement

In CEL, Power factor improved significantly by installing detuned reactors in APFC Panels and Harmonic Active Filter at HT & LT lines which has resulted in saving & conservation of electricity.

Presently our company achieving PF≥ 0.99

2) Utilization of Solar Energy

We have installed & operating multiple in-house solar PV plants having capacity around 1.5-MWp. We have also net metering system in our company campus in which we are utilizing the solar power directly by load in working days and by exporting solar power to grid in non-working days. This also helps to reduce the load on grid.



Solar proportion in our total electricity consumption was 43 % in FY 2021-22.

4.0 Implementation of RTI Act

Government of India has enacted the Right to Information Act (RTI) 2005 with a view to bring-in transparency and accountability in the working of Public Authorities. Your Company has evolved necessary structure to facilitate implementation of the RTI Act in the Company.

Information Officer has been appointed and an Appellate Authority has been designated for smooth implementation of various provisions of the RTI Act. Necessary information has also been posted on the website of the Company www.celindia.co.in .

5.0 Human Resource Development

a. Welfare of the reserved categories All Government directives relating to the reserved category such as SC, ST, Physically Differently abled, Ex-servicemen etc. were implemented during the year.

b. Industrial Relations and Human Resource Development Industrial Relations continued to be harmonious during the year. The Company has imparted training to the workmen

and executives at various levels through in-house programs as well as participating in external programs in relevant areas which has been helpful in the development and growth of employees. A system of regular shop level and plant level meetings has been put in place for improving workers participation in Management. Online APARs have also been implemented for all levels of executives.

Process of regular recruitments at various levels in keeping with the Company's growth & technology needs has been put in place to induct a new blood into the Company.

c. Status of Sexual Harassment of Women at Workplace

The Company has in place a Policy on Prevention, Prohibition ad Redressal of Sexual Harassment of Women at Workplace. As per the provisions of the Sexual Harassment of Women at Workplace Prevention, Prohibition and Redressal Act, 2013, an internal complaints committee has been set up, where any aggrieved female employee can lodge complaint.All concerned persons, as per the Act, are covered under the policy. During the year 2021-22, there was no complaint received/ disposed off.

6.0 Implementation of e-Office in CEL

During previous year, e-office was implemented in Central Electronics Ltd to make all internal and external correspondence in e-files to Ministries in digital mode only.

The e-office was successfully implemented and all employees are trained for use of e-office. Physical movements of files is discontinued in toto. Various training programmes at different level, were undertaken to make the employees aware and motivate them to use e-office platform.

Implementation of e-office, not only reduced the consumption of papers significantly but also brought in transparency, quick decisions in files, and smart functioning of the affairs of the company. It also enhanced the security and availability of the files/records at one place.

7.0 Corporate Governance

The Company believes that Corporate Governance provides principled process and structure necessary for attaining the Objectives of the Company. Your Directors ensure that Govt. Guidelines/Directives are followed in full. Management Discussion Analysis and Corporate Governance report form part of the Directors Report.

The DPE guidelines on Corporate Governance for CPSEs provide that the CPSEs would be graded on the basis of their compliance with the guidelines. During 2021-2022 all the four quarterly self-evaluation reports have been "Excellent" and the Company expects to receive the Excellent grading from Department of Public Enterprises for the year 2021-2022.

.8.0 MoU evaluation/performance

As per the letter dated 18th January, 2022 issued by Director (MOU), Department of Public Enterprises, Central Electronics Limited was rated Very Good in its MOU evaluation for the year 2020-2021.

CHAPTER 11 ADMINISTRATION & FINANCE

ADMINISTRATION & FINANCE

ADMINISTRATION & FINANCE

1.0 ADMINISTRATION

The Department of Scientific & Industrial Research (DSIR) was created in January, 1985. The Administrative Division of the Department comprises of Establishment Section, General Section and Vigilance Unit that looks after activities related to personnel, implementation of the Flexible Complementary Scheme (FCS) promotion meant for the Scientists (Group 'A'), foreign deputations of officers, vigilance matters, administrative reform mechanism, work relating to CGHS facilities, staff welfare, co-ordination etc. During the year 2022, DSIR organized events like Hindi Pakhwada, Vigilance Awareness Week, Yoga Day, Constitution Day etc. Further, Department of Scientific and Industrial Research (DSIR) successfully conducted Special Campaign 2.O from 2nd October, 2022 to 31st October, 2022. The progress of the Campaign was reviewed with Nodal Officers of CSIR, NRDC and CEL at regular intervals.

Some of the achievements of the Department during the Campaign are listed as under:-

a) **Record Management:-** With the start of the Special Campaign this year, a total of 23,036 files of DSIR, NRDC, CSIR Headquarters and its laboratories across the country were reviewed, out of which 14576 files were weeded out. Besides, most of the files have been digitized in the Department.

b) **Cleanliness Drive:-** Department and its organizations actively participated in the cleanliness drive organized during the period. A total of 113 cleanliness drives were conducted against the target of 39 in the Department of Scientific and Industrial Research, Council of Scientific and Industrial Research, PSUs - Central Electronics Limited and National Research Development Corporation. Cleanliness awareness programmes were organized and hygiene kits were distributed in the field offices.

d) **Disposal of Public Grievances:** During the Special Campaign, a total of 111 grievances were disposed off. Some of the grievances pertaining to the Council of Scientific and Industrial Research (an autonomous Body under control of DSIR) that were pending from a considerable time were disposed off through the concerted efforts of team officers.

e) **Space Freed:** During the Special Campaign, action was taken for removal of junk items, scrap materials and old equipment to free space. Total 11,36,371 sq.ft. space area was freed from CSIR Headquarters and its laboratories across the country during the campaign.

f) **Easing of Rules/Processes:-** During the special Campaign, 25 Rules/Processes were identified, out of which 11 have been simplified.

g) **Best Practices:-** Geo-tagging of files of CSIR has been selected under the category of Best Practices by DARPG.

1.1 Staff Strength:

The staff in position against the regular posts under different groups in the Department, other than Autonomous Bodies viz. Council of Scientific and Industrial Research (CSIR) and Public Sector Undertakings viz. National Research Development Corporation (NRDC) and Central Electronics Limited (CEL) as on 15/12/2022 is given below.

	General	SC	ST	OBC	Total
Group 'A' (Gazetted)	27*	04	02	04	37*
Group 'B' (Gazetted)	04	02	00	01	07
Group 'B' (Non-Gazetted)	07	03	02	03	15
Group 'C'	01	04	02	04	11
Total	**39***	**13**	**06**	**12**	**70***

*Excluding one post of Joint Secretary (Administration) which is on notional basis.

2.0 FINANCE

The Financial summary giving the BE 2022-23, RE 2022-23, AE 2022-23 (upto 31.12.2022) and BE 2023-24 (proposed) for DSIR is given Table 1

3.0 RAJBHASHA SECTION

In order to ensure compliance of constitutional and legal provisions regarding the official language of the Union and to promote the use of Hindi for official purposes of the Union, the Official Language Section has been established in the Department of Scientific and Industrial Research under the Ministry of Science and Technology. The Official Language Section has been continuously making efforts to speed up the use of Hindi in the official work of the Union. During the period under report, the Official Language Section has taken the following steps to ensure progressive use of Hindi in the Department and in the Autonomous Bodies/ Public Sector Undertakings under its administrative control:

- In compliance with Section 3(3) of the Official Languages Act, 1963, the provisions of this Act were fully complied with and all documents, reports, monthly summaries etc. were issued bilingually.
- 31st meeting of the Joint Hindi Advisory Committee of the Ministry of Science and Technology and Earth Sciences under the Chairmanship of Hon'ble Minister of State for Science and Technology and Earth Sciences, Dr. Jitendra Singh was held on 06.06.2022 and 26.12.2022 respectively at Prithvi Bhawan, Lodhi Road, New Delhi-110003. Joint Secretary and officers of the Hindi Section of the Department participated in the said meetings.
- Offices/Institutions under the control of this Department were inspected by the Second Sub-Committee of the Committee of Parliament on Official Language on 30.04.2022-CSIO, Chandigarh, on 18.05.2022-CLRI, Chennai, on 20.05.2022-CERI, Karaikudi on 17.06.2022-IICT, Hyderabad, on 24.08.2022-CCMB and NGII, Hyderabad, on 26.08.2022-CFTRI, Mysore, on 26.09.2022-NIIST, Thiruvananthapuram, on 18.10.2022-CSMCRI, Bhavnagar, on 16.11.2022-IICB and CGCRI, Kolkata in which the concerned officers represented on behalf of the department.
- On the occasion of "Hindi Day - 14.09.2022" in this department, Hindi Pakhwara was organized from 14.09.2022 to 29.09.2022. As per the direction of the Department of Official Language, the Hindi Pakhwara started from the Surat conference. Joint Secretary, Deputy Director (Official Language) and two senior translation officers of the department participated in the conference. During the Pakhwara, various Hindi competitions organized in the office and the successful participants were awarded cash prizes and certificates through a closing ceremony in the conference hall of the department.

4.0 EXTRACTS OF AUDIT OBSERVATIONS

Audit paras pertaining to DSIR that appeared in the CAG report of 2022 are placed at Annexure 12

Table 1: FINANCIAL SUMMARY (RS. IN CRORE)															
Scheme	Actual Expenditure 2021-22			Budget Estimates 2022-23			Revised Estimates 2022-23			Actual Expenditure upto 31.12.2022			Budget Estimates 2023-24		
	Revenue	Capital	Total	Revenue	Capital	Total	Revenue	Capital	Total	Revenue	Capital	Total	Revenue	Capital	Total
DSIR - Secretariat	13.45	0	13.45	17.7	0	17.7	16.44	0`0	16.44	11.85	0	11.85	18.47	0	18.47
DSIR Building	0	10	10	0	10	10	00	00	00	0	0	0	00	00	00
Central Sector Schemes/Projects															
Industrial Research & Development(IR&D)															
PRISM	2.47	0	2.47	3.5	0	3.5	3.50	0	3.50	2.25	0	2.25	3	0	3
PACE (Grants)	0.76	0	0.76	1	0	1	1	0	1	0.01	0	0.01	0.15	00	0.15
PACE (Loan)	0	0.6	0.6	0	2	2	0	2	2	0	0	0	0	2.20	2.20
BIRD(CRTDH)	11.41	0	11.41	17.5	0	17.5	17.50	0	17.50	8.54	0	8.54	14.50	00	14.50
A2K+	3.89	0	3.89	5	0	5	5	0	5	1.38	0	1.38	3.45	00	3.45
Assistant to PSEs for other Scientific Research															
CEL(Grants)	1	0	1	0	0	0	3.18	0	3.18	0	0	0	3.03	00	3.03
CEL(Equity)	0	0	0	0	0	0	0	1.5	1.5	0	0	0	00	6.20	6.20
NRDC	10	0	10	10	0	10	10	0	10	5.00	0	5.00	12.50	00	12.50
Total Central Sector Schemes/Projects	**29.53**	**0.6**	**30.13**												
	37	2	39	40.18	3.5	43.68	17.18	0	17.18	36.63	8.4	45.03			
Other Central Sector Expenditure (Autonomous Bodies)															
Council of Scientific and Industrial Research(CSIR)															
National Laboratories-CSIR	4605.26	0	4605.26	5102.7	0	5102.7	5310.03	00	5310.03	4470.97	0	4470.97	5175.51	0	5175.51
Research Schemes Scholarships & Fellowship-CSIR	474.95	0	474.95	460.06	0	460.06	564.06	00	564.06	461.89	0	461.89	500	0	500
Total CSIR	**5080.21**	**0**	**5080.21**	**5562.76**	**0**	**5562.76**	**5874.09**	**0**	**5874.09**	**4932.86**	**0**	**4932.86**	**5675.51**		**5675.51**
CDC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
APCTT (Contributions)UN Body	7.23	0	7.23	6.5	0	6.5	6.90	0	6.90	5.04	0	5.04	7.00	0	7.00
APCTT (Building) UN Body	0	0.04	0.04	0	0.5	0.5	0	0.50	0.50	0	0	0	0	0.50	0.50
Grand Total DSIR inclusive CSIR	**5130.42**	**10.64**	**5141.06**	**5623.96**	**12.5**	**5636.46**	**5937.61**	**4.00**	**5941.61**	**4966.93**	**0**	**4966.93**	**5737.61**	**8.9**	**5746.51**
Note: Actuals are as per elekha statement as on 31.12.2022.															

ANNEXURE-1

Statement of Recognition of In-house R&D units (Fresh Recognition)

Month	Receipt	Cumulative Receipt	Disposal	Cumulative Disposal	No. Companies Recognized	Endorsement of total recognized companies	New Companies recognized	Total R&D Units recognized
December	16	16	0	0	12	0	12	12
January	16	32	34	34	8	0	8	8
February	39	71	0	34	12	5	7	12
March	36	107	51	85	11	1	10	11
April	4	111	0	85	11	0	11	11
May	0	111	14	99	14	1	13	14
June	33	144	0	99	2	1	1	3
July	28	172	40	139	12	2	10	13
August	21	193	0	139	14	3	11	15
September	21	214	81	220	7	1	6	7
October	14	228	23	243	13	4	914	
November	13	241	0	243	9	2	7	10
December	2	265	20	263	11	1	10	11
Total	252	265	263	263	136	21	115	141

ANNEXURE-2

STATEMENT ON RENEWAL OF RECOGNITION OF IN-HOUSE R&D UNITs HAVING VALID RECOGNITION UPTO 31.03.2022

Month	Year	Receipts	Cumulative Receipts*	Disposal	Cumulative Disposal*
January	2022	176	176	31	31
February	2022	250	426	22	53
March	2022	152	578	100	153
April	2022	73	651	45	198
May	2022	12	663	151	349
June	2022	17	680	117	466
July	2022	0	680	64	530
August	2022	0	680	29	559
September	2022	1	681	34	593
October	2022	0	681	32	625
November	2022	1	682	14	639
December	2022	1	683	19	658

Note: A total of 25 applications are being processed currently in the department.
* Cumulative receipts and disposal include 31 applications with renewal validity upto 31.03.2021

ANNEXURE – 3

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL EXPENDITURE MORE THAN Rs. 5000.00 LAKHS

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
1.	Syngene International Ltd.	165736
2.	Dr. Reddy's Laboratories Ltd.	116135
3.	Sun Pharmaceutical Industries Ltd.	96792
4.	Maruti Suzuki India Ltd.	93429
5.	AurobindoPharma Ltd.	84046
6.	Wockhardt Ltd.	62177
7.	Bharat Electronics Ltd.	61537
8.	CuraTeQ Biologics Pvt. Ltd.	38589
9.	Macleods Pharmaceuticals Ltd.	31495
10.	Veeda Clinical Research Ltd.	30480
11.	Suguna Foods Pvt. Ltd.	22980
12.	Applied Materials India Pvt. Ltd.	21361
13.	Tata Advanced Systems Ltd.	18608
14.	Apollo Tyres Ltd.	18192
15.	Pfizer Healthcare India Pvt. Ltd.	16302
16.	NatcoPharma Ltd.	15963
17.	ITC Ltd.	15380
18.	PI Industries Ltd.	15074
19.	PiramalPharma Ltd.	14023
20.	Sanofi Healthcare India Pvt. Ltd.	13674
21.	Micro Labs Ltd.	13646
22.	BioconPharma Ltd.	12860
23.	Emcure Pharmaceuticals Ltd.	12310
24.	Ajanta Pharma Ltd.	12226
25.	Gland Pharma Ltd.	12195
26.	Fresenius Kabi Oncology Ltd.	10838
27.	Tejas Networks Ltd.	10686
28.	Uno Minda Ltd.	9390
29.	Bharat Bio-tech International Ltd.	7654
30.	Shilpa Medicare Ltd.	7624
31.	Sahajanand Medical Technologies Pvt. Ltd.	7450
32.	Lotus Labs Pvt. Ltd.	7160
33.	Johnson & Johnson Pvt. Ltd.	6715
34.	Shahi Exports Pvt. Ltd.	6561

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
35.	Granules India Ltd.	6526
36.	Grasim Industries Ltd.	6477
37.	Kalash Seeds Pvt. Ltd.	6463
38.	Tafe Motors and Tractors Ltd.	6272
39.	Nektar Therapeutics (India) Pvt. Ltd.	5923
40.	Kirloskar Oil Engines Ltd.	5732
41.	Hikal Ltd.	5669
42.	Teva API India Pvt. Ltd.	5340

ANNEXURE – 4

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL EXPENDITURE IN THE RANGE OF Rs. 500.00 LAKHS TO Rs. 5000.00 LAKHS

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
1.	Bigtec Pvt. Ltd.	4872
2.	Gharda Chemicals Ltd.	4870
3.	Jubilant Generics Ltd.	4764
4.	Piaggio Vehicles Pvt. Ltd.	4708
5.	Daikin Airconditioning India Pvt. Ltd.	4598
6.	Tally Solutions Pvt. Ltd.	4563
7.	Incozen Therapeutics Pvt. Ltd.	4445
8.	Centaur Pharmaceuticals Pvt. Ltd.	4314
9.	Mando Automotive India Pvt Ltd.	4200
10.	Bayer CropScience Ltd.	3848
11.	Medha Servo Drives Pvt. Ltd.	3793
12.	Norwich Clinical Services Pvt. Ltd.	3772
13.	Varroc Engineering Ltd.	3758
14.	CaplinSteriles Ltd.	3739
15.	Medreich Ltd.	3227
16.	Britannia Industries Ltd.	3215
17.	Kaveri Seeds Company Ltd.	3013
18.	Kansai Nerolac Paints Ltd.	3007
19.	Marico Ltd.	2966
20.	NMDC Ltd.	2920
21.	JBM Auto Ltd.	2829
22.	DCM Shriram Ltd.	2825
23.	Akums Drugs & Pharmaceuticals Ltd.	2718
24.	RecipharmPharmaservices Pvt. Ltd.	2704
25.	Health Biotech Ltd.	2700
26.	Venkateshwara Research & Breeding Farm Pvt. Ltd.	2676
27.	J.B. Chemicals & Pharmaceuticals Ltd.	2663
28.	Mylan Pharmaceuticals Pvt. Ltd.	2644
29.	Amber Enterprises India Ltd.	2634
30.	Signify Innovations India Ltd.	2618
31.	Omniactive Health Technologies Ltd.	2495
32.	Eastman Exports Global Clothing (P) Ltd.	2480
33.	Metrochem API Pvt. Ltd.	2442
34.	Ajeet Seeds Pvt. Ltd.	2440
35.	Action Construction Equipment Ltd.	2431

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
36.	Xylopia Labs Pvt. Ltd,	2425
37.	Synapse Labs Pvt. Ltd.	2375
38.	Subros Ltd.	2366
39.	Neuland Laboratories Ltd.	2309
40.	SH Kelkar& Company Ltd.	2213
41.	AstecLifesciences Ltd.	2200
42.	Skipper Ltd.	2189
43.	Navin Fluorine International Ltd.	2167
44.	Polycab India Ltd.	2075
45.	Syngenta India Pvt. Ltd.	2061
46.	Delphi-TVS Technologies Ltd.	1918
47.	Sudarshan Chemical Industries Ltd.	1901
48.	CavinKare Pvt. Ltd.	1879
49.	Amoli Organics Pvt. Ltd.	1836
50.	RijkZwaan India Seeds Pvt. Ltd.	1806
51.	Rasi Seeds (P) Ltd.	1706
52.	Symed Labs Ltd.	1704
53.	Harman Finochem Ltd.	1689
54.	Elmeasure (India) Pvt. Ltd.	1680
55.	Rane Brake Lining Ltd.	1661
56.	Balkrishna Industries Ltd.	1650
57.	Dow Chemical International Pvt. Ltd.	1627
58.	BDR Pharmaceuticals International Pvt. Ltd.	1601
59.	Reliable Autotech Pvt. Ltd.	1573
60.	Excel Industries Ltd.	1521
61.	ShilpaBiologicals Pvt. Ltd.	1500
62.	Yashraj Biotechnology Ltd.	1498
63.	Godrej Agrovet Ltd.	1496
64.	ZIM Laboratories Ltd.	1479
65.	Matrix Comsec Pvt. Ltd.	1467
66.	Clariant India Ltd.	1390
67.	Siechem Technologies Pvt. Ltd.	1385
68.	Luminous Power Technologies Pvt. Ltd.	1298
69.	Mahindra Defence System Ltd.	1250
70.	IOL Chemicals and Pharmaceuticals Ltd.	1229
71.	SundaramFastners Ltd.	1200
72.	Alpha Design Technologies Pvt. Ltd.	1187
73.	Kennametal India Ltd.	1179
74.	Gujarat State Fertilizers and Chemicals Ltd.	1148
75.	AMI Life Sciences Pvt. Ltd.	1127
76.	Mynvax Pvt. Ltd.	1124
77.	Tube Investments of India Ltd.	1122

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
78.	OptimusPharma Pvt. Ltd.	1110
79.	NTF (India) Pvt. Ltd.	1109
80.	Amara Raja Batteries Ltd.	1094
81.	Galaxy Surfactants Ltd.	1078
82.	AscenHyVeg Pvt. Ltd.	1060
83.	Caplin Point Laboratories Ltd.	1057
84.	Bliss GVS Pharma Ltd.	1054
85.	Ion Exchange (India) Ltd.	1040
86.	Wallace Pharmaceuticals Pvt. Ltd.	1039
87.	Jindal Stainless (Hisar) Ltd.	1025
88.	Lincoln Pharmaceuticals Ltd.	1022
89.	CortevaAgriscience Seeds Pvt. Ltd.	1005
90.	Ace Designers Ltd.	953
91.	SAVA Healthcare Ltd.	945
92.	SMS Pharmaceuticals Ltd.	943
93.	Birla Carbon India Pvt. Ltd.	935
94.	TRL Krosaki Refractories Ltd.	935
95.	HM.Clause (India) Pvt. Ltd.	919
96.	HMC MM Auto Ltd.	909
97.	Pulse Pharmaceuticals Pvt. Ltd.	901
98.	Uflex Ltd.	898
99.	Sanzyme Biologics Pvt. Ltd.	892
100.	VEM Technologies Pvt. Ltd.	870
101.	Matrix Clothing Pvt. Ltd. Gurgaon, Haryana	865
102.	Thermax Ltd.	858
103.	RPG Life Sciences Ltd.	846
104.	Valeo Friction Materials India Pvt. Ltd.	844
105.	Vrinda Technologies Pvt. Ltd.	844
106.	Zuventus Healthcare Ltd.	830
107.	SandenVikas (India) Pvt Ltd.	818
108.	Laxmi Organic Industries Ltd.	808
109.	KemwellBiopharma Pvt. Ltd.	808
110.	Hind Rectifiers Ltd.	765
111.	Ramkrishna Forgings Ltd.	765
112.	FEV India Pvt. Ltd.	742
113.	Ace Antenna India Pvt. Ltd.	738
114.	IDRS Labs Pvt. Ltd.	732
115.	Godavari Biorefineries Ltd.	722
116.	Doehler India Pvt. Ltd.	713
117.	ZCL Chemicals Ltd.	712
118.	Accord Software & Systems Pvt. Ltd.	711
119.	AshapuraMinechem Ltd.	705

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
120.	Teregne Biotech Private Ltd.	698
121.	Natural Remedies Pvt Ltd.	693
122.	Indo-American Hybrid Seeds (India) Pvt. Ltd.	687
123.	LinkwellTelesystems (P) Ltd.	686
124.	Sundaram Clayton Ltd.	679
125.	Avantel Ltd.	675
126.	Deem Roll-Tech Ltd.	636
127.	ALP Nishikawa Company Pvt. Ltd.	631
128.	Mark Exhaust Systems Ltd.	630
129.	Chennai Petroleum Corporation Ltd.	626
130.	Atul Auto Ltd.	603
131.	Gencrest Pvt. Ltd.	588
132.	Pharma Technologies Pvt. Ltd.	588
133.	AVT Natural Products Ltd.	586
134.	NACL Industries Ltd.	576
135.	Axxonet System Technologies Pvt. Ltd.	545
136.	Radiant Corporation Pvt. Ltd.	544
137.	General Industrial Controls Pvt. Ltd.	542
138.	India Glycols Ltd.	536
139.	Kokuyo Camlin Ltd.	535
140.	Mantra Softech (India) Pvt. Ltd.	531
141.	CPL Biologicals Pvt. Ltd.	531
142.	Mindarika Pvt. Ltd.	529
143.	RusanPharma Ltd.	527
144.	T Stanes& Company Ltd.	522
145.	JasminInfotech Pvt. Ltd.	522
146.	Allengers Medical Systems Ltd.	518
147.	United Spirits Ltd.	515
148.	Efftronics Systems Pvt. Ltd.	508
149.	Neon Laboratories Ltd.	502

ANNEXURE - 5

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL EXPENDITURE IN THE RANGE OF Rs. 200.00 LAKHS TO Rs. 500.00 LAKHS

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
1.	Alkyl Amines Chemicals Ltd.	497
2.	River Engineering Pvt. Ltd.	496
3.	HimadriSpeciality Chemical Ltd.	494
4.	Knorr-Bremse Systems for Commercial Vehicles India Pvt. Ltd.	491
5.	Electrolab India Pvt. Ltd.	488
6.	Max Specialty Films Ltd.	481
7.	Ador Welding Ltd.	478
8.	Tamil Nadu Newsprint and Papers Ltd.	471
9.	K L J Polymers and Chemicals Ltd.	470
10.	Camlin Fine Sciences Ltd., Mumbai	468
11.	Bajaj Healthcare Ltd.	456
12.	Forus Health Pvt. Ltd., Bangalore	450
13.	Vanamali Organics Pvt. Ltd.	449
14.	Avesthagen Ltd.	447
15.	Shaily Engineering Plastics Ltd.	446
16.	Integral Biosciences Pvt. Ltd.	443
17.	Enaltec Labs Pvt. Ltd.	442
18.	Aspartika Biotech Pvt. Ltd.	439
19.	Vulcan Industrial Engineering Company Pvt. Ltd.	437
20.	Celon Laboratories Pvt. Ltd.	434
21.	Noble Seeds Pvt. Ltd.	431
22.	Avantari Technologies Pvt. Ltd.	427
23.	Vidya Herbs Pvt Ltd	419
24.	GeneSys Biologics Pvt. Ltd.	413
25.	Theragen Biologics Pvt. Ltd.	411
26.	Sulphur Mills Ltd.	408
27.	Biogenomics Ltd.	406
28.	IREL (India) Ltd.	405
29.	Multiplex Bio-Tech Pvt. Ltd.	400
30.	Rex- Tone Industries Ltd.	391
31.	MegafinePharmaPvt Ltd.	389
32.	Kaisha Lifesciences Pvt. Ltd.	389
33.	V B Medicare Pvt Ltd.	383
34.	Parle Global Technologies Pvt. Ltd.	380
35.	Naprod Life Sciences Pvt. Ltd.	371

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
36.	Kirloskar Ferrous Industries Ltd.	369
37.	Radix Electrosystems Pvt. Ltd.	368
38.	Remidio Innovative Solutions Pvt. Ltd.	360
39.	EmmennarPharma Pvt. Ltd.	349
40.	Apcotex Industries Ltd.	349
41.	Deepak Novochem Technologies Ltd.	347
42.	JSW Steel Coated Products Ltd.	346
43.	QH Talbros Pvt. Ltd.	345
44.	Sigma Electric Manufacturing Corporation Pvt. Ltd.	345
45.	Panacea Medical Technologies Pvt. Ltd.	343
46.	Raptakos Brett & Co. Ltd.	343
47.	Rishabh Instruments Pvt. Ltd.	340
48.	CharakPharma Pvt. Ltd.	339
49.	Eagle Seeds & Biotech Ltd.	338
50.	JLC Electromet Pvt. Ltd.	337
51.	Prodigy Technovations Pvt. Ltd.	334
52.	Symphony Pharma Life Sciences Pvt. Ltd.	333
53.	Bry -Air (Asia) Pvt Ltd	333
54.	Manipal Technologies Ltd.	331
55.	BeejSheetal Research Pvt Ltd.	328
56.	Jyoti CNC Automation Ltd.	328
57.	Zelle Biotechnology Pvt. Ltd.	327
58.	Sanzyme Pvt. Ltd.	325
59.	Precision Automation and Robotics India Pvt. Ltd.	322
60.	L&T Construction Equipment Ltd.	316
61.	Jayant Agro-Organics Ltd.	311
62.	Clonz Biotech Pvt. Ltd.	309
63.	Connectwell Industries Pvt. Ltd.	304
64.	Ace Manufacturing Systems Ltd.	303
65.	Enpro Industries Pvt. Ltd.	301
66.	Ideal Cures Pvt. Ltd.	299
67.	Praj Industries Ltd.	294
68.	Franco-Indian Pharmaceuticals Pvt. Ltd.	294
69.	Premier Medical Corporation Pvt. Ltd.	293
70.	SRL Ltd.	289
71.	NRB Bearings Ltd.	285
72.	Keggfarms (P) Ltd.	274
73.	Indbro Research and Breeding Farms Pvt. Ltd.	272
74.	LPS Bossard Pvt. Ltd.	272
75.	Elecon Engineering Company Ltd.	266
76.	Laxmi Hydraulics Pvt. Ltd.	263
77.	Hester Biosciences Ltd.	262

S.NO.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
78.	Parle Elizabeth Tools Pvt. Ltd.	259
79.	Zeon Lifesciences Ltd.	254
80.	Metropolitan Eximchem Pvt. Ltd.	254
81.	Rashtriya Chemicals & Fertilizers Ltd.	253
82.	BVG Life Sciences Ltd.	252
83.	R RKabel Ltd.	251
84.	Desiccant Rotors International Pvt. Ltd.	249
85.	Encardio-Rite Electronics Pvt. Ltd.	248
86.	Shalimar Paints Ltd.	248
87.	Srikem Laboratories Pvt. Ltd.	247
88.	CDE Asia Ltd.	246
89.	International Healthcare Ltd.	240
90.	Kandui Industries Pvt. Ltd.	239
91.	Indo Colchem Pvt. Ltd., Ahmedabad	238
92.	Benchbio Pvt. Ltd.	237
93.	SiddharthCarbochem Products Ltd.	234
94.	Metallizing Equipment Co. Pvt. Ltd.	231
95.	Tata Steel Ltd.	231
96.	YagantiAgrotech Pvt. Ltd.	230
97.	Nichino India Pvt. Ltd.	228
98.	Blue Cross Laboratories Pvt. Ltd.	228
99.	United Genetics India Pvt. Ltd.	224
100.	Sugen life sciences (P) Ltd.	223
101.	Finar Ltd.	221
102.	La Renon Health Care Pvt. Ltd.	217
103.	Kinetic Green Energy & Power Solutions Ltd.	217
104.	GhatgePatil Industries Ltd.	214
105.	EssaeDigitronics Pvt. Ltd.	214
106.	Plastiblends India Ltd.	214
107.	Savio India Pvt. Ltd.	213
108.	Tasty Bite Eatables Ltd.	212
109.	Indo US Bio-Tech Ltd.	207
110.	East Coast Magnets Pvt. Ltd.	206
111.	Dhiti Life Sciences Pvt. Ltd.	206
112.	Gangwal Healthcare Pvt. Ltd.	205
113.	Steerlife India Pvt. Ltd.	202
114.	Pharmanza Herbal Pvt. Ltd.	201
115.	Multani Pharmaceutical Ltd.	200

ANNEXURE -6

List of Scientific & Industrial Research Organizations (SIROs) recognised by DSIR during the period December 2021 to December 2022.

SNo.	Name of the Organization	Recognition granted upto
	Natural and Applied Sciences	
1.	DivyasamparkiHUBRoorkee for Devices Materials and Technology Foundation, IIT-Roorkee, Roorkee, Haridwar (Uttarakhand)	31.03.2023
2.	Technology Innovation in Exploration & Mining Foundation, IIT(ISM)-Dhanbad, Dhanbad (Jharkhand)	31.03.2023
3.	Sarvajanik University, Surat (Gujarat)	31.03.2024
4.	I-HUB Quantum Technology Foundation, IISER-Pune, Pune (Maharashtra)	31.03.2023
5.	Graphic Era Hill University, Dehradun (Uttarakhand)	31.03.2024
6.	Himalayan Research Group (HRG), Shimla (Himachal Pradesh)	31.03.2024
7.	Karupa Foundation, Mettupalayam (Tamil Nadu)	31.03.2024
8.	SreeVidyanikethan Educational Trust, A. Rangampet, Chittoor District (Andhra Pradesh)	31.03.2024
9.	Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology Trust, Chennai (Tamil Nadu)	31.03.2024
10.	Maheshwara Educational Society, Narsampet, District Warangal (Telangana)	31.03.2024
11.	National Dope Testing Laboratory, New Delhi	31.03.2024
12.	Lloyd Institute of Management and Technology of Satilila Charitable Society, Greater Noida (UP)	31.03.2025
13.	Sri SivasubramaniyaNadar College of Engineering of SSN Trust, Kalavakkam, Kanchipuram District (Tamil Nadu)	31.03.2025
14.	Ved Foundation, Delhi	31.03.2025
15.	Dakshin Foundation, Bengaluru (Karnataka)	31.03.2025
16.	Sarojini Educational Society, Surampalem, East Godavari District (Andhra Pradesh)	31.03.2025
17.	Jakkula Educational Society, Secunderabad (Telangana)	31.03.2025
18.	IIT Kharagpur Ai4icps I Hub Foundation, IIT-Kharagpur Campus, District PaschimMedinipore (West Bengal)	31.03.2024
19.	Sri Visweswaraiah Educational Society, Chebrolu, Guntur District (Andhra Pradesh)	31.03.2025
20.	VidyaPratishthan, Baramati, Pune (Maharashtra)	31.03.2025
21.	AIC IISER Pune Seed Foundation, IISER-Pune Campus, Pune (Maharashtra)	31.03.2025
22.	IIT Madras Research Park, Chennai (Tamil Nadu)	31.03.2025
23.	K. Ramakrishnan Health and Educational Trust, Karur (Tamil Nadu)	31.03.2025
24.	G.V. Govindaswamy Naidu Charities, Udumalpet, Tiruppur District (Tamil Nadu)	31.03.2025
25.	Foundation for Ecological Research Advocacy and Learning (FERAL), Auroville, Villupuram District (Tamil Nadu)	31.03.2025
26.	Shobhit Institute of Engineering and Technology (Deemed to be University), Modipuram, Meerut (Uttar Pradesh)	31.03.2025
27.	National Institute of Electronics and Information Technology (NIELIT), Kozhikode (Kerala)	31.03.2025
28.	Indian Institute of Information Technology, Bhagalpur (Bihar)	31.03.2025

SNo.	Name of the Organization	Recognition granted upto
29.	Indo French Educational Trust, Villupuram (Tamil Nadu)	31.03.2025
30.	Kamaraj College of Engineering and Technology Managing Board, K.Vellakulam, Madurai District (Tamil Nadu)	31.03.2025
31.	IITI DRISHTI CPS Foundation, Mhow, Indore (MP)	31.03.2025
32.	IHUB NTIHAC Foundation, Kalyanpur, Kanpur Nagar (Uttar Pradesh)	31.03.2025
33.	Kashmir Advanced Scientific Research Centre, Bandipora (Jammu and Kashmir)	31.03.2025
34.	PoddarSansthan, Jaipur (Rajasthan)	31.03.2025
35.	AIC-AMTZ Medi Valley Incubation Council, Vishakhapatnam (Andhra Pradesh)	31.03.2025
36.	UM DAE Centre for Excellence in Basic Sciences, Mumbai (Maharashtra)	31.03.2025
37.	VIT-AP University, Guntur (Andhra Pradesh)	31.03.2025
	Agricultural Sciences	
38.	Sri KondaLaxmanTelangana State Horticultural University, Mulugu, Siddipet District (Telangana) Social Sciences	31.03.2025
39.	New Delhi Institute of Management of Society for Employment and Career Counselling, New Delhi	31.03.2024
40.	Indian Institute of Management, Visakhapatnam (Andhra Pradesh)	31.03.2025
41.	Indian School of Business, Hyderabad (Telangana)	31.03.2025
42.	Ardent Foundation, Phungreitang West, Ukhrul (Manipur)	31.03.2025
	Medical Sciences	
43.	Society for Research in Metabolic Disorders, Thiruvananthapuram (Kerala)	31.03.2024
44.	Sanskriti University, Mathura (Uttar Pradesh)	31.03.2024
45.	Society for the Advancement of Environmental Sciences, Lucknow (Uttar Pradesh)	31.03.2024
46.	Vedic and Futuristic Edutech, Lucknow (Uttar Pradesh)	31.03.2024
47.	DM Education & Research Foundation Trust, Wayanad (Kerala)	31.03.2024
48.	IQRAA International Hospital & Research Centre of JDT Islam Orphanage Committee, Calicut (Kerala)	31.03.2024
49.	All India Institute of Medical Sciences-Rishikesh, (Uttarakhand)	31.03.2024
50.	Sri DevarajUrs Academy of Higher Education and Research, Kolar (Karnataka)	31.03.2024
51.	Saveetha Institute of Medical and Technical Sciences (Deemed to be University), Chennai (Tamil Nadu)	31.03.2024
52.	Shyam Shah Medical College Society, Multi-Disciplinary Research Unit, Rewa (Madhya Pradesh)	31.03.2024
53.	Sri Ramachandra Educational Trust, Ariyur, Puducherry	31.03.2024
54.	SreeAnjaneya Medical Trust, Kozhikode (Kerala)	31.03.2024
55.	All India Institute of Medical Sciences, Raipur (Chhattisgarh)	31.03.2024
56.	Institute of Kidney Diseases & Research Centre (IKDRC), Ahmedabad (Gujarat)	31.03.2024
57.	PP Savani University, Surat (Gujarat)	31.03.2023
58.	Pankajakasthuri Herbal Research Foundation, Thiruvananthapuram (Kerala)	31.03.2024
59.	Doctors For You, Mumbai (Maharashtra)	31.03.2024
60.	Mahayana Theravada Vajrayana Buddhist Religious and Charitable Trust, Meerut (Uttar Pradesh)	31.03.2025
61.	JanardanRai Nagar Rajasthan Vidyapeeth (Deemed to be University), Udaipur (Rajasthan)	31.03.2025
62.	Kolkata Gynecological Oncology Trials and Translational Research Group, Kolkata (West Bengal)	31.03.2025

SNo.	Name of the Organization	Recognition granted upto
63.	Foundation of Healthcare Technologies Society, New Delhi	31.03.2025
64.	JSS Academy of Higher Education & Research, Mysuru (Karnataka)	31.03.2025
65.	Post Graduate Institute of Dental Sciences, Rohtak (Haryana)	31.03.2025
66.	Central Research Laboratory of Kempegowda Institute of Medical Science, Bengaluru (Karnataka)	31.03.2025
67.	DeshBhagat University, MandiGobindgarh, District Fatehgarh Sahib (Punjab)	31.03.2025
68.	Tilak Maharashtra Vidyapeeth, Pune (Maharashtra)	31.03.2025
69.	Venu Charitable Society, New Delhi	31.03.2025
70.	K.J. Somaiya Medical Trust, Mumbai (Maharashtra)	31.03.2025
71.	Shriyam Human Welfare Trust, Patna (Bihar)	31.03.2024
72.	National Foundation for Liver Research, Chennai (Tamil Nadu)	31.03.2025
73.	Smt. Shakuntala Educational & Welfare Society (SSEWS), Greater Noida, Gautam Buddha Nagar (Uttar Pradesh)	31.03.2025
74.	SomaiyaVidyavihar University, Mumbai (Maharashtra)	31.03.2025
75.	BGS Global Institute of Medical Sciences (BGS GIMS), Bengaluru Urban (Karnataka)	31.03.2025
76.	All India Institute of Medical Sciences, Phulwarisharif, Patna (Bihar)	31.03.2025
77.	Noida International University, Gautam Buddha Nagar (UP)	31.03.2025
78.	F.I.A.M.C. Bio-Medical Ethics Centre, Mumbai (Maharashtra)	31.03.2025
79.	Gajra Raja Medical College, Gwalior (Madhya Pradesh)	31.03.2025
80.	Sawai Man Singh Medical College and Attached Hospitals, Jaipur (Rajasthan)	31.03.2025
81.	Government Medical College & Hospital, Chandigarh	31.03.2025
82.	All India Institute of Medical Sciences (AIIMS), Guwahati (Assam)	31.03.2025
83.	TeerthankerMahaveer University, Moradabad (UP)	31.03.2025
84.	Christian Institute of Health Sciences and Research, Diphupar, Dimapur (Nagaland)	31.03.2025
85.	B.Y.L. Nair Hospital &Topiwala National Medical College Research Society, Mumbai (Maharashtra)	31.03.2025
86.	G.H. Raisoni University, Chhindwara (Madhya Pradesh)	31.03.2025
87.	Sankar Foundation, Visakhapatnam (Andhra Pradesh)	31.03.2025

ANNEXURE- 7

DETAILS OF PROJECTS SUPPORTED UNDER PROMOTING INNOVATIONS IN INDIVIDUALS, START-UPs AND MSMEs (PRISM)

New Projects supported

1. Comprehensive and Application-based Solution for Addressing Malnutrition (CASAM) by community health workers
2. Smart Monitoring System for beekeeping farms.
3. Radio Frequency Energy Harvesting.
4. Copper Coated Multifunctional Cotton Fabrics.
5. Development of harvesting machine for henna
6. Sustainable Space Cooling Solution
7. Portable Apple Cleaning and Grading Machine
8. Emerging future of Pottery Solar Powered Pottery Wheel
9. Development of multifunctional metal bending, twisting, scroll making, auger forming machine and their variants
10. Smartvest- World's first wearable assistive device with real time speed guided navigation for the blind & visually impaired people.
11. Design and fabrication of a multicolour reactor with stirrer
12. Development of Vertical Quadripilator Lathe
13. Design and Development of Reducing Atmosphere, Redox Fabric Indigo Dyeing Machine
14. Sustainable Photovoltaic Thermal (PVT) Rickshaw for Rural Transportation
15. A User friendly & Affordable Head movement based Mouse for Computer
16. Real time Adaptive sterilization of indoor spaces for protection against SARS CoV2 and other pathogenic organism
17. Development of halt face piece Air Purifier
18. Development of Multi use Smart Eye-care Diagnostic Solution
19. A novel diffusion coating process to enhance wear resistance of tooling and machine parts
20. Energy efficient Air conditioner using a customize ejector
21. Use of waste biomass for the development of edible coating
22. Automatic mechatronic device for blood component extractor.
23. Redesigning of the traditional handloom
24. An Indigenous Air-Conditioning Facility for Hospitals during the Covid-19 Pandemic.
25. Tea Leaf Classifier Machine

26. Automatic Power Generating arrangement employing synchronous dynamo electric machine using freely hanging load and having improved feed back and Torque transmission mechanism.
27. Development of polymeric microneedle device for the targeted delivery of therapeutics to the posterior segment of eye
28. A pain-free affordable and self-use glucometer for accurate measurement of glucose from saliva used for testing blood glucose levels
29. Development of biodegradable stent for cervix reconstruction for women with cervical Atresia
30. Development of Plastic Dust Extractor Machine
31. Development of indigenous ceramic discs for sputter sources and electronic applications

Ongoing projects supported

1. AMBU (Aqua Management Binary Unit)
2. Infusion Flow Monitoring Device
3. Building ZincGel Battery for e-Rickshaw (electric three wheelers)
4. Casil-O-Scope- The affordable & portable eye examining device
5. Compact societal composter
6. Low cost handheld device for detection of oral cancer
7. Redesigning, testing and implementation of blowpipe (baklas) to protect the goldsmiths from exposure to smoke/fume during melting of gold beads/jewellery
8. Braille slate for maths learning
9. Development of SRM for EV Applications
10. Iron and vitamin c chocolate
11. Development of Enhanced Potato Yield using Tuberonic Acid based novel approach
12. Power appliance for Toiler Cleaning

ANNEXURE- 8

DETAILS OF COMPLETED PROJECTS SUPPORTED UNDER PROMOTING INNOVATIONS IN INDIVIDUALS, START-UPs AND MSMEs (PRISM)

Completed Projects supported

1. A radio frequency device for detection, imaging and mapping of underground utilities.
2. Development of Inflated Solar Dryer and Destalking Machine for Chilli.
3. Elimination of viruses such as SARS-CoV-2 in condition recirculated air using electrostatics.
4. Design, Development, Fabrication, Testing and Validation of a 1000-Watt Calibration Grade Solid State Power Source with multiple unit synchronising/IoT capabilities
5. Multipurpose Innovative Sprayer Farmers
6. Microfluidic Enzymatic Biofuel Cell for Energy Harvesting and Blood parameters Monitoring
7. Manually Operated Machine for Cutting of Wheat and Paddy Crops
8. Development of Bael Fruit Pulp Extractor
9. Affordable Hardened Plastic Based Bamboo Splinting Machine for Productivity Enhancement
10. Power Assisted Cement Bag Loader
11. Versatile Hydraulic jack for rapid tyre change and maintenance
12. Development of UAV Avionics for Drone Delivery - BVLOS Operation
13. Design and Development of Ultrasonic Impact Test Unit for enhancing the Fatigue Performance of HSLA Steels
14. Development of portable micro-friction stir welding machine as a green technology
15. Energy Efficient Smart Transformer
16. Flexcrutch: Flexure and kinetic shape based crutches for enhanced mobility and reduced energy consumption.
17. Formulation of diabetic cookies by using sea grass and millets.

ANNEXURE-9

Details of the projects supported under Technology Development and Utilization Programme for Women (TDUPW) During the year 2022-2023

S.No	Title of Project	Name of Organization
1	Development of Women Entrepreneurs in Different Sericulture	Kalasalingam Academy of Research and Education, Anand Nagar –Krishnankoil
2	Empowerment of Rural Women through Capacity Building Training in Food Processing Sector	The Gandhigram Rural Institute – Deemed to be University Gandhigram, Dindigul – 624302 Tamilnadu, India
3	Livelihood Enhancement for resources poor and covid-19 victim families women and girls through skilling and enterprising.	Coastal Voluntary Network, Andhra Pradesh
4	Skill Satellite Centre under Technology Development and utilization programme for women TDUPW/A2K+.	PSGR KRISHNAMMAL College for Women, Peelamedu, Coimbatore

ANNEXURE 10

LIST OF APCTT's PARTNER INSTITUTIONS

1. Asia-Pacific Economic Cooperation
2. Asian Development Bank
3. Bangladesh Council of Scientific and Industrial Research, Bangladesh
4. BansomdejchaoprayaRajabhat University, Bangkok, Thailand
5. Centre for East Asian Studies, Jawaharlal Nehru University, India
6. Centre of Excellence for Electrical Energy Storage Technology and Department of Industrial Engineering, UniversitasSebelasMaret, Indonesia
7. Center for Industry, SME and Business Competition Studies, UniversitasTrisakti, Indonesia
8. Centre for the Fourth Industrial Revolution India, World Economic Forum, India
9. Center for Research on Health and Social Care Management, SDA Bocconi School of Management, Bocconi University, Italy
10. Climate Technology Centre & Network, Copenhagen, Denmark
11. Council of Scientific and Industrial Research, Government of India
12. CSIR-Central Electrochemical Research Institute
13. CSIR-Institute of Genomics and Integrative Biology (CSIR-IGIB), New Delhi, India
14. Department of Biotechnology, Tribhubhan University, Kathmandu, Nepal
15. Department of Industry, Ministry of Industry Commerce & Supplies, Government of Nepal
16. Department of International Cooperation, Ministry of Science and Technology, People's Republic of China
17. Department of Science and Human Resources of the Ministry of Healthcare, Kazakhstan
18. Department of Science and Technology, Government of India
19. Department of Scientific and Industrial Research
20. Economic Research Institute for ASEAN and East Asia, Indonesia
21. Environment and Development Division of ESCAP
22. Gavi, the Vaccine Alliance, Geneva, Switzerland
23. Global Antibiotic Research and Development Partnership, Drugs for Neglected Diseases Initiative
24. Graduate School of International Studies, Yonsei University, Seoul, The Republic of Korea
25. Green Technology Centre, Republic of Korea
26. Guangdong HUST Industrial Technology Research Institute, China
27. Guangzhou University, People's Republic of China
28. Hong Kong University of Science and Technology, China

29. India Smart Grid Forum
30. Indian Council of Agricultural Research, Government of India
31. Indian Council of Medical Research, Government of India
32. Indian Institute of Technology Bombay, Mumbai, India
33. Indian Institute of Technology, Delhi, India
34. Indian Institute of Technology, Kanpur, India
35. Indian Institute of Technology, Kharagpur, India
36. Indian Institute of Technology Madras, Chennai, India
37. Indo-German Energy Forum
38. Industrial Engineering Department, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia
39. Industrial Technology Development Institute, Department of Science and Technology, Government of Philippines, the Philippines
40. Infrastructure Development Company Limited, Bangladesh
41. Institute for Global Environmental Strategies, Japan
42. Institute of Developing Economies, Japan External Trade Organization, Japan
43. International Energy Agency, Paris, France
44. International Renewable Energy Agency
45. International Solar Alliance, India
46. International Vaccine Institute, the Republic of Korea
47. Japan Science and Technology Agency
48. Korea Drug Development Fund, Seoul, the Republic of Korea
49. Korea Research Institute of Bioscience and Biotechnology, Daejeon, the Republic of Korea
50. Malaysia Genome and Vaccine Institute, National Institutes of Biotechnology, Malaysia
51. Ministry of Electronics and Information Technology, Government of India
52. Ministry of Environment, Forest and Climate Change, Government of India
53. Ministry of New and Renewable Energy, Government of India
54. Ministry of Science and Technology, Government of Pakistan, Pakistan
55. MMGH Consulting GmbH, Switzerland
56. National Agency for Research and Innovation, Indonesia
57. National Center for Genetic Engineering and Biotechnology, Thailand
58. National Energy Technology Center, National Science and Technology Development Center, Thailand
59. National Engineering Research & Development Centre, Government of Sri Lanka
60. National Institute of Biotechnology, Dhaka, India
61. National Institute for Environmental Studies, Tsukuba, Japan

62. National Institute of Technology, Arunachal Pradesh, India
63. National Office for the Implementation of Innovations and Transfer of Technology, Ministry of Innovative Development, Uzbekistan
64. Pakistan Science Foundation (PSF), Islamabad, Pakistan
65. Research and Information System for Developing Countries, New Delhi, India
66. School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore
67. School of Engineering, Macquarie University, Australia
68. School of Renewable Energy and Smart Grid Technology, Naresuan University, Thailand
69. Sri Lanka Institute of Biotechnology, Homagama, Sri Lanka
70. South Centre, Geneva, Switzerland
71. Subregional Office for South and South-West Asia of ESCAP
72. Technology Application and Promotion Institute, Department of Science and Technology, the Philippines
73. Thailand Institute of Scientific and Technological Research, Thailand
74. Thailand Program Management Unit for Competitiveness, Thailand
75. Thammasat University, PathumThani, Thailand
76. The Energy and Resources Institute, India
77. United Nations Resident Coordinator, Bangladesh
78. University of Philippines Los Banos, the Philippines
79. University of Technology Sydney, Australia
80. World Economic Forum
81. Yunnan Academy of Scientific and Technical Information, China

ANNEXURE 11

List of Publications of the APCTT (January 2022-December 2022)

Publication title	**Focus area**	**Periodicity**	**Target audience**
Asia-Pacific Tech Monitor	Technology transfer for sustainable development in the Asia-Pacific (Jan-Mar 2022) in support to the theme of the 78th ESCAP Commission Session held in May 2022	Quarterly	Science technology and innovation policymakers, small and medium enterprises,research and development institutions, academia, technology transfer intermediaries
	Innovative technologies for air pollution control (Apr- Jun 2022)	Quarterly	
	Regional cooperation for innovation and technology transfer – emerging strategies, models and collaborative networks(Jul-Sep 2022) – In press	Quarterly	
	Affordable and sustainable clean energy technologies – Emerging policies and business models (Oct-Dec 2022) – In press	Quarterly	
Study report on 'Development of enabling strategy for the transfer of inclusive innovations and technologies'	Inclusive innovations and technologies	One-time report	Policy makers and Government officials, technology promotion agencies
Publication on 'Intellectual Property Management and Technology Licensing'	Intellectual Property Management and Technology Licensing – Guide for Policymakers and Managers of Research and Development Institutes	One-time publication	Policymakers, managers of technology licensing and transfer offices of research and development institutes, and the private sector enterprises
Three theme papers on innovation, transfer and diffusion of fourth industrial revolution technologies for (i) sustainable development, (ii) healthcare, and (iii) climate change mitigation	Fourth industrial revolution technologies for sustainable development, healthcare, and climate change mitigation	One-time reports	Policy makers and Government officials, technology promotion agencies, public, private as well as non-governmental organizations, research and development institutions and academia

ANNEXURE 12

EXTRACTS OF AUDIT OBSERVATIONS BY CAG

Audit paras pertaining to DSIR that appeared in the CAG report of 2021

Audit Observations on DSIR :

-Nil-

Audit Observations on Autonomous Bodies under DSIR – Council of Scientific and Industrial Research (CSIR) :

Report No. 2 of 2021

Para 11.1 : Functionality of IT application system 'OneCSIR'

The IT Application System 'OneCSIR' developed by the Council of Scientific and Industrial Research could not be utilized to its full potential due to non availability of some of the modules leading to non implementation of several processes in the system and lack of input controls & validation checks that rendered the database incomplete and unreliable.

Financial Year	CAG Para	Action taken/Proposed to be taken
2020-21	CAG Para No. 54 of Report No. 17 of 2017 titled "Avoidable Expenditure Due to Non-Disposal of Unutilized Land"	Final Action Taken Note on CAG Para No. 5.4 of Report No. 17 of 2017 uploaded on APMS portal on 17.12.2020 after incorporating the vetting comments of DG Audit (SD) dated 02.08.2019
2021-22	CAG Para No. 11.1 of Report No. 2 of 2021 titled "Functionality of IT Application System OneCSIR	Under process for obtaining the approval of competent authority for uploading on CAG APMS portal.
2022-23	Nil	

Pendency position of ATNs in respect of Audit Observations

S.No.	Year	No. of Paras/PA reports on which ATNs have been submitted to PAC after vetting by Audit	Details of the Paras/PA reports on which ATNs are pending		
			No. of ATNs not sent by the Ministry even for the first time	No. of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	No. of ATNs which have been finally vetted by Audit but have not been submitted by the Ministry to PAC
1.	2020	2	0	0	0
2.	2021	0	1*	0	0

* The ATN received from concerned unit is under examination at CSIR Hqrs level and shall be submitted shortly after obtaining the approval of the Competent Authority.

CSIR Establishments

BIOLOGICAL SCIENCES

CSIR-CCMB	Centre for Cellular and Molecular Biology, Hyderabad
CSIR-CDRI	Central Drug Research Institute, Lucknow
CSIR-CFTRI	Central Food Technological Research Institute, Mysore
CSIR-CIMAP	Central Institute of Medicinal & Aromatic Plants, Lucknow
CSIR-IGIB	Institute of Genomics & Integrative Biology, Delhi
CSIR-IHBT	Institute of Himalayan Bio resource Technology, Palampur
CSIR-IICB	Indian Institute of Chemical Biology, Kolkata
CSIR-IIIM	Indian Institute of Integrative Medicine, Jammu
CSIR-IMTECH	Institute of Microbial Technology, Chandigarh
CSIR-IITR	Indian Institute of Toxicology Research, Lucknow
CSIR-NBRI	National Botanical Research Institute, Lucknow

CHEMICAL SCIENCES

CSIR-CLRI	Central Leather Research Institute, Chennai
CSIR-CECRI	Central Electrochemical Research Institute, Karaikudi
CSIR-CSMCRI	Central Salt & Marine Chemicals Research Institute, Bhavnagar
CSIR-CIMFR	Central Institute of Mining & Fuel Research, Dhanbad
CSIR-IICT	Indian Institute of Chemical Technology, Hyderabad
CSIR-IIP	Indian Institute of Petroleum, Dehradun
CSIR-NCL	National Chemical Laboratory, Pune
CSIR-NEIST	North-East Institute of Science and Technology, Jorhat
CSIR-NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram

ENGINEERING SCIENCES

CSIR-AMPRI	Advanced Materials and Processes Research Institute, Bhopal
CSIR-CBRI	Central Building Research Institute, Roorkee
CSIR-CGCRI	Central Glass and Ceramic Research Institute, Kolkata
CSIR-CMERI	Central Mechanical Engineering Research Institute, Durgapur

CSIR-CRRI	Central Road Research Institute, New Delhi
CSIR-IMMT	Institute of Minerals and Materials Technology, Bhubaneswar
CSIR-NAL	National Aerospace Laboratories, Bengaluru
CSIR-NEERI	National Environmental Engineering Research Institute, Nagpur
CSIR-NML	National Metallurgical Laboratory, Jamshedpur
CSIR-SERC	Structural Engineering Research Centre, Chennai

INFORMATION SCIENCES

CSIR-NIScPR	National Institute of Science Communication and Policy Research, New Delhi (Merger of CSIR-NISCAIR & CSIR- NISTADS)
CSIR-4-PI	Fourth Paradigm Institute, Bengaluru

PHYSICAL SCIENCES

CSIR-CEERI	Central Electronics Engineering Research Institute, Pilani
CSIR-CSIO	Central Scientific Instruments Organisation, Chandigarh
CSIR-NGRI	National Geophysical Research Institute, Hyderabad
CSIR-NIO	National Institute of Oceanography, Goa
CSIR-NPL	National Physical Laboratory, New Delhi

UNITS

CSIR-HRDC	Human Resource Development Centre, Ghaziabad
CSIR-TKDL	Traditional Knowledge Digital Library, Ghaziabad
CSIR-URDIP	Unit for Research and Development of Information Products, Pune
CSIR-OSDD	Open Source Drug Delivery, New Delhi
CSIR-TRISUTRA	Translational Research and Innovative Science through Ayurgenomics, New Delhi

ABBREVIATIONS / ACRONYMS

AMPRI	Advanced Material and Processes Research Institute
APCTT	Asian and Pacific Centre for Transfer of Technology
CBDT	Central Board of Direct Taxes
CBRI	Central Building Research Institute
CCMB	Centre for Cellular and Molecular Biology
CDC	Consultancy Development Centre
CDRI	Central Drug Research Institute
CDS/ISIS	Computerized Data Services/Integrated Set of Information Systems
CECRI	Central Electrochemical Research Institute
CEERI	Central Electronics Engineering Research Institute
CFTRI	Central Food Technological Research Institute
CGCRI	Central Glass and Ceramic Research Institute
CII	Confederation of Indian Industry
CIMAP	Central Institute of Medicinal & Aromatic Plants
CIMFR	Central Institute of Mining and Fuel Research
CITT	Centre for International Trade in Technology
CLRI	Central Leather Research Institute
CMERI	Central Mechanical Engineering Research Institute
CRRI	Central Road Research Institute
CSIO	Central Scientific Instruments Organisation
CSIR	Council of Scientific & Industrial Research
CSMCRI	Central Salt & Marine Chemicals Research Institute
DBT	Department of Bio-Technology
DCPC	Department of Chemicals & Petrochemicals
DCSSI	Development Commissioner, Small Scale Industries
DRDO	Defence Research and Development Organization
DSIR	Department of Scientific & Industrial Research
ESCAP	Economic and Social Commission for Asia and the Pacific
EXIM	Export-Import
FC	Foreign Collaborations
FICCI	Federation of Indian Chambers of Commerce and Industry
ICAR	Indian Council of Agricultural Research
ICAS	Indian Council of Ayurveda & Siddha

ICMR	Indian Council of Medical Research
ICSSR	Indian Council of Social Sciences Research
ICSTI	International Centre for Science & Technology Information
IDAMS	Internationally Developed Data Management System
IGIB	Institute of Genomics & Integrative Biology
IGNOU	Indira Gandhi National Open University
IHBT	Institute of Himalayan Bioresource Technology
IICB	Indian Institute of Chemical Biology
IICT	Indian Institute of Chemical Technology
IIFT	Indian Institute of Foreign Trade
IIIM	Indian Institute of Integrative Medicine
IIP	Indian Institute of Petroleum
IISc	Indian Institute of Science
IIT	Indian Institute of Technology
IITR	Indian Institute of Toxicology Research
IMMT	Institute of Minerals and Materials Technology
IMT	Institute of Microbial Technology
INFLIBNET	Information Library Network
INSA	Indian National Science Academy
IPR	Intellectual Property Rights
ISRO	Indian Space Research Organization
ITPO	India Trade Promotion Organization
LAN	Local Area Network
LCA	Light Combat Aircraft
MDR	Multi Drug Resistance
MIT	Ministry of Information Technology
MoU	Memorandum of Understanding
NACIDS	National Access Centres to International Database Services
NAFEN	National Foundation of Indian Engineers
NAL	National Aerospace Laboratories
NBRI	National Botanical Research Institute
NCAER	National Council of Applied Economic Research
NCL	National Chemical Laboratory
NCSI	National Centre for Science Information
NEERI	National Environmental Engineering Research Institute

NEIST	North-East Institute of Science & Technology
NGRI	National Geophysical Research Institute
NICMAR	National Institute of Construction Management and Research
NID	National Institute of Design
NIDC	National Industrial Development Corporation
NIFT	National Institute of Fashion Technology
NIIST	National Institute for Inter-disciplinary Science and Technology
NIO	National Institute of Oceanography
NISCAIR	National Institute of Science Communication and Information Resources
NISTADS	National Institute of Science Technology and Development Studies
NMCC	National Manufacturing Competitiveness Council
NML	National Metallurgical Laboratory
NPL	National Physical Laboratory
NRDC	National Research Development Corporation
NRFC	National Register of Foreign Collaborations
NSTMIS	National Science and Technology Management Information System
PSE	Public Sector Enterprise
SERC	Structural Engineering Research Centre
SIRO	Scientific and Industrial Research Organization
SME	Small and Medium Enterprise.
TCO	Technical Consultancy Organization
TDB	Technology Development Board
TEDO	Technology Export Development Organization
TePP	Technopreneur Promotion Programme
TIFAC	Technology Information Forecasting and Assessment Council
TM	Technology Management
TQM	Total Quality Management
UGC	University Grants Commission
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
WIPO	World Intellectual Property Organization

Council of Scientific & Industrial Research (CSIR)
Anusandhan Bhawan, 2 Rafi Marg, New Delhi-110001
www.csir.res.in

National Research Development Corporation (NRDC)
20-22, Zamroodpur Community Centre,
Kailash Colony Extention, New Delhi-110048
www.nrdcindia.com

Cenral Electronics Limited (CEL)
4 Industrial Area, Sahibabad, Uttar Pradesh - 201010
www.celindia.co.in

www.dsir.gov.in

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